Metropolitan Water Reclamation District of Greater Chicago

RESEARCH AND DEVELOPMENT DEPARTMENT

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DESCRIPTION OF THE CHICAGO WATERWAY SYSTEM FOR THE USE ATTAINABILITY ANALYSIS

March 2008

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO
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FOR THE USE ATTAINABILITY ANALYSIS

Research and Development Department
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CHICAGO WATERWAY SYSTEM

The Chicago Waterway System (CWS) consists of 78 miles of canals, which serve the Chicago area for two principal purposes, the drainage of urban storm water runoff and treated municipal wastewater effluent, and the support of commercial navigation. While the CWS was not constructed with recreational or aquatic life uses in mind, other purposes have evolved over time including recreational boating, fishing, streamside recreation and, where possible, aquatic habitat for wildlife. Approximately 75 percent of the length are man-made canals where no waterway existed previously and the remainder are natural streams that have been deepened, straightened and/or widened to such an extent that reversion to the natural state is not possible. The flow of water in the CWS is artificially controlled by hydraulic structures (see Figure 1).

Due to the artificial nature of the CWS, its ability to support aquatic life and recreational uses are inherently limited. The absence of gradual sloping banks, shallow littoral zone habitat, and bends result in a limited habitat for aquatic biota. Homogenous silt sediments that severely restrict macroinvertebrate and fish populations are deposited throughout much of the CWS due to the unnatural stream flow dynamics. Some recreational activities can be hazardous in the CWS, due to the extent of commercial traffic, as well as the lack of safe exit points from the water.

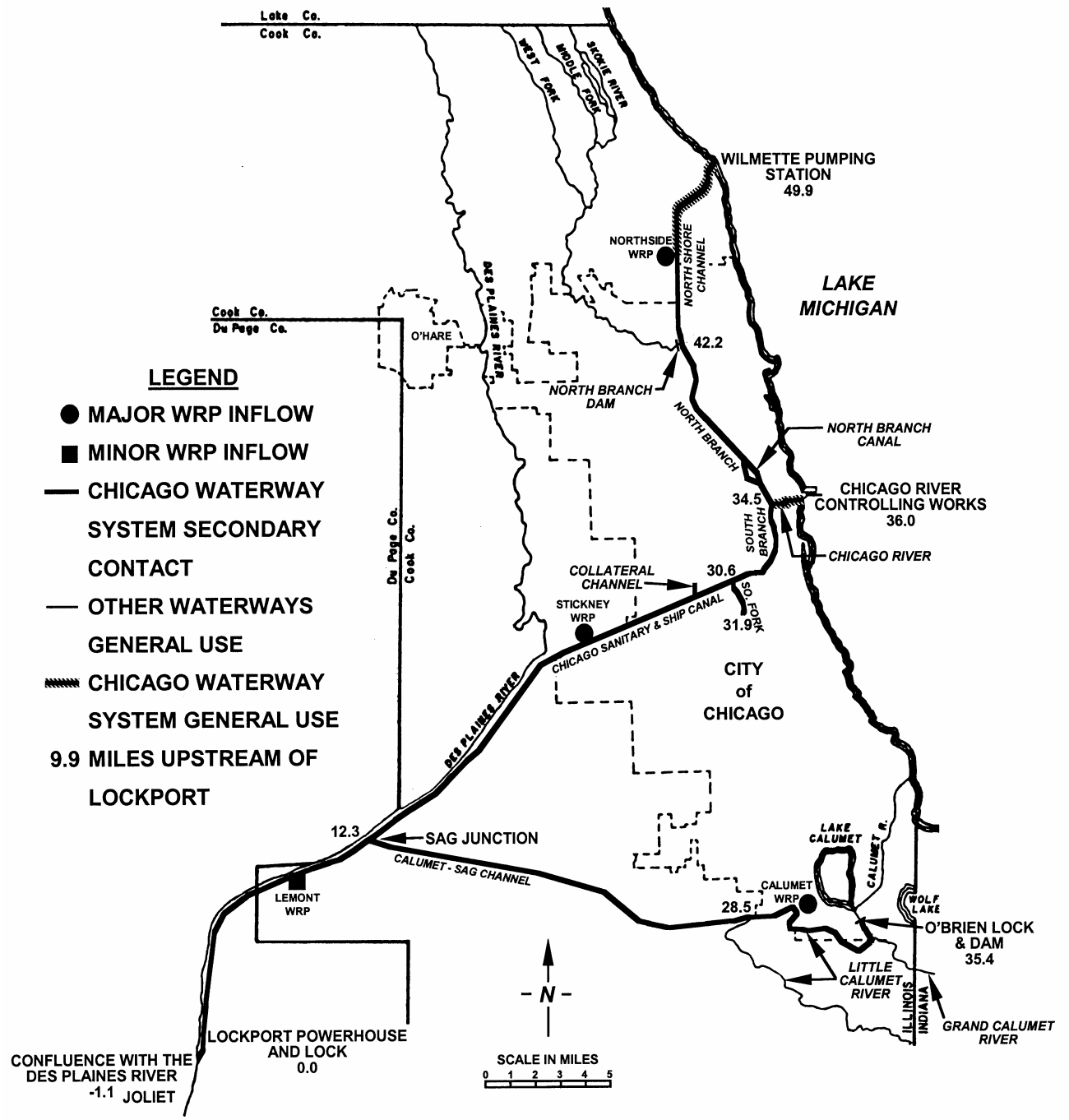
System Description

The Lockport Controlling Works (LCW) is one of two outlet control structures for the CWS. All flow from the CWS's 740 square mile watershed discharges from the Chicago Sanitary and Ship Canal (CSSC) to the Des Plaines River north of the city of Joliet. The confluence is 1.1 miles downstream of the Lockport Powerhouse and Lock (LP&L). This reach is the upper end of the Brandon Road navigation pool. The LP&L is the single outlet control for the CWS. It should be noted that on Figure 1, distances on the CWS are measured from the LP&L. The CWS has two river systems, the Calumet River System and the Chicago River System.

