Foiled Plans, Fouled Waters

by Sarah Lynn Cunningham, PE

Abstract

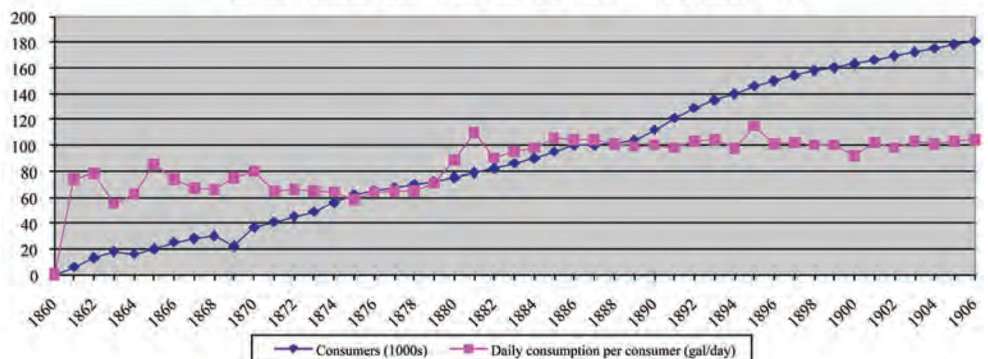
Most American cities of the Progressive Era chose to avoid the costs of building two separate sewer systems for wastewater and stormwater, and instead constructed one combined system to convey both flows to waterways, sans treatment. Following four decades of municipal water-line installation, the Commissioners of Sewerage of Louisville (Kentucky) was empowered to build sewers early in the 20th Century. Unlike most of its counterparts, Louisville responded to recurring disease epidemics by opting to install separate sewer systems to protect water quality in Beargrass Creek. However, obstacles chronically undermined the efforts of commission engineers to protect the public that swam, waded and fished there. Wildcat plumbers took advantage of weak enforcement and installed illegal cross-connections: "soil pipes" tapped into storm sewers continued to contaminate the creek, and gutters and downspouts overflowed sanitary sewers into basements and the stream. Elected officials' unwillingness to impose fees on voters and voters' reluctance to approve bond issues meant that funding came up far short of that required for the infrastructure that they demanded. And the city allowed, encouraged even, developers to continue building new neighborhoods, most well beyond the reach of infrastructure. As the commission fell further behind, it ultimately abandoned its health-based policy and switched to constructing only combined sewers—in retrospect a regrettable decision that will burden water quality and community coffers for decades to come, until combined sewer overflows are adequately mitigated. Still, the story of these forward-thinking engineers deserves to be told.

Introduction

The disposal of human wastes in 19th-century urban America was haphazard, unsanitary and unpleasant. Some households merely tossed sewage onto the ground while others dumped it into cesspools (holes filled with crushed rock, also known as dry wells or seepage pits)[1], but most city dwellers relied on privy vaults—earthen pits inside cellars or backyard outhouses—that were not water tight.[2] Privies reeked of nauseating odors, and methane gas posed a special danger to smokers.[3] The proximity of these noxious privies to homes was seen as unhealthy because they "use[d] up the oxygen from the air" and "load[ed] it with pestilential gases."[4] They also leaked into and polluted groundwater, wells and cisterns. In his 1899 annual report, Louisville's Health Officer wrote, "That many of public wells are contaminated by our privy vault system can not be questioned."[5]

Privies overflowed or had to be covered over, abandoned and replaced, unless emptied at least annually. That dirty job was done by private contractors, often African Americans, called tubmen,[6] or night men, because stirring those repugnant odors was relegated to when nearly everyone else slept. Tubmen used hand tools to excavate wet "night soil" into buckets and tubs, and then loaded them onto leaky wagons and hauled them to nearby water bodies, open land on the outskirts of town, farm acreage or fertilizer factories—leaving an infectious trail along their routes. The widespread failure of the privy vault system began with the pressures of urban crowding, and was completed by the introductions of running water and the indoor water closet or flush toilet.[7]

Municipalities constructed potable water systems to supply businesses and households, fight fires and wash down streets. Because this urban utility was infinitely more convenient and sanitary than outdoor hand-pumps, customers who could afford to pay for it eagerly tapped into its distribution lines. By 1860, municipally-supplied water flowed in 136 US cities, including Louisville; by 1880, that number had more than quadrupled to 598 communities. With access to water, per-capita consumption and installations of toilets grew exponentially. However, most flush toilets were plumbed to empty into privies or cesspools, which rapidly overflowed into cellars and backyards, and from there into alleys and streets.[8] One leading engineer complained of the "steady growth



