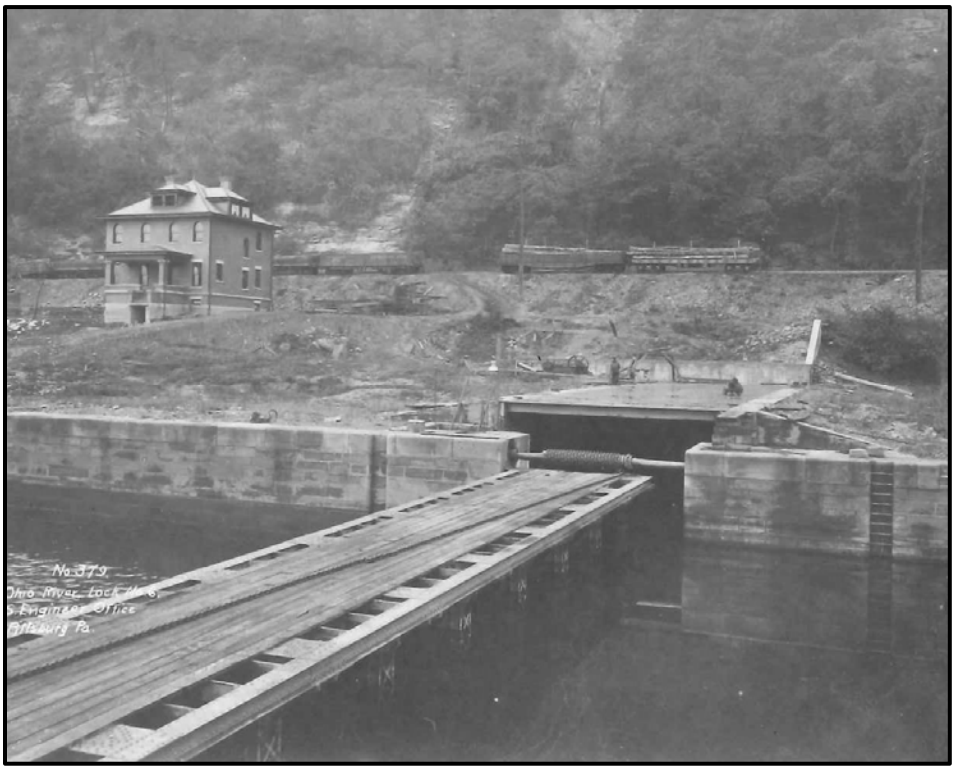
Historical Overview

Merrill Lock and Dam No. 6

Potter Township, Beaver County, Pennsylvania

1904-1936



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1.0 Introduction

During the nineteenth century rafts, flatboats, keelboats, steamboats, and barges transported passengers, livestock, produce, fuel, and manufactured goods up and down the Ohio River. After the Civil War the coal trade increased rapidly and made up a growing portion of the commerce on the river. As downriver communities and industries grew ever more dependent on shipments of coal from Pittsburgh, Pennsylvania, and commercial traffic on the river intensified, concerns about the navigability of the Ohio River became more urgent and widespread. In response the U.S. Army Corps of Engineers proposed implementation of a slack-water system of locks and dams, which was ultimately spearheaded by Cincinnati District Engineer William Emery Merrill, the "Father of the Ohio River Improvement," for whom Lock and Dam No. 6 was posthumously named.

Merrill Lock and Dam No. 6 was completed in 1904 as part of a federally sponsored system of locks and moveable dams on the Ohio River that provided a reliable, year-round slack-water navigation for commercial and passenger traffic between Pittsburgh, Pennsylvania and the mouth of the Beaver River.[1] Merrill Lock and Dam No. 6 originally featured a brick powerhouse, two brick locktender's houses, a Chanoine-type wicket dam with Pasqueau hurters, two bear-trap weirs, a Thomas A-frame weir, and a 110-by-600-foot lock. In 1922-23 Merrill Lock and Dam No. 6 was brought into compliance with the new 9-foot navigation standard established by the River and Harbor Act of March 3, 1905.[2] However, the completion of the Montgomery Locks and Dam in 1936 rendered Merrill Lock and Dam No. 6 obsolete, and two years later the federal government sold the property to the McClain Fire Brick Company of Pittsburgh for $3,500.[3] In 1980 Preservation Consortium, Inc. successfully nominated the remaining structures at Merrill Lock and Dam No. 6 to the National Register of Historic Places for its significance in the areas of architecture, engineering, and transportation.[4] In 1993 the downstream lockkeepers' house was torn down after it was severely damaged in an automobile accident.[5] And in 2000, after years of neglect, the lock powerhouse was repurposed as a restaurant catering to the summer trade, but in recent years has fallen once again into disuse. As of 2014 the property, including the remains of

[1] J. H. Bausman, "History of the Ohio and Beaver Rivers and Their Improvement," in *1892-1904, Merrill Dam and Lock No. 6 Opening Celebration* ([Merrill Dam Opening Celebration Association], 1904), [22]; Leland R. Johnson, *The Davis Island Lock and Dam* (Pittsburgh, Pennsylvania: U.S. Army Engineer District, 1985), 113-114.
[2] *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1905), 475; *Annual Report of the Chief of Engineers, United States Army*, part 1 (Washington: Government Printing Office: 1906), 522,525; Edwin Stevenson, "Putting the Finishing Touches on Dams in Rivers: Great Impetus to Pittsburgh Commerce," *Pittsburgh Post*, August 12, 1906: 24; "River Harbor Will Extend 30 Miles Soon," *Pittsburgh Press*, December 3, 1907: 1; "Raising the Dams: Clearing Up Preparatory to Putting Up the Wicketts," *Pittsburgh Post-Gazette*, April 29, 1908: 15; "To Take River Stages from Six Dams When Up," *Pittsburgh Daily Post*, June 23, 1908: 5; "River News," *Pittsburgh Daily Post*, October 10, 1922: 14; *Pittsburgh Daily Post*, August 28, 1923.
[3] "Pittsburgh District > Missions > Navigation > Locks and Dams > Montgomery Locks & Dam," *U. S. Army Corps of Engineers*, December 13, 2016, http://www.lrp.usace.army.mil/Missions/Navigation/Locks-and-Dams/Montgomery-Locks-Dam/; United States of America [Quitclaim] Deed to McClain Fire Brick Company, January 17, 1938, Roger A. Weaver papers, Beaver County Historical Research and Landmarks Foundation, Freedom, Pennsylvania.
[4] Roger A. Weaver, National Register of Historic Places Inventory – Nomination Form for Merrill Lock No. 6, Beaver County, June 24, 1980.
[5] Bob Bauder, "Old Dam and Lock Site for Sale: Just $108,000," *The Beaver County Times* (Beaver, Pennsylvania).

the lock powerhouse and upstream lockkeeper's house, remained in private ownership (see Figure 1 for site location).[6]

To document the history of Merrill Lock and Dam No. 6 on the Ohio River, research was conducted at libraries and repositories in Beaver County, Pittsburgh, Harrisburg, and Philadelphia, Pennsylvania. A number of public and private institutions maintain archival collections indispensable for understanding not only the construction and operation of Lock and Dam No. 6 but also the political opposition surmounted by the government engineers, businessmen, and politicians who built a federally sponsored system of locks and dams on the Ohio River during the late nineteenth and early twentieth centuries. Foremost among them were the Offices of the Pittsburgh Engineering District of the United States Army Corp of Engineers (USACE) and the Detre Library and Archives at the Senator John Heinz History Center in Pittsburgh; the Pennsylvania State Archives in Harrisburg; the National Archives (NARA) at Philadelphia; and, the Beaver County Historical Research and Landmarks Foundation and the Beaver County Genealogy and History Center. No less important to the undertaking were digital archives and collections; *Newspapers.com*, the Library of Congress' *Chronicling America* and *Digital Collections* websites, and the *HathiTrust Digital Library* all proved to be valuable sources of information about the events and personalities central to the design, construction, and operation of Lock and Dam No. 6. Finally, the USACE provides free online access to a variety of excellent publications on the history of the Corps of Engineers, its various districts, and its engineering projects through the *USACE Digital Library* webpage.[7]

Finally, a word regarding terminology seems appropriate. In this document the phrase "Chanoine wicket dam" has been reserved, for the most part, to refer to a particular type of movable dam built and operated in France using technology invented by Jacques Chanoine of the French Corps of Engineers in 1852. Similar structures built in the United States during the late nineteenth and early twentieth centuries, like at Davis Island and Lock and Dam No. 6, are referred to as "Chanoine-type" wicket dams. Additionally, throughout the text Lock and Dam No. 6 on the Ohio River is referred to variously as Merrill Lock and Dam No. 6, Lock and Dam No. 6, or simply No. 6. The decision to do so is primarily stylistic although some effort was made to refrain from using the name "Merrill" before the untimely death of Cincinnati District Engineer William Emery Merrill in 1891.

The value of Leland R. Johnson's *The Davis Island Lock and Dam* which provides a thorough discussion of Davis Island Lock and Dam No. 1 and a comprehensive overview of nineteenth- and twentieth-century efforts to improve the Ohio River navigation cannot be overstated. Likewise engineering drawings and photographs of the facilities at Lock and Dam No. 6 stored at the Offices of the Pittsburgh Engineering District of the USACE and the annual reports of the Secretary of War, the War Department, and the Chief of Engineers (available online through the *HathiTrust*

[6] Woodene Merriman, "It's a lock: Restaurant adds new patios to distinctive site and special menu," *post-gazette.com*, May 26, 2000, http://old.post-gazette.com/dining/20000526Dine.asp.
[7] "Newspapers.com – Historical Newspapers from 1700s – 2000s" [subscription database], *ancestry.com*, https://www.newspapers.com/; "Chronicling America, Historic American Newspapers," *Library of Congress*, http://chroniclingamerica.loc.gov/; "Digital Collections," *Library of Congress*, https://www.loc.gov/collections/; "HathiTrust Digital Library," *HathiTrust*, https://www.hathitrust.org/; "Histories," *USACE*, http://cdm266001.cdmhost.com/cdm/landingpage/collection/p16021coll4.

Digital Library) supplied a wealth of details about the engineering and construction of Lock and Dam No. 6. This historical overview was written by AECOM Historian Brian M. Albright.

This historical overview was generated to address a mitigation stipulation in a Programmatic Agreement between the United States Army Corps of Engineers, Pennsylvania State Historic Preservation Office and Shell Chemical Appalachia, LLC (hereafter Shell) to address the effects of the nearby Shell petrochemical complex on historic resources. The complex was subject to Section 106 of the National Historic Preservation Act and it was determined that Merrill Lock No. 6 was in the project's area of potential effects. Merrill Lock No. 6 is listed on the National Register of Historic Places and it was determined that the project would have an adverse effect upon the Lock No. 6 property. All parties agreed to partially mitigate the adverse effect by producing this historical overview.

Acknowledgments
Special thanks are due to Conrad Weiser of the USACE; Brenda Applegate, Executive Director of the Beaver County Historical Research and Landmarks Foundation; and, archivist Patrick Connelly at NARA—their assistance and enthusiasm were vitally important to the development of this document.

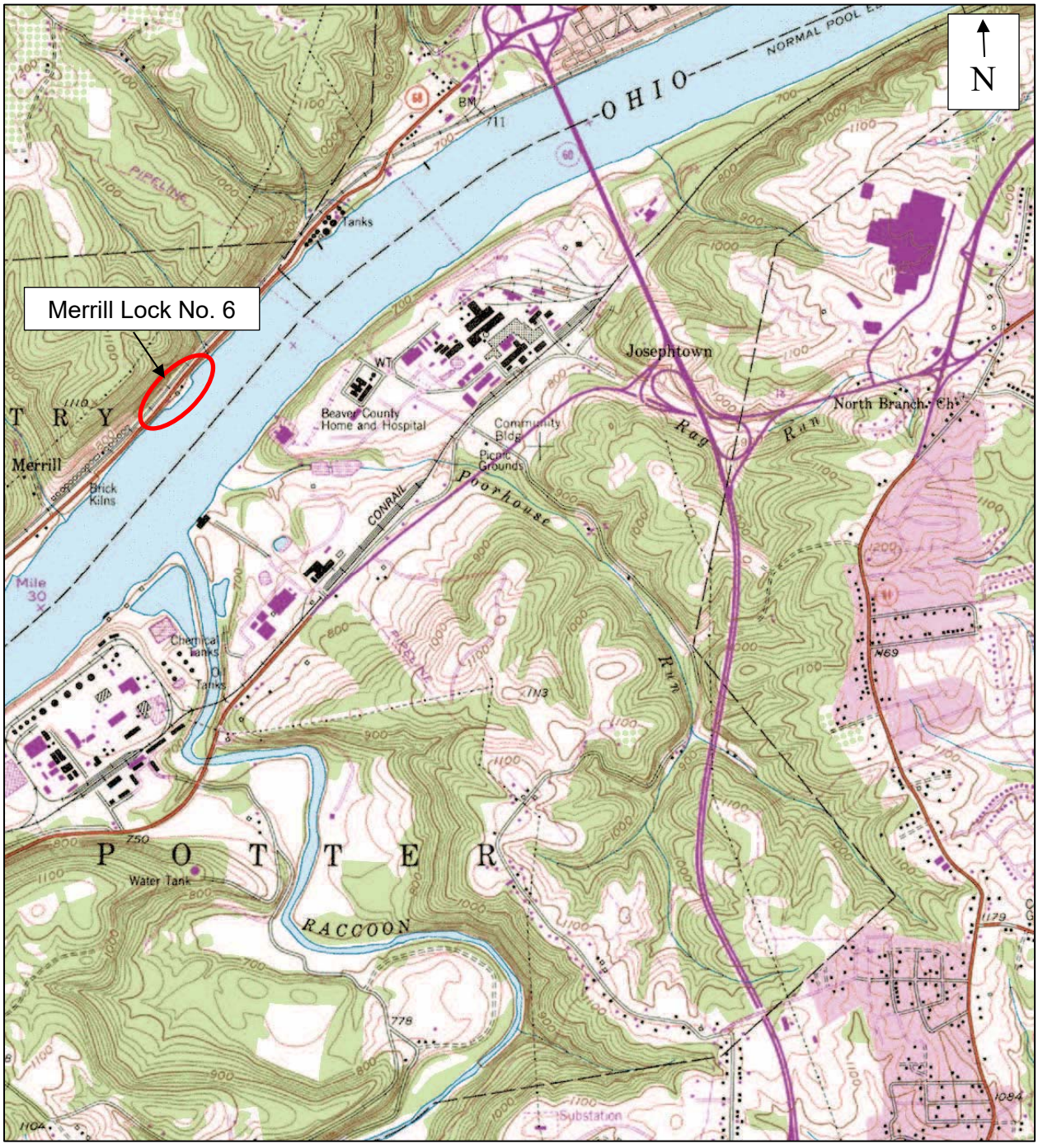

Figure 1. Site Location Map.

2.0 The Unimproved Ohio River

During the nineteenth century rafts, flatboats, keelboats, steamboats, and barges transported passengers, livestock, produce, fuel, and manufactured goods up and down the Ohio River (Figures 2 and 3). While commerce on the river occurred only intermittently in the first decades of the nineteenth century, by the 1820s regular traffic was established between Pittsburgh, Pennsylvania and Louisville, Kentucky. A decade later the volume of freight carried by steamboats on the Ohio River matched, and soon surpassed, the annual combined freight tonnage carried by the river's flatboats and keelboats; at the same time, steamboats quickly monopolized the passenger and upriver freight traffic on the river.[8]

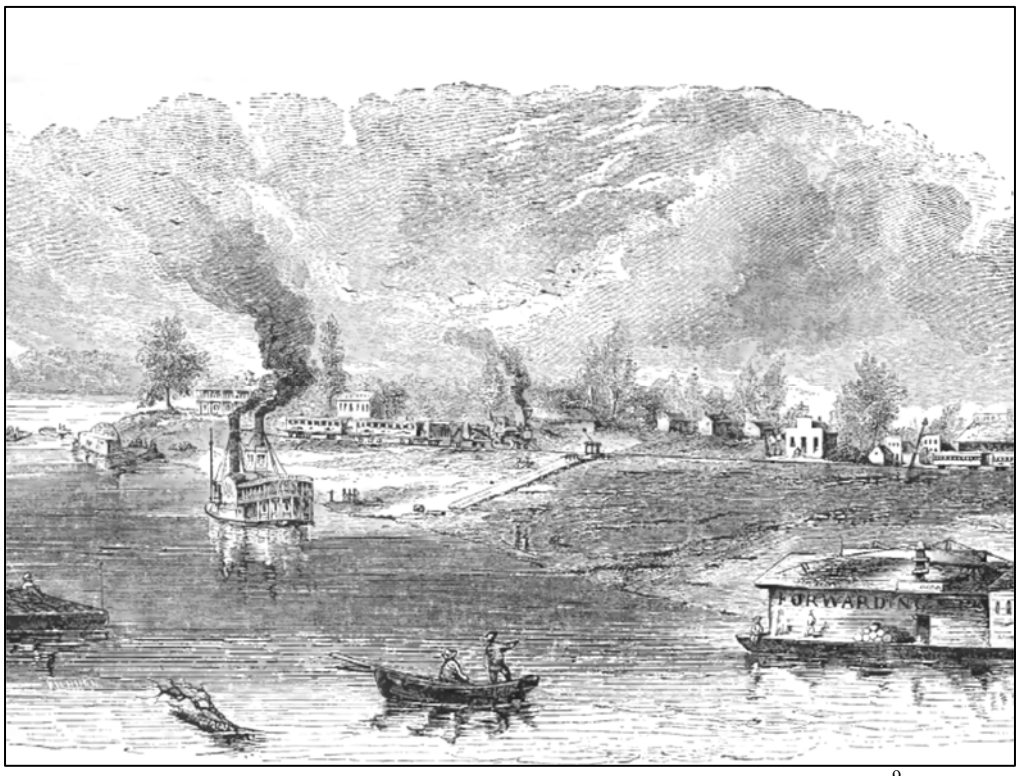

Figure 2. View of the junction of the Mississippi and Ohio rivers at Cairo, Illinois.[9]

After the Civil War the coal trade grew rapidly and made up a steadily increasing portion of the commerce carried out on the Ohio River. While 2 to 3 million bushels of coal were shipped down the Ohio every year in the early nineteenth century, by 1866 the volume of coal sent downriver at high water reached 40 million bushels annually.[10] As downriver communities and industries grew ever more dependent on shipments of coal from Pittsburgh and commercial traffic on the river intensified, concerns about the navigability of the Ohio River became more urgent and more widespread. At times the Ohio River rose more than thirty feet in the course of several days causing extensive destruction; at other times low water levels hampered local and regional commerce in

[8] Michael C. Robinson, *History of Navigation in the Ohio River Basin* (U.S. Army Engineer Water Resources Support Center, 1983), 5-8, 17; "Steamboat Times: A Pictorial History of the Mississippi Steamboating Era," *steamboattimes.com*, December 15, 2016, http://steamboattimes.com/index.html.
[9] Ballou, M. M., "The City of Cairo, Illinois," *Ballou's Pictorial* 11, no. 9 (August 30, 1856): 140.
[10] Robinson, *History of Navigation*, 23-24.

ways that directly affected residents throughout the Ohio Valley.[11] During one-third of the years between 1837 and 1866 the Ohio River experienced persistently low water levels for months at a time.[12]

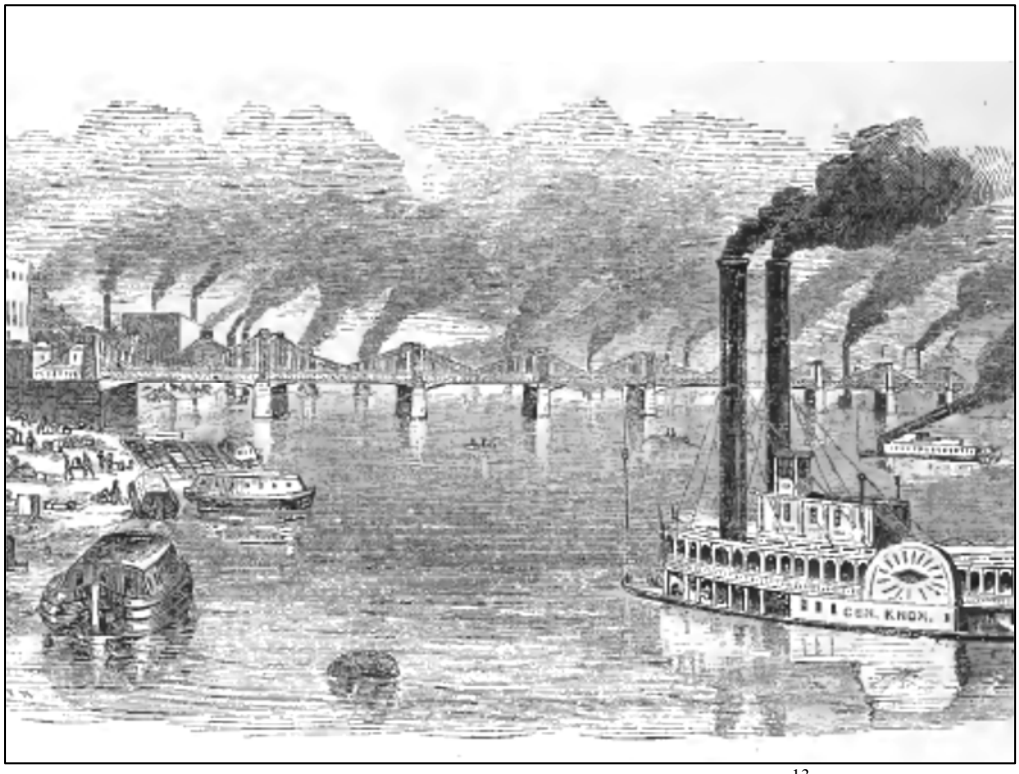

Figure 3. Bridge over the Monongahela River, Pittsburgh, Pennsylvania.[13]

In 1867 William Milnor Roberts (1810-1881), United States Engineer in charge of the Ohio River improvements, described the conditions that prevailed on the river.

> The Ohio river [sic] always, during a considerable portion of every year, affords a very superior navigation for steamers and heavy coal barges … it is a goodly river during much of every season, and there is no period when it cannot be navigated by light-draught vessels, adapted specifically to the low water trade.
>
> Notwithstanding this general fact, there are occasional dry seasons, when the river falls to a very low stage, when for weeks—sometimes, though rarely, extending to several months—the Upper Ohio affords only a navigation for very light-draught boats and all the large steamers are laidup [sic], and the coal business suspended.[14]

When extended periods of low water grounded steamboats and coal barges, mills and factories on the Ohio River closed for want of fuel and raw materials, laborers went without work, and freight

[11] Robinson, *History of Navigation*, 9-10, 23; Clarence W. Newman, *Ohio River Navigation: Past, Present, Future* (United States Army Corps of Engineers, 1979), 2.
[12] W. Milnor Roberts, "The Ohio River," *Pittsburgh Daily Post*, July 16, 1867: 2.
[13] Ballou, M. M., "Views in Pittsburg [sic], PA.," *Ballou's Pictorial* 12, no. 8 (February 21, 1857): 120.
[14] W. Milnor Roberts, "The Ohio River," *Pittsburgh Daily Post*, July 16, 1867: 2.

costs soared. Downriver cities that relied on Pittsburgh coal were particularly hard hit.[15] In 1830-1831

> The communication by steam has been effectually cut off between Pittsburg [sic] and Wheeling and Louisville, and sufficient water has not been found on the bars below the falls to admit of a safe flat boat navigation. On our immense importations from the eastern cities, the freight from Pittsburg [sic] and Wheeling to Louisville has been one dollar per hundred pounds; the voyage down has been protracted to thirty or forty days, and heavy losses have been sustained by running boats on logs and rocks.[16]

In the summer of 1862 water levels fell exceptionally low; a flat boat at Steubenville, Ohio that drew only seventeen inches ran aground on the river and "no description of steamer" could leave port.[17] It was estimated that a typical coal barge loaded with twelve- to sixteen-thousand bushels of coal required no less than eight feet of water in the Ohio River channel to safely make the downriver trip from Pittsburgh but during low water the depth of the channel might fall to 18 inches or less.[18]

As the annual spring freshets receded and the Ohio became impassible, grain and produce markets stagnated. In 1867 at Pittsburgh,

> Dullness was decidedly the leading feature of the market; the spring trade being over, dealers will have to exercise patience until an improvement takes place. The weather was changeable; the Ohio river [sic] being low navigation continues difficult … the dull season has hung on longer this time than usual.[19]

In addition to annual and seasonal variations in water level, hazardous weather conditions affected traffic on the Ohio River. Floods and wrecks resulting in property damage, lost revenues, and loss of life were not uncommon. In the winter of 1873 rising floodwaters on the Ohio River caused extensive destruction in Pittsburgh and surrounding communities.