The Calumet River System is 23.1 miles in length and includes the Calumet-Sag Channel (CSC) and the Little Calumet River (LCR) (also called the LCR North). The Chicago River System consists of 55.1 miles of waterways and includes the Chicago River, CSSC, North Branch, North Branch Canal (NBC), North Shore Channel (NSC), South Branch, and South Fork. The South Fork is commonly known as Bubbly Creek. Each river system will be described separately.

Chicago River System. The CSSC extends upstream from the confluence with the Des Plaines River for a distance of 31.1 miles to South Damen Avenue in the city of Chicago (Chicago). The waterway then becomes the South Branch, extending upstream for 4.5 miles to the junction of the Chicago River and the North Branch. The South Fork flows into the South Branch and extends upstream for 1.3 miles, ending at 38th Street in Chicago. The Chicago River extends upstream from the junction of the North and South Branches for 1.5 miles and ends at

FIGURE 1: CHICAGO WATERWAY SYSTEM



the Chicago River Controlling Works (CRCW). The North Branch extends upstream from the junction of the Chicago River and South Branch for 7.7 miles to the North Branch Dam, located south of Foster Street in Chicago. The NBC is an alternate route around Goose Island between Chicago and North Avenues and is 1.0 mile long. At the North Branch Dam, the waterway becomes the NSC, extending upstream for 7.7 miles, ending at the Wilmette Pumping Station (WPS).

Calumet River System. The CSC extends upstream from its junction with the CSSC (Sag Junction) for 16.2 miles to the LCR. At this point, the waterway becomes the LCR and extends upstream 6.9 miles, ending at the O'Brien Lock and Dam (OL&D). It should be noted that the Calumet River extends upstream of the OL&D to Lake Michigan. However, since the Calumet River is directly connected to Lake Michigan, it is not considered part of the CWS. The water level and flow in the Calumet River can not be controlled the way that the CWS is controlled.

Tributaries to the Chicago Waterway System. There are several streams that contribute flow to the CWS. These include the Grand Calumet River, LCR above its confluence with the CWS (also called LCR South), the North Branch above the North Branch Dam and numerous small watersheds along the CSC and CSSC. In addition, there are numerous small stormwater drainage inputs along the CWS, including areas served by storm sewers, parking lots, street ends, rooftop drains, etc.

Control and Management of Flow

Flow in the CWS is managed by the Metropolitan Water Reclamation District of Greater Chicago (District), but is subject to regulation under U. S. Supreme Court Decree and 33 CFR Parts 207.420 and 207.425. The CFR provides for the maintenance of navigable depths to support commercial navigation. The Chicago River at the CRCW and the LCR at the OL&D must be maintained between -0.5 feet, Chicago City Datum (CCD) and -2.0 feet, CCD water levels per Code of Federal Regulations during normal conditions. The water level at the Sag Junction must be maintained between -4.0 feet, CCD and -1.8 feet, CCD. The lower limits allow the federal navigation project depths to be maintained throughout the CWS above the LP&L, while the upper limit prevents unintentional reversal into Lake Michigan. The ideal water elevation at CRCW and the OL&D is -2.00 feet, CCD. This water elevation provides the greatest level of flood protection by maintaining the highest allowable capacity available for the transportation of stormwater runoff without requiring permission from the United States Army Corps of Engineers (USACE) to further lower the water elevation. The upper limit of -1.80 feet, CCD and -2.00 feet, CCD at the Sag Junction and the LCW, respectively, are set to prevent washout of the soil banks of the canal at the LP&L.

The U. S. Supreme Court Decree governs the quantity of water from Lake Michigan that is diverted out of the Great Lakes Basin into the Mississippi River Basin by the State of Illinois (Illinois). Within Illinois, this quantity is subject to regulation by the Illinois Department of Natural Resources, Division of Water Resources (DWR). The DWR issues allocation orders for

annual average quantities of diversion. Most of the diversion is allocated to municipalities for domestic consumption. The District has an order that allows it to divert water for improvement of water quality and this is referred to as discretionary diversion. Currently and through 2014, the District allocation is for an annual average of 270 cubic feet per second (cfs). In 2015, it is scheduled to be reduced to an annual average of 101 cfs.

An additional annual average of 35 cfs is allocated to the District for navigation makeup. This is necessary to restore the CWS to the required water level for navigation following a system draw down for wet weather operations.

There are two other diversion categories which do not have a specific allocation, but for which the DWR maintains a reserve quantity. An approximate annual average of 100 cfs is the reserve needed for operation of the locks at CRCW and OL&D for passage of navigation traffic.

Another approximate annual average of 50 cfs is reserved for leakage through the walls and structures separating the lake and river. The actual amount of each of these reserves varies with the level of Lake Michigan.

Accounting for the amount of water diverted from Lake Michigan is the responsibility of the DWR and the USACE, Chicago District. The measurement of quantities of diversion and the method of accounting are specified in the U. S. Supreme Court Decree and in a 1996 Memo of Understanding between the U. S. Department of Justice and the several states bordering the Great Lakes.

Inflow and Outflow

All outflow exits the CWS at the LP&L and the LCW. However, there are several sources of inflow to the CWS. These include WRP effluent, discretionary diversion, navigation and leakage, tributaries, storm runoff, and combined sewer overflows (CSO).

Outflow. The average annual flow leaving the CWS in Water Year (WY) 2005 was 2,725 cfs as measured by the U. S. Geological Survey (USGS) at Romeoville Road. Maximum and minimum daily discharge during WY 2005 was 13,973 and 1,287 cfs, respectively. Since 1986, the maximum and minimum WY annual average discharges have been 4,113 and 2,342 cfs, respectively. The maximum instantaneous discharge was 19,500 cfs on February 21, 1997. There are periods of zero and negative discharge due to operations at the LP&L and the hydraulic peculiarities of the CWS.

