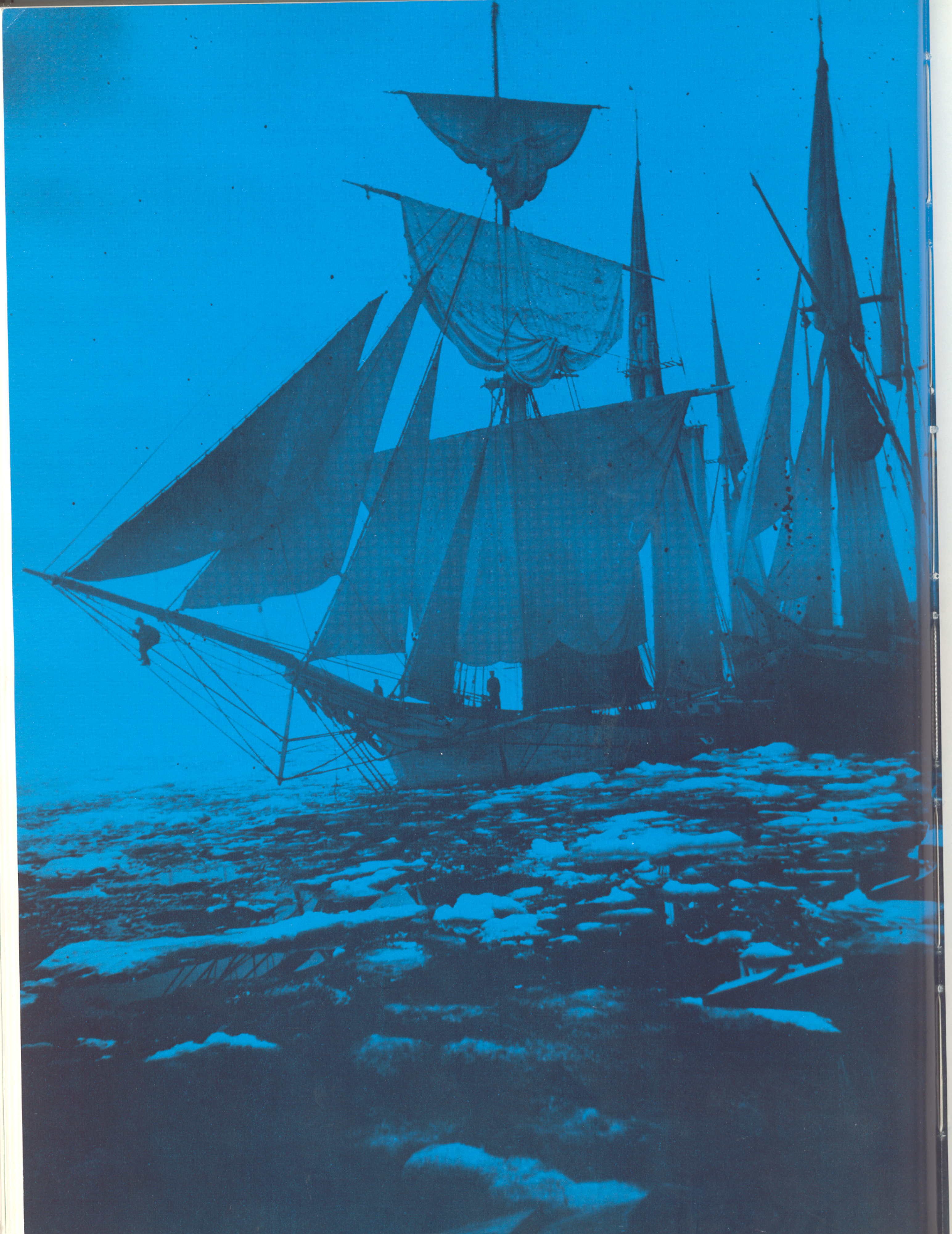


Chapter Eight: Lake Superior

Known to the Chippewa as "Gitchee Gumee," Lake Superior is the largest of the five Great Lakes, and the largest fresh water lake in the world. The French translation of "superior" means "upper," but the English term is also a true description of this lake. Lake Superior has a surface of 31,800 square miles and holds 2,935 cubic miles of cool, clear water. Because the temperature of the lake from the surface to the 100-foot depth remains nearly constant throughout the year, this inland sea is often covered by fog in the summer and subject to violent storms in the spring and fall. During much of the nine-month navigation season travel can be treacherous along its 395-mile length.[1]

The fur trade was the white man's first commercial enterprise in the Lake Superior region. The demand of Europeans for furs sent adventurous traders farther and farther inland from the Atlantic.[2] Before the end of the seventeenth century French canoes had entered Lake Superior.[3] Traders, priests and military men established the French presence on the north and south shores of the lake and a century later the British took over the area. Posts were established at the natural harbors at Kaministiquia and Nipigon, and there and at the Grand Portage and LaPointe European goods were traded for the Indians' harvest of furs.[4] The high point of the fur trade came in 1733 when beaver pelts worth 221,000 livres were received by the French Company of New France.[5] The greatest fur trade activity on Lake Superior came between 1740 and 1745. Less than a century later when two fur trade enterprises, the North West Company and the Hudson's Bay Company, were merged, the supply of fur bearing animals in the Lake Superior region had been depleted.[6]

The fur trade, like most of the commercial enterprises that succeeded it in the Lake Superior watershed, was an extractive industry. Furs brought from the hinterland were transported across Lake Superior through the narrows at St. Mary's Rapids into Lake Huron, and on to Montreal, the head of deep water shipping. Carried on by water transport, they finally reached processing and marketing centers in Europe.

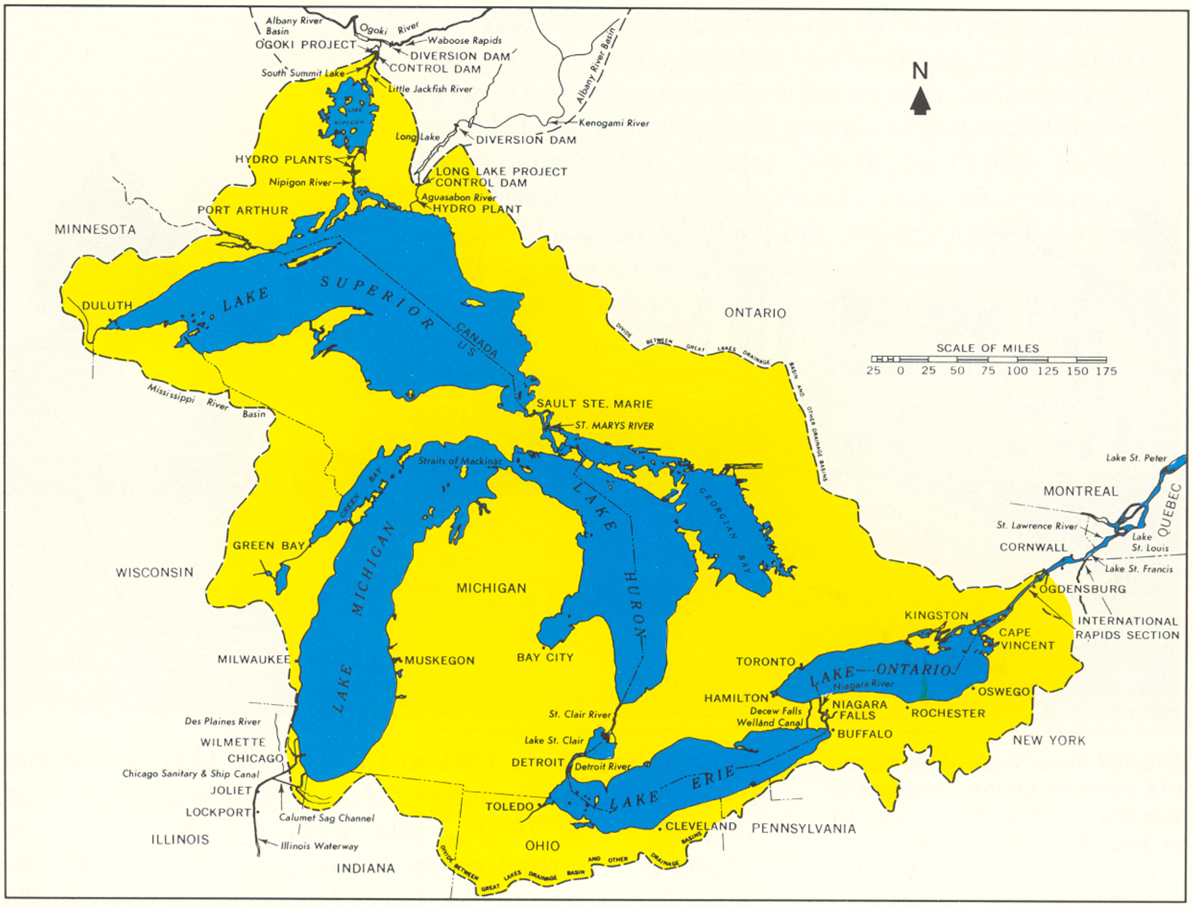
Schooners were the first large vessels used to carry copper out of Lake Superior ports. The schooner pictured here is sailing amid ice floes in 1875.

The Lake Superior area has never been a manufacturing center. In the lumber era sawmills and paper mills were built to process white pine and spruce, but finished wood products were usually manufactured elsewhere. When iron ore became the main staple of the area's economy, the steel mills were located on Lake Michigan and Lake Erie. Duluth mills have produced flour, but most of the wheat shipped to the lake port has been sent on to eastern terminals. Grain was not processed into beer, breakfast food, crackers, cookies, or other edible commodities until recent years, when Jeno Paulucci and Chun King made fortunes in this field.

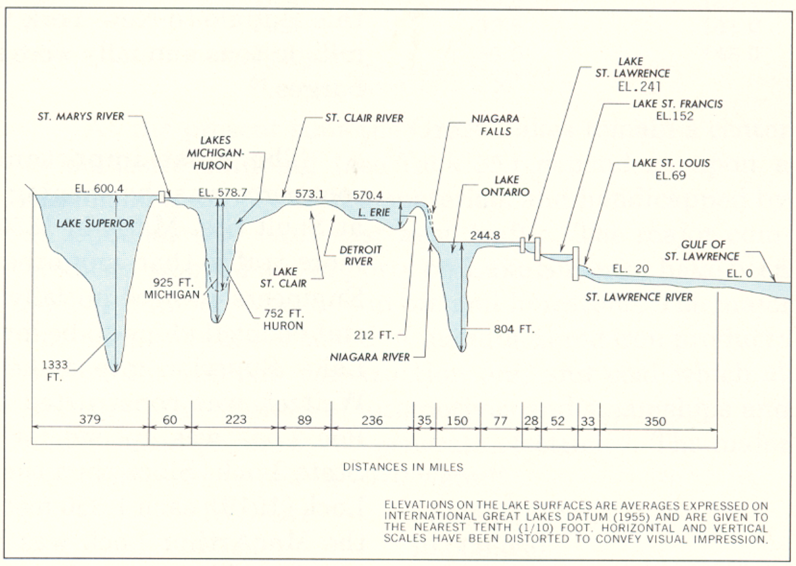
Some primary processing of raw materials such as fur, timber, iron ore, copper and wheat has been done on Lake Superior, but producing consumer goods such as hats, furniture, automobiles, electrical supplies and Cream of Wheat has not been a significant part of Lake Superior economic life. As Canadian historian Harold Innis has noted, most of man's energy around Lake Superior "has been directed toward the exploitation of staple products and the tendency has been cumulative."[7] The area surrounding the greatest of the Great Lakes has provided raw materials for the consumers of many international industrial and metropolitan centers. Outside capitalists have developed in this Great Lakes area a complex transportation network to supply their manufacturing plants and marketing systems. By 1936 the Duluth terminal alone accommodated sixty steamship companies operating 460 lake carriers.[8]

Since the time of the fur trade traffic on Lake Superior has been largely one-way. Succeeding generations have had to confront this imbalance of export over import. Both the waters and the shipping flow west to east. From Lake Superior, 602 feet above sea level, a series of sixteen locks in five canals now serve ocean-going ships along the 2,342-mile channel from Duluth to the Atlantic Ocean. The largest and oldest of these locks is the Welland Canal which, by-passing Niagara Falls, has linked Lake Erie and Lake Ontario since 1829. The original twenty-five locks have been reduced to eight, raising ships 326 feet.'[9]

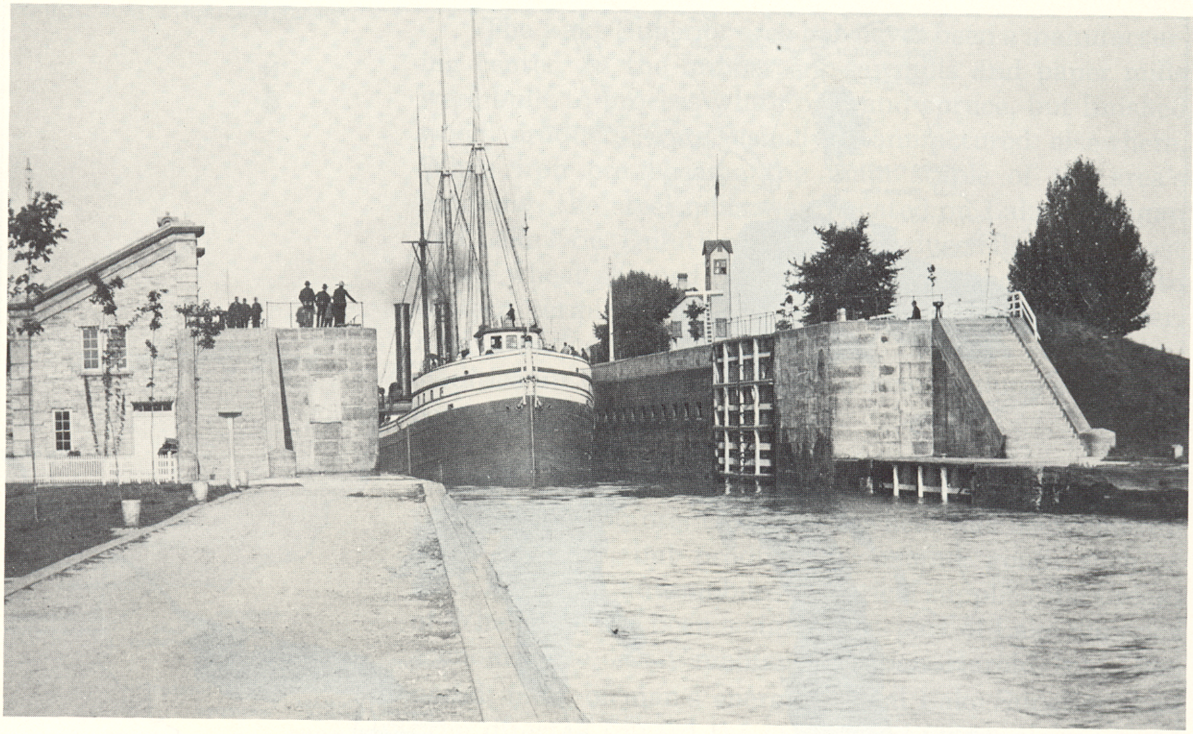
Yet the Welland Canal did not become the main nineteenth century transportation link between the Great Lakes and the Atlantic Ocean. Even though the amount of wheat shipped through the Welland Canal increased from



Though the St. Lawrence River is the oldest water route into the interior of North America, it was not until 1959 that ocean-going vessels could sail from the Atlantic Ocean to Lake Superior along a 2,342-mile channel.



This profile of the Great Lakes watershed indicates the major transition points where locks and canals had to be constructed to allow the free flow of traffic.



The first major work of the Corps of Engineers on the Great Lakes was the construction of the locks at Sault Ste. Marie.