> The fleet of coal boats and barges moored to the center pier of the Smithfield street bridge, which was well secured by heavy hawsers, broke loose and floated in the direction of the steamboat landing, striking a number of tug boats, and sinking the Victor Wilson and the Oil Valley … About eleven o'clock another large fleet of coal boats hove in sight with no one on board. Some thirty packages were in the fleet … it became evident that the fleet could not pass the railroad bridge without striking one or more of the piers. The people lined the bridges and shore in great numbers, and when the crash came it caused a shudder among them to see the property so melt away in the angry waters.[20]

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[15] Johnson, *Davis Island*, 2.
[16] Memorial of Sundry Inhabitants of Pittsburg [sic], Penn., Praying that the navigation of the Ohio river, from its mouth to Pittsburg [sic], may be improved, &c., January 21, 1831, Detre Library and Archives, Senator John Heinz History Center.
[17] "Low Water," *The Wheeling Daily Intelligencer* (Wheeling, West Virginia), August 27, 1862:3.
[18] W. Milnor Roberts, "The Ohio River," *Pittsburgh Daily Post*, July 16, 1867: 2.
[19] "Pittsburgh Produce Market," *Pittsburgh Daily Post*, June 22, 1867: 8.
[20] "River Disasters," *Pittsburgh Daily Post*, February 18, 1873: 4.

One coal boat escaped immediate destruction at the railroad bridge but it passed into the Ohio River "in a sinking condition."[21]

In 1874 the wreckage was even more widespread when a summer storm caused the river to rise "fourteen inches in twenty-two minutes." Although the city of Pittsburgh saw the greatest losses of life and property, downriver communities like Beaver also suffered "very considerable" damage.

> N. J. Bigley had a coal boat sunk near the glass works, and one fuel boat and a fuel flat … [and] The towboat "N. J. Bigley" was blown head on some loaded barges at the same place. The coal boats belonging to Wm. H. Brown were sunk opposite Mingo Creek, Third pool. The flood from this little creek at this place swept entirely across the river. Fifteen loaded coalboats [sic] and barges broke loose from John A. Wood & Son's landing, just below Saw Mill run [sic].[22]

Newspaper reports confirmed that the flooding caused widespread "death and destruction" sweeping away whole families, homes, livestock, stables, and bridges.[23]

Even the breakup of river ice proved a mixed blessing for rivermen. Massive flows of ice and debris carried on swelling rivers destroyed port facilities and watercraft even as their passing opened the river to navigation. In the first days of 1873, the *Petrolia* and the "old Allegheny tow" were struck and sunk by ice at Pittsburgh's Smithfield Street Bridge.[24] In neighboring Beaver County towboats, wharf boats, ferries, flats, barges, and rafts at anchor suffered $10,000 in damages when the ice gorged "into the mouth of the Beaver."[25] And in 1877 "ice and coal boat disasters" on the Ohio amounted to $4,000,000 in property losses and killed more than seventy people.[26]

Exceptional weather events aside, even experienced river pilots met with misfortune on the Ohio River. In 1854 a packet boat struck a snag and sunk in deep water damaging $200,000 in dry goods.[27] In 1866 the steamer *Winchester* out of Pittsburgh

> Was returning freighted with hay and oil, and when near East Liverpool, Ohio, about 4 o'clock Saturday morning, she was discovered to be on fire. She was immediately run ashore and made fast, but the fire spread so rapidly that the passengers could only escape by jumping into the river. About fifteen persons were drowned.[28]

And in the winter of 1868 a towboat, valued at $10,000, struck a bridge pier and immediately sank with two deckhands lost to the icy waters. [29]

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[21] "River Disasters," *Pittsburgh Daily Post*, February 18, 1873: 4.
[22] "Death and Desolation," *The Pittsburgh Daily Commercial*, July 28, 1874: 4.
[23] "Death and Desolation," *The Pittsburgh Daily Commercial*, July 28, 1874: 4.
[24] "River News," *The Wheeling Daily Intelligencer*, January 4, 1873: 1.
[25] "The Break-up at Rochester, Pa.," *The Pittsburgh Daily Commercial*, January 3, 1873: 4.
[26] "River Disasters," *The Philadelphia Inquirer*, December 31, 1877: 1.
[27] "News for River Men," *Pittsburgh Daily Post*, January 7, 1854: 2.
[28] *The Adams Sentinel* (Gettysburg, Pennsylvania), March 6, 1866: 4.
[29] "Telegraphic Summary," *Pittsburgh Daily Post*, January 3, 1868: 1.

Increasing passenger traffic on the river brought its own risks. On the night of July 4, 1882 the *Scioto*, loaded with hundreds of revelers from East Liverpool, Wellsville, and Steubenville, Ohio collided with the *John Lomas* carrying 200 passengers from Martin's Ferry. The *Scioto* sank in three minutes sending fifty-seven passengers to the bottom of the river all due to a signaling error (Figure 4).

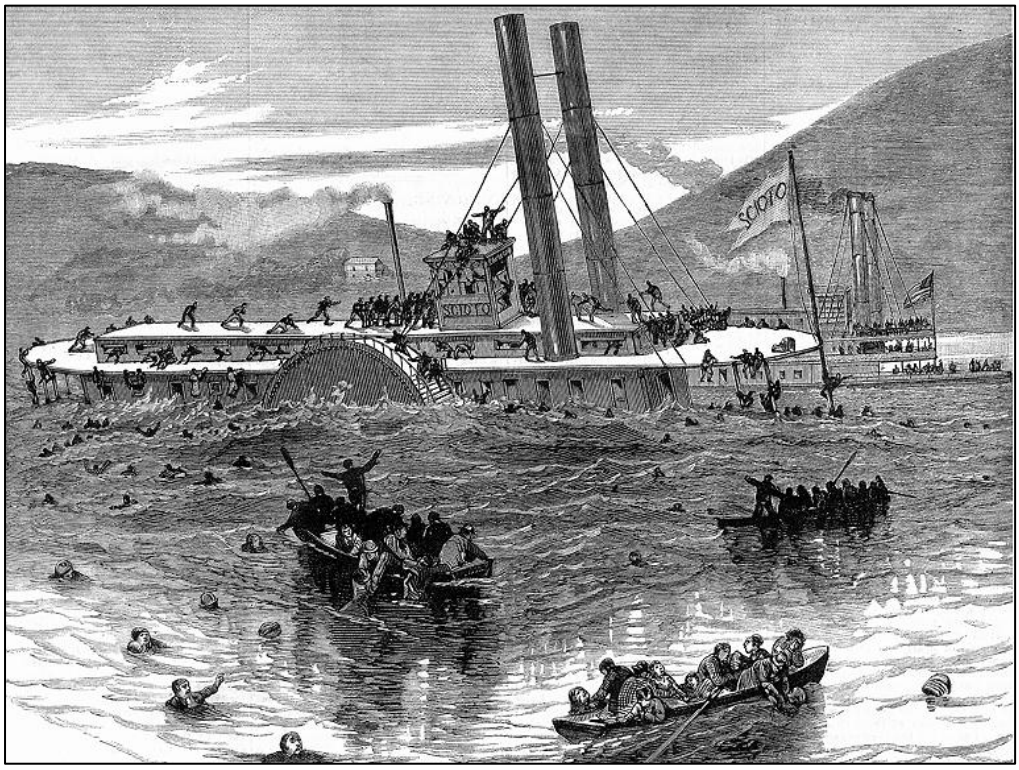

Figure 4. The Collision of the Steamers "Scioto" and "John Lomas," in the Ohio River.[30]

> The boats came together with a tremendous crash, the Lomas striking the Scioto on the larboard or left hand side, just about the ash box, tearing into her guards, and making a large hole in the hull, through which she began taking water at a rapid rate. As may be imagined the confusion on board was terrible. The number of women and children was especially large, and as the boat began to settle at once, the scene was heartrending.[31]

To manage the risks associated with river travel and to promote commerce, the federal government, states, and municipalities pursued various strategies to keep river channels and ports open and free of impediments, natural or otherwise.[32] Encountering political opposition to federally-sponsored internal improvement projects and the deadening effects of recurrent economic downturns,

[30] *Frank Leslie's Illustrated Newspaper* 65 (July 15, 1882): cover.
[31] Timothy R. Brookes, "A Pall of Egyptian Gloom: The Sinking of the Scioto," *East Liverpool Historical Society*, December 20, 2016, http://www.eastliverpoolhistoricalsociety.org/scioto1.htm; "Fourteen Bodies," *Pittsburgh Daily Post*, July 6, 1882: 4.
[32] "Call for a Meeting in Relation to the Louisville Canal," *Pittsburgh Daily Post*, February 9, 1852: 3; "Wheeling Bridge Case," *Pittsburgh Daily Post*, February 9, 1852: 3; "The Ohio River Navigation," *The Philadelphia Inquirer*, March 8, 1871: 1; Robinson, *History of Navigation*, 8-9, 12-16.

antebellum efforts to improve the navigability of the Ohio River were sporadic and haphazard. Before the Civil War the work of improving the river consisted largely of topographical surveys; experiments to ascertain the best methods of increasing channel depths; efforts at canalization by means of traditional wing dam (i.e., spur dike) construction; and, the removal of obstructions to navigation like rocks, snags, and sandbars.[33] But even these programs had largely ceased by 1857 in the wake of vetoed navigation bills and failed congressional appropriations in 1845, 1846, and 1852.[34]

[33] Richard Peters (ed.), *The Public Statutes at Large of the United States of America*, vol. 4 (Boston, Massachusetts: Charles C. Little and James Brown, 1846), 32-33; Richard Peters (ed.), *The Public Statutes at Large of the United States of America*, vol. 5 (Boston, Massachusetts: Little, Brown and Company, 1856), 510; Robinson, *History of Navigation*, 11-17.
[34] Robinson, *History of Navigation*, 16-17.

3.0 Improving the Ohio River: William Emery Merrill and Davis Island

In 1831 the citizens of Pittsburgh "convinced of the practicability of rendering the Ohio navigable throughout the summer and fall months" solicited an appropriation from Congress to underwrite the construction of a series of wing dams on the Ohio River between Pittsburgh and Cairo, Illinois. The project's supporters hoped to secure the invaluable "commercial and national advantages" that a reliable three- to four-foot navigation would deliver. Inspired by the accomplishments of Henry M. Shreve and Stephen H. Long who used wing dams to increase channel depths in the 1820s, supporters of the proposed Ohio River improvements expected that the work could be "speedily accomplished … for an inconsiderable amount" (i.e., about $325,000).[35]

> Of the importance of the proposed work, it appears to your petitioners there can be no difference of opinion. Its commercial advantages would be extensively felt by more than half the States in the confederacy; while it would be equally important in the event of a future invasion of the country, as it would add to the facilities for transporting troops and munitions of war, from the east to the west, and from the west to the east.[36]

Despite the optimism of the Pittsburgh petitioners that "there can be no difference of opinion" regarding the establishment of a reliable navigation on the Ohio River, projects that might affect navigation on the river were often met with suspicion from unexpected quarters. New construction, particularly railroad bridges, but also dikes, dams, and locks, provoked anxiety among rivermen not only for the physical hazards that they posed to passing watercraft but also for their potential economic impacts. Relief was often sought in newspapers and the courts as well as through appeals to state and federal legislatures. Opposing parties debated whether certain projects might pose serious material obstructions to commerce and navigation on the river *per se* and questioned whether or not the river—a "natural highway" that benefited "all the commerce and business in the valley"—ought to be compromised to advance narrower interests. Even much-needed navigation improvements were viewed with ambivalence; in the 1870s rivermen and coal shippers suspected that the Ohio River improvements proposed by the Army Corps of Engineers and supported by local manufacturers were secretly intended to curtail the free and open navigation of western waters to the benefit of the railroad interests.[37]

Such unexpected antagonism was met and eventually overcome by the "Father of the Ohio River Improvement," Colonel William Emery Merrill (1837-1891) of the Army Corps of Engineers (Figure 5). Praised as "one of the most efficient men" that the Corps of Engineers had "ever

[35] Memorial of Sundry Inhabitants of Pittsburg [sic], Penn., Praying that the navigation of the Ohio river, from its mouth to Pittsburg [sic], may be improved, &c., January 21, 1831, Detre Library and Archives, Senator John Heinz History Center; David P. Billington, Donald C. Jackson, and Martin V. Melosi, *The History of Large Federal Dams: Planning, Design and Construction in the Era of Big Dams* (Denver, Colorado: U.S. Department of the Interior, Bureau of Reclamation, 2005), 16.
[36] Memorial of Sundry Inhabitants of Pittsburg [sic], Penn., Praying that the navigation of the Ohio river, from its mouth to Pittsburg [sic], may be improved, &c., January 21, 1831, Detre Library and Archives, Senator John Heinz History Center.
[37] "Wheeling Bridge Case," *Pittsburgh Daily Post*, March 4, 1852: 2; "Bridge Across the Allegheny River at Pittsburgh," *The Pittsburgh Commercial*, December 25, 1875: 2; *The Congressional Globe: Containing the Debates and Proceedings of the Second Session Fortieth Congress* (City of Washington: Office of the Congressional Globe, 1868), 4288-4289.

produced," Merrill was born at Fort Howard, Wisconsin to Captain Moses E. Merrill of Brunswick, Maine and Louisa Slaughter of Virginia.[38] After receiving his early education in Kentucky and Ohio, Merrill attended St. James College near Hagerstown, Maryland before reporting to West Point as a cadet in 1854. During his first year at West Point seventeen-year-old Merrill, possessed of a knack for foreign languages, served as assistant professor of Spanish earning him the lifelong nickname "Padre."[39] After graduating from West Point at the head of his class, Merrill served as Assistant Engineer on fortification, river, and harbor work in Savannah, Georgia and Fernandina, Florida before he returned to the United States Military Academy as an instructor in the Department of Engineering just before the outbreak of the Civil War.[40]

Figure 5. William Emery Merrill (1837-1891)[41]

Although Merrill had gained some practical civil engineering experience during his time in Georgia and Florida, it was during the Civil War that he honed the problem-solving and engineering skills that would serve him well in the Ohio Valley. At the beginning of the war Merrill was assigned to the Department of the Ohio under General George B. McClellan. Tasked with fortifying locations in Maryland and West Virginia, Merrill was captured late in the summer of

[38] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 56-57; Johnson, *Davis Island*, 17-18; Society of the Army of the Cumberland, *Society of the Army of the Cumberland, Twenty-Third Reunion, Chickamauga, Georgia, 1892* (Cincinnati, Ohio: Robert Clarke & Co., 1892), 177.

[39] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 57.

[40] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 58; Frank Moore Colby and George Sandeman (eds.), *Nelson's Encyclopaedia*, vol. 8 (New York: Thomas Nelson & Sons, 1907), 96.

[41] Leland R. Johnson, *The Falls City Engineers: A History of the Louisville District, Corps of Engineers, United States Army* (Louisville, Kentucky: 1974), 157.

1861 and imprisoned in Richmond's infamous Libby Prison for five months. During his imprisonment Merrill and another prisoner managed to escape and cover 30 miles of ground before they were recaptured and returned two days later.[42]

After he was released as part of a prisoner exchange, Merrill served as Assistant Engineer in the Army of the Potomac and was wounded in the siege of Yorktown in the spring of 1862. During his recuperation Merrill was placed in temporary charge of the construction of the defenses of Washington and was present at the Battle of Manassas (Second Bull Run) before taking over as Superintending Engineer of the defenses of Newport and Covington and as Chief Engineer of the Army of Kentucky in August of 1862. From the spring of 1863 until the summer of 1865 Merrill served in the Army of the Cumberland alternately as head of its Topographical Department and as its Chief Engineer responsible for planning the defenses of McMinnville, Tennessee and superintending the defenses of Knoxville. In 1864 he was promoted to the rank of colonel of the U.S. Veteran Volunteer Engineers and supervised the construction of 160 fortified timber blockhouses and defensive works protecting military railroad bridges in Tennessee, Northern Alabama, and Georgia.[43] After the war Merrill served for several years as Chief Engineer of the Military Division of the Missouri under General Sherman at St. Louis, Missouri and later under General Sheridan at Chicago, Illinois.[44] In 1870 Merrill was appointed Chief Engineer of the Pittsburgh (later Cincinnati) District in charge of the improvements on the Ohio River and its tributaries.[45]

Among Merrill's first actions as Chief Engineer was reevaluating the Army Engineers' plans for the radical improvement of the Ohio River navigation. Merrill concurred with the recommendation of his predecessor, William Milnor Roberts, that a slack-water system of locks and dams, like that in place on the Monongahela River, was the best solution announcing that "after a full investigation, Mr. Roberts decided in favor of the slack-water system, and I fully agree with him."[46] Unfortunately Merrill's unequivocal support for Robert's plan coincided with an unusually long period of low water and sparked a decade-long struggle between the manufacturers and businessmen of Pittsburgh who favored the proposed slack-water system and the coal shippers and rivermen who came out against it.[47]

Noting that railroads could haul "no more than a small part of the inland commerce" of the region and that no amount of "railroad running or railroad building" could remedy the deficit, businessmen, manufacturers, and merchants championed the proposed slack-water system and the

[42] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 58-59.
[43] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 59-60.
[44] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 61.
[45] William H. Powell, *Powell's Records of Living Officers of the United States Army* (Philadelphia, Pennsylvania: L. R. Hamersly & Co., 1890), 394.
[46] Johnson, *Davis Island*, 19; "River Improvement," *Pittsburgh Daily Commercial*, December 6, 1874: 4.
[47] Johnson, *Davis Island*, 20-21, 43; Robinson, *History of Navigation*, 25.

uninterrupted year-round navigation of the Ohio River that it promised. Touting the broadly-shared benefits the improvements would bring, boosters proclaimed that

> All the vast regions drained by the Ohio and Mississippi rivers, from Pittsburgh and St. Paul to New Orleans, have an equal interest in the question. At this moment they are feeling it. If to float the grain of the West the improvement of the navigation of a single river were needed, is it supposed that it would not be improved? The coal of Pittsburgh is nearly as essential as the grain of the West—at any rate, it cannot be dispensed with—and by reason of obstructions to the Ohio river the threatened famine in the one is as real as it would be in the other were it similarly situated.[48]

The coal shippers and river men countered that the proposed locks and dams would hinder free and open navigation on the river. They argued that the seasonal rises on which the coal trade depended were of so brief a duration that "no more than a third" of Pittsburgh's massive coal fleet could pass successfully through a lock in the time available.[49] Furthermore, a system of locks and dams would increase the costs of river transport and diminish its carrying capacity.

> There are two conspicuous and principal advantages in river or water transportation, viz, *cheapness* and *unlimited capacity*. Whatever tends to lessen or destroy either or both of these, to that extent tends to lessen or destroy the utility and advantage of this method of transfer … It is scarcely necessary to say that a navigable river, when open and unobstructed, affords the means for transportation, limited only by the number and character of the vessels which may be put upon its waters, and which may be increased in number and aggregate of tonnage to an extent practically infinite and limitless … [but] now it is incontestable that a dam and the consequent lockages must increase the expense of the carrying trades on water and also lessen its capacity for transportation in any given time.[50]

Merrill suspected that a system of locks and movable dams could effect a reliable year-round navigation on the Ohio River without hindering the coal fleet during periods of high water. In 1872 he and General Godfrey Weitzel (1835-1844) were appointed to a Corps of Engineers Board of Inquiry charged with evaluating the latest developments in movable dam technology. Weitzel, the civil engineer who accepted the surrender of Richmond, Virginia on April 3, 1865, had for several years been supervising engineer in charge of improvements on the Tennessee, Cumberland, and Wabash Rivers, and at the Falls of the Ohio. After examining designs for a hydraulic caisson gate created by Felix R. Brunot of Pittsburgh, the "bear trap" gates that John DuBois built on the Susquehanna River, and several other American designs, Merrill and Weitzel determined that none would be sufficient to close the more than 300-foot wide navigation chutes required on the Ohio River.[51] Merrill then turned to European designs, and after making "a careful study of the inland waterways of France," seized on the various moveable dam technologies used on the Seine, Yonne, Marne, and Meuse rivers as possible solutions.[52]

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[48] *Pittsburgh Daily Commercial*, November 2, 1871: 2.
[49] Johnson, *Davis Island*, 20-21.
[50] "Improving the Ohio, The Proposed Lock System Examined," *Pittsburgh Post-Gazette*, May 14, 1877: 4.
[51] Joe N. Ballard, *The History of the U. S. Army Corps of Engineers* (Alexandria, Virginia: Office of History, 1998), 42-43; Johnson, *Davis Island*, 24-27.
[52] Johnson, *Davis Island*, 37-38; United States Army Corps of Engineers, *The Ohio River: Charts, Drawings, and Description of Features Affecting Navigation, War Department Rules and Regulations for the River and its*

After wading through stacks of foreign-language engineering reports Merrill sent his assistant Lieutenant Frederick Augustus Mahan (1847-1924) (son of renowned military theorist and United States Military Academy Professor of Engineering, Dennis H. Mahan) to Paris to inspect the movable dams in operation there and to consult with French engineers. Encouraged by Mahan's favorable reports on the workings of the Port-à-l'Anglais Dam on the Seine, in 1874 Merrill recommended the construction a system of thirteen locks and movable Chanoine-type wicket dams on the Ohio River below Pittsburgh to provide reliable year-round slack-water navigation that would not hinder the passage of the coal fleet during periods of high water. (At Merrill's request Mahan was appointed resident engineer in charge of the construction of the first movable dam on the Ohio River at Davis Island in 1878, a position he occupied until 1884.)[53]

The following year Merrill's initial designs and budget estimates for the slack-water project were approved by a Corps of Engineers Review Board and a delegation of pro-improvement Pittsburgh businessmen, led by former U. S. Representative and longtime champion of federal internal improvement projects General James K. Moorhead (1806-1884), travelled to Washington, D. C. and lobbied to secure funding for the proposed slack-water system on the Ohio River. Aware that monies to support the construction of all thirteen proposed lock-and-dam structures were unlikely to be allocated in the aftermath of the financial Panic of 1873, the members of the Pittsburgh delegation successfully concentrated their efforts on funding the lock and dam nearest the city. As a result of their efforts the Rivers and Harbors Act of 1875 diverted one-third of the $300,000 earmarked for improvements to the channel of the Ohio River to the construction of Davis Island Lock and Dam No. 1, the completion of which, they hoped, would secure a year-round navigable port for the city of Pittsburgh and begin the long-anticipated canalization of the Ohio River.[54]

Still opposition to the proposed system continued. Representatives of the coal and river trades cried foul and appealed in vain to John H. Reagan, Chairman of the Commerce Committee of the House of Representatives.

> We respectfully, but earnestly request of you honorable committee, and of Congress, that the moneys appropriated to the improvement of the Ohio be applied in accordance with the language of the law, and not a purpose which can only injure and destroy the commerce that already exists, while it will develop no other. We represent vested rights, in large amount, developed on a natural highway. Those who seek the construction of Davis Island Dam, have no such rights interested or affected. We represent a large public commerce, which we solemnly affirm will be ruined by the proposed dam. We deny that the series of dams proposed will benefit navigation. They will change a great natural highway into a vast canal, with locks and dams. Universal experience teaches that canals are out of use

Tributaries,[and] Navigable Depths and Tables of Distances for Tributaries, 1916, revised to June 30, 1922 (Washington: Government Printing Office, 1922), 150; G. William Quatman, "The Engineer Who Captured Richmond," *The Military Engineer*, May 16, 2017, http://themilitaryengineer.com/index.php/item/554-the-engineer-who-captured-richmond; George W. Cullum, *Biographical Register of the Officers and Graduates of the U. S. Military Academy at West Point, N. Y.*," volume 2, nos. 1001 to 2000 (Boston: Houghton, Mifflin and Company, 1891), 607.

[53] Johnson, *Davis Island*, 34-35, 39-40, 45; Robinson, *History of Navigation*, 26; Henry L. Abbot, *Memoir of Dennis Hart Mahan, 1802-1871* (Washington: National Academy of Sciences, 1886), 32-33.

[54] Johnson, *Davis Island*, 43-45.

