UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A RIVER IN REVERSE: AN ENVIRONMENTAL HISTORY OF THE CHICAGO SANITARY AND SHIP CANAL

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

MASTER OF ARTS

By

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Norman, Oklahoma
2015

A RIVER IN REVERSE: AN ENVIRONMENTAL HISTORY OF THE CHICAGO SANITARY AND SHIP CANAL

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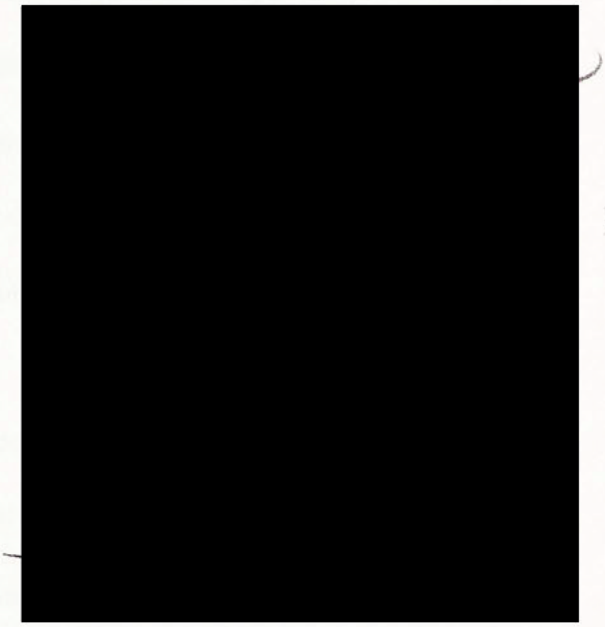

Acknowledgements

I would first like to thank the three primary archives that provided the source material necessary to produce this work. Most of my research occurred at the Harold Washington Library of the Chicago Public Library System in the Government Documents department. The courteous, friendly, and helpful staff there made the process quite enjoyable. The Chicago Historical Society at the Chicago History Museum also offered some valuable resources, including a few maps and information regarding the operations of the meat-packing industry in Chicago during the late nineteenth century. Many of the sources I encountered here helped me frame and contextualize my project. Lastly, I would like to thank James Akerman and Patrick Morris, curators of the Department of Maps and Modern Manuscripts at the Newberry Library in Chicago for taking time out of their extremely busy schedules to sit down with me and introduce to the many beautiful maps and resources that the Newberry has to offer. Your generosity was truly an influence on me. I would like to extend a personal thanks to Michael Conzen for allowing me to use one of his own maps of the Illinois and Michigan Canal.

This project would not be possible without the guidance, support, firm criticism, and patience of my advisor, Kathleen Brosnan of the University of Oklahoma Department of History. Thank you for helping me find both my story and my argument. I would also like to thank my committee at the University of Oklahoma; David Wrobel and Sterling Evans of the Department of History, and Peter Soppelsa of the History of Science Department. Your insight and continued presence throughout this process insured that I never lost sight of the larger picture in my research. I must also extend a

word of thanks to Katrina Lacher of the University of Central Oklahoma Department of History and Geography for sparking my interest in environmental history in the first place.

In closing, I would like to make a few personal acknowledgements, particularly to Kayla Griffis-Molina, Michael Molina, and Bethany Mowry. Your continued support has guided me immensely throughout my time at the University of Oklahoma. I cannot adequately thank you all for being absolutely tremendous friends. Thank you. Finally, to my parents Melinda and John Corpolongo. You have taught me to keep working and to keep improving. The work is never done, and I owe so much to both of you for helping me start. This thesis is dedicated to you.

J. Matthew Corpolongo
Norman, Oklahoma-April, 2015

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Introduction

In 2010, *The New York Times* highlighted the growing issue of Asian carp in the Illinois River. As the fish overwhelmed many tributaries of the Mississippi and Illinois Rivers, "federal and state officials defended their efforts to ward off the Asian carp."[1] Southern farmers in the United States introduced the strong and resilient Asian carp in the 1970s to help clean their commercial ponds. Originally from regions on the Indian Subcontinent, the fish had no natural predators in the area, reproduced at an alarming rate upon arrival, jumped into boats, and soon threatened not only other fish and aquatic species, but the livelihoods of regional residents. To address the problem, state and federal leaders proposed closing the Chicago Sanitary and Ship Canal ("Sanitary Canal"), an engineered waterway that connects the Chicago River with the Illinois River and, ultimately, the Mississippi. The carp traveled up the Mississippi and its tributaries into areas surrounding Chicago, threatening Lake Michigan and the Great Lakes. Ironically, Illinois engineers and sanitarians opened the canal in 1900 to protect Lake Michigan by reversing the Chicago River's flow to pull polluted water away from the city.

Since 1900, the State of Illinois, the City of Chicago, and the U.S. government used the Sanitary Canal to clean water in the Chicagoland area and transport goods through the Mississippi River valley. To maintain these functions, the Metropolitan Water Reclamation Board of Greater Chicago built safeguards along the waterway including electrified fences and gates to prevent the carp from entering the city. Nonetheless, in November 2009, residents discovered the fish in a small channel

[1] Emma Graves, "Illinois Tries United Front Against Fish and Lawsuit," *The New York Times*, 13 January, 2010, A21.(Entire paragraph, Ibid., A21).

attached to the Chicago River's North Branch near the northern suburb of Wilmett Despite the safeguards, nature disrupted the best laid plans of civic leaders and led to litigation. In 2009, Michigan Attorney General Mike Cox sought an injunction from the U.S. Supreme Court, forcing the U.S. Army Corps of Engineers ("The Corps"), the State of Illinois, and the city's sewer authority to close the canal. The Corps assisted in the construction and maintenance of the canal. Illinois Attorney General Lisa Madigan joined U.S. Solicitor General Elena Kagan in opposing the injunction. Madigan asserted that pulling the plug on the Sanitary Canal would cost 1.5 billion dollars' worth of lost goods to the Great Lakes region. President Barack Obama supported keeping the canal open and after a year, the Supreme Court sided with the federal government, Illinois, and the city. As of March 2015, the Sanitary Canal remains open.

Public initiatives such as this canal had characterized Chicago's municipal culture since at the least the World's Columbian Exposition in 1893. The fair's slogan of "I Will," reflects the city's sense of superiority, determination, and commitment to municipal growth.[2] Chicago, having risen from the devastation of the great 1871 fire, presented itself as a symbol of American success and an ever expanding nation- state that stretched from the Atlantic to the Pacific. Opened just seven years after the fair, the Sanitary Canal embodied Chicago's emergence as an international commercial metropolis. It also reflected a reversal, of not just a river, but of method. Those administrating the canal's construction wanted to accomplish more than the simple diversion of polluted waters from Lake Michigan. Many within Chicago's municipal leadership, and within the Illinois state government, viewed the Sanitary Canal project

[2]"Chicago," *Scribner's Monthly*, Vol. 10, 5. September, 1875, 1. This article courtesy of the University of Oklahoma Libraries' ProQuest online newspapers and periodicals collection.

as an opportunity to create a better society for their constituents. Confronting and resolving sanitation challenges meant the improvement of lives through public initiative and ingenuity. Using new technology and the prevailing sanitation theories, civic leaders chose canals as a method to improve public health.

The Sanitary Canal represented an unexpected shift in the municipal development of Chicago. The canal era in the United States largely ended with the construction of the Illinois and Michigan ("I&M") Canal from 1837 to 1848. At that time, water transportation gradually gave way to rail, and Chicago's role as a national railroad hub allowed for much of the city's industrial growth. However, in a unique solution to sanitation problems, local, state, and federal leaders returned to canal technology some fifty years later, viewing the Sanitary Canal as the ultimate opportunity to ensure public health and to forge a new period of economic and social vitality. City officials' dual goal for the Sanitary Canal coincided with Chicago's successes in rebuilding after the Great Fire and in constructing the World's Columbian Exposition. In the end, the canal succeeded in combating pollution and improving Chicago's water, but the continued struggles of the working people affected most by industrial pollution constituted a failure that civic leaders could not avoid.

Despite the canal's diminished success, its construction and use constituted a new era for both Chicago and the United States; a period during which civic leaders expanded the application of artificial waterways beyond travel and transportation. The Sanitary Canal is significant for three reasons. In no other instance in the United States did a city, state, or federal entity reverse a river's flow to forge an entirely new sanitation system. The timing of the canal project also constitutes an important

difference between the Chicago River case and other locations. In *River Republic,* the historian Daniel McCool outlines the historical use of American rivers to improve water quality, noting that the Environmental Protection Agency, established in 1970, targeted water pollution and aimed to improve river cleanliness by 1983. With the threat to the city's primary potable water supply, Chicago leaders and state officials made water cleanliness a top priority more than seven decades before rivers garnered such systematic attention from the federal government.[3] Finally, while many of the projects outlined in McCool's work, including the rerouting of western rivers or the dredging of the Hudson River, were enormous civic undertakings, they did not occur on the same scale as the Sanitary Canal venture.

Although people radically altered many other rivers on the continent, including the Columbia River, as illustrated by Richard White in *The Organic Machine*, the reversal of a river's flow remained a project exclusive to Chicago. Major engineering works designed to harness the Columbia's commercial potential, including the Grand Coulee Dam, represented an enormous endeavor that forever changed the core characteristics of an entire river system.[4] However, the engineering of the Chicago River constituted both a new sanitation tool while extending its ecological parameters to improve public health and maintain economic viability. Civic leaders redirected the river and, in turn, refashioned it to confront their challenges. In *The Chicago River*, historian Libby Hill illustrates how Chicago's ascension to international prominence at the beginning of the twentieth century intersected with ecology which included the

[3] Daniel McCool, *River Republic: The Fall and Rise of America's Rivers*, (New York: Columbia University Press, 1983), 190-2.
[4] Richard White, *The Organic Machine: The Remaking of the Columbia River*, (New York: Hill and Wang, 1995), x-xi, 52-6.

Chicago River and the surrounding portages.[5] Hill contends that city and river formed a symbiotic bond that resulted in changes for both Chicago's built environment and the natural features that afforded its economic success. However, the Sanitary Canal forged relationships with other rivers and spaces outside of Chicago's urban sprawl, which broadened its environmental implications to include many other communities and waterways. It also represented much more than a source for financial viability; it became a method for forging a more secure society through the supposed improvement of a natural riverine system. Thus, the Sanitary Canal became more than a new sanitation strategy for the polluted metropolis; it altered how rivers near the city interacted with one another.

A casual reader might assume that the title, *A River in Reverse*, suggests a story of declension that has been a common narrative in environmental history. However, the Chicago River story is more complicated. The Sanitary Canal replaced with artificial connections the portages that Indians and others employed for centuries to link the river with other regional waterways. As the Asian carp later illustrated, the new Chicago River emerged as the core of a larger riparian structure and gained connections to many tributaries and distributaries that formed a complex amalgamation of waterways all culminating in a single human-made channel.[6] The Sanitary Canal marked a return to

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[5] Libby Hill, *The Chicago River: A Natural and Unnatural History*, (Chicago: Lake Claremont Press, 2000), 6. Hill's work also examines the long-term implications for the Chicago River during the twentieth century and provides a close analysis of the ecological and geological changes that resulted from the Sanitary Canal project. The book's geographic scope remains exclusively within the Chicagoland area and addresses many of the local responses to recent policies regarding the Sanitary Canal and other issues pertinent to Chicago in conjunction with the Chicago River.

[6] Ari Kelman discusses how the city of New Orleans, often with state and federal assistance, engineered the Mississippi River to facilitate economic growth and to improve public health. Ari Kelman, *A River and Its City: The Nature of Landscape in New Orleans*, (Berkeley: University of California Press, 2003), 5.

commercial canal use while reversing a river to drain polluted water, improve public health, and establish an entirely engineered river system.

Within the field of environmental history, there is great discussion surrounding the definition of nature and how it applies to built environments. Considering that the Sanitary Canal is indeed a built river-system, it is important to evaluate how that discourse applies to its story. Here, the Sanitary Canal interacts with the surrounding environment, as reflected in the Asian carp issue. Although engineers built the Chicago River-system with natural materials, they never viewed the canal as a natural feature; the geological processes of the earth did not create it. Instead, the canal spawned a distinctive ecosystem that combined multiple waterways. In this thesis, "nature," "natural," and other similar variations of the word, or similar terms, appear when the author believes their meaning is clear. The usage of these terms is, in no way, a reflection of that debate nor is it an attempt to contribute to discussions of environmental theory. Instead, this work maintains a material analysis of the Chicago River.

Given the amount of work devoted to defining nature, it is important to simply evaluate the interactions between people in their surroundings. Waste disposal within these environs continues to be a powerful element of that interaction. The sanitation challenges facing Chicago residents and officials is a well-researched topic in the field of urban-environmental history. Strong contributions that discuss working-class activism in nineteenth-century Chicago, including Dominic Pacyga's *Polish Immigrants and Industrial Chicago*, also address the city's sanitary problems.[7] However, the living

[7] Dominic Pacyga, *Polish Immigrants and Industrial Chicago: Workers on the South Side, 1880-1922*, (Chicago: University of Chicago Press, 1991), 68-9; 72-4; 162.

conditions precipitated by industrial development and the militant opposition to those circumstances composes the focus of this work and many others documenting labor in the Packingtown area.[8] This rich historiography illustrates some of the most important aspects of Chicago's social history and merits continued attention from readers. This thesis however, privileges the river itself, its ecological components, and the changes applied to it between1892 and 1900.

While the construction of the Sanitary Canal and its use in Chicago and Illinois garners far less attention in labor and urban history, American sanitation history is a strong and diverse field that acknowledges the importance of river pollution. This field views this topic as a crucial part of understanding urban economics and socio-political relations. Urban environmental history explains how people established food and water supplies within constructed spaces, while advocating for a study of cities and their connection with the natural world. The immense contributions of urban-environmental history, reflected in the work of Joel Tarr and Martin Melosi for example, connect issues of human production, consumption, and the shifting characteristics of the city as an environment. While Tarr emphasizes technology and urban development in sanitation history, Melosi more explicitly connects urban and environmental history. For Melosi, the city not only has a place in environmental history, but is the most

[8] Some of the works documenting the sanitary conditions and labor organizing in Packingtown include: James Barrett, Work *and Community in the Jungle: Chicago's Packinghouse Workers, 1894-1922*, (Urbana: University of Illinois Press, 1987).; Rick Halpern, *Down on the Killing Floor: Black and White Workers in Chicago's Packinghouses, 1904-54*, (Urbana: University of Illinois Press, 1997).; Dominic A. Pacyga, *Polish Immigrants and Industrial Chicago: Workers on the South Side, 1880-1922*, (Chicago: University of Chicago Press, 1991).; Louise Carroll Wade, *Chicago's Pride: The Stockyards, Packingtown, and Environs in the Nineteenth Century*, (Urbana: University of Illinois Press, 1981).; Sylvia Hood Washington, *Packing Them In: An Archeology of Environmental Racism in Chicago, 1865-1954*, (Lanham, MD: Lexington Books, 2005).

profound reflection of the human interaction with nature.[9] While many urban-environmental historians view the city as an organism, distinct differences emerged in the field since the earlier research of the 1980s. The primary difference between the two groups of environmental historians is that earlier scholars, Tarr and Melosi included, highlight the intersections between environment, technology, and nineteenth century socio-economic policy, while later historians, as discussed below, interject culture, gender, politics, and intellectual history in their studies of the built environment. Though this key differentiation exists, the analysis of capitalist development in the United States remains a common element throughout urban-environmental history.

In *The Search for the Ultimate Sink,* Tarr argues that the major challenge facing most civic leaders in history was building a functional clean city. The disposal of human waste and pollution often complicated this task. In this collection of essays, Tarr views pollution as the product of interactions between technology, scientific knowledge, human culture, and the environment.[10] Tarr describes the development of nineteenth-century sanitation systems as a response to political pressure from people most affected by pollution, particularly industrial laborers and other residents in working-class neighborhoods. As sewage and wastes degraded living spaces in many cities, American leaders frantically searched for methods to dispose of or simply mask the damage. Tarr

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[9] Martin Melosi, *The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present*, (Pittsburgh: University of Pittsburgh Press, 2004). The edition of this work cited here is an abridged version of the original book. The original won the George Perkins Marsh Prize from the American Society for Environmental History, the Urban History Association Prize for the best book in North American Urban History, the Abel Wolman Prize from the Public Works Historical Society, and the Sidney Edelstein Prize from the Society for the History of Technology. For an even more comprehensive analysis of United States urban sanitation history, consult the original work; Martin Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present (Creating the North American Landscape)*, (Baltimore: Johns Hopkins University Press, 1999).

[10] Joel Tarr, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, (Akron: University of Akron Press, 1996), xxix, 7.

identifies those places or temporary methods as "sinks." The Chicago River and Lake Michigan both served as sinks during the mid- to late nineteenth century. The temporary nature of sinks demands an analysis of political conflict and its influence on the viability of sanitary services. Tarr describes the debates between politicians and engineering professionals concerning potential sanitation strategies, each seeking either a frugal or more permanent answer. This reveals how politicians intended to facilitate specific solutions. Tarr's book introduces many of the issues that urban environmental historians later address and captures the interdisciplinary perspectives of the field. While Tarr offers a broad analysis of urban environmental history in his anthology, the essays privilege engineering theories and technologies implemented by civic leaders, a trend continued by Melosi.

In his pivotal contribution, *The Sanitary City*, Melosi maintains that American sanitation systems presented the most dynamic interactions between people and the environment and that sanitation strategies often defined American cities. Melosi describes such methods as the "circulatory system of the city," and his analysis displays how those mechanizations including sewer systems and water treatment plants, reflected the struggle of urban officials to develop clean living spaces.[11] To function effectively, an urban place needed to become a "sanitary city" which required an infrastructure that could facilitate the distribution of clean air, water, food, and shelter while eliminating harmful human and animal wastes. [12] The planning and construction of the Sanitary Canal reflected this type of infrastructure and leadership described in Melosi's argument. The application of sanitation theory and the shift from Miasmatic to

[11] Melosi, *The Sanitary City*, 1-2.
[12] Ibid., 5.

Germ Theory constitutes an important aspect of Melosi's analysis that aids in an understanding of how political and technological elites fought pollution. Through the nineteenth century, Miasmatic, or "filth" theory dominated the sanitation efforts of many public leaders. This theory asserts that all pollution problems emanate from the presence of foul air, whereas Germ Theory places the existence of bacterial organisms as the real threat to public health and sanitation.[13] An understanding of this shift in American sanitation history is crucial in any discussion of why city officials chose to reverse the Chicago River.

The cultural shift in history is visible in recent works by Harold Platt, Daniel Schneider, and Carl Smith. In *Shock Cities*, Platt builds on the influential work of Tarr and Melosi, but emphasizes issues of urban social justice, while adopting a comparative approach that compares sanitation efforts in Manchester, England and Chicago during the late nineteenth century.[14] As "shock cities," these urban centers expanded rapidly, often developing severe sanitation problems that coincided with massive economic disparity. Municipal leaders in these places attempted to respond to the "horrors and wonders of contemporary society" by reconciling the contradiction between impressive technological advances and the backwardness of pollution, poverty, and oppression. Platt highlights issues of environmental and social justice to provide a "bottom-up history" through an illustration of the militant political organization of working class

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[13] Many people also used Miasmatic Theory to explain the prevalence of diseases such as cholera and Chlamydia as well as the persistence of Bubonic Plague during the fourteenth century.

[14] Harold Platt, *Shock Cities: The Environmental Transformations of Manchester and Chicago*, (Chicago: The University of Chicago Press, 2005). For further analysis of Atlantic cultural, political, and technological changes see also: Daniel Rodgers, *Atlantic Crossings: Social Politics in a Progressive Age*, (New York: Belknap Press, 2000). Rodgers' work assesses the intellectual, scientific, and technological influences of European countries on Progressive Era reforms in the United States that includes the infrastructural development of major cities including New York City and Chicago.

women and men, who demanded sanitary living conditions.[15] Privileging the politics of environmental degradation over engineering solutions, Platt illustrates the paradoxes of capitalist industry that produced many economic opportunities through a discussion of urban development, socioeconomic disparities, class conflict, and the emergence of suburbs.

Similar to Platt, Daniel Schneider assesses the movement of urban wastes in his work, *Hybrid Nature*. Schneider identifies the contradictory ideologies of nineteenth-century urban leaders which allows for his emphasis on intellectual history. Schneider also analyzes the sewage treatment plant ecosystem, which included contaminants as their own productive engines within the structure of the industrial ecosystem, particularly through the biotechnology industry.[16] By identifying the contradictions of nature and technology, public sanitation efforts versus private methods, and purification and profit, Schneider describes the struggle of urban elites to address industrial pollution while maintaining commercial viability.[17] He concludes the monograph by examining the privatization of public sanitation and even the patenting of living organisms; both are, Schneider claims, contradictions to the goal of waste disposal and purification. Sanitarians in Chicago attempted to accomplish both with the Sanitary Canal. Schneider offers a strongly-supported balance between enviro-technological and intellectual history that highlights the cultural constructs surrounding both pollution and sanitation.