210,105 bushels in 1831 to 1,579,996 in 1841, and during the same period the number of barrel staves increased from 137,718 to 2,776,161, and lumber from 986,888 to 3,580,911 feet, the Erie Canal, completed in 1825, was the main shipping route for Great Lakes commerce. In 1836, merchandise totaling 54,219 tons was transported along this Buffalo-to-New York City route, and by 1851 over a million tons annually were loaded on Erie Canal boats and barges.[10]

The most important event for Lake Superior commerce was the opening of St. Mary's Locks and Canal at Sault Ste. Marie in 1855. The canal eventually carried more traffic than any other in the world.[11] This Corps of Engineers project initially cost over one million dollars and enabled ships to be lowered the twenty-one feet from Lake Superior into Lake Huron. A second lock, the Weitzel, was constructed in 1881, and in 1896 the first Poe Lock was opened for traffic, replacing the original State Lock. Since then the Davis Lock (1914) and Sabin Lock (1919), each 1,350 feet long, have been added. In 1943 the MacArthur Lock was built for ships drawing thirty-one feet. The latest Corps of Engineers improvement of St. Mary's Rapids was the new Poe Lock completed in 1968, which accommodates seventy-five per cent of all ocean-going carriers.[12]

With the completion of the St. Lawrence Seaway in 1959, the story of shipping on the Great Lakes came full cycle. Those who organized the French fur trade realized that they were developing, operating and maintaining an entire commercial system. When the British disrupted this network in 1763, and twenty years later when it was divided between British and Americans, it no longer operated as a single system. To be successful, commerce on the Great Lakes and St. Lawrence Seaway must be coordinated unit.[13] This was the most important fact discussed at the Winter Navigation Seminar conducted by the Corps of Engineers in December, 1972.[14] The St. Lawrence Seaway has been slow to develop its commercial potential. Although it was designed to handle fifty million tons of international freight a year, this total was not achieved until 1970.[15]

TABLE 35 FOREIGN AND DOMESTIC TONNAGE AT GREAT LAKES PORTS, (in millions of tons)

Year	Foreign Imports	Foreign Imports	Domestic Tonnage
1963	18.0	28.5	141.7
1964	24.2	30.5	151.4
1965	25.0	31.8	153.7
1966	26.7	31.8	164.0
1967	27.7	27.6	153.6
1968	32.1	30.4	151.1
1969	24.6	35.9	160.8
1970	26.4	35.9	157.1
1971	26.0	33.5	141.0
1972	25.1	35.0	145.0

From: Office of The Chief of Engineers *Annual Report, 1973*, p. 33.

At the present time the Great Lakes remain a center of domestic shipping (see Table 35) dependent upon a diminishing supply of raw materials and handicapped by an imbalance of local east-west traffic. The major commodities shipped out of ports on Lake Superior have been copper, lumber, wheat, iron ore and limestone. The major incoming freight consisted of manufactured iron products during the railroad construction era, and coal which at first fired the engines of locomotives and steamships and now is used primarily to generate electricity. The major commodities shipped in 1970 were:[16]

Iron Ore	94,000,000 tons
Coal	49,000,000
Limestone	36,000,000
Grain	22,000,000
Other	36,000,000
TOTAL:	237,000,000 tons

The limestone is used for fluxing steel, manufacturing cement, road surfacing and fertilizer. Grain from the West and coal from the East have been important to shipping since the early 1880s, as the exports and imports from Duluth show.[17]

Date	Tons of Coal	Bushels of Wheat
1880	420,000	3,021,287
1887	1,041,000	37,114,321
1899	892,204	72,969,700
1910	8,298,399	28,636,014
1920	9,030,696	34,211,629
1930	9,802,875	64,601,210[16]

Copper and lumber were once important commodities. Though the Michigan copper lodes produced eighty to ninety percent of the nation's output in the 1870s, during their peak year (1916) they only accounted for thirteen percent of the copper mined in the United States.[18] Between 1880 and 1910, the lumber trade was huge. The tugging of log rafts out of the Great Lakes peaked in 1895 at 279,229,743 feet. The sawing of lumber at Duluth in 1890 amounted to 207 million board feet.[19] The city of Tonawanda, New York, near Buffalo on Lake Erie, became the greatest white pine assembly and distribution center in the world. Much of Tonawanda's lumber came from Duluth; in fact, fifty percent of all Duluth exports in 1895 were destined for the Buffalo port. Ten years later thirty Duluth sawmills cut 736 million board feet to be shipped on Great Lakes "hookers." By 1914 exported lumber had dropped to an insignificant 218,264 board feet.[20] The Lake Superior cutover pine lands were transformed into national forests: the Chippewa and Superior in Minnesota, the Chequamegon and Nicolet in Wisconsin, and the Hiawatha, Ottawa and Marquette in Michigan.

During the twentieth century, iron ore has been the mainstay of Lake Superior shipping. Six ranges have been the major source of this commodity, and by the 1930s they were producing two-thirds of the world's supply of iron ore.[21]

Year Begun	Range	Location	Total Tonnage Produced (to 1937)
1854	Marquette	Michigan	194,000,000
1872	Menominee	Michigan	183,000,000
1884	Gogebic	Michigan-Wisconsin	207,000,000
1884	Vermilion	Minnesota	65,000,000
1892	Mesabi	Minnesota	1,031,000,000
1911	Cuyuna	Minnesota	38,000,000

The peak year for shipment of iron ore came in 1951 when over 100 million long tons were dug out of the soil. The Mesabi Range alone produced 73 million tons of that record total. The first ore shipped out of Minnesota left from Agate Bay at Two Harbors in 1884. It came from the Soudan Mine in the Vermilion Range. In 1875 George C. Stone and George C. Stuntz arranged with the Philadelphia financiers Charlemagne Tower and Samuel Munson for capital to begin mining. By 1890 there were 284 companies in the Tower-Babbitt area.[22]

The "Seven Iron Men" of the Merritt family, under the leadership of Leonidas Merritt, discovered the rich Mesabi Range in 1890. Unable to finance the purchase of lands and large equipment or the construction of a railroad line to Duluth, the Merritt brothers lost their original investment and by 1900 John D. Rockefeller was the owner of the Mesabi.[23] Cuyler Adams and his dog Una discovered the Cuyuna (Cuyler-Una) Range in 1895 and in 1911 the Kennedy Mine at Crosby and Ironton was in operation. Seven years later thirty-two mines in this range were producing red earth for the blast furnaces of Illinois, Indiana, Ohio and Pennsylvania.[24] The Vermilion and Cuyuna ranges never supplied more than five million tons in a single year, but the open pits of the Mesabi shipped a record eighty-one million tons in 1953. Much of the Mesabi ore was over sixty percent pure iron. Between 1884 and 1960, Minnesota deposits provided American industry with an incredible 2,484,854,372 long tons of iron ore.[25]

The tremendous production of iron ore meant that the original schooners and steamers plying the lake in the 1880s had to be increased. Alexander McDougall, a shipbuilder in Duluth, launched forty-six "whalebacks" between 1888 and 1898 to carry iron ore. During this same

TABLE 36 COMMERCE AT LAKE SUPERIOR HARBORS IN THE ST. PAUL DISTRICT
(in tons)

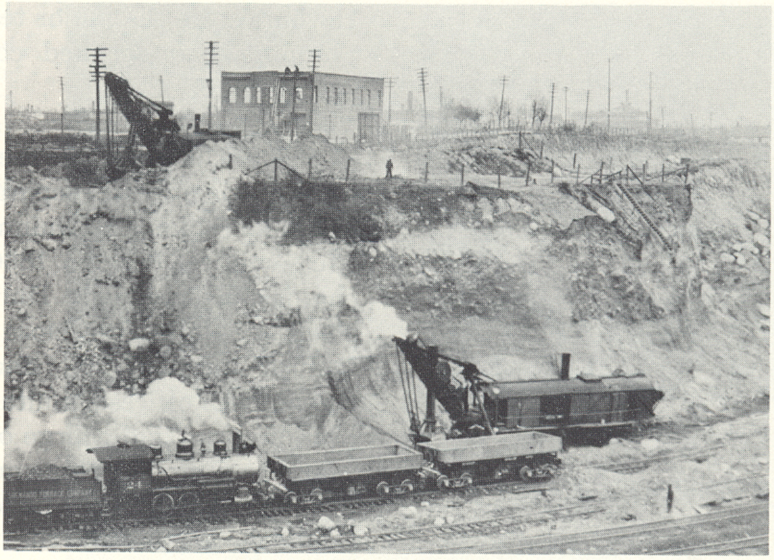
Commercial Harbor	1899	1914	1920	1930	1940	1950	1960	1970
Grand Marais, Minnesota	6,203	2,216	14,447	2,599	28,601	16,526	47,649	35,706
Duluth-Superior	3,293,478	33,535,704	46,808,613	45,726,085	54,147,695	63,149,107	42,677,800	42,758,965
Two Harbors	4,604,252	6,668,005	10,704,464	7,203,145	12,040,912	19,164,058	15,266,451	5,255,623
Port Wing	31,427	1,986	2,310	—	1,760	207	278	235
Ashland	4,000,000 (1902)	4,432,452	9,836,329	6,238,594 202,350 logs	7,212,432 203,607 logs	6,107,194 75,412 logs	1,573,845	412,205
Ontonagon	1,518 1,500,000 Logs	12,032	2,950	27,447	26,084	14,479	11,092	11,981
Keweenaw Waterway	1,422,784	1,077,032	1,148,748	Through: 334,910 Local: 825,324	122,326 437,527	207,219 389,361	473,846 1,045,576	431,382 1,295,512
Marquette	3,427,903	794,543	1,138,165	2,685,565	877,604	901,236	925,095	1,558,809
Presque Isle	1,475,787	1,436,391	3,042,433	2,707,085	5,367,973	3,850,192	4,340,418	3,879,634
Grand Marais, Michigan	116,050	656	315	508	316	5,407	77	47

From: Office of the Chief of Engineers
Annual Reports, for respective years.

period Rockefeller organized the Bessemer Steamship Company, and by 1901 this fleet of steel ships and barges totaled sixty vessels. Ore boats continued to grow in size until 730- by 75-foot carriers drawing twenty-six feet of water and holding up to 27,000 tons were common. One of these boats can hold ore from 250 train cars.[26]

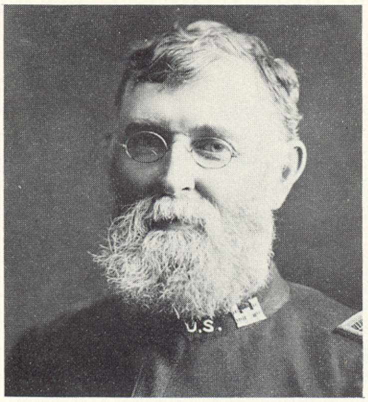
Harbors on the southwestern end of Lake Superior were not adequate to handle the amount of shipping that developed. From the establishment of an office at Detroit in 1845, the Corps of Engineers has been in charge of improving transportation on Lake Superior. The development of mining and the activities of the Corps on Lake Superior are inseparable. The Corps built the locks at Sault Ste. Marie in 1855, opening Lake Superior for traffic to and from the smelting furnaces on the lower lakes. Subsequent Corps enlargements of the "Soo" canal have been made to accommodate the growth of the mining industry.[27] The southern and western harbors on Lake

The largest open pit mine in the world is the Hull-Rust mine on the Mesabi Range. This 1915 photograph shows the huge hole undermining the streets of Hibbing, Minnesota. This town was moved several times to make room for this ever-expanding pit in the rich iron region.



Superior (Marquette, Presque Isle, Port Wing, Eagle Harbor, Ontonagon, Ashland, Superior, Duluth and Two Harbors) were all improved to aid navigation. Harbors of refuge were built at the towns of Grand Marais in Minnesota and Michigan, and at Portage Lake and Princess Point on the Keweenaw Waterway, so ore boats could avoid fall and spring storms. The rise and decline of harbor traffic closely followed the rise and decline of iron mining (see Table 36). The peak years for Lake Superior shipping occurred in the 1950s, when Duluth and Two

These whalebacks from Duluth are resting at the government pier at Sault St. Marie in 1898.



Major James B. Quinn was the first district engineer at Duluth, serving from 1886 to 1890.

Harbors were the major terminals for Mesabi Range ore. Shipping has declined considerably since that period (see Table 37).

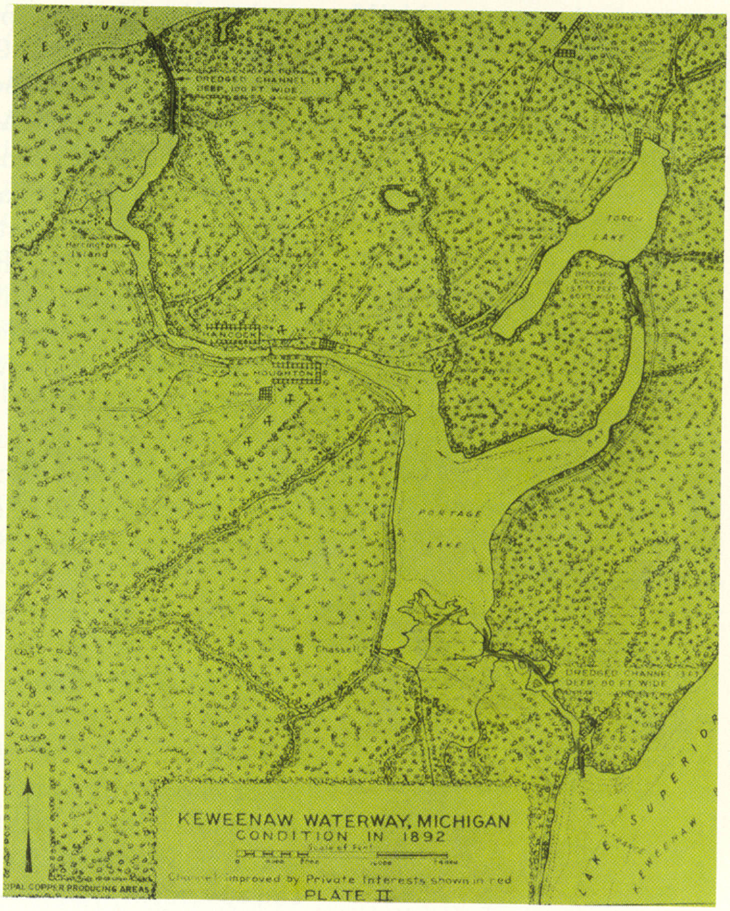
The Duluth office became an independent district in 1886 when it was separated from the St. Paul District and Major James B. Quinn was appointed as resident district engineer.[28] From 1886 to 1955, thirty-three district engineers served the Duluth office (see Appendix II). There was always a close working relationship between Duluth and St. Paul, and six times district engineers served both offices simultaneously. After 1881 the Duluth headquarters had charge of all lake ports from Sault Ste. Marie to Grand Portage on the Canadian border. In 1919 the Rainy Lake and Lake of the Woods International Boundary Waters and the harbors at Zippel Bay, Baudette and Warroad on Lake of the Woods were transferred to the district. In 1955 the Duluth section again became part of the St. Paul District, along with all Lake Superior ports west of Au Train Bay, Michigan.

TABLE 37 COMPARATIVE TONNAGE AT GREAT LAKES HARBORS

Harbor	1895	1955	1972
Chicago, Illinois	12,722,199	38,969,159	46,838,259
Duluth-Superior, Minnesota-Wisconsin	11,434,272	68,311,332	37,896,954
Cleveland, Ohio	5,649,537	20,426,617	23,865,810
Buffalo, New York	9,612,423	22,962,000	9,226,253
Milwaukee, Wisconsin	7,280,538	8,711,557	5,373,630
Two Harbors, Minnesota	4,900,000	19,102,852	6,777,639
Ashtabula, Ohio	4,410,984	13,068,009	12,063,864
Erie, Pennsylvania	3,323,672	6,920,782	1,360,244
Toledo, Ohio	1,806,673	35,724,536	25,248,550

From: Office of The Chief of Engineers *Annual Reports, 1895, 1955, 1972.*

The Keweenaw Peninsula was an important source of copper and a barrier for Great Lakes shipping until the Corps of Engineers improved the natural waterway which cuts through the rugged finger of land jutting into Lake Superior.