[of] the ‘modern conveniences’ scattered throughout the house by the profuse hand of the plumber, with no regard to the effect on the atmosphere of the dwelling.”[9]

And while hundreds of cities constructed waterworks and distribution lines—that paradoxically magnified the contaminating reach of sewage—none coincidentally built sewer systems, much less wastewater treatment facilities. None of the approximately six hundred US cities operating water distribution systems in the 1880s had comparable sewer systems. Even when American cities began installing sewers, the impetus was not to improve sanitation, but to “prevent the flooding or dampness of cellars, and the obstruction of traffic by the accumulation of storm-water” after heavy storms. And cities expanded the reach of their water service pipes with little regard for any negative impacts on downstream neighbors.[10]

Poor sanitation coupled with Louisville’s location along the Ohio River created extensive stagnant swamplands—and mosquito breeding. Sewage commonly contaminated those sloughs, as well as the stream and well water that most residents drank. Successive deadly epidemics of cholera, yellow fever, malaria, typhoid fever and dysentery throughout the 19th century earned the town the nickname, “Graveyard of the West.” The city appointed its first health officers in 1823 and authorized its first Board of Health in 1865. Only 19 of the other 133 US cities of 30,000 or more residents surpassed Louisville’s average rate of 60 deaths per year from typhoid fever during 1898-1900—when a rate of more than 15 to 20 belied polluted water. Water-borne typhoid fever and the “Saffron Scourge” continued to plague Louisville at rates above national norms into the 20th century.[11]

That engineers and medical doctors espoused a pair of pervasive misconceptions even after science disproved them, hampered municipal responses to these epidemics, nationally and locally. These professionals believed that dirt and miasmas—vapors and foul odors from sewage, filth and decaying matter—caused sickness.[12] The habits of foreigners and the poor—crowded into tenements with the highest concentrations of side-by-side privies and wells—were often singled out as “filthy” and blamed for spreading diseases—even in communities discharging sewage above downstream community’s water intake pipes.[13] Sanitary engineers identified themselves as the “scientific scavenger” charged with keeping the air “pure,” by “removing all garbage, and by carrying out a proper system of drainage and sewerage.”[14] And the “purifying nature” of moving water was seen as capable of cleansing all impurities that industrial era cities and factories dumped into it.[15] Because mosquitoes transmitted yellow fever and malaria, these early sewers—built to drain rainwater from streets and stagnant water from low-lying ground—eradicated breeding pools and reduced those diseases’ transmission rates, albeit while also perpetuating the miasma myth.[16]

Design Debates

The first generation of sanitary engineers grappling with how best to manage sewage, considered two options to privies: pneumatic ejector and water carriage systems, using vacuum pressure and water, respectively, to evacuate or flush and then transport sewage.[17] Complicated, relatively unreliable and expensive, the former was soon dropped from serious consideration.[18] The water-carriage system, developed mid-century in Europe,[19] had drawbacks, too.

Large quantities of water were required to convey everything from household bath water and toilet flushes to slaughterhouse blood and grease to toxic industrial wastes into the nearest water body, which often “bec[a]me an elongated, open cess-pool of the worst variety.”[20] The more enlightened medical doctors of the day warned of spreading disease downstream, while chemists and farmers complained about the loss of fertilizer. Sewers also shifted the financial and maintenance responsibilities for sewage removal from individual property owners to municipalities.[21]

However, the demands of a public eager to flush its bodily wastes out of sight and out of mind easily drowned those concerns. Most physicians and sanitarians saw sewers as providing significant reductions in the incidence of typhoid fever and other infectious diseases. And by significantly reducing foul odors, disease and sewage overflows, industrialists and elected officials saw sewers as good for property values, as well as a city’s business climate and image, particularly in the South where the higher incidence of infectious diseases hampered growth and development. Consequently, despite few mechanisms for financing sewers—bonds, special assessments, such as one-time connection fees, and general revenues, all viewed skeptically by fee-adverse property owners—water and sewer infrastructure projects were 19th century cities’ biggest capital investments.[22]

But municipalities could not install water-carriage systems without wrestling through the debate between two very different designs: A combined sewer system is a single network of large-diameter pipes designed to carry “all sewage matter, slops, rain water from roofs, roads,” etc. A separate system consists of dual networks of pipes: smaller-diameter for “all foul matters and liquids,” (also called sanitary waste), and larger-diameter for “the removal of storm-water direct to the nearest natural outlet or water course.”[23] All sewers in the U.S. were combined, until Lenox, Massachusetts, built the first separate sewer system in 1875-1876.[24] Until the 20th century development of wastewater treatment processes, both systems only transferred local sewage hazards to wider swaths of downstream neighborhoods or communities. These deliberations in the late-19th and early-20th centuries tended to focus on least costs.[25]

