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METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO: HISTORICAL BEGINNING BRINGS ENVIRONMENTAL IMPROVEMENTS

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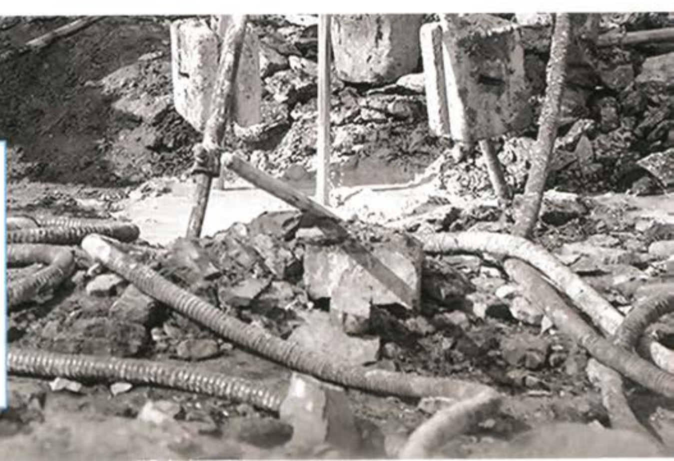

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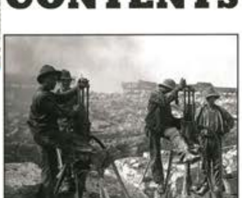

FEATURES

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Historical Beginning Brings Environmental Improvements

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

HISTORICAL BEGINNING BRINGS ENVIRONMENTAL IMPROVEMENTS

by
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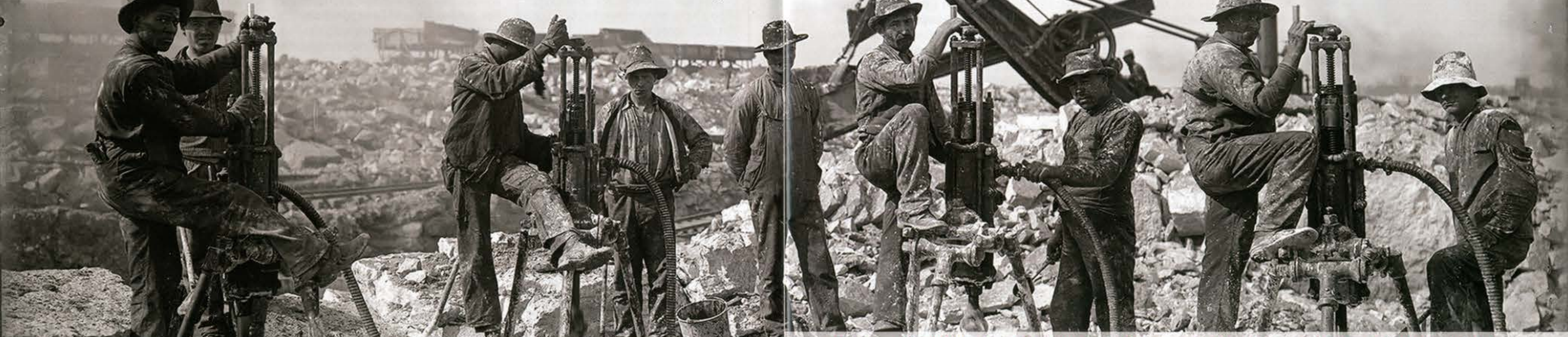


Mud-splattered laborers drilling holes for explosives during the excavation of the Chicago Sanitary and Ship Canal (CSSC) extension in 1904.

HISTORY OF THE MWRD

In 1889, the state of Illinois embarked on a path that would vastly improve the quality of life in Chicago. The Sanitary District of Chicago, known a century later as the Metropolitan Water Reclamation District of Greater Chicago (MWRD), was created to end the problem of waterborne diseases like cholera, typhoid and dysentery that killed hundreds of Chicago residents via drinking water.

At the time, the polluted Chicago River was emptying into Lake Michigan – Chicago's drinking water source. The Sanitary District was charged with developing a plan to prevent sewage from infiltrating the drinking water intake pipes that stretched two miles into the lake. So, construction began on the Sanitary and Ship Canal. To reverse the flow of the polluted Chicago River away from the lake, the Sanitary District dug deep, wide channels, which caused the local waterways to flow backward and down toward the Gulf of Mexico. The Sanitary and Ship Canal opened on Jan. 2, 1900.