Water Reclamation Plant Effluent. Over 70 percent of the annual flow in the system is from the discharge of treated municipal wastewater effluent from the Calumet, Lemont, North Side, and Stickney Water Reclamation Plants (WRPs) owned and operated by the District. During the winter months, virtually 100 percent of the flow is from these WRPs; during the summer

months, about 50 percent of the flow is from the WRPs. The WRPs are also shown on Figure 1. During 2006, these WRPs had the following flow characteristics:

WRP	Average Annual Flow (MGD*)	Design Average Flow (MGD*)	Design Maximum Flow (MGD*)
Calumet	283	354	430
Lemont	2.31	2.3	4.0
North Side	244	333	450
Stickney	729	1,200	1,440

*MGD=million gallons per day (1 MGD = 1.547 cfs).

Discretionary Diversion. Discretionary diversion is introduced into the system from Lake Michigan to maintain adequate water quality. This occurs at three locations, WPS, CRCW, and OL&D, shown on Figure 1.

Discretionary diversion is seasonal and is scheduled such that most flow is during warm weather months of June through October. Some flow is scheduled throughout the year for the NSC due to more sensitive water quality conditions. Discretionary diversion flows for calendar year 2006 were as follows:

Inflow Facility	Average Annual (cfs)	Monthly	
		Minimum (cfs)	Maximum (cfs)
WPS	40.4	0	129
CRCW	127.5	0	428
OL&D	83.5	0	303

Navigation and Leakage. This flow consists of discharge to support navigation in the operation of locks and leakage through structures and walls separating the lake and river. There is no navigation traffic at the WPS. It should be noted that navigation flows are seasonal. In addition, the quantity is dependent on the lake level, since flow at CRCW and OL&D is by gravity only. Leakage, formerly a significant quantity at CRCW, has been reduced through repair of gates and construction of new walls. The average annual, monthly maximum, and monthly minimum flows at each of these facilities for calendar year 2006 were as follows:

Facility	Navigation			Lockage			Leakage		
	Average Annual (cfs)	Monthly Max (cfs)	Monthly Min (cfs)	Average Annual (cfs)	Monthly Max (cfs)	Monthly Min (cfs)	Average Annual (cfs)	Monthly Max (cfs)	Monthly Min (cfs)
WPS	0	0	0	0	0	0	1.3	2.2	0.0
CRCW	27.4	101	0	13.8	32	1.0	14	19	10.0
OL&D	8.7	52	0	19.1	43	4.0	8.9	10	7.0

The average annual discharge for WY 2006 measured by the USGS downstream from CRCW is 155 cfs. Due to a lack of funding, the gauges at the other two intake facilities, OL&D and WPS are no longer active.

Tributaries. The major tributaries to the CWS are the LCR, which has a watershed area of over 210 square miles, and the North Branch Chicago River, with a watershed area of 113 square miles. Other tributaries discharging into the CSC include Crooked Creek, East Stony Creek, Illinois and Michigan Canal, Midlothian Creek, Mill Creek, Navajo Creek, Saganashkee Slough, Tinley Creek, and West Stony Creek. Tributaries discharging into the CSSC include the Illinois and Michigan Canal diversion ditches and Summit-Lyons Conduit. Please refer to the CWS Listing of Facilities, Inflows, and Monitoring Locations (CWS List) located at the end of this report.

Storm Runoff. Numerous storm sewers discharge to the CWS from several municipalities and Illinois Department of Transportation drainage facilities. A complete inventory of these facilities is not available.

Combined Sewer Overflow. The combined sewer area within the District serves a collection area of approximately 375 square miles, which includes most of the city of Chicago. There are 255 CSOs that discharge to the CWS from about 40 municipalities and the District. Discharge event reports and more CSO information are available at www.mwrd.org.

Major Pumping Stations. The CSO outfalls include five major pumping stations (PS) which serve a collection area of about 54.8 square miles. These stations include the Racine Avenue PS, which discharges into the South Fork of the South Branch of the Chicago River (also known as Bubbly Creek); the 95th Street PS, which discharges into the Calumet River; the 122nd Street PS, which discharges into the Calumet River; the 125th Street PS, which discharges into the Little Calumet River, and the North Branch PS which discharges into the North Branch of the Chicago River. The pumping capacities of these major pumping stations to the CWS during storm events are detailed below:

Pumping Station	Pumping Capacity to the CWS During Storm Events (cfs)
North Branch PS	1,500
Racine Avenue PS	3,125
95th Street PS	855
122nd Street PS	375
125th Street PS	1,140

PHYSICAL DESCRIPTION OF THE WATERWAYS

Chicago River System

North Shore Channel. (Photograph 1) This man-made channel is 7.7 miles in length and is straight throughout except for four bends in alignment near Devon and Central Avenues and Emerson and Linden Streets. It has steep earthen side slopes and a width of 90 feet. The depth varies from 5 to 10 feet. The NSC was completed in 1910 in order to divert water from Lake Michigan to dilute and flush wastewater downstream through the North Branch Chicago River. It also served as a conveyance for wastewater from communities north of Chicago.

Land use along the NSC is generally urban commercial and residential. In-stream aquatic habitat is often present along the partly shaded banks, in the form of aquatic plants, tree roots, and brush debris jams. Presently, there are often stagnant flow conditions in the NSC above the North Side WRP discharge. In the northernmost reaches of the NSC, near Central Avenue, a variety of sediment types are present and the depth of fines is generally one foot or less. Just upstream of the North Side WRP, at Oakton Avenue, silt makes up the majority of sediment composition, with deeper depth of fines than the upstream reaches (2-4 feet). In the reach directly downstream of the North Side WRP, near Touhy Avenue, a majority of the sediment is comprised of sand. Depth of fines range from under a foot up to 5 feet. Near Foster Avenue, approaching the confluence with the North Branch Chicago River, sediment is mixed and depth of fines is less than a foot.

Photograph 1: Aerial view of the North Shore Channel with Howard Street Bridge in the foreground.