Keweenaw Waterway

In 1839 the first schooner to sail on Lake Superior, the "Algonquin," was slid over the icy portage at Sault Ste. Marie. The crew sailed the boat to Isle Royale, the largest island in Lake Superior, in search of copper. In 1840 copper deposits were discovered by Dr. Douglass Houghton, state geologist of Michigan, on Keweenaw Point, fifty-five miles southeast of Isle Royale, and six more schooners were pushed and dragged over the portage. The first permanent towns on Lake Superior were located at Copper Harbor and Eagle River on the Keweenaw Peninsula. When the Calumet Mining Company began copper-mining operations, the twin towns of Hancock and Houghton, Michigan, located on Portage Lake on the eastern side of the peninsula, became important terminals.[29]

The hard covering of the Keweenaw Peninsula is among the most ancient of lands on the surface of the earth and is the only place where pure copper is found in large quantities. Over 200 companies have been chartered to work in this area. The largest single hunk of copper ever mined came from the Minnesota lode in 1856. It weighed 527 tons and took twenty men fifteen months to dislodge. By 1898 the Keweenaw Peninsula was considered the richest piece of real estate in the United States. By that year one operation, the Red Jacket mine, had already distributed fifty-five million dollars in dividends. In addition to copper, the red sandstone quarries in Jackobsville provided exterior walls for many prominent buildings in England, New York, New Orleans, Buffalo and Chicago. To the east of the peninsula is the deepest portion of Lake Superior and also the best fishing grounds. By 1940 over 150 commercial fishermen operated out of the waters around Portage Lake.[30]

The Keweenaw Peninsula is the most prominent physical feature of the Lake Superior shoreline. It juts out sixty miles into the lake about half-way between Duluth and the "Soo" locks. Forty-five miles from its rocky point is a waterway about twenty-four miles long. In its natural state this water route, which cuts completely across the peninsula, was navigable for about sixteen miles. The state of Michigan chartered the Portage Lake and River Improvement Company in 1861 and it dredged the eastern outlet. In 1864 the Portage Lake and Lake Superior Ship Canal, Railway and Iron Company was organized to improve the western end. A two-mile, lake-level canal, thirteen feet deep and 100 feet wide, was begun in 1868 and completed in 1873.[31]

In 1890 the Corps of Engineers was asked to operate the canal as an alternate shipping route and a harbor of refuge for Lake Superior vessels. Congress appropriated $350,000 to purchase the franchise rights, lands and physical properties. It was a good bargain for the mining interests because the whole project was in a "dilapidated condition." The Corps of Engineers was willing to pay the price because it wished to regulate the use of the canal.[32]

Earlier in 1886 the Corps had attempted to stop a stamp mill located on Portage Lake from dumping tailings into the water. The company challenged the authority of the Corps and Major Quinn responded by establishing harbor lines around the lake. When the stamp mill refused to acknowledge the existence of the harbor lines, the district attorney for western Michigan was asked to issue an injunction against the mill operators. The Department of Justice delayed action by requesting a new Corps of Engineers survey of the area.[33] By the time Corps personnel had set twenty stone monuments establishing the harbor boundaries, Congress had made the Corps administrators of the whole Great Lakes waterway.[34] Regulations were finally approved in 1895.[35] The dumping of tailings into Lake Superior waters has been a long-standing problem. It appeared again later in the twentieth century when taconite replaced iron ore as the major commodity shipped on Lake Superior (see Chapter Ten).

After 1890 the Keweenaw waterway was used more for transportation of local products than as a short cut for Lake Superior vessels (see Table 38). Coal, manufactured iron, salt, copper and miscellaneous merchandise went west and copper, flour, wheat, pig iron, iron ore, lumber and grain went east. Between 1894 and 1904 passenger traffic averaged 30,000 to 40,000 fares.[36] Copper and coal were major local commodities, and in 1909 a total of 9,619,000 board feet of logs was shipped through the waterway.[37] Through tonnage decreased after 1914 with the decline of lumbering in the area.

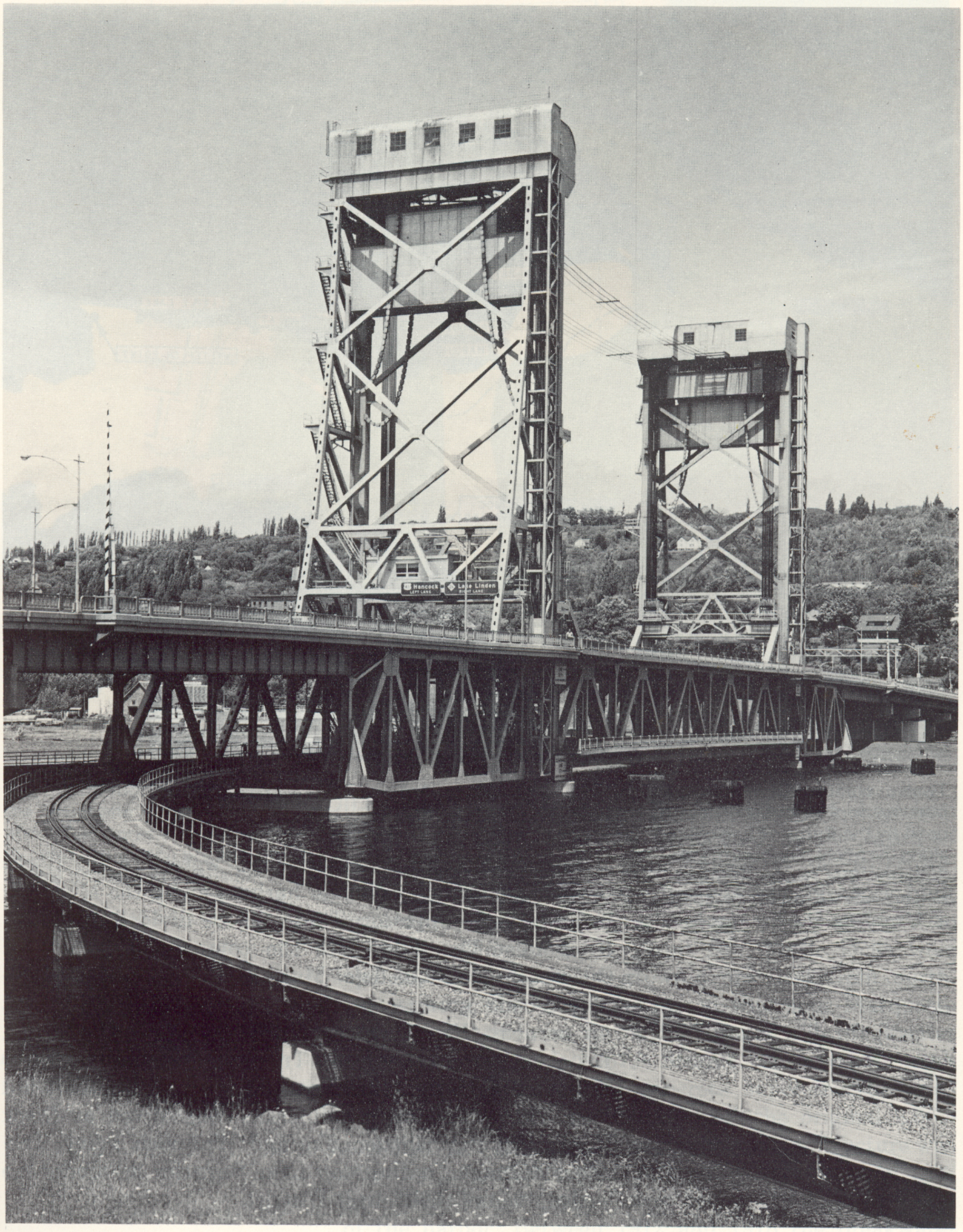
TABLE 38 TONNAGE SHIPPED THROUGH KEWEENAW WATERWAY

Year	Local Commerce	Through Commerce	Combined Traffic
1900	—	—	1,734,136
1905	—	—	3,691,536
1910	1,153,627	1,231,049	2,384,676
1915	1,374,036	1,088,293	2,463,329
1921	655,265	285,416	940,681
1925	661,677	406,044	1,067,721
1930	825,324	334,910	1,160,234
1935	256,224	123,090	379,314
1940	437,527	122,326	559,853
1945	370,934	356,622	727,556
1950	389,361	207,219	596,580
1955	336,309	397,271	733,580
1960	—	—	1,167,021
1965	—	—	465,480
1970	—	—	431,382
1973	—	—	229,425

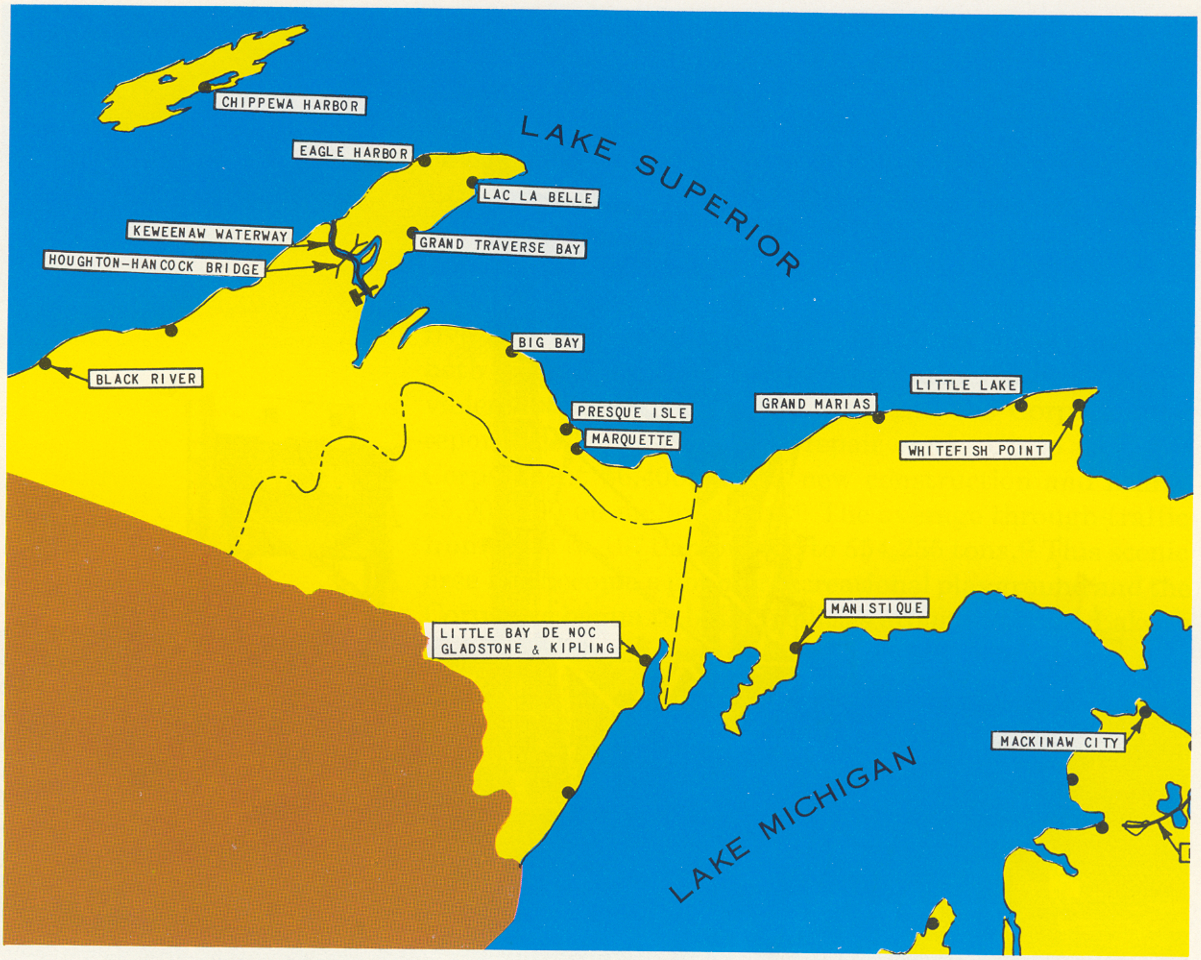
From: Office of the Chief of Engineers
Annual Reports, for respective years

An average of forty-six vessels a year used the Lily Pond harbor of refuge west of Hancock and Houghton at the turn of the century.[38] Eventually two areas, an upper or western refuge and a lower or eastern refuge, were developed and by 1915 over 250 lake vessels a year benefitted from these facilities.[39] Over 300,000 cubic yards were dredged in making the Princess Point cutoffs in the 1920s. The waterway was enlarged in 1898, 1910 and 1935 to accommodate changes in vessel size.[40] It now has a twenty-five foot depth and is 300 feet wide. The breakwaters on both ends have been subject to much damage by the violent storms that hit the area and the Corps annual reports document frequent repair work. Up to 1973 the Corps spent $6,406,140 on new construction and nearly $5,904,300 on maintenance.[41] The average through-traffic from 1946 to 1971 amounted to 554,255 tons.[42] This scenic area has become a popular recreational playground and the Corps has begun to build facilities around Portage Lake to accommodate this use of the waterway.

Though local interests delayed improvements on the waterway in 1910 by blocking the acquisition of land, the biggest controversy in the twentieth century arose over the rights of vehicle traffic to pass between Hancock and Houghton. When the Board of Engineers examined the waterway in 1886, they noted that the low railroad and vehicle bridge between Houghton and Hancock was a serious obstacle to navigation.[43] In 1895 a new swing bridge was built and when it had to be repaired after being struck by a freighter in 1906, the clearance was increased from 68 to 118 feet. This bridge was inadequate for the large ore boats, and too narrow for more than one lane of automobile traffic. The bridge was the only crossing between the mainland and the peninsula. For fifty years vehicles were delayed by its frequent openings and its inadequate size. Finally in 1955 the secretary of the army used the powers of the Truman-Hobbs Act of 1940 to order a new lift bridge with two levels to accommodate both rail and automobile usage. It was completed in 1960 at a cost of over eleven million dollars, of which the federal government contributed $4,230,000. The new bridge has the world's heaviest lift span (four and one-half million pounds) and now accommodates all lake vessels drawing twenty-five feet of water.[44]



The new Houghton-Hancock bridge completed in 1960 connects the mainland to the Keweenaw Peninsula.

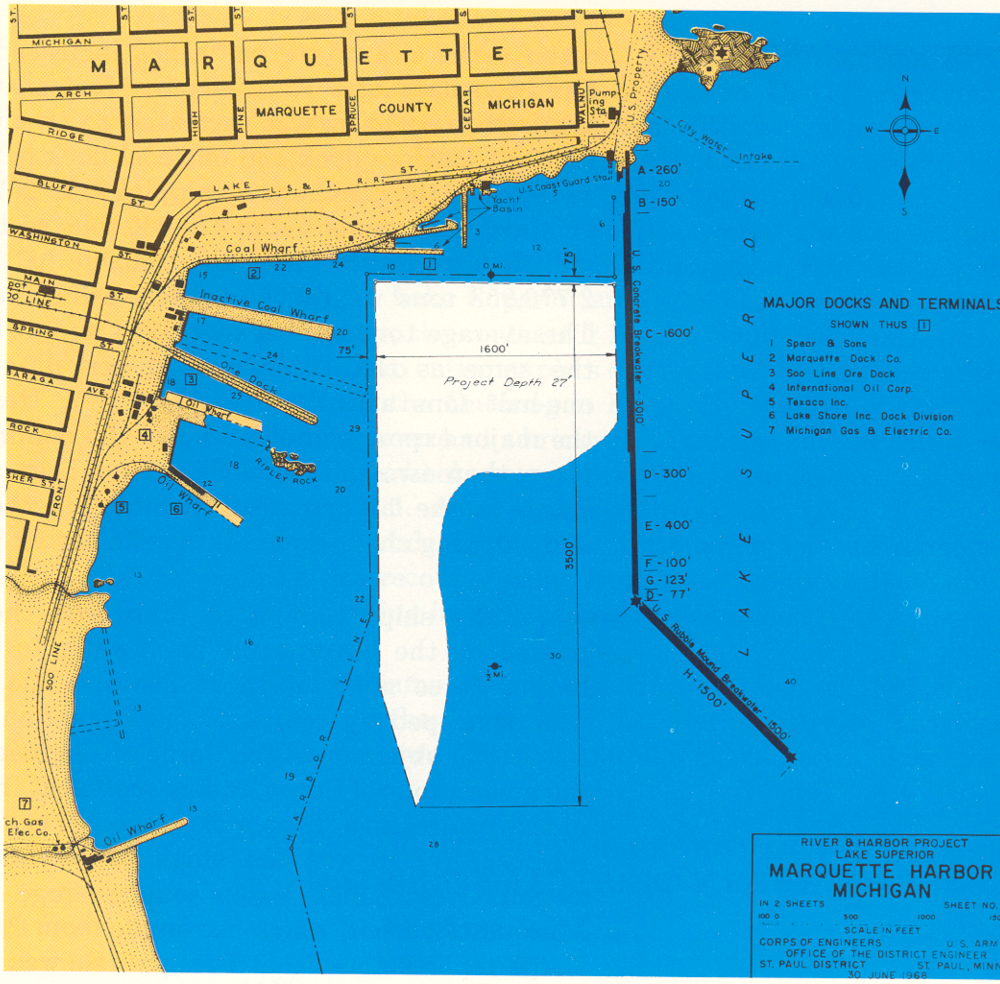


Twelve commercial and small boat harbors have been developed by the Corps of Engineers along the Michigan shore of Lake Superior. The two most important are located three miles apart at Marquette and Presque Isle.