> from four to six months each year. The effect, therefore, of turning the Ohio River into a canal will be to facilitate the formation of ice, thus preventing its use. Colonel Merrill proposes to prevent this by opening and shutting the locks, but our observations and experience is that the piers alone afford starting points for ice formations. Hence ice would be sure to form …We insist that ours will be destroyed by the series of dams of which this is one. And with us must suffer every citizen and town on the Ohio and Mississippi, that now secures cheap coal. We therefore solemnly protest against an appropriation for the continuance of work on the Davis Island Dam.[55]

To counter the tenacious opposition of the coal shippers and rivermen and to put an end to delays caused by recalcitrant property owners who refused to part with their riverfront parcels, in 1877 proponents of the slack-water project in the Pennsylvania State Legislature—aided by the lobbying efforts of Merrill and Moorhead—succeeded in securing to the federal government permission to acquire

> Certain lands within the State and bordering on the Ohio, Monongahela, and Youghiogheny rivers for the purpose of erecting thereon dams, abutments, locks, lock-houses, offices and necessary structures for the construction and maintenance of slack-water navigation on said rivers and ceding jurisdiction over the same and for imposing fines and penalties for willful injuries to the grounds, buildings and appurtenances.[56]

Thereafter the Army Corps of Engineers was the ultimate arbiter of, and permitting body for, riverfront construction and improvement activities as well as proposed bridges, transmission lines, sewers, and pipelines that crossed the Ohio River in Pennsylvania. But even before acquiring formal jurisdictional control of the river, many local residents had grown to trust the expertise of the Army engineers and requested that they comment on the design features of particular undertakings that might affect navigation. In 1875, in response to Pittsburgh steamboat builder James Rees' concerns, Chief Engineer Merrill reported that the Union Bridge, previously authorized by the state of Pennsylvania, represented a "serious and unnecessary obstruction to navigation" that might be ameliorated by "removal of a part of the bridge and the insertion of a draw."[57]

In 1878 Merrill's superiors, still wary of failure, sent him to France to make a further study of European movable dam technologies with an eye toward avoiding "costly experiments." Although the Chanoine wicket dams that Merrill favored had been used "on the principal Rivers of France" for decades, no one had attempted their operation on the scale of Merrill's designs and many of his critics remained unconvinced. But Merrill's trip to France only reinforced his conviction that a system of Chanoine-type wicket dams would solve the Ohio River navigation problem. On his return Merrill translated essays and pamphlets by Russian, French, and German engineers describing and evaluating current European methods of river improvement that were compiled and

[55] "Statement of the Coal and River Trade, in Opposition to the Davis Island Dam," in *Internal Improvement Pamphlets (General) of the Durrett Collection, arranged chronologically* ([c.1875]), 16-17.
[56] Johnson, *Davis Island*, 48-51; *Report of the Secretary of War*, Vol. 2, Part 1 (Washington: Government Printing Office, 1877), 635.
[57] "Bridge across the Allegheny River at Pittsburgh," *The Pittsburgh Commercial*, December 25, 1875: 2.

printed by the Corps of Engineers as *Improvement of Non-Tidal Rivers*.[58] With section titles like "River Locks Do Not Retard Navigation," "Defects of Spur-Dikes," and "Canalization Reduces the Cost of Traction for Ascending Navigation," leading European engineers lent authoritative albeit unsolicited support to Merrill's views.[59]

After years of politicking and delays the construction of Davis Island Lock and Dam No. 1 on the Ohio River below Pittsburgh began in 1878 and was completed in 1885 at a cost of just over $940,000 (Figure 6). "In spite of popular prejudice and opposition, and even contrary to the judgment of the French engineers who invented the type, and who doubted its practicability on so large a scale," Merrill succeeded in building the largest movable dam in the world. The experimental structure at Davis Island 4.7 miles below Pittsburgh successfully paired a movable Chanoine-type wicket dam with a 110-by-600-foot rolling-gate lock of Merrill's own design large enough to accommodate "one towboat, ten coal barges and two fuel flats" in a single passage and established a reliable 6-foot-deep slack-water harbor for the city of Pittsburgh.[60]

In 1888 Pittsburgh coal shippers and rivermen, won over by the success of the Davis Island experiment, threw their support behind the Corps of Engineers' plans to extend the Ohio River navigation twenty-five miles downstream. Merrill opted to begin construction with No. 6 below the mouth of the Beaver River, hoping to improve the navigability of the Beaver and Erie Canal and trusting that the completion of Lock and Dam No. 6 would guarantee the construction of Locks and Dams 2 through 5 between it and Davis Island.[61] Owing in no small part to the energetic promotion of Senator (and Republican National Committee Chairman) Matthew Stanley Quay (1833-1904) of Beaver, Congress made an initial appropriation of $250,000 for the construction of Lock and Dam No. 6 on the Ohio River on September 19, 1890.[62]

[58] Willi H. Hager, *Hydraulicians in the USA, 1800-2000* (London: CRC Press, 2015), 2342; William E. Merrill (trans.), *Improvement of Non-Tidal Rivers* (Washington: Government Printing Office, 1881), 1-4; Army of the Cumberland, *Twenty-Third Reunion* (Cincinnati, Ohio: Robert Clarke & Co., 1892), 176; Pittsburgh Chamber of Commerce, *Industries of Pittsburgh: Trade, Commerce and Manufactures* (Pittsburgh, Pennsylvania: Richard Edwards, 1879), 61; "Memoirs of Deceased Members," *Proceedings of the American Society of Civil Engineers* 18 (March, 1892): 92.
[59] Merrill, *Non-Tidal Rivers*, 10, 26, 180.
[60] Francis J. Crilly, "William E. Merrill, No. 1825, Class of 1859," *Twenty-Third Annual Reunion of the Association of Graduates of the United States Military Academy at West Point, New York, June 9, 1892* (Saginaw, Michigan: Seemann & Peters, 1892), 61-62; Corps of Engineers, *The Ohio River*, 150; Johnson, *Davis Island*, 97-98.
[61] Johnson, *Davis Island*, 113-114.
[62] *Annual Report of the Chief of Engineers*, Part 3 (Washington: Government Printing Office, 1893), 2482; "Merrill Dam Celebration," *Pittsburgh Press*, October 15, 1904: 5; *Matthew Stanley Quay (Late a Senator from Pennsylvania), Memorial Addresses Delivered in the Senate and House of Representatives, Third Session of the Fifty-eight Congress* (Washington: Government Printing Office, 1905), 6, 27; Smith Curtis, "The Late Senator M. S. Quay," in *1892-1904, Merrill Dam and Lock No. 6 Opening Celebration* ([Merrill Dam Opening Celebration Association], 1904), [30].

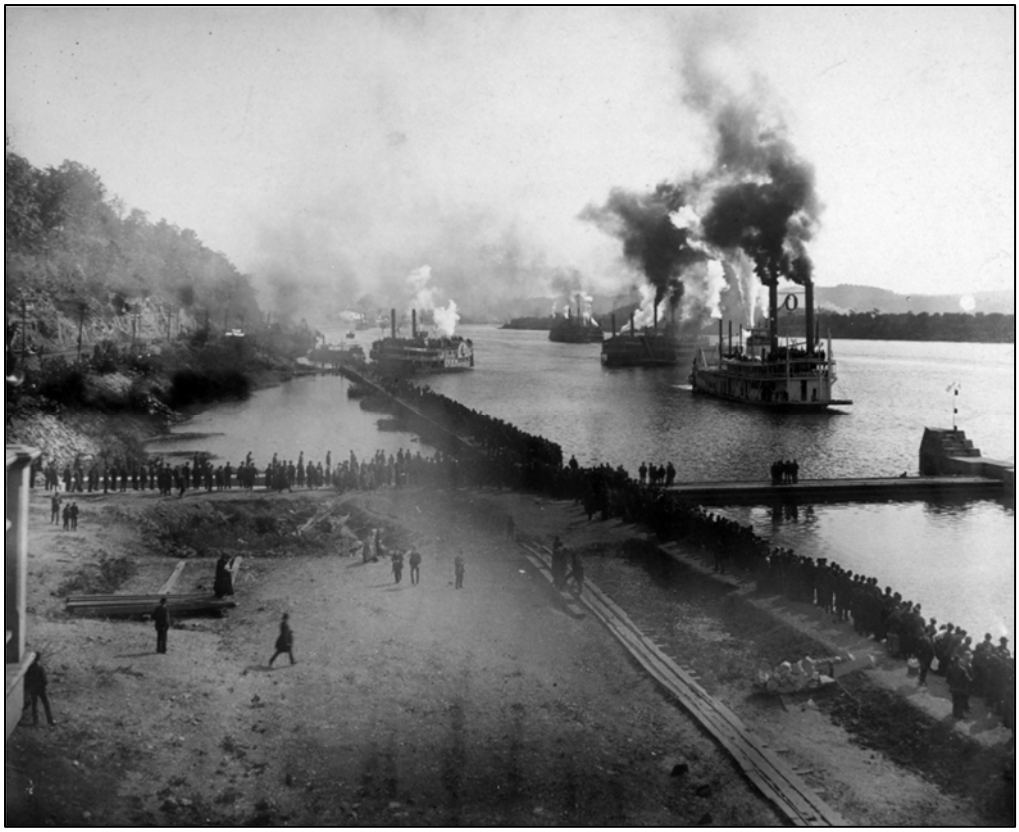

Figure 6. Davis Island Lock and Dam opening celebrations, October 7, 1885.[63]

[63] E. J. Carpenter, "Celebration at Opening of Davis Island Dam | University of Missouri-St. Louis Digital Library," *UMSL Digital Library*, May 16, 2017, http://dl.mospace.umsystem.edu/umsl/islandora/object/umsl%3A39510.

4.0 Building Lock and Dam No. 6

Lock and Dam No. 6 located 28.8 miles below Pittsburgh improved on Merrill's designs for Davis Island Lock and Dam No. 1 and established a reliable six-foot slack-water pool on the Ohio River extending from Poorhouse Run to Freedom Borough, Beaver County.[64] Work on Lock and Dam No. 6 began on June 2, 1892 and was largely completed by October of 1904 at a cost of $1,040,000. Although not yet officially open, on August 5, 1904 the *Lorena*, a sternwheel packet boat out of Ohio, and the *Greenwood*, a sternwheeler out of West Virginia became the first boats to lock through at Lock and Dam No. 6.[65] Occasionally called the Beaver Movable Dam, Lock and Dam No. 6 was more commonly referred to as the Merrill Lock and Dam in tribute to Merrill, who died suddenly in 1891. The railroad station near Lock and Dam No. 6 was likewise called Merrill Station in his honor.[66]

Initially construction at Lock and Dam No. 6 was carried out under the supervision of the resident engineer William Martin (c.1846-c.1926), formerly the chief civilian assistant to Army Engineer Mahan at Davis Island Lock and Dam No. 1. Although Martin was well-regarded for his "experience on the Davis Island Dam and superior fitness for the work" building Lock and Dam No. 6 on the Ohio River proved to be a technically difficult and expensive undertaking.[67] Many of the same conditions that hampered navigation on the Ohio River also affected construction budgets and schedules at Lock and Dam No. 6. High water, ice, and accidents stalled work, damaged construction, delayed the delivery of materials, and flooded worksites.

During the initial construction season in 1892 a small army of engineers, draftsmen, inspectors, carpenters, masons, mechanics, and day laborers under Martin's direction began excavations for the foundation of the lock's river wall, sank a 6.3-acre cofferdam for the construction of the lock, and erected "all the temporary buildings" and "the [power] plant required in the construction of the permanent work." The 1892 season saw the completion of a 292-foot section of the drift chute for the lock and the construction of the permanent foundation for the boiler house, a brick and concrete "floor supported on I-beams." However, the $250,000 appropriated for the construction of Lock and Dam No. 6 was already deemed insufficient and less than a month after breaking ground a second congressional appropriation of $100,000 was made for Lock and Dam No. 6 as part of the Rivers and Harbors Act of 1892.[68]

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[64] A. B. McGrew, "Movable Dams," in *1892-1904, Merrill Dam and Lock No. 6 Opening Celebration* ([Merrill Dam Opening Celebration Association], 1904), [25]; United States Geological Survey, *Pennsylvania, Beaver Quadrangle*, reprinted 1930 (1904).

[65] J. H. Bausman, "History of the Ohio and Beaver Rivers and Their Improvement," in *1892-1904, Merrill Dam and Lock No. 6 Opening Celebration* ([Merrill Dam Opening Celebration Association], 1904), [22]; "'Steamboat Lorena' by Marshall University," *Marshall University*, January 18, 2017, http://mds.marshall.edu/river/76/; "'Steamboat, Greenwood, on the Ohio River' by Marshall University," *Marshall University*, January 18, 2017, http://mds.marshall.edu/river/11/.

[66] Edward Wegman, *The Design and Construction of Dams* (New York: John Wiley & Sons, 1907), 366; *The Philadelphia Record Almanac* (Philadelphia: The Record Publishing Company, 1894), 96.

[67] *Annual Reports of the War Department*, *Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1897), 2358; *Annual Report of the Secretary of War*, volume 2, part 3 (Washington: Government Printing Office, 1894),1871; Johnson, *Davis Island*, 87-88.

[68] *Annual Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1893), 2482; *Annual Report of the Secretary of War*, part 1 (Washington: Government Printing Office, 1893), 313; William L. Sibert, Captain William L. Sibert to Heine Safety Boiler Co., Pittsburgh, Pennsylvania, April 15, 1903. Press Copies of

After the river ice thawed and the spring freshets receded active work on Lock and Dam No. 6 resumed on July 1, 1893 and continued until Tuesday, November 21 when construction was temporarily suspended after tragedy struck the Bradley and Kenoy Hotel at Merrill Station. An early morning fire destroyed the hotel, killed seven dam workers, injured several others, and left dozens destitute. Eighteen days later active work at Lock and Dam No. 6 was suspended for the winter season. The annual report of the Secretary of War indicated that the work at Lock and Dam No. 6 had "progressed satisfactorily" during the 1893 season; repairs were made to the "protecting cribs of the coffer dams" after they were damaged by spring floods and eighty percent of the work on the river wall, drift chute, gate recesses, and lock foundations was completed. Additionally, more than a third of the land wall of the lock was finished.[69]

The 1894 construction season commenced on Friday, July 20 and continued into the New Year. Although masonry work at Lock and Dam No. 6 was suspended on December 11 because of cold temperatures, excavation of the lock chamber continued until January 5, 1895. Two days after the cessation of construction high water carried away 330 feet of the cofferdam. Fortunately, the damage was considered relatively minor as "two short spurs connecting each end of the break with the completed part of the river wall again inclosed [sic] all work to be done." The progress made during the 1894 season was described as satisfactory, eighty percent of the work having been completed.[70]

The 1895 construction season proved generally uneventful. When work was suspended for the winter season on December 2, the lock at No. 6 was nearly completed but for its gates, operating machinery, and some "minor details."[71] A month into the 1896 construction season the final plans for the construction of the Chanoine-type movable dam at No. 6 were approved by the Army Engineers. Unfortunately, when the work at Lock and Dam No. 6 was suspended in early December little progress had been made on the lock because the "operations were much interrupted by high water."[72]

On April 29, 1897 the contract for the construction of the Chanoine-type wicket dam and the adjacent masonry piers—valued at "about $94,000"—was awarded to Hulings Brothers of Pittsburgh. "General Contractors and Proprietors of the Dredge Boat 'Eastern'" Edward J. and Harry B. Hulings advertised their expertise in "DREDGING and OTHER SUBMARINE WORK, and Building Dykes, Abutments, &c." On Wednesday, June 2, Hulings Brothers began installation of the cofferdam needed to build the wicket dam at No. 6 and at the end of the week Congress

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Letters Sent, Ohio River, Box 1, Volume 1, Records of the Corps of Engineers, Pittsburgh, Pennsylvania, RG 77, NARA at Philadelphia.

[69] *Annual Report of the Secretary of War*, volume 2, part 3 (Washington: Government Printing Office, 1894), 1870; "Burned to Death," *The Pittsburgh Press*, November 21, 1893: 1; *Annual Report of the Secretary of War*, part 1 (Washington: Government Printing Office, 1894), 287.

[70] *Annual Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1895), 2364; *Report of the Secretary of War*, part 1 (Washington: Government Printing Office, 1895), 320.

[71] "Improving the Rivers," *The Pittsburgh Press*, May 4, 1895: 2; *Report of the Secretary of War*, Volume 2, Part 4 (Washington: Government Printing Office, 1896), 2100; *Report of the Secretary of War*, Part 1 (Washington: Government Printing Office, 1896), 276.

[72] *Report of the Secretary of War*, volume 2, part 4 (Washington: Government Printing Office, 1896), 2100; *Annual Reports of the War Department*, *Report of the Chief of Engineers*, Part 3 (Washington: Government Printing Office, 1897), 2358; *Report of the Secretary of War*, Part 1 (Washington: Government Printing Office, 1896), 276.

appropriated an additional $300,000 to the project. By late summer Hulings Brothers had begun work on the foundation of the dam and were driving piles for the installation of grillage. By the first week in November the construction of the concrete breast of the dam was underway with an anticipated completion date of mid-November. Nonetheless the government engineers were dissatisfied with the pace of Hulings Brothers' work (in the contractors' defense the high waters that had slowed construction during the 1896 season continued to do so in 1897) and on Monday, November 15, William Martin, resident engineer at Davis Island, assumed direct oversight of dam construction at No. 6. At that point the work that had been completed under the Hulings Brothers' contract included "all excavation for foundations, all pilings for grillage, sheet piling on upstream side of concrete for a length of 500 feet, and concrete laid within 6 inches of required depth, for a distance of 336 feet." As Martin parsed the situation, the government "has not taken the contract out of the hands" of Hulings Brothers but, rather, intends to complete the work "at their expense." In any event the government's actions proved disastrous for Hulings Brothers. A panic among their creditors resulted in the issuance of writs of execution totaling over $35,000 against their assets under which "all the personal property of the firm at Merrill" and in Pittsburgh was seized for sale by the county sheriffs. On December 23 active work at Lock and Dam No. 6 was suspended for the winter season.[73]

The same year as the Hulings Brothers debacle, Martin, already the resident engineer at Davis Island and the supervising engineer at Lock and Dam No. 6, was placed in charge of construction at Locks and Dams 2 through 5. Not surprisingly productivity and quality suffered. In 1901, after construction on the Ohio River was delegated to Captain William E. Craighill (1833-1909) of the newly established Wheeling District, Merrill's replacement in the Cincinnati District, William Herbert Bixby (1849-1928) relieved Martin of his construction supervision responsibilities and transferred him and Davis Island Lock and Dam No. 1 to the Pittsburgh District. The matter of overriding concern to Craighill and Bixby was the quality of cement Martin used at Locks and Dams 2 through 5. (Only after the Pittsburgh Chamber of Commerce appealed to President Roosevelt in 1902 was local control of construction at Locks and Dams 2 through 6 restored.) From 1903 onward construction of the Locks and Dams on the Ohio River in Pennsylvania was the responsibility of Pittsburgh District Engineer William L. Sibert (1860-1935). The on-site supervision of construction at Lock and Dam No. 6 was delegated to Assistant Engineer William Hobbs Chadbourn Jr. (1865-1939), a graduate of the Massachusetts Institute of Technology who joined the Corps of Engineers in 1889. Before coming to the Ohio River valley Chadbourn had worked in North Carolina where he was charged with surveying the Neuse River (1897), Cape Lookout (1897), and the New River (1899) as well as supervising improvements on Contentnea Creek (1896-1897). Chadbourn would remain at Lock and Dam No. 6 until 1906 when he retired from the Corps of Engineers and accepted a position as the chief engineer of the Chicago, Great

[73] *Annual Reports of the War Department*, *Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1897), 2325, 2358; *Annual Reports of the War Department*, *Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1897), 357, 359; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1898), 2081; "Along the Rivers," *The Pittsburgh Press*, November 4, 1897: 3; *J. F. Diffenbacher's Directory of Pittsburg and Allegheny Cities for 1895* (Pittsburgh: Stevenson & Foster Co., 1895), [1034]; "Hulings Gets A Big Contract," *Pittsburgh Daily Post*, May 5, 1897: 7; "More Executions Issued," *Pittsburgh Daily Post*, November 19, 1897: 3; "News from the Rivers," *Pittsburgh Daily Post*, November 23, 1897: 7.

Western Railway. William Martin stayed on at Davis Island until 1905 when Sibert (perhaps justifiably) attempted to reduce his salary prompting his resignation.[74]

Even after resolving the supervision problem at No. 6, varying the type of cement used in construction remained a sensitive subject. District Engineer Silbert responded to an inquiry by Chadbourn in 1904.

> This office does not consider it good practice to use two or more kinds of cement in the same piece of work. The question of brand of cement was settled in this case when the contractor submitted the brand that has been used so far in the work. This office knows of no reason for not continuing the use of the cement first decided upon. When a question is once settled concerning a contract it must remain so settled unless there are very serious reasons for bringing it up again, otherwise the Government might be called upon to decide whether or not it would adopt a new brand of cement each week.[75]

Work was resumed at Lock and Dam No. 6 in April of 1898 and continued until August 6 when high water "flooded the works and suspended operations" for three weeks. At the beginning of August a plan for implementing two bear-trap weirs and a movable Thomas A-frame dam south of the wicket dam at No. 6 replaced an earlier plan that utilized 3 bear-trap weirs and by early October workers at No. 6 had begun removing the cofferdam surrounding the navigable pass. (Bear-trap weirs consist of two rectangular leaves with a hinged base that could be raised and lowered as necessary to pass off large drift which accumulates above a dam, with minimal affects to the depth of the upriver pool). Work completed during the season included the installation of timber facing on the upper and lower guiding walls of the lock, concrete work, and the excavation of 7,000 cubic feet of soil and rock from the lock approaches. Approximately 420 feet of the navigable pass at No. 6 was finished and open to navigation, "the spill crib outside the river lock wall [was] finished, and the greater part of the pass cofferdam [was] removed," but the lock itself remained without machinery. Additionally, substantial work was completed on the cofferdams required for the construction of the bear-trap weirs and the A-frame dam.[76]

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[74] Johnson, *Davis Island*, 116-118; "Merrill Dam Celebration," *The Pittsburgh Press*, October 15, 1904: 5; Edward M. Dawson (comp.), *Official Register of the United States*, vol. 1 (Washington: Government Printing Office, 1901), 517; *Official Register of the United States*, vol. 1 (Washington: Government Printing Office, 1905), 420; Elaine Chadbourne Bacon, *The Chadbourne Family in America: A Genealogy* (Penobscot Press, 1994), 382; "What '86 are Doing," *The Tech* 6, no. 3 (November 18, 1886): 42; *Report of the Chief of Engineers*, part 2 (Washington: Government Printing Office, 1897), 1389-1391, 1393, 1431-1433; *Report of the Chief of Engineers*, part 2 (Washington: Government Printing Office, 1899), 1501; *Journal of the Executive Proceedings of the Senate of the United States of America, Fifty-Fifth Congress*, vol. 31, part 1 (Government Printing Office, 1909), 989; "Inexpressibly Sad Death," *Wilmington Morning Star* (Wilmington, North Carolina), May 11, 1910: 5; "Position for Chadbourn," *The Decatur Herald* (Decatur, Illinois), July 17, 1906:1; "Davis Island Dam Formally Transferred by Captain W. E. Craighill, Navigation Still Suspended," *Pittsburgh Daily Post*, January 21, 1902: 3.

[75] William L. Sibert, Captain William L. Sibert to W. H. Chadbourn, Jr., June 8, 1904. Press Copies of Letters Sent, Ohio River, Box 2, Volume 2, Records of the Corps of Engineers, Pittsburgh, Pennsylvania, RG 77, NARA at Philadelphia.

[76] *Annual Reports of the War Department, Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1898), 2081; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1898), 359; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1899), 415; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1899), 2353; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1899), 415.

On May 10, 1899 a contract for the completion of the "weirs, piers, and uncompleted section of pass" was awarded to the Evansville Contract Company of Evansville, Indiana. Soon thereafter work on the bear-trap weirs and the A-frame dam was underway. By the last weeks of September work was "progressing nicely"— and "decided headway" had been made that would "facilitate the passage of outgoing tows" when "good water" came in the spring. By the end of the construction season, the contract work on "weirs, piers and abutment" was about one-third complete but "the lock gate, maneuvering apparatus (including power-house machinery, boats, etc.), the employees' quarters, storehouses, and grading, paving, riprapping, etc., of banks" still remained unfinished and unfunded. As for the wicket dam, the concrete foundation and its timber components were completed, all of its iron work was placed, and all but five of its wickets were installed.[77]

The resumption of construction in 1900 was delayed "on account of the contractor's inability to unwater the cofferdam inclosure [sic]" and flooding ended the season prematurely. The abbreviated season notwithstanding by late November the work on the "weirs, piers and abutment" was about four-fifths complete and the concrete foundation of bear-trap weir No. 1 was finished, its timber framework was erected, the pedestals for the gate axes were in place, and its steel work greatly advanced. Furthermore, at bear-trap weir No. 2 and the A-frame dam the construction of the foundations and timber frameworks was underway.[78]

Insufficient funding necessitated the premature suspension of the weirs, piers and abutments contract with the Evansville Contract Company on September 7, 1901. However, despite the suspension, both bear-trap weirs were completed, and the A-frame dam was largely finished. Additional funds for completing the work at Lock and Dam No. 6 were allocated on June 13, 1902 and the following October a new contract was awarded to the Evansville Contract Company to complete two masonry piers associated with the A-frame dam and the south shore abutment. By the end of the 1902 construction season Lock and Dam No. 6 still lacked a powerhouse, residences, and lock machinery and some necessary modifications to the A-frame dam were still pending but the piers begun by the Evansville Contract Company were nearly complete and the construction of the south shore abutment was underway.[79]

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[77] *Annual Reports of the War Department, Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1899), 415; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 3 (Washington: Government Printing Office, 1899), 2353; "Water in the Pools," *The Pittsburgh Press*, September 21, 1899: 11; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1900), 474; *Annual Reports of the War Department, Report of the Chief of Engineers*, part 5 (Washington: Government Printing Office, 1900), 3148.

[78] *Annual Reports of the War Department, Report of the Chief of Engineers*, part 4 (Washington: Government Printing Office, 1901), 2668; *Annual Reports of the War Department, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1901), 474-475; *Annual Reports of the War Department, Report of the Chief of Engineers*, Part 4 (Washington: Government Printing Office, 1901), 2663.