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[15] Platt, *Shock Cities*, xiv.
[16] Daniel Schneider, *Hybrid Nature: Sewage Treatment and the Contradictions of the Industrial Ecosystem*, (Cambridge: The MIT Press, 2011), 206.
[17] Ibid., xx.

Though technology remains a key component of most urban environmental history, many later scholars who followed Platt and Schneider devote more attention to American urban culture including Carl Smith. In *City Water, City Life*, Smith synthesizes sanitation history with nineteenth-century cultural and intellectual history while illustrating how water use influenced the development of public services. Smith argues that a city is as much an "infrastructure of ideas" as it is a gathering of people and maintains that ideology often accompanied industrialization.[18] This infrastructure of ideas is the cultural and ideological development philosophy that constitutes a shared ethos among urban planners and officials. To present this concept, Smith analyzes the construction of water services in Philadelphia, Boston, and Chicago, while studying Progressive Era politics. Within these ideals, many features of the modern city, including parks, offered an escape from urban life to a culturally-sanctioned nature. While Smith engages with material history, including the development of running water and the water closet, most of the work is ideological. However, Smith reveals the narrow scope of a cultural-intellectual perspective in that the ideas he presents are those of the affluent with the leisure time and education to consider them. The foundational works of urban-environmental history examined the material elements of sanitation while works, such as *City Water, City Life*, considers its cultural aspects.

Urban environmental historians have yet to apply these various approaches to the story of the Sanitary Canal, though its predecessor, the I&M Canal, appears in the work of important scholars such as William Cronon, Michael Conzen, and Robin Einhorn. These authors illustrate Chicago's complexity as a city, commercial power, and

[18] Carl Smith, *City Water, City Life: Water and the Infrastructure of Ideas in Urbanizing Philadelphia, Boston, and Chicago*, (Chicago: University of Chicago Press, 2013), 2.

environmental phenomenon. A true understanding of the Sanitary Canal requires knowledge not only of the sanitation strategies employed by civic leaders, but also of how Chicago's economic and ecological development precipitated the distinct environmental challenges that demanded such a radical response. Cronon's *Nature's Metropolis* established new trends and perspectives in Chicago historiography.[19] Cronon argues that Chicago's interactions with its hinterlands sustained both the city and its periphery. For Cronon, Chicago constituted its own environment and developed largely because of the surrounding ecological conditions. Railroads established the lumber, meat-packing, and grain industries that fueled Chicago's economy throughout the late nineteenth and twentieth century. These rail lines linked the city-center, like a hub and spoke, with rural areas that sustained its growing population. A study of the city's outward relations, however, *Nature's Metropolis* pays little attention to some of Chicago's natural features, such as the Chicago River and Lake Michigan.

Historical studies of the I&M Canal also offer excellent insight for this analysis of the Sanitary Canal as both waterways occurred in the same environment and eventually merged together. The geographer Michael Conzen has been at the forefront of documenting this waterway's role in Chicago's early growth and argues that the corridor linking Lake Michigan to the Illinois River provided the I&M Canal's location.[20] Therefore, the I&M Canal laid the foundation for Chicago in the latter half of

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[19] William Cronon, *Nature's Metropolis: Chicago and the Great West*, (New York: W.W. Norton and Co., 1991).

[20] Kay J. Carr and Michael Conzen, *The Illinois and Michigan Canal National Heritage Corridor*, (De Kalb: University of Northern Illinois Press, 1988). Conzen also wrote an introduction to the re-issuing of the WPA Guide to Illinois in 1983 with Neil Harris. This work, though an excellent primary source for information regarding Chicago and the state of Illinois more broadly in 1930, there is little information regarding the Sanitary and Shipping Canal nor is there an analysis of the waterway's role in the current development of present-day Chicago. Federal Writers' Project of the Works Projects Administration,

the nineteenth century. Conzen's comprehensive study offers the audience an inexhaustible array of information, resources, and historical context essential for a synthesis of Chicago's environment.

While Cronon and Conzen provide readers an analysis of Chicago's peripheral geographic and economic connections, Robin Einhorn's work shows how political-economic thought spurred Chicago's maturation. In *Property Rules*, Einhorn asserts that municipal government in mid- nineteenth-century Chicago emerged amidst profound anxieties about the consequences of empowering a democratic government in addressing public interests.[21] Einhorn illustrates the undemocratic process of American economic and political development, reflected in Chicago's industrial rise and through commerce in other cities. However, through the economic and political growth it facilitated, the I&M Canal established a "reform ethic" that continued even after the Civil War.[22] Einhorn's study holds especially powerful implications for the building of the Sanitary Canal. On the one hand, many of the city's municipal leaders theorized that the waterway would not only solve Chicago's pollution problems, but would alleviate the social ramifications surrounding those challenges. Many leaders acknowledged their struggles, and acted in a truly philanthropic way. Einhorn's contributions remind historians not to place undue faith in the comparison of present government, and the socio-political structures of the past, though it is impossible to ignore the economic disparities and oppression that lay at the heart of the Chicago River story.

Michael Conzen and Neil Harris, Introduction, *The WPA Guide to Illinois: The Federal Writers' Project Guide to 1930s Illinois*, (New York: Pantheon Books, 1983).

[21] Robin Einhorn, *Property Rules: Political Economy in Chicago, 1833-1872*, (Chicago: University of Chicago Press, 1991), ix.

[22] Ibid., 22.

Despite these various urban-environmental histories and the economic and political histories of Chicago, there has been no significant analysis of the city's sanitation problems or the distinctive solutions its leaders developed. Unearthing one of the most infamous public health issues in U.S. history reveals how those leaders viewed their place in the ever-changing fabric of American society and the citizens affected most by pollution. This work will argue for the relative success of the Sanitary Canal project and its importance in the maturation and continued commercial vitality of the country's then second-largest city.

Three archives proved essential to this study: the Harold Washington Library Center, a subsidiary of the Chicago Public Library System, the Newberry Library; and the Chicago Historical Society at the Chicago History Museum. Engineering documents, particularly those published by the Chicago Sanitary District, and the internal reports produced by other relevant agencies, constitute the most significant documentation for this study. One core piece of this material includes the *History of the Chicago Sanitary and Ship Canal* published by the Sanitary District in 1924. However, newspapers such as the *Chicago Daily Tribune*, legal documents from both Illinois and Missouri, and legislation passed by state and local governing bodies, provide a description of the conditions that prompted the Sanitary Canal project and the consequences that followed.

Chapter one, "Sinks and Stinks," illustrates the roles of civic leaders and the surrounding environment in addressing these sanitation problems, and asserts that their early failures made the Sanitary Canal project a necessity. Chapter two, "Draining the Sink," describes the Canal's construction while maintaining that it achieved only partial

success in addressing the stated goals of the political and technological elites who supervised its implementation. The inversion of river currents remains the most prominent and perhaps crucial element in the Sanitary Canal story, but the canal's reconstitution as a sanitation strategy and its binding of many area waterways into a new, singular river ecosystem, reveal the canal's underappreciated centrality in the evolving urban environmental history of the United States.

Chapter 1: Sinks and Stinks

Any history of the Chicago Sanitary and Ship ("Sanitary") Canal necessarily begins with an analysis of the Illinois and Michigan ("I&M") Canal.[1] The two waterways share environmental, geographic, and economic foundations. Prior to European colonization, the region later occupied by the city of Chicago linked Amerindian settlements with western sub-humid environments and the eastern seaboard. The location and its ecological features supported many different Indigenous peoples prior to Anglo settlement. The Illinois River valley, which included the lands surrounding the Chicago River, provided a home to the Cahokia and Illinois civilizations well into the seventeenth century. With the arrival of Europeans in the eighteenth and nineteenth centuries, the importance of this connection intensified.[2]

With the Chicago River and Lake Michigan, the surrounding portages contributed to the attractiveness of Chicago's eventual location and provided a central identifying element for that area. They were the city's birth-place. These portages linked two bodies of water that connected the Illinois and Des Plaines rivers to the Chicago River and then to Lake Michigan. Mud Lake, the primary body of water within the Chicago Portage, established a continuous route between the Mississippi River and the Great Lakes. As the historical geographer Michael Conzen observes, the Illinois Valley, which linked the Chicago Portage with southern sections of Illinois, offered a "natural

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[1] All abbreviations, shown in parentheses, will be used to maintain consistency, clarity, and brevity throughout the work. The main title, term, or name used to identify something, will always be listed in full first, then followed by the abbreviation thereafter.

[2] Carr and Conzen, *The Illinois and Michigan Canal National Heritage Corridor*, 3-5. The historical geographer Michael Conzen documents the development of the I&M Canal and the environmental conditions that facilitated its the success. This source is an excellent guide to various primary resources concerning the development of both the Illinois and Michigan Canal and the city of Chicago. The work organizes various maps, charts, newspapers, and other materials relevant to the subject.

highway together with a virtually continuous string of deposits including gravels, sands, and clays" that offered building materials. The linkages with this region made Chicago a prime location for a transportation nucleus.[3]

Many different groups of people from the Indigenous to Europeans, and Caribbean peoples, including the Haitian Jean Baptiste Point du Sable, interacted with one another in this region while engaging in commercial transactions such as the fur trade. These economic, social, and cultural developments made the Chicago Portage a "significant channel of movement."[4] French-Canadian explorer Louis Jolliet first recommended in 1674 that a canal be built to further commerce in the region and to ship merchandise from the Great Lakes to French colonial holdings in the southern Mississippi River valley. British settlers moved into the area during the late eighteenth century and wrested the waters of the Illinois and Chicago Rivers from native peoples inhabiting the area; they hoped to establish economic and political dominion. This arrival forged what the historian Richard White terms the "middle ground."[5] Here, Indigenous and European peoples established systems of interaction that were social, cultural, and economic in nature, but eventually dissolved into the dehumanization of one group over the other. Eventually, this clash resulted in the complete colonization of the Great Lakes region by Anglo Americans. With the passage of the Treaty of Greenville in 1783, which yielded the Illinois River basin to the United States, Anglo-American settlers set to work organizing the Chicago Portage. The construction of Fort Dearborn in 1803 solidified the military struggle between the United States and

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[3] Ibid., 4.
[4] Ibid., 6.
[5] Richard White, *The Middle Ground: Indians, Empires, and Republics in the Great Lakes Region, 1650-1815*, (Cambridge: Cambridge University Press, 1991), xxv-iii.

remaining Indigenous tribes including the Potawatomis. For many American political and economic leaders, "internal improvements" constituted an urgent need to maintain both commerce and defense.[6]

Figure 1: Map of the Illinois River Valley. Courtesy of the United States Geological Survey, www.usgs.gov

At the time of its incorporation in 1833, Chicago was but a minor fishing village. Even during its earliest days, the Chicago River provided the primary repository of both human and non-human wastes.[7] As industries moved to the city by the 1840s, this refuse increased. Boosters, however, used the I&M Canal's construction to lure new businesses, particularly since the village also had access to abundant natural resources including lumber and arable land. While the I&M Canal would provide the first transportation system linking Chicago with the Mississippi River valley, the railroad

[6] Ibid., 7-8.
[7] Platt, *Shock Cities*, 101.

later facilitated the formation of the key industries that contributed to the city's future sanitation woes. Railroad companies selected Chicago as a prime hub for the movement of merchandise and building materials, favoring its proximity to the Great Lakes, the Midwest, and other economic centers along the Atlantic coast.[8]

On July 4, 1836, workers broke ground at Canalport, a village just outside Chicago.[9] After significant work stoppages in 1837 and 1841, due to the wide-spread economic panics, the canal opened for traffic in April1848. The I&M Canal connected the central section of Illinois with Chicago and its periphery. During the construction, various towns and farming communities emerged along the canal route, further solidifying its economic importance. This transportation highway also contributed to the boosterism that brought significant attention to Chicago as the canal's location embraced the convenience of the confluence of the Chicago and Des Plaines rivers.[10]

[8] Ibid., 101, 153-4.
[9] Carr and Conzen, *The Illinois and Michigan Canal National Heritage Corridor*, 8.
[10] Ibid., 9.; Robin L. Einhorn, *Property Rules: Political Economy in Chicago, 1833-1872*, (Chicago: University of Chicago Press, 1991), 26.; For Figure 1, see: Ibid., Chapter 1, "The Historical and Geographical Development of the Illinois & Michigan Canal National Heritage Corridor," (DeKalb and Chicago: Northern Illinois University Press, 1988), 12.

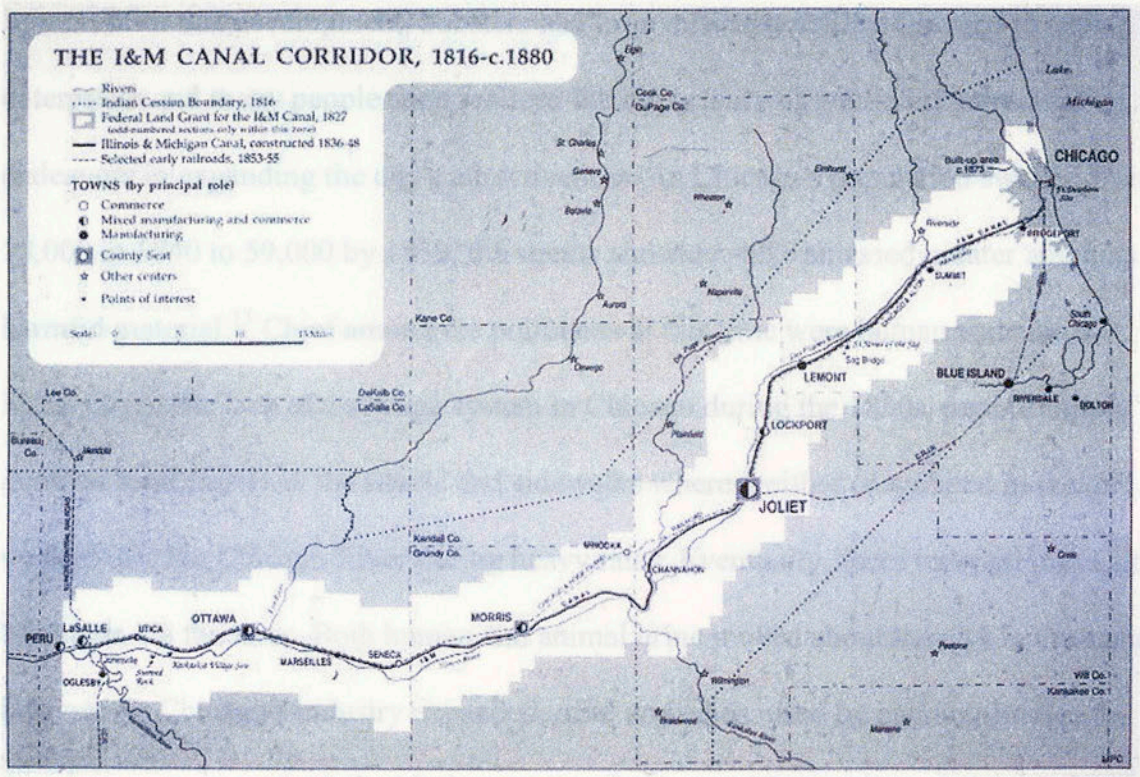

Figure 2: Map Courtesy of Michael Conzen, (Conzen, 1988).

While ease of access and plentiful natural resources reflected Chicago's commercial potential, its proponents knew long-term success required infrastructural improvements within the next decade. Such projects would make Chicago competitive with other Midwestern cities, particularly St. Louis.[11] The I&M Canal remained the impetus for such advancements and the growth of Illinois towns during its construction, including Ottawa and Peoria. Once construction ended, Chicago controlled the canal and much of the merchandise it transported. Soon, with the expansion of many towns along the Illinois River, farmers began trading their crops in Chicago. With its growth as a railroad center, Chicago took financial command of the region and surpassed St. Louis as the favored transportation and economic hub of the upper -Midwest.[12]

[11] Platt, *Shock Cities*, 102.
[12] Conzen, *The Illinois and Michigan Canal National Heritage Corridor*, 11-3.

With this development, boosters had little difficulty selling Chicago to new enterprises and many people soon realized the importance of public infrastructure endeavors in expanding the city's attractiveness. As Chicago's population swelled from 18,000 in 1840 to 59,000 by 1850, the streets and sidewalks amassed greater amounts of harmful material.[13] Chief among the pollutants at this time were human and animal feces. Given the lack of a sewage system in Chicago during the 1850s, people simply dumped fecal matter in the streets and sidewalks where it either coagulated in the dirt or washed into the Chicago River during heavy rains. Eventually, feces traveled into Lake Michigan via the river. Both human and animal urine moved about the city in the same fashion. As Chicago's industry expanded, offal and acids, used by packing-houses to dissolve carcasses, mingled with the growing amounts of feces, urine, and animal corpses. All of this material combined to pollute the city's only sources of drinking water and produced an unbearable stench, particularly in the growing, cramped working class neighborhoods on the South Side. Residents often disposed of garbage and other domestic wastes in the same fashion as urine and feces, adding to the pollution cocktail in both streets and waterways. The city's relatively low elevation contributed to flooding and allowed refuse to quickly drift throughout the city, causing a hindrance to both travel and sanitation.[14] Standing water also attracted disease-carrying insects and rats, particularly in areas near the river on the south and west sides. If Chicago residents wanted to project a clean and safe image for their city to enhance commercial development, these problems required attention.

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[13] Platt, *Shock Cities*, 98.; Dennis McClerendon, "Chicago Growth: 1850-1990," tigger. uic.edu, accessed: 7 March, 2015.

[14] Platt, *Shock Cities*, 99.; Chicago's elevation above sea-level is 673 feet. Figure courtesy of : United States Geological Survey, "Elevations and Distances in the United States," egsc.usgs.gov, accessed: 6 March, 2015.

Civic and economic leaders attempted several strategies to clean the streets as described in A.T. Andreas' booster history of Chicago. First, city officials laid wooden planks across roads to cover sewage and allow for easier cleaning. The wood accommodated foot and horse traffic well, but with the arrival of carriages and wagons, many of the planks snapped, causing accidents. Thereafter, a variation of gravel and sand paved many of the city's streets until the turn of the century. Engineers and sanitarians, including Ellis Sylvester Chesbrough, the chief engineer for the Chicago Board of Sewerage Commissioners and the mastermind of Boston's water distribution system, advocated the draining of roads into the Chicago River. By 1851, this constituted a common practice.[15] With the improvement of city bridges and drains, many larger industrial businesses moved into the area including tanneries, breweries, brick mills, and meat-packing plants. Nonetheless, it was the transition from private entities to the combined efforts of municipal organizations that marked a shift in the administration of public works projects. Residents began to place greater trust in elected officials and a technological elite to make the necessary changes for economic expansion, while ensuring clean living spaces. And when those conditions declined, citizens quickly blamed the same men.

The emergence of industrial enterprises, combined with an increase in population, meant mounting refuse soon afflicted the surrounding environment. The demand for food, water, and other necessities of life, both in and around the city, rapidly created an enormous dilemma for Chicago leaders. Packing companies such as Swift and Armour deposited their wastes in the nearby Chicago River which fed Lake

[15] A.T. Andreas, *History of Chicago: From the Earliest Period to the Present Time, Vol. I*, (Chicago: A.T. Andreas, Publisher, 1884), 198-200. Readers interested in Andreas' work can find it in its entirety online, free of charge.

Michigan, the city's primary water source. City leaders quickly faced challenges from industrial wastes, prompting the search for a sanitary solution that included use of the I&M Canal.[16] As pollution increased in the city, civic leaders soon realized that the sanitary situation required significant alterations to both the city's natural surroundings and the I&M Canal. To address the pollution, municipal leaders needed an entirely new method that combined the scientific developments of the nineteenth century and new sanitation methods.

In the case of Chicago, the need to sustain a rapidly growing population precipitated the depositing of animal carcasses in the Chicago River, polluting the city's drinking water. Although the Chicago River and Lake Michigan housed much of the refuse created by meat-packing plants and glue factories, surrounding areas constituted another urban sink.[17] The failure of these methods to resolve the problems of industrial pollution and citizens' living conditions made the construction of the Sanitary Canal absolutely necessary.

Cities represent a complex interaction between people and their surroundings. Urban environments, historians William Cronon and Martin Melosi argue, are often constructed with materials found in the surrounding environs.[18] Cities reflect the ways in which people gather food, construct shelters, and facilitate the means of their existence, often in confined spaces alongside thousands of individuals. Urban-environmental historians attempt to analyze and illustrate those interactions. However, urban people also interact with rural citizens in a variety of ways from commerce to culture. Cities, for example, have relied on rural places for their food supplies.

[16] Ibid., 30.
[17] Platt, *Shock Cities*, 135.
[18] Cronon, *Nature's Metropolis,* 13; and Melosi, *The Sanitary City,* 3.

Exchanges between a city and the hinterland also included the consequences of industrialization. The effects of mass production, supervised by determined, urban-based, corporate industrialists, had implications for the sanitary conditions of nearby peripheries, affecting the livelihoods of residents outside of the city. The Sanitary Canal was an attempt to secure healthy living spaces and the distribution of and access to safe drinking water. It reflected the central goal of the city as an environment: provision of the basic needs of life to a large, dense population.[19] Simultaneously, civic leaders promised to address sanitary relations with the hinterland through canal use.