North Branch Chicago River. (Photograph 2) From the junction of the Chicago River and the South Branch upstream to Belmont Avenue, a distance of 5.1 miles, the river follows its original course and has several bends. The North Branch is a natural portion of the CWS that was historically straightened, widened, and dredged to accommodate increased volume of diluted wastewater from the man-made NSC. The width varies from 150 to 300 feet and the depth varies from 10 to 15 feet. In several reaches, vertical dock walls have been constructed and are in various states of disrepair. From Belmont Avenue to the North Branch Dam, 2.6 miles, the channel has been either straightened or relocated into fairly straight segments with steep earthen side slopes. The width is generally 90 feet and the depth is approximately 10 feet in the center part of the channel.

Today, the northern deep-draft portion of the North Branch Chicago River by Wilson Avenue has mostly urban residential land use and contains in-stream habitat with logs, boulders, and an under-cut bank. In these upstream reaches, sediment is comprised mostly of cobble and sand, with fine sediments usually less than a foot deep. Further downstream, near Diversey Avenue, land use changes to mostly commercial/industrial, and there is decreased canopy cover. Sediment consists mostly of silt with scoured concrete in some areas, and depth of fines ranges from approximately 1-3 feet. There is limited in-stream habitat near the banks, including debris jams, boulders and tree roots. As the North Branch approaches downtown Chicago, physical habitat is further degraded. Near Grand Avenue, land use is primarily industrial/commercial, with periodic vertical sheet pile walls and concrete "banks." There is a lack of in-stream habitat and little canopy cover. Sediment is comprised primarily of silt with depth of fines ranging from 1 to greater than 5 feet.

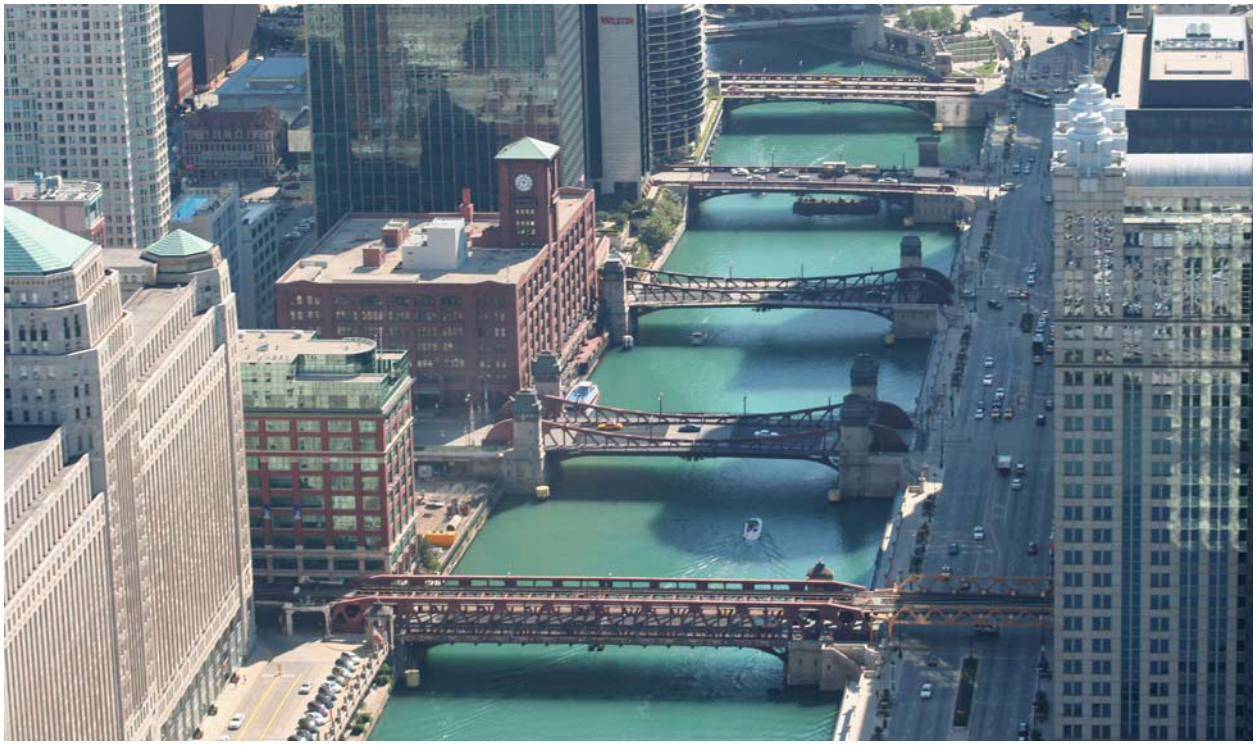
Photograph 2: North Branch Chicago River, west from Halsted Street Bridge.

North Branch Canal. (Photograph 3) This canal was man-made in the 1870s. It forms the east side of Goose Island, has a straight alignment and is one mile in length. The width varies from 80 to 120 feet and the depth from 4 to 8 feet.

Photograph 3: North Branch Canal, northwest from Halsted Street Bridge.

Chicago River. (Photograph 4) The Chicago River, 1.5 miles in length, is 200 feet wide west of Michigan Avenue and wider, up to 400 feet wide, east thereof. It has vertical side walls throughout its length. It is 20 feet deep at the west end and 26 feet deep at the east end. The river alignment is generally straight with three bends near Michigan Avenue and State and Orleans Streets. The Chicago River historically flowed into Lake Michigan, but was reversed by the construction of the CSSC, and the mouth of the river was altered where it met Lake Michigan. Its entire length was also dredged, widened, and straightened so that shipping vessels could travel through it in the 1800s and to facilitate urban development of the downtown area.

Currently, the Chicago River contains extreme physical limitations to recreation and aquatic habitat, as it flows right through downtown Chicago and contains steep vertical sheet piling walls. There are no shallow areas and there is very little to no canopy cover. Fine grained silt sediments predominate. Because of the temperature and salinity differential between the warmer, more saline water from the NBCR and the colder, less saline water of Lake Michigan, density currents are sometimes established in the Chicago River. These density currents can result in simultaneous bi-directional flow in the Chicago River. In addition, the gradient of the bed is very small, making it difficult to push the water out of the Chicago River.