[79] *Annual Reports of the War Department, Report of the Chief of Engineers*, part 1 (Washington: Government Printing Office, 1902), 411; *Annual Reports of the War Department, Report of the Chief of Engineers*, Part 3 (Washington: Government Printing Office, 1902), 1920-1921; *Annual Reports of the War Department,* Volume 7*, Report of the Chief of Engineers*, Part 3 (Washington: Government Printing Office, 1904), 2517; *Annual Reports of the War Department,* Volume 9*, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1903), 436; *Annual Reports of the War Department,* Volume 10*, Report of the Chief of Engineers*, Part 2 (Washington: Government Printing Office, 1903), 1675; "No Money to Pay Bills." *The Pittsburgh Press*, September 6, 1901: 11.

On May 29, 1903 a contract in the amount of $15,890 for the construction of the lock power house was awarded to the W. W. Wood Company of Wheeling, West Virginia and on June 6, 1903 the Penn Bridge Company of Beaver Falls, the lowest bidder, secured a $36,000 contract to build and erect "in place" the 120-ton rolling steel lock gates required at Lock and Dam No. 6. Under the direction of Assistant Engineer Chadbourn the lock powerhouse was completed on January 7, 1904 and two days later the Evansville Contract Company finished their work on the piers and abutments on the south side of the river. At the conclusion of the 1903-4 construction season, the lock and dam and all essential components were complete "except the lock gates, which [were] about two-thirds erected in place." The "masonry of the lock, 600 feet of navigable pass (Chanoine type), two bear-trap weirs of 120 feet span each were completed; [and] one weir of 120 feet span of A-frame was practically completed." The outstanding work at the site included: "grading and paving the lock yard, completing the riprapping on the abutment side of the river, dredging a large bar at head of lock, purchasing site and building a dam tender's dwelling, placing iron covers for grate recesses, erecting electric-light plant, and placing cement walks, gutters, curbing, etc."[80]

On Thursday, August 4, 1904 the wickets at Lock and Dam No. 6 were successfully raised for the first time. Less than two weeks later the outstanding work at Lock and Dam No. 6—including putting the last touches on the massive rolling lock gates—was completed and the two bear-trap weirs were successfully raised (Figure 7). The only remaining task at Lock and Dam No. 6 was building the lockkeepers' houses that were designed by noted West Virginia architects Millard Giesey and Frederick F. Faris in 1902-03. A construction contract for the residences was awarded to T. J. Williams of Pittsburgh on September 4, 1904 and the twin two-and-a-half story brick residences flanking the lock's powerhouse were completed in January of 1905.[81] The new lock and dam on the Ohio lived up to the high standard set at Davis Island; during Merrill Lock and Dam No. 6's first year in operation, 3,083,359 tons of freight passed through it, including 12,788 vessel carrying 2,851,079 tons of coal and 99,612 tons of iron and steel products.[82]

The year after Merrill Lock and Dam No. 6 opened, the River and Harbor Act of March 3, 1905 paved the way for the creation of a nine-foot slack-water system of navigation on the Ohio River between Pittsburgh and Cairo, Illinois. As part of the act Congress allocated $500,000 for dredging and modifications necessary to bring Locks and Dams 2 through 5 (still under construction) and

[80] William L. Sibert, Captain William L. Sibert to Hon. M. S. Quay, July 14, 1903. Press Copies of Letters Sent, Ohio River, Box 1, Volume 1, Records of the Corps of Engineers, Pittsburgh, Pennsylvania, RG 77, NARA at Philadelphia; William L. Sibert, Captain William L. Sibert to Brigadier General G. L. Gillespie, Chief of Engineers, May 4, 1903. Press Copies of Letters Sent, Ohio River, Box 1, Volume 1, Records of the Corps of Engineers, Pittsburgh, Pennsylvania, RG 77, NARA at Philadelphia; *Annual Reports of the War Department,* Volume 7*, Report of the Chief of Engineers*, Part 3 (Washington: Government Printing Office, 1904), 2522; "Bids on Steel Lock Gates," *Pittsburgh Daily Post*, May 20, 1903: 5; *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1904), 465.

[81] *Annual Reports of the War Department for the Fiscal Year Ending June 30, 1904*, volume 7, *Report of the Chief of Engineers* (Government Printing Office, 1904), 2522; "Merrill Wickets Up," *Pittsburgh Weekly Gazette*, August 7, 1904: 26; *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1905), 475; *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 2 (Washington: Government Printing Office, 1905), 1843; William L. Sibert, Captain William L. Sibert to Major George A. Zinn, June 29, 1903. Press Copies of Letters Sent, Ohio River, Box 1, Volume 1, Records of the Corps of Engineers, Pittsburgh, Pennsylvania, RG 77, NARA at Philadelphia.

[82] *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1905), 475; *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 2 (Washington: Government Printing Office, 1905), 1844.

newly completed Lock and Dam No. 6 into compliance with the new 9-foot standard.[83] In 1922-23 the required upgrades were completed and a 9-foot slack-water pool was established between Merrill Lock and Dam No. 6 and Freedom Borough.[84]

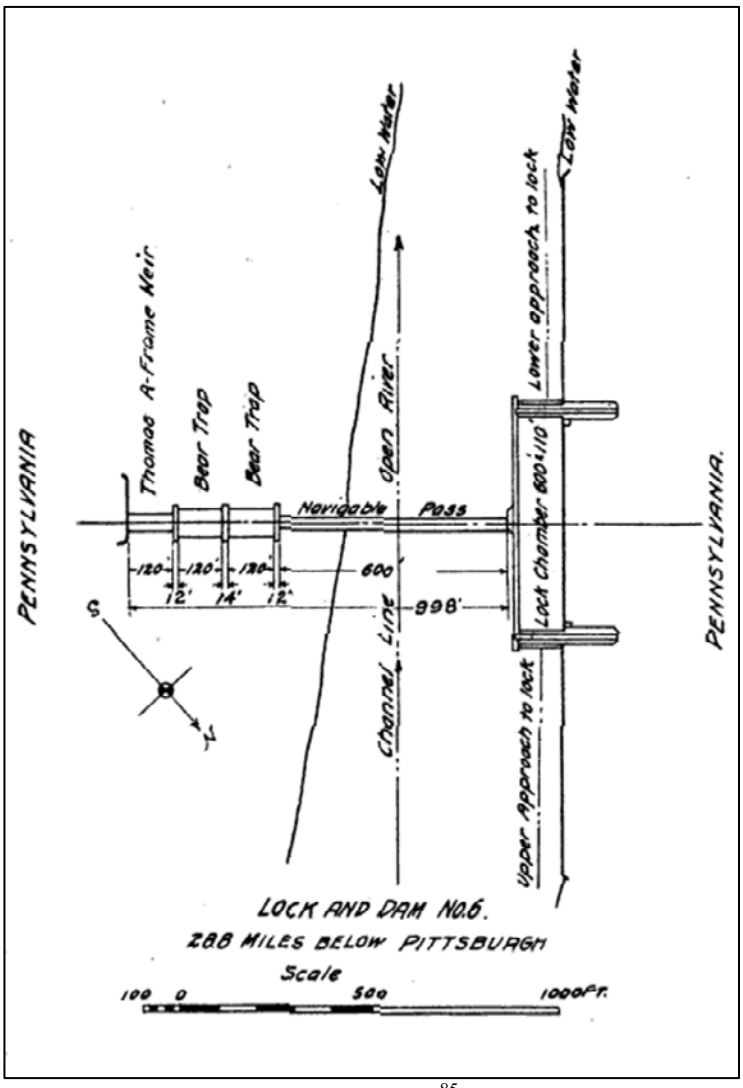

Figure 7. Merrill Lock and Dam No. 6.[85]

[83] *Annual Reports of the War Department,* Volume 5*, Report of the Chief of Engineers*, Part 1 (Washington: Government Printing Office, 1905), 475; *Annual Report of the Chief of Engineers, United States Army*, part 1 (Washington: Government Printing Office: 1906), 522,525.
[84] Edwin Stevenson, "Putting the Finishing Touches on Dams in Rivers: Great Impetus to Pittsburgh Commerce," *Pittsburgh Post*, August 12, 1906: 24; "River Harbor Will Extend 30 Miles Soon," *Pittsburgh Press*, December 3, 1907: 1; "Raising the Dams: Clearing Up Preparatory to Putting Up the Wicketts," *Pittsburgh Post-Gazette*, April 29, 1908: 15; "To Take River Stages from Six Dams When Up," *Pittsburgh Daily Post*, June 23, 1908: 5; "River News," *Pittsburgh Daily Post*, October 10, 1922: 14; *Pittsburgh Daily Post*, August 28, 1923.
[85] R. R. Jones, *The Ohio River: Charts, Drawings, and Descriptions of Features*, revised to March 31, 1920 (Washington: Government Printing Office, 1920), 166.

5.0 Merrill Lock and Dam No. 6 on the Ohio River

Merrill Lock and Dam No. 6 shared several state-of-the-art design elements with Davis Island. Owing to the outsized dimensions of the Ohio River locks—standardized by District Engineer Merrill at 110-by-600 feet to accommodate "fourteen large coal boats and the accompanying steamer"—traditional swinging miter gates were inadequate to the task of closing them against the weight of the volume of water behind them. To close the oversized lock chambers Merrill designed a system of steam-powered wheel-mounted rolling gates—with "recesses for the reception of the gates when open" (Figure 8).[86]

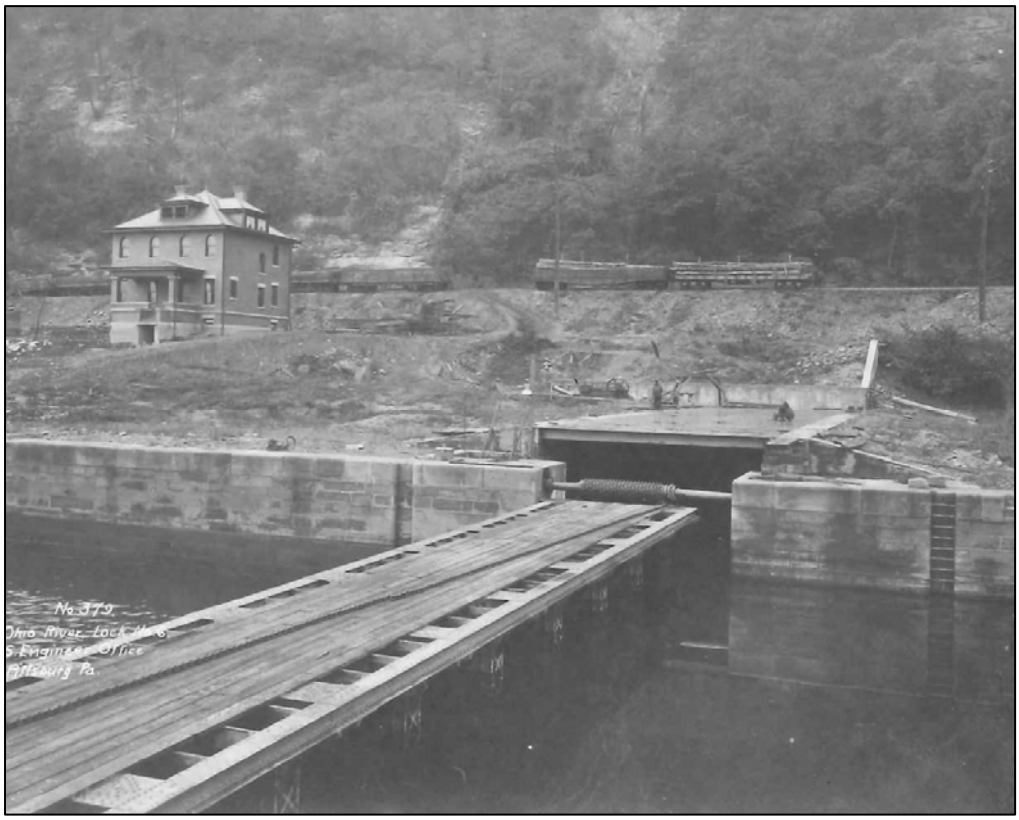

Figure 8. Merrill Lock and Dam No. 6, lockkeepers' residence, steam powered rolling lock gate, and recess.[87]

Similarly both facilities employed movable Chanoine-type wicket dams with Pasqueau hurters (Figures 9 and 10).[88] A French design championed by Merrill, Chanoine wicket dams were moveable dams consisting of a series of hinged steel-bound timber gates (or wickets) that lay flat against a masonry foundation at high water leaving an open channel for navigation but which could

[86] Robinson, *History of Navigation*, 26; Newman, *Ohio River Navigation*, 25; *The Executive Documents of the House of Representatives for the First Session of the Fiftieth Congress, 1887-88* (Washington, DC: Government Printing Office, 1889), 1796; "Thousands Cheer Opening of Dam," *Pittsburgh Weekly Gazette*, October 16, 1904: 2.
[87] Ohio River Lock No. 6 [Lockkeepers' Residence, Lock Gate, and Lock Recess], The Pittsburgh Engineering District of the United States Army Corps of Engineers. Pittsburgh, Pennsylvania.
[88] "Merrill Dam Celebration," *The Pittsburgh Press*, October 15, 1904: 5; A. B. McGrew, "Movable Dams," in *1892-1904, Merrill Dam and Lock No. 6 Opening Celebration* ([Merrill Dam Opening Celebration Association], 1904), [25].

be raised on end at low water to form a dam. The massive individually hinged wickets were raised and lowered by a crew on a maneuver boat riding upstream of the dam or from an adjacent service-bridge.[89] (Davis Island had, at first, employed a service-bridge to open and close the wickets but soon switched to the use of a maneuver boat when the bridge was destroyed by the Johnstown Flood in 1889.) Although Davis Island and Merrill Lock and Dam No. 6 were the first such dams built on the Ohio River, the Army Corps of Engineers had completed the nation's first Chanoine wicket dams on West Virginia's Kanawha River in 1880.[90]

The general mechanics of Chanoine-type wicket dams are rather well documented in civil engineering reference works and professional journals of the time. From *The Design and Construction of Dams* (1907),

> The term "wicket" has been applied in the United States to a shutter revolving on an axel placed near its middle. Described in detail, a Chanoine wicket consists of three parts … A rectangular panel of wood or iron; the horse, or trestle, supporting the axel of the shutter, and the prop holding up the horse and having its foot bearing against a cast-iron shoe, called a "hurter" (in French "heurtoir') fixed to the apron. The parts of the shutter above and below the axle are called respectively the "chase" and the "breach." Two maneuvering chains are usually attached to the shutter, one to the top and the other to the bottom.
>
> Several wickets, placed side by side, form the dam. To prevent the panels from interfering with each other by swelling, etc. they are placed about 2 to 4 inches apart. When the leakage between the wickets is greater than the minimum flow in the river the spaces between the wickets can be closed by needles [i.e., wooden spars] or by nailing strips of wood to the shutters.
>
> The axels of the weir-wickets are placed so they will revolve automatically when the water reaches a certain height, but those of the pass are attached at the center of the shutter. The pass wickets do not oscillate, therefore, when the water rises. They can be readily lowered by the tripping-bar when required.[91]

And from *The Engineering Record, Building Record and Sanitary Engineer* (1909),

> The moveable parts of the Chanoine dam consist of the wicket, which is made of timber with a steel binding, the horse or frame, hinged to the trestle boxes of the foundation at one end and the wicket at the other, and the prop which supports the horse and wicket. The fixed parts are the hurter which supports the end of the prop when the wicket is up and guides it in its rise and descent, the horse boxes in the foundation, forming the points of rotation for the horse, and the sill (of timber, capped with steel or cast iron) which

[89] Wegman, *Dams*, 330.
[90] "Huntington District>About>History>Great Kanawha," *U.S. Army Corps of Engineers*, December 13, 2016, http://www.lrh.usace.army.mil/About/History/Great-Kanawha/; "Kanawha Locks and Dams," *mywvhome.com*, December 13, 2016, http://www.mywvhome.com/1900s/locks.html; Wegman, *Dams*, 330-332; Newman, *Ohio River Navigation*, 25.
[91] Wegman, *Dams*, 327-328.

> completes the water closure when the dam is up, and protects the moveable parts from injury when they are down.[92]

No. 6's one-hundred and fifty Chanoine wickets measured 3¾ feet wide with three inches left between each wicket to prevent fouling and rested at 20 degrees to the vertical when deployed. The wickets at Lock and Dam No. 6 were 15 feet 2 inches long (rather shorter than those used at neighboring dams) and, when raised, were supported by forged steel props nearly a half foot in diameter. At No. 6 the wickets of the navigable pass were opened and closed by means of a derrick boat with a "double-drum hoisting-engine."[93]

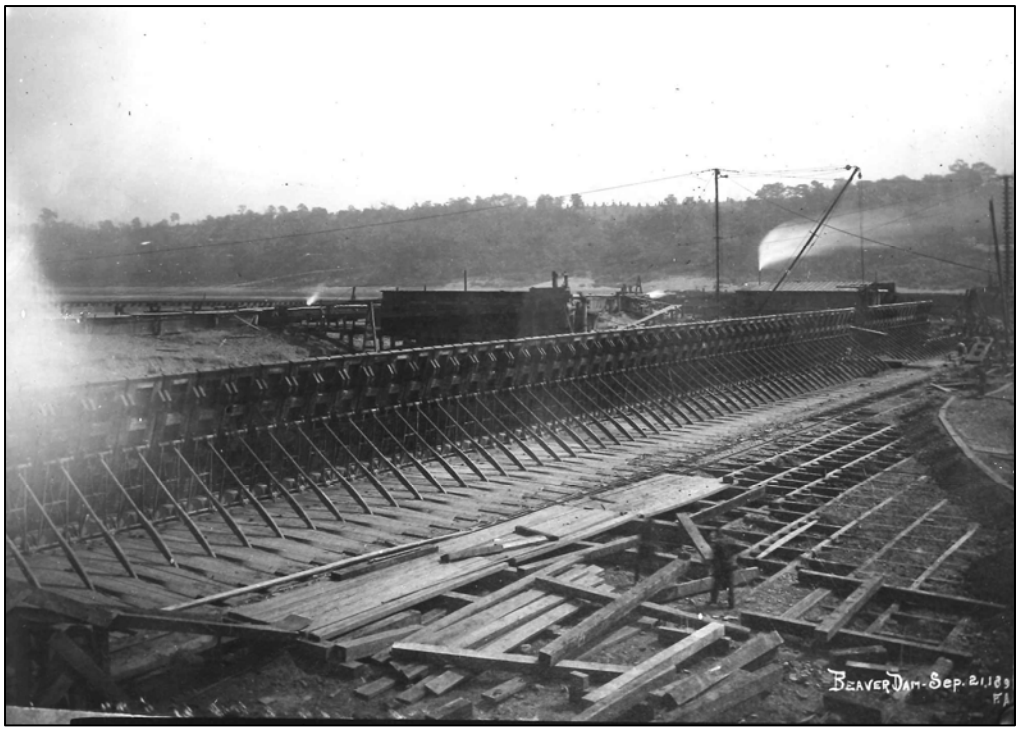

Figure 9. Merrill Lock and Dam No. 6, propped Chanoine-type wickets and Pasqueau hurters, September 21, 189[?].[94]

[92] P. S. Bond, "The Permanent Improvement of the Ohio River.—III," *The Engineering Record, Building Record and Sanitary Engineer* 59 (January 9, 1909): 41.
[93] "Merrill Dam Celebration," *The Pittsburgh Press*, October 15, 1904: 5; Ohio River Locks & Dams, Emsworth to 53 Inclusive, Data Sheet, December 15, 1931, (Office Chief of Engineers), District Engineer Office, Huntington, West Virginia (Successor to Wheeling District Office), 1899-1943, Box 3, Navigable Waterways, 1899-1941, RG 77, NARA at Philadelphia; P. S. Bond, "The Permanent Improvement of the Ohio River.—III," *The Engineering Record, Building Record and Sanitary Engineer* 59, no. 2 (January 9, 1909): 42; Wegman, *Dams*, 365.
[94] Beaver Dam, Sep. 21, 189_, The Pittsburgh Engineering District of the United States Army Corps of Engineers. Pittsburgh, Pennsylvania.

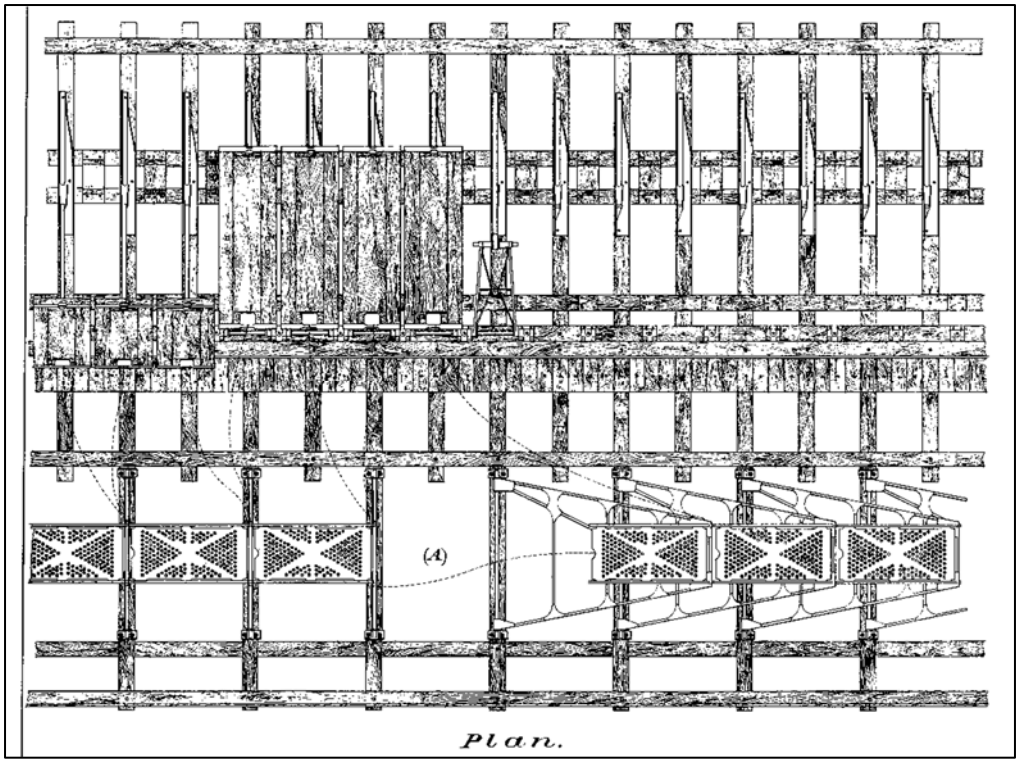

Figure 10. Plan of Chanoine-type wickets at Davis Island, 1889.[95]

The wicket dams at Davis Island and Merrill both employed Pasqueau hurters (Figure 11). When the earliest Chanoine wicket dams were built in France one or two tripping-bars were employed to raise and lower all of the wickets *simultaneously* but such mechanisms were prone to malfunctions and could render the entire dam inoperable. The Pasqueau hurter was a "special double-grooved hurter and slide" designed to allow each wicket to be raised and lowered *individually* from a boat or service-bridge. Tripping-bars had another drawback that made them unsuitable for use on the Ohio River; they were sufficient for passes no wider than 150 feet, far narrower than the 600-foot navigable pass Merrill required.[96]

The foundation of the dam at No. 6 was composed of a rigid frame of 12-by-12-inch white oak timbers embedded in poured concrete to which the components of the wicket dam (e.g., the steel horse, horse-box, and cast-iron hurters) were bolted.[97] The foundation measured 12 feet wide and was reinforced with sheet piles on the upstream side.[98] Between 1897 and 1900 alone the construction of the wicket dam at No. 6, including the foundation, wickets, and adjacent pier, consumed well over 3,000 cubic yards of concrete, over 400,000 feet b.m. (board measure) of structural timber, and nearly 10,000 feet b.m. of sheet piling.[99]

[95] "Ohio River – Davis Island dam, plate no. 12, weir 1, plan | Library of Congress," *Library of Congress*, May 17, 2017, https://www.loc.gov/item/2008677294/.
[96] Wegman, *Dams*, 330-332.
[97] "Merrill Dam Celebration," *The Pittsburgh Press*, October 15, 1904: 5.
[98] Wegman, *Dams*, 365; P. S. Bond, "The Permanent Improvement of the Ohio River.—III," *The Engineering Record, Building Record and Sanitary Engineer* 59, no. 2 (January 9, 1909): 42.
[99] Dam No. 6 Ohio River, Account of the Construction of the Navigable Pass and Pier at Junction with Weir No. 1. United States Army Corps of Engineers, Pittsburgh District, Pittsburgh, Pennsylvania.