Much of the sanitation historiography begins with the work of Melosi and Joel Tarr. Having worked in the field of urban history as early as the 1970s, Tarr developed many of the established concepts within the scholarship today, including the concept of pollution sinks.[20] Tarr explains that sinks, in the context of urban-sanitation history, were any place or solution employed to temporarily address sanitation problems. In *The Search for the Ultimate Sink*, Tarr advocates against this sanitation strategy. Sinks often failed as urban sanitation methods, although many civic leaders considered them effective. Rather than removing the problem, sinks simply changed its location. Industrialization required the use of raw materials from the land either nearby or afar. Consumption of these resources, which can include the use of lumber in the burning of

[19] See: Christopher F. Jones, *Routes of Power: Energy and Modern America*, (Cambridge: Harvard University Press, 2014), 4-5. Historian Christopher Jones argues that infrastructure, such as canals, established social authority by those who administrated their creation. This authority allowed for security, established through infrastructure, meaning that public officials derived significant political and economic power resulting from the responsibility of establishing sanitary systems. Canals, specifically, also afforded the transmission of energy throughout an area which aided in the solidification of public control and security among civic leaders. Jones frequently offers the transportation of coal during the nineteenth century as an example of this phenomenon.

[20] Tarr, *The Search for the Ultimate Sink*, xxix.

coal, creates pollution, while simultaneously sustaining the process of industrialization. Thus, consumption allows for the creation of harmful industrial wastes and sewage.

In the case of Chicago, city officials viewed areas affected by industrial refuse, including the Town of Lake neighborhood, as a containment site for these pollutants and provided only superficial answers to a problem that threatened the city's potable water supplies.[21] The Sanitary Canal, initially referred to as a "Drainage Channel" by local media such as the *Chicago Daily Tribune*, illustrated how city leaders approached industrial pollution.[22] Once the river, Lake Michigan, and hinterland sinks filled to capacity and threatened public health, local and state officials elected to alter an environment almost beyond recognition to address the problem.

Much of this decision reflects arguments made by Melosi in his landmark work, *The Sanitary City*. Melosi maintains that sanitation systems in the United States presented the most dynamic interactions between people and the environment. These methods and systems, according to Melosi, and the ways in which civic leaders dealt with industrial pollution, often defined American cities.[23] Similar to Melosi, Daniel Schneider discusses the development of sanitation practices in Britain and the influence of those methods on American cities, focusing particularly on how such methods presented a contradiction involving the building of clean communities at the expense of a degraded environment. Early on, sanitarians believed that only natural methods of addressing pollution merited consideration, particularly in the depositing of wastes, via

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[21] The Town of Lake is known today as the Back of the Yards. It would not take this name until the 1930s. For consistency with the time period, the original name of this community is used here.
[22] "Can Use the Canal: Arguments of Attorneys for the Drainage Board," *The Chicago Daily Tribune*, 3 February, 1893, 9. Historical newspapers are courtesy of the ProQuest digital archives through the University of Oklahoma Libraries.
[23] Melosi, *The Sanitary City*, 5.

wagon and barrel, directly into the surrounding soil.[24] Sanitation leaders in Chicago employed this option, not surprisingly, to little effect. Much like the pollution sink concept, sanitarians merely moved sewage and waste rather than treating or disposing of it. Melosi contends that such methods affected these areas negatively, allowing for refuse to increase.[25]

Chicago leaders endeavored to create a sanitary city defined by the services provided to citizens. However, these solutions, as Melosi notes, allowed industrial wastes to accumulate in Lake Michigan or nearby streams, threatening both the supply of potable water and creating an intolerable odor. Despite the enormity of the projects, their impetus emerged from the political agitation of people in neighborhoods most affected, particularly on the South Side. The crisis of pollution in the Chicago River, and the attempted solutions to combat it, reflect the importance of sanitary systems in nineteenth-century American cities. Municipal leaders viewed pollution as not only a threat to public health, but also as a challenge to the city's place in the United States as a center of commerce, culture, and politics.[26]

The source of industrial waste and sewage in Chicago stems from the geological configuration of the surrounding environment. The soil near Chicago is primarily composed of a bedrock layer and sanded floors of both the river and Lake Michigan. Prior to glacial departure in the Great Lakes region, ice and water covered the area near present-day Chicago. This body of water extended from the central portion of the

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[24] Schneider, *Hybrid Nature*, 6.
[25] Melosi, *The Sanitary City*, 5.
[26] The Chicago Sanitary District, *History of the Chicago Sanitary and Ship Canal*, (Chicago: City of Chicago Publishers, 1924), iii. A complete photocopied reproduction of this source and all of its accompanying documents can be found at the Harold Washington Library Center in Municipal Records collection of the Government Information division.

continent toward what would become the Great Plains. As glaciers receded and a more arid climate prevailed, the massive glacial sea diminished, forming large lakes. As melting ice formed expansive bodies of water, a large river extended from one of the lakes bisecting the entire continent forming an "ancient connection between the northern glacial lakes and the Gulf of Mexico." Glacial retreat also created many smaller rivers and lakes in the region that flowed into the larger channel later known as the Mississippi River. Two of these channels were the Des Plaines and Kankakee rivers that, in earlier years, linked the entire area to the Mississippi. Large amounts of rock and sediment formed during this glacial process that provided the floors for both Lake Michigan and the Chicago River. This sediment and thin rock layer slowed the Mississippi's current and eased the flow of water into the newly formed Lake Michigan. During this glacial epoch, sand and gravel settled in the central and western portions of the region that neighbored the lakes.[27]

These deposits created a slight ridge near what would become Lake Michigan as well as the Niagara limestone that formed the lake bottom. The settling of this sediment provided for a continual slope that created the open prairies surrounding present-day Chicago, although this also meant that the neighboring land rested around forty feet higher than the city's elevation during the 1800s. Excavation would provide a significant change in the flow of area rivers, directing water in the opposite direction of the lakes. Engineers explored this concept during construction of the I&M Canal in the 1840s and applied it during the planning stages for the Sanitary Canal in the 1880s.

The geological development of the area surrounding Chicago provided both its prime location and the close, sensitive connections between waterways that allowed for

[27] Ibid., 95-97 (quotation, 96).

sewage and wastes to travel so easily. As the rapidly maturing city attracted more people and industries, pollution soon presented a disturbing issue. The need for the Sanitary Canal emerged from the challenges and failures associated with earlier methods used to address both water distribution and sanitation. Some of the options considered by civic officials included the containment of industrial waste and sewage in barrels while moving them via carriages and trains outside the city. These attempts proved highly impractical and people living in the Illinois and Des Plaines River valleys rejected them. The first method for holding and distributing drinking water involved the use of primitive wells, although water carriers also filled barrels and hauled lake water from the shore into interior neighborhoods.

When Chicago was a small village, community leaders dug water wells on the limestone bedrock above a layer of clay. The depth of these wells usually did not exceed six and twelve feet. Therefore, wash water and waste water from homes and factories usually found its way into neighborhood streets and the accumulation of these effluents coagulated above ground, seeping into the thin layer of clay beneath the mostly dirt roads and infected wells. Local street crews removed this water and deposited it into the Chicago River. Over time, the water cultivated an unpleasant odor that offended anyone within close proximity to a well or any potable water dispenser.[28] Despite their continued use, the stench of these wells eventually resembled that of a privy vault and drew considerable criticism from local residents and community leaders.

Increasingly complex, yet still primitive, solutions emerged during the mid-nineteenth century. The first hydraulic pumping system and treatment mill in Chicago constituted the initial drive toward dispersing potable water to numerous

[28] Ibid., 27.

neighborhoods. Engineers believed it would provide excellent support to the existing water lines.[29] The Chicago Hydraulic Company, commissioned in January of 1836, developed a cast-iron pump and water mill in the central financial district in 1840. The primitive mill utilized wooden pipes to deposit lake water into treatment containers moved through the city on wagons. In *Shock Cities*, the historian Harold Platt discusses the operation of these pipes and mills, which the Hydraulic Company powered with steam.[30]

The entire system likely resulted from the financial pressure of boosters and local politicians, who wanted to ensure a marketable city for new investors and businesses. However, this technology provided the city's southern division with very little water, as neither Lake Michigan nor the Chicago River provided the necessary currents to propel water through the system. Slow currents caused the water to stagnate, leaving it susceptible to contamination by diseases, cholera included. So, while the pipelines provided a reservoir for water, it left the sanitation issues of the city unresolved.[31] Eventually, ordinary Chicagoans "tabooed" the municipal well water and continued to access private wells and purveyors.[32] Wealthier people living in the central and northern divisions of Chicago ignored the services of the mill, often obtaining their water from private wells and pumps. Therefore, public support for these ineffective works waned even as industrial waste increased in the Chicago River.

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[29] Ibid., 29.
[30] Platt, *Shock Cities*, 207.
[31] Ibid., 207-8.
[32] *History of the Chicago Sanitary and Ship Canal*, 30.

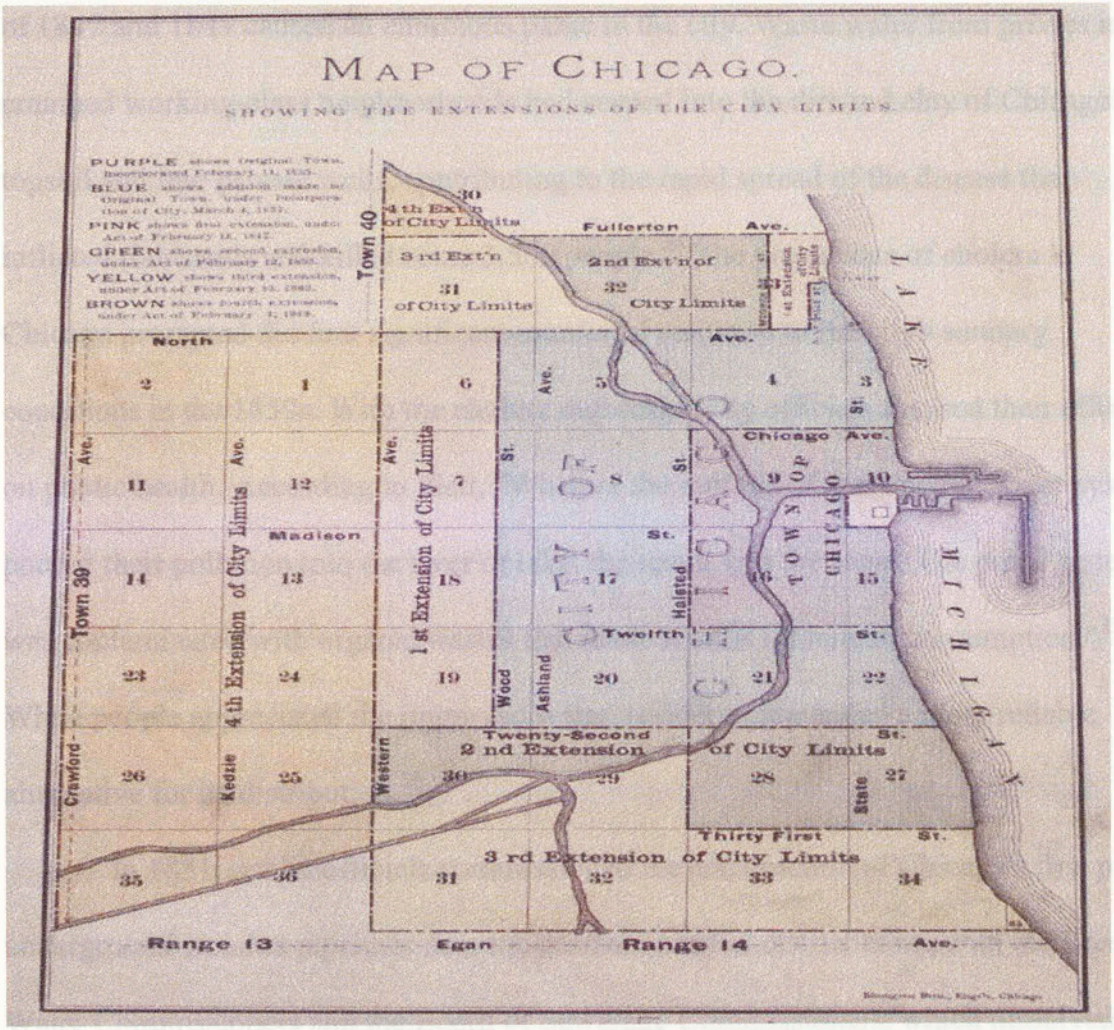

Figure 3: Map courtesy of the Harold Washington Library Center (City of Chicago, 1871). Map showing the expansion of the Chicago City Limits from 1833 to 1870.

The Chicago Hydraulic Company made little money off of the public mill and works project, although the structure remained in service.[33] While the purity of Chicago's drinking water improved slightly after the treatment mill installation, the Illinois General Assembly saw fit to incorporate the company even after the loss of public use and support. However, increasing threats from water-borne diseases and foul air, forced the incorporation of the Chicago Hydraulic Company. The cholera outbreaks

[33] *History of the Chicago Sanitary and Ship Canal*, 30.

of 1847 and 1849 caused an enormous panic in the city. Waste water from privies in cramped working-class neighborhoods had seeped into the dirt and clay of Chicago's topsoil and into private wells, contributing to the rapid spread of the disease that inflicted thousands and killed some 3,500 people.[34] The prevalence of cholera in Chicago prompted the first significant municipal response to the city's sanitary conditions in the 1850s. With the cholera outbreaks, city officials focused their efforts on public health. According to Platt, "Whether the outfalls of these public water systems poured their pollution into the river or lake, the result was the same. The piped water was contaminated with organic wastes that made it unfit for human consumption."[35] While people appreciated the improved water, residents demanded a more reliable alternative for its distribution.[36]

In 1851, public officials commissioned the construction of Chicago's first public underground wooden pipelines near the central financial district along with the Board of Water Commissioners and the Board of Sewerage Commissioners, which dissolved the Hydraulic Company and created a public response to river pollution. That same year, city engineers implemented the first major sewer system in an attempt to eliminate the sewage. Many within the city's government and sanitation community thought that a similar system, designed to carry clean water, provided a viable option. The initial mains often failed and water carriers continued to draw water from the lake. Soon, engineers designed iron pipelines which decreased failures in the system. The city commissioned the first public well built with these iron lines in 1854; it served primarily North Side communities, while those on the South Side still drew their water

[34] Andreas, *History of Chicago*, 595-7.
[35] Platt, *Shock Cities*, 209.
[36] *History of the Chicago Sanitary and Ship Canal*, 28.

from substandard wooden wells or from purveyors hauling water from the shore, a practice that continued through the 1860s.[37] Collecting lake water was difficult and public pressure from the city's southern division prompted the first city-wide attempt to bring clean drinking water to the most people possible.

The Board of Water and Sewerage Commissioners provided the earliest systematic response to Chicago's sanitary challenges, though they dealt with distributing clean water and disposing of refuse, respectively. Although there was minor protest against this action, the city moved forward with plans to build its own water works beginning in 1853. Initially, the city built the new works along the lakefront, just north of downtown. In 1854, the boards commissioned two more works in downtown, separate from the sewage and water systems, which began service in 1874. These complicated works demanded significant labor to operate, and required employees, working in shifts, to control it twelve hours a day.

In 1876, Ellis Chesbrough, having impressed the Board of Sewerage Commissioners with his work on the Boston Sewer System, examined the plans of Chicago's first sewer network, determined to improve them.[38] During the early 1870s, the Chicago River sink grew fouler and more dangerous to public health than ever before. Chicago's rapidly increasing population brought a commensurate rise in the production of human and animal wastes, although industrial refuse remained the city's primary polluter. The pumping works used in the sewer system often released sediment and lake life into neighborhood wells, which flowed into bathtubs and kitchen sinks.[39] City leaders and residents alike questioned the viability of the science and technology

[37] Ibid., 28.
[38] Ibid., 32; "Anniversary of the Drainage Canal," *The Chicago Daily Tribune*, 3 August, 1895, 3.
[39] Platt, *Shock Cities*, 140.

used to distribute lake water. As the sanitary situation in Chicago worsened, the Board of Sewerage Commissioners examined larger projects that targeted the flow of water in and out of the city. Engineers offered alternatives to the wells and lake pumps used for both water distribution and sanitation. The concept of filtration also emerged during these discussions, though many engineers, Chesbrough included, doubted their effectiveness.

One of the bolder suggestions involved the construction of a tunnel underneath the city that connected fresh lake water to inner-city neighborhoods; it garnered significant attention from civic leaders as it required less money and maintenance. Civil engineers also concluded that another similar tunnel would provide relief from many of the sensory complaints regarding sewage.[40] These tunnels would transport polluted water underground, eliminating the possibility of direct contact with residents, while providing potable water. This subterranean configuration also potentially protected against any interference with navigation on city-streets, the river, or the lake. Eventually, Chesbrough directed the Sewerage Board to replace the system's first wooden and iron pipelines with stone and concrete lines that improved sewage and water transportation. By 1880, the entire Chicago Sewer System used concrete lines and attracted national and international attention.

The new stone tunnels of the improved Chicago Sewer System marked a directional shift for the city. Rather than focus on temporary solutions to Chicago's sanitary problems, civic leaders and engineers devoted much of their planning to projects that involved drastic environmental alterations, including the construction of a subterranean infrastructure. In this instance, the building of a water and sewage system

[40] *History of the Chicago Sanitary and Ship Canal*, 32-3.

affected the soil, bedrock, and water in Chicago. The pipelines were not simple improvements to an urban infrastructure; they involved a physical manipulation of the earth. The Chicago Sewer System addressed waste drainage, but did not eliminate the threat to safe drinking water caused by pollution. However, as sewage mounted in the natural water sources of the Chicago River and Lake Michigan, city officials concluded that carrying drinking water to residents was the least of their problems. Civil engineers decided that sewage disposal must be the city's continued focus.

Subterranean tunnels and pipelines, although complex in their design, neither completely disposed of wastes nor addressed pollution sources. Disposal and treatment of contaminated river and lake water emerged as a priority for municipal leaders. For city engineers, bacteria constituted the best answer to waste disposal and treatment, reflecting an emerging trend previously established by English scientists in the late 1860s and early 1870s.[41] According to historian Daniel Schneider, bacterial treatment, which exploded in popularity during the early twentieth century, constituted the "most effective" method of detoxifying contaminated water.[42] These small organisms would break down wastes, creating compounds of ammonia and ammonia nitrate that pumps would then move into holding tanks for disintegration. The Board of Sewerage Commissioners favored natural options to waste disposal for its cost-effectiveness and ease of operation.[43]

Although this enormous civic project provided Chicago citizens with cleaner streets and safer water, while offering a new pathway for sewage, packinghouses and slaughtering facilities on the South Side continued to work. Civic officials dealt with the

[41] Schneider, *Hybrid Nature*, 28.
[42] Ibid., 29.
[43] *History of the Chicago Sanitary and Ship Canal*, 37.

sewage, now they had to address industrial wastes. While the Sewer System momentarily abated the problem, city leaders soon realized they could not merely hide industrial wastes or dump them in a waterway; movement and dilution constituted the only viable option.[44] State and local officials knew that the social and political consequences of pollution in the nation's second-largest city could be catastrophic and harmful to the region's economy.

Pressure intensified from many ordinary people affected by foul water in the Chicago River and Lake Michigan. By the late 1870s, conditions deteriorated so horrifically that residents formed the Citizens' Association of Chicago, composed of business owners, laborers, and others affected by packing house pollution throughout the city.[45] The association acquired its own engineering council and offered information to the Sanitary District in hopes of inspiring action. Harold Platt studies the social conflict between urban leaders and residents affected by industrial pollution, highlighting the social upheaval in urban areas affected by industrial pollution while illustrating the struggle between people living amidst environmental degradation and those able to escape it. Emphasizing social justice issues in both American and English cities, Platt reveals how sanitation problems presented opportunities for marginalized peoples to enter the political arena and advocate for positive change.

The founding of the Citizens' Association, an organization that offered a platform for working people to discuss their living conditions, reflects this assertion.[46]

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[44] Ibid., 35.

[45] The Citizens' Association of Chicago, *The Annual Report of the Citizens' Association of Chicago*, (Chicago: Hazlett and Reed, Printers and Publishers, 1877), 12.

[46] Ibid., 12. Printed copies of these documents are bound and held in the Municipal Records collection of the Government Information division at the Harold Washington Library Center in Chicago, Illinois. The archive possesses a complete collection of the Citizens' Association reports. Original copies can be accessed at the Newberry Library's Special Collections in Chicago, Illinois.

To highlight the importance of urban sanitation, the Association's annual reports dedicated an entire entry to "smells" associated with lake and river pollution. Through activity in the Citizens' Association, public demonstrations, and town hall meetings, residents pressured authorities, thus hastening the response to water and air contamination in industrial neighborhoods. For city officials and those administrating the canal's construction, addressing citizens' concerns involved geographic, economic, environmental, and political challenges. Therefore, the ecological damage wrought by meat-packing plants and glue factories constituted both an environmental and social quandary.