In the late-19th century, most engineers accepted the views of sanitary engineer Rudolph Hering, whose analysis of numerous European sewer systems of various designs was published by the National Board of Health in 1882. Hering concluded that all designs were capable of improving sanitation and that municipalities could choose according to their site-based installation and maintenance costs. Though he regularly professed objectivity, his arguments showed a strong preference for combined sewers:[26]

Separate sewers would provide no significant benefit over combined sewers as long as storms washed contamination from streets littered with horse manure and rubbish "as foul as ordinary sewage" into streams. If storm sewers were required to remove urban storm run-off, the cost of building them slightly bigger to accommodate comparatively small quantities of wastewater would be negligible. Sewers big enough for workers to enter would be easier and cheaper to maintain. Having two systems increased the risks that plumbers could mistakenly make connections "to the wrong sewer," defeating the primary value of a separate system.[27]

After untreated sewage undeniably overwhelmed a growing number of streams' self-cleansing abilities, some engineers advocated that cities control disease by filtering drinking water. In his 1907 book, *Clean Water and How to Get It*, engineer Allen Hazen pointed out that, "To protect the water supply of Louisville, it would be necessary to purify the sewage of Cincinnati, Pittsburgh and hundreds of smaller cities upon the Ohio River and its tributaries." He concluded that, "Looking at the whole matter as one great engineering problem, it is clearly and unmistakably better to purify the water supplies taken from the rivers than to purify the sewage before it is discharged into them."[28]

Other engineers, equally confident of the germ theory and the etiologies of water-borne diseases, argued for separate sewers. Scientists began taking samples from various locations, analyzing them for specific pollutants and plotting the results onto maps to show underground movement of polluted water from privy vaults and cesspools to water wells. Health agencies began collecting data on the causes of death; early epidemiological studies demonstrated connections between contaminated wells and typhoid and cholera. Later analyses showed incremental declines in water-borne diseases after the installation of municipal drinking water and, later, sewers. These engineers also saw combined sewers as too big to keep sewage moving during dry periods, yet too small to handle the heaviest storms. Lastly, they considered odor control an insurmountable challenge in cavernous combined sewers.[29]

Perhaps the best known sanitarian in that critical time was Colonel George E. Waring, Jr., who was not an engineer, but an agriculturalist with engineering work experience. From his work for Frederick Law Olmsted—the charismatic pioneer of American landscape architecture who convinced city leaders to set aside prime real estate for public parks—Waring learned to parlay his personality to persuade others to his way of thinking. His articles employed flamboyant language, and were published in popular magazines, such as Atlantic Monthly, as well as trade journals. After constructing the separate sewers in Lenox, he submitted a \$200,000 bid to build a similar system in Memphis, Tennessee, after an especially deadly epidemic of yellow fever. With only \$368,702 raised through a special tax to spend, the city chose Waring's proposal over the \$1,000,000 bid from a pair of engineers, one of whom was Charles Hermany of Louisville. Waring used the drop in Memphis' yellow fever rates following construction of the sewers to widely promote his design. However, his atypical design—under-sized pipes and substitution of lamp holes for man holes—only added to the controversy within the engineering profession.[30]

Waring's lack of formal training only added to many engineers' reluctance to take the risks that they associated with selling separate sewer designs to their municipal clients. Leonard Metcalf and Harrison Eddy, leading sanitary engineers of the early-20th century, wrote the influential three-volume design manual, American Sewerage Practice—updated editions of which are still used by engineers today. In their first chapter, entitled, "The Lessons Taught by Early Sewerage Works," (Volume *I—Design of Sewers*, published in 1914), they bemoaned the fact that, "American sewerage practice is noteworthy among the branches of engineering for the preponderating influence of experience rather than experiment upon [its] development . . ."[31]

Through the first decade of the 20th century, the type of sewer system selected by municipalities strongly correlated with the city's size: smaller cities typically installed separate sewers, supplemented with surface drainage piping. However, greater concentrations of impervious surface—and thus stormwater runoff—led cities of more than 100,000 residents to build combined sewers by a seven-to-one margin. Because health officials in most states failed to persuade municipal decision-makers to see combined sewers as universal threats to public health until the 1920s and 1930s, most US cities ended up with some of both types of sewers, i.e., combined in older areas and separate in more recently sewered areas.[32]