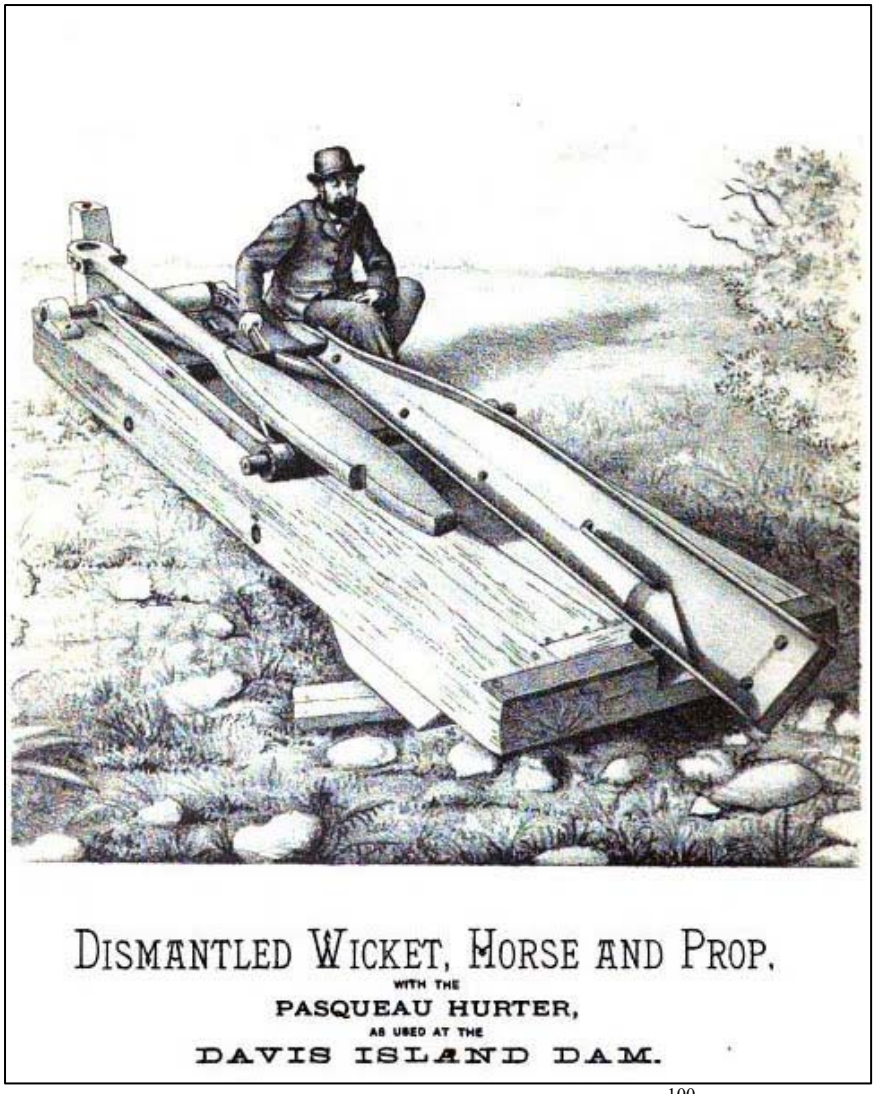

Figure 11. Wicket, horse, and prop with the Pasqueau Hurter.[100]

Two wood and steel moveable dam structures known as bear-trap gates lay south of the wicket dam (Figure 12). The largest of their kind in the world, these mechanisms consisted of two rectangular leaves with a hinged base that could be raised and lowered as necessary.[101] The bear traps were designed to pass off "the masses of large drift which accumulate above the dam" without much affecting the depth of the upriver pool.[102]

[100] Lewis M. Haupt, "On the Adaptation of Movable Dams to the Ohio and Other Rivers of the United States as Practiced by the United States Corps of Engineers," *Proceedings of the Engineers' Club of Philadelphia* 4, no. 5 (1885), Plate 21.
[101] Wegman, *Dams*, 365.
[102] *Report of the Chief of Engineers*, part 3 (Washington, DC: Government Printing Office, 1899), 2351.

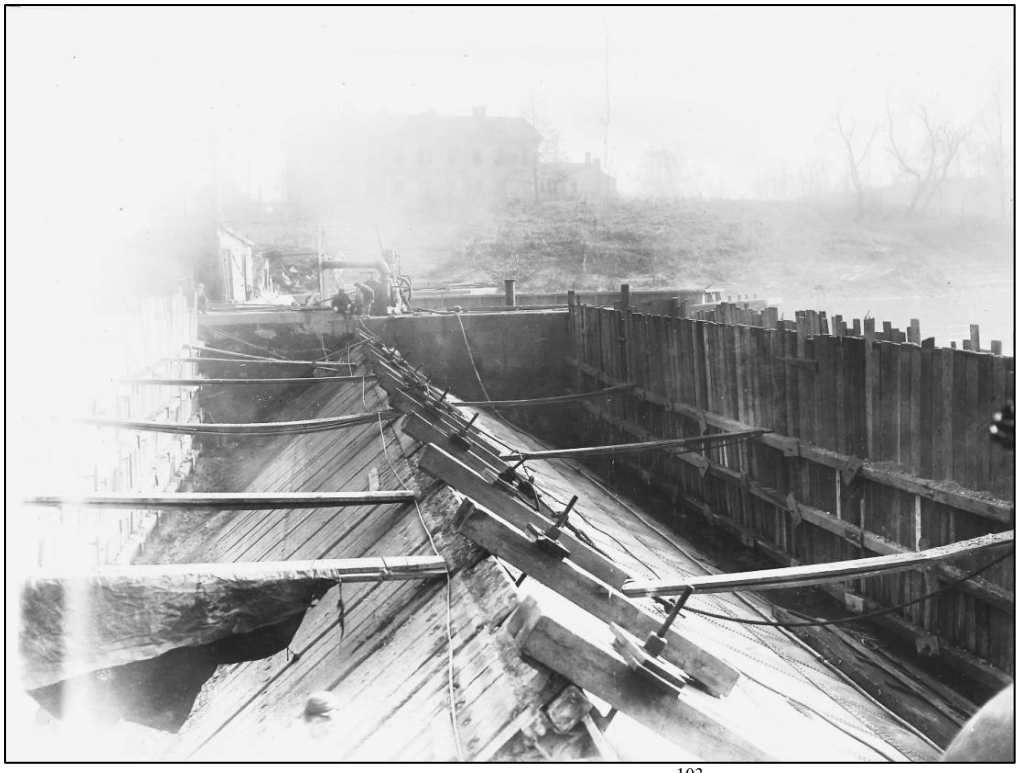

Figure 12. Repairs to the bear-trap weirs, November 10, 1924.[103]

> When the gate is down the up-stream leaf overlaps the down-stream leaf. The gate is raised by the pressure of the water from the upper pool, which is conveyed in a channel controlled by a sluice-gate to a chamber constructed under the gate. A second channel, also provided with a gate or stop-cock, connects this chamber with the lower pool. When the connection with the upper pool is opened while that with the lower pool is closed, water from the upper pool fills the chamber under the gate. This causes the down-stream leaf to rise, first by flotation and then by the impulse from the flow of water. In rising, the lower leaf raises the upper leaf by its edge sliding under it, the friction being reduced by rollers.[104]

Beyond the bear-trap weirs lay a moveable Thomas A-frame dam that functioned poorly and quickly became clogged with sand and gravel (Figure 13).[105] Lockmaster Robert C. McCullough described the situation in 1911.

> There was a bar where the A-frame weir was built, which had to be removed … the bar reformed after the cofferdam was removed and at the present time is about even with the crest (standing position) of the A-frames on both the upper and lower sides. The *gravel* and *sand* is banked up against the frames on both sides. The weir was never operated since the

[103] Dam 6 – Repairs to Bear Trap, November 10, 1924, The Pittsburgh Engineering District of the United States Army Corps of Engineers. Pittsburgh, Pennsylvania.
[104] Wegman, *Dams*, 344-345.
[105] Wegman, *Dams*, 365; Johnson, *Davis Island*, 114-115.

cofferdam was removed, and the openings beneath the A-frames are also filled with *gravel*.[106]

Figure 13. Thomas A-frame dam at Merrill Lock and Dam No. 6.[107]

[106] *Professional Memoirs: Corp of Engineers, United States Army and Engineer Department at Large*, vol. 3, nos. 9-12 (Washington, D.C.: Press of the Engineer School, 1911), 334.
[107] Ohio River Dam No. 6, 1901 [Thomas A-frame], The Pittsburgh Engineering District of the United States Army Corps of Engineers. Pittsburgh, Pennsylvania.

6.0 The Opening Celebration

Although vessels had been passing through Lock and Dam No. 6 since late summer, on October 15, 1904 Beaver County celebrated the formal opening of the Merrill Dam. Businessmen heralded its completion as "the coming of a new and better highway of transportation for all towns along the Ohio River … one that is not dependent upon rainfalls or seasons." In the weeks leading up to the celebration prominent citizens from across the Beaver Valley—led by John Fleming Dravo (1819-1905) (Figure 14)—organized the Merrill Dam Opening Celebration Association to mark the completion of No. 6 "in a very enthusiastic and hearty way."[108]

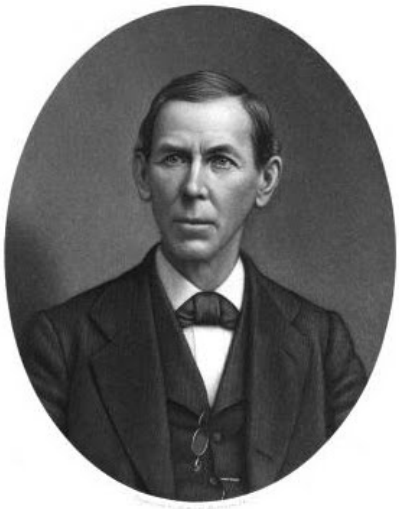

Figure 14. John Fleming Dravo (1819-1905).[109]

Members of the Republican Party active in state and national politics were conspicuous among the attendees. Captain Dravo, known as the "Dean of the Waterways," was a two-time Republican state legislator renowned as an "active and vigilant" defender of "river interests." In 1868 he organized the Pittsburgh and Connellsville Gas, Coal and Coke Company and was a charter member and president of the Pittsburgh Chamber of Commerce. Other Republican Party luminaries that joined the Association were five-time Pennsylvania lawmaker and Cannelton coal operator Ira F. Mansfield; Republican state legislator and cooperage manufacturer Thomas Livingston Kennedy of New Brighton; and, hardware manufacturer and former U.S. Representative Charles Champlain Townsend. Other prominent local figures like James Pinney Leaf of Leaf Brothers, Civil Engineers joined as did popular Harmonist millionaire, bandmaster, conductor, and composer, John S. Duss of Economy.[110]

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[108] Charles Blanchard, *The Progressive Men of the Commonwealth of Pennsylvania*, volume 1 (Logansport, Indiana: A. W. Bowen & Co., 1900), 147-149; John W. Jordan, *Encyclopedia of Pennsylvania Biography*, volume 1 (New York: Lewis Historical Publishing Company, 1914), 74-75; "John Fleming Dravo," *The Iron Age* 76 (October 5, 1905), 906; "The River Interests," *Pittsburgh Daily Post*, September 12, 1877.

[109] *Encyclopaedia of Contemporary Biography*, volume 2 (New York: Atlantic Publishing & Engraving Company, 1890) 122-123

[110] J. H. Bausman, *History of Beaver County Pennsylvania and its Centennial Celebration* (New York: The Knickerbocker Press, 1904), 244-245, 710, 728, 944-945; Charles Blanchard, *The Progressive Men of the Commonwealth of Pennsylvania*, volume 1 (Logansport, Indiana: A. W. Bowen & Co., 1900), 147-149; John W. Jordan, *Encyclopedia of Pennsylvania Biography*, volume 1 (New York: Lewis Historical Publishing Company,

The Association sent out 1,600 invitations to governors, senators, and other "distinguished persons" from Pennsylvania and surrounding states and planned a day's entertainments. To guarantee sufficient attendance at what they hoped would be "one of the greatest events in the history of Beaver County," organizers arranged for reduced railroad fares for the day. The schedule of events included a morning baseball game between the Rochester Athletic Club and a team from Monaca; a noontime bell and whistle salute to the new lock and dam; and, with cries of "On to Merrill!" an afternoon river parade of steamboats and barges to Lock No. 6 for a formal opening ceremony.[111] Somewhere on the order of 25,000 people, mostly from the Beaver Valley, attended the day's events; speeches were made by esteemed locals; and, letters of regret were read from President Roosevelt and other worthies. While some grumbling occurred regarding the duration of the construction, it was recognized that the improvements to the Ohio River were "of great importance to the people of the river towns, as it improves their facilities for manufacturing."[112] After the ceremony the crowds returned upriver to enjoy an impromptu carnival at Industry, an evening concert at Rochester, and fireworks over the mouth of the Beaver.[113]

A reporter described Merrill Lock and Dam No. 6 as it appeared during its opening celebrations in the autumn of 1904.

> The distance between the gates of the lock is 600 feet, a trifle less than that of the Davis Island dam … The total width of the lock is 110 feet. The noteworthy difference between this and the ordinary lock is the employment of rolling instead of swinging gates, and the construction of recesses for the gates when open. These recesses, or slips, are built toward the shore from the lock, a distance of 120 feet. The total length of the river lock is 689 feet. The wall is 11 feet thick, and has a height of 17 feet above, and 2½ feet below the gate sill making a total height of 19½ feet. Including the development of the recesses, the land wall is 199 feet long.
>
> The moveable dam begins at the river lock wall, at a point 200 feet above the lower dock gate and extends to the abutment on the south bank of the river at the Beaver county courthouse. The dam proper is 1,000 feet long, having a navigable pass of 600 feet, closed by Chanonie wickes [sic], also two bear traps of 120 feet each, separated from the navigable pass and from each other by piers in which are located the maneuvering valves. Compressed air is used in creating an initial head in raising the bear trap gates.[114]

1914), 74-75; "John Fleming Dravo," *The Iron Age* 76 (October 5, 1905), 906; "The River Interests," *Pittsburgh Daily Post*, September 12, 1877; "Leaf Family Papers," *University of Pittsburgh Library System*, July 1, 2006, http://digital.library.pitt.edu/cgi-bin/f/findaid/findaid-idx?type=simple;c=ascead;view=text;subview=outline;didno=US-PPiU-ais197012; John W. Jordan, *Genealogical and Personal History of Beaver County, Pennsylvania* (New York: Lewis Historical Publishing Company, 1914), 33, 480, 1030; *The National Cyclopedia of American Biography*, volume 4 (New York: James T. White & Company, 1897), 557.

[111] "Arrangements Are All Complete for Tomorrow," *Pittsburgh Weekly Gazette*, October 14, 1904: 10; "Plan Naval Parade," *The Pittsburgh Press*, October 7, 1904: 8.

[112] "A Great Celebration," *The Butler Citizen* (Butler, Pennsylvania), October 20, 1904: 2.

[113] "Dam Opening Celebration was Notable," *The Pittsburgh Press*, October 16, 1904: 4.

[114] "Merrill Dam Celebration," *The Pittsburgh Press*, October 15, 1904: 5.

7.0 Lockmasters, Dam Tenders, and Laborers

When it opened in 1904 Merrill Lock and Dam No. 6 was operated under the supervision of Assistant Engineer Chadbourn, but on opening day Thomas E. Clark (1857-1928), a pattern maker by trade and president of the Marine Manufacturing and Supply Company of Pittsburgh (est. 1901), served as lockmaster, likely in an honorary capacity. While in his twenties Clark had worked for George Westinghouse building the inventor's "first rotary engine and dynamo" and he was fast earning a reputation in Pittsburgh as "an authority on river machinery."[115]

In 1906, after Assistant Engineer Chadbourn's departure, Robert Caldwell McCullough (1873-1953) took over as lockmaster at Lock and Dam No. 6, occupying the lockmaster's house with his wife and children (Figure 15). McCullough was a native of Beaver County who had joined the construction gangs at No. 6 as a day laborer in the early 1890s. Around 1900 he was appointed to the position of lockman at Davis Island and later returned to No. 6 as a dam tender. At No. 6 McCullough supervised a crew that included his brother Fred Homer McCullough (1885-1957), lock tender Harry Bevington (1873-1960), blacksmith Harry Patterson Hays (1863-1936), and laborers Roy Engle Hays (1888-1964) and Andrew Leis (1875-1953). Most of the men who worked for the Corps of Engineers under McCullough were natives of western Pennsylvania and lived at No. 6 with their families in the residences that flanked the power house on River Road (Figure 16).[116]

A talented engineer McCullough was named Superintendent of Locks and Dams on the Ohio River in 1910 and in 1917 the Allegheny River was placed under his supervision.[117] His promotion aside, McCullough continued on as lockmaster at Merrill Lock and Dam No. 6 until 1916 when he moved to Coraopolis in Allegheny County.[118] Thereafter his brother, Fred, took over as lockmaster, a position he retained until the completion of the Montgomery Island Dam in 1936. After the closure of Merrill Lock and Dam No. 6, Fred Homer McCullough served as lockmaster at Montgomery Lock and Dam until his retirement in 1953.[119]

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[115] "Merrill Dam Celebration," *The Pittsburgh Press*, October 15, 1904: 5; "Captain T. E. Clark," *The Pittsburgh Press*, May 9, 1928: 6; George Thornton Fleming, *History of Pittsburgh and Environs*, vol. 4 (New York and Chicago: American Historical Society, 1922), 151-152.

[116] 1910 United States Federal Census, Industry, Beaver, Pennsylvania, ED 34: 2B; George A. Zerr, "Without Rivers City Soon Would Become Industrial Cemetery," *Pittsburgh Daily Post*, October 3, 1926: 64; "Beaver, Pa.," *Pittsburgh Post-Gazette*, October 14, 1912: 12; "River Expert McCullough Dies at 79," *The Pittsburgh Press*, January 13, 1953: 38; "Retired River Engineer for District Dies," *Pittsburgh Post-Gazette*, January 13, 1953: 11; "Veteran River Engineer to Retire," *Pittsburgh Post-Gazette*, January 16, 1943: 10.

[117] George A. Zerr, "Without Rivers City Soon Would Become Industrial Cemetery," *Pittsburgh Daily Post*, October 3, 1926: 64; "River Expert McCullough Dies at 79," *The Pittsburgh Press*, January 13, 1953: 38; "Retired River Engineer for District Dies," *Pittsburgh Post-Gazette*, January 13, 1953: 11; "Veteran River Engineer to Retire," *Pittsburgh Post-Gazette*, January 16, 1943: 10.

[118] "U.S., World War I Draft Registration Cards, 1917-1918," *ancestry.com*, January 19, 2017, card for Robert Caldwell McCullough, serial no. 4265, order no. 2974, Local Draft Board 1, Coraopolis, Allegheny, Pennsylvania, citing *World War I Selective Service System Draft Registration Cards, 1917–1918*, NARA microfilm publication M1509, roll 1852248; Industry Township, 1904-1905, 1907-1925. Tax Records, 1802-1928, Group 1, Carton 70, Pennsylvania State Archives.

[119] "Death Record, Fred H. McCullough," *Simpson's Leader-Times* (Kittanning, Pennsylvania), September 11, 1957.

Figure 15. Ohio and Allegheny Rivers Superintendent Robert Caldwell McCullough.[120]

Throughout the twenties and thirties other local men found work at Lock and Dam No. 6 including dam tender Oliver Riley Smith and lockman Ben Smith of Beaver County, James Monroe Stauffer from Jefferson County, and engineman William McCullough (Figure 17). The district repair crews that travelled up and down the Ohio River attracted laborers from more distant communities. Men like Maryland-born ironworker John Pleasant, English machinist James Brooks, African-American steelworker Leroy Harris, and Italian immigrant Salvatore Zecchio came to the Pittsburgh region and found work on the Ohio River Locks and Dams. Several of the laborers at Lock and Dam No. 6 remained with the Corps of Engineers for the remainder of their working lives. In 1930 Alsatian immigrant Andrew Leis, who had worked at No. 6 under lockmaster Robert McCullough, was still working as a lockman (probably at Lock No. 5 near Freedom); Oliver Reilly Smith went on to work under lockmaster Fred Homer McCullough at the newly built Montgomery Island Dam after Lock No. 6 closed; and, in the 1940s, James Monroe Stauffer was working at Lock No. 10 in Steubenville, Ohio.[121]

[120] George A. Zerr, "Without Rivers City Would Become Industrial Cemetery," *Pittsburgh Daily Post*, October 3, 1926: 64.

[121] 1920 United States Federal Census, Industry, Beaver, Pennsylvania, ED 46: 7A; 1930 United States Federal Census, Industry, Beaver, Pennsylvania, ED 66: 3B; 1930 United States Federal Census, McKeesport, Allegheny, Pennsylvania, ED 675: 10A; 1930 United States Federal Census, Beaver Falls, Beaver, Pennsylvania, ED 33: 26A; 1920 United States Federal Census, Pittsburgh Ward 11, Allegheny, Pennsylvania, ED 495: 12B; 1920 United States Federal Census, Herkimer, Herkimer, New York, ED 23: 17B; 1930 United States Federal Census, Beaver, Beaver, Pennsylvania, ED 28: 3A; World War II Draft Registration Card for Ollie Riley Smith, No. 2837, April 27, 1942; World War II Draft Registration Card for James Monroe Stauffer, No. 476, April 25, 1942; George A. Zerr, "Without Rivers City Would Become Industrial Cemetery," *Pittsburgh Daily Post*, October 3, 1926: 64.

Figure 16. Plan of the downstream lockmasters' residence at Merrill Lock and Dam No. 6.[122]

[122] William Martin, Ohio River Dam No. 6, Design of Residence for Lock-tenders at Downstream Location, Front Elevation, The Pittsburgh Engineering District of the United States Army Corps of Engineers. Pittsburgh, Pennsylvania.

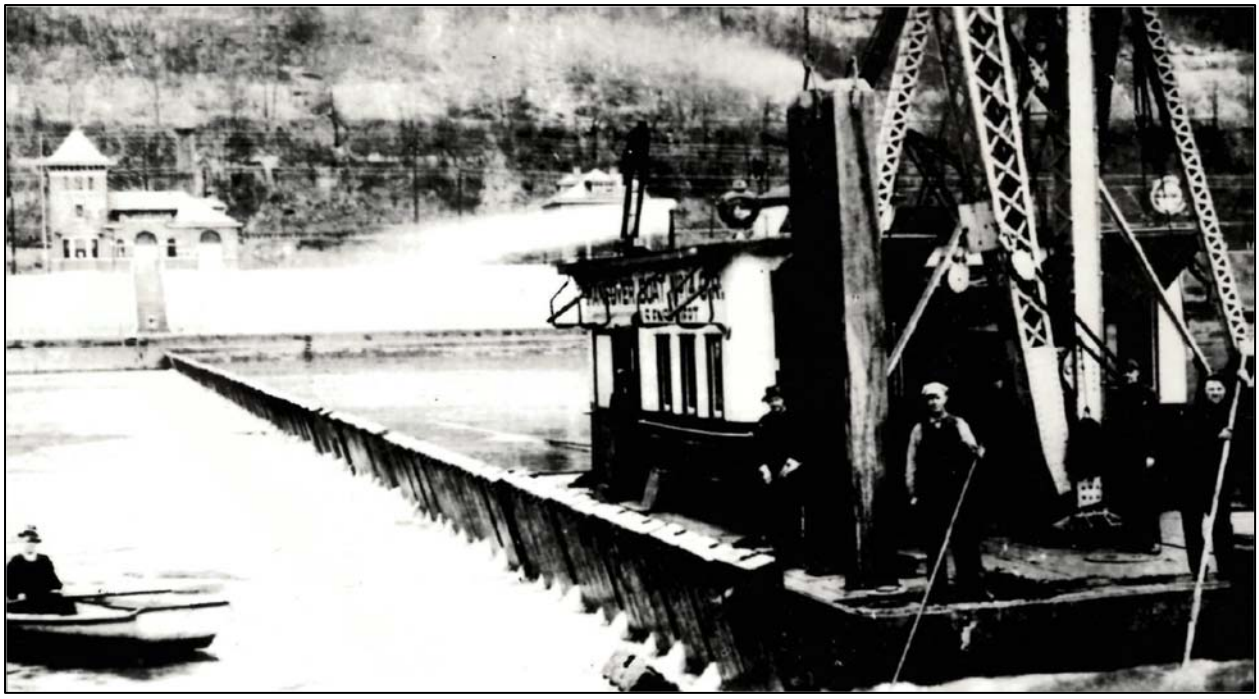

Figure 17. Raising the wickets at Merrill Lock and Dam No. 6. Several of the men who worked there are depicted, including, on the right, from left to right: Bill Merrian holding the hookline; Oliver Riley Smith, holding the pole at the corner of the boat; Lee Smith; and, Fred Homer McCullough, holding a pole. The man on the skiff, identified as William McConnel, may be engineman William McCullough.[123]

Photographs of the former powerhouse and lockmaster (locktender) house taken in 2014 are presented in Appendix A. Original architectural plans of the powerhouse and locktender's house are presented in Appendix B.

[123] Cassandra Forsyth, USACE, "Wicket raising operation at Lock and Dam No. 6 - Ohio River - pre-1936," message to Martin Abbot, AECOM, January 10, 2020, email.