These adverse conditions included a powerful stench from the river and the lack of potable water, caused by the contamination of Lake Michigan. City residents also confronted an immense sewage problem linked both to the massive meat packing industry, which employed thousands of workers, and an increasing population.

Figure 4: Map courtesy of the United States Geological Survey, www.usgs.gov, accessed, 15 January, 2015. Map of the I&M and Sanitary Canal routes; present day. Note the connections with the Des Plaines, Du Page and Kankakee Rivers.

Determined to enact swift and decisive changes, the State of Illinois and the City of Chicago, in 1889, dissolved both the Board of Water Commissioners and the Board of Sewerage Commissioners, combining the responsibilities of both entities in a new organization: The Chicago Sanitary District. As a state agency, the Sanitary District had jurisdiction in both Chicago and all surrounding areas affected by Chicago River pollution. Initially, the District favored a solution similar to the Sewer System and considered building a massive tunnel that connected the river, while improving older

pipes, to rural areas outside the city.[47] This proposed tunnel would move wastes out of the Chicago River and into holding pools in the hinterlands. The Board of Sewerage Commissioners began the project in 1866, and the new Sanitary District viewed the tunnel as a viable solution to industrial wastes following further improvements.

The Sanitary District consulted the designs of European water tunnels while considering plans for the tunnel modifications. Many drainage tunnels founded in Europe were large, expensive, and cumbersome. Therefore, the District elected to build a smaller tunnel to support the larger drain in the event of any inadequacies or failures. The city, with its "population and wealth," could opt for a larger system later, rather than rely on the individual drainage tunnels used in this early system.[48] This decision represented the state and municipal approach to sanitation funding. Often, city officials assumed that the growing wealth of Chicago would aid in the financial support of its endeavors.[49] While the Board of Sewerage Commissioners moved toward building more complicated sanitation systems, the Sanitary District largely inherited its fiscal habits. The District experimented with these drainage tunnels, modeled after prototypes used by the Sewerage Board, and found that they could not adequately move the quantity of wastes needed to improve Chicago's sanitation. By 1890, The District found that only a large canal or similar waterway could move the necessary amount of sewage.

Lake Michigan provided the city's drinking water, but also held the majority of its industrial waste and sewage. The packinghouses and glue factories on the South Side

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[47] *History of the Chicago Sanitary and Ship Canal,* 35.
[48] Ibid., 35.
[49] Platt, *Shock Cities*, 145.

deposited most of its refuse into the Chicago River.[50] The District leaders claimed that former and some current city officials and industrialists were "unwilling to make radical changes in its methods," including a substantial alteration of the urban environment with perceived expensive technologies.[51] Dumping sewage into a waterway seemed much easier and more financially sound for businesses. Platt documents two different factions within the Chicago sanitation community known as the "Lake Party" and the "Mississippi Party," who each argued for different methods of addressing Chicago's pollution problem. Those in the "Lake Party" advocated the continued dumping of sewage and industrial refuse in Lake Michigan, while those in the "Mississippi Party" believed forcing pollutants through the I&M Canal the most viable option. Although the District ultimately chose to construct a drainage canal to remove contaminates, Platt states that civic leaders always regarded the lake as the final answer to sanitation issues.[52]

Removing contaminated water was one issue, but disposing of pollutants demanded greater operator expertise and additional funding. The seemingly unlimited amount of fresh lake water, combined with the belief in insurmountable sanitary crises, challenged leaders to seek a viable decision about industrial pollution.[53] The problem was also twofold: the city had to provide greater access to clean water, while eliminating sewage and pollution.

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[50] *History of the Chicago Sanitary and Ship Canal*, iv.
[51] Ibid., iv.
[52] Platt, *Shock Cities*, 139.
[53] Ibid., 139.

Chemical water treatment involving the use of soaps also appeared "impossible" according to the Sanitary District report.[54] The complexity and expense of these options prompted many within the Chicago engineering and scientific communities to support the neutralization of sewage through dilution. Although many Chicago sanitarians intermittently considered the canal method, researchers and civic leaders still grappled with how to effectively eliminate the wastes rather than only drain them from Lake Michigan. Bacterial solutions to sewage and waste dilution grew steadily in popularity, particularly in Europe since the 1860s.[55] City engineers, many of whom began working with the Sewerage Board, borrowed most of the scientific theories surrounding bacterial treatment of water from the German biologist, Ferdinand Julius Cohn, who studied the interaction of bacteria within aquatic environments.[56] Cohn discovered and researched one such kind of bacterial organism, *Micrococcus Cohn* (*M. Cohn*), which District officials found in Chicago water ways. City scientists and engineers endeavored to defend against this bacterium and other contaminates through improved sanitation. The bacterium is harmful if consumed prior to cooking, causing significant gastro-intestinal problems.[57]

However, *M. Cohn*, if aerated, can dissolve animal matter and other packinghouse refuse, which comprised the wastes in the Chicago River. Bacteria, needing the particulates to survive, multiply while moving through the water as they feed. Once these micro-organisms consume the remaining pollutants, they cease to

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[54] *History of the Chicago Sanitary and Ship Canal*, iv.
[55] Schneider, *Hybrid Nature*, 30.
[56] *History of the Chicago Sanitary and Ship Canal*, 37., See also: Antoine Magnin, *Bacteria*, (New York: W. Wood and Company, 1884), 65. This book explains the classification of many of the various bacteria found in Chicago water ways during the nineteenth century, including M. Cohn. It can be accessed via Google Books.
[57] Magnin, *Bacteria*, 65.

reproduce, allowing for the dispersal of any bacterial life or wastes that exist in water. The Sanitary District consulted the Sewerage Board's studies of *M. Cohn* and other bacterial agents that could potentially dilute Chicago's industrial wastes. Analyzing experiments conducted by the Royal University of Ireland, chemists, biologists, and engineers working for the Sewerage Board found that the amount of contaminates flowing through urban waters required large amounts of ammonia to decompose them. Oxygen provided by a current proved the most effective solution to this particular problem, through its availability; potential for reuse, and cost-effectiveness.[58]

However, this method still proved inadequate as the volume of sewage produced by the growing city still posed a significant threat to the process's viability. The bacterial and chemical aeration method required a large volume of water to achieve effectiveness. District engineers theorized that aeration of sewage and wastes through a drainage canal, possibly the I&M Canal, would adequately move and degrade sewage without additional technology beyond the pumps already established near the city center. The plan was inexpensive, clean, and easy to operate. The slow current of the Chicago River, however, required additional propellants in the water to facilitate the introduction of oxygen needed for the disintegration of industrial pollutants.

City engineers assessed the effectiveness of three primary methods of sanitation available in the 1880s. The first involved the direct removal of wastes by discharge into an ocean, sea or other large body of water. The second plan sanitized water by intermittent infiltration or irrigation in various holding pools connected to a canal by pipes where operators would drain and clean the water. The third concept involved the actual chemical treatment of waters while simultaneously removing contaminants from

[58] *History of the Chicago Sanitary and Ship Canal*, 37.

polluted areas, expanding the amount of safe waters in those neighborhoods or towns. The Sanitary District concluded that the slow-moving stream provided the most effective option when combined with a chemical water treatment. Based on the studies in Ireland, the report concluded, "not only is this method of sewage disposal theoretically correct, but the results have been attained in practice."[59] Although these methods resulted in some positive results in European cities, the viability of this solution for Chicago remained uncertain.

The Sanitary District justified its decision to facilitate an oxygen-based treatment of the Chicago River by highlighting the flaws of other sanitation methods. Moving effluents into a larger body of water seemed impractical for Chicago's situation. Lake Michigan provided drinking water, but also lacked the size and necessary current to dissipate contaminates sufficiently to produce potable water. Irrigation and filtration methods, with which the city loosely experimented in the 1860s and 1870s, also required cool air and soft soil to facilitate the proper disintegration of pollutants. Although many of Chicago's streets were unpaved, engineers imported dirt and sediment from outlying areas to execute this plan so as not to use materials needed for road maintenance.[60] Furthermore, Chicago's frigid winters reduced the movement of riparian waters and meant months of stagnation which increased the potential for further contamination. The Sanitary District grappled with an experimental solution involving sewage distribution to rural irrigation areas along the city's western and southern boundaries. This experiment ultimately failed as farmers, wanting substantial harvests, often ignored the treatment and irrigation of sewage and sent the wastes to farms as

[59] Ibid., 40-1.
[60] Ibid., 42.

fertilizer. Instead, wastes simply sat on the top soil and contaminated surrounding crops. Losing money, many of the farmers dumped sewage into the Calumet River along Chicago's southern periphery. Here, horse manure, industrial sewage, and other animal wastes sent to rural areas matriculated back into the city's aquatic ecosystems.

The various attempts to address Chicago's sanitary situation often tried to both distribute water and purify it while industrial pollutants continued to pour into the lake. Pumps, tunnels, and drains all contributed to the city's infrastructure, and Chesbrough's sewer network drew national praise. However, the environmental situation, which included foul odors and contaminated drinking water, demanded that civic leaders find alternatives to the superficial methods adopted by civil agencies through the 1880s. Residents cited the continuing offensiveness of their living conditions, stating in the Citizens' Association report, "If present means are unsuccessful, a combined and vigorous effort of great extent, both in its character and its continuance, may be necessary."[61] Chesbrough's sewerage system, despite its relative novelty, largely failed to accommodate the rising population and the amount of waste produced by city factories. Therefore, the Sanitary District began to examine the Chicago River itself and discussed methods for water purification and waste disposal.

Chemical treatment of the Chicago River constituted the first step toward what would emerge as the Sanitary Canal project. The idea began in the 1860s after a report, filed by Chesbrough for the Sewerage Commission, concluded that the river's "offensiveness," constituted the chief pollution concern.[62] Initially, the District proposed

[61] *The Annual Report of the Citizens' Association of Chicago*, 13.
[62] *History of the Chicago Sanitary and Ship Canal*, 63. The retrospective report of the Chicago Sanitary District worked backward it its presentation of the canal project, stating the various methods employed by the District in addressing the pollution of the Chicago River, then moving to a discussion of the Illinois

two plans. The first involved a short canal, connecting a set of pumping works to the Chicago River to better move water and sewage through the city while also treating it with the ammonia and ammonia nitrate compounds from the aeration of *M. Cohn*. The second proposal suggested that the summit of the I&M Canal be shortened and diverted so as to connect with a deeper channel cut through the Mud and Des Plaines Rivers. The District ordered its engineers to compile additional information on each recommendation. They found that without a purification or pumping method, any alteration to either the I&M Canal, or the feeding rivers and Lake Michigan, would render the project ineffective. Should the City Council approve a drainage canal for Chicago, the Sanitary District would have to maintain its navigability. Therefore, when waters froze during the winter months, pumps would need to propel the river's current to adequately divert sewage away from the city while simultaneously treating it.[63]

Filtration and treatment of the Chicago River proved a highly complicated endeavor. However, many of the mechanisms central to the successful operation of the Sanitary Canal, including pumping works near the Bridgeport neighborhood on the city's south side, originated with the initial purification efforts of the late 1860s. The District mandated that the canal be navigable for commercial use, while also carrying water away from the city.[64] At forty-six miles long and fourteen feet deep, the Sanitary Canal would serve a dual purpose which included maintaining a transportation network in and out of the city, as well as a conduit through which engineers could carry and treat

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and Michigan Canal and then on to a discussion of the formation of the Sanitary District itself. The narrative ends with a chapter detailing the inauguration of the work for the Chicago Sanitary and Shipping Canal.

[63] W.M. Harman, *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, "Proceedings," City of Chicago, 8, December, 1891, 295. These transcripts of the Sanitary District's meetings and weekly activities can be accessed, in their original printed form, at the Harold Washington Library Center in the Municipal Records collection of the Government Information division.

[64] *History of the Chicago Sanitary and Ship Canal*, 88.

wastes.[65] During the canal's planning stages, engineers also favored a connection between the canal and the city's sewer system for water and waste disposal. However, the canal's primary purpose, stated often by the Sanitary District, was the disposal of contaminants from industrial operations in the city's southern division. The District left no doubt in its designation of the contaminated Chicago River as the primary threat to public health. "While the sewers were responsible to some extent, the pollution was chargeable chiefly to the slaughter and packing-houses in and around the city, besides from that, distilleries, glue factories, establishments for rendering offal, etc."[66] City officials, District leaders, and engineers argued for water filtration as a chief component of a more comprehensive sanitary system.

Utilizing Chesbrough's earlier studies, the Sanitary District concluded that the river water should be treated, not merely moved away from Lake Michigan, ensuring that industrial wastes would not contaminate water in the Illinois and Mississippi Rivers downstream. Before selecting the most effective treatment measure, the District collected data from riparian waters. The initial tests examined extant bacteria in the Chicago River.[67] The District also analyzed ammonia levels in the river to determine the appropriate response to pollution. Scientists working for the District quickly deemed ammonia treatment of water an impractical solution as the rate of contamination far outpaced the ability of the District to apply chemical treatments. A standard for analyzing water contamination in the 1880s did not exist. Therefore, upon its founding, the Sanitary District examined water sources in areas adjacent to the river to analyze

[65] Harman, *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, "Proceedings," 297.
[66] *History of the Chicago Sanitary and Ship Canal*, 66.
[67] Ibid., 17.

water composition, chemically, relative to the actual amount of pollution in the river.[68] Engineers found this data critical not only for the canal's construction but for the treatment mechanisms accompanying it.

The District also investigated the practices of the State Boards of Health in both Massachusetts and Connecticut to frame their analyses. The District chose these states as many rivers there flowed from lakes ecologically similar to Lake Michigan. The Connecticut State Board of Health published the findings of its water analyses in its *Fourteenth Annual Report* in 1892.[69] The Sanitary District of Chicago referred to these laboratory reports as a way to assess the effectiveness of the practices adopted by the Connecticut State Board of Health. The District found that lake waters assessed in the report closely resembled those of Lake Michigan, despite various vegetative differences. The state of Connecticut provided the tools and scientists needed to analyze water in the Chicago River and Lake Michigan. The Connecticut State Board of Health found that Lake Michigan's water had a "decidedly greenish tinge," and discovered more than 100,000,000 living bacterial organisms harmful to human health.[70] Although pure upon first inspection, when pumped from a hydrant, the water from Lake Michigan was "highly polluted."[71] These tests allowed the Sanitary District to assess the actual pollution encountered by Chicago residents in their drinking water.

During analyses of the Chicago River, the District found that the summers of 1885 and 1886 yielded the highest amount of river pollution. Dr. John H. Long of the Illinois State Board of Health and a faculty member of the Illinois Medical College,

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[68] Ibid., 18.
[69] Ibid.; and *Fourteenth Annual Report* of the State Board of Health of Connecticut, 1886., cited in *History of the Chicago Sanitary and Ship Canal*, 40-5.
[70] *History of the Chicago Sanitary and Ship Canal*, 18-9.
[71] Ibid., 19.

assessed the water from one single hydrant every Saturday during the two year span. Long published his findings in the *Ninth Annual Report of the Illinois State Board of Health* and reached similar conclusions to the Connecticut State Board of Health. In conjunction with the Connecticut study of water from the initial hydrant, which discovered nearly 100,000 bacterial organisms in one glass of water, Long also assessed the water level of the Chicago River near Bridgeport on the city's South Side. Considering factors such as rainfall, temperature, and water current, Long found no connection between these variables and river pollution. Long broadened his study to include Lakeview and Evanston water supplies and found that similar conditions existed there along with waters in the Des Plaines River at Joliet and the Illinois River at Ottawa and Peoria.

In all, the Sanitary District authorized 152 chemical analyses and 880 water level measurements.[72] The purpose of this comparison was to highlight the extent of water pollution in the Chicago River and Lake Michigan, and to see if methods used in Connecticut could prove useful for Chicago. Although difficult to determine, it may also be possible that the comparison served to deflect criticism of Chicago's sanitation situation and of those charged with managing it. Ultimately, engineers and scientists working for the District concluded that the problems demanded an entire overhaul of the Chicago River.

Secretary of the Illinois State Board of Health, Dr. John H. Rauch, studied Chicago water quality for about 10 years, and observed that water purity in the Chicago River and Lake Michigan was "particularly bad" during the period between 1885 and

[72] Ibid., 20.

1886.[73] Between August fourth and eleventh of 1885, the city experienced unusually high rainfall causing the river to overflow, especially at the Ogden-Wentworth ditch near Bridgeport. Flooding occurred here, carrying sewage, animal waste, and other industrial pollutants into sources of Chicago's drinking water. Much of this pollution originated from the South Fork of the South Branch of the Chicago River, a popular disposal site for the meat-packing and glue factories in the area. With large amounts of rainfall in the city between August fourth and eleventh, the Des Plaines River flowed freely into the South Branch of the Chicago River. Combined with the stifling summer heat, the conditions became particularly unbearable and degraded to a "more offensive condition than any time since."[74]

The effluent from both the Des Plaines and Chicago Rivers poured into the city for over a month prior to the start of these tests. Therefore, the samples reflected the pollution of both the river and the lake at its worst.[75] District scientists compared these waters with those from Hartford, Connecticut in the same year. The Hartford samples, the comparative framework for Chicago's water, displayed a higher level of pollution than what the Illinois State Board of Health observed during the summer of 1885. Much of the water involved in the Hartford study flowed from small streams and creeks six miles outside of the city in dense, wooded areas. It was also a city of 53,000 in 1885, compared to Chicago's population of more than 1,000,000.[76] The water administered by the Chicago Sanitary District was urban water that directly affected hundreds of

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[73] Ibid., 20.
[74] The South Fork of the Chicago River-South Branch is also more commonly known as "Bubbly Creek," made infamous by Upton Sinclair's novel *The Jungle*, Upton Sinclair, The Jungle, (New York: Dover Thrift Publications, 2011), 20.
[75] Ibid., 21.
[76] Ibid., 22-3.

thousands of people, many of whom lived down stream or in the city's South Side working-class communities.

The dire sanitary situation persisted in Chicago. Pumps installed along the South Branch of the river struggled to accommodate water flowing into the city and Lake Michigan during periods of heavy precipitation. Therefore, pollutants went untreated. Civil engineers momentarily stopped the pumps during floods, allowing the water and its contents to coagulate further in affected areas of the city. It was in these situations that sanitarians collected their best samples. During this time, Chicago imported water to replace the potable sources lost as a result of contamination or examination.[77] The Sanitary District found that water imported into the city also contained pollutants, thus eliminating the option of combining Chicago's water with outside sources. Armed with a year of biological data, collected by both the Illinois State Board of Health and the Connecticut State Board of Health, the District could support its claim for a new sanitary canal.

Proposed in 1889, the Sanitary Canal would extend forty miles between the South Side of Chicago and the town of Joliet. Initial funding for the project came from the City of Chicago and adjoining townships and included government bonds and donations from private entities, specifically the Northern Trust Company of Chicago, whose leaders saw a long-term commercial benefit to creating a healthier city.[78] The report states that "no public question relating to the physical improvement of the

[77] Ibid., 24-5.

[78] Chas Baly, *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, "First Regular Meeting" City of Chicago, 2, February, 1890, 8. The City of Chicago published records of the meetings of the Sanitary District that is bounded and held in Government Information at the Harold Washington Library in Chicago, Illinois. This volume details the organization of the Sanitary District and the formative measures taken to begin work on the Drainage Canal.

country, ever received closer or more prolonged attention."[79] The initial stages of construction focused on the geological characteristics of the Chicago River and the surrounding region. The District ordered laborers to begin digging through the clay, bedrock, and gravel on the river bed to initiate the dredging process. Downstream, surveyors assessed the topography of the Des Plaines River valley concluding that the hills required excavation to accommodate the canal and to aid in altering the depths of the river during construction.[80] Engineers used sediment and rock from these hills to alter the river bottom and either obstruct or hasten the travel of riparian waters as necessary. The entire project relied upon the manipulation and alteration of the landscape. To shift the river's current and perform a complete reversal, engineers dredged the river floor altering water levels all along the proposed canal route. These processes constituted the first steps taken by the Sanitary District in the summer of 1890 to build the Sanitary Canal.

The Chicago Sanitary District later issued a history of its operations in 1924, describing the specific natural conditions that made Chicago a preeminent American city, but that also contributed to many of its ecological problems.[81] The Sanitary District likely released its report to explain the city's ecological situation and justify the methods used to remedy the environmental and public health crises their fellow citizens faced. According to Harold Platt, civic leaders often took credit for even marginal successes.[82]

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[79] *History of the Chicago Sanitary and Ship Canal*, iv.
[80] Ibid., 96.
[81] Ibid., iii. This history described the development of Chicago, its industries, and the emergence of the sanitation challenges that confronted the District. Within this narrative, the District illustrated the reasoning behind many of their decisions and justified the methods and plans they adopted. While a comprehensive history, its accuracy must be questioned, however lightly, as the purpose for the narrative likely involved a defense of the District's actions. Therefore, this chapter uses secondary accounts of the Drainage Canal to balance the narrative of the District.
[82] Platt, *Shock Cities*, 136.

