Sanitary Sewer System Development and Municipal Governance in Austin, Texas 1880 to 1913

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Abstract

This paper explores the rise of sanitary sewer systems in Austin, Texas. The emergence of sewers in Austin was not the result of growing public awareness in sanitary issues or a gradual expansion of municipal government services. Instead, sewer systems were constructed and maintained by private parties interested in servicing their individual properties, or in the case of an entrepreneur, in realizing a profit. These initial systems were operated for three decades until the municipal government purchased the systems in 1913 to form a comprehensive, publicly-owned sewer system The purchase of the systems by the municipality came about after a significant change in municipal governance, indicating that infrastructure systems are highly correlated with political structure. The history of sewer service in Austin suggests that the study of infrastructure should not only include the examination of the materials that constitute the physical network but also the political and social institutions that enable the networks to function.

With respect to the emerging debate over sustainable urban infrastructure, the case of Austin demonstrates the contingency of historic infrastructure systems. Austin sewers could have been different due to alternative political, social and technical conditions. Likewise, the adoption of sustainable technologies in the future is contingent. Embracing this contingency is an effective way to direct infrastructure change. The adoption of new forms of infrastructure will depend on our ability to successfully negotiate existing political, social and technical frameworks.

Introduction

At first glance, the history and sustainability of urban infrastructure appear to be at opposite ends of the theoretical spectrum. While history is inherently focused on describing past events, sustainability addresses how the future world should be. So how are these seemingly disparate approaches related? Certainly, sustainability can take a number of valuable lessons from history. Historical studies in the field of Science and Technology Studies help us understand the political, social cultural, economic and technical aspects of urban infrastructure systems. The Large Technical Systems approach is a specific example of how history can help us understand the social, cultural, economic and political aspects of technologies.

A more substantial connection between history and sustainability can be found in the American Pragmatist tradition and the idea of contingency. Pragmatists such as John Dewey, Charles Peirce, William James, and Richard Rorty argue that both history and the future (in this case, a sustainable future) are contingent, based on location, time, actors, culture, and so on. Through acknowledgement of the contingency of a historical event such as the creation or changing of an urban infrastructure system, we can begin to better understand the elements that are required to create a sustainable infrastructure system in the future. Thus, the past and future are not prescribed or fixed but emerge for specific reasons that can be understood and potentially changed. A pragmatist approach to infrastructure studies changes the academic from a mere spectator to an actor who can affect change in the future direction of the infrastructure development.

This paper is divided into two parts. In the first part, I introduce the history of sanitary sewer development in Austin, Texas from 1880 to 1912. The Austin example highlights the importance of governance in adopting new infrastructure technologies as well as social, economic and technological factors. The Austin sewer system developed for particular reasons but the system could have been different. In the second part of the paper, I introduce the idea of contingency as the link between history and sustainability. An analysis of infrastructure systems based not on a master narrative but on the belief that they are contingent allows for the possibility that other pasts and futures are possible. Thus, history can inform the sustainability debate while redefining the academic as a problem solver instead of a theorist.

The Introduction of Sewers to Austin (1880 to 1890)

In 1881, the preeminent American sanitary engineer George Waring drafted a report documenting the history and present condition of Austin, Texas in terms of its city services. His report included the capital city's population growth since 1840 (see Figure 1). Austin was a growing town with many modern conveniences including over 72 miles of unpaved roads, passenger trains, a mass transit system consisting of a streetcar drawn by mules, sidewalks and gas lamps on the downtown main streets, electricity, and a privately owned water supply (see Figure 2). A lack of industry prevented the city from growing at rates comparable to neighbouring cities such as Houston and Fort Worth but nonetheless, Austin was a viable community and was slowly becoming a government and higher education centre.