Michigan Ports

In addition to the Keweenaw waterway the Corps developed twelve additional harbors along the Michigan shore of Lake Superior. These can be divided into three categories. The oldest are the commercial harbors of Ontonagon, Presque Isle, Marquette and Grand Marais. The second group consists of small boat harbors built on or near the Keweenaw Peninsula at Eagle Harbor, Lac La Belle Lake, Grand Traverse Bay and Chippewa Bay on Isle Royale. In the third group are post-World War II harbors for small craft constructed at Black River, Big Bay, Little Lake and Whitefish Point. Two other Michigan harbors on Lake Superior are under the jurisdiction of the Detroit District.

The two most important Michigan ports, Marquette and Presque Isle, only three miles apart, are located in the heart of Michigan's Marquette Iron Range.



The 4,500-foot breakwater in the Marquette harbor protects about 350 acres and facilitates the shipping of iron ore and the receipt of coal and petroleum.

Marquette, Michigan, the third largest American harbor on Lake Superior, is located in the heart of Michigan's Marquette Iron Range. W. A. Burt discovered iron deposits there in 1844 but furnaces built at Marquette to process the ore were abandoned in 1855, the same year the Sault Ste. Marie locks were opened. To protect the growing ore fleet from northeast storms, the Corps contracted with four Marquette and New York firms to build a timber crib breakwater across the harbor in 1867.[45] Storms continued to break down this barrier and a concrete superstructure was authorized in 1890 which extended the original 2,000-foot pier by 1,000 feet.[46] The concrete superstructure was built by government plant and hired labor between 1897 and 1905. In 1911 the Corps began the first dredging of the harbor. Between 1912 and 1918 the breakwater was extended another 1,500 feet. During construction the timber crib design proved to be inadequate and rubble mound construction was substituted.[47]

As the size of ore boats has increased, the harbor has been deepened. A twenty-five-foot channel was authorized in 1935; it was increased to twenty-seven feet in 1960. One ore dock and one coal dock have accounted for most of the commerical shipping.[48] In 1872 the freight at Marquette amounted to 370,000 tons with 780 arrivals and departures. By 1900 the tonnage had increased to 2,776,953 tons with 2,060 vessels using the terminals.[49] The average tonnage between 1964 and 1971 was about the same as the 1910 to 1920 period: a million and one-half tons annually (see Table 39). Iron ore is still the major export and oil and coal the dominant imports. More than two million dollars have been spent by the Corps in the 110 years of maintaining the breakwater and shipping channels in Marquette harbor.[50]

Many ships coming to Marquette, however, have passed by the government breakwater to enter a small harbor three miles north at Presque Isle. This harbor was developed by congressional resolution in 1896 over the strong objection of the Corps of Engineers.[51] Succeeding generations of Corps leaders scoffed at the designation of this project as a "harbor of refuge." It never served that purpose, for it was too small to provide storm protection. Great Lakes vessels sought refuge instead at the Marquette harbor, which has ample room to shelter ships. Corps reports noted that Presque Isle was "essentially a shipping point, pure and simple."[52] The harbor breakwater was built solely to satisfy large mining interests and the Lake Superior and Ishpeming Railroad Company.[53] The fact that the harbor was built when a good harbor for the shipment of ore already existed with ample railroad connections and terminal facilities within a very short distance caused criticism. The project consisted of a 1,000-foot breakwater which was eventually extended to 2,816 feet.[54] Federal costs for the project including maintenance have not exceeded one million dollars over the past seventy years, yet commerce from the port has overshadowed that of nearby Marquette (see Table 39).[55]

While the Presque Isle and Marquette harbors were becoming important iron ore ports, Ontonagon on the other side of the Keweenaw waterway was developing into a major lumbering center.[56] Actually it was around Ontonagon that the earliest interests in copper mining centered. This was because of a large copper rock on the river bank. Copper nuggets from the Ontonagon River were sent to France as early as 1668. In 1771 Alexander Henry built a forty-ton sloop with which he hoped to ship copper from the Ontonagon area. His venture failed and Ontonagon copper remained undisturbed until 1847 when Samuel Knapp discovered the site of prehistoric diggings. By 1850 Ontonagon was the largest village on Lake Superior and town officials hired Charles T. Harvey, the contractor for the Sault Ste. Marie locks, to build two entrance piers 650 feet and 700 feet long at the mouth of the Ontonagon River. By the eve of the Civil War the town had a brickyard, tannery, smelter, brewery, sawmill, school, newspaper, four churches and a five-story hotel. After the Civil War the price of copper dropped and the town of Ontonagon lost its economic base. Its recovery came from the virgin forests of white pine growing in the Ontonagon watershed.[57]

The same Rivers and Harbors Act of 1867 which approved the breakwater at Marquette also provided funds for two 250-foot parallel piers and a 2,220-foot

TABLE 39 COMPARATIVE GROWTH OF TONNAGE AT MARQUETTE AND PRESQUE ISLE HARBORS

Year	Marquette	Presque Isle
1900	2,776,953	1,578,603
1905	1,684,750	2,006,786
1910	2,435,791	2,117,649
1915	1,470,233	2,419,666
1920	1,138,165	3,042,433
1925	1,692,554	2,517,185
1930	2,685,565	2,707,085
1935	857,620	2,629,789
1940	877,604	5,367,973
1945	759,554	3,747,483
1950	901,236	3,850,192
1955	766,924	5,701,514
1960	925,095	4,340,418
1965	1,664,340	5,944,623
1970	1,558,809	3,879,634
1973	773,540	3,740,726

From: Office of the Chief of Engineers *Annual Reports,* for respective years.

TABLE 40 COMMERCE AT MICHIGAN LUMBER PORTS ON LAKE SUPERIOR

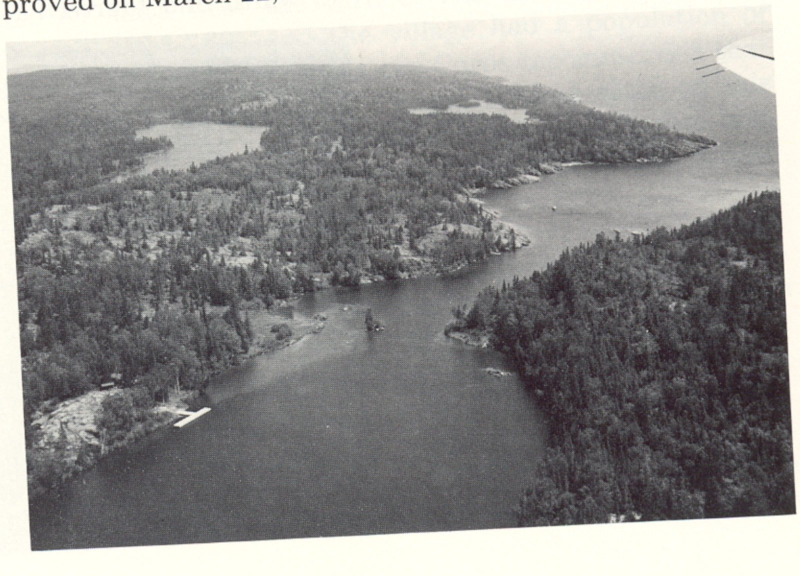
Year	Grand Marais	Ontonagon	
	Tons	Tons	Additional Traffic, Board Feet of Logs Rafted
1895	56,208	181,050	
1900	111,224	7,352	1,300,000
1905	76,810	30,506	8,025,000
1910	19,520	22,059	2,750,000
1915	710	4,697	1,000,000
1920	315	2,950	
1925	740	24,839	
1930	508	27,447	
1935	466	28,243	
1940	316	26,084	
1945	280	26,058	
1950	5,407	14,479	
1955	107	39	
1960	77	11,092	
1965	18	25,151	
1970	47	11,981	
1973	9	—	

From: Office of the Chief of Engineers *Annual Reports,* for respective years.

inner harbor to be constructed at the mouth of the Ontonagon River. This channel, originally seven feet, was deepened to a twelve-foot level. During the 1880's and 1890s, millions of feet of logs were floated down the Ontonagon River. Although some copper (119 tons in 1887) and fish were exported, the harbor served as a major outlet for Michigan timber on Lake Superior for thirty years. Timber exports ended abruptly in August, 1896, when a devastating fire destroyed much of the town and its major industry, the large Diamond Match Company.[58] It took five years for the town to rebuild, but Diamond Match was not a part of the reconstruction. A large sawmill was erected on the site of the Diamond Match property, but cut timber was shipped out by rail rather than by boat.[59] Table 40 shows the sharp decline in tonnage shipped after the fire. Of the 7,352 tons recorded for 1900, 6,700 tons were imported railroad ties. During the past fifty years the Ontonagon harbor has been maintained primarily as a refuge for small craft.

Between the commercial harbors at Marquette and Presque Isle and the Soo Locks is a rough 140 miles of rocky shoreline.[60] In 1871 the Corps surveyed this unpopulated area for a harbor site. They picked a place called Grand Marais, which translated means "great marsh." This natural haven, ninety miles west of the Soo Locks and midway between Marquette harbor and Whitefish Point, was designated by Congress in 1881 as a harbor of refuge. Subsequently, the Corps built two parallel stone-filled, timber-crib entrance piers and a pile dike closing off the natural entrance. Two years later the village of Grand Marais, Michigan, was surveyed and subdivided adjacent to the harbor. Some logging and commercial fishing utilized the harbor between 1896 and 1910, but since then it has been used primarily as a refuge for boats on the windswept shore of Lake Superior. Drifting sand has continually formed a bar at the entrance piers, necessitating periodic dredging by the Corps.[61] The Grand Marais harbor was maintained by the Duluth District until 1955 when it was transferred to the Detroit District.

On March 2, 1945, Congress approved a large number of small boat harbors. Most of these projects required that local authorities contribute to the initial cost, develop public piers, provide for a local board of directors to administer harbor activities and assume liability for any damages due to construction and maintenance. Grand Traverse Bay, Lac La Belle, Eagle Harbor and Chippewa Bay were treated as one project with the stipulation that the Corps receive assurances of local co-operation for all four harbors before construction could begin on any one. Assurances of local willingness to comply were submitted by the Michigan State Waterways Commission and approved on March 22, 1948.[62]

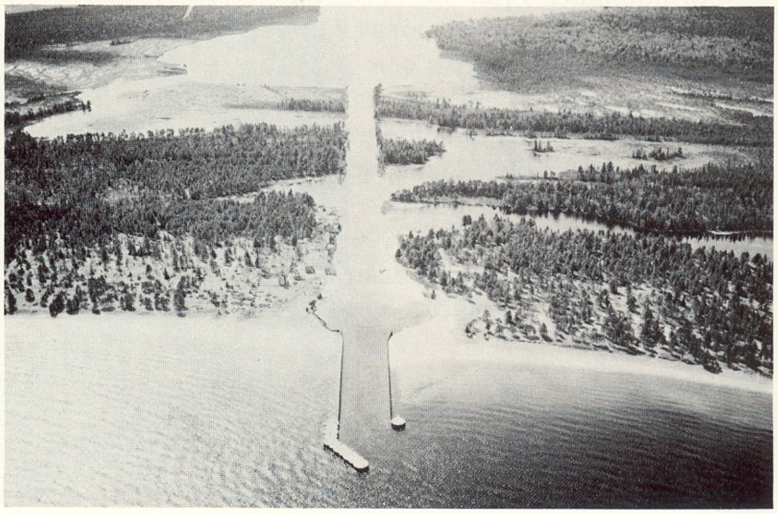


Chippewa harbor at Isle Royale is one of four small boat harbors built by the St. Paul District in the state of Michigan since World War II.

A channel seventy-eight feet wide and fourteen feet deep in Chippewa harbor on Isle Royale was dredged between 1956 and 1958. There have been no provisions for continuing maintenance. Isle Royale became part of the national park system in 1940 and the harbor is used by summer excursion boats for tourists who visit the pre-Columbian copper mines and wildlife sanctuary on the island.[63] At Grand Traverse Bay two parallel piers were built to form an entrance channel to a small boat basin measuring 200 by 400 feet. This project was completed in 1950, the piers were extended in 1962, and the harbor has needed continual dredging and breakwater repair.[64] In the past fifteen years maintenance has cost twice as much as the original project. A small commercial fishing fleet with an average annual catch of 436 tons has utilized the harbor.

Lac La Belle harbor has a unique history. It was used in the nineteenth century as a terminal for copper mining. The Mendota Ship Canal, 100 feet wide and twelve feet deep, was built between Bete Grise Bay and Lac La Belle Lake by mining interests in 1865. Contracts were let for the construction of two parallel piers in 1958. The inner canal was dredged, providing a ten-foot depth for recreational and fishing boats.[65] The breakwaters have been subject to storm damage and Corps repair.

The fourth harbor in this group was not a new Corps project. Eagle Harbor had been maintained by Corps engineers since 1867 when a plan was approved to cut a channel through the rock reef blocking the entrance to the harbor. An entrance channel 130 feet in width and fourteen feet in depth was begun by two



Laç la Belle harbor on the Keweenaw Peninsula has an interesting history. It was formerly a ship canal owned by the copper industry. In 1958 the Corps built a ten-foot channel for recreational and fishing boats and extended the breakwaters into Lake Superior.