But as cities expanded, so did the sanitary design challenges. Increasing concentrations of rooftops, paved streets, sidewalks and, eventually, parking lots necessitated more drainage, as more streets flooded. Worse, runoff-filled sewers increasingly back-flowed into basements—creating significant health risks, political liabilities and costly damage claims, prompting cities to construct two new types of sewers: "Relief sewers" ran alongside older sewers to convey excess wet-weather flow. Inside periodic junction boxes, semi-partitions between the original and relief sewers kept smaller, dry-weather flows in the original sewer, yet allowed voluminous, wet-weather flows to leap over the partition into the relief sewer. To further reduce the risks of back-ups, these sewers had "regulators," overflow outlets now called combined sewer overflows (CSOs), allowing excess stormwater and sewage to flow into the nearest water body. "Interceptor sewers" redirected flows in stream-bound sewers, initially away from smaller and into larger streams and, later, away from streams and into treatment facilities. However, regulators emptied excess interceptor flow into receiving streams, rather than basements.[33]

While the installation of sewers reduced the local incidence of certain diseases, the public health benefits of sewerization were not reaped universally. Business districts and more affluent areas of town often off-loaded their sewage to lower-lying, less affluent areas. Similarly, upstream cities shifted their sewage to downstream cities. Besides damaging downstream drinking water supplies, sewers also commonly damaged the industrial utility and recreational value of receiving waters.[34]

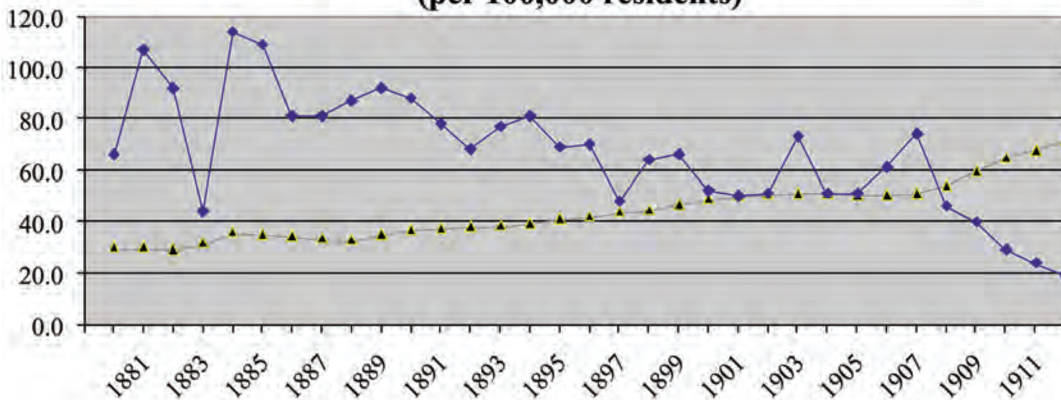
Looking back on these debates, historians have seen those advocating separate systems as having the strongest argument from the perspective of public health. Yet most cities opted for combined systems, an option that historians have tended to argue was based on least costs. A study of Louisville's history of sewer construction complicates this story.

The Louisville Story

Louisville generally followed this pattern. Like the rest of the nation, it first built sewers, not to remove disease risks from residential areas, but to drain stormwater from its business district,[35] as well as ponds that served as garbage dumps, attracted pigs and bred the mosquitoes that carried malaria and typhoid fever.[36]

The city's earliest attempts to provide municipal drinking water in the1830s failed due to consumer resistance. Before germs became commonly understood, Louisvillians tended to assume that their well water was potable as long as it was palatable and looked reasonably clean after the mud settled. Only after several fires in the business district and a promise to leave free corner wells in place, did the Kentucky legislature authorize the Louisville Water Company's creation in 1854. When city water first flowed in 1860, the initial customers were chiefly businesses, including such large consumers as public baths, hospitals, restaurants and a paper mill. Far into the 20th century, most residents preferred the free water from their wells to paying for city water,[37] even though fewer than two miles of storm sewers existed that year.[38]

In 1867, the city began constructing sewers to empty into Beargrass Creek, as well as the Ohio river.[39] Beginning in the 1870s, a series of city engineers constructed several large trunk sewers, including the four-mile-long Western Outfall. By 1880, only 37 miles of sewers (30 miles per 100,000 residents) served 60% of Louisville's quadrupled population of nearly 124,000 residents then liberally consuming city water.[40] In 1883, the local Commercial Club hired Rudolph Hering to do a sanitary survey; he observed that citizens living along Beargrass Creek suffered more than their share of typhoid fever.[41] By 1900, 100 miles of sewers (49 miles per 100,000 residents) served the still ballooning population of almost 205,000 residents.[42] With more residents consuming city water and flushing to sewers, the local typhoid death rate began a slow decline. The graph shows the inverse relationship between sewer installations and typhoid deaths.[43]