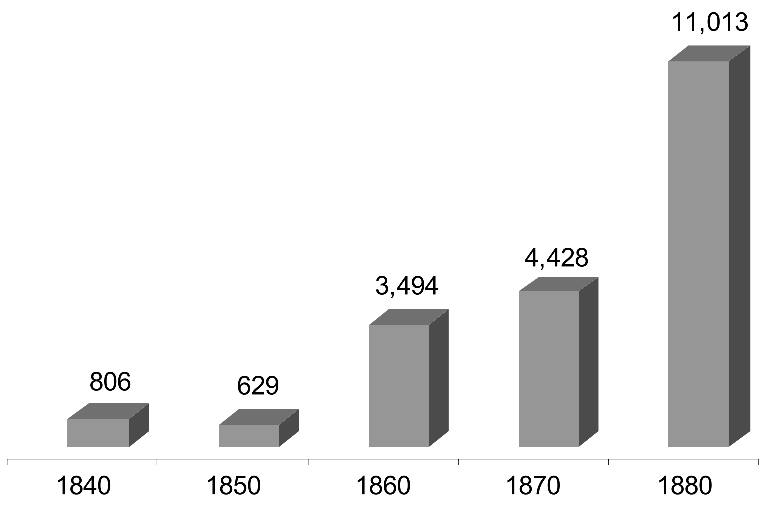

Figure 1: Austin's Population, 1840-1880 (source: Waring and Cable 1881).

Figure 2: Austin's Congress Avenue in 1875 (Source: Austin History Center).

In his report, Waring noted the absence of particular amenities that were common in other cities of the same size most importantly the lack of wastewater infrastructure. Liquid wastes were discharged into street gutters while human wastes were discharged into privately owned cesspools. He did not contend that these practices were causing problems in 1881 but his report implied that a more advanced system might be warranted as the population of the city increased (Waring & Cable 1881). Waring's report is notable because it was written at a pivotal time in Austin's municipal history when a water supply network was readily available to many of the city's residents but no sewer system existed to remove generated wastewater volumes. The technology of water supply was not linked to the technology of wastewater service as it is today and thus, the metabolic network of the city was not yet in place.

Many U.S. cities in the latter half of the 19th century were adopting underground sewer systems as a public or private service (Tarr 1988). Between 1870 and 1920, the percentage of the total urban population in the U.S. served by sewers increased from 50% to 87% (see Figure 3). Sewer systems had initially been viewed as a luxury but gradually transformed into a necessity as water use in urban areas increased.

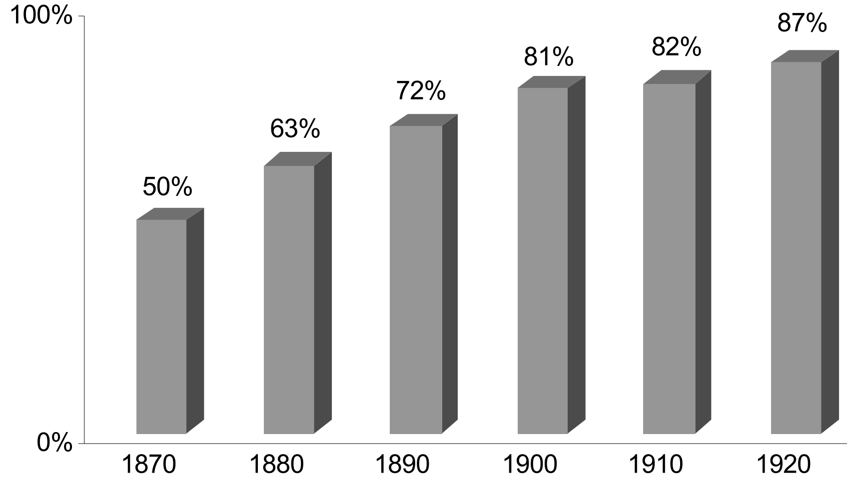

Figure 3: U.S. Urban Sewered Populations (source: Melosi 2000).

However, many cities had recently invested public funds in expensive water systems and had little money available for additional infrastructure investment. The newly introduced water systems created problems when the existing cesspool-privy vault system could not accommodate the additional wastewater volumes (Burian et al. 2000; Melosi 2000). Municipal governments valued the sanitary benefits of sewage systems but struggled with a means to pay for the systems.