Big Bay harbor is located about thirty-three miles northwest of Marquette, Michigan. It is one of the Corps projects that has a problem of beach erosion due to the breakwaters.

separate contractors in 1875. They both failed. Then the Corps, utilizing the experience gained from blasting rock with nitroglycerin at Hell Gate in New York harbor, employed its own equipment and men. The job was completed at a cost of $10.83 a cubic-yard, a considerable savings over the previous contracts which were let at forty dollars and fifty-eight dollars a cubic-yard.[66] Copper ore, lumber and fish were shipped from this harbor until near the turn of the century. Commerce ceased after 1895 and the village had a population of less than 100 in 1926 when the Corps recommended that the project be abandoned. Congress never acted on this recommendation and in 1959 a small boat harbor was built in the inner basin at the site of a former Coast Guard station.[67]

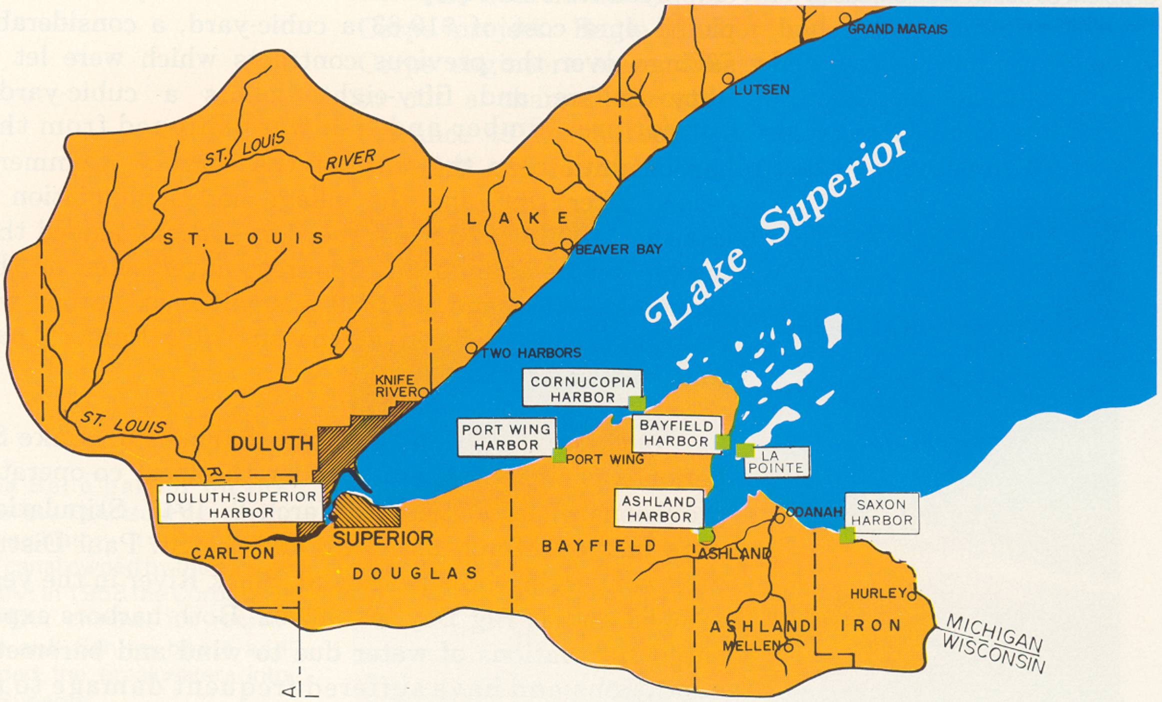
A third group of Michigan harbors on Lake Superior was linked together under the local co-operation provisions of legislation of March 2, 1945. Stipulations were met on March 22, 1948, and the St. Paul District built converging breakwaters at Black River in the years 1956-58 and at Big Bay in 1960-62. Both harbors experienced fluctuations of water due to wind and barometric conditions and have suffered frequent damage to the breakwaters from storms. Maintenance costs on Big Bay have been greater than the original project expenses of $398,500. A beach erosion problem caused by the breakwater appeared immediately after completion of the work at Big Bay. Remedial work on the east shoreline has been attempted, but the whole problem is still under study, and similar beach erosion has occurred on other Corps projects on Lake Superior at Presque Isle, Grand Marais, Whitefish Point and Grand Traverse Bay.[68] Reconnaissance reports have been ordered for all of these harbors.

Studies are under way for a small boat harbor at Little Girls Point. Similar studies for harbors at Misery River and at Au Train and Shelter bays are now inactive.

Wisconsin Ports

Seven harbors improved by the Corps on Lake Superior are along shoreline owned by the state of Wisconsin. Three were designed for commercial traffic and four were constructed with ten-foot depths for small boats and recreational craft. The commercial harbor at Superior will be discussed later in a separate section. Other than Superior, the major center of commerce was in Chequamegon Bay at the city of Ashland.

Along the Wisconsin shore line of Lake Superior the Corps of Engineers has improved seven harbors, three for commercial and four for recreational purposes.



Chequamegon Bay was an early point of settlement on the southern shore of Lake Superior. The *Jesuit Relations* record that in the mid-seventeenth century over 4,000 Indians from seven different tribes lived in this area utilizing its natural abundance of game, fish, forests and wild rice. The French built a post at Chequamegon in 1692 and made it the headquarters for their activities in the Lake Superior region. Madeline Island in the bay was a major British trading center for the North West Company in 1783 and in 1808 the island became the headquarters for John Jacob Astor's American Fur Company. The fur company withdrew from the region in 1853. Two years later government surveyors established boundary lines around Chequamegon Bay and the rush began to build the city of Ashland into a major commercial center. The panic of 1857, the Civil War and the Depression of 1873 kept the area from rapid development. But the completion of the Wisconsin Central Railroad from Milwaukee to Ashland in 1877 and the opening of The Northern Pacific and Chicago, St. Paul, Minneapolis and Omaha lines in 1885 brought a burst of growth to this secluded harbor. Capital investments and labor were attracted by the discovery of iron ore in the Gogebic range, the large white pine reserves and the presence of brownstone quarries.[69] A Corps of Engineers survey of the harbor in 1879 reported little need for commercial shipping, but a second examination in 1885 reported that the booming town with fifteen hotels, five sawmills, three railroads and a new iron ore dock warranted federal assistance.[70] In 1889 the Corps began construction of the longest breakwater on Lake Superior. The 7,363-foot timber crib pier was completed in 1894, reinforced with rubble stone between 1908 and 1910 and increased another 589 feet in 1911 and 1912.[71] The large harbor at Ashland, which covers 1,600 acres and three miles of city lake front, was dredged in 1898 to accommodate the ships with twenty-foot draft that were going through the new Poe Lock at the "Soo."[72] During this period Ashland had five ore docks, four coal piers, four pig iron terminals and five lumber wharves. By 1918 iron ore accounted for eighty-nine percent of the freight, coal for 7.6 percent and lumber for only 3.4 percent.[73]

Along with other commercial harbors on the lake, the Ashland channels were dredged to a twenty-five foot depth in 1935 and deepened to twenty-seven feet in 1960. Since the depletion of ore deposits, the commercial use of

TABLE 41 TONNAGE SHIPPED FROM WISCONSIN PORTS ON LAKE SUPERIOR

Year	Port Wing	Ashland
1890	—	2,816,924
1895	—	3,747,251
1900	—	3,295,000
1905	44,394	4,916,174
1910	25,149	5,694,174
1915	1,432	6,534,410
1920	2,310	9,836,329
1925	244	8,215,552
1930	—	6,440,944
1935	24	3,836,630
1940	1,760	7,212,432
1945	152	5,455,114
1950	207	6,107,194
1955	271	4,477,187
1960	278	1,573,845
1965	175	873,310
1970	235	412,205
1973	197	369,532

From: Office of the Chief of Engineers
Annual Reports, for respective years.

the harbor has decreased considerably. The 333,555 tons shipped in 1975 consisted primarily of coal, limestone and lignite.[74] Over two and one-half million dollars has been spent by the Corps in the past ninety years in improving the harbor facilities and repairing the frequent damage caused by storms. During the height of ore transport, Corps engineers calculated that the mining industry saved eight million dollars a year shipping by water from Ashland via the Great Lakes over the estimated cost of shipping by rail.[75]

In order to accommodate northern Wisconsin lumbering interests, the Corps surveyed the Port Wing harbor on the Flag River in 1896. Four years earlier it had been surveyed by T. N. Okerstrom, temporary improvements had been constructed by the logging companies and a narrow sixteen-foot channel already had been dredged.[76] Congress appropriated funds in 1902 for building two parallel piers, one 835 feet and the other 1,917 feet, to form a protective entrance to the harbor.[77] As Table 41 shows, the lumbering concerns kept the port busy for about fifteen years, even though the primary sawmill shut down in 1905. There was an ample supply of brownstone in the area and some of this building material was quarried for commercial use.[78] In 1948 the harbor, which is midway between Superior and Ashland, was rehabilitated for the use of small vessels drawing fifteen feet or less. Four fishing wharves provide facilities for a small amount of tonnage that still comes into the port.

In addition to the harbor at Port Wing, between 1937 and 1967 the Corps developed four small boat harbors on the 100 miles of northern Wisconsin shore. All of these harbors have channels of ten-foot depth and aid both local fishermen as well as pleasure craft. The Cornucopia harbor was improved between 1937 and 1939 although Corps reports adverse to this project had been submitted in 1921 and 1931.[79] In 1954 the Corps dredged a turning basin at Cornucopia and reconstructed two breakwaters that had been built by local fishing interests.[80]

A Works Progress Administration (WPA) project in Iron County developed a small boat harbor in 1939 at the mouth of Oronto Creek at Saxon, Wisconsin. In 1958 the Corps was directed to improve the channel to Saxon and replace the worn-out breakwaters. The stipulations for local co-operation on this project included easements for land, maintenance of the Oronto Creek diversion

This picture of the shore line at Saxon harbor shows the beach erosion that has occurred as a result of the Corps-designed breakwater.

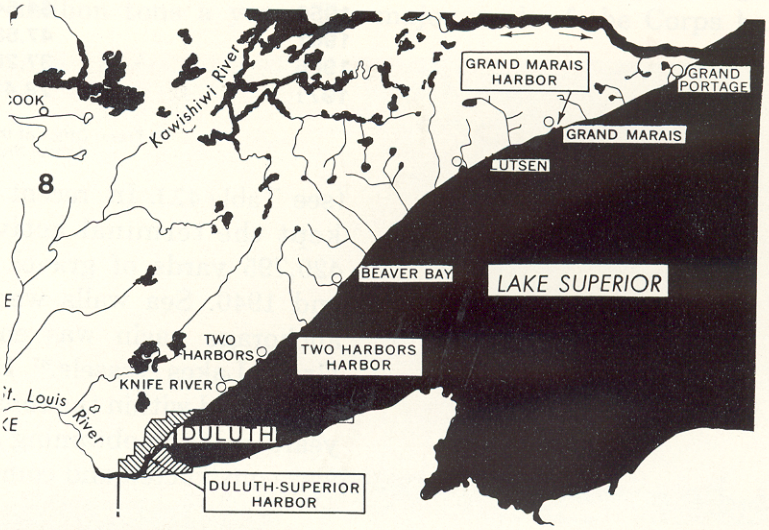
channel, a nine percent cash contribution, and a "properly constituted public body to regulate the use of harbor facilities." These requirements were complied with on October 20, 1964, and the project was completed in 1967.[81] However, the breakwaters have contributed to an erosion problem on the west shore of the harbor entrance and the Corps is currently working on a solution to the situation. A "design deficiency" also exists in a near-by boat harbor at Bayfield north of Chequamegon Bay. The St. Paul District improved the existing basin and extended the city pier 103 feet and the breakwater 139 feet; assurances of local co-operation were accepted in 1959, nine years after Congress first approved the project. The harbor has nine private wharves, a boat repair pier, a city-owned dock and three additional places to berth boats. "Excessive inner harbor turbulence" from northwest winds causes problems for small boats in the harbor during stormy weather.[82] The Corps is studying the possible extension of the breakwater to reduce the wave action.

The Corps maintains the projects at Bayfield, Saxon and Cornucopia. The small boat harbor constructed for $130,900 on Madeline Island at La Pointe did not have a maintenance provision. The breakwater there was extended in 1967 and the Corps dredged the inner basin to depths of eight and ten feet.[83] A small boat harbor has also been proposed for near-by Washburn, and a study is underway. One of the finest areas for recreational boating in Lake Superior is around the Apostle Islands in the vicinity of Chequamegon Bay. The six small boat harbors built by the Corps in the bay area are designed to help stimulate the tourist industry in this economically depressed region.

Minnesota Ports

Along the north shore of Lake Superior the Corps has developed three commercial harbors and one small boat harbor. Three other harbors for recreational craft are in the planning stage. The commercial harbors are at Grand Marais, Two Harbors (Agate Bay) and Duluth.

The harbor at Grand Marais was first developed in 1879 as a refuge for Great Lakes ships. It was the only place of refuge on the 125-mile stretch from Duluth to Port Arthur (Thunder Bay). Between 1881 and 1900 an average of 172 vessels a year sought refuge at Grand Marais. A breakwater was completed from Mayhew's Point in 1882. A twenty-six acre inner basin was dredged between 1879 and 1897, and the harbor was deepened to sixteen feet.[84] The existence of the village is directly related to the maintenance of the area as a harbor of refuge. Although Grand Marais hoped to become a port for the shipment of iron ore from the Vermilion Range, the railroad terminus became Two Harbors instead. Without railroad connections the port never became an important commercial harbor.[85] A sawmill was built in 1903 and for the next ten years lumber was shipped from the port in comparatively small amounts. Some commercial fishing added to the tonnage



Along the north shore of Lake Superior the Corps has developed three commercial harbors and one small boat facility. Three more recreational harbors are in the design stage.

The harbor of refuge at Grand Marais, Minnesota was first built by the Corps in 1881. This 1958 photograph shows the breakwater and lighthouse.

TABLE 42 COMMERCE AT MINNESOTA PORTS ON LAKE SUPERIOR (in tons)

Year	Grand Marais	Two Harbors
1886	475	326,350
1891	319	1,041,233
1896	1,360	1,905,559
1901	24,118	5,816,583
1906	30,910	9,566,874
1911	15,350	7,422,559
1916	4,552	12,349,278
1921	7,500	3,980,097
1926	94,557	7,277,017
1931	7,683	—
1936	13,297	—
1941	22,102	16,831,847
1946	29,339	15,673,235
1951	19,940	22,063,940
1956	64,545	16,037,641
1961	47,587	11,418,152
1966	37,283	3,076,562
1971	28,419	4,909,816

From: Office of the Chief of Engineers
Annual Reports, for respective years.

(see Table 42). In recent years pulpwood shipping has kept the terminal active.[86] Local interests dredged 420,795 yards of gravel from the harbor between 1922 and 1940. Sea walls were constructed in 1935 and the anchorage basin was enlarged to accommodate larger Great Lakes vessels.[87] In 1950 a small boat basin was authorized within the commercial harbor and, after several years' delay in obtaining assurances of local co-operation, was constructed and completed.

Two Harbors, before 1884 known as Agate Bay, has always been an iron ore port. The original purpose of government improvements there was to provide a harbor of refuge as well. Some coal has been imported, but ninety-nine percent of all the commerce has been iron ore, first from the Vermilion Range, then from the Mesabi, and finally from taconite processing. The federal government spent $5,015,162 for construction and maintenance of the harbor between 1886 and 1972.[88] By 1910 Corps improvements in Two Harbors were saving the mining companies eighteen million dollars annually in transportation costs, according to Corps of Engineers calculations from rates for comparable rail shipments.[89]

The original project consisted of the construction of two converging breakwaters enclosing 109 acres of harbor. The eastern pier was 1,000 feet long and the western,

900. Contracts were let in sections as funds became available. It took fifteen years to complete the project, in part because of the fifty-foot depth of the water at the harbor entrance.[90] By 1895 over 1,000 vessels were entering and leaving Two Harbors each year. Ten years later this number had doubled. In 1908 the United States Steel Corporation completed here the first concrete and steel dock built in America.[91] Ore boats continued to arrive in the town's Agate Bay harbor until 1963, when the major iron ore deposits became depleted. Then for two years the harbor was only used by pleasure boats and fishing rigs. Dredging begun in 1935 was partially discontinued and public recreational facilities were built. Beginning in 1966 taconite ore drew the large barges and ore boats into Two Harbors. Cargo traffic is now up to eight million tons a year. The major work of the Corps has

Agate Bay at Two Harbors, Minnesota, became an important iron ore port in the 1880's. This photograph was taken in 1899.