8.0 Operation and Maintenance

The men who served as lockmasters as well as the lock and dam tenders, enginemen, and laborers under their supervision were charged with operating and maintaining the equipment at Lock and Dam No. 6 and managing the level of the pool above it to ensure the safe passage of ships and barges up and down the Ohio River. Much of the repair work at No. 6 was a matter of routine maintenance. During the winter season and during extended periods of low water, lockkeepers, their staff, and district repair crews cleared sand, gravel, and debris from the lock approaches, gates, and movable dams; repaired or replaced damaged machinery and wickets; and, mended damage to exposed portions of No. 6's masonry piers, lock chamber, abutments, and buildings. The regular accumulation of sediment that had doomed the Thomas A-frame at No. 6 was also a problem for the bear-trap weirs and as a result regular maintenance and dredging were necessary to keep them operational. Much of the work conducted was preventative, aimed at saving "the millions invested in Government property" and preventing the delays on the river associated with major repair operations.[124]

Nonetheless more complicated modifications and repairs were undertaken as needed. Extensive and costly repairs to No. 6's bear-trap weirs requiring the installation of a cofferdam were carried out in the autumn of 1917[125] In 1922 a gas-powered engine and compressor were installed in the lock powerhouse as a backup to the steam plant already in place.[126] A year later the nonfunctional Thomas A-frame dam at No. 6 was replaced with a 120-foot-long fixed concrete weir and in 1924 the lock's old timber guide walls were replaced with concrete.[127] In the spring of 1925 seven repair crews operating 24 hours a day under the direction of Assistant Engineer John W. Arras installed "new axels, gate wheels, a water seal, posts, diagonals and a track," completing the first notable repairs needed to Merrill's rolling lock gates since their construction and installation in 1903-4.[128] Two years later the lock gates required additional mending after they were rammed by a steamboat and in 1928 the bear-trap weirs at No. 6 were completely replaced.[129]

Raising and lowering the wickets to manage the depth of the pool upriver or to permit the passage of traffic was time consuming, difficult, and dangerous work. While the lock gates at No. 6 were being repaired in 1926, lockmaster Fred McCullough's team had to raise and lower the wickets repeatedly to allow passage of steamers and other craft. On June 9 McCullough set a record by raising and lowering the 150 wickets at No. 6 in one hour and thirty-three minutes.[130] However,

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[124] *Professional Memoirs: Corp of Engineers, United States Army and Engineer Department at Large*, vol. 3, nos. 9-12 (Washington, D.C.: Press of the Engineer School, 1911), 334; "Repairs at Dams," *Pittsburgh Post-Gazette*, May 12, 1916: 3; George A. Zerr, "Without Rivers City Would Soon Become Industrial Cemetery," *Pittsburgh Daily Post*, October 3, 1926: 64; "Big Tow of Steel Moving Down River," *Pittsburgh Post-Gazette*, April 22, 1924: 17; "News of Rivers," *Pittsburgh Daily Post*, May 18, 1917: 3; *Pittsburgh Daily Post*, November 5, 1926: 18.
[125] "News of Rivers," *Pittsburgh Daily Post*, October 23, 1917: 9; "News of Rivers," Pittsburgh Daily Post, August 14, 1917: 11.
[126] "News of Rivers," *Pittsburgh Daily Post*, October 28, 1922: 11.
[127] *Pittsburgh Daily Post*, July 7, 1923; "Lockmasters Begin Annual Trip Today," *Pittsburgh Post-Gazette*, October 14, 1924: 10; *Pittsburgh Daily Post*, October 17, 1924: 13.
[128] "Lock 6, Ohio River, Repairs Rushed," *Pittsburgh Post-Gazette*, March 11, 1925: 8; "River Stages Permit Lock Work to Go On," Pittsburgh Post-Gazette, March 15, 1925: 30.
[129] "News of the Rivers," *Pittsburgh Daily Post*, March 2, 1927: 11; "Will Build Steel Hull," *Pittsburgh Post-Gazette*, August 2, 1928: 12.
[130] "News of the Rivers," *Pittsburgh Daily Post*, June 9, 1926.

using the 110-by-600-foot lock was preferable; during the early decades of the twentieth century the longest coal tows could lock through in twenty to thirty minutes.[131] During periods of "extreme low" water, the coordinated opening of the wickets at multiple dams on the Upper Ohio River was also used to create an "artificial rise" downriver to help move stranded coal barges.[132] Considering the volume of goods moving downriver from Pittsburgh, the efforts of the government engineers to maintain an uninterrupted navigation on Ohio River were well justified. The monthly commercial tonnage reported on the Ohio River in January of 1924 alone included 312,285 tons of coal, 70,568 tons of gravel, 65,389 tons of sand, and 35,420 tons of steel products.[133]

Extraordinary circumstances sometimes demanded that the families of the lockmen lend a hand. On March 12, 1911, quick-thinking Stella M. McCullough (1881-1952), the wife of lockmaster Robert Caldwell McCullough, saved a local man from drowning.

> Isaac Beer, 20 years old, of Beaver Falls, was saved from death by drowning in the Ohio River, at Merrill dam, yesterday afternoon, when he fell into the water from the lock walls. Mrs. Robert McCullough, wife of the lockmaster, called her husband, who, by lying on the top of the lock wall, his body extending out over the edge, while his wife held his feet, extended a pole to [Isaac] Beer, and held him until he was brought to the shore by William Eakin in a boat.[134]

[131] *Official Documents, Comprising the Department and Other Reports made to the Governor, Senate and House of Representative of Pennsylvania*, volume 3 (Harrisburg: Edwin K. Meyers, 1892), 90; *House Documents*, volume 21 (Washington: Government Printing Office, 1912), 255.
[132] "News of Rivers," *Pittsburgh Daily Post*, November 20, 1917: 13.
[133] "News of Rivers," *Pittsburgh Daily Post*, January 12, 1924: 7.
[134] "Saved from River, Drowning Man Held Until Boat Arrives," *Pittsburgh Daily Post*, March 14, 1911: 1.

9.0 The Modernization of the Ohio River

In the autumn of 1929, the newly completed nine-foot slack-water navigation was celebrated up and down the Ohio River with music, parades, and dedications.

> All the large cities and many of the smaller ones are partners in the prosperity that the Ohio water route makes possible. In commemoration of the completion of the project the Ohio Valley Improvement Association arranged a river parade to start at Pittsburgh and end at Cairo. The wharf at Pittsburgh was lined with twenty-five vessels steamed up and ready to go. President Herbert Hoover, aboard the *Greenbrier* made the trip as far as Louisville and made speeches at many places along the way. Thus, a new era in Ohio river [sic] commerce was inaugurated.[135]

At a cost of $118 million and nearly two decades in the making, the system's fifty locks and movable dams provided a navigable channel sufficiently deep to accommodate the largest boats on the river at all seasons of the year.[136] The timing of the project's completion was fortunate; in the face of the drought of 1929-1931 the completed system immediately proved its worth and successfully maintained a nine-foot channel on the Ohio throughout the summer of 1930.[137] The commercial benefits of the nine-foot slack-water navigation were experienced almost immediately despite the outbreak of the Great Depression.

> While the total tonnage transported is still less than in 1929, the increase in value of the shipments during 1933, scarcely a normal business year generally, exceeded the value of shipments in 1929, the peak year of "prosperity". Reports, as yet unpublished, show a continuous increment in value of shipment.[138]

Less than seven years later in June 1936 Ohio River Locks and Dams 4 through 6 were eliminated by the completion of the new high-lift Montgomery Locks and Dam that featured a 110-by-600 foot main lock and a 56-by-360 foot auxiliary lock. Montgomery likewise did away with the movable Chanoine-type wicket dams previously favored on the Ohio River; instead it featured a gated dam, a design that permitted "increased control over the water level in the navigation pool upriver."[139] Two years later the Merrill Lock and Dam No. 6 property was sold to the McClain Fire Brick Company of Pittsburgh for $3,500.[140]

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[135] Charles K. Palmer, "Ohio Valley Commerce, 1787-1936," *Indiana Magazine of History* 33, no. 2 (June, 1937): 170; "Ohioans Turn Out for River Pageant," *New York Times*, October 20, 1929: 30.
[136] "Ohioans Turn Out for River Pageant," *New York Times*, October 20, 1929: 30; Charles K. Palmer, "Ohio Valley Commerce, 1787-1936," *Indiana Magazine of History* 33, no. 2 (June, 1937):153.
[137] Thomas F. Barton, "Twenty-five Years' Use of the 9-Foot Ohio River Channel," *Economic Geography* 33, no. 1 (Jan., 1957): 43.
[138] Charles K. Palmer, "Ohio Valley Commerce, 1787-1936," *Indiana Magazine of History* 33, no. 2 (June, 1937): 169.
[139] "Pittsburgh District > Missions > Navigation > Locks and Dams > Montgomery Locks & Dam," *U. S. Army Corps of Engineers*, December 13, 2016, http://www.lrp.usace.army.mil/Missions/Navigation/Locks-and-Dams/Montgomery-Locks-Dam/.
[140] United States of America [Quitclaim] Deed to McClain Fire Brick Company, January 17, 1938, Roger A. Weaver papers, Beaver County Historical Research and Landmarks Foundation, Freedom, Pennsylvania.

Aided by access to a reliable navigable channel, freight traffic on the Ohio River nearly tripled between 1928 and 1953 when it reach 62 million tons annually.[141] By midcentury barges carried coal and coke, oil and gasoline, gravel, iron and steel up and downstream the full length of the river.[142] However, decades of rather steady freight increases notwithstanding, by the 1950s the inadequacy of the system's 110-by-600 foot locks was widely recognized. As newer more powerful tugs pushed ever longer strings of barges on the river, the need to double-lock tows resulted in 10- to 12-hour delays at all the old Locks and Dams on the Ohio River. As economic historian Thomas Barton described the situation,

> Although a 600-foot lock was considered by some exorbitantly long in 1910, they are now too short and form bottlenecks to the smooth flow of traffic. Many of the modern tows measure over 1000 feet in length … Tows of this length must be broken into two or three or even more sections in order to fit the lock chamber.
>
> The breaking of the tow and double locking is a laborious, slow process costly both in time and money … Moreover, for a tow moving the length of the river it must be repeated at each of the 46 locks during low water stage. In addition, time is lost by other tows which must wait their turn while the double locking is in process. It takes about 90 minutes on the average for a long tow to double lock at a dam. As the number of large tows and the volume of traffic mounts each year the time lost in double locking and waiting for a turn to lock become increasingly serious. Even the long, speedy, one-barge wide tows must be broken and the two sections placed in the lock side by side in order to negotiate a single lockage.[143]

In light of rising repair costs, structural deterioration, and increased river traffic, and to forestall the inevitable commercial crisis that the overburdened 9-foot navigation system would catalyze, on March 11, 1953 the Corps of Engineers approved the development of a multi-decade "full-scale modernization program" that would benefit "terminal operations, carriers, and shippers, alike." The modernization program's goals included the creation of a twelve-foot navigable channel the entire length of the Ohio River; reducing lockage times by eliminating the need to double-lock large tows and by reducing the number of lockages required to transit the Ohio; and, curtailing growing operations and maintenance costs associated with the older structures, all by upgrading and/or replacing them with a smaller number of "higher-lift dams and larger modern locks." The new facilities were to feature 110-by-1200 foot main locks and 100-by-600 foot auxiliary locks paired with fixed non-navigable dams. In the absence of the Chanoine-type wickets characteristic of the older system of locks and dams on the Ohio River, the new system would feature "massive radial steel gates," known as Tainter gates, that regulated pool depths without impeding flow during high water stages. As an added benefit, the increased volume of water impounded by the new high lift dams would further reduce seasonal fluctuations in channel depth and furnish an

[141] Thomas F. Barton, "Twenty-five Years' Use of the 9-Foot Ohio River Channel," *Economic Geography* 33, no. 1 (Jan., 1957): 43.
[142] Thomas F. Barton, "Twenty-five Years' Use of the 9-Foot Ohio River Channel," *Economic Geography* 33, no. 1 (Jan., 1957): 44.
[143] Thomas F. Barton, "Twenty-five Years' Use of the 9-Foot Ohio River Channel," *Economic Geography* 33, no. 1 (Jan., 1957): 45.

expanded domestic and industrial water supply to communities and businesses along the Ohio River.[144]

Implementation of the Ohio River modernization program began in 1954 with the construction of Kentucky's Greenup Locks and Dam (opened in 1962), then described as "a single step in a long-range program aimed at creating a twelve-foot river channel" between Cairo and Pittsburgh. The commencement of work at Greenup was followed closely by work at Ohio's New Cumberland and Meldahl Locks and Dams (opened in 1961), and Markland Locks and Dam (1963) on the Kentucky-Indiana border.[145]

As part of the USACE's Ohio River Modernization Program, the Pittsburgh Engineering District oversaw the construction of the New Cumberland Locks and Dam located at Stratton, Ohio two miles above New Cumberland, West Virginia. The New Cumberland Locks and Dam replaced Ohio River Locks and Dams 7 through 9 which, nearly a half-century old, were in an advanced state of disrepair by the 1950s. In 1954 Chief of Engineers Lt. General Samuel D. Sturgis Jr. testified to a Senate committee that Lock No. 7 could "collapse any day." At the time some wondered if investing in flood-control reservoirs may have impacted maintenance and repair budgets for the river's older lock and dam structures. By 1955 the situation was dire.

> At No. 7, the concrete lock walls already are crumbling into the river and have pulled away as much as six inches from the supporting river bank. Similar deterioration has set in at Locks No. 8 and 9, down the river … A collapse at Lock No. 7, closing the river to navigation could jeopardize as many as 50,000 jobs overnight.[146]

Construction on the New Cumberland Locks and Dam began in 1955. Its 110-by-1,200 foot and 56-by-600 foot lock chambers were completed in 1959 and its fixed dam and abutments were completed the following year. By 1961 New Cumberland Locks and Dam was fully operational providing a reliable twelve-foot pool as far upriver as the Montgomery Locks and Dam.[147]

A record volume of commercial cargo, estimated at 96 million tons, transited the Ohio River in 1964, an increase of 7.45 million tons over 1963. That year, five of the nineteen proposed high-lift locks and dams were in operation on the Ohio River. Coke and coal "ranked first" among the cargoes followed by oil and gasoline; stone, sand, and gravel; and, chemicals.[148] Describing the effects of the modernizing system in 1968, "the new dams cut as much as four hours from the time needed to move large towboats and their string of barges up and downstream."

> The modernization of the Ohio since the end of World War II has seen six of the high-lift dams completed and nine of the older locking systems replaced. In each case the new dams have created "lakes" stretching 25 to 50 miles in length. The Corps expects two results

[144] Newman, *Ohio River Navigation*, 36-37; Thomas F. Barton, "Twenty-five Years' Use of the 9-Foot Ohio River Channel," *Economic Geography* 33, no. 1 (Jan., 1957): 48-49.
[145] Newman, *Ohio River Navigation*, 38-39; "Ohio Dam Work Dedicated," *New York Times*, July 23, 1962.
[146] Guy V. Miller, "Ohio River's Navigation Being Modernized," *Pittsburgh Post-Gazette*, October 22, 1955: 23.
[147] Newman, *Ohio River Navigation*, 39, 51; "Pittsburgh District > Missions > Navigation > Locks and Dams > New Cumberland Locks & Dam," *U. S. Army Corps of Engineers*, December 13, 2016, http://www.lrp.usace.army.mil/Missions/Navigation/Locks-and-Dams/New-Cumberland-Locks-Dam/.
[148] "Shipments Break Ohio River Record," *New York Times*, July 15, 1965: 59.

> from these improvements—a lowering of costs to commercial towboat operators and wider recreational use of the waterway …Eventually, the old 46-dam system will be replaced by 19 modern structures.[149]

By early 1979 the number of high-lift locks and dams in operation on the Ohio River reached thirteen replacing 39 older structures.[150] The completion of the Smithland Locks and Dam on the Kentucky-Illinois border—featuring two 110-by-1200 foot locks—eliminated Locks and Dams Nos. 50 and 51 in 1980 and the last remnants of the nine-foot navigation, Locks and Dams 52 and 53, are scheduled to be closed in 2018 with the completion of the Olmstead Locks and Dam Project.[151]

Already by the early 21st century the Ohio River locks and dams below Pittsburgh, too old and small, were considered an impediment to the region's ability "to reap the economic benefits of river commerce." Pittsburgh officials and the USACE, considering an upgrade, identified the Montgomery lock and dam near Vanport to be "the biggest hitch" in the system. With a lock half as long as newer locks, many tows had to be decoupled, passed through the lock in two runs, then reassembled, creating an hours-long bottleneck that discouraged the continued growth of river traffic. Although lock crews were completing 45 to 52 lockages a day, wait times for barges passing through the lock approached 48 hours. Officials from the Association for the Development of Interstate Navigability in America's Ohio Valley and the USACE described the need for costly repairs—and the delays they caused—"as 'symptomatic' of a lack of attention the federal government has paid to lock repair" despite the fact that 95,000 jobs in the region were in some degree dependent on river commerce.[152]

The 2016 USACE Upper Ohio Navigation Study (UONS) addressed lock condition and capacity issues associated with the Emsworth, Dashields, and Montgomery Lock and Dams (the site of the former Merrill Lock and Dam No. 6 is between the Dashields and Montgomery facilities) through the analysis period of 2025-2074. The Emsworth, Dashields, and Montgomery facilities (collectively EDM) are the oldest ones yet to be addressed in the post-1955 system Ohio River modernization effort. All three facilities underwent a major rehabilitation in the 1980s to extend their useful life another 25 years. Average annual traffic through EDM is between 18 and 19 million tons per year, with coal accounting for approximately 63 percent of the EDM traffic. The UONS concluded that the reliability of EDM is seriously compromised by deteriorated structural concrete and antiquated operating systems, and recommended replacement of each auxiliary lock with construction of one new lock chamber at each facility for a total cost of $2.3 billion (based on October 2014 price levels).[153]

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[149] "'Chain of Lakes' Pressed in Ohio," *New York Times*, December 1, 1968: S15.
[150] Newman, *Ohio River Navigation*, 51.
[151] "Louisville District > Missions > Civil Works > Navigation > Locks and Dams > Olmsted Locks and Dam," *U. S. Army Corps of Engineers*, December 13, 2016, http://www.lrl.usace.army.mil/Missions/Civil-Works/Navigation/Locks-and-Dams/Olmsted-Locks-and-Dam/.
[152] Gabriel Ireton, "Boats backed up at Ohio lock," *Pittsburgh Post-Gazette*, August 1, 1986: 5.
[153] Upper Ohio Navigation Study, Pennsylvania. Final Feasibility Report and Integrated Environmental Impact Statement. US Army Corps of Engineers, Pittsburgh District. October 2014 (Revised August 2016). http://www.lrp.usace.army.mil.

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Appendix A

Building Photos (2014)

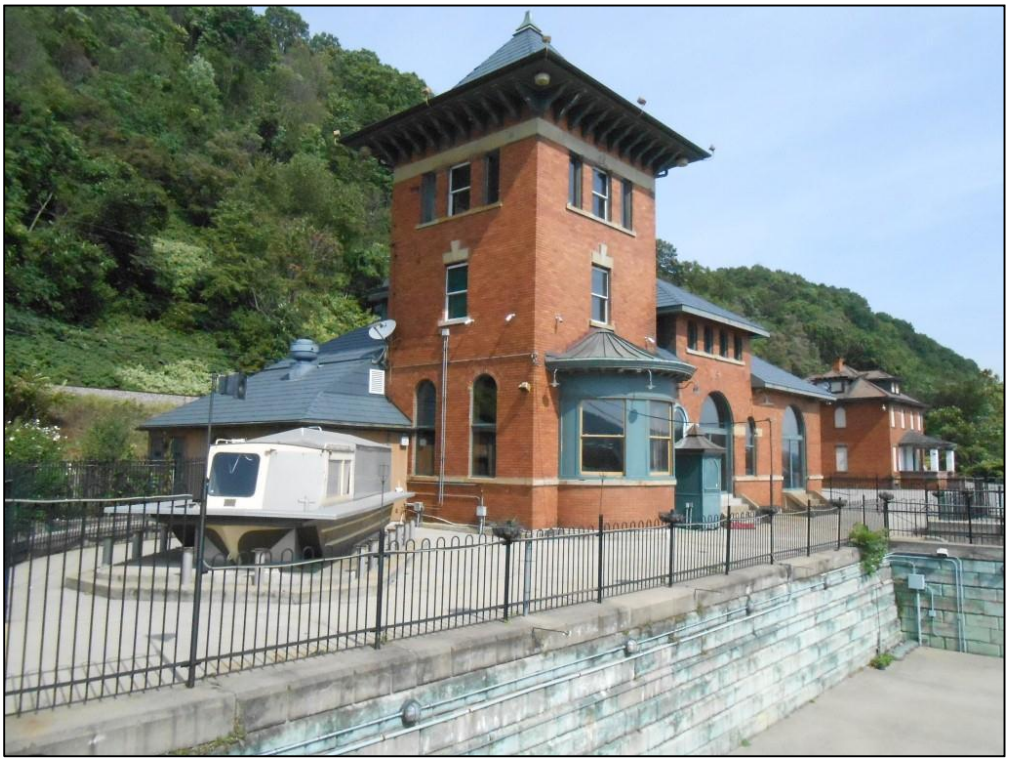


Photo 1. Merrill Lock No. 6. View north of former powerhouse.

Photo 2. Merrill Lock No. 6. View southwest of former powerhouse.

Photo 3. Merrill Lock No. 6. View northeast of former powerhouse.

Photo 4. Merrill Lock No. 6. Detail view of southwest façade.

Photo 5. Merrill Lock No. 6. View northeast of esplanade.

Photo 6. Merrill Lock No. 6. View southwest of esplanade.

Photo 7. Merrill Lock No. 6. View southwest of former lockkeeper's house.

Photo 8. Merrill Lock No. 6. View north of former lockkeeper's house.

Photo 9. Merrill Lock No. 6. Detail view of front façade of former lockkeeper's house.

Appendix B

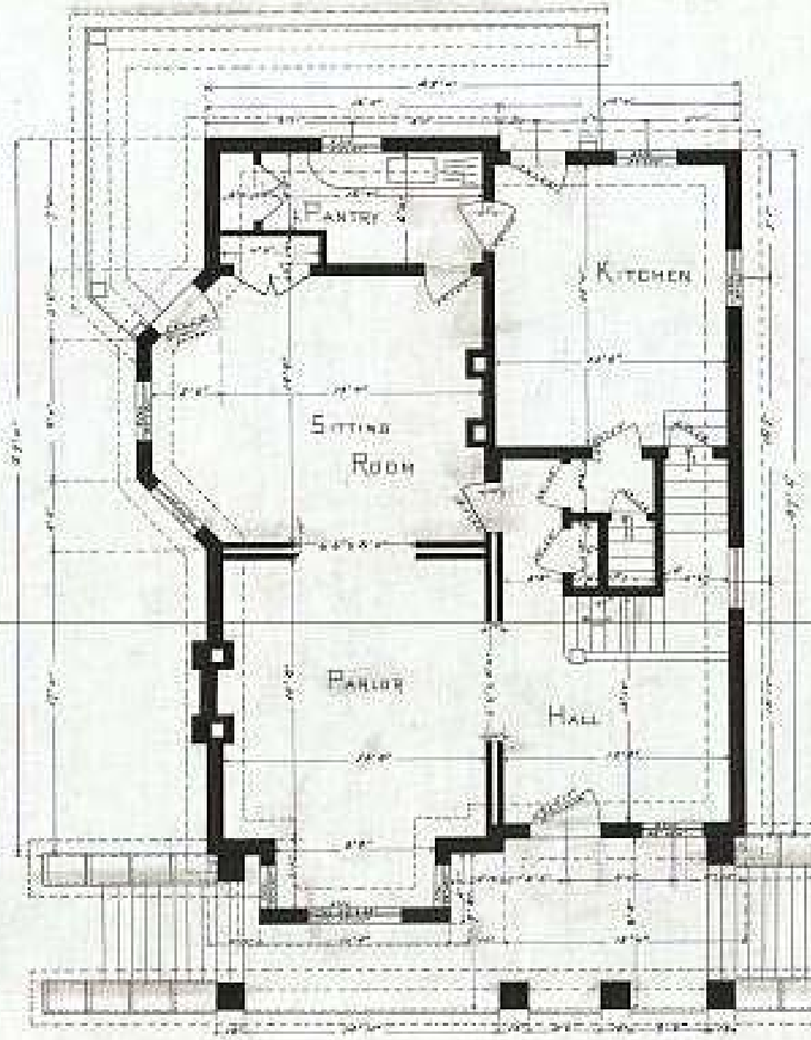
Architectural Plans

This appendix consists of two sets of incomplete architectural plans for buildings that were constructed at Merrill Lock and Dam No. 6. The plans are from the archives of the Pittsburgh District of the USACE. One set is for the locktender's house (the upstream and downstream locktender houses were identical designs), whose design was overseen by Major W.H. Bixby of the USACE. The second set of plans is for the powerhouse, whose design was overseen by Captain W.E. Craighill of the USACE. None of the plan sheets are dated.