For city leaders, the manipulation of a river system, for the public good, constituted a resounding achievement.[83] Sanitary projects reflected the Progressive ideals of taming nature and providing public services while managing natural surroundings through the solidification of centralized state authority.[84] Throughout the nineteenth century, and even into the twentieth, civic leaders and businessmen still used advertising and boosters to lure new commercial prospects and investments. The report chronicles the canal's construction and the reasoning employed by engineers and Sanitary District officials, but also reveals civic leaders' notions about the environment. For many in Chicago's government and sanitation community, Lake Michigan offered not only the most effective repository for industrial wastes and sewage, but represented the immensity of nature and the ecological challenges facing the city.[85] The report begins with a description of Chicago's unique situation and the complex challenges that it presented for reformers.

The District's report also illustrates, however, the challenge that city officials faced in justifying a project with no apparent commercial impetus or benefit. As planning for the project progressed, District leaders continually explored other ways to defend the canal, such as soliciting the support of the United States Congress and the nation's military.[86] Officials within the War Department wanted to ensure a means of defense for the Great Lakes region during a potential invasion, and the river systems in the area. In the project's early days, the Sanitary District largely cited political pressure

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[83] "Anniversary of the Drainage Canal," *The Chicago Daily Tribune*, 3 August, 1895, 3.
[84] See: Smith, *City Water, City Life.* Here, Smith provides an intellectual and cultural history of water management in Boston, Philadelphia, and Chicago during the nineteenth century. Smith emphasizes the reforms of Progressive Era leaders and how they viewed the city and nature.
[85] Platt, *Shock Cities*, 136-8.
[86] Richard Prendergast, *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, "Daily Proceedings," 11 July, 1890, 22.

as the primary impetus for seeking an answer to the city's dilemma. Military support for the project allowed the District to procure funding to finance the project and to further justify such an enormous endeavor.

Although Chicago remained a financial capital in the then-western portion of the country, largely because of its adequate portages and proximity to Lake Michigan, the idea for a canal to serve Chicago only emerged as a way to construct another means of travel and trade. Construction of a canal to address sanitation, as a concept, did not arise until industrialization, after the condition of the city's environment degraded beyond tolerance. Upon completion of the project, the Sanitary Canal would improve water quality while providing an important commercial shipping lane.

As industrial pollution increased in the Chicago River and Lake Michigan, City Council and District officials discovered that the problem required more complex methods designed to actually dissipate and degrade wastes, rather than simply remove them from certain neighborhoods. The exponential rate at which meat-packing companies deposited blood and animal carcasses into the river demanded that the city address not only where contaminated water went, but its sanitary condition. Public pressure and financial constraints complicated the ability of the District to adequately address the issue, and many methods ranging from irrigation and filtration to lakeside pumps, garnered significant consideration from engineers and politicians. However, none of these methods successfully balanced the need to address environmental degradation and citizens' access to clean drinking water with protecting the city's financial solvency. Although the Chicago River flowed into Lake Michigan, the Sanitary District moved to further manipulate the land, devising one last technological

advancement that reversed a river while fashioning a new weapon in the struggle against urban pollution. By 1900, the Chicago River would be a river in name only.

Chapter 2: Draining the Sink

Officials in the Illinois state government and within the Sanitary District held high expectations for their bold sanitation strategy. If their plans worked, the Sanitary and Ship ("Sanitary") Canal would divert wastes away from the city of Chicago and Lake Michigan completely and permanently. Civic leaders wanted the project to be a resounding victory. To deem this endeavor successful, from a municipal perspective, was to not only improve the city's drinking water but to do so in a way that solidified the reputation of public servants in the minds of residents. In the end, the canal, which framed the commercial and sanitary character of the city during the twentieth century, succeeded in the most practical ways possible: it moved sewage and slaughterhouse wastes out of the city, while diluting them and improving water quality for many residents. However, the canal failed to achieve another stated goal of city and District leaders – establishing cleaner living conditions in Chicago's working-class neighborhoods – largely because of the unwillingness of municipal leaders to address the complex root causes of poverty in an industrializing America.

Although the canal addressed one problem in sanitation, it required further improvements after it opened for traffic. Both the Sanitary Canal and the Chicago River reversal were two steps in a larger sanitation strategy designed to provide city residents with clean water and living conditions. The new riverine system established by the Sanitary Canal succeeded in pulling large amounts of pollution out of Lake Michigan, which allowed for a cleaner supply of municipal water. Although the presence of improved water quality, in many areas of the city, constituted a significant success for Chicago and its leaders, engineers made many modifications to the canal to address

continuing sanitation challenges, such as noxious odors, the prevalence of industrial wastes, and water pollution in communities near the Union Stockyards.

When it first contemplated the possible solutions, the Chicago Sanitary District initially planned to use and expand a portion of the Illinois and Michigan (I&M) Canal to build the Sanitary Canal.[1] Eventually, the District chose a route that involved integrating other regional rivers in the construction of a new channel paralleling the I&M Canal.[2] The Sanitary Canal begins on Chicago's South Side, drawing water from Lake Michigan and the Chicago River outside of the city limits. The Sanitary Canal and the I&M Canal run parallel to each other as they move south and west of the city. Between the Summit township and the city of Joliet, both the Des Plaines River and the I&M Canal parallel the Sanitary Canal, with the former being the only naturally - occurring waterway among the three.[3]

The waterways involved in the Sanitary Canal case all, eventually, flow into the Illinois River, which runs northeast to southwest. (See Figure 5) The Des Plaines River, originating in southern Wisconsin, flows south and into the Illinois River at the town of Channahon, west of Chicago. The Little Calumet moves from east to west along the southern outskirts of Chicago and connects with the Des Plaines River at Lemont. The Kankakee River, located about thirty miles to the south of the Little Calumet, also flows east to west and merges with the Illinois just south of Channahon, which is the confluence of the Des Plaines and the Illinois rivers. Among all of the rivers involved in the Sanitary District's project, the Chicago River is the outlier. Originally flowing west to east and into Lake Michigan, the Chicago River demanded the most engineering of

[1] *History of the Chicago Sanitary and Ship Canal*, 92-4. Footnotes 2-3, Ibid., 95, Ibid., 96.

all of the relevant waterways. Prior to the I&M Canal's construction, no continuous link between the Illinois and the Chicago rivers existed. Although the I&M Canal provided such a connection, to establish a reversal of flow required dredging, digging, land excavation, and a set of pumping works to manage the current's speed. The I&M Canal merges with the Sanitary Canal at the village of Lockport. It is then, south of the town of Channahon, that the Des Plaines flows into the Illinois River and then connects to the Mississippi at Alton, Illinois.

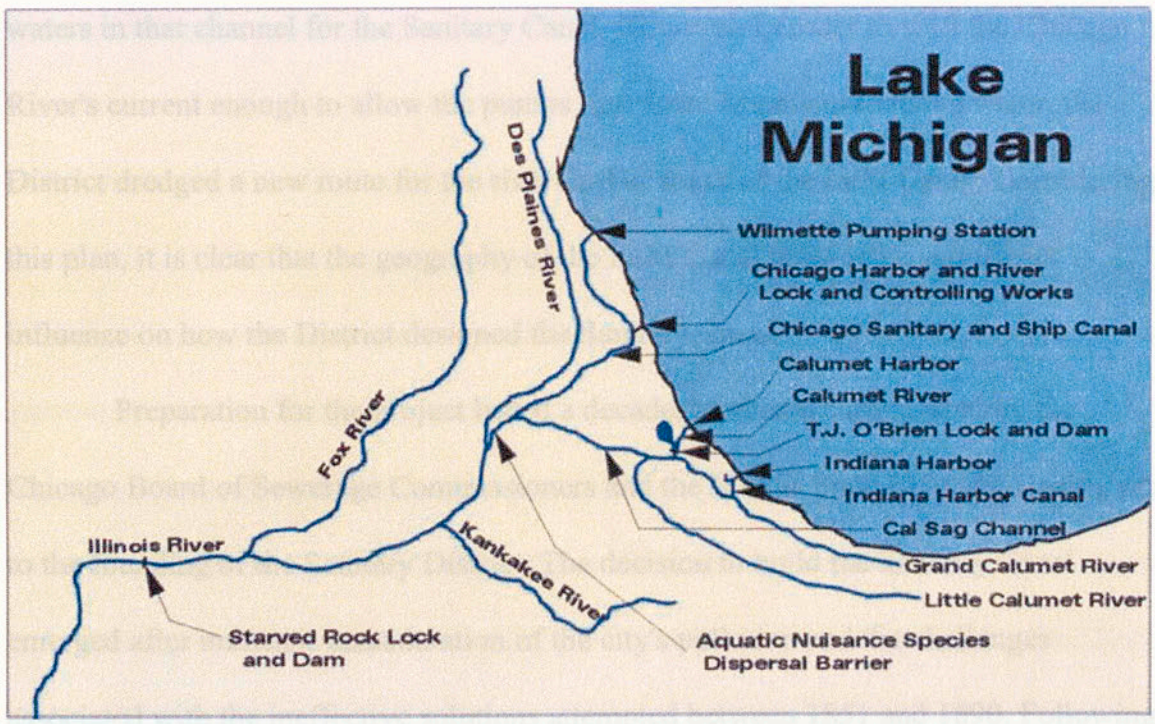

Figure 5: Rivers of the Chicago Area. Image courtesy of the U.S. Fish and Wildlife Service, http://www.fws.gov/midwest/mussel/images/chicago_rivers.html.

Having secured the rights to build the canal from both the Illinois General Assembly and the U.S. Congress, the Sanitary District planned to transport contaminated water outside Chicago while providing a commercial waterway that accommodated both warships and commercial vessels and, in effect, supplanted the

region's natural river system.[4] Though engineers used water in the South Branch of the Chicago River to build the Sanitary Canal, the District also built a channel that extended from the far northern section of the North Branch at Wilmette where a major pumping station pushed cleaner water into the canal. This channel pulled polluted waters on the North Side to the South Branch of the Chicago River for transport and treatment into the main canal. Originally, the I&M Canal connected the Des Plaines River with the much shorter Chicago River, which allowed the Sanitary District to utilize some of the waters in that channel for the Sanitary Canal. However, in order to shift the Chicago River's current enough to allow the pumps near Lake Michigan to move water, the District dredged a new route for the river farther south of the I&M Canal. Considering this plan, it is clear that the geography of the I&M Canal provided a significant influence on how the District designed the Sanitary Canal.

Preparation for the project lasted a decade, a process commanded by the Chicago Board of Sewerage Commissioners and the Illinois State Board of Health, prior to the founding of the Sanitary District. The decision to build the Sanitary Canal emerged after immense consideration of the city's pollution and the challenges associated with the ineffective solutions attempted between 1851 and 1890. Following water analyses conducted in the 1880s by the Illinois State Board of Health Chief Engineer Lyman E. Cooley, who replaced the retired Ellis Chesbrough in 1889, decided that the first step in the construction of the Sanitary Canal was to dredge the Calumet, Des Plaines, and Kankakee Rivers.[5]

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[4] Ibid., 95-8.

[5] Ibid., 98; and Prendergast, *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, 12 November, 1891, 263. Reporting to Richard Prendergast, the chairman of the Sanitary District's Board of Trustees Chairman, Cooley documented all elements of the construction process. Composed of

The District relied heavily on the history of the region in addition to its own geographical research. A line of ridges that run north and south just west of Chicago constituted the subcontinental divide for the region and provided for the original flow of the Chicago River. The construction of the Sanitary Canal required the excavation of this ridge to help tip the flow of water from Lake Michigan toward the Des Plaines River. These elements were some of the Sanitary District's central focuses in its geographic analyses, along with the rivers of northern Illinois. The District's post-construction report, published in 1924, discusses its use of journals kept by the French-Canadian explorer Louis Joliet and the French Jesuit missionary Jacques Marquette. While exploring the Mississippi River system in the 1670s, they reached Lake Michigan via the Illinois, Des Plaines, and Chicago rivers, and various portages, helping to establish the region's fur trade and providing some of the first European-style maps and surveys of the area. These sources were particularly useful in contextualizing those aspects of the geography untouched by the I&M Canal, including river depths and land elevation.[6] The Sanitary Canal had two principal purposes: to pull polluted water out of Lake Michigan and Chicago, while offering a commercial waterway linking the Illinois River with the nation's second largest city. Reversing the Chicago River remained vital to the achievement of these tasks. While the I&M Canal constituted a true triumph of human ingenuity, the Sanitary Canal went further. The Sanitary Canal's construction also involved widening the Chicago River to no "less than 160 feet wide and 22 feet

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sanitarians, businessmen, and local politicians, the Board needed as much information as possible so that it could allocate resources accordingly, while the Board of Sewerage Trustees, the Canal Trustees Board, and the Law Enforcement Board completed the legal organization for the project.

[6] *History of the Chicago Sanitary and Ship Canal*, 101-2.

deep" which tripled the width of the I&M Canal.[7] This widening ensured the accommodation of larger commercial and military vessels.

While evaluating the area's topography, the Sanitary District's Board of Trustees also acquired the necessary authority to complete its work. In 1888, the Illinois General Assembly passed the Sanitary District Enabling Act which formed the Chicago Sanitary District and stated its purposes. This legislation emerged after various town hall meetings in Chicago, organized by the Citizens' Association, in which residents affected by poor sanitary conditions, argued the case for immediate and large-scale action to its city aldermen and state legislators.[8] However, the District Enabling Act, which initiated preparatory work on the project, did not authorize the canal construction, nor did it allow the District to issue bonds. A year later in 1889, the General Assembly passed an additional law that gave the District bond-issuing abilities and allowed it to begin work on the Sanitary Canal. With this authorization from the Illinois General Assembly, the Sanitary District formed an advisory committee made up of two Illinois State senators, two state legislators, and the Mayor of Chicago. This board of five compiled reports and observations of the District's operations in the surrounding suburbs.[9] The committee then reported back to the Illinois General Assembly to provide public visibility of the work performed in their locales.

The Citizens' Association of Chicago, having gained significant political influence in Chicago politics due to its strong organization, continued to pressure civic

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[7] Ibid., 374. While "Hurd" likely refers to the publisher of Illinois legislation, and not the actual title of the law, this is how the Sanitary District identifies the legislation in its narrative.
[8] Ibid., 375. The Hurd Act also placed the limits on the Sanitary Canal's width as many residents in Ottawa and Peoria expressed concern about the possibility of further flooding in the area if the canal was too large and forced large amounts of additional water through the Illinois River.
[9] Ibid., 375-6.

officials to act and realize their "dream" of clean drinking water.[10] A chapter within the District's report entitled "The Work of the Chicago Citizen's Association" reflects this entity's power while suggesting the importance of organized citizen responses in building the Sanitary Canal.[11] The Citizens' Association believed that the project represented an opportunity to remedy its sanitary problems, but residents to the south and west of the city expressed doubt.[12] Many leaders in the District discussed the need to ensure proper dilution of wastes since so many residents downstream from Chicago worried about the continued presence of sewage and refuse.[13] Therefore, District officials maintained an awareness of the various opinions about their operations both inside the city and around the state, prior to and after the District received authorization to commence construction.[14]

Although the Citizens' Association of Chicago offered its complete support for the Sanitary Canal, opposition remained. After the 1889 formation of the Sanitary District, the City of Chicago and the State of Illinois held public meetings in downtown Chicago to discuss the project's plans and describe to state residents the particulars of the process.[15] Constituents from surrounding communities such as Des Plaines and Joliet expressed approval for the project, demanding that the proposed canal resolve their own sanitation issues. However, residents near the Illinois River, particularly in

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[10] *Citizens' Association of Chicago*, "Main Drainage," (Chicago: Hazlett and Reed Printers, November, 1881), 15. All of these transcripts can be found in either their original printed form, or in photocopied publications at the Harold Washington Library Center in its Municipal Records collection in the Government Information division.

[11] *History of the Chicago Sanitary and Ship Canal*, 336. The District refers to the Citizens' Association of Chicago here as the "Chicago Citizens' Association," though the former is the official name of the organization.

[12] *Citizens' Association of Chicago*, "Main Drainage," 16.

[13] Ibid., 17.

[14] *Citizens' Association of Chicago*, "Ship Canal," (Chicago: Hazlett and Reed Printers, October, 1880), 21.

[15] *History of the Chicago Sanitary and Ship Canal*, 376.

Peoria and Ottawa, opposed the project, voicing concerns about the destination of sewage and wastes once the canal opened.[16] Many of these people remained skeptical about the extent of waste dilution once the wastes moved beyond Chicago's city limits. The belief that the city simply wanted to dump its refuse on rural areas colored many of the opinions surrounding the project. Increased taxation in northern Illinois also incited significant public opposition, although most Chicago-area residents ultimately accepted the higher taxes. These town hall meetings served to offer comfort to many citizens who previously believed their opinions were falling on deaf ears. Following the public meetings, residents near the Des Plaines River discussed the project with their representatives in the General Assembly. Overall, there was significant support for the project and most people were hopeful that it would improve sanitary conditions in both Chicago and northern Illinois. On April 11, 1889, during a special session, the Assembly passed the Sanitary District Enabling Act. In the end, those representing Illinois Valley citizens authorized the project by a margin of 92 to 42.

This law outlined all of the tasks and responsibilities of the District as well as its constraints. The law prohibited the formation of other sanitary or engineering entities outside the District, meaning it had to, initially, complete the Sanitary Canal alone and with its own resources.[17] Illinois legislators did not, however, restrict the aid of federal agencies to assist in the Sanitary Canal project. The legislation did allow the District to generate revenue from the operation of docks and hydraulic pumps that provided water, and eventually electricity, to various neighborhoods. Therefore, the Sanitary District created some of its own revenue from canal operations along with the public funding it

[16] Ibid., 376-7.
[17] Ibid., 378-403. Law quoted within: *History of the Chicago Sanitary and Ship Canal.*

received from the State of Illinois. State legislators wanted the District to maintain transparency and insure that all public funding appropriately supported canal building. Thus, the District needed to establish various internal committees and boards to report to the Illinois General Assembly about the progress of construction.[18]

The law also allowed the District to establish all of its governing bodies. the District's Board of Trustees administrated the entity's funding along with the Drainage Board and the Board of Engineers, which assessed environmental conditions and canal construction, respectively. In addition to these internal bodies, other smaller departments emerged that dealt with responsibilities such as press briefings and labor relations. Ultimately, the District's organization reflected the complexity of its assumed task, and operated efficiently, with the Board of Trustees meeting daily. The Sanitary District, as a result of this act, became and remains the primary steward of the sanitation and water distribution strategy for metropolitan Chicago today.[19]

Despite earning the state's authorization and initially ample funding to begin construction, problems surfaced. Work on the Sanitary Canal did not ensue for another two years.[20] In the interim, according to the District's daily proceedings, the Drainage Board squandered more than one million dollars of the money procured from public sources to commence construction.[21] Cooley ordered additional surveys of the areas affected by canal construction, but did so in a manner that wasted both time and money. Under Cooley's supervision, officials duplicated many findings from previous surveys

[18] Ibid., 378-80, 403.
[19] Today, the Chicago Sanitary District is known as the Metropolitan Water Reclamation District of Greater Chicago.
[20] *History of the Chicago Sanitary and Ship Canal*, 405.
[21] Prendergast, *Proceedings of the Board of Trustees of the Sanitary District of Chicago*, "Drainage Board," 27 November 1891, 279.

and proposed additional modifications to the canal plan without considering their ultimate necessity. The Sanitary District's Board of Trustees fired Cooley as Chief Engineer and hired William E. Worthen.[22] This personnel maneuver avoided an investigation by the Illinois General Assembly and tempered some of the harsh media scrutiny. Worthen incorporated some of Cooley's work, but recommended the building of additional trenches between the towns of Summit and Joliet. The proposed trenches would allow engineers to make deeper cuts in the bedrock on the canal floor, increasing the flow of water and saving $25,700,000 in construction costs over the length of the project. Prendergast and other trustees, including Cooley, who retained his board membership, authorized the move and the spending of an additional $7,000,000 a year in both labor and materials.