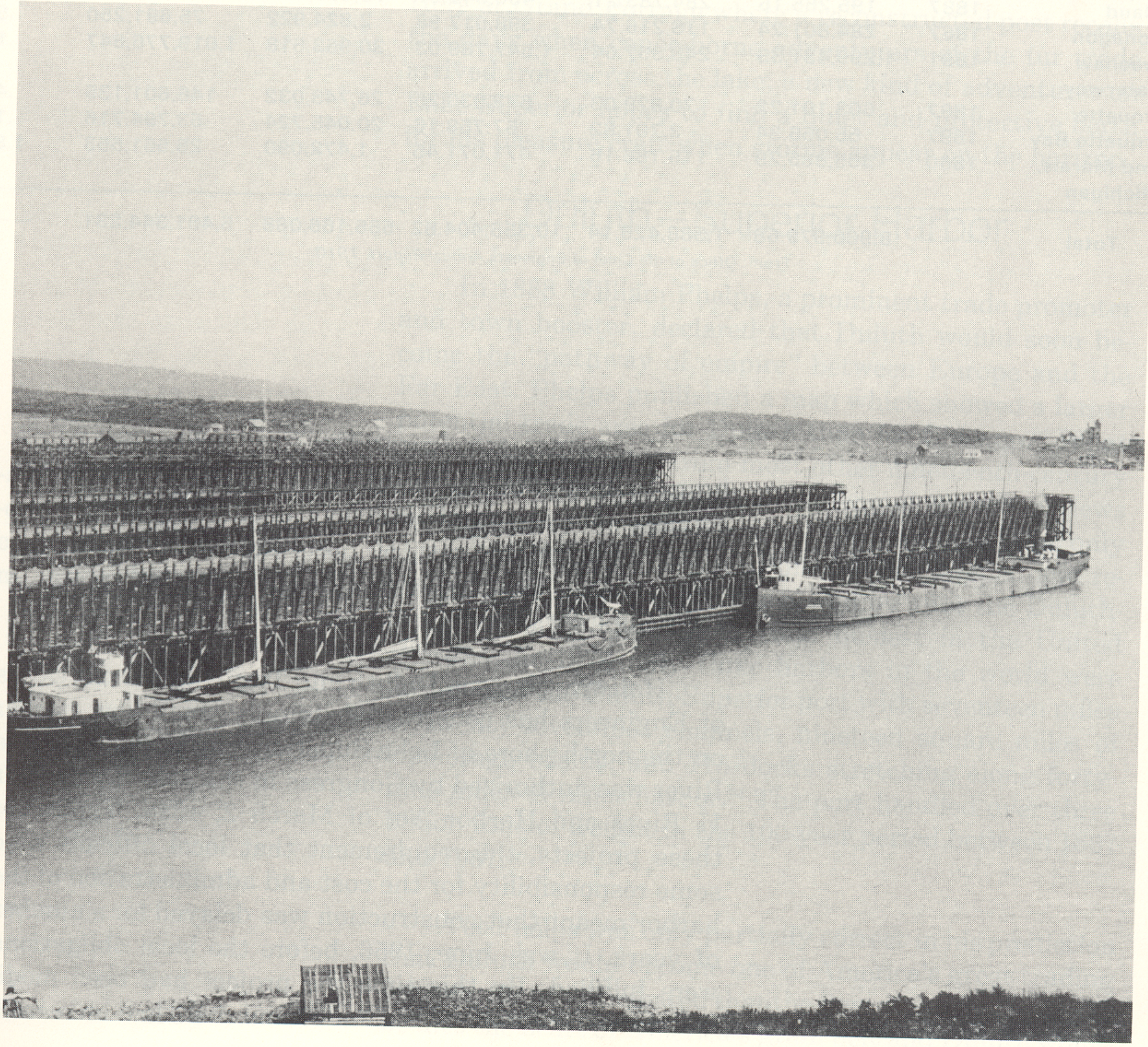


TABLE 43
HARBOR COSTS AND TONNAGE FIGURES FOR LAKE SUPERIOR PORTS IN 1910

Name of harbor	Date of commencement	Expended by the United States to June 30, 1910: For Improvement	For Maintenance	Total Expended	Total Commerce to December 31, 1909: Tons (2,000 pounds)	Estimated Value	Percentage ratio of total amount expended to estimated value
Grand Marais, Minnesota	1880	$ 160,936.68	$ 5,387.74	$ 166,324.42	395,002	$ 12,272,165	1.36
Two Harbors	1887	234,057.53	21,415.34	255,472.87	95,890,902	233,820,370	.11
Duluth-Superior	1867	5,737,142.88	516,030.00	6,253,172.88	298,508,435	3,365,288,779	.18
Port Wing	1903	41,301.95	10,517.46	51,819.41	329,039	3,945,552	1.31
Ashland	1887	195,265.16	284,783.21	480,048.37	79,003,424	544,591,864	.09
Ontonagon	1867	284,801.24	113,216.74	398,017.98	2,824,922	75,691,250	.53
Keweenaw waterway	1891	1,299,431.39	248,357.64	1,547,789.03	30,953,518	1,019,776,847	.15
Marquette	1867	603,101.22	70,829.03	673,930.25	26,743,032	146,601,135	.46
Marquette Bay	1897	55,056.34	2,701.82	57,758.16	20,045,724	53,794,716	.11
Grand Marais, Michigan	1880	355,885.29	115,186.16	471,071.45	1,472,090	25,561,553	1.84
Total	---	8,966,979.68	1,388,425.14	10,355,404.82	556,166,088	5,481,344,231	---

From: Office of the Chief of Engineers *Annual Report, 1910.*

been to maintain the breakwaters because storms continually damage what man has created. Table 43 provides data on the cost of port improvements at Two Harbors as compared to other commercial ports on Lake Superior.

Halfway between Duluth and Two Harbors the Corps of Engineers has constructed its only small boat harbor on the north shore of Lake Superior. The harbor at Knife River was authorized by Congress in the post-World War II River and Harbor Act of March 2, 1945. Typical of these projects, the requirement that local officials take some responsibility for the cost and administration of the harbor meant that construction was delayed for a number of years. It was June, 1956, before the local obligations were fulfilled. By this time the project had been modified, breakwaters had been added and costs had increased.

The Corps finished the project by June, 1958. Northeasterly winds cause turbulence in the harbor and studies are now under way to provide better protection for recreational craft in the inner harbor.

Plans for three other harbors are under study. Costs have gone up considerably since such small craft harbors were first authorized by Congress in 1945. Two breakwaters 240 and 425 feet long with a twelve-foot entrance channel and a six-foot deep, 50- by 225-foot inner channel near Lutsen, Minnesota, are expected to cost $1,660,000. A similar harbor near Beaver Bay with only one 550-foot breakwater will cost about $1,400,000 if construction is not delayed. A third small boat harbor is proposed for Grand Portage within the Grand Portage Indian Reservation; The reconnaissance study was completed in 1974. Here at Grand Portage where a reconstructed post recalls the days when canoe-borne adventurers of the fur trade arrived from across the lake, a new kind of adventurer on Lake Superior hopes to find a quiet and protective berth for his pleasure craft when storms appear on the horizon.

Duluth—Superior Harbor

In 1888 William Phelps, a prominent trade promoter and town booster, declared that Duluth would soon become the "pathway of empire" between Europe and the Far East. Phelps published a map which showed a larger potential trade area for Duluth than for Chicago.[92] What distinguished Phelps from most other nineteenth-century city promoters was the fact that many of his urban views came true. Within fifteen years of Phelps's prediction only the ports of New York and Philadelphia shipped and received more goods than Duluth, and by 1911 the Duluth-Superior harbor was the second busiest in the United States.[93] In 1976 only three harbors in the world were larger than the Duluth-Superior port with seventeen miles of twenty-seven-foot channels, nineteen square miles of anchorage basins, and 113 docks stretching along forty-nine miles of inner harbor.[94] The port handled over three billion tons of freight in the 100-year period between 1867 and 1967.

Yet Phelps was only partially correct in his prediction that Duluth would become one of America's great trading centers, for he anticipated that the flow of commerce would be into the heart of America's grain belt and Duluth would

William Phelps, in an attempt to promote Duluth as a commercial center, published this map in 1888 showing that the hinterland of "Zenith City" was larger than the potential trade area for Chicago.

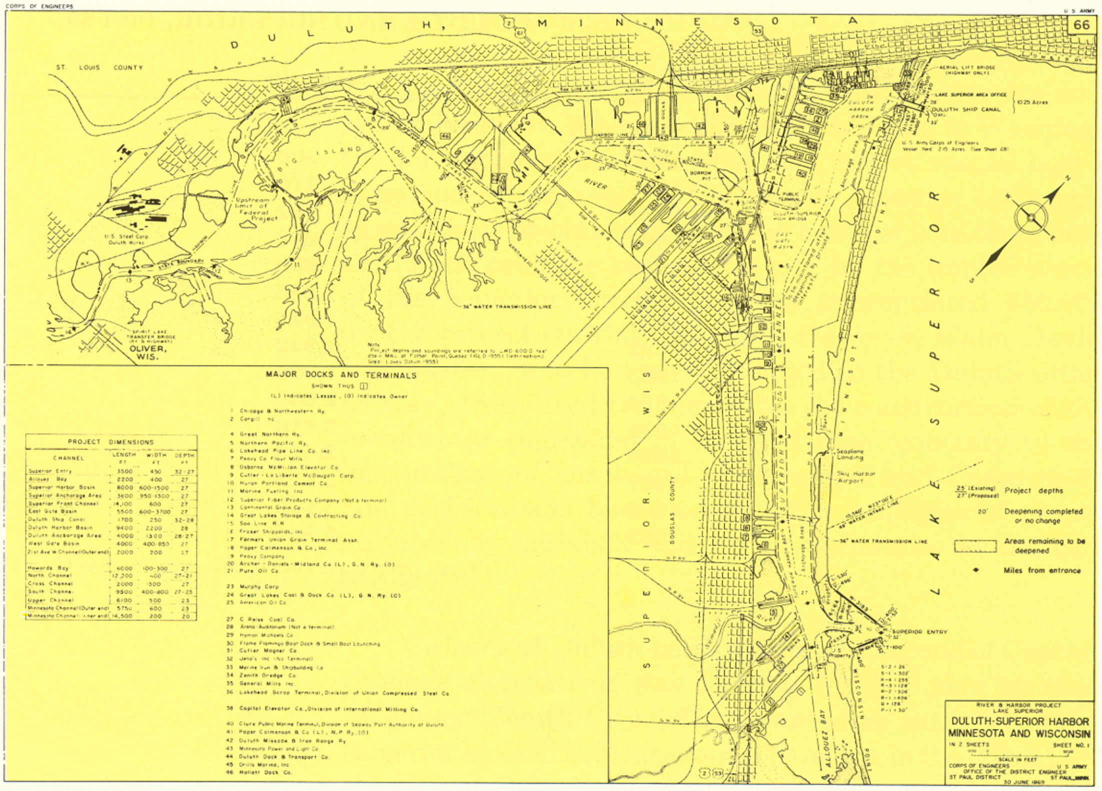
become the connecting link between the two seacoasts. Phelps pointed with pride to the good rail connections at Duluth. The Northern Pacific had 3,182 miles of track; the St. Paul, Minneapolis and Manitoba had over 3,000 miles; and the Duluth, North Shore and Atlantic tied in with the Canadian Pacific system. But instead of going west, the bulk of Duluth's traffic went east into the industrial regions of the lower Great Lakes. The artificial

This government map of the Duluth-Superior harbor was drawn in 1908. It provides a graphic view of the St. Louis River and the harbor entrances at either end of Minnesota Point.

harbor did indeed become the "crowning excellence" of Duluth's growth and development, but few products from Europe or the Orient were responsible for this success story. Instead of becoming a "gateway" of international commerce Duluth became a national "garden" of natural resources where the products of the soil were cut, dug and shipped to eastern processors. Iron ore from the rich Mesabi deposits furnished the dominant commodity, though grain, coal, scrap iron and petroleum have also kept dock hands busy filling lake freighters.

Unlike other great harbors of the world, Duluth-Superior does not have to worry about tides, but problems still remain. The original harbor was located at Superior, Wisconsin, where a natural but shallow and narrow channel scoured by the St. Louis River opened into Superior Bay. A "seiche" or wave, in oscillations up to three or four feet, caused by atmospheric conditions, flows both in and out of this channel. Captain Ernest D. Peek reported in 1914 that the seiche could reverse itself several times within an hour and cause both current and depth problems for shipping.[95] In fact, signal lights have been installed at the Superior entry to notify pilots of the direction and velocity of the flow.

This modern Corps of Engineers project map of the Duluth-Superior harbor discloses the seventeen miles of dredged channels, anchorage areas, and maneuvering basins which make this harbor the fourth largest shipping port in the world.



After the Civil War the Corps of Engineers began improving the entrance to Superior Bay by building two timber piers. The abutments provided a narrow channel which aided the scouring action of the St. Louis River. The piers were completed in 1875. Dredging of the inner harbor commenced in 1884 and in 1885 lumber mills around the new village of West Superior processed 74,500,000 board feet of lumber.[96] Yet despite the growth of the lumbering at St. Louis Bay and the harbor improvements of the Corps, trade declined at Superior and grew in importance at Duluth.[97] Duluth's growing supremacy was the result of the city's importance as a railroad terminal. By 1914 only two American cities had better railroad facilities.[98] Table X shows the prominence of Duluth over Superior in the last two decades of the nineteenth century. Duluth served a broad hinterland; Superior did not.

The first commercial activity in Duluth began when a trading port was opened by Daniel Greysolon, Sieur Du Luth, in 1679. The first lake pier was built by George Stuntz in 1852 at Minnesota Point. This narrow

TABLE 44

ARRIVALS AND DEPARTURES OF VESSELS AT DULUTH AND SUPERIOR, 1884-99

Year	Superior	Duluth
1884	194	1,791
1885	200	1,797
1886	316	2,021
1887	462	2,475
1888	812	2,200
1889	900	2,528
1890	1,256	2,534
1891	1,610	2,895
1892	1,940	3,482
1893	1,909	3,305
1894	2,000	4,514
1895	3,418	7,568
1896	3,525	7,423
1897	3,529	6,229
1898	3,962	6,908
1899	3,964	7,562

From: Office of the Chief of Engineers
Annual Report, 1900.

finger of land about six miles long separated Lake Superior from the backwaters of the St. Louis River. Floating bogs and cranberry bushes clogged the shallow waters behind Minnesota Point. A lighthouse was built by the federal government in 1858 to warn ships against approaching too close to this narrow peninsula. Captain George G. Meade of the United States Topographical Corps ordered W. H. Hearding to make a survey ot the St. Louis River channel and Minnesota Point in 1861.[99] Another survey in 1869 by Captain James W. Cuyler followed after both the Lake Superior and Mississippi Railroad and the Northern Pacific decided to locate their terminals on the west side of the St. Louis River.[100] Cuyler proposed three alternatives for harbor facilities at Duluth:

1) To make a harbor outside Minnesota Point in Lake Superior by the construction of a breakwater; cost estimate: $387,000.
2) To dredge a harbor at the northwest end of Superior Bay and obtain access to it by a canal cut through Minnesota Point; cost estimate: $270,000.
3) To make use of the Superior entry by dredging a channel behind Minnesota Point and developing an artificial harbor in the northwest end of Superior Bay; cost estimate: $210,000.

Captain Cuyler argued for the third alternative and Major Junius B. Wheeler submitted this plan to Washington for approval on November 30, 1869. A special board of engineers convened in Chicago in January, 1870, and agreed that the present and future needs of lake commerce at Duluth could be sufficiently met by the improvement of the Superior entry. Congress appropriated $60,000 for the project on March 3, 1871. However, Major David C. Houston, who had been assigned to the Duluth office in May, 1870, used the money for the construction of the breakwater suggested in the first plan, contrary to the instructions of the board of engineers and Congress.[101] His decision was based on a unique sequence of events initiated by activists and urban visionaries in the city of Duluth.

Citizens of Duluth believed that the second of Captain Cuyler's alternatives was the only feasible plan for their future as "Zenith City." They wanted an entry into Lake Superior located in Minnesota. Therefore, in the fall of 1870 the city of Duluth began to dig a canal across Minnesota

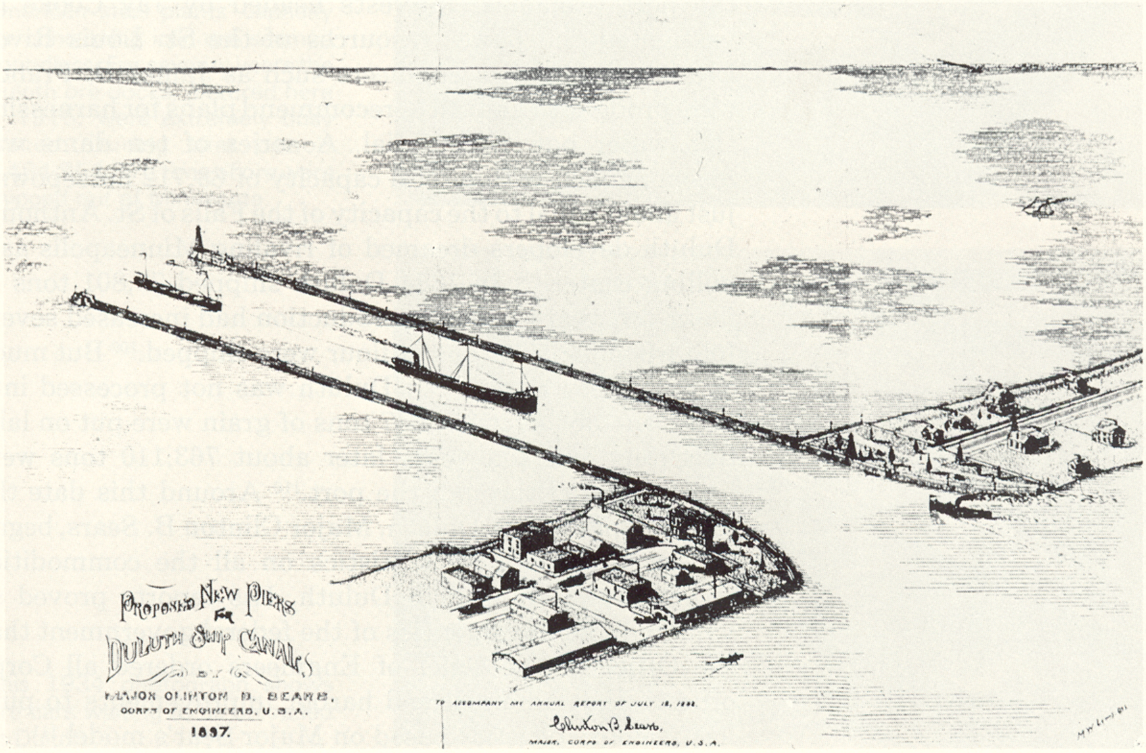
The Duluth ship canal was dug in 1870 contrary to the wishes of the state of Wisconsin and the United States War Department.