Austin first benefited from a water supply system in the mid-1870s when a private company constructed and began to operate a water distribution network. By the late 1870s, problems with overflowing privy vaults and cesspools were becoming more prevalent as water use increased sharply. The municipal government was interested in building and operating a municipal sewer system to handle the wastewater volumes but realized that such a system was beyond their budgetary means. Therefore, they turned to other government entities and well-funded entrepreneurs to provide sewer service for their city. The municipality recognized public ownership of a comprehensive sewer system as a future goal and saw the intermediate step of private ownership as a necessary step towards this goal. The strategy would provide the city with the opportunity to purchase the private systems and convert them into a public service when financing was available (Melosi 2000).

In December of 1880, the Austin City Council passed an ordinance granting permission to the U.S. Government, the State of Texas, the County of Travis, and private residents of Austin to construct underground sewage systems. The ordinance required a minimum diameter of 12 inches for the mains and required the system owners to keep their pipes in proper working order. Construction of these systems would be supervised by the Austin Board of Health to ensure that the sewers were constructed in a sanitary manner (City of Austin 1886).

In April 1881, the City Council passed a second sewer ordinance that was more specific than the previous ordinance. This ordinance granted the U.S. government permission to construct a sewer from two Federal buildings in downtown Austin to the Colorado River. The city reserved the right to connect all public buildings to the sewer free of charge and also included a stipulation that residents could connect with the sewer under terms agreed upon with the U.S. Government (City of Austin 1886). As such, the Federal government was allowed to build a private sewer in Austin but only if this service was available to residents and businesses.

In mid-1882, the City Council passed a third ordinance allowing the State of Texas to construct and operate sewer systems to manage their various state buildings throughout the city. The ordinance required sewer mains at least 15 inches in diameter and these were to be laid under the supervision of the City Engineer of Austin who would ensure proper design and construction. Instead of discharging into the Colorado River directly, these sewers would discharge into Waller Creek on the eastern edge of downtown and eventually reach the river. Again, the City reserved the right to connect public buildings to the system free of charge and for citizens to connect through contract with the State government. The owner of the system was in charge of maintaining the sewer and keeping it in good working order (City of Austin 1886). These ordinances allowed for municipal oversight but not construction or operation of sewers by the municipality.

Neither the Federal nor the State government systems were comprehensive in nature and instead consisted of a minimal number of mains to transport sewage volumes directly from their respective buildings to a receiving waterbody by the shortest route possible. A handful of residents likely connected to these systems through private branches but the limited geographic coverage of the mains prevented widespread utilization. In essence, these systems were isolated instances of a public service network and were only available to a small number of city residents with the means to afford them. The concept of universal access to sewer service was yet to be experienced by the residents of Austin.

During this same time period, the City Council granted permission to a well-funded private resident and entrepreneur named W.B. Brush to construct and operate a more comprehensive sewerage system in downtown Austin. Little information is available on Brush except for his proposal to build a system with a main that ran along the alley to the east of Congress Avenue (the main thoroughfare) and extend from the County Courthouse to the Colorado River. The City required the mains to be a minimum of 20 inches in diameter, suggesting that the system served a larger area than the Federal and State government systems. The City reserved the right to connect public buildings to the network free of charge and also decreed that any person could connect to the main sewer line or its branches but must pay W.B. Brush a one-time payment not to exceed $250 for any building (except hotels and livery stables where the sum could not exceed $500). Finally, the city reserved the right to purchase the system from Brush after five years of operation for a 'reasonable' price (City of Austin 1886).

The Brush system did not encompass the entire downtown area but was considerably more extensive than the government systems and was intended not as a private system for a small number of buildings but a network to serve the public in the densest part of the city and create a profit for Brush. Brush's system was, in essence, the modern sewer system concept that created a network of sanitary service in the most populated area of the city. However, the significant difference with Brush's system was that his was a private venture built and operated for capital gain and not for the public good.

With the completion of the Brush system, Austin was serviced by three independent sewerage systems at the end of the 1880s (see Figure 4). The Federal government sewer serviced the post office and the Federal courthouse in downtown Austin. The State government maintained several small sewer systems for the Asylum, the Institute for the Blind, the Capitol building and related buildings, and the Deaf and Dumb Institute. Finally, the Brush system consisting of a large main that ran parallel to Congress Avenue with laterals extending four to five blocks on the east-west cross streets. Brush's system had an estimated two miles of mains to serve businesses and residents in the densest areas of downtown (Brown [date unknown]).