All of these events drew significant criticism from the press, something that Prendergast feared from the outset. Covering the District's meetings in 1891, the *Chicago Daily Tribune* expressed doubt about the District's competency. According to the paper, the District "promised decisions and action...but has yet to take any," citing continued discussions of hydraulic pumps and talk of decreasing public spending on the project.[23] Needless work continued throughout the year as Worthen and other District members debated the canal's location.[24] The loss of valuable time claimed more victims. Prendergast also lost his post as Board president due to both the mismanagement of operations between 1890 and 1891 and Illinois politics.[25] Cooley, a Republican, secured a place on the Board of Trustees after various House campaign victories in 1892, and

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[22] *History of the Chicago Sanitary and Ship Canal*, 408-11.
[23] *Chicago Daily Tribune*, "The Drainage Canal Meeting: No Definite Action Taken-Another Meeting to be Held," 23 October, 1891, 3.
[24] *History of the Chicago Sanitary and Ship Canal*, 423.
[25] Ibid., 425.

this pressure forced Prendergast, a Democrat, to resign, amidst his party's loss of public support.[26]

Despite this political wrangling and growing media and public skepticism, construction finally began in 1892. The District held an inaugural ceremony on September 3, near the Cook County line. A train carrying state dignitaries arrived at a small platform where various members of the General Assembly and the Sanitary District gave speeches emphasizing the canal's importance and the promised benefits for Chicago. Those in attendance included new District President Frank Wenter, Trustee Prendergast, Trustee Cooley, and Chief Engineer Worthen. Speakers supported the ideals of politicians and their "unwavering" commitment to the "public interest," through attention paid to citizens' sanitary concerns.[27] According to the *Chicago Daily Tribune*, the District selected the location as it provided the boundary between the two areas most affected by pollution: Chicago in Cook County and the river valleys in DuPage County. The paper also mentioned the location's importance; it reflected the District's attempt to bring the two constituencies together under the banner of improved sanitation, despite lingering political and economic differences.[28]

This inauguration attracted national interest. The *New York Times* sent a contingent of reporters to cover the beginning of construction, highlighting the project's importance for Chicago and for the prevailing national sanitation movement. According to the *Times*, the excavation of the proposed waterway constituted an "enterprise that will rank, when completed, with the most important modern marvels of engineering."

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[26] *The New York Times*, "For a Great Waterway: Work Begun on the Big Ditch From the Lakes," 3 September, 1892, 6.; *History of the Chicago Sanitary and Ship Canal*, 425.; *Chicago Daily Tribune*, To Begin the Ditch: Drainage Board to Hold 'Shovel Day' Ceremonies, 2 September, 1892, 8.
[27] *History of the Chicago Sanitary and Ship Canal*, 424-7.
[28] *Chicago Daily Tribune*, "To Begin the Ditch," 8.

Despite the pomp and circumstance, media coverage suggests that many Chicagoland residents still doubted the project's potential.[29] Pressure on the District and its endeavors steadily increased. That same day, the *Daily Tribune* published an article discussing the persistence of cholera in Chicago, in part, because of the ongoing political and territorial disputes between the City of Chicago and the Illinois State Board of Health.[30] Reporters at the *New York Times* learned of the political battles between District members, which claimed the jobs of both Cooley and Prendergast, which suggests the national attention being received by the District's activities.[31]

Despite some of the discouraging press, the District continued excavating the continental ridge along Chicago's western perimeter. However, the secondary streams and rivers proved as crucial to this project as the gently sloping Illinois plains. The feeder channels, including the Des Plaines and Calumet rivers, required leveling and dredging to ensure a sufficient current for the canal link to be built between the Chicago and Des Plaines rivers.[32] Workers detonated several tons of TNT on a small hill that straddled the Cook and Will county line, for example, to alter the area's elevation and to create a space for the canal bed.[33] Although the initial plans involved using the original I&M Canal and Des Plaines River beds for the Sanitary Canal, the District needed to accommodate a much larger space for the waterway while varying the elevation on the canal floor. This phase of the construction process lasted some two more years before dredging work commenced on the feeding rivers.

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[29] *The New York Times*, "For a Great Waterway," 6.
[30] *Chicago Daily Tribune*, "Will Fight Cholera: Local Physicians Take Steps to Meet the Plague," 11 September, 1892, 3.
[31] *The New York Times*, "For a Great Waterway," 6.
[32] *History of the Chicago Sanitary and Ship Canal*, 106.
[33] *Chicago Daily Tribune*, "To Begin the Ditch," 8.

Construction Schedules for Components of the Sanitation System		
Component/Project	**Started**	**Completed**
1. Illinois and Michigan Canal---Connected to the S&S Canal at Lockport, Ill.	1836	1848
2. Chicago Sanitary and Ship Canal	1892---(Excavated between 1893 and 1896)	1900
3. North Shore Channel-Wilmette, Ill.---Connected via the North Branch of the Chicago River	1907---(Excavated between 1908 and 1909)	1910
4. Calumet-Sag Channel---Connected to S&S Canal at Lemont, Ill.	1911---(Excavated between 1912 and 1914)	1922

Table 1: Construction Schedules for the Components of the Sanitation System.

Construction of the Sanitary Canal occurred largely in phases; excavation occurred first and dredging followed. The excavation and earthen removal process constituted the most expensive and time-consuming phase in building the Sanitary Canal. By the time the District released its first engineering assessment in 1895, it already had issued more than $12 million in bonds and estimated the total cost of the completed project to just more than $26 million.[34] However, District leaders believed this construction stage was the most important as it laid not only the foundation for the drainage ditch, but also the other channels that would facilitate pollution removal.

[34] Sanitary District of Chicago, *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, (Chicago: City of Chicago Publishers, 1895), 7-18. These documents can be accessed in their original printed form at the Harold Washington Library Center in the Municipal Records collection in the Government Information division

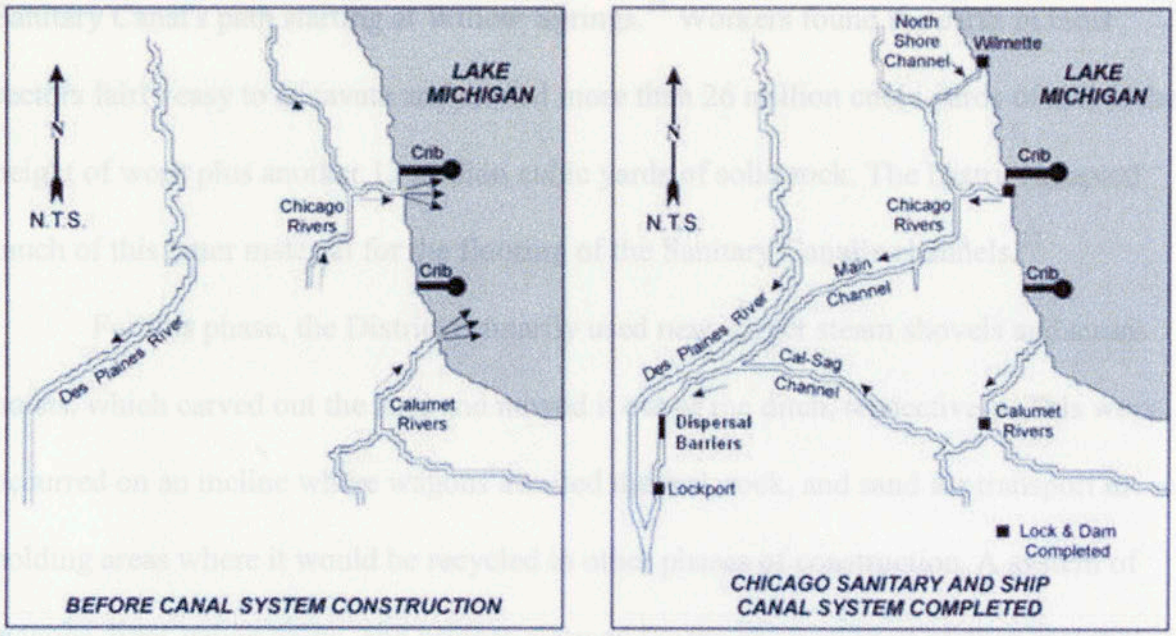

Figure 6: Sanitary and Ship Canal System: Before and After. Source: United States Army Corps of Engineers. http://www.usgs.gov/.

In September 1894, primary work commenced on the feeding waterways. A third Chief Engineer, Isham Randolph, rose to the position in 1893 after concerns emerged among members of the Board of Trustees surrounding Worthen's ability to draft a plan for river reversal that effectively utilized District time and money. The District used contracted labor for canal construction, employing companies from Chicago and surrounding communities including Romeoville and Lockport. Because of the close proximity of these towns and businesses to the canal site, and considering that the towns both had prior experience with the I&M Canal, the companies could access the area easily without committing too many resources to transportation.[35] According to the District's engineering reports, the strategy adopted by Engineer Randolph involved continuing the project in one mile-length sections, identified by letter, along the

[35] Ibid., 18.

Sanitary Canal's path starting at Willow Springs.[36] Workers found the earth in most sectors fairly easy to excavate and moved more than 26 million cubic yards of soil at the height of work plus another 12 million cubic yards of solid rock. The District adapted much of this latter material for the flooring of the Sanitary Canal's channels.[37]

For this phase, the District primarily used new, larger steam shovels and steam hoists, which carved out the land and moved it out of the ditch, respectively. This work occurred on an incline where wagons awaited the soil, rock, and sand for transport to holding areas where it would be recycled in other phases of construction. A system of wagons, light-gauge trains, and bridges allowed for the excavation of earthen material, and provided much of the transportation needed for equipment and personnel. According to the District's engineering reports on the construction's early stages, workers could move a hundred yards worth of land in an hour with these machines.[38] Engineers employed the cantilever conveyor to remove larger objects including boulders, but it also provided a bridge for the movement of equipment. This machine had wheels that allowed for 360 degree rotations and had two cantilever arms that carried materials onto a conveyor belt running parallel to the ditch. Running at full capacity, the cantilever conveyor moved more than 500 cubic yards of earth in an hour.[39] Although large and complex, the bridge only required one operator, making it both efficient and inexpensive.

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[36] Ibid., 7. The District used the engineering reports during their internal meetings, and also referenced them in reports to the Illinois General Assembly. Neither the District, the City of Chicago, nor the State of Illinois published the documentation of the construction progress publically.
[37] Ibid., 10-2; and *The Chicago Daily Tribune*, "Advance on the Drainage Canal," 1 January, 1895, 12.
[38] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 8-12.
[39] *The Chicago Daily Tribune*, "Advance on the Drainage Canal," 12.

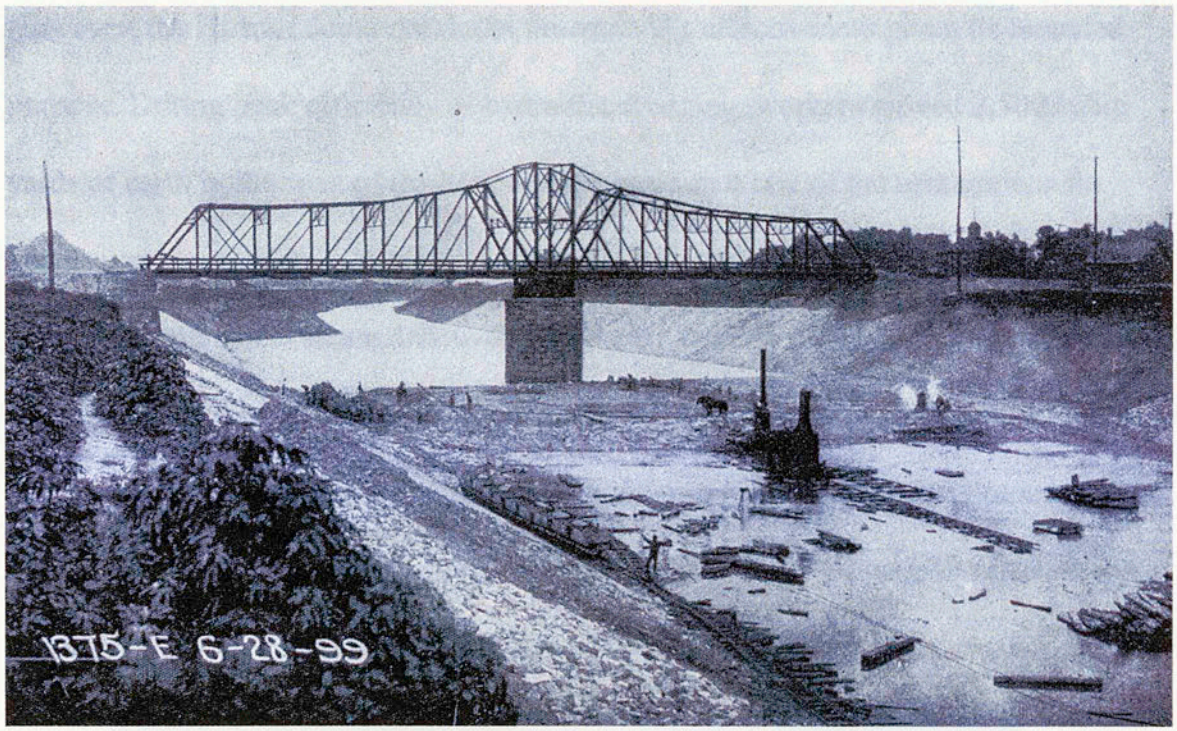

Figure 7: New Bridge Crossing the Canal Ditch, Looking East, 1899. Image Courtesy of F.E. Compton and Co. (1914), Chicago Historical Society.

The District employed many of the most popular construction methods of the period to build the canal, though it used them rather strategically.[40] For sections of the drainage ditch that included mostly soil, sand, and gravel, engineers employed steam shovels, steam hoists, and the cantilever conveyor. Generally, the work on these areas of the canal route progressed quickly, and in an assembly-line fashion, with various machines lined up in the construction zone carrying materials out of the ditch. While working on areas of the channel that involved moving partially submerged material, District workers utilized the hydraulic dredging method. The concept of hydraulic dredging included the use of a small boat fitted with a shovel that cut out sections of the river floor while lifting it above water and to another location. Although a common

[40] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 18.

method in canal building, the District report described the process as tedious and slow. However, the District could not doubt the method's effectiveness given its intended purpose. During peak efficiency of hydraulic dredging, workers moved 2,500 cubic yards of earth in the span of ten hours, easily making it one of the best options for underwater excavation.[41] In areas of the ditch that involved heavy rock, laborers used explosives and a new steam drill to dig, while the conveyor bridge moved the elements out of the trough onto rail cars, wagons, or holding containers for transport. The District chose to rely on the cantilever conveyors for most of the excavation and movement of the trenches' lighter materials. The District owned eleven of the cantilever conveyors and designated them "the best possible machines" for soil removal.[42]

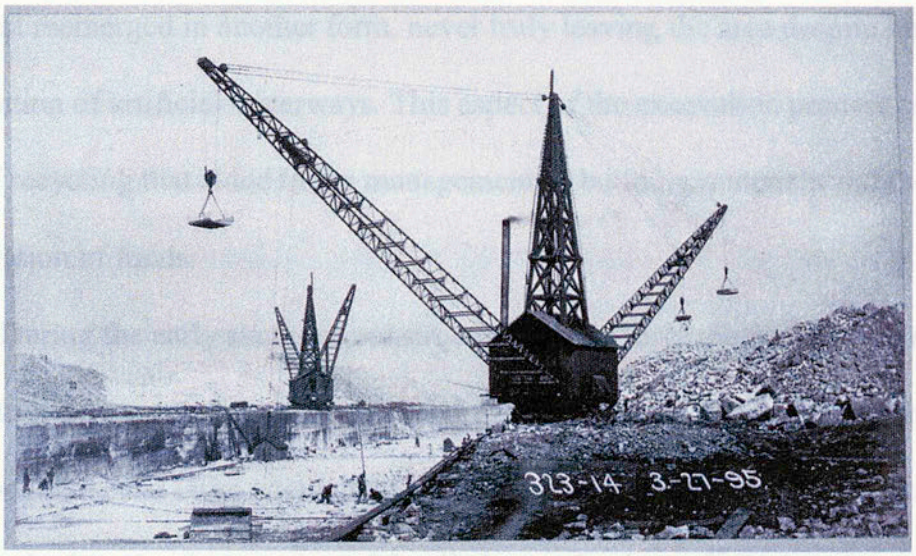

Figure 8: Lift Cranes along the Canal Ditch, 1895. Image Courtesy of the Encyclopedia of Chicago.

The "glacial recesses," as documented in the engineering reports, made for relatively soft, porous soil and sand mixed with some gravel, all of which yielded easily

[41] *The Chicago Daily Tribune*, "Advance on the Drainage Canal," 12.
[42] *History of the Chicago Sanitary and Ship Canal*, 106.

to steam shovels.[43] While laborers excavated in Chicago and eastern Will County, the District sent engineers up the Des Plaines River toward the northern sections of the Chicagoland area. Here, work began on a nineteen-mile levee system meant to "divorce" waters of the Des Plaines into the new drainage trench that assisted in carrying effluents out of Chicago and Lake Michigan.[44] Adding more glacial drift, gravel, sand, or rock to the bottom of the various waterways involved a significant shift in the flow and strength of riparian currents. In fact, an important aspect of the Chicago River reversal was the removal of land to build new channels. Engineers used much of the solid rock and gravel to construct retaining walls near levees and water locks along the canal route. Therefore, they moved earthen materials to accommodate the drainage ditch that reemerged in another form, never truly leaving the area despite the construction of artificial waterways. This aspect of the excavation process constituted a form of recycling that aided in the management of building materials and the conservation of funds.

During the early stages of construction, particularly the dredging of new ditches, the District encountered some personnel difficulties because of more challenging soils. Rock, boulders, and large amounts of gravel "embedded in blue cement" proved particularly daunting in a section of the ditch near Lockport.[45] Ricker, Lee and Co. demanded additional compensation to pay workers for the extra time spent trying to dislodge matter from these ditches. The Sanitary District failed to inform many of the contractors about the nature of the earthen materials along the construction route, meaning that workers arrived at the site unprepared and sometimes unequipped to

[43] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 18-9.
[44] *History of the Chicago Sanitary and Ship Canal*, 115.
[45] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 18-9.

handle certain excavation locations. According to some contractors, the District described most of the earthen matter as "glacial drift," that required little work to move. Instead, workers sometimes stood idle, awaiting the arrival of larger machines to remove rock from the channels or devised other strategies for exploding the material or moving it in pieces. Regardless of these varied solutions, workers remained on site for much longer periods of time than their managers had expected to pay. Labor costs, initially budgeted at nearly $180,000, threatened to increase, placing new demands for more monetary resources on the District. After many legal battles, District officials paid the overtime money to the contractors, including Ricker, Lee.[46]

Wages for canal workers caused frequent problems, unexpected boulders notwithstanding. Many laborers, working for contractors such as the McCormick Company, seldom received more than thirty cents an hour for dangerous work which often involved explosives, heavy machinery, and movement near ledges, cliffs, and water.[47] On multiple occasions, detonation devices failed causing blasts in the channels where the concussive explosions and falling rocks injured workers.[48] One particular 1894 explosion, in a section of the drainage ditch near Lemont, killed three workers. Although injuries were common, these were the only three laborers killed in the canal construction. Ironically, poor sanitary conditions in the workers' camps also spread illnesses such as dysentery. Furthermore, many of the encampments also lacked clean privy vaults and garbage receptacles.[49] Housing further undermined laborers' health and safety. Most accommodations were nothing more than wooden shacks which offered

[46] *The Chicago Daily Tribune*, "Hard Digging in Drainage Canal," 5 April, 1894, 3.
[47] *The Chicago Daily Tribune*, "Drainage Canal Laborers Strike," 5 January, 1893, 7.
[48] *The Chicago Daily Tribune*, "Explosions on the Drainage Canal," 6 January 1894, 6.
[49] *The Chicago Daily Tribune*, "Drainage Canal Laborers Strike," 7.

little protection from the elements.[50] Though many workers did not suffer diseases such as typhoid fever as many laborers did during the Panama Canal construction, dysentery inflicted hundreds of men working in the canal ditch.

A twenty-page exposé in the *Daily Tribune* detailed these horrid conditions, inciting public protest. Dangerous equipment and terrain, long hours, and low pay, sometimes less than promised, prompted workers building the Sanitary Canal to organize.[51] According to the *Daily Tribune*, the McCormick Company told workers they would receive thirty-three cents an hour for their work, which was not to exceed, in normal conditions, eight hours. Many laborers often worked in excess of thirteen hours for their thirty-three cent an hour daily wage. Pay deception by contractors and lapses in oversight and management on the part of the Sanitary District, led workers to strike at the drainage ditch near Lockport.