Photograph 4: The Chicago River, looking east. Wells Street Bridge in foreground.

South Branch Chicago River. (Photograph 5) This 4.5 mile long segment generally follows its original course and has several bends, though it was somewhat straightened and channelized between 1928–1929 for the convenience of navigation. A short reach between Roosevelt Road and 18th Street was relocated in 1928 to eliminate a major bend. The South Branch has vertical dock walls throughout most of its length. The width varies from 200 to 250 feet and the depth from 15 to 20 feet.

Today, there is very little in-stream habitat or canopy cover along the South Branch and urban industrial and commercial land uses predominate. Near Madison Street in downtown Chicago, the sediment is almost entirely made up of silt, with about one foot depth of fines. Downstream at Loomis Street, the side channels are mostly scoured bedrock with silt and sludge deposits in the center. Depth of fines range from 3-5 feet in these center sediments.

Photograph 5: Northeastern aerial view of the South Branch Chicago River. Loomis Street Bridge in the foreground.

South Fork South Branch Chicago River. (Photograph 6) This segment is 1.3 miles in length, varies from 100 to 200 feet in width, and from 3 to 13 feet in depth. Steep earthen or rip-rap banks predominate along the South Fork, with vertical sheet piling walls along several reaches. The South Fork is infamous for receiving offal waste from the Union Stock Yards beginning in the late 1800s. Gases generated by decaying waste from the slaughterhouse and rendering operations would bubble up to the surface, prompting the South Fork South Branch Chicago River to be nicknamed Bubbly Creek. The Stickney WRP was completed in 1942, so the waterways no longer functioned as open sewers. However, decomposition of organic matter in the sediment still results in bubbling gases escaping to the surface of Bubbly Creek. Stagnant flow conditions are common in Bubbly Creek unless there is discharge from the Racine Avenue Pumping Station (RAPS). Hazardous flow conditions can be present during and following significant rain events due to RAPS.

Urban industrial and commercial land uses are most common, although residential areas have been recently established along the northern reach of Bubbly Creek. Logs and brush debris jams are present as in-stream cover along much of the creek. The sediment is characterized mostly by sludge and silt deposits, with depth of fines down to 5 feet.

Photograph 6: South Fork South Branch Chicago River, aka. Bubbly Creek, north from 35th Street Bridge.

Chicago Sanitary and Ship Canal. (Photograph 7) This 31.1 mile long man-made channel has many different shapes and sizes. Its alignment is straight throughout its length, except for four bends, near Harlem Avenue, La Grange and Romeoville Roads, and in Lockport. Downstream of the LP&L, a reach of 1.1 miles, the depth is 10 feet and the width is 200 feet. Upstream of the LP&L, the depth varies from 20 to 27 feet. The reach immediately upstream of the LP&L, 2.4 miles in length, varies in width from 160 to 300 feet. The east bank of this reach is a vertical concrete wall. The west bank varies from vertical dock wall to a steep rockfill embankment. The next 14.6 miles of the CSSC have vertical concrete or rock walls 160 feet apart. The last 13.0 miles have a trapezoidal shape, 220 feet wide, with steep earth or rock side slopes. There are several areas with vertical dock walls in this last reach.

Excavation of the CSSC from the South Branch Chicago River to Lockport was completed in 1900. Its construction facilitated the reversal of the Chicago River such that Chicago's wastewater no longer flowed into Lake Michigan. Industrial and commercial land use dominates the riparian zone along most of the CSSC. There is little to no canopy cover and in-stream habitat for aquatic life is limited to snags and debris accumulated near bridge abutments. Silt and sludge comprises a majority of the sediment at Damen Avenue, with depth of fines ranging from <1-9 feet. At Cicero Avenue, deposited sediments are comprised of mostly silt and sludge, with <1-4 feet depth of fines. Sediment was slightly more variable at Harlem Avenue, where silt predominated, but there was also sand, gravel, cobble, and boulders near the bridge. The bedrock was exposed due to scouring near Route 83 and Stephen Street, with some scattered silt deposits. Areas of scouring, as well as pockets of deep silty sediments also occur near Lockport, although habitat improves slightly near the sunken barges on the west bank. Aquatic vegetation and snags are present in this shallow area with deep sand and silt deposits.

Photograph 7: Aerial view of the Chicago Sanitary and Ship Canal, upstream of Calumet-Sag junction, near McCook Reservoir (under construction).

Calumet River System

Little Calumet River. (Photograph 8) The LCR, 6.9 miles in length, has been deepened and widened from its original natural condition. There are several changes in alignment, with one full 180-degree bend west of Indiana Avenue. Its width varies from 250 to 350 feet and its depth is generally 12 feet in the center part of the channel. It has few vertical dock walls and most of the banks are earthen side slopes.

In-stream habitat for aquatic life is generally available along the LCR in the form of boulders, logs, brush debris jams, overhanging terrestrial vegetation, and aquatic vegetation in some reaches. Riparian land use along the LCR upstream of the Calumet WRP outfall, near Indiana Avenue, is generally urban industrial and commercial. The sediments in this reach are mostly characterized by sludge and silt deposits, but there are also gravel substrates in the center of the river. Depth of fines range from <1 to 7 feet. Downstream of the WRP, at Halsted Street, land use varies from urban commercial to forest and wetland. Sediments are relatively heterogeneous, although the substrate is sometimes scoured in the center, with exposed bedrock. Thus, depth of fines range from 0 to approximately 3 feet in these areas.

Photograph 8: Little Calumet River, looking east from underneath Halsted Street Bridge.

Calumet-Sag Channel. (Photograph 9) A man-made channel, completed in 1922 to reverse the flow of the Calumet River, the CSC is 16.2 miles long with a generally trapezoidal shape, 225 feet wide and approximately 10 feet deep. In some sections, the north bank is a vertical wall. The alignment is generally straight with three bends near Western, Crawford, and Ridgeland Avenues, and thus there is no riffle, run, or pool development. The channel was excavated through limestone and bedrock, so current conditions constitute mostly silt and sludge deposited on a hard consolidated substrate. Near its eastern terminus, sediments from Ashland Avenue are mostly silt with depth of fines from 1-2 feet. Logjams and boulders are found on the bank, and there is no aquatic vegetation other than attached green algae. In its mid-section, sediment at Cicero Avenue is mostly comprised of sludge and silt, with depths of fines ranging from 3-9 feet. There is an open canopy with logs and boulders on the side bank.