From an engineering perspective, all of these systems were relatively simple, using gravity to convey liquid waste volumes to the point of discharge at Waller Creek or the Colorado River. The sizes of the pipes as specified by the City ordinances were derived from growing wastewater conveyance expertise. Engineering methods to determine proper slope and minimum diameter of the mains and branches was just becoming standard practice at the turn of the century. Books such as Modern Methods of Sewage Disposal by George Waring described the current state of knowledge of sewer system design based on several decades of empirical data (Waring 1986). The Austin systems were comprised of the least expensive yet most effective materials available (typically glazed earthen pipe) except at stream crossings where more expensive cast iron pipe was used (see Figure 5). The slope of the pipes was a primary concern to the owners and the City to avoid standing sewage and backups. None of the systems employed wastewater treatment before discharge into the receiving waterbody.

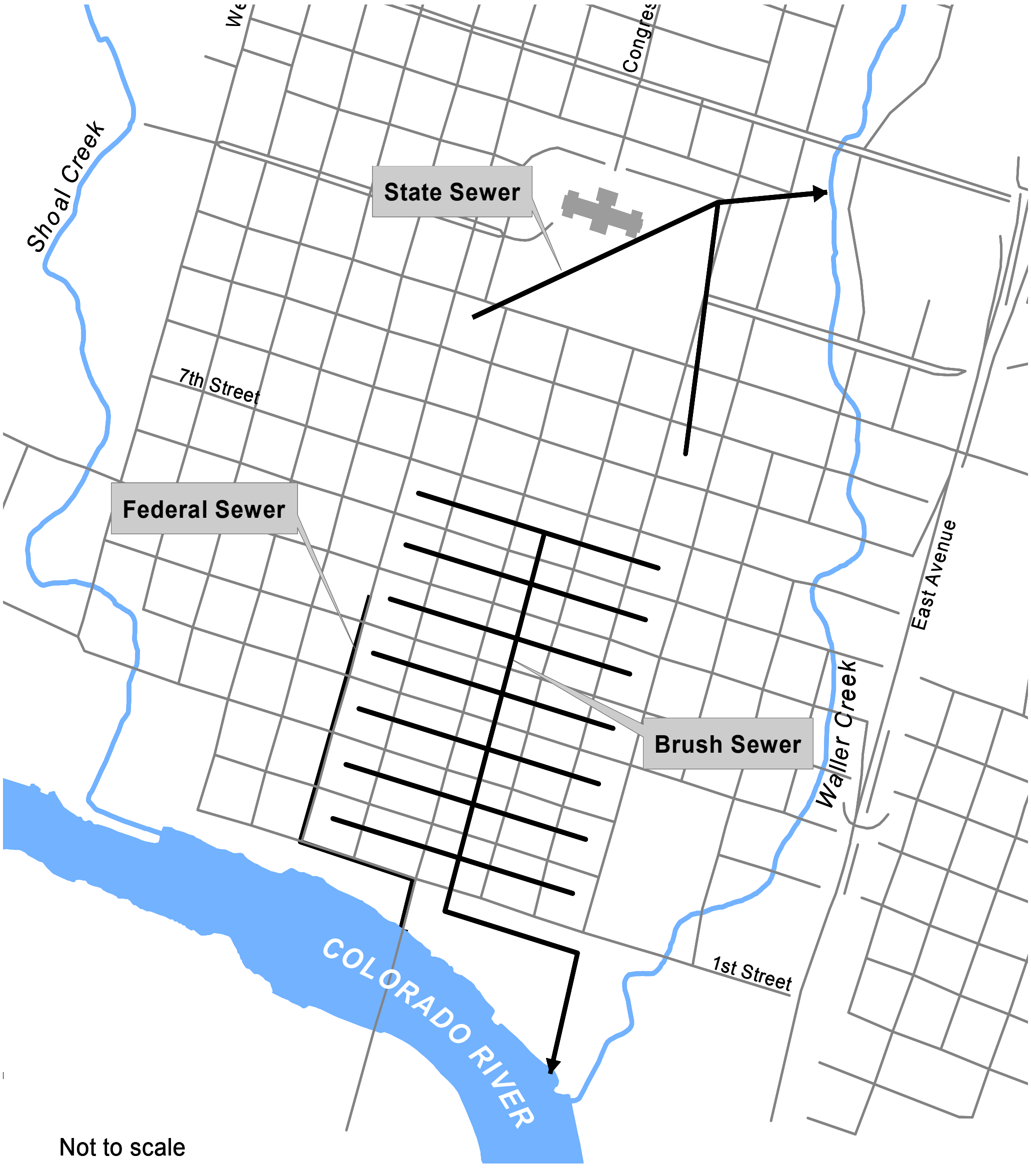

Figure 4: Approximate Locations of Austin Sewer Systems in 1889 (after Krause 1973).

This combination of government and private sewer systems was intended to fulfill the needs of city residents for wastewater services at a time when the municipal government was unable to provide it. The City wisely retained control over the construction of the systems through oversight by the City Engineer or the Board of Health as well as reserved the right to connect all of its buildings to the system free of charge. They also imposed a cap on rates that these entities could charge city residents to connect to their systems. All of these measures served the municipal government by granting it control over the private systems without having the responsibility of ownership or maintenance. However, this arrangement did not create an ideal service network by any means. Without the legal authority to plan comprehensively and tax residents, the municipal government could only be opportunistic in developing infrastructure. The City was essentially exploiting parties with greater sources of capital to provide a public service that would greatly benefit the downtown residences and businesses. As a result, the sewer systems that emerged did not follow a comprehensive plan but created a patchwork of sewer mains that served only a small portion of the urban population and did not allow for extension in the future (Burian et al. 2000).