The strike lasted two weeks in January 1893 and forced the District to make changes in its project administration. During and following the incursion, District leaders initiated weekly inspections of worker camps and negotiated with contractors to increase wages. On the morning of the strike, the Drainage Board met and established parameters for the camp inspections and issued disease maps of the area to officials near work sites. The disease maps displayed the areas around the construction site where illnesses were most prevalent. This new protocol prioritized certain areas for inspection by assessing the impact of diseases, particularly near Lockport and Willow Springs. Soon, the District issued additional bonds to support contractors in the purchase of newer technology, including cantilever conveyors, to increase worker efficiency and

[50] *The Chicago Daily Tribune*, "Along the Drainage Canal," 26 May, 1895, 41.
[51] *The Chicago Daily Tribune*, "Drainage Canal Laborers Strike," 7.

safety that offset the costs of the initial capital outlay. With further District oversight of the contractor-maintained camps, workers soon saw their wages and work-place safety improve, though conditions remained rather dangerous as evidenced by blasts in 1894.[52]

Despite these different challenges, work continued on the canal. Most operations occurred between 1894 and 1896.[53] Dredging and cutting of the earth constituted only a few aspects of the Sanitary Canal's construction. The District endeavored to ensure that the canal and the ditches that facilitated it were ready to accept drainage in the most efficient way possible to both offer relief to areas ravaged by pollution and save money. Although the I&M Canal provided some portions of the new drainage channel, particularly in Chicago city limits, the District also constructed thirteen miles of new trenches to carry the waters from the Sanitary Canal.[54] The material composition of each canal section differed largely based on the soils that workers encountered during construction. Some components had floors and bases of solid rock or concrete, while other sections of the canal utilized gravel and sand flooring. At each new section, workers installed locks and gates that regulated water levels and allowed for further control of the Des Plaines River, particularly during spring and summer flooding. Engineers conducted the same process for the feeding rivers, particularly the Little Calumet near the city's southern edge.[55]

Along the route, District engineers constructed pumping and purification works to facilitate the aeration process once the canal could accept water. In addition to the construction of ditches, levees, and aeration pumps, the District also ordered the

[52] Ibid., 7; *The Chicago Daily Tribune*, "Explosions on the Drainage Canal," 6.
[53] *The Chicago Daily Tribune*, "Advance on the Drainage Canal," 1 January, 1895, 12.
[54] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 9.
[55] Ibid., 9-10, 75-6.

installation of small concrete dams and spillways between Summit and Joliet to maintain the canal's depth and current. The District needed to sustain pre-construction water levels in order to keep sewage and wastes in place until workers allowed each ditch to accept effluents. The District also linked the Sanitary Canal to the Chicago Sewer System to facilitate rapid disposal of inner-city wastes.[56] During the early stages of construction, the District ordered the installment of concrete pipes which connected the sewers to the canal.[57] Building this connection to the sewer system was convenient since the excavation process allowed workers to place sewage tunnels into the canal ditches. These modifications simply added to the complexity of the Sanitary Canal and furthered its pivotal role in confronting Chicago's pollution challenges.

Though the function of this waterway completely differed from the original flow and character of the Chicago and Des Plaines Rivers, the Sanitary Canal, whether with its natural or artificial components, interacted directly with the surrounding environment used to build it. Engineers manipulated the earth, in radical ways to address enormous sanitation challenges in Chicago and its hinterlands. Throughout the entire construction process, the District reinforced many of the same economic and environmental linkages between Chicago and adjacent communities. To reverse the Chicago River's flow, the Sanitary Canal required additional waters and current from feeding rivers and a smaller drainage canal through the Little Calumet River. In his landmark work, *Nature's Metropolis*, William Cronon discusses the intricate relationship between the urban center of Chicago and neighboring areas, arguing that Chicago could not survive without the resources transported into the city from primarily

[56] George B. Swift, *The Chicago Daily Tribune*, "To Aid Water Supply: Mayor Urges Swift Action From the Drainage Board," 26 May, 1895, 8.
[57] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 8.

rural areas. However, Cronon also maintains that this relationship relied on Chicago's economic rise to prominence in the mid-nineteenth century. The city's success, aided by the financial support and promotion of urban boosters, originated in the city's geographic location and the amenities of the portage and Lake Michigan.[58] The links between the river, Chicago's ascension, and its hinterland development constitute a continuing thread throughout the city's history that the emergence of industrial pollution complicated. Connections between all of the area waterways eased the flow of contaminants in Chicago and surrounding communities. In neighboring areas, commercial traffic increased along with the interference of state government in the affairs of rural residents. However, many people believed that the canal represented a unique opportunity to improve their lived conditions and held high expectations for the project. The success of the canal rested, largely, on how those affected citizens viewed its effectiveness.

The Sanitary Canal opened for traffic between Chicago and Lockport in January 1900.[59] The completion of operations, as expected, drew both local and national media attention amidst lingering questions about the canal's ultimate performance.[60] Perhaps a dozen spectators joined a few District officials and workers to view the opening of the water gates, marking the beginning of the canal's use. Frigid temperatures caused ice to block waters in the canal, preventing one of the locks to open and requiring workers to explode the frozen blockage.[61]Upon displacing the ice, 30,000 cubic feet of water poured through the locks and continued to run throughout the day until peak capacity

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[58] Cronon, *Nature's* Metropolis, 7-9, 23-4.
[59] *The Washington Post*, "Big Drainage Canal Open," 2 January, 1900, 3.; *The New York Times*, " Chicago Drainage Canal: Water of River turned into Main Channel, 2 January, 1900, 5.
[60] "Big Drainage Canal Open," 3.; "Chicago Drainage Canal," 5.
[61] *The Washington Post*, "Big Drainage Canal Open," 3.

exceeded 50,000 cubic feet of water a minute. With the start of operations, the canal soon moved 300,000 cubic feet of water every minute, although still only half of its intended volume.[62] Unlike its inauguration, the 33-million-dollar canal opened without any ceremony, because of concerns surrounding how much water could move through the canal in winter. Although the reporter for the *Washington Post* did not mention it in the article, the absence of pleasantries and ceremony likely had connections to the controversies, delays, disputes, and various setbacks faced by the District throughout the canal's construction. Engineers also feared flooding Lockport and Joliet if they released the canal's entire capacity too quickly, particularly before a national audience.[63] Were a flood to occur before a large audience, the District would receive even more negative publicity and face a public catastrophe. Only after about a week's worth of water flow did the canal's current and depth match the capacity of its feeder channels and the Illinois River south and west of Joliet.[64]According to the *Washington Post*, "probably never before has the completion of a public work of this magnitude, been marked with such absolute lack of ceremony."[65] While the Sanitary Canal certainly constituted an engineering marvel, the actual focus of the article was, in fact, the living conditions in Chicago.

The Sanitary Canal marked a significant achievement in civil service, and environmental engineering. However, the mere presence of the canal reflected the desperation of local, state, and federal governments, faced with impending political and economic peril. The opening of the canal likely did not incite much celebration, but

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[62] *The Wall Street Journal*, "The Drainage Canal," 6 January, 1900, 2.
[63] *The Washington Post*, "Big Drainage Canal Open," 3.
[64] *The New York Times*, " Chicago Drainage Canal: Water of River turned into Main Channel, 2 January, 1900, 5.
[65] "Chicago Drainage Canal: Water of River Turned into Main Channel," 5.

somber determination and apprehension; a desire to see the goal through. A large public audience and media presence would likely document any further setbacks and failures, thus adding to the controversy surrounding the Sanitary Canal's construction.

However, even by 1900, the larger canal scheme remained unfinished. Sections near Joliet and the connections to the Illinois River required additional work that included the construction of new flood gates and further dredging of the canal bed. Many of these improvements required further District funding which sparked new financial and legal crises for canal officials. Few in the local media seemed surprised given the delays early in the construction process. Perhaps some of the hidden expenses included many of the bridges crossing the canal and the Chicago River at various intervals along its route.[66] Since the District was a state agency, it could charge other communities and entities in Illinois for services that the District could not complete with its own resources. While this practice did not emerge in all areas and in all instances of canal construction, the District still drew criticism from the public and from the media regarding some of its borrowing procedures during the final days of work. Much like the wasted time and money that framed the project's beginning, criticism of the District and the entire process continued and remained a permanent fixture until the reversal in 1900. Nonetheless, work eventually ended and hopes for a cleaner city, though tempered, remained strong.

The initial environmental and sanitation results of the canal were far from certain. In 1900, the new Board of Trustees reported that the Sanitary Canal would lower lake levels, easing the passage of sewage and wastes through the waterway. However, the District admitted that operation of the canal constituted an ongoing

[66] *Chicago Daily Tribune*, "Report on Drainage Canal is Delayed Several Months," 14 June, 1900, 6.

experiment, and that it might take several years for the canal to perform at capacity. The District also revealed that the accommodation of shipping traffic demanded a widening of the waterway to facilitate the flow of 600,000 gallons of water from the lake and sewer system. The widening and improvements to purification works meant that the District needed an additional 100,000 dollars to complete the Chicago Harbor and the sanitation facility established there. The United States Army Corps of Engineers ("the Corps") provided just over $101,000 to the Sanitary District, in addition to engineering advice, to complete the harbor. Both parties agreed this measure helped to complete the shipping route from the Mississippi River to Lake Michigan and thus, served military needs.[67]

The District had little time to consider the immediate responses to its work; it had to proceed. Continuing the interaction with surrounding natural features, work continued on the canal and the waterways needed to facilitate its operation. The District intended for the Calumet-Sag (C&S) Canal, which could accommodate around 300,000 cubic feet of water and reverse the flow of the Little Calumet River, to provide sanitation relief to people near the Illinois and Indiana border. District engineers, through excavation, built the Sanitary Canal to hold around 600,000 cubic feet of water to service around 3,000,000 people in both Cook and Will Counties.[68] The added drainage capabilities of the future C&S Canal allowed engineers to monitor water levels in the Sanitary Canal and other rivers associated with drainage operations. Following the excavation process in 1896, the District administered the building and maintenance of pumping and sanitation works along the canal route.

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[67] *The Chicago Daily Tribune*, "Gives Facts on Drainage Canal," 30 October, 1900, 16.
[68] *A Concise Report on its Organizations, Resources, Constructive Work, Methods, and Progress*, 9-10.

There were, however, people who opposed the project, even before construction began. Many residents in northern Missouri, particularly near the St. Louis area, expressed strong concern regarding the Sanitary Canal and the transportation of wastes downstream, even during the excavation process in 1895. Representative Richard Bartholdt of St. Louis introduced a bill in the U.S. House of Representatives to investigate Sanitary Canal's water. The bill moved to halt construction of the Sanitary Canal until the investigative committee could determine its water quality, however, the bill died on the house floor likely because of federal support for the District. Therefore, the Sanitary Canal's opening ensued as scheduled, though the Supreme Court set a hearing date for April 2.[69]

The hearing, which involved representatives from the State of Illinois, the State of Missouri, and the Chicago Sanitary District, convened in Washington D.C. [70] The arguments from Missouri stated that the livelihoods and living conditions of Chicago residents should not come at the expense of people living downstream. However, the State of Illinois and the Sanitary District argued that its engineers dilute all sewage flowing through the canal, and that the cities of Omaha, Nebraska and Kansas City, Missouri had similar sanitation issues, although St. Louis elected to not sue either city. Furthering its argument, the State of Illinois claimed that Missouri did not issue its suit until the canal opened, despite knowing the intentions of the Sanitary District ten years prior to the start of construction, choosing, instead, to sue the State of Illinois after it commissioned the Sanitary Canal project.[71] Ultimately, the Supreme Court sided with the State of Illinois and the Sanitary District, citing interstate commerce. However, the

[69] *The Chicago Daily Tribune*, "Aimed at the Drainage Canal," 6.
[70] *The New York Times*, "Chicago Drainage Canal Suit," 23 April, 1900, 3.
[71] *The Chicago Daily Tribune*, "Demurs in Canal Suit," 10 April, 1900, 8.

Corps promised to maintain a "reasonable level of cleanliness" in the river for the people of St. Louis; the Sanitary Canal avoided an early closure.

While the State of Illinois avoided this potential catastrophe, difficulties continued for the Sanitary District, particularly concerning local entities and the control of canal waters. In 1913, Lyman E. Cooley, still serving as a consulting engineer, released another internal report to the Illinois General Assembly and the City of Chicago regarding one of the main feeders to the Sanitary Canal, the C&S Canal on Chicago's south side. This report revealed difficulties facing the District regarding the channel's performance in diverting water from the South Side.[72] The District intended for the C&S Canal to bring in added water from Lake Michigan into the Sanitary Canal to aid in the Chicago River reversal. Additionally, the C&S Canal would work toward transporting polluted waters from industrial areas near Blue Island, Illinois toward the Sanitary Canal.

While the District reversed the Chicago River, it also shifted the flow of the Little Calumet to serve both purposes of feeder and drain for the city's southern periphery. Cooley noted in his report the presence of added rock and glacial shift in the C&S Canal which prevented the proper amount of water, at around 50,000 cubic feet, to flow into the Sanitary Canal While the Chicago River no longer flowed into Lake Michigan in 1913, the C&S Canal did not perform up to its intended standard, which allowed for further pollution in communities south of Chicago. Flood-control posed

[72] Lyman E. Cooley, *The Calumet District: Supplement to the Brief-Diversion of the Waters of the Great Lakes by Way of the Sanitary and Ship Canal*, (Chicago: City of Chicago Publishing Co., 1913), 1-5. This source also documents many of the Sanitary District's efforts on the South Side of Chicago from the 1880s up to the report's release in 1913. It is a useful source for information about some of the feeder canals into the Chicago Sanitary and Shipping Canal. These documents can be accessed at the Harold Washington Library in its Municipal Records collection within the Government Information division.

another issue. In 1909, Cooley documented a flood in areas near Blue Island and Morgan Park from the channel. While not a life-threatening event, Cooley stated that this type of situation had the potential to cause significant loss of life and property.

An increase in population in the southern division also meant that the services of the C&S Canal constituted a more pressing necessity. Therefore, Cooley recommended additional funding to remove added earthen materials from the channel and to push more water through the C&S Canal.[73] Cooley suggested an enormous sum of around $15,000,000 to clear the waterway, a two-year long task. Eventually, the Sanitary District agreed with the recommendations of its consultant and commissioned work to clear the channel of additional rock and earthen material diverting more water from Lake Michigan along the southern periphery of Chicago and into the Sanitary Canal. Modifications to the C&S Canal continued through 1922.

The reversal of the Chicago River, which allowed the District to force sewage and pollution out of Lake Michigan, initially saw success. Contaminated water, by 1919, moved through the channel at a rate of 600,000 cubic feet an hour and improved the efficiency and effectiveness of the Chicago Sewer System. However, the District realized, even after the completion of the Sanitary Canal, that the industrial production on the South Side continued and forced more pollution into the now reengineered Chicago River. Though none of this contamination affected downtown Chicago or Lake Michigan, problems persisted in industrial communities, particularly Packingtown. The District submitted another assessment of continued pollution near the Union Stockyards which generated a major portion of the city's economic output into the early twentieth

[73] Ibid., 5.

century.[74] In 1919, the Sanitary District still confronted severe environmental contamination emanating from the meat-packing facilities near the Union Stockyards. The District identified the Stockyards as the continuing culprit in the polluting of Chicago and its surrounding areas.

This report reflects the District's recognition of something that most sanitation entities, and even the sanitation community up to that point, ignored or denied. That realization was even the most advanced engineering efforts in the United States did not completely end the ecological contamination associated with capitalist production. Instead, the Sanitary District simply drained wastes from urban sinks in southern sections of Chicago and Lake Michigan, diluted them, and shifted them elsewhere. Though engineers viewed the Sanitary Canal as a permanent solution to the city's polluted living conditions, the meat-packing industry seemed just as immovable. Historian Sylvia Washington, in her work *Packing Them In*, illustrates how Black packinghouse workers in the 1950s still faced poor drinking water and cramped living conditions that often involved the presence of disease-carrying insects and rats.[75] Washington's appraisal of the continued struggles of working-class people of color demonstrates the depth of the sanitary crisis in Chicago; even the greatest earth-moving project in U.S. history could not address the issue completely.

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[74] The Chicago Sanitary District, *The Stockyards Treatment Plant*, (Chicago: City of Chicago Publishing Co., 1919), 1. Here, Packingtown largely refers to the modern-day Back of the Yards neighborhood just south of the Union Stockyards and the Chicago River. The approximate boundaries of this community are Pershing Rd. on the north with Halsted Ave. on the east and Western Ave. on the west. Garfield Blvd. constitutes the neighborhood's southern boundary. These documents can be accessed at the Harold Washington Library Center in the Municipal Records collection within the Government Information division.

[75] Sylvia Hood Washington, *Packing Them In: An Archeology of Environmental Racism in Chicago, 1865-1954*, (Lanham, MD: Lexington Books, 2013), 5.

However, in 1919, the District considered attacking pollution at its largest source. Prior to the beginning of the First World War, South Side industries stalled slightly, which decreased pollution. However, once the war ended and the population in Chicago exploded following the Great Migration, meat-packing and other industries returned to their original productive capacity. District engineers noted the continued issue of industrial waste in the South Fork of the Chicago River, known as "Bubbly Creek."[76] While the Sanitary Canal brought large amounts of wastes and sewage out of the city and of Lake Michigan, packing companies, especially Armour and Swift, used the small stream as a sink, causing severely polluted living conditions characterized by a foul stench and large amounts of coagulated, standing sewage.[77]

The District's proposed solution to the ongoing issue involved the construction of a water treatment plant near the Union Stockyards. The Sanitary District, along with engineers working within the meat-packing industry formed a joint committee following the First World War to determine the composition of sewage and wastes in the South Fork and how best to eliminate them. Both parties involved encouraged the collaborative effort in order to appear more cooperative to a public weary of sanitation problems. The District also agreed that the engineers working with the slaughterhouses could offer insight regarding the production of wastes and further information about how to battle them. Though the diversion of waters in the Chicago River from Lake Michigan largely succeeded, most of the effluent in Bubbly Creek remained stagnate after the reversal. This meant that while sewage and wastes did flow into the Sanitary

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[76] *The Stockyards Treatment Plant*, 2, 8-9. Here, the District refers to both the formal name of the stream (The South Fork of the South Branch Chicago River), and Bubbly Creek. For the sake of brevity, this work will use "South Fork" and "Bubbly Creek" interchangeably.
[77] Ibid., 2-4.

Canal, the current did not exist to create a sufficient flow in the South Fork. This actually threatened the District's control of the Sanitary Canal and its treatment works as the Federal Government applied intense pressure on the organization to solve a problem many believed should no longer exist.

To remedy the situation, engineers from both the District and the packers considered several solutions, but decided upon more direct treatment of water prior to dispensing it into the Sanitary Canal. However, both groups believed that water levels in Lake Michigan might help the issue. The media, as well as some members of the public expressed concern that the water levels in Lake Michigan, which lowered following the river reversal, might threaten the Sanitary Canal's performance.[78] The District's Board of Trustees requested that the Corps empty water from the St. Lawrence and the St. Clair Rivers to increase the depth of Lake Michigan.[79] The added lake water would then increase water levels in the Sanitary Canal thus forcing more water through the channel for dilution, while dispensing it into the Illinois River.[80] The U.S. government concluded that this solution would not provide the adequate water needed to remove sewage and wastes from Packingtown.[81]

Ultimately, federal agencies instructed the District to construct a water treatment plant near Bubbly Creek to directly purify waters before they emptied into the Sanitary Canal. In addition to this measure, the District also chose to close off a section of Bubbly Creek to build a small retention pond at the far end of the stream as a holding area for water treatment. Additionally, to divert more water through the canal, and to

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[78] Ibid., 4.; *The Chicago Daily Tribune*, "Gives Facts on Drainage Canal," 16.
[79] *The Stockyards Treatment Plant*, 4.
[80] *The Chicago Daily Tribune*, "Gives Facts on Drainage Canal," 16.
[81] *The Stockyards Treatment Plant*, 4.; and Washington, *Packing Them In,* 130.

aid in cleaning the South Fork, the District returned to one of its earlier goals to widen the Sanitary Canal which involved connection with the I&M Canal. The three waterways appeared this way in 1899:

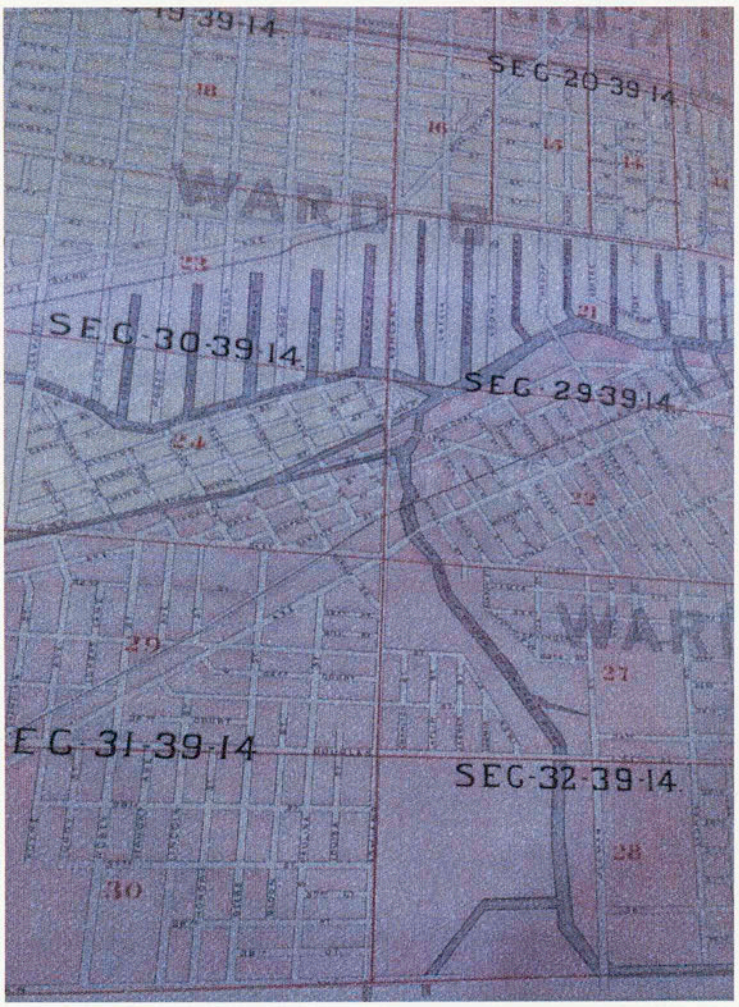

Figure 9: South Fork of the South Branch of the Chicago River showing the connection with the Chicago River and the I&M Canal (1886). Map Courtesy of the Newberry Library.