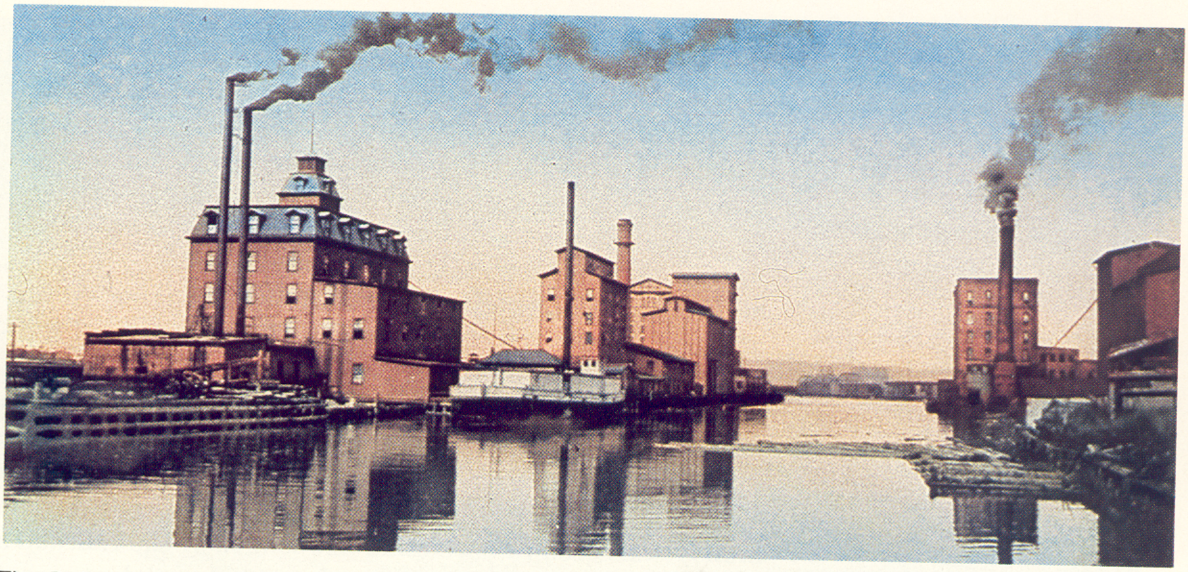
Point. Wisconsin residents became alarmed at the possible eclipse of Superior as the main port at the western end of Lake Superior. The governor of Wisconsin, the state legislature and congressional leaders asked the War Department to take immediate action. With the canal threatened, every citizen of Duluth was called out with shovels and picks to help dig on Sunday, April 30, 1871. Within three days water was flowing through Minnesota Point into Lake Superior.[102] On June 13, 1871 the War Department obtained a court injunction halting any further work. The Northern Pacific Railroad provided the city with funds to complete the 250-foot wide canal in 1872.[103]

Wisconsin officials now feared that the St. Louis River would be diverted and ruin the natural channel at the Superior entry. Lifting its injunction, the court ordered Duluth to build a dike from Minnesota Point to Rice Point, isolating the new Duluth harbor from Superior Bay and the natural flow of the St. Louis River. A makeshift dike of cribwork piers, rock and sand was completed in March, 1872. It was eventually crushed by ice and washed out. An engineering survey ordered by the governor of Wisconsin in 1872 showed no serious shoaling of the Superior harbor was caused by the Duluth project.[104] In 1905 John H. Darling made a Corps study of the Superior entry and concluded that the Wisconsin channel had been deepened by the scouring action of the St. Louis River and that the Duluth canal had not caused great physical damage to the Superior port.[105] Commercial injury was another matter.

At the same time that the Corps was building the piers at the Superior entry and Duluth was digging its unauthorized canal, the Lake Superior and Mississippi Railroad had begun to implement Captain Cuyler's first plan by building a timber breakwater along Minnesota Point in order to unload needed construction materials for western railroad lines. It was on this work that Major Houston expended $60,000 in 1871 and another $50,000 in 1872. The money was used in extending the length of the railroad's breakwater 1,200 feet. In November, 1872, a violent storm damaged this work and the whole project was abandoned. A board of engineers consisting of Colonel John N. Macomb, Lieutenant Colonel Zealous B. Tower, Major Godfrey Weitzel, Major David Houston and Major Francis U. Farquhar met in Chicago in April, 1873, and decided to take over the Duluth canal project from the city of Duluth, complete the piers into the lake and dredge the channel.[106]

The Duluth harbor soon overshadowed its rival at Superior because of the excellent railroad terminals developed on the Minnesota side. This sketch was drawn by a member of the Corps of Engineers in 1897.

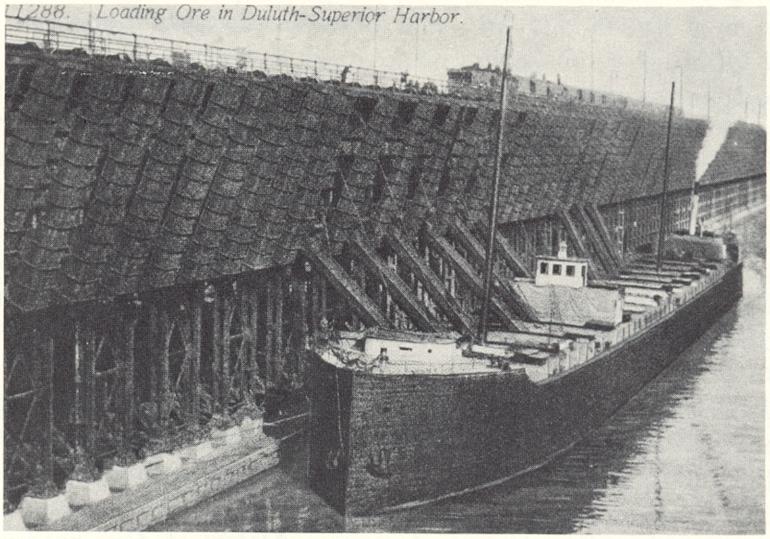




The Duluth flour mills, pictured here in 1904, became practically the only industry located on Lake Superior for processing the huge amounts of raw materials that passed through the Duluth port.

Duluth harbor development dates from this decision. Facilities were greatly expanded in the 1870s, especially by the railroads as more grain was exported from the Duluth terminal and more rails, coal and ties were imported for the construction of tracks in the Midwest and West Coast. Before long Duluth was served by eleven railroads. The first flour mill began operation at Duluth in 1886 and the first coal dock was built a year later.[107] By 1883, 322 million board feet of lumber were shipped from the port. Financial interests headed by Jay Cooke investigated the power resources of the St. Louis River. Leading hydraulics engineers such as James B. Francis were brought to Duluth to recommend plans for harnessing this water power potential. A series of ten dams was recommended with a total capacity of 63,712 horsepower, just about equal to the capacity of the Falls of St. Anthony. Duluth developers dreamed of rivaling Minneapolis as a milling center.[108] In 1884 Duluth shipped 79,801 tons of flour; ten years later the production had increased sevenfold when 546,580 tons of flour were shipped.[109] But much of the wheat received in Duluth was not processed into flour. In 1884 over 346,537 tons of grain were put on lake freighters and ten years later about 763,110 tons were being shipped through the port.[110] Around this date the district engineer at Duluth, Major Clinton B. Sears, began to assemble detailed statistics on all the commodities received and shipped in Duluth. His reports proved so valuable to many agencies of the federal government that the Office of the Chief of Engineers ordered all Corps officers that administered harbor improvements to publish similar statistics based on Major Sear's model.[111]

Though the port of Duluth had developed rapidly between 1872 and 1892, the most significant change occurred when the first iron ore dock was built in 1892. The Corps of Engineers responded to the immense implications of this event by convening a special board of engineers in 1894 to consider the future needs of the harbor. General Orlando M. Poe, Major James F. Gregory and Major Sears recommended a vast plan of improvement which included rebuilding the entries for both Duluth and Superior and dredging a huge inner harbor. This was vital, for over one-half of the shipments going through the "Soo" locks came from Duluth-Superior, and the Corps had already begun building the Poe Lock at Sault Ste. Marie, the largest canal in the world at that time. The board also advised the Corps to treat the Duluth-Superior harbor as a single entity.[112] As a result, appropriations for Corps



American steel plants' capacity for consuming iron ore seemed boundless. For seventy years the Duluth ore docks, pictured here in 1915, were extremely busy places. During that period 2,484,854,372 tons of ore were shipped out of Minnesota.

This 1934 photograph shows ore cars waiting to be unloaded at Duluth.

improvements at Superior and Duluth were combined in 1896.

The dredging operations for the improved harbor were to be the largest ever undertaken in a single project by the Corps of Engineers up to that time. Keen competition for the contracts on this job resulted in very low bids. The estimated cost was fifteen cents a cubic yard, but the bids came in for half that amount. Part of the reason for this extraordinarily low price, according to Major David D. Gaillard, was an important change in congressional appropriations policy. Projects up to this time had been sanctioned annually in a piecemeal manner. In the case of the Duluth-Superior harbor project, money was provided for the completion of the whole project. Thus contractors could provide bids based on a much more economical use of materials and labor.

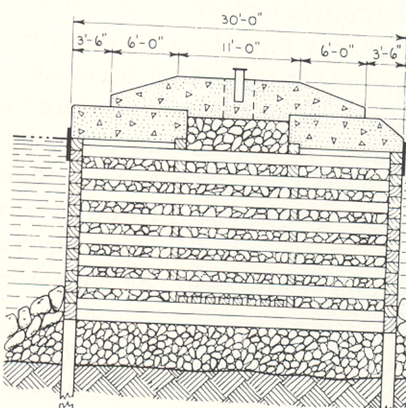
The plan called for seventeen miles of dredged channels from 120 to 600 feet wide and twenty feet deep. The turning and anchorage basins equaled about 360 acres, with an average depth of twenty-two feet. Two firms—Williams, Green, and Williams and Charles S. Barker—were awarded the contracts. With nine dipper dredges, one hydraulic dredge, thirteen tugs, and twenty-two dump scows they moved 21,697,243 cubic yards of material between June, 1897, and November, 1902. Records were set. The dipper dredge removed 7,126 cubic yards in one sixteen-hour day and the hydraulic dredge dug 18,475 cubic yards in one twenty-four-hour period.[113]

Much of the dredged material was deposited on Barker's Island, named after the captain and owner of one of the dredging companies. The depository was over a mile long and contained over one and one-half million cubic yards. It was used as a dredge dump until 1964, when the area was designated a wildlife sanctuary. A road was built to the island in 1959 and the Duluth Excursion Company built a ticket office and dock there in 1961. The Head of the Lakes Maritime Society purchased the old whaleback vessel "Meteor" and made the island the site of a maritime museum. In the early 1970s Seaway Engineering Company made a study of the island for the city of Superior and recommended further development of a 300-slip marina. Grants from the Soil Conservation Service and the Economic Development Administration were obtained to develop the island as a tourist and wildlife center.[114] Then the Department of Natural Resources halted the project because a nest of an endangered species of piping plovers had been sighted in a sandy depression. If there are people within 100 feet, the plover will not incubate its eggs. Even though the last sighting of plovers on Barker's Island occurred in 1972, four years later the project still had not been approved.[115]

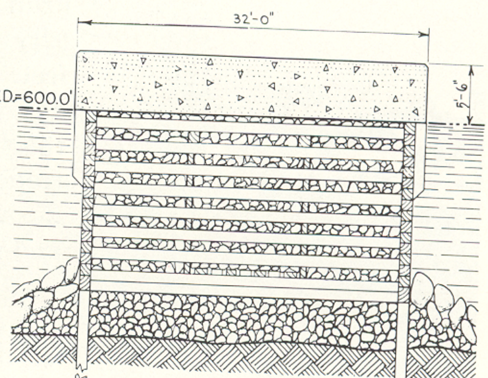
The Duluth entry was rebuilt between 1898 and 1901. Two parallel piers 1,734 feet long were constructed with a concrete superstructure on rock-filled timber crib substructures supported by wooden piles. This 300-foot entry was developed at a cost of $650,000 and stands today although it was built without reinforced concrete—a tribute to the skillful work and careful design of the workmen and engineers. During severe storms, waves overtop the parapet walls by several feet and the heavy concrete superstructure has been observed to move laterally by one-tenth of an inch. Though the iron lampposts have been broken off 20.25 feet above the low water level by waves and blocks of ice hurled by the waves, the piers have withstood an average of thirty-five storms (gales of forty miles per hour) every year for over seventy-five years.[116]

The breakwaters for the commercial harbors on Lake Superior all have similar design. The substructures rest on bearing piles and were built using timber cribs filled with rock. The superstructures are of concrete and form raised promenades. There is no technical distinction between the words "pier" and "breakwater" in reference to these Corps structures on Lake Superior.

In 1902 the Corps of Engineers began replacing the piers at the Superior entry. The new piers were designed by Lieutenant Colonel Clinton B. Sears, John H. Darling and Clarence Coleman. The construction was supervised by Major David Gaillard, who later worked on the design and construction of the Panama Canal. He chose to build the piers entirely of concrete because of the high cost of white pine, although this lumber, when continually submerged in fresh water, is "practically imperishable." But the cost of Portland cement had greatly decreased while the cost of



PIERHEAD
50' beginning 50' from outer End.
Superstructure built 1930
SECTION-M

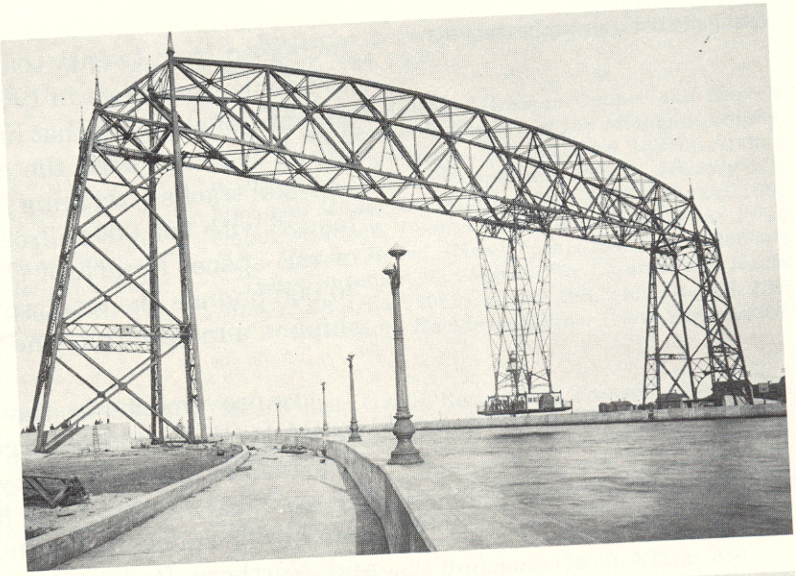


LIGHTHOUSE FOUNDATION
Outer 50'
Superstructure built 1920
SECTION-N

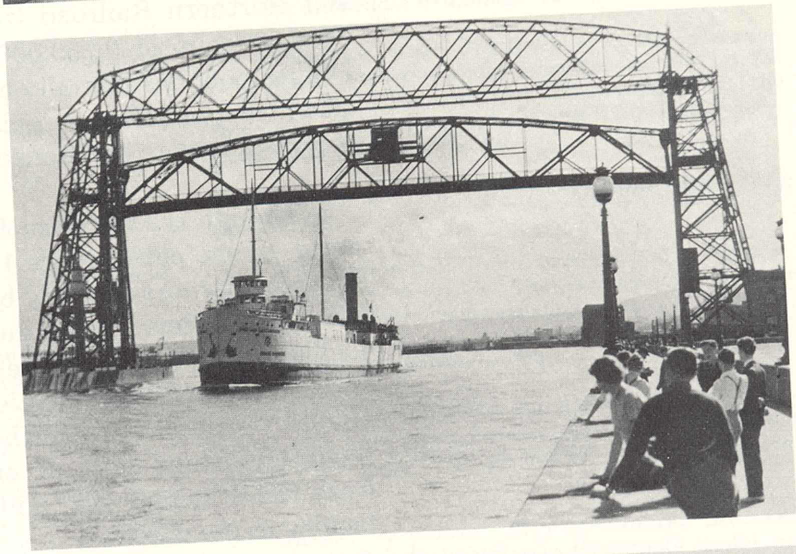
white pine had doubled between 1893 and 1903.[117] The Superior piers were placed 500 feet apart and were 2,096 and 1,584 feet long. They were protected by two converging breakwaters a mile in length that form an arrowhead into Lake Superior. This project was completed in 1914.