Locktender's House

Original Plans and Elevations

Front Elevation



First Floor Plan

OHIO RIVER
DAM No 6

(72)
4 Sheets
Sheet No 1

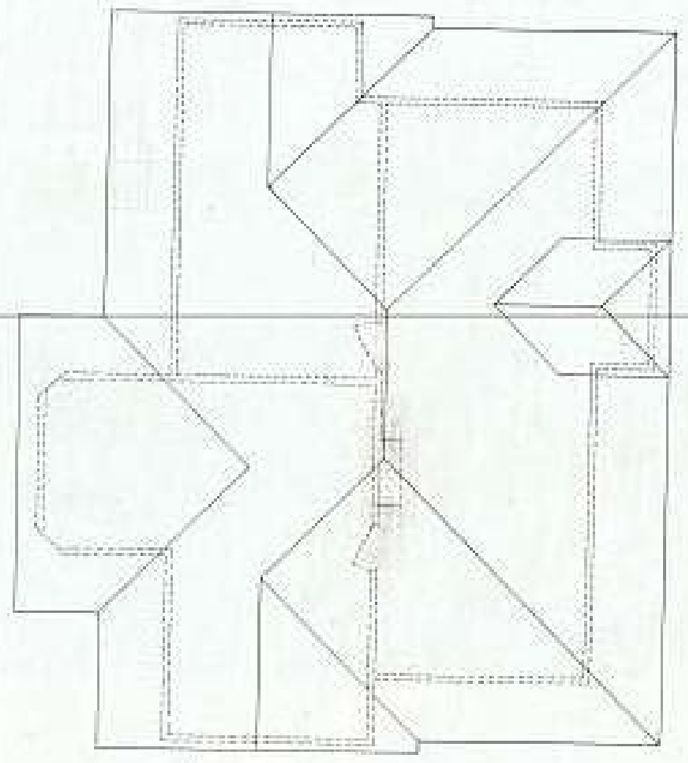
Design Of Residence For Lock-Tenders At Down-Stream Location

Drawn By Direction Of Major W.H.Bixby,
Corps Of Engineers, U.S.A.

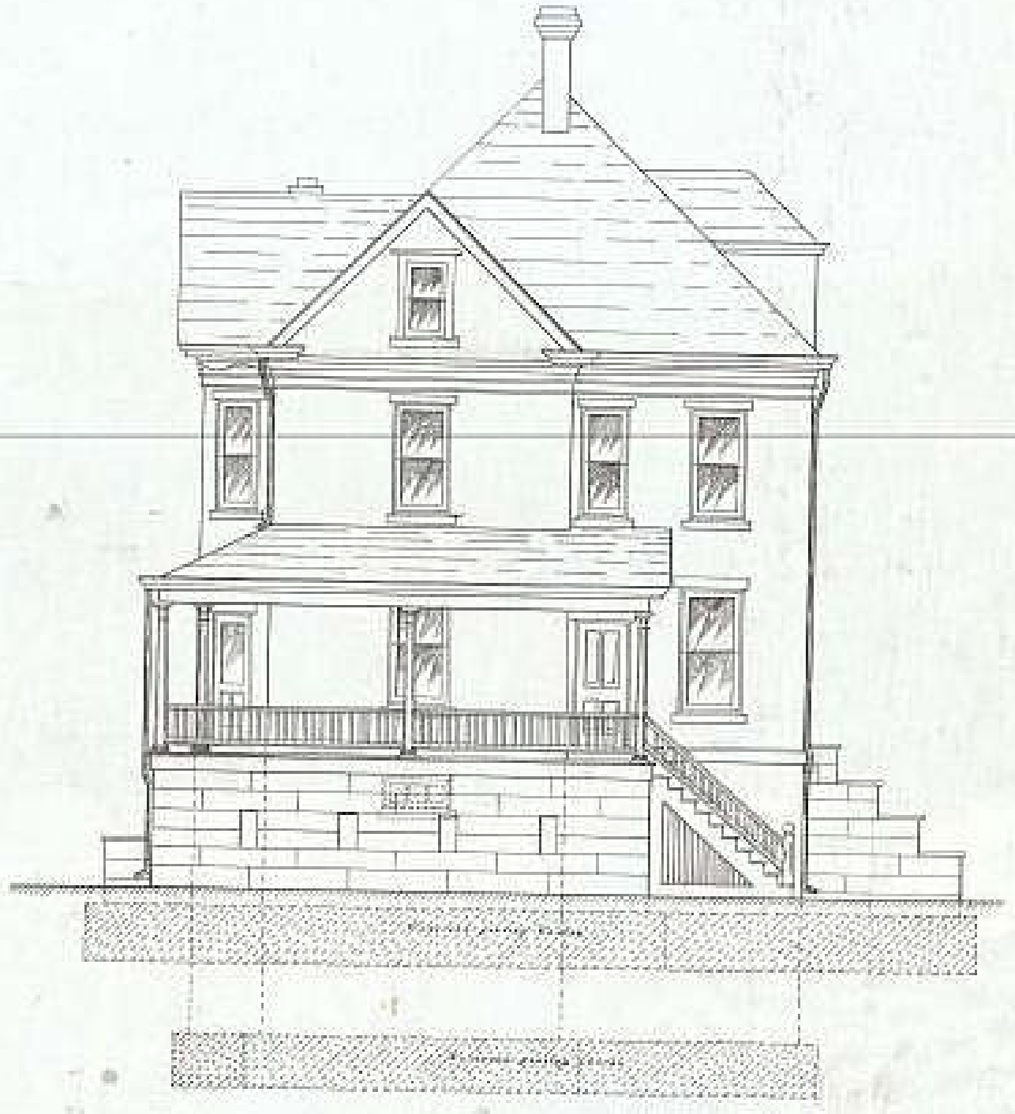
Scale 1/4" = 1ft.

Drawn & Traced By

William Merritt,
Resident Engineer



Attic And Roof Plan



Rear Elevation

OHIO RIVER
DAM No 6

Design Of Residence For Lock-Tenders
At Up-Stream Location

Drawn By Direction Of Major W. H. Bixby,
Corps Of Engineers, U.S.A.

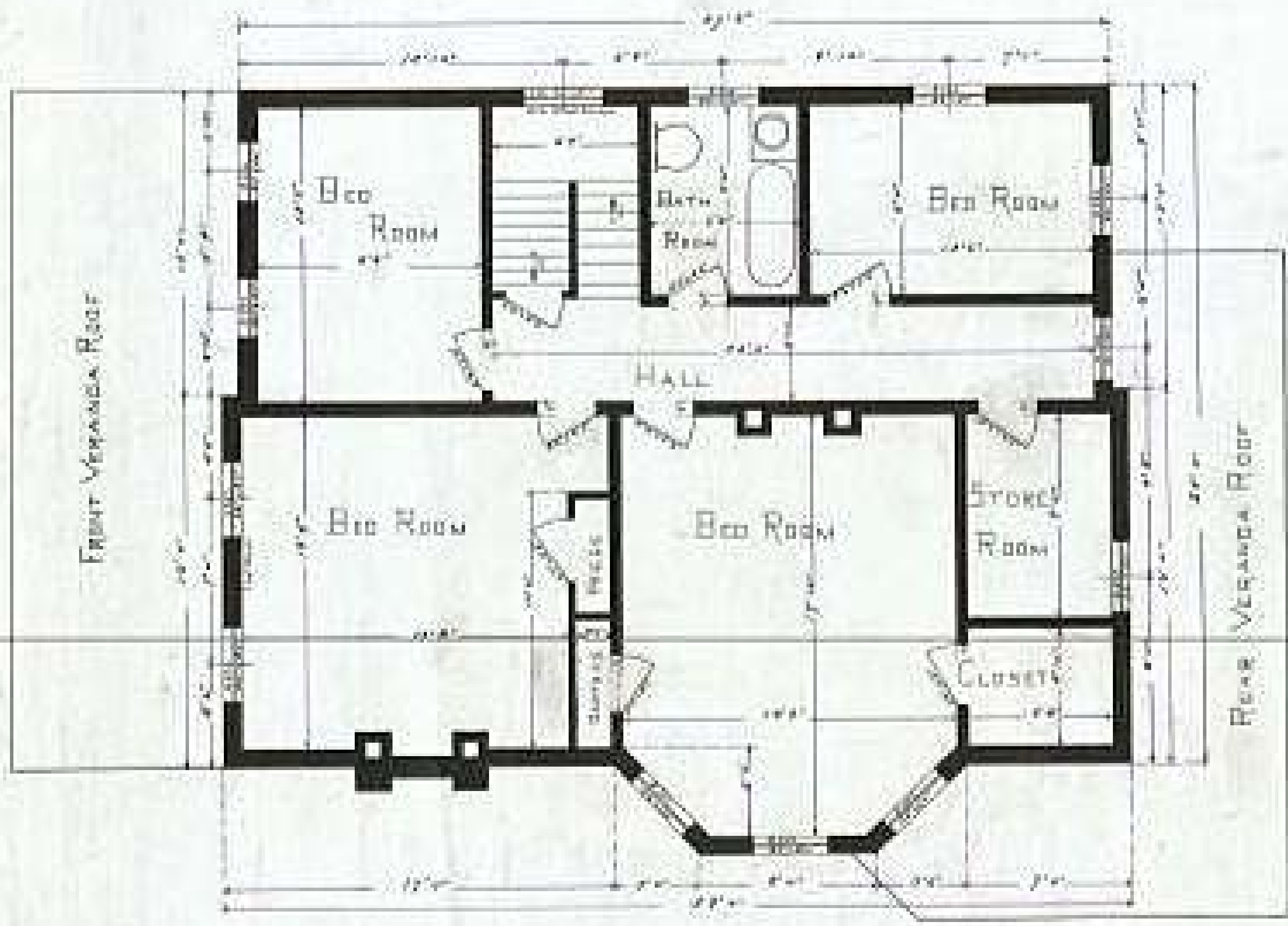
Scale: 1/4"-1ft.

Drawn & Traced By R.J. Pollock

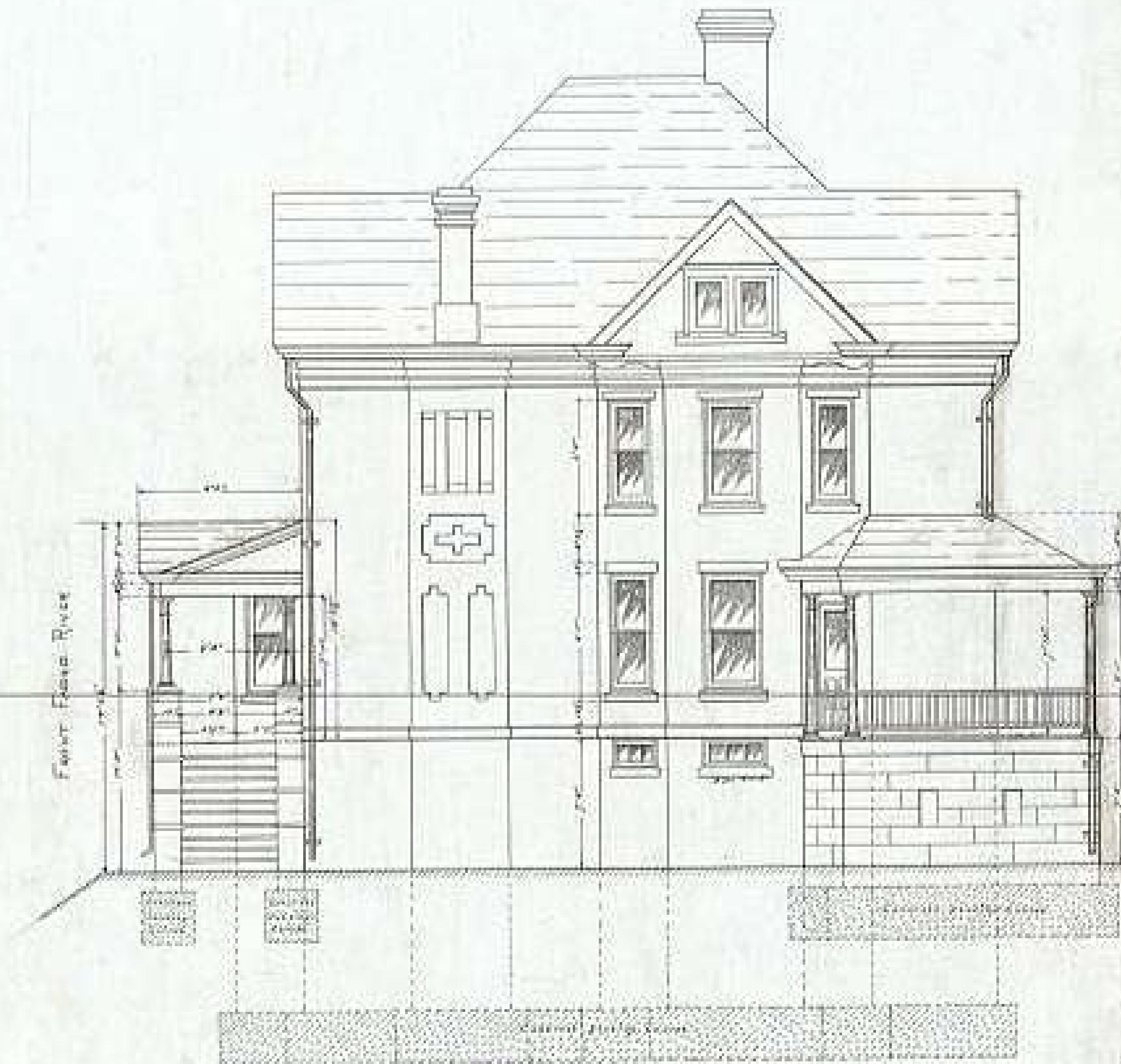
William Merdes,
Resident Engineer

36 E
4 Sheets
Sheet No 2

D-34-48



Second Floor Plan



Side Elevation

OHIO RIVER
DAM Nº 6

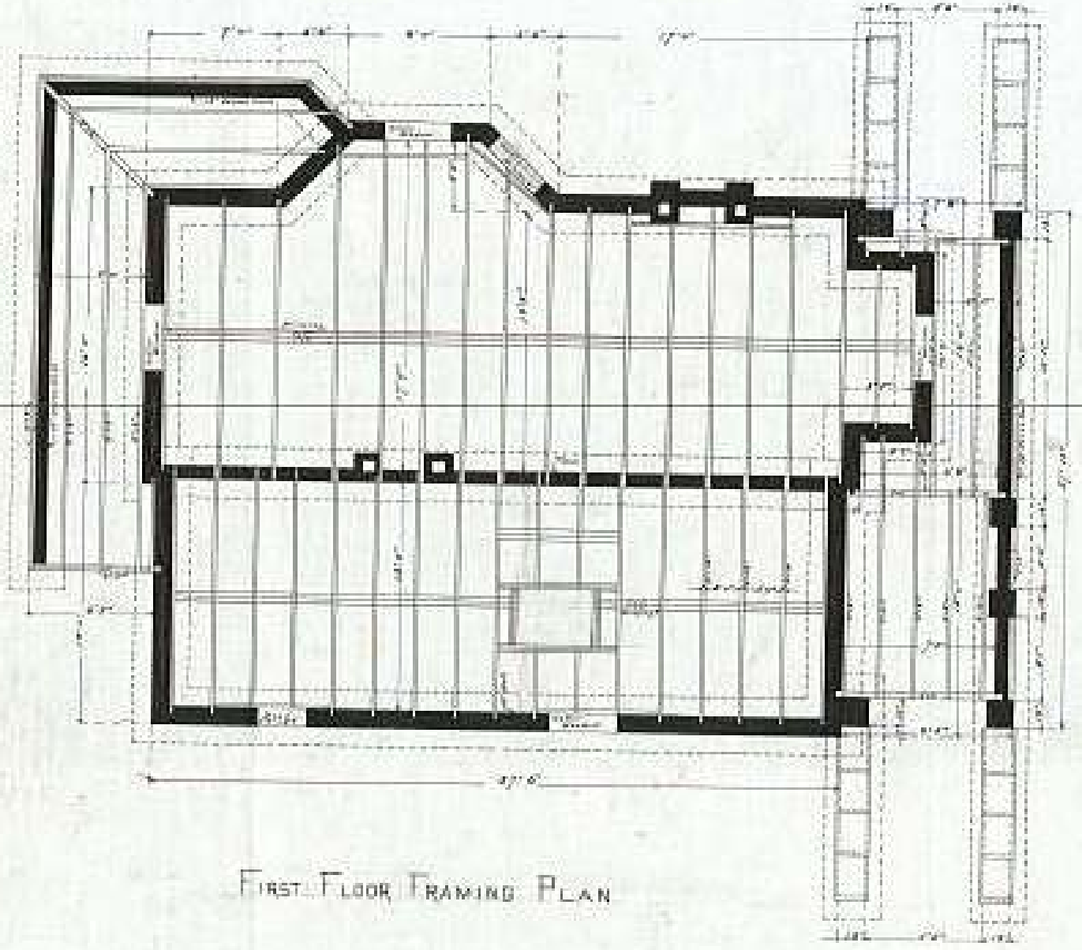
4 Sheets
Sheet Nº 2

Design Of Residence For Lock-Tenders
At Up-Stream Location
Drawn By Direction Of Major W. H. Bixby,
Corps Of Engineers, U.S.A.

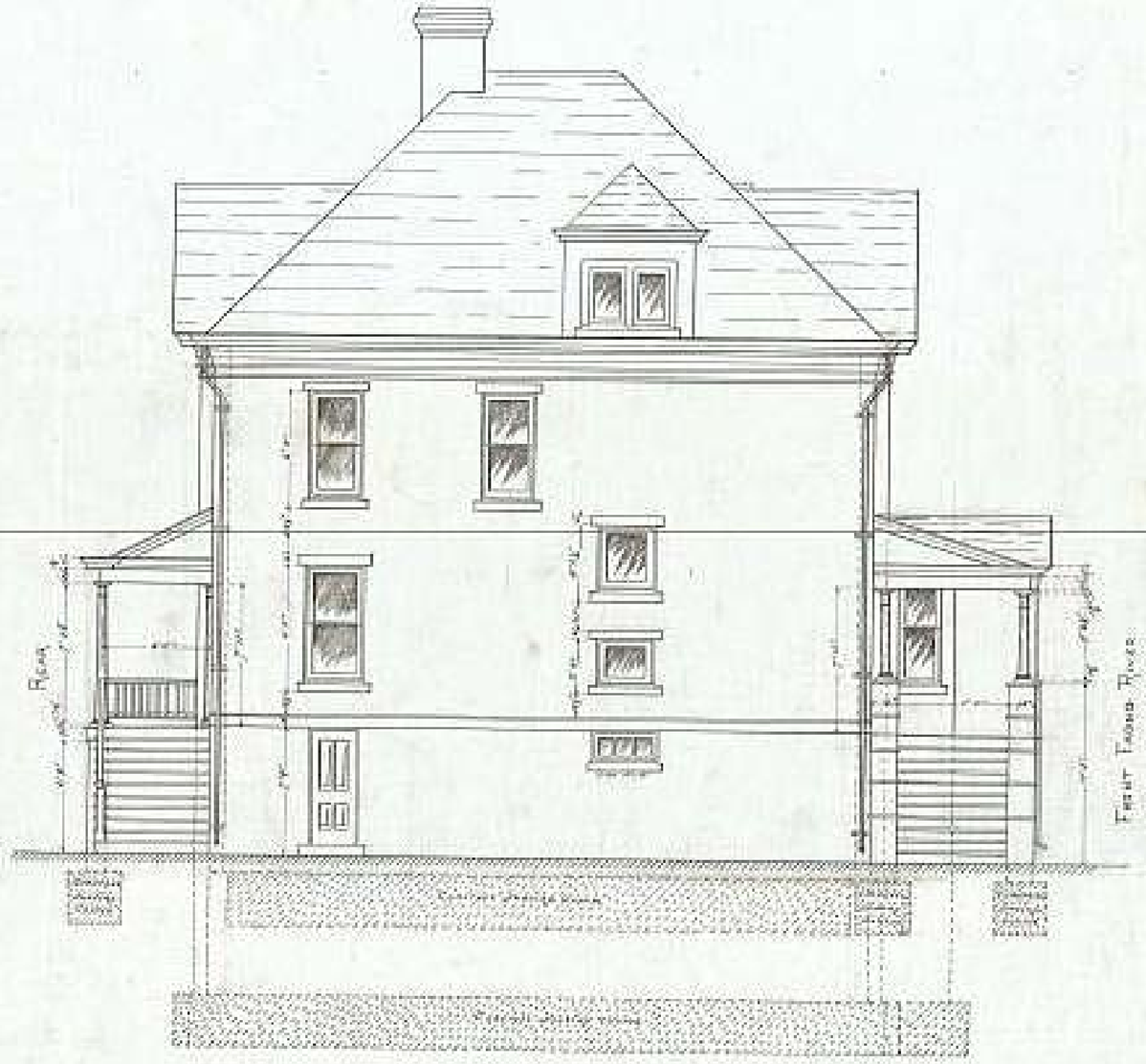
Scale ¼" = 1 Ft.

Drawn & Traced By

Resident Engineer



First Floor Framing Plan



Side Elevation

OHIO RIVER
DAM № 6

Design Of Residence For Lock-Tenders
At Up-Stream Location

Sheet 75½
4 Sheets
Sheet No. 4

Drawn By Direction Of Major W. H. B. x b y t
Corps Of Engineers, U.S.A.

Scale ¼" - 1 Ft.

Drawn & Traced By [illegible]

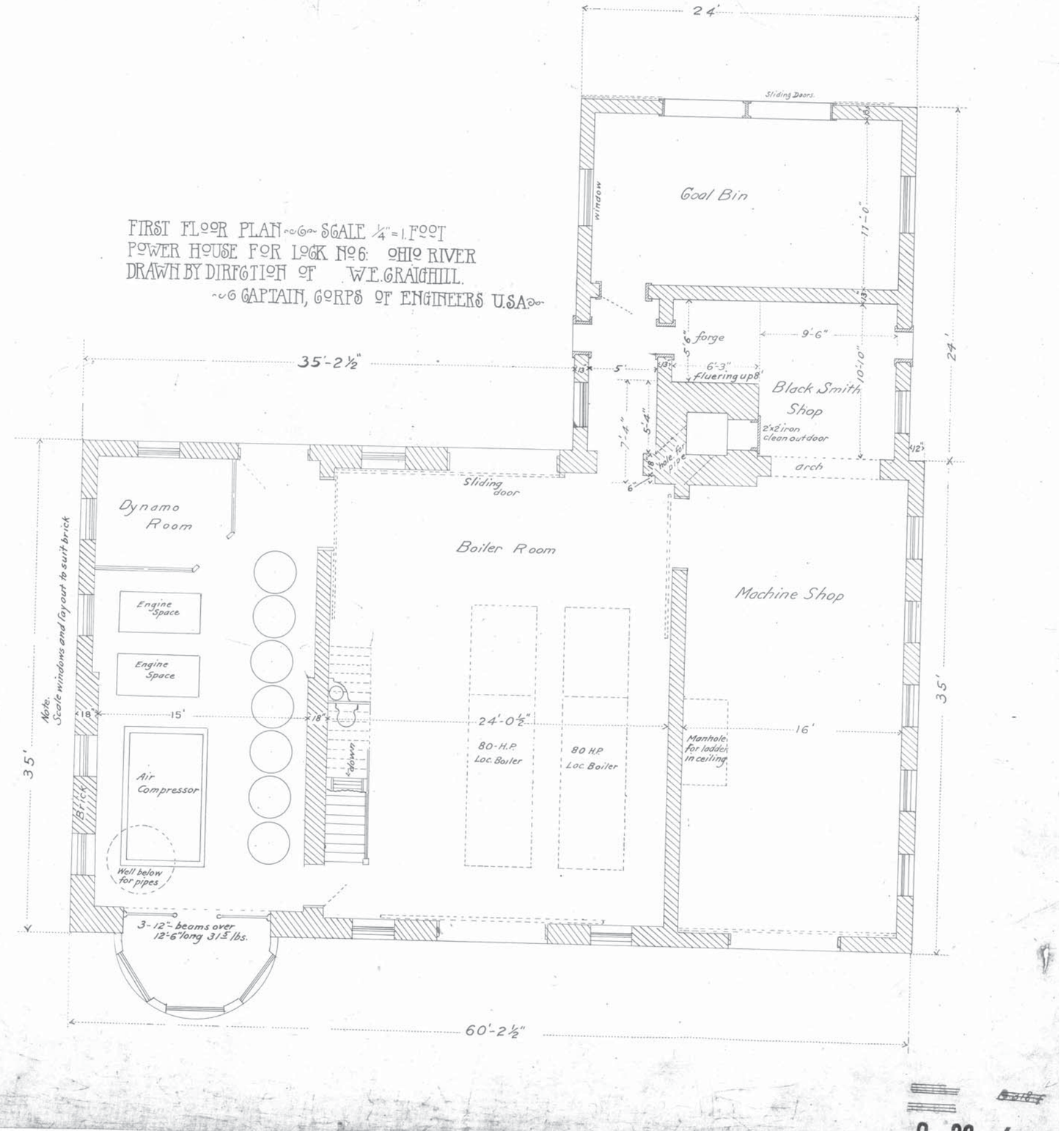
William Martin
Resident Engineer.