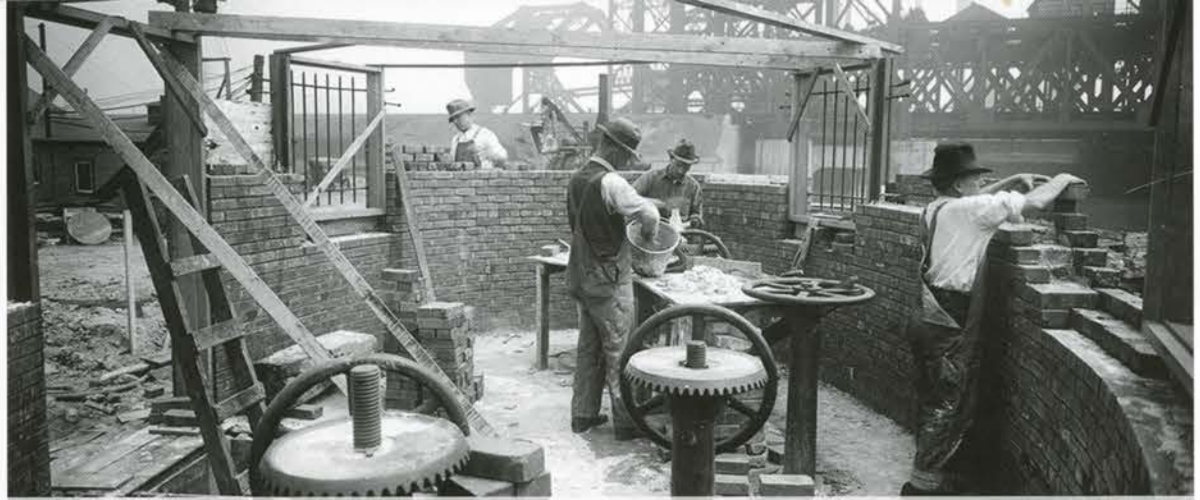
The reversal of the Chicago River resulted in a reduction in waterborne diseases and deaths. However, communities that were downstream of this new flow expressed concerns. Subsequently, the Sanitary District studied existing sewage treatment technologies, visiting plants in England and Germany where they were already treating dirty water.

By 1923, the Sanitary District built its first treatment facility, the Calumet Water Reclamation Plant (WRP), on the south side of Chicago. This plant now serves more than 1 million people in a 300-square-mile area, including surrounding south suburbs. It treats an average of 354 million gallons per day (MGD).

Wastewater treatment's early beginnings started with primary treatment that allows heavy pieces to settle on the bottom of tanks, while fats and oils float to the top, all of which are removed and taken to landfills. In the following years, secondary treatment was developed, relying on microorganisms to clean the water through a biological process in which good bacteria consumes bad.

DISINFECTION

In 2011, the Chicago Area Waterway System (CAWS) had secondary contact classification for water quality standards, meaning direct contact with water was not recommended. The MWRD Board of Commissioners adopted a policy to disinfect on June 7, 2011. MWRD officials instituted a blue-ribbon panel to evaluate available disinfection technologies and devoted eight months to research and testing to determine optimal solutions for disinfecting at the most economical cost.



Masons build a headhouse for the Calumet intercepting sewer system on June 13, 1923.

On July 17, 2015, U.S. Sen. Dick Durbin, D-Ill., U.S. Environmental Protection Agency (EPA) Region 5 Administrator Susan Hedman and other community leaders joined the MWRD in unveiling a new disinfection facility at the Calumet WRP to further improve the water entering the CAWS.