The I&M Canal initially flowed directly into the Sanitary Canal on the South Side and the South Fork naturally split off into two smaller streams toward its far southern extremity (See Figure 9).[82] However, after the widening of the Sanitary Canal, the District forced it into the original path of the I&M Canal.

[82] E. Robinson, *Robinson's Atlas of the City of Chicago, Illinois, Vol. II*, (Washington D.C., Office of the Librarians of Congress, 1886), 1. Image courtesy of the Newberry Library in Chicago, Illinois, Special Collections, Cartographic Collections.

Figure 10: Present Day Satellite Image of the South Fork South Branch Chicago River. All of the original areas that provided the source of the I&M Canal have been completely filled. Image courtesy of Bubbly Creek Framework Plan.

The above image (Figure 10) illustrates the changes made to the Sanitary Canal and to the South Fork near the Union Stockyards.[83] Upon widening the Sanitary Canal, a stronger current, along with additional water from Lake Michigan, provided sufficient riparian flow to facilitate the dilution of wastes with the proposed water-treatment works and the activated sludge process. The I&M Canal no longer exists in this area, and the South Fork connects directly to the Sanitary Canal. The two small streams at the southern extremity of Bubbly Creek now combine to form the retention pond intended to coagulate sewage for treatment and to then force it forward. The District's proposed treatment works would then utilize the activated sludge process, similar to the dilution used in the Sanitary Canal, to disintegrate wastes in the South Fork.[84]

Basing its designs on works constructed in Milwaukee, the Sanitary District constructed an experimental plant in 1915 to test the activated sludge process and deemed the action appropriate for the Packingtown situation. District engineers then converted the once experimental plant into a final operating facility near the southern extremity of the South Fork to begin waste dilution. The Sanitary District estimated that enough pollution existed in Bubbly Creek to equal that produced by over one million people, which constituted thirty-three percent of the District's sanitation operations. Public funding of the project provided the financial support for both the water-treatment plant and the reconfiguration of the South Fork. The Board of Trustees concluded that all of the work required an additional $250,000,000 to complete.

[83] Image courtesy of: Google-www.site-design.com. Bubbly Creek Framework Plan. This site contains information regarding private initiatives to revitalize the Union Stockyards area and contains maps and old photographs of the area particularly with contemporary images of the South Fork of the South Branch Chicago River.

[84] *The Stockyards Treatment Plant*, 8-10.

The efforts of the Sanitary District, much like its work with the Sanitary Canal, produced mixed results. While water quality near the Union Stockyards improved, and nearly all of the sewage and wastes produced by the city's numerous industries flowed through the new Sanitary Canal, many working-class people still confronted severely unhealthy living and working conditions, particularly those within the meat-packing industry. Workers lived in close quarters, lacked access to running water, and still dealt with much of the slaughterhouse refuse. Along with these issues, many laborers also worked in severely dangerous jobs involving close work with their hands and with equipment for which they had little training to operate. Many of the challenges experienced by working-class individuals prior to the construction of the Sanitary Canal persisted after it opened.[85] As a result, this difficult environment caused many workers to unionize, forming the Amalgamated Meat-Cutters' Union in 1946. This organization required that the meat-packing companies provide its workers with aprons, gloves, and proper training as part of a collective-bargaining agreement to protect its members.[86]

The challenges facing meat-packing workers in the Union Stockyards reflects an aspect of the Chicago River story that demands consideration. While civic leaders viewed the Sanitary Canal project as a resounding success, suggested by the various reports issued by the District following its completion, many problems remained in the

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[85] Betty Burke, "Interview," *WPA L.C. Project Writers' Unit*, (Washington D.C., Library of Congress), 10 October, 1940, 1-2. These sources courtesy of the United States Library of Congress online collections. All of the transcripts from the Federal Writers' Program are available in this database and contain the recollections of various working people from across the country speaking about their lived experiences, their heritage, and topics connected to their cultural upbringing. These documents are an excellent resource for research of cultural and labor history.

[86] Amalgamated Meat-Cutters' and Butcher Workmen of North America, *Twenty-Second General Convention*, (San Diego: A Amalgamated Meat-Cutters' and Butcher Workmen of North America), 8 July, 1968, 1-2. This transcript provides a brief history of the union prior to the proceedings of the membership. These documents can be accessed at the Chicago Historical Society archives at the Chicago History Museum in the Amalgamated Meat-Cutters and Butcher Workmen of North America Records (1953-7) collection, MSS Lot A, Box 5, Folder 15a.

city and neighboring areas.[87] However, it is important to consider whether or not this project constituted a success and what that might entail. It is clear that the Sanitary Canal did improve living conditions in Chicago and surrounding communities. Access to potable water improved, sewage no longer lingered in the streets, and the canal both diluted and transported pollutants out of Lake Michigan. The entire nation, as evidenced by the coverage of the canal's construction and operation, reveled in the achievements reflected by the canal's presence. In the age of rail, an engineered waterway took center-stage. Never before had something on this scale occurred in the United States, or the world, and certainly not on the scale then displayed in Chicago. In all of these instances, the canal succeeded and fulfilled many of the goals outlined by the Sanitary District at its founding in 1889, and long after the river reversal.[88]

Despite these apparent victories, the Sanitary Canal did not completely solve the issues many hoped it would. The grievances stated by the Citizens' Association of Chicago during the 1870s and 1880s reflected the desire to see much more comprehensive change in the overall conditions of city life.[89] Once the canal entered its first years of operation, many municipal leaders soon realized that the true causes of many of the city's sanitation challenges originated with the industry that their predecessors fought so hard to establish decades earlier. Wanting to cement Chicago's elite economic status for the coming years, city boosters helped to establish the rail lines connecting Chicago with the Great Plains and the Eastern Seaboard. This same transportation network brought the industries instrumental in making Chicago both an

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[87] *History of the Chicago Sanitary and Shipping Canal*, 427.
[88] *The Stockyards Treatment Plant*, 1919, 1. It is important to note that much of the commercial shipping traffic in Chicago today, travels on the Sanitary and Ship Canal.
[89] *Citizens' Association of Chicago*, "Main Drainage,"15.

economic engine and an environmental conundrum. Success for the Sanitary Canal's administrators balanced the need to create healthy living spaces, while ensuring that civil service and reform solidified its influence on an emergent twentieth century American society. However, though railroads characterized much of Chicago's industrial development, the Sanitary Canal encapsulated the positive consequences of commercial growth, while providing the key answer to its environmental challenges.

The Sanitary District, and the leaders supporting it, wanted to eliminate pollution and to ensure the public witnessed this achievement. Viewing the waterway as an engine for public health, service, and achievement, District leaders believed their sanitation strategy the ultimate answer to many of the city's problems. That belief is apparent in all of the reports and histories released about their work.[90] Local, state, and federal cooperation also framed this belief and helped realize the overarching faith in technology. However, the canal, although acting as a drain for one of the most polluted sinks in the country, merely moved sewage, without addressing the economic production that put wastes in neighborhoods and on city streets in the first place. Earthen materials made the canal, though it moved purely by human ingenuity, completing goals for the sake of human lives. The Sanitary Canal fought pollution and constituted a complex, new riverine system, but it did not change the circumstances of working-class life in the nineteenth century. Nonetheless, the canal remained the center of Chicago's infrastructure at the opening of the twentieth century.

[90] *History of the Chicago Sanitary and Shipping Canal*, 425.

Conclusion

Public works projects such as the Sanitary and Ship ("Sanitary") Canal constituted a significant addition to Chicago's municipal culture at the dawn of the twentieth century. The World's Fair of 1893 occurred during the Sanitary Canal's construction and reflected many of the same goals that influenced the river reversal project including the commitment to economic strength. The fair's slogan of "I Will" captured the city's sense of superiority, determination, and aspirations for municipal growth. Having survived the devastation of the great 1871 fire, Chicago presented itself as a symbol of Americanism amidst continual westward expansion.[1] Opened to traffic just seven years after the fair, the Sanitary Canal embodied Chicago's emergence as an international commercial metropolis. It also involved a reversal, of not just a river, but of technology. During an era characterized by rail, the canal marked a return to older, perceived obsolete systems of inland transportation to improve public sanitation while maintaining vital shipping lanes.

The men who administered the canal's construction endeavored to accomplish more than the simple diversion of polluted waters from Lake Michigan. Many within Chicago's municipal leadership, and within the Illinois state government, viewed the Sanitary Canal project as an opportunity to create a better society for their constituents. Confronting sanitation challenges meant the improvement of lives through public initiative and ingenuity. Using new technology and the prevailing sanitation theories, civic leaders chose canals as a sanitation strategy to improve public health. Ultimately, the canal succeeded in combating pollution and improving water quality, but the

[1] Chicago," *Scribner's Monthly*, Vol. 10, 5. September, 1875, 1.

continued struggles of the working people affected most by industrial pollution constituted a notable and unexpected failure. Historian Sylvia Washington argues that the contamination of working communities of color originated with the exclusion of peoples living in those neighborhoods from access to public services.[2] Washington highlights this racism of this exclusion and illustrates how the goals of improved sanitation did not always involve those who suffered pollution most. Many of the root causes of economic and environmental inequality, tied to the search for greater wealth accumulation, remained unchallenged by the enormous Sanitary Canal project.

Despite its eventual failings, the Sanitary Canal represented an unexpected shift in the municipal development of Chicago. The canal era in the United States largely ended with the construction of the Illinois and Michigan ("I&M") Canal from 1837 to 1848. Thereafter, water transportation gradually gave way to rail, though water remained an inexpensive alternative for bulk shipping. With the establishment of multiple rail lines and with increased boosterism, Chicago's role as a national railroad hub allowed for much of the city's industrial growth. However, in a unique solution to sanitation problems, local, state, and federal leaders returned to canal technology some fifty years later, viewing the Sanitary Canal as the ultimate opportunity to insure public health and to forge a new period of economic and social vitality. City officials' dual goal for the project coincided with a successful rebuilding after the Great Fire and in hosting the World's Columbian Exposition.

Despite the canal's diminished success, it introduced a new era for both Chicago and the United States, a period during which civic leaders expanded the application of artificial waterways beyond transportation. In no other instance in the United States did

[2] Washington, *Packing Them In,* 5. Also see Barrett, *Work and Community in the Jungle.*

a city, state, or federal entity reverse a river's flow to forge an entirely new sanitation system. The timing of the canal project also constitutes an important difference between the Chicago River case and other locations. Many of the country's endeavors to improve water quality occurred following the establishment of the Environmental Protection Agency in 1970 and the passage of the Clean Water Act of 1972. With the latter, the U.S. government greatly expanded the Federal Water Pollution Control Act of 1948 and initiated a systematic approach to clean American rivers. Only after this development did many state and national leaders commit to improving the water quality of American rivers, a goal they sought to reach by 1983. However, confronted with enormous water pollution in the Chicago River and Lake Michigan, civic leaders in Chicago and Illinois addressed water quality long before it garnered such systematic attention from the federal government. With the threat to the city's potable water supply, Chicago leaders and state officials made water quality a top priority more than seven decades before it emerged as a national sanitation issue.[3] Finally, while many public sanitation projects, including the rerouting of western rivers or the dredging of the Hudson River, were enormous civic undertakings, they did not occur on the same scale as the Sanitary Canal venture which involved the entire Illinois River and Mississippi River valleys.

The re-engineering of the Chicago River provided a new sanitation tool while extending its ecological parameters to improve public health and maintain economic viability. Civic leaders redirected the river and, in turn, refashioned it to confront their challenges. It represented much more than a business opportunity for public officials; it became a method for forging a more secure society through the supposed improvement of a natural riverine system. Thus, the Sanitary Canal became more than a new

[3] McCool, *River Republic*, 190-4.

sanitation strategy for the polluted metropolis; it altered how rivers interacted with one another. The Sanitary Canal replaced with artificial connections the portages that Indians and others employed for centuries to link the river with other regional waterways. The re-engineered Chicago River emerged as the core of a larger riparian structure that involved many tributaries and distributaries, forming a complex amalgamation of waterways all culminating in a single human-made channel.[4] The Sanitary Canal reversed a river, drained a city's polluted water, improved its public health, marked a return to commercial canal use, and established an entirely engineered river system.

Pollution in the Chicago River made the Sanitary Canal construction a necessity. The failed attempts to address the city's polluted environment only increased pressure on local and state leaders to find more effective and permanent methods. Some of the decidedly unsuccessful strategies included the use of a new sewer pipeline, which moved sewage to the Chicago River. This strategy only continued the problem. Another failure involved storing the industrial sewage and human and animal wastes in barrels and shipping them via wagons to outlying areas surrounding the city. As industrial production increased in the meat-packing plants, tanneries, glue factories, breweries, and brick foundries during the 1870s, the continued disposal of human and animal feces, urine, mud, trash, offal, and acids, intensified the concerns of people living in working class neighborhoods. This led to further protests and political organization as exemplified in the actions taken by the Citizens' Association of Chicago.[5]

[4] Kelman, *A River and Its City,* 5.
[5] *Citizens' Association of Chicago*, "Main Drainage," 16.

The public response to the declining living conditions in the city constituted yet another deciding factor in the Sanitary Canal plan. Public officials possessed an intense faith in the potential for technology to insure greater municipal efficiency and address the concerns of citizens. Ultimately, this faith bordered on a technological hubris; a blind devotion to works and a conviction that they would accomplish the goals assigned to them. This faith, linked to the trust in the Progressive Era symbol of the public leader and civil engineer, guided much of the vision created by local, state and federal leaders. The involvement of the federal government also constituted another important aspect of the Sanitary Canal story. Cooperation between the Sanitary District and the U.S. Army Corps of Engineers established a federal commitment to the canal project, revealing the importance of that endeavor to the nation. Chicago was the nation's second-largest city in 1900. To ensure continued commercial prosperity and a positive public image, city officials endeavored to maintain a high quality of life for their fellow citizens including clean living spaces and drinking water. One cannot separate the link between the Sanitary Canal and the political ambitions of its administrators, and those who benefited from its success.

Many officials in the Sanitary District, including Lyman E. Cooley, knew that the city's socio-political situation could deteriorate in tandem with the sanitary conditions if city leaders could not produce a long-term solution to water pollution. Many of these officials believed in the potential of technological advancements when considering how to address waste and sewage. During a period of increased working-class organization and militancy, many within the Chicago political and economic elite wanted to ensure that not only would the city's image reflect its commercial potential,

but would address the needs of citizens in an attempt to dissuade further political agitation. Combined with the city's national reputation and the protest of residents, displayed by the Citizens' Association, civic leaders faced limited time to improve living conditions. Therefore, a complete and radical change of the environment, within and surrounding the city, emerged as the only viable option left to the political and technological elites in Chicago and Illinois.

The Sanitary Canal also marked a return to perceived obsolete waterways to address pollution, although the project held important environmental implications. Many of the workers and engineers who built the Sanitary Canal later found employment in the construction of the Panama Canal between 1904 and 1914. The Sanitary Canal proved to the country and the world the potential utility and relevance of canals. And once the Sanitary Canal opened for traffic in 1900, the Chicago River ceased to resemble the waterway that existed prior to the project's completion. Instead, the river constituted an entirely new and engineered riparian system.

The I&M Canal produced a similar arrangement that connected the Chicago River with the Illinois and Mississippi rivers. However, a key difference between the I&M Canal and the Sanitary Canal surrounded the respective purposes for building the two waterways. For the I&M Canal, public officials viewed access to the Mississippi from the Great Lakes as essential for Chicago's growth and, during a time that predated rail, canals remained the only viable option to provide this link. Commerce and economic development rested in the construction of a waterway that provided a continuous avenue for commerce. With regards to the Sanitary Canal, state and city leaders still viewed commercial shipping as an important component of Chicago's

economic vitality, but the forced removal of water pollution constituted an even more pressing concern. Thus, sanitarians and engineers knew that the Sanitary Canal had to go further than the I&M Canal in terms of its potential uses.

Another important aspect of the Sanitary Canal story is how it differed from the I&M Canal in its incorporation of the Chicago River structure. The Sanitary Canal placed the river at the core of its operations and required using the Chicago River and surrounding waterways to fulfill its intended purpose of improved water quality. Instead of only providing a transit conduit to the Illinois River, the Sanitary Canal actually formed an extension of the Chicago River that used its reversed current and added waters to drain Chicago's polluted neighborhoods. Size, depth, and scale also constituted key differences between the two waterways. Nearly three times wider and approximately three times deeper than the I&M Canal, the Sanitary Canal allowed for the movement of much larger ships and thus significantly more cargo. This expanded Chicago's commercial potential while addressing sanitation. These differences reflect the central environmental implications of the Sanitary Canal project both in terms of the engineered river system and sanitation policies adopted by civic leaders.

It is clear that the Chicago River reversal provides insight into how civic leaders approached the socio-political implications of environmental degradation. The construction of the Sanitary Canal also reveals the attitudes of municipal officials about the ramifications of building and maintaining a clean, safe city for its economic and political image. The Sanitary Canal case illustrates many of the complex interactions that people have with their environment that include the use of natural features, including rivers, to secure clean living spaces and economic vitality. Thus, the Chicago

River story reveals some of the many ways that humans affect their surroundings, and how activities such as canal building can remain vitally important long after completion. The Sanitary Canal, today, is an integral component of Chicago's urban landscape and is the core of a system built to secure the prominence of one of the world's most important cities.

This continued study should not come at the expense of the gains made in studies of political, economic, and cultural history. Historians must continue to balance material and ideological analyses of sanitation history within urban-environmental historiography. Any complete evaluation of the interactions between people in built environments requires a careful appraisal of the ideologies that shape those interactions and the ecological results of the actions inspired by ideology. The contributions of Joel Tarr and Martin Melosi, particularly in *The Search for the Ultimate Sink* and *The Sanitary City*, respectively, remain the foundations of the field.[6] Any true understanding of urban-environmental history must draw upon their work and the discussions within the field that followed. Economic history is also crucial to studying urban-environmental history as it reveals how the industrial production, or lack thereof, in a given place affects human interaction with their environment. Studies of economic history can illustrate how people viewed their surroundings. Robin Einhorn's *Property Rules* brilliantly blends analyses of nineteenth-century American politics and industrial development.[7] Given that urban spaces require natural resources to grow and remain viable; consideration of economic processes is essential in writing environmental

[6] Tarr, *The Search for the Ultimate* Sink; Melosi, *The Sanitary City*.
[7] Einhorn, *Property Rules*.

history. The field needs further contributions that balance the economic, cultural, material, ideological, and ecological elements of urban-environmental history.

The Sanitary Canal continues to create news that historians will likely consider, particularly as the Asian carp present an ongoing dilemma for the Great Lakes region.[8] The University of Notre Dame is heading the current assault on the carp in the Illinois River and in the Sanitary Canal. Developing the use of environmental DNA ("eDNA"), university researchers found a more accurate way of tracing the movements of the fugitive fish, which could aid in the containment of their populations in specific areas where they can be systematically killed, or captured, likely with electrocution or holding pens within the Sanitary Canal itself. Once again, the canal is poised to provide a solution to an expensive human-made environmental challenge; the carp have cost more than seven billion dollars in time lost in the transportation of goods.[9]

Many states in the Great Lakes region, including Ohio, Michigan, and Illinois, view the irritating presence of the fish as a threat to their economy. However, the Sanitary Canal remains open. The carp highlights the intricate and unforeseen interactions between people and their surroundings that are not always apparent when civil endeavors, such as the Sanitary Canal, are being constructed. The intentions of public officials do not always consider the future implications of their work. The Asian carp displays this rather well, as the entire system, facilitated by the canal, allowed for the fish to travel so widely. While engineers removed wastes and sewage from Chicago, few people considered the ecological implications of such a waterway that provides connections with other riparian features that may or may not be desired. The Sanitary

[8] Tom Henry, "Notre Dame on Front Lines in War against Asian Carp," *The Toledo Blade*, 8 March, 2015, www.toledoblade.com, accessed, 10 March 2015. Footnote 9: Ibid.

Canal aided in pollution removal and in the improvement of Chicago's water quality; perhaps it will remove the Asian cap. Either way, city officials seem determined to try.[10]

The securing of clean living conditions and the distribution of the fundamental necessities of life are essential goals of any city or society. The Chicago Sanitary and Ship Canal reflects the lengths to which people will go to establish that security. Today, the canal remains open for business and an integral aspect of Chicago's landscape. The river reversal project helped Chicago transition from a regional transportation hub to an economic capital of national and international significance. It represents the city's struggles and its triumphs. What the canal also reflects is the city's historic commitment to advanced public works projects and the environmental ramifications of those endeavors.

[10] Ibid.

Figure 11: South Branch of the Chicago River looking north toward the Loop. Image courtesy of the United States Geological Survey. www.usgs.gov, accessed, 10 March, 2015.

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