In his 1898 annual report, Louisville's Health Officer, M. K. Allen, said of Beargrass Creek, "the filth poured into it by sewers and from other sources . . . causes a polluted atmosphere, laden with disease germs. This stream should be covered over and made into a sewer." He predicted that, "When a perfect system of sewerage is completed we may expect greater immunity from disease of a malarial type," and urged that the construction of sewers be "pushed forward more vigorously, as our city needs very many more."[44] But due to "lack of funds," the City of Louisville all but ceased to extend sewers after 1899—despite continued waves of immigrants and construction of street-car suburbs beyond the sewershed. Sewage flowed in curbside gutters, as typhoid death rates hovered in the mid-50s per 100,000 residents and spiked to 73 per 100,000 in 1903.[45] More pavement generated more run-off and basement and street flooding; contesting damage suits and paying judgments became costly.[46]

After voters rejected bond issues to pay for extending sewers in 1902 and 1904, Mayor Paul C. Barth and other leaders persuaded the Kentucky General Assembly to adopt an act in March, 1906 that enabled the appointment of the Commissioners of Sewerage of Louisville, and a $4,000,000 bond proposal to go before the voters that November. In the interim, the promptly appointed commission hired consulting engineers Samuel M. Gray of Providence, Rhode Island, and Harrison P. Eddy of Worcester, Massachusetts, to assist its chief engineer, Joshua B. F. Breed. With the assistance of a survey team furloughed by the federal government, these engineers and their staffs immediately began planning sewer projects and presented their recommendations to the mayor and General Council by October—before voters went to the polls the following month. Local newspapers promoted the proposal and, this time, voters approved the bond issue by a better than two-to-one margin.[47]

Aware of the challenges of funding Louisville's immense infrastructure needs, the engineers reasoned that the flow in the Ohio River was so large and rapid that the city could indefinitely forego building a "purification" facility, and could instead concentrate its resources on installing sewers. Still, they warned of the inevitability that the federal government would someday ban the discharge of wastewater into navigable waterways, and proposed to design all new sewers to flow to one outfall on the Ohio River, to facilitate later interception and diversion to a treatment plant.[48]

The report offered three options for sewer design, but recommended the one that

would, first, protect health by diverting sewage from Beargrass Creek toward the Ohio River and then solve as many other sewer and drainage problems as possible with the remaining funds. Given the expense of rebuilding hundred-plus miles of existing combined sewers, the commission decided to continue using them and to construct any new sewers draining into them as combined sewers as well. Similarly, lest the cost of dual systems to serve the neighborhoods furthest from the Ohio river consumed too much funding, it proposed combined sewers for those areas too. But the commission proposed separate sewers for the Beargrass Creek sewershed above Cherokee Park—where the public frequently swam—and for areas near the river, with prevalent bedrock or slope to allow smaller diameter sewers.[49]

Major projects for the city's south, west and east sides headed the list of proposed infrastructure. The especially flat South End lacked sewers and suffered from chronic flooding. Fearing ruinous groundwater infiltration into a separate sewer deep in chronically soggy terrain, the commission proposed a combined trunk sewer, dubbed the Southern Outfall. Because Shawnee Park and other amusement parks along the river on the city's west side were "quite a favorite resort for health and pleasure . . . during the summer months," the commission proposed to then redirect the flow discharging from the existing combined Northwestern Outfall to the downstream Southern Outfall to eliminate "objectionable conditions in the vicinity of [those] parks." Though it characterized Beargrass Creek as "an open sewer [and] in many places, a succession of foul, stagnant ponds," it rejected calls for covering and turning it into a sewer. To protect public health, it instead proposed interceptor sewers along both banks, to divert the flow in existing sewers to the Ohio River. Lastly, it specified separate sewers to serve the Letterle Avenue, Brownsboro Road, Mellwood Avenue, Cherokee Park and Crescent Hill areas, all draining to Beargrass Creek, near the Ohio River because it was generally hilly and full of bedrock.[50]