"Today marks another significant date in the history of the Metropolitan Water Reclamation District of Greater Chicago, which dates back to 1889 when the district was first tasked with addressing the issue of contamination in Lake Michigan. Since then, we have constructed more than 60 miles of canals, reversed the flow of the Chicago River and built seven water reclamation plants. Creating a disinfection facility at Calumet is another chapter in our history of water treatment and one more upgrade we have made to improve the region's water quality. I commend our board and staff for delivering this project ahead of schedule and on budget." *– MWRD President Mariyana Spyropoulos, Calumet WRP Disinfection Ribbon Cutting, July 17, 2015*

The new chlorination/dechlorination process reduces the amount of pathogenic bacteria in the water released from the plant into the Calumet River system. Disinfection technology neutralizes or kills bacteria and microorganisms in treated water, reducing the risk of health problems resulting from direct contact with the water. Disinfection occurs after wastewater passes through a series of treatment processes, including screening, filtering, settling and microbial aeration. Using an existing chlorine contact chamber, retrofitted for more efficient contact at Calumet WRP, engineers modified and replaced all interior baffle walls and associated walkways, replaced weir gates, discharge gates, drain sluice gates, inlet sluice gates and a bypass sluice gate, replaced liquid sodium hypochlorite diffuser piping, installed liquid sodium bisulfite diffuser piping, and installed sampling pumps.

"The new Calumet disinfection facility will improve water quality for the growing number of people who kayak, water ski and enjoy other recreational activities in the Chicago Area Waterway System. U.S. EPA is proud to have played a role in making this project happen -- a project that created a lot of good jobs and will improve water quality for years to come." *– USEPA Region 5 Administrator Susan Hedman, Calumet WRP Disinfection Ribbon Cutting, July 17, 2015*

The MWRD is also implementing disinfection at the O'Brien WRP in Skokie, Ill., by constructing an ultraviolet radiation (UV) system to disinfect water prior to entering the CAWS. The MWRD allocated resources and funding to allow disinfection to occur without increasing taxes.

MWRD TREATMENT PLANTS

In 1919, the Board of Commissioners passed an ordinance committing the Sanitary District to construct and operate sewage treatment plants. The MWRD's seven wastewater treatment plants have maximum flows that range from 4 MGD at the Lemont WRP to 1.44 billion gallons per day at the Stickney WRP. *(See Table 1)*

While water reclamation is the answer to cleaning polluted water before it enters the waterways, it does not provide answers to flood prevention, another of the MWRD's core missions. The MWRD is addressing this problem with the Tunnel and Reservoir Plan (TARP), commonly known as the "Deep Tunnel."

"This is a historic moment for the Chicago/Calumet river system and one of the most significant water quality improvements in decades.

Table 1

FACILITY	MGD	CITY
Calumet	430	Chicago
Egan	50	Schaumburg
Hanover Park	22	Hanover Park
Kirie	110	Des Plaines
Lemont	4	Lemont
O'Brien	450	Skokie
Stickney	1,440	Cicero

Friends (of the Chicago River) commends the MWRD Board for their leadership in making this day come. Not only are we achieving a new benchmark in water quality, we are also investing in the health of our communities by improving quality of life and access to the river for recreation and exercise while creating business income and jobs." *– Margaret Frisbie, Executive Director, Friends of the Chicago River, Calumet WRP Disinfection Ribbon Cutting, July 17, 2015*

TUNNEL & RESERVOIR PLAN (TARP)

Like many older cities, Chicago has a combined sewer system in which sanitary sewage from homes, offices and industries drain into the same pipes as rainwater. Most of these combined sewers were built before wastewater treatment existed and were designed to drain directly into rivers. Conversely, separate sewers handle sewage and rainwater in sewers that do not connect to each other; separate sewers are more common in newer areas.