Figure 5: Example of Vitrified Clay Sewer Pipe (source: www.sewerhistory.org).

Piecemeal Systems and Stagnation (1890 to 1909)

Over the next two decades, a lack of municipal funding resulted in slow expansion of the sewer systems or in essence, a period of stagnation. The most significant sewer activity occurred in June of 1892 when the City Council passed an ordinance allowing a second private interest, the Lewis Mercer Construction Company, to construct additional sewer lines in the downtown area. These lines did not compete with the Brush system but instead increased the service area significantly. In a meeting on February 26, 1892, the City Council justified the ordinance by emphasizing the "great public benefit to be derived from a system of sewers and the great expense and risk which will be incurred by the grantees of the franchise [the Lewis Mercer Construction Company] in the construction of said sewers" (City of Austin 1892).

Again, the City was demonstrating both its allegiance to its residents and its fiscally conservative policy with regard to tax revenues by allowing a second private party to expand sewer service in downtown Austin and incur the risk of capital investment. This additional system would serve more city residents and possibly compete with the existing system, resulting in lower user rates. Unlike the one-time rate structure for the Brush system, the ordinance for the Lewis Mercer system specified an installation and connection fee as well as a yearly rate for users of the system. The company could charge a maximum fee of $75 for installation and connection to the sewer network and then variable rates depending on the size of the house or number of water closets (City of Austin 1892). Table 1 summarizes the rate structure. Clearly, the financial aspects of sewer service were becoming more refined and the change to quarterly rates from a one-time fee was intended to provide more affordable service to residents.

After the Lewis Mercer system was completed, competition between the two private systems in downtown Austin only lasted for a few years. In 1895, Lewis Mercer purchased the Brush system, combined both systems into a unified whole, and renamed the company as the Austin Sewerage Company (Brown [date unknown]). More than likely, neither owner was generating sufficient revenue to operate independently and merged to reduce operating costs.

Table 1: Quarterly Service Rates, 1892 (source: City of Austin 1892).