Upstream of Southwest Highway, land use is generally urban industrial, however, near its western terminus, shortly upstream of the confluence with the CSSC, land is leased to and managed by the Forest Preserve District of Cook County. Substrate at Route 83 is mostly comprised of silt and sludge, with a depth of fines of 1-7 feet. In this reach, some parts of the south bank have boulders and small rock ledge, while the north bank is vertical limestone wall.

Photograph 9: The Calumet-Sag Channel, east from 104th Street Bridge.

Use Classification

General Use Waters. This use classification has been designated by the Illinois Pollution Control Board (IPCB) for the 1.6 mile length of the Chicago River and the 4.0 mile reach of the NSC from the North Side WRP outfall to the WPS. The General Use standards are found at 35 Illinois Administrative Code (IAC) Section 202.200 and are established to protect aquatic life, wildlife, body-contact recreation (swimming), water supply, and Secondary Contact uses.

Secondary Contact Waters. All other portions of the CWS have been designated by the IPCB for this use classification. The Secondary Contact standards are found at 35 IAC Section 302.400 and are established to protect indigenous species, non-contact recreation (boating), and commercial navigation.

Facility Descriptions

Chicago River Controlling Works. The CRCW controls the flow of water between the lake and Chicago River. This facility was built by the District in 1938 and was maintained and operated by them until 1984. In this year, the maintenance and operation responsibilities were transferred to the USACE. It consists of walls separating the river and the lake, a navigation lock, two sets of sluice gates, and a pumping station. The lock is 80 feet wide by 600 feet long, with a normal lift of 2.0 feet in size. The two sets of underwater sluice gates consist of four gates each, each gate being 10- by 10-feet in size. The sluice gates allow gravity flow from Lake Michigan to the Chicago River when the lake level is higher than the Chicago River. The pumping station has three pumps of 30 cfs each. The pumps can only discharge from the river to the lake and were installed in 2000 for the purpose of returning excess leakage and lockage water to the lake. The pumps have yet to be used for this purpose.

Lockport Controlling Works. The LCW is owned and operated by the District. It is an auxiliary facility used during storm operations to discharge flood waters to the Des Plaines River. It is located two miles upstream of the LP&L and is used when discharge above the capacity of the LP&L is needed. It has seven sluice gates, each being 30 feet wide and 20 feet high. The gate sill is at elevation -15.0 feet, CCD.

Lockport Powerhouse and Lock. The powerhouse is owned and operated by the District. It was built in 1907 and is currently licensed for two hydroelectric generating units with a total capacity of 13,500 kilowatts, nine submerged sluice gates for the discharge of storm water and one surface sluice gate for flushing debris. The lock is owned and operated by the USACE and was built in 1933. It is 110 feet wide and 600 feet long with a normal lift of 37 feet.

Newly licensed generating units have a combined capacity of 5,000 cfs. Each submerged sluice gate is capable of a maximum discharge of 2,500 cfs. A fill or empty event for the lock during normal water levels causes a discharge of 2,000 cfs over a 20-minute period. During storm operations, the discharge capacity through the facility is increased to facilitate the drainage of stormwater. This lowers the upstream water level and increases water velocities in the channel.

O'Brien Lock and Dam. This facility was built in 1960 and is owned and operated by the USACE. The lock is 110 feet wide and 1,000 feet long with a normal lift of 2.0 feet. Flow regulation from Lake Michigan to the Calumet River is accomplished with four submerged sluice gates, each 10- by 10-feet in size. The gate opening for flow regulation is under the direction of the District and the actual operation is performed by the USACE.

Wilmette Pumping Station. The WPS is located beneath, and is integral with, the Sheridan Road Bridge and controls the flow of water between Lake Michigan and the NSC. It was built in 1910 and is owned and operated by the District. Lake water is brought into the channel for augmenting low flows for water quality maintenance. The station has four horizontal screw pumps rated at 250 cfs at a lift of 3.0 feet. The pump propellers are 9.0 feet in diameter and located in tunnels that run under the floor of the station from the Wilmette Harbor to the channel. Pumping is necessary when lake levels are low.

Adjacent to the south side of the pumping station is a concrete channel and sluice gate to allow for the passage of water by gravity when pumping is not necessary (when the lake level is higher than the level in the NSC). The channel is 30 feet wide and 11 feet deep. During storm operations, when the channel surcharges and the water level nears 5.0 feet, CCD, the sluice gate can be opened to relieve the channel to the lake.

Five temporary pumps with an aggregate capacity of 50 cfs were installed in 2000 due to non-operation of the large original pumps. In 2002, one of the original pumps was rehabilitated for use since the five temporary pumps have insufficient capacity for water quality maintenance.

Instream and Sidestream Elevated Pool Aeration Stations. Instream aeration stations are located on the North Shore Channel at Devon Avenue and on the North Branch Chicago River at Webster Avenue. The Devon and Webster Avenue stations have been in service since 1979 and 1980, respectively. These facilities are operated as needed by the District to maintain dissolved oxygen in the northern Chicago River System.

The sidestream elevated pool aeration (SEPA) stations are owned and operated by the District. There are three SEPA stations on the CSC, and one each on the Little Calumet and Calumet Rivers. Water from the channel is lifted 12- to 15-feet and allowed to drop over a series of weirs to create a waterfall and add oxygen to the waterway. SEPA stations have been operating since 1994 to help overcome dissolved oxygen sags in the Calumet River System. These stations are not operated in the winter months.