Though the Mayor and General Council approved the commission's plan, court challenges and nationwide financial instabilities delayed the commencement of construction until January, 1908, when the commission took on a furious pace, letting 59 contracts in two years.[51] But from its start, demands for better drainage delayed the agency's plans. Another major project began the conversion of the Middle Fork of Beargrass Creek from a shallow, meandering stream into a deep, concrete-lined engineered channel with vertical walls, aiming to stop growing volumes of contaminated runoff from flooding adjacent homes, businesses and railroad tracks.[52]

The nascent commission's 1910 report showed that daunting challenges pushed it further behind: increasing water use overloaded older sewers not designed for such volumes. Besides continued population growth, municipal annexations added new neighborhoods to the service area. Its budget barely paid for a few trunk and interceptor sewers—and no lateral or collector sewers into neighborhoods—yet the city continued to build new streets with neither storm nor sanitary sewers, imposing significantly slower and more expensive retroactive work on the commission. And as the

The South Fork of Beargrass was originally a meandering stream, here running through Germantown with St. Therese Catholic Church in the background.

The South Fork of Beargrass Creek frequently overflowed its banks, fully submerging the main Louisville & Nashville rail line. This view is looking north from Breckinridge Street.

Trying to control flooding, the South Fork of Beargrass Creek was converted into an engineered channel, with a dry-weather channel running down its center.

Allowing homes to be built ahead of sewers meant retrofitting, greater costs, longer schedules and nuisances for residents. This project was at Southern Parkway and Wellington Avenue in 1929.

Packing houses routinely dumped offal into Beargrass Creek where it ran through Butchertown. High water after a snow melt partially collapsed a bridge constructed to allow dumping on both sides of the stream."

paved portion of the service area continued to expand and flooding worsened, the commission issued the following caution regarding its separate sewers:[53]

> Untiring care will always be necessary to insure the discharge of the sewage from the buildings into the sanitary sewers and also to prevent any storm water from entering them. None of the sanitary sewers are large enough to accommodate storm water even from very small areas, and should storm water be allowed to enter them, flooding of the houses will occur. On the other hand, the entrance of sewage into the storm drains might cause a great nuisance in the open creeks into which they will ultimately discharge.

Pointing out that "fecal matter was visible along the shore . . . on the Kentucky side," a 1911 water-quality report proclaimed the Ohio River "decidedly repulsive" where Louisville's sewers discharged into it. The mouth of Beargrass Creek "seemed to be boiling, due to septic action," with its water "thick with black suspended matter" and its "stench . . . almost unbearable."[54] Voters nonetheless rejected a proposed $2 million bond issue in 1912, forcing the otherwise broke commission out of business in 1913, after laying 54 miles of sewers.[55] In a report on its accomplishments, the commission measured its success against the benchmark of typhoid death rates. While acknowledging reductions due to the August, 1909, start-up of the water company's filtration system—twenty months after sewer construction began—its analysis showed a strong correlation between increased sewers in the ground and reduced typhoid deaths. As evidence, it cited a Health Department analysis of all 138 local typhoid cases during the 1910-1911 fiscal year, fatal or not, and the victims' water sources and sewage disposal methods: 79% got sick despite drinking filtered city water, while 73% still relied on open privy vaults.[56]

The city sold its Louisville Gas & Electric Company and used the $1,387,500 in proceeds to allow its Board of Public Works to continue sewer construction and Beargrass Creek channelization. That money ran out in 1915, essentially ending sewer construction until 1919, when voters approved a $2 million bond issue—after civic and business groups endorsed it, local newspapers published maps showing streets still relied on privies and advocated air-dropped promotional literature. The second appointed Commissioners of Sewerage resumed sewer construction at a feverish pace through the 1920s and 1930s, also with the proceeds of two more general obligation bonds, for $5 million in 1924 and $10 million in 1928.[57]

In 1926, Mayor A. A. Mill, Chief Engineer Joshua B. F. Breed and other Commissioners of Sewerage officials pose in the newly completed sewer under 8th Street and Broadway.