Over one million dollars of the appropriation was saved on the construction in the Duluth-Superior harbor. Some of this money was used in 1905 to provide tourist facilities at Canal Park and to construct a boatyard for the Corps of Engineers floating plant.[118] While the new piers were under construction the city of Duluth began building one of the famous landmarks of the Duluth harbor, the Aerial Lift Bridge. This bridge, designed by Claude A. P. Turner and modeled after a similar structure in Rouen, France, is the only one of its kind in the United States. In fifty-five seconds the 386-foot structure can be lifted 138 feet. It makes about twenty-five trips up and down in a day.[119] The city of Duluth had obtained permission from the Corps in 1893 to dig a tunnel under the Duluth entrance, but decided instead to build a bridge of Turner's design.[120] In 1978 eleven bridges provide for rail, truck and automobile traffic over the harbor channels.

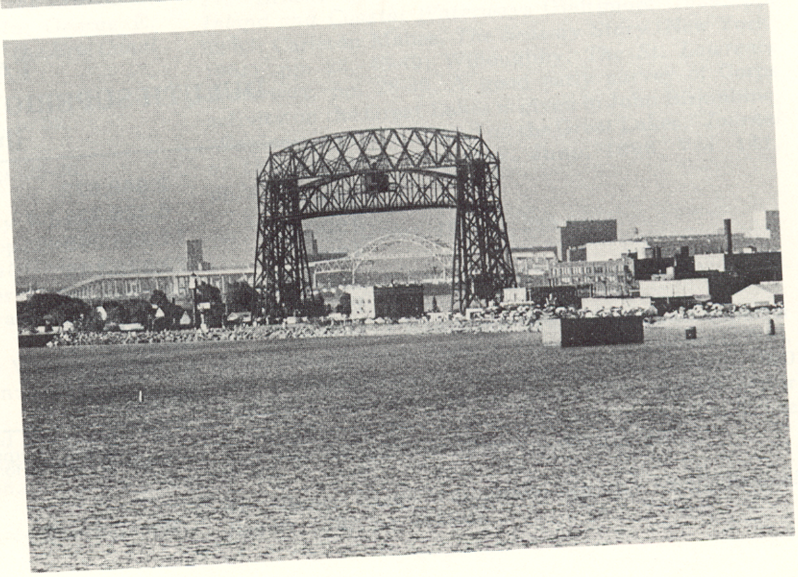
Since the turn of the century, additional enlargements of the harbor have been authorized in 1908, 1916, 1927, 1935, 1952 and 1960.[121] The depth of the channels was



The first conveyance for people going from Duluth to Minnesota Point was this cable car, shown ferrying passengers in 1910.



The "people ferry" was changed into an aerial lift bridge which became a Duluth landmark. This photograph was taken in 1940.



By 1963 the new interstate highway bridge formed a backdrop for the historic aerial lift bridge and was one of eleven bridges which now span the harbor between Duluth, Minnesota, and Superior, Wisconsin.

increased from twenty to twenty-five feet in the 1930s and to twenty-seven feet in 1960s. It is difficult to visualize the amount of shipping that has gone through these channels. Major Gaillard used the example in 1903 of two parallel railroad tracks stretching from New York to San Francisco loaded with 900,000 railroad cars squeezed into every foot of rail space. If each of the 900,000 railroad cars carried 40,000 pounds the total would equal the amount of freight shipped annually from the Duluth-Superior harbor.

Improvements in the technology of cargo transfer were crucial. By 1905 a cargo of 5,217 tons of iron ore could be loaded in less than thirty minutes. Docks extending as far as 2,850 feet into the harbor were equipped with as many as 384 pockets. The huge pier of the Duluth, Mesabi and Northern Railroad was built in the early 1890s for $436,000 out of 9,250,000 board feet of lumber.[122] The Duluth port has not only been important in shipping, but also in shipbuilding, especially during World War II when 355 vessels were christened there.

Though the Corps of Engineers has treated the twin ports as one entity since 1896, they are still operated as separate harbors of entry by the states of Minnesota and Wisconsin. Thus there is much duplication of services and facilities. Since the commerce of the harbor is no longer growing, many have questioned how long this duplication should continue.[123] Nevertheless, the harbor remains the most important port of entry on the world's largest fresh-water inland sea, and the fourth largest shipping facility in the world.

TABLE 45
DULUTH-SUPERIOR HARBOR COMMERCE
(in tons)

1890	2,848,672	1935	51,334,641
1895	6,325,351	1940	54,137,695
1900	11,725,245	1945	65,410,743
1905	22,676,145	1950	63,149,107
1910	36,684,578	1955	68,311,332
1915	40,494,672	1960	42,677,800
1920	46,808,613	1965	46,177,391
1925	51,334,641	1970	42,758,965
1930	45,726,085	1973	48,158,190

From: Corps of Engineers
Annual Reports, for the respective years

Notes

1. A dated but still useful historical work on Lake Superior is Grace Lee Nute, *Lake Superior* (New York: 1944); for geological background see Charles R. Van Hise and Charles K. Leith. *The Geology of the Lake Superior Region* (Washington: 1911).

2. Harold A. Innis, *The Fur Trade in Canada* (New Haven: 1962), p. 387.

3. The area was opened by Daniel Greysolon, Sieur du Luth; see Theodore C. Blegen, *Minnesota: A History of the State* (Minneapolis: 1963), pp. 45-51.

4. Innis, *The Fur Trade In Canada,* p. 113.

5. Innis, *The Fur Trade In Canada,* p. 99. One livre was equal to a pound of silver at that time.

6. Innis, *The Fur Trade In Canada,* p. 393.

7. Innis, *The Fur Trade In Canada,* p. 385.

8. Captain E. J. Ditzel, "Duluth-Superior Harbor," [W. P. A. Writers Project, Duluth, 1936], mimeographed copy in University of Minnesota-Duluth holdings of the St. Louis Historial Society.

9. Franklin J. Ryder, "The Saga of an Inland Sea: A Story of Lake Superior and the Corps of Engineers' Operations on the Lake," August 1, 1968, pp. 23-40, SPD, Ryder Collection, St. Paul. William R. Willoughby, *The St. Lawrence Waterway* (Madison: 1961), pp. 16-27.

10. George Rogers Taylor, *The Transportation Revolution 1815-1860* (New York: 1951), pp. 161-63; Ronald E. Shaw, *Erie Water West: A History of the Erie Canal 1792-1854* (Lexington: 1966), pp. 260-78; George E. London, *Stars in the Water: The Story of the Erie Canal* (New York: 1974), pp. 220-22.

11. Taylor, *Transportation Revolution,* p. 52.

12. Ryder, "Saga of an Inland Sea," pp. 25-26.

13. Great Lakes-St. Lawrence Seaway Winter Navigation Board, *Annual Report, 1972,* pp. 89-100; Eric Schenker, *Analysis of International Great Lakes Shipping and Hinterland* (Center for Great Lakes Studies, "Special Report," no. 23 [Milwaukee]).

14. Great Lakes-St. Lawrence Seaway Winter Navigation Seminar, *Proceedings* (Washington: 1972).

15. David W. Oberlin, "An Extended Season on the St. Lawrence Seaway...Outlook and Potential," Winter Navigation Seminar, *Proceedings,* p. 35.

16. Corps of Engineers *Water Resource Development in Michigan*) Chicago: 1973), p. 3.

17. Statistics from *Annual Reports* of *1880, 1887, 1899, 1910, 1920, 1930.*

18. William B. Gates, *Michigan Copper and Boston Dollars: An Economic History of the Michigan Copper Mining Industry* (Cambridge: 1951), pp. 188-92; Arthur W. Thurber, *Calumet Copper and People: History of a Michigan Mining Community, 1864-1970* (1974), p. 106; Angus Murdock, *Boom Copper: The Story of the First U.S. Mining Board* (New York: 1943), pp. 230-40; C. Harry Benedict, *Red Metal: The Calumet and Hecla Story* (Ann Arbor: 1952), pp. 80, 196, 200, 204, 208, 210; Ira B. Joralemon, *Romantic Copper* (New York: 1935), p. 65.

19. William Gerald Rector, *Log Transportation in the Lake States Lumber Industry 1840-1918* (Glendale: 1953), p. 169.

20. Agnes M. Larson, *History of the White Pine Industry,* pp. 247-64.

21. *Encyclopeadia Britannica* (1956), XII, p. 650.

22. Fremont P. Wirth, *The Discovery and Exploration of the Minnesota Iron Lands* (Cedar Rapids: 1937), p. 23; N. H. Winchell, "The Discovery and Development of the Iron Ores of Minnesota," Minnesota Historical Society, *Collections,* VIII, pp. 25, 40.

23. Paul De Kruif, *Seven Iron Men* (New York: 1929), pp. 199-216.

24. Wirth, *Minnesota Iron Lands,* pp. 25-27; Frank F. Grout, and J. F. Wolff, Sr., *The Geology of the Cuyuna District, Minnesota* (Minneapolis: 1955), p. 1.

25. Blegen, *Minnesota,* p. 374.

26. Nute, *Lake Superior,* pp. 128-44; Walter Havighurst, *The Long Ships Passing: The Story of the Great Lakes* (New York: 1942), pp. 260-62; Blegen, *Minnesota,* p. 370.

27. Ernest S. Clowes, *Shipways to the Sea: Our Inland and Coastal Waterways* (Baltimore: 1929), pp. 62-63; Carleton Mabee, *The Seaway Story* (New York: 1961), pp. 23, 45-49; Willoughby, *The St. Lawrence Waterway,* pp. 28-39. A good early survey of Corps activity on the Great Lakes is given in John Birkinbine, "Engineering as Exhibited on the Great Lakes," *Journal of the Franklin Institute,* June, 1896, Vol. 141, pp. 428-44.

28. *Annual Report, 1887,* p. 253.

29. Havighurst, *The Long Ships Passing,* pp. 162-72.

30. "History of Keweenaw Waterway Lake Superior Michigan," Duluth District, Corps of Engineers (1940), one of a series of harbor histories prepared between 1939 and 1941 and on file in the present-day Lake Superior Area office of the St. Paul District, in Duluth. These histories are cited hereafter by title and date.

31. Ryder, "Saga of an Inland Sea," pp. 52-55; *Annual Report, 1892,* pp. 2158-65.

32. *Annual Report, 1893,* pp. 341-42.

33. *Annual Report, 1890,* p. 247, Appendix HH-12.

34. *Annual Report, 1891,* p. 316, Appendix KK-14.

35. *Annual Report, 1895,* p. 350.

36. *Annual Report, 1921,* p. 1011.

37. *Annual Report, 1910,* p. 2086.

38. *Annual Report, 1910,* p. 750.

39. *Annual Report, 1916,* p. 1288; "History of Keweenaw Waterway, Lake Superior, Michigan," 1940.

40. 49 Congress, 2 session, *House Executive Documents,* no. 105; 60 Congress, 1 session, *House Executive Documents,* no. 325; 73 Congress, 1 session, *House Executive Documents,* no. 55.

41. Corps of Engineers, *Water Resources Development in Michigan* (Chicago: 1975), p. 27.

42. Corps of Engineers, *Water Resources Development in Michigan* (Chicago: 1973), pp. 31-33.

43. 49 Congress, 2 session, *House Executive Documents,* no. 105.

44. Ryder, "Saga of an Inland Sea," pp. 54-55; Corps of Engineers, *Water Resources Development in Michigan* (Chicago: 1975), p. 25.

45. "History of Marquette Harbor, Michigan," 1939.

46. *Annual Report, 1891,* p. 315.

47. "History of Marquette Harbor," pp. 12-14.

48. 61 Congress, 2 session, *House Executive Documents,* no. 573; 72 Congress, 1 session, Rivers and Harbors Committee, *Documents,* no. 20; *Annual Report, 1940,* p. 1566.

49. *Annual Report, 1901,* pp. 512-13.

50. Corps of Engineers, *Water Resources Development in Michigan* (Chicago: 1975), p. 24.

51. *Annual Report, 1896,* p. 307, Appendix HH-10; 54 Congress, 1 session, *House Documents,* no. 318.

52. *Annual Report, 1906,* p. 577; *1908,* p. 602; *1913,* p. 1079.

53. *Annual Report, 1910,* pp. 753-54; "History of Presque Isle Harbor, Michigan," 1939.

54. 54 Congress, 1 session, *House Documents,* no. 318; 72 Congress, 2 session, *House Documents,* no. 473.

55. Corps of Engineers, *Water Resources Development in Michigan* (Chicago: 1975), p. 27.

56. It was estimated that Ontonagon County had four billion feet of standing white pine and red pine; see Nute, *Lake Superior,* pp. 195-96; Rector, *Log Transportation,* p. 49.

57. "History of Ontonagon Harbor, Michigan," 1939.

58. *Annual Report, 1897,* p. 389.

59. *Annual Report, 1904,* p. 511; for the Corps decision not to develop any further the commercial harbor of Ontonagon, see 58 Congress, 2 session, *House Documents,* no. 235.

60. See "Lake Superior, Chart No. 9," United States Department of Commerce (September 14, 1973).

61. "History of Grand Marais Harbor, Michigan," 1939.

62. *Annual Report, 1955,* pp. 1020-21.

63. *Annual Report, 1958,* p. 1102; 78 Congress, 2 session, *House Documents,* no. 446; for a background sketch of Isle Royale, see Nute, *Lake Superior,* pp. 320-27; Bob Oetting, "Isle Royale, National Park," *Conservation Volunteer,* XXV (1961), November-December.

64. *Annual Report, 1962,* pp. 1259-60.

65. *Annual Report, 1958,* pp. 1109-10.

66. *Annual Report, 1867,* p. 20, Appendix A-2; *1871,* p. 31; *1876,* pp. 112-13, Appendix Z-2; see also "Removal of Hell Gate Rocks," *Scientific American,* September 30, 1876.

67. "History of Eagle Harbor, Michigan," 1939.

68. *Annual Report, 1972,* pp. 27-33.

69. "History of Ashland Harbor, Wisconsin," 1940.

70. *Annual Report, 1889,* p. 155; *1880,* p. 1929; *1885,* p. 2010; *1886,* p. 1676; *1887,* p. 1961.

71. *Annual Report, 1889,* pp. 270-71, Appendix HH-5; 48 Congress, 2 session, *House Executive Documents,* no. 89.

72. *Annual Report, 1898,* pp. 380-81.

73. *Annual Report, 1918,* pp. 1373-74.

74. Corps of Engineers, *Water Resources Development in Wisconsin,* (St. Paul: 1977), p. 111.

75. *Annual Report, 1906,* p. 570.

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