User	**Rate per Quarter**
Houses	
Up to 5 bedrooms	$2.50
Each addition bedroom (up to 10)	$0.50
Each addition bedroom (greater than 10)	$0.75
Hotels	
20 bedrooms or less	$7.50
Each additional bedroom	$0.75
Factories, stores and offices (per water closet)	$2.50

Despite the extension of sewer service to the most densely populated areas of the city, many people did not use the systems. The cost for service continued to be high despite the newly introduced quarterly rate structure. The operators of the Austin Sewerage system in particular received continual criticism from residents for its high rates. The cause of this criticism was likely due to its widespread reach as compared to the other systems and the likelihood that charges for this system were higher than the government sewer systems. It is also likely that maintenance and operations of the private system were lacking. As such, a significant number of residents continued to use the existing cesspool-privy vault system which often overflowed to create unsanitary and unaesthetic conditions as well as contaminate groundwater wells. From a social perspective, sewers continued to be perceived as a luxury item and not a sanitary necessity.

In addition to their problems with the private sewer service in Austin, residents were in a continual struggle with the private water supply company that delivered an intermittent water supply of variable quality throughout the 1880s and 1890s. The concept of using a private sewer system may well have been tainted by unsatisfactory experiences with the private water supply company. As late as 1901, the local newspaper reported, "the water situation in Austin is more serious than it has been in many months. In fact in many parts of the town there is a water famine" (Austin Daily Statesman 1901). This was directly related to the sewer system because if water was not available on a regular basis, then there was no need for residents to pay for sewer service. The Austin Daily Statesman reported that "…on account of not enough water being received to flush the (water) closets, a most unsanitary condition prevails…" (Austin Daily Statesman 1901). The connection between the water service and the sewer service was becoming more apparent as the demand for water as well as the creation of wastewater volumes increased (Melosi 2000).

In 1894, the municipal government responded to resident demands for a consistent water supply and built a dam to provide ample electricity and water. The completion of the dam allowed the city to provide water service and compete directly with the private water company for several years. However, the dam broke in April of 1900 and after much negotiation, the city purchased the private water company in 1902 and created Austin's first public water supply system (McLaurin 1937).

While many of Austin's residents did not use the sewer systems for economic reasons or out of distrust of a private service company, other residents continually urged the City Council to persuade the Austin

Sewerage Company to extend the sewer network to their neighbourhoods. For example, a petition was presented to the City Council by Henry G. Stokes and ten other residents that called for extending the sewer system further west of downtown to improve the sanitary conditions in populated areas of the city where they lived (City of Austin 1910a; City of Austin 1910b). The company was not quick to respond to requests by the City Council because from their perspective they were not getting full use out of their existing network and had no incentive to expand their services. In addition, the company was wary to expand their system until water service was more stable. As a result, the company often asked the city for more time in extending the system and the city readily complied with their requests (City of Austin 1893; City of Austin 1894). Thus, an inherent conflict existed between the interests of the private service provider and the needs of the city residents.

The local newspaper was also critical of the existing sewer system, typically from a sanitary viewpoint. An example of a common complaint occurred in the Austin Statesman on August 27, 1903, when the writer described the noxious smell of the gutters on Congress Avenue and the fact that it was impossible to keep the gutters sanitary, concluding that, “the only way to get results is to banish the gutters and have sewers and paved streets” (Austin Statesman 1903). Dr. W.J. Mathews, the president of the Austin Board of Health, furthered the sanitary argument and called for sewer service to be extended to all areas of the city, with connection to every house and business, and sewage treatment before release to the river. “Nothing is so conducive to the health of a city as properly constructed sewers,” he stated. He went on to note that the problem was that, “…quite a large portion of our citizens can not connect with any sewer” (Austin Statesman 1909a).

An estimate of public access to sewers was provided by two engineers in 1908 and these are shown for each of the existing sewer systems in Figure 6 (Tyler & Ramsdell 1908). The engineers noted that the sewer systems covered a large part of the city but connections were relatively few. At the time of the study, the total population of the city consisted of about 30,000 people whereas the sewer systems served an estimated 10,550 residents (U.S. Census 2003). Thus, residents had the potential to utilize sewer service but only a third actually did so.