Proliferating duties cancelled the reincarnated commission's successes. By 1921, the city had 285 miles of sewers, but nearly all were hydraulically overloaded during wet weather, and many areas were still unsewered. The City Health Officer calculated that typhoid had cost Louisvillians nearly $14 million over the previous eighteen years. Population, annexed service area and impervious surfaces continued to expand, while funding did not. Flooded streets delayed streetcars and other traffic. Interceptor sewers extended along Beargrass Creek, but no further than Cherokee Park, as upstream development marched on. The separate sewers proved under-sized; designed strictly for residential sewage, they lacked adequate margin for larger generators such as schools and laundries, for groundwater infiltration through bad joints and for downspouts and gutters tapped in "accidentally or surreptitiously." And lest the mix back into basements, regulators combined sewer overflows to allow excess flow to escape to Beargrass Creek and the Ohio River, which became routine features of interceptor and relief sewers.[58] In 1923, the City Health Officer declared the creek to be "an open sewer" and threatened to use dye to identify the responsible homeowners if necessary to protect children playing in Cherokee Park, after his inspectors waded along it to confirm the presence of buried "straight shot" soil pipes.[59]

In 1924, 46% of the city still lacked sewers.[60] The commission's 1929 report showed that—despite letting twenty construction contracts costing $5 million in the previous four years, expanding the system to 396 miles—competing demands continued to far outpace its best efforts to protect public health. Cross connections abounded, prompting a call for systematic inspection and correction. Homeowners and especially landlords often ignored an ordinance requiring them to abandon privies and connect to sewers as soon as they became available. At least ten regulators overflowed into Beargrass Creek. Admitting a lack of current data on the impact of Louisville's sewage on the Ohio River, it proposed periodic water-quality monitoring. Full-page photos showed flooding in the South End, including boys in bowery caps standing in thigh-high water in front of their new homes. Declaring its tasks "obviously impossible" with only a $10 million bond issue to spend, the commission made its priority combined trunk sewers where none yet existed.[61]

A branch of Mill Creek flooded Manitua Avenue, newly constructed without drainage infrastructure, in 1929.

The Joint Sanitary Survey and Research Committee, a collaboration between health officials and the plumbing industry, organized itself in 1936 after federal health officials declared that Louisville's inordinately high concentration of twelve thousand privies threatened renewed epidemics. While health inspectors conducted door-to-door inspections—and ordered cross-connections corrected, septic tank overflow pipes capped and, where sewers existed, privies surrendered—the trade group promoted the training and licensure of master plumbers. The health board quickly halved the privy tally, mainly by ordering sewer connections.[62] Still, the community's failure to dedicate adequate resources for sanitary sewers frustrated the Department of Public Health as well. In its 1936-1937 annual report, this body of medical doctors, nurses and sanitarians responded in strikingly blunt terms:[63]

> In some parts of the city septic tank drainage and partially treated sewage is flowing openly in the street gutters, and is . . . creating a sanitary nuisance and a health problem of a major character. For this reason outdoor privies if they were of a sanitary design would in most cases be preferred to the septic tank . . . The only correct and permanent solution for these conditions is the construction of sanitary sewers . . . It is questionable if this improvement will be brought about for many years to come because of the extensive expenditures necessary . . . and particularly so because of the large amounts of money required to construct the combined system of sewers.

In 1940, the federal Works Progress Administration paid day laborers to dig the trench in which the Beals Branch sewer would be constructed.

When its money ran out shortly after the nation entered World War Two, this commission, too, went out of business. Its 1942 final report was 894 pages of accomplishments, financial accounting, design manual, operations handbook, preliminary plans for future projects and raising revenues—and lamentations: Louisville's 550 miles of sewers were "built piecemeal and inconformity to the immediate needs and the funds available, rather than [on] comprehensive long-range planning." Neither a treatment facility nor a unified outfall had been built. The locks and hydroelectric dam com-

pleted across the river in 1927 created an elevated upper pool, as well as hydraulic and sanitary problems in the sewers discharging into it; the mouth of Beargrass Creek stagnated and became "exceedingly obnoxious and unsanitary." The 1937 flood did further damage. Wet-weather overflows, malfunctioning regulators, brewery slops, stockyard wash-downs, industrial waste and "straight-shot" pipes, kept Beargrass Creek unfit for swimming, and improper connections killed the commitment to separate sewers:[64]

> In general, the Commission's policy has been to construct combined sewers rather than separate systems. The principle reason for this is the difficulty of preventing misuse of the separate system. Experience in Louisville shows that it is impossible for the city officials . . . to prevent the connection of some house sewers to the storm drains and connections of some house drains to the separate sewers. This results (1) in the discharge of dry-weather sewage into the storm drains and thence into the streams, thereby polluting the streams, and (2) in the discharge of stormwater into the separate sewers and thence into the intercepting sewers, thereby surcharging these sewers. These evils are so objectionable that, in the opinion of the Commission's engineers, use of the separate system in Louisville should be avoided whenever practicable, in designing sewerage works.