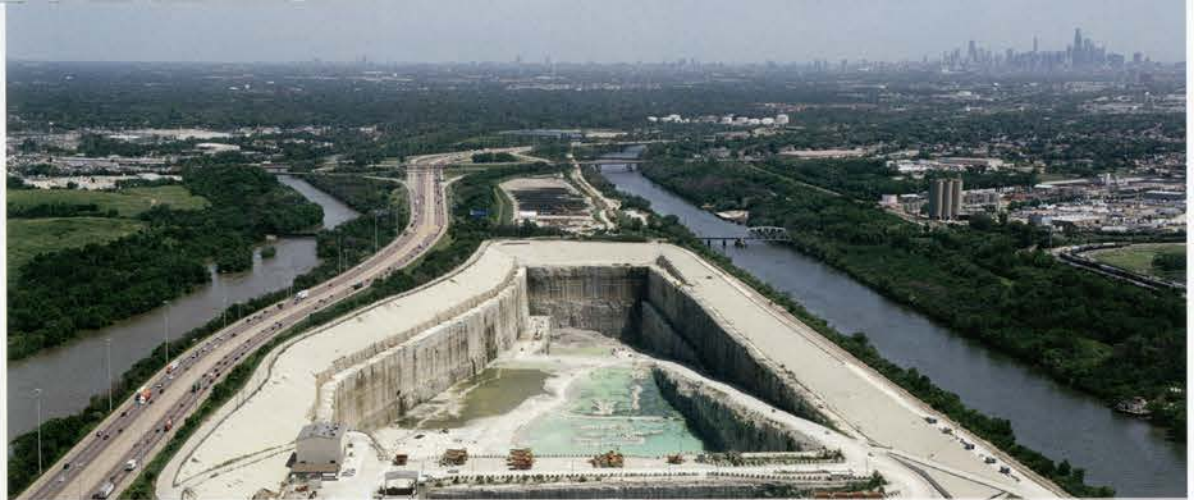
In the early 20th century, the MWRD built large intercepting sewers to redirect sewers to the WRPs to clean the water. This system works well in dry weather; however, in heavy rains the intercepting sewers and WRPs can reach capacity and result in combined sewer overflows (CSOs) to the river, which impairs water quality and contributes to flooding.

As development spread through the Chicago area, paved surfaces directed increasing amounts of stormwater runoff into the combined sewer system. By the 1960s, sewers were overflowing into the river more than 100 days a year and flooding had become a persistent issue. In 1967, officials of the MWRD, the state of Illinois, Cook County and the city of Chicago formed the Flood Control Coordinating Committee to find a solution to the region's flooding and water pollution problems caused by combined sewer overflows. The committee considered 50 alternatives and selected the Tunnel and Reservoir Plan as the most cost-effective approach to providing maximum benefits with minimal negative impacts. The most obvious solution, replacing combined sewers with separate storm and sanitary pipes, was too costly, disruptive to

Table 2

TARP FACILITY	VOLUME (BILLION GALLONS)
Majewski Reservoir	.35
Thornton Reservoir	7.9
McCook Reservoir	10.00
Tunnels -109 miles	2.3
Total storage	20.55

A completed portion of a tunnel that connects the Thornton Composite Reservoir to the Calumet Tunnel System during construction in 2013.

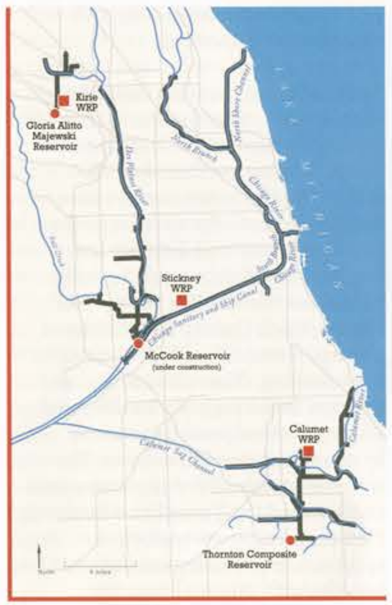


When completed, the MWRD's McCook Reservoir will have a 10 billion gallon capacity and serve a 254.7 square mile area.

communities, and unable to provide flood relief. In 1972, staff at the MWRD developed plans to create TARP, more commonly known as the "Deep Tunnel."

TARP covers a 352-mile service area including Chicago and 51 suburbs and was constructed in two phases:

- Phase I is for pollution control. As large as 33 feet in diameter, 109 miles of tunnels were constructed to hold rainwater mixed with sewage during storm events. Tunnel construction began in 1975 and the entire tunnel system was operational in 2006.
- Phase II is for flood control. The construction of manmade reservoirs to collect additional rainwater mixed with sewage comprises Phase II. Two TARP reservoirs have been completed: the Gloria Alitto Majewski Reservoir was finished in 1998 and is the smallest of the TARP reservoirs; the Thornton Reservoir was recently completed and is used for overbank flooding as well as TARP storage. The McCook Reservoir is set to go online in two separate stages: the first in 2017 and the second in 2029. McCook, like Thornton, is being excavated from limestone by commercial quarry operators. Partnering with commercial quarries has allowed the reservoirs to be completed economically and efficiently.