Operation Plan

Dry Weather Conditions. Dry weather conditions are typically characterized by flat water levels, below average flows from the WRPs, normal intake from the lake, and a flow of approximately 1,800 cfs through the LP&L. Normal dry weather discharge is released from the CWS through hydroelectric generating units and the navigation lock at the LP&L. The water level in the Chicago River at the CRCW and in the LCR at the OL&D is ideally maintained at -2.0 feet, CCD. Discretionary diversion is brought into the CWS at the CRCW, OL&D, and WPS per the planned schedule.

Wet Weather Conditions. When weather forecasts indicate that rainfall is likely to occur, the CWS is readied for wet weather operations. Discretionary diversion, if in progress, is curtailed and discharge at the LP&L is increased. This lowers the water level in the lower reaches of the CWS to provide storage for incoming storm flow and increases the hydraulic gradient to move more water through and out of the CWS. If no or very light rainfall occurs, the operations are returned to the dry weather mode. Light rainfall, less than 0.33 inches, normally causes little disruption in operations.

If rainfall is moderate, 0.33 to 0.67 inches, most CSOs are initially captured by the Tunnel and Reservoir Plan (TARP) and only reach the CWS through increased discharge from the WRPs. However, direct inflow of other storm runoff does occur under these conditions. Additional discharge at the LP&L is achieved by increasing the discharge through the LP&L's two generating units to their maximum capacity. Discharge necessary beyond the maximum discharge of the generating units (5,000 cfs) is put thorough sluice pit gates at the LP&L and, if necessary, the LCW. Water levels in the upper part of the CWS will rise due to storm inflow and increased WRP discharge. After the peak water level is reached, the water levels begin to subside. Discharge at the LP&L is gradually reduced by closing gates as the CWS returns to dry weather conditions. When -2.0 feet, CCD, is reached at the CRCW and/or OL&D, discretionary diversion is resumed, if appropriate.

If rainfall is heavy, 0.67 to 1.5 inches, TARP will fill and excess CSOs will be discharged to the CWS from pumping stations and CSO outfalls. Other storm runoff from tributary watersheds and storm sewers is significant and imposes an additional hydraulic load on the CWS. The operation of the CWS will be similar to the above description, with the exception that increased discharges at the LP&L are initiated more rapidly.

Excessive rainfall, 1.5 inches or greater, especially if preceded by antecedent rainfall, will likely cause extreme water levels in the upper part of the CWS. If water levels reach 3.5 feet, CCD, at the CRCW and the OL&D and are rising, it will be necessary to relieve the CWS by discharging excess flood water to Lake Michigan at those points. If the water level at WPS reaches 4.5 to 5.0 feet, CCD, it is necessary to relieve the CWS at the WPS. The decision to provide for such relief at each facility is made based on the potential for continued area rainfall and on the water level conditions at each facility.

Measurement of Discharge and Water Level

United States Geological Survey. The USGS maintains discharge measurement stations at several locations in the CWS and its tributaries. These are summarized in the following table. Water level is also available at these locations.

River	Location	Number
Chicago River	Columbus Drive	05536123
Chicago Sanitary & Ship Canal	Romeoville Road	05536995
Grand Calumet River (T)	Hohman Avenue	05536357 (Indiana)
Little Calumet River	O'Brien Lock & Dam	05536357
Little Calumet River (T)	Cottage Grove Avenue	05536290
Midlothian Creek (T)	Kilbourn Avenue	05536340
North Branch (T)	Albany Avenue	05536105
North Shore Channel	Maple Street	05536101
Tinley Creek (T)	135th Street	05536500

All locations in Illinois, except as indicated. Tributary streams are designated (T).

Metropolitan Water Reclamation District of Greater Chicago. The District maintains a network of rain gauges in the watershed and nine water level measurement stations on the CWS. See the CWS List for water level measurement locations.

Monitoring of Water Quality

Illinois Environmental Protection Agency. IEPA operates an Ambient Water Quality Monitoring (AWQM) Program throughout Illinois with over 200 monitoring locations. Two of these are located on the CWS, on the CSC at Route 83 and the CSSC at Lockport.

Metropolitan Water Reclamation District of Greater Chicago. The District also operates an AWQM Program and has 20 locations on the CWS. In addition, District performs monitoring for biological conditions, physical habitat, and sediment quality at all these locations. At some locations, the monitoring is performed annually and at other, once in four years. In addition, there are 30 locations in the CWS where dissolved oxygen and temperature are measured hourly with continuous in-situ monitors. See the CWS List.

United States Environmental Protection Agency. USEPA performs no regular monitoring, but has conducted surveys of sediment quality for some reaches of the CWS.

United States Army Corps of Engineers. USACE performs no regular monitoring, but has conducted surveys of sediment quality for some reaches of the CWS.

ACRYONYM LIST

AWQM	Ambient Water Quality Monitoring
CCD	Chicago City Datum
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CRCW	Chicago River Controlling Works
CSC	Calumet-Sag Channel
CSO	Combined sewer overflow
CSSC	Chicago Sanitary and Ship Canal
CWS	Chicago Waterway System
District	Metropolitan Water Reclamation District of Greater Chicago
DWR	Illinois Department of Natural Resources, Division of Water Resources
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
LCR	Little Calumet River
LCW	Lockport Controlling Works
LP&L	Lockport Powerhouse and Lock
MGD	Million Gallons per Day
NBC	North Branch Canal
NPDES	National Pollutant Discharge Elimination System
NSC	North Shore Channel
OL&D	O'Brien Lock and Dam
RAPS	Racine Avenue Pumping Station
SEPA	Sidestream Elevated Pool Aeration
TARP	Tunnel and Reservoir Plan
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WPS	Wilmette Pumping Station
WRP	Water Reclamation Plant
WY	Water Year (October 1 through September 30)