6-16-42

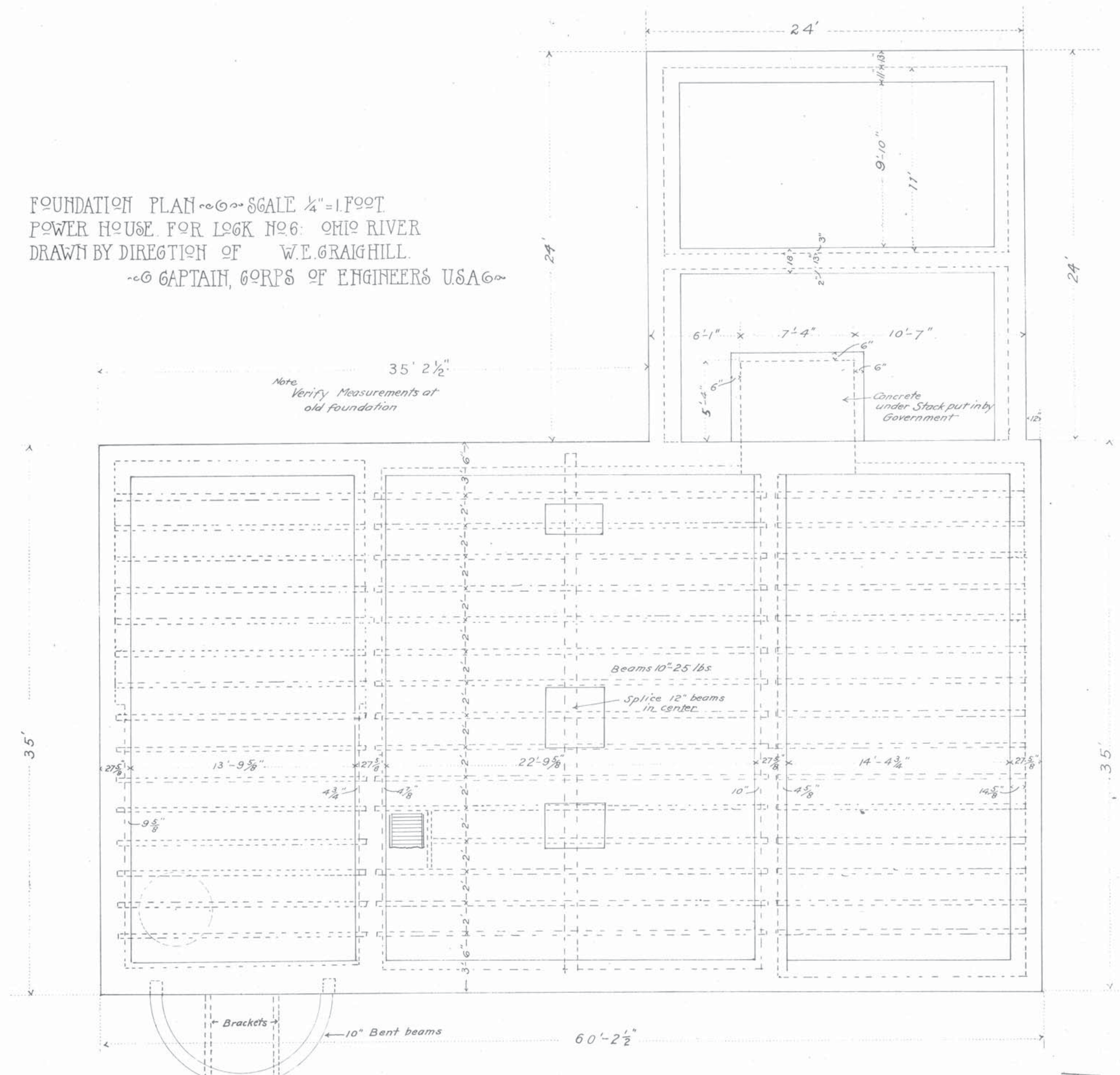
Powerhouse

Original Plans and Elevations

FIRST FLOOR PLAN ~ SCALE ¼" = 1 FOOT
POWER HOUSE FOR LOCK No 6. OHIO RIVER
DRAWN BY DIRECTION OF W.E. CRAIGHILL.
CAPTAIN, CORPS OF ENGINEERS U.S.A.



FOUNDATION PLAN SCALE ¼" = 1 FOOT
POWER HOUSE FOR LOCK No. 6: OHIO RIVER
DRAWN BY DIRECTION OF W. E. CRAIGHILL.
CAPTAIN, CORPS OF ENGINEERS U.S.A.



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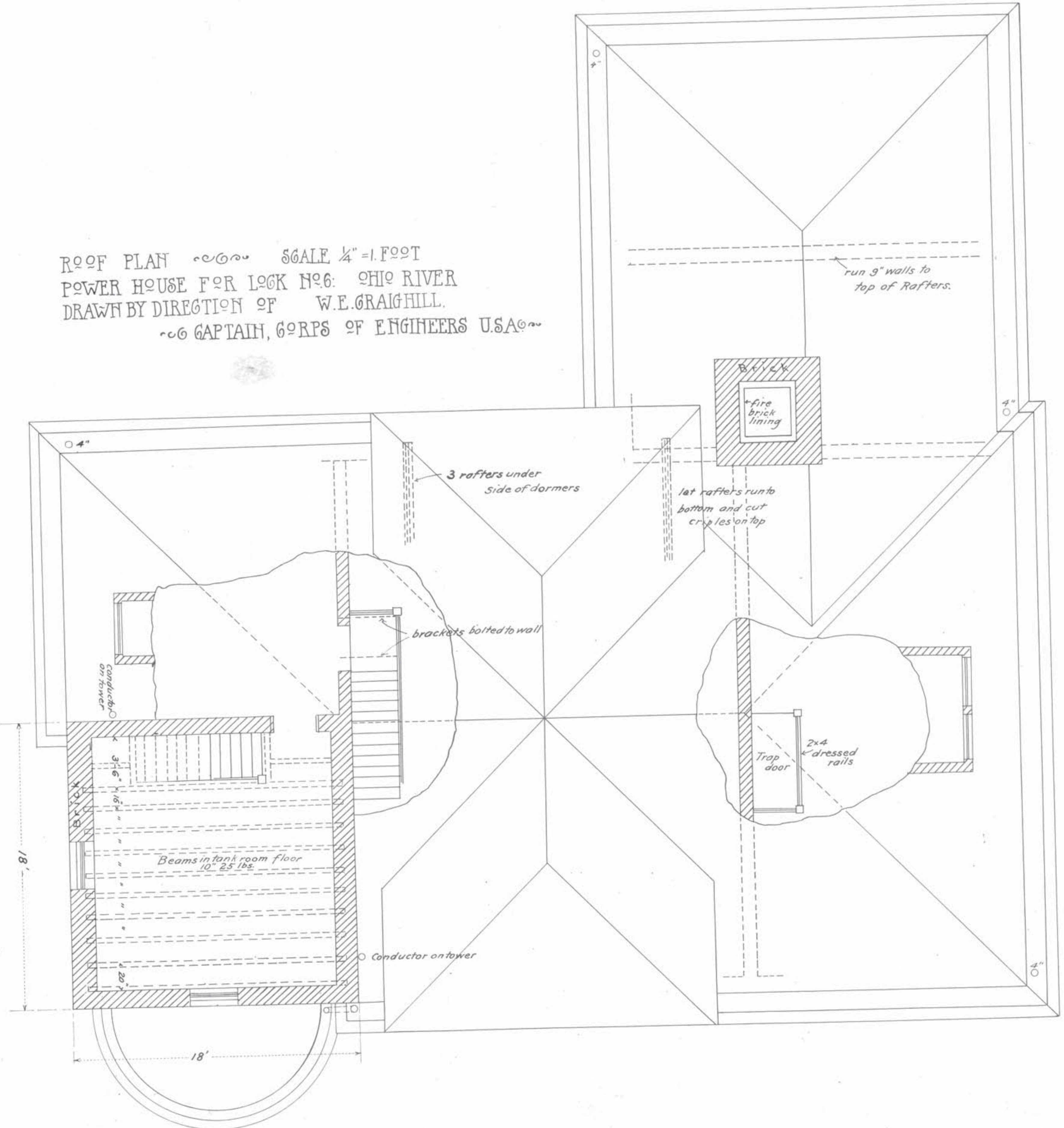
9 sheets - sheet No. 9



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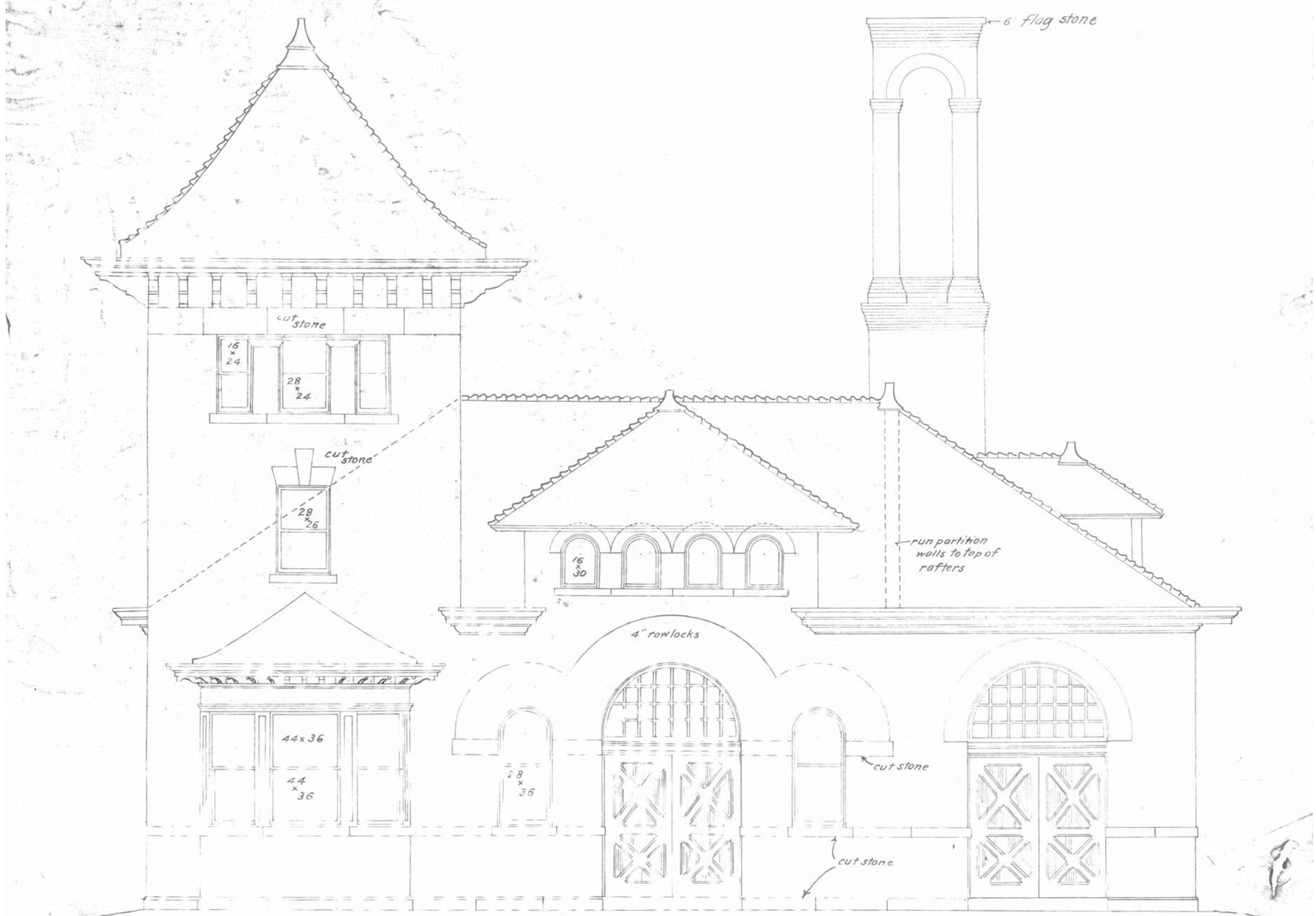
9 sheets - sheet No. 7.



RIVER ELEVATION. SCALE ¼" = 1 FOOT.
POWER HOUSE FOR LOCK NO. 6: OHIO RIVER
DRAWN BY DIRECTION OF W.E. CRAIGHILL.
CAPTAIN, CORPS OF ENGINEERS U.S.A.

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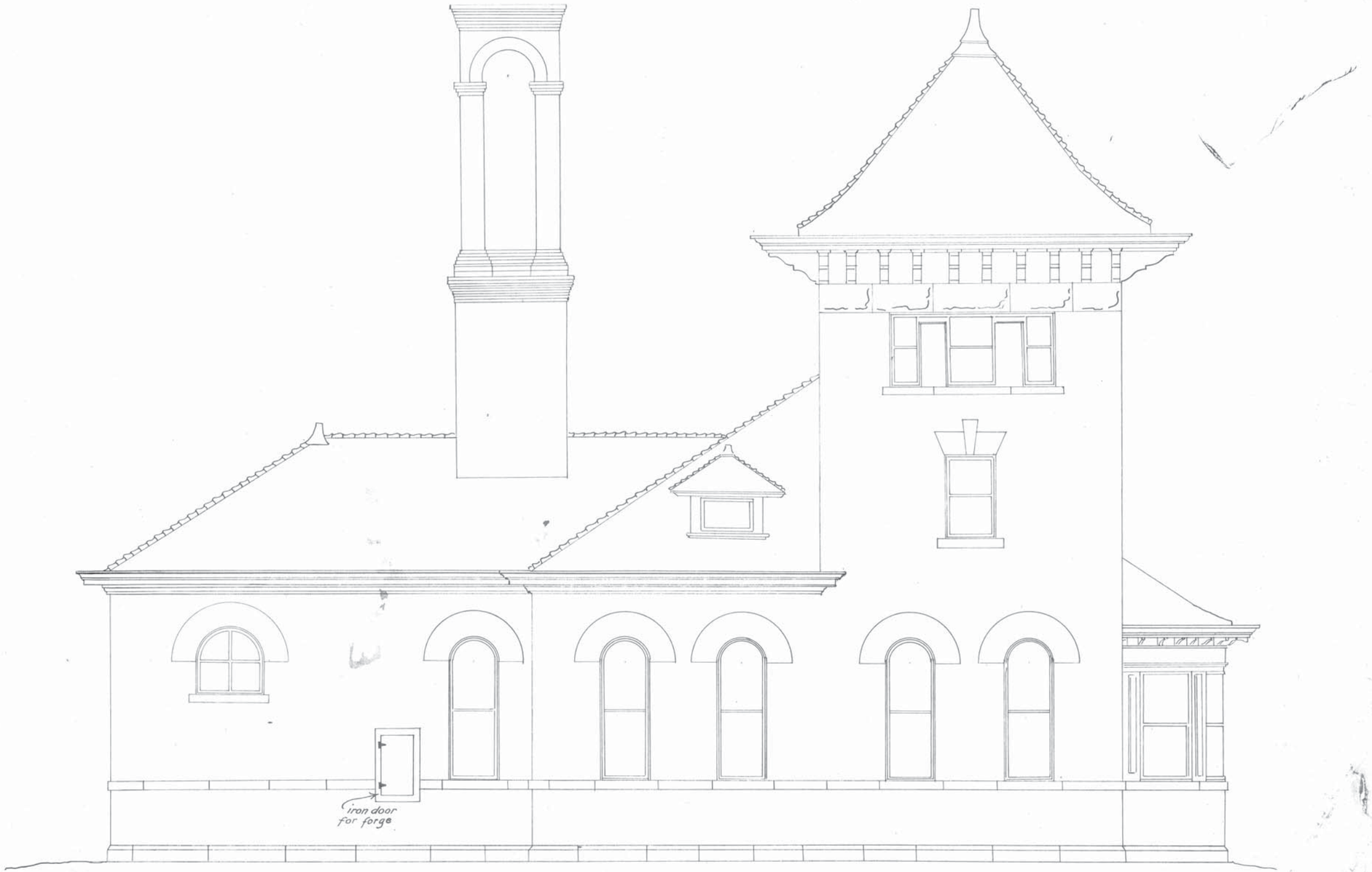
9 sheets - sheet No. 1

RAILROAD ELEVATION. SCALE ¼" = 1 FOOT.
POWER HOUSE FOR LOCK No. 6: OHIO RIVER.
DRAWN BY DIRECTION OF W. E. CRAIGHILL
CAPTAIN, CORPS OF ENGINEERS U.S.A.

0 - 36. - 4

9 sheets - sheet No. 2.



SOUTH ELEVATION. SCALE 1/4" = 1 FOOT.
POWER HOUSE FOR LOCK NO. 6. OHIO RIVER
DRAWN BY DIRECTION OF W.E. CRAIGHILL
CAPTAIN, CORPS OF ENGINEERS U.S.A.

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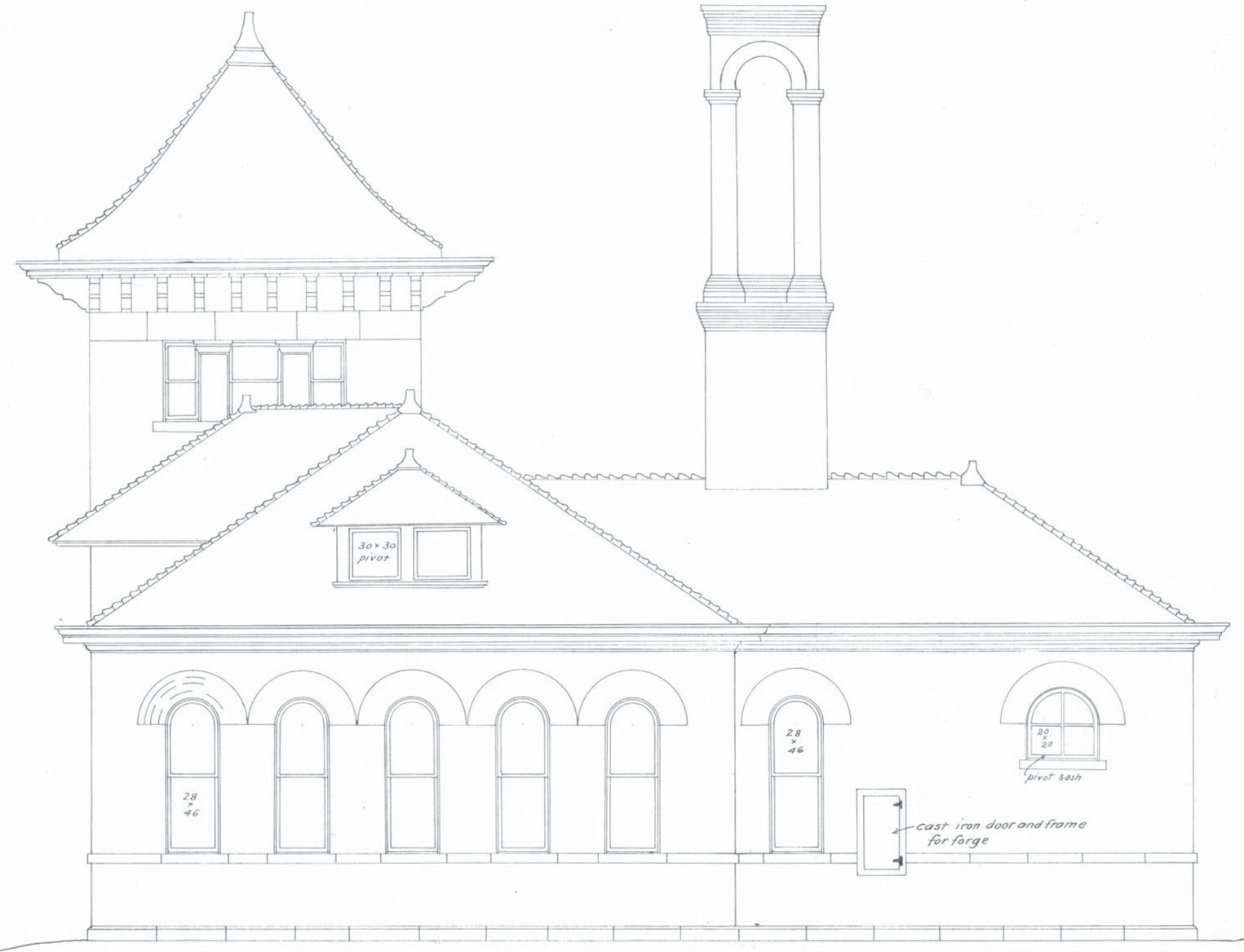
9 sheets - sheet No. 4.



NORTH ELEVATION. SCALE 1/4" = 1. FOOT.
POWER HOUSE FOR LOCK NO. 6: OHIO RIVER
DRAWN BY DIRECTION OF W.E. GRAIGHILL.
CAPTAIN, CORPS OF ENGINEERS U.S.A.

0 - 36. - 4

9 sheets - sheet No. 3.

LONGITUDNAL SECTION SCALE ¼" = 1 FOOT
POWER HOUSE FOR LOCK No. 6: OHIO RIVER
DRAWN BY DIRECTION OF W.E. CRAIGHILL
CAPTAIN, CORPS OF ENGINEERS, U.S.A.

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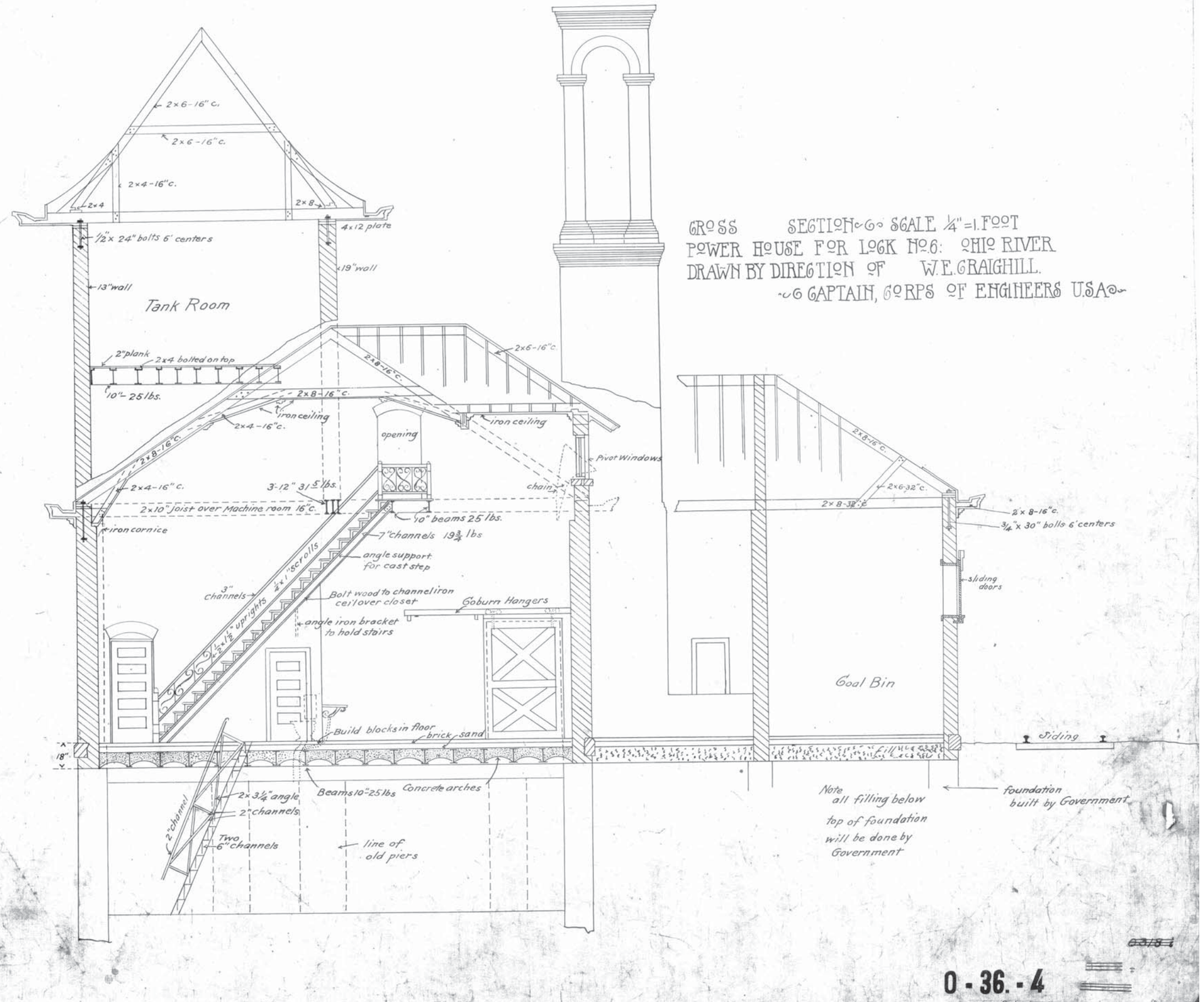
9 sheets - sheet No. 8.

CROSS SECTION. SCALE 1/4" = 1 FOOT
POWER HOUSE FOR LOCK No. 6: OHIO RIVER
DRAWN BY DIRECTION OF W.E. CRAIGHILL.
CAPTAIN, CORPS OF ENGINEERS U.S.A.



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9 sheets - sheet No. 9