Conclusion

Public officials do not always take the easiest or cheapest route. Despite embracing inaccurate notions about the ability of the Ohio River to safely absorb sewage pollution, the first Commissioners of the Sewerage of Louisville were relatively progressive and more conscious of public-health issues than their peers in most American cities. A mere six years into the 20th century, they polled experts and concluded that enough consensus existed to justify a policy of building separate sewers wherever feasible, plus some eventual form of wastewater treatment prior to discharge into the Ohio River. Yet funding foundered, forcing the commission to divide its attention between retrofitting sanitary and storm sewers into inhabited areas, improving drainage and constructing sewers in new street-car suburbs under construction. Worse, the misdeeds and mistakes of plumbers thwarted commission engineers' good intentions, forcing them to abandon separate sewers for more expensive combined sewers, further slowing the extension of service and adding to stream pollution. Like any public policy, it is only as effective as its implementation and enforceability. Without taxpayer support for adequate funding as well as transparent mechanisms to ensure good design, proper construction and meaningful regulatory enforcement, including protection of whistle blowers, even the best public policy can in the end come up short.

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End Notes

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16 Molly Caldwell Crosby, The American Plague: The untold story of yellow fever, the epidemic that shaped our history (New York: Berkeley Publishing, 2006), 89; and John R. Pierce and Jim Writer, Yellow Jack: How Yellow Fever Ravaged America and Walter Reed Discovered Its Deadly Secrets (Hoboken, NJ: Wiley and Sons, 2005) 21-22.

17 J.T. Brown and W.H. Maxwell, eds., “Sewerage,” The Encyclopedia of Municipal and Sanitary Engineering (New York: Van Nostrand Co., 1910), 421.

18 Stanton and Pierson, Separate System of Sewerage, 35-37; and Tarr, McCurley and Yosie, Pollution and Reform, 63.

19 Rudolph Hering, “Report of the Results of an Examination Made in 1880 of Several Sewerage Works in Europe,” (App. A), Annual Report of the National Board of Health (Washington: GPO, 1882), 103-104; and George E. Waring, “Sanitary Drainage,” 57-58. The first water-carriage system was built in London, England. One of the two leading parameters for measuring water quality still in use in the U.S. is the five-day biochemical oxygen demand (BOD5), also from England. It measures how much oxygen is consumed by decomposing water-borne pollution over five days—whether conducted in England or the significantly larger U.S.—because a pollutant discharged in the most inland English stream reaches the sea in five days. Its oxygen demand was assumed to then be irrelevant.

20 Stanton and Pierson, Separate System of Sewerage, 20.

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22 Ibid.

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28 Allen Hazen, Clean Water and How to Get It (New York: John Wiley and Sons, 1907), 35-36, 72-81 and 200.

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30 Tarr, Search for the Ultimate Sink, 138-140; Leonard Metcalf and Harrison P. Eddy, American Sewerage Practice, Volume I—Design of Sewers, (New York: McGraw-Hill, 1914), 24-25.

31 Metcalf and Eddy, American Sewerage Practice, 1; George Tchobanoglous, Franklin L. Burton (ed.) and H. David Stensel, Wastewater Engineering: Treatment and Reuse, 4th Ed. (New York: McGraw-Hill, 2002); and Tarr, Search for the Ultimate Sink, 152-155.

32 Tarr, Search for the Ultimate Sink, 152-155.

33 Tarr, Search for the Ultimate Sink, 146-148 and 153-155; and Metcalf and Eddy, American Sewerage Practice, 46. The US Environmental Protection Agency (EPA) estimates that CSOs and combined sewer systems are still a major source of water pollution in 772 American cities—serving approximately 40 million residents—mainly in the Northeast, Great Lakes region and Pacific Northwest. In 1989, the EPA developed the so-called “CSO Strategy” through negotiations with various interested parties, under the guise of the federal Clean Water Act. The strategy called for the adoption of the “nine minimum controls” and the development of city-specific control plans for ameliorating, if not eliminating CSOs. States then wrote these requirements into discharge permits, effectively mandating the CSO Strategy. See Combined Sewer Overflow Demographics, http://cfpub.epa.gov/npdes/cso/demo.cfm?program_id=5, accessed on Sept. 13, 2008. Like sewers, CSOs come in a wide range of designs, often custom designed for site-specific situations, making their mitigation especially challenging, slow and expensive.

34 Baird, Encyclopedia of Louisville, 271-274; and Tarr, McCurley and Yosie, Pollution and Reform, 59.

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36 Baird, Encyclopedia of Louisville, 271-274.

37 Yater, George H. “Louisville Water Company,” in The Encyclopedia of Louisville (Lexington: Univ. Press of Kentucky, 2001), 576-577.

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