CHICAGO WATERWAY SYSTEM
LISTING OF FACILITY INFLOW AND MONITORING LOCATIONS

Location	USGS River Mile	Distance U/S of Lockport	Comments
CHICAGO SANITARY & SHIP CANAL			
Des Plaines River Confluence	290.1	-1.1	
Lockport Powerhouse & Lock	291.1	0.0	Flow District WL, WQ, DO
Lockport Controlling Works	293.2	2.1	District WL
Will County Power Plant, Cooling Water	296.0	4.9	OU, IN
Romeoville Road	296.2	5.1	USGS DM
Citgo Petroleum Corporation	298.0	6.9	
Stephens Street	300.5	9.4	District WQ
Lemont Water Reclamation Plant	300.6	9.5	IN
Argonne Laboratory	302.3	11.2	USGS, DM, OU, IN
Illinois and Michigan Canal Connector Ditch	303.0	11.9	IN
Sag Junction	303.4	12.3	Confluence
Highway 83	304.1	13.0	District WQ, DO
Baltimore & Ohio Railroad	312.3	21.2	District DO
Summit-Lyons Conduit Inflow	313.3	22.2	IN
Harlem Avenue	314.0	22.9	District WQ
Stickney Water Reclamation Plant	315.5	24.4	IN
Cicero Avenue	317.3	26.2	District WQ, DO
Crawford Power Plant, Cooling Water	318.5	27.4	OU, IN
Western Avenue	320.6	29.5	District WL
SOUTH BRANCH			
Damen Avenue	321.1	30.0	
South Fork	321.7	30.6	Confluence
Loomis Street	321.9	30.8	District DO, WQ
Fisk Power Plant, Cooling Water	322.0	30.9	OU, IN
Jackson Boulevard	325.0	33.9	
Madison Street	325.3	34.2	District WQ
North Branch & Chicago River Junction	325.6	34.5	Confluence
SOUTH FORK			
Interstate Route 55	321.9	30.8	District DO, WQ
36th Street	322.5	31.4	District DO
Racine Avenue Pumping Station	322.8	31.7	CSO
NORTH BRANCH			
Kinzie Street	325.8	34.7	District DO
Grand Avenue	326.0	34.9	District WQ
Division Street	327.3	36.2	District
Webster Avenue Instream Aeration Station	238.9	37.8	SA
Fullerton Avenue	329.4	38.3	District DO
Diversey Parkway	330.1	39.0	District WQ
Addison Street	331.3	40.2	District DO
Wilson Avenue	332.6	41.5	District WQ
Lawrence Avenue	332.9	41.8	District WL
North Branch Pump Station	333.1	42.0	CSO
North Branch Dam	333.3	42.2	Tributary IN

CHICAGO WATERWAY SYSTEM
LISTING OF FACILITY INFLOW AND MONITORING LOCATIONS (Continued)

Location	USGS River Mile	Distance U/S of Lockport	Comments
NORTH SHORE CHANNEL			
Foster Avenue	333.5	42.4	District WQ, DO
Devon Avenue Instream Aeration Station	335.0	43.9	SA
Devon Avenue	335.0	43.9	District
Touhy Avenue	336.0	44.9	District WQ
North Side Water Reclamation Plant	336.9	45.8	IN
Oakton Street	337.0	45.9	District WQ
Main Street	337.5	46.4	District DO
Simpson Street	339.5	48.4	
Central Street	340.2	49.1	District WQ
Maple Avenue	340.6	49.5	USGS DM
Linden Street	340.8	49.7	
Sheridan Road (Wilmette Pumping Station)	341.0	49.9	District WL, IN
CHICAGO RIVER			
North and South Branch Junction	325.6	34.5	
Wells Street	325.8	34.7	District WQ
Clark Street	325.9	34.8	District DO
Michigan Avenue	326.4	35.3	
Columbus Drive	326.6	35.5	USGS DM, WL
Lake Shore Drive	326.9	35.8	District WQ
Chicago River Controlling Works	327.1	36.0	District WL
SOUTH FORK			
South Branch Junction	321.7	30.6	Confluence
Archer Avenue	322.1	31.0	District DO, WQ
Racine Avenue Pumping Station	323.0	31.9	CSO
CALUMET-SAG CHANNEL			
Sag Junction	303.4	12.3	Confluence
SEPA Station No. 5 at Junction	303.4	12.3	SA
Illinois and Michigan Canal	303.7	12.6	IN
Highway 83	304.3	13.2	District WQ, DO
104th Street	307.5	16.4	District DO
Crooked Creek	308.1	17.0	IN
Mill Creek	309.0	17.9	IN
Stony Creek (West)	309.4	18.3	IN
Southwest Highway	310.7	19.6	District WL
SEPA Station No. 4	311.7	20.6	SA
Harlem Avenue	311.7	20.6	
Navajo Creek	312.6	21.5	IN
Tinley Creek	314.1	23.0	IN
Cicero Avenue	315.0	23.9	District WQ, DO
Midlothian Creek	317.1	26.0	IN
Kedzie Avenue	317.1	26.0	
Stony Creek (East)	317.9	26.8	IN

CHICAGO WATERWAY SYSTEM
LISTING OF FACILITY INFLOW AND MONITORING LOCATIONS (Continued)

Location	USGS River Mile	Distance U/S of Lockport	Comments
SEPA Station No. 3	318.0	26.9	SA
Division Street	318.0	27.5	
Ashland Avenue	319.1	28.0	District WQ
Little Calumet River Junction	319.6	28.5	Tributary IN
Little Calumet River			
Halsted Street	320.1	29.0	District WQ, DO
SEPA Station No. 2	321.3	30.2	SA
Calumet Water Reclamation Plant	321.4	30.3	IN
125th Street Pump Station	321.4	30.3	CSO
Indiana Avenue	322.4	31.3	District WQ
C & WI Railroad	322.6	31.5	District WQ
Conrail Railroad	325.4	34.3	
Grand Calumet River	325.7	34.6	IN
O'Brien Lock and Dam	326.5	35.4	USGS DM District WL

WL=water level measurement.
WQ=water quality sampling location.
DM=discharge measurement location.
OU=outflow.
IN=inflow.
CSO=combined sewer overflow pumped inflow during storms.
DO=continuous dissolved oxygen monitoring location.
SA=supplemental aeration.
District=Metropolitan Water Reclamation District of Greater Chicago.
USGS=United States Geological Survey.