Construction was planned so that completed portions of the system could be put into operation as work continued elsewhere. The scale and depth of the project was unlike anything previously undertaken and required innovative approaches to tunneling. Newly developed tunnel boring machines were used instead of traditional blasting to minimize vibrations, expedite progress and reduce damage to surrounding rock. To protect groundwater from leakage and protect the tunnels from water infiltration, cracks in the limestone were sealed with grout and the tunnels were lined with concrete. The volume for each of the reservoirs and tunnels is illustrated in Table 2.

To date, TARP has been extremely successful in preventing flooding and pollution caused by CSOs and will be more effective when the larger reservoirs are on line. Since the tunnels became operational, CSOs have been reduced from an average of 100 days per year to 50. As water quality has improved, local waterways have become home to increasingly healthy and diverse fish populations and popular destinations for recreation. Other cities around the world have taken note of TARP's success and are now undertaking similar deep tunnel projects.

PHOSPHORUS RECOVERY

Utilities, in general, are in a transformative stage. For Chicago and Cook County, the MWRD is the original environmental protection organization, as evidenced by our improvements to drinking water, implementation of wastewater treatment and commitment to stormwater management. But we recognize that there are opportunities to do even more, so we are expanding and reimagining our role and embarking on a resource recovery model. As part of this objective, the MWRD is building the world's largest phosphorus recovery system at the Stickney WRP.

Construction in 2013 of a tunnel that will be the main passageway for water to flow into and out of the 7.9 billion gallon capacity Thornton Composite Reservoir.

Phosphorus is a non-renewable resource that is essential for life. Sourced from rock mines, the phosphorus must be transported considerable distances for distribution. However, it is estimated that there are fewer than 100 years' worth of phosphorus reserves remaining worldwide. In the meantime, used in excess, phosphorus discharged to waterways can contribute to water quality problems and dead zones; in fact, it is estimated that there are more than 200 documented dead zones around the world. Managing the overabundance of phosphorus in our waterways with the dwindling supply needed to support life is a challenge shared throughout the world.

With anticipated regulatory limitations for nutrients, the MWRD was proactive in voluntarily accepting a 1.0 mg/L limitation for total phosphorus in its next permit at the Stickney WRP. This permit included a compliance schedule to meet that limitation. The MWRD was in the process of changing its operations to enhance the biological phosphorus removal in our secondary aeration tanks using current infrastructure. Part of our proposed compliance schedule is the installation of a sidestream phosphorus recovery system, which will remove phosphorus from the centrifuge centrate recycle stream. The combination of this and the enhanced biological phosphorus removal will result in the lower effluent limitation. Additionally, this process will recover phosphorus and make it available for reuse. Unlike other phosphorus products in fertilizers, this product is non-soluble in water and provides a slow release of its nutrients to plant life.

BECOMING THE UTILITY OF THE FUTURE

The MWRD has other initiatives under way as we work to become the utility of the future. We recently received legislative approval allowing our exceptional quality biosolids to be used as a renewable soil amendment for parkland application and are pursuing water recovery partnerships in a major industrial corridor. We're working on denitritation as a full stream energy reduction process and implementing a food-to-energy project on the way to energy neutrality by 2023. We're also exploring an algae acceleration process that has the potential to transform the clean water world. Environmental improvement will continue far into the future as long as our drive, vision and commitment to progress exists.

about the author

Allison Fore has served as the public and intergovernmental affairs officer at the MWRD of Greater Chicago for four years. She has 20 years of experience in government communications, having also worked for the Illinois State Treasurer and Illinois General Assembly. She received her Bachelors of Science degree from Indiana University and Masters of Arts degree from the University of Chicago.

The MWRD's 7.9 billion gallon capacity Thornton Composite Reservoir is a major part of the Tunnel and Reservoir Plan and will provide flood protection benefits for 556,000 people in 14 communities throughout the south side of Chicagoland.