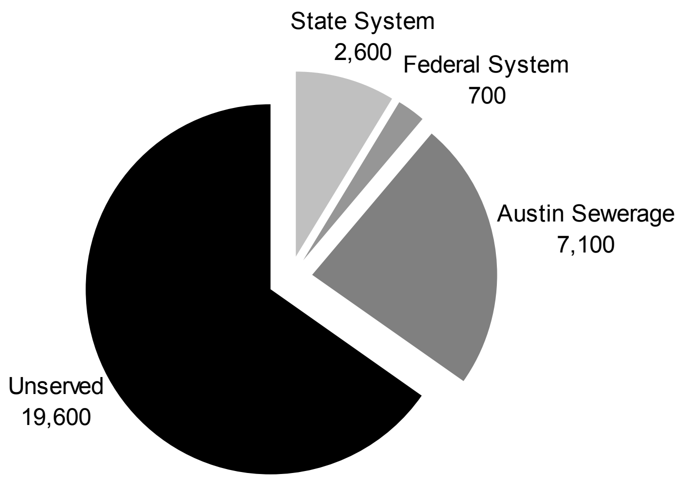

Figure 6: Populations Served by Austin Sewers, 1908 (source: Tyler & Ramsdell 1908).

The most comprehensive information regarding the public services of Austin was documented by William Hamilton in A Social Survey of Austin in 1913. With regard to sanitary conditions, Hamilton stated that Austin was "still in the Dark Ages of sanitary and health regulations." He methodically surveyed the sanitary services available throughout the city and noted that service varied drastically depending on location in the city. Many people were still dependent on private systems for water supply and sewage disposal in the city, even in areas where public water supply and sewer services were readily available. The author criticized the municipal government for not exerting their powers to force residents to patronize the private sewer system and create a more sanitary urban environment. He was particularly incensed about private wells that were contaminated with human waste from overloaded privies and cesspools. For example, he estimated that about one-third of the residents in Hyde Park, an inner city neighbourhood, continued to use cesspools. Finally, he described the waterways of Waller Creek and Little Shoal Creek as open sewers flowing through the city (Hamilton 1913). The social value of sewers was lagging behind the sanitary knowledge of the period.

Austin's Sewer Systems Become Public (1909 to 1913)

Public pressure was continually building for a change in the existing sewer systems because they did not satisfactorily service the city as a whole and where they did serve, rates were higher than the average citizen was willing or able to pay. A change in government structure eventually allowed for the public sewer system to emerge in Austin. Until 1909, the City operated under an aldermanic form of government, a structure that was subject to graft (McLaurin 1937). In 1909, the government changed from the aldermanic structure to a commission form of government where the mayor and four council members were elected every two years. This was a common occurrence in U.S. cities at the turn of the century as machine authority gave way to more democratic forms of governance. The reform of municipal government included a broadening of regulatory power of the city that resulted in greater public ownership of utilities, including water and sewer services (Melosi 2000).

Unlike the aldermanic structure, the new form of government included a City Council that was more directly responsible to the needs of citizens and significantly reduced the mayor's municipal powers and influence. The change in governance was the result, in part, of a response to the need for wastewater infrastructure, and underscores how different types of infrastructure services are related to different forms of governance. In this case, the change in government structure resulted in a change in the type of municipal services provided because the City Council was now more accountable to the desires of the public.

In 1909, Mayor Alexander Woolridge advocated the purchase of the existing sewer systems to be owned by the city and suggested that $100,000 be devoted to purchasing the existing system from the Austin Sewerage Company (Austin Statesman 1909b). The City Council subsequently issued a $250,000 bond vote for election in May of 1912 and it passed by a margin of almost three to one (City of Austin 1912). A substantial portion of the bond ($100,000) was earmarked to purchase the existing system while the remainder was used to initiate a massive expansion process. On January 14, 1913, the city purchased the mains of the Austin Sewerage Company and also let a contract to extend the existing system by 20 miles (Hamilton 1913). The emergence of this new comprehensive sewer plan resolved three key issues for the City. Most importantly, the system was comprehensive and created a logical and unified citywide service network that could be expanded over time as the city grew. This was in stark contrast to the piecemeal systems that were in existence and it represented the City's intent to wrest control of the sewer as a public service for all as opposed to a private luxury for the few. Second, the system would effectively protect public health by being a citywide system that every resident could utilize (Melosi 2000). Third, the system would improve the image of the city and attract businesses to settle there, increasing tax revenues and promoting economic growth.

Of course, public ownership of the sewer system was not enough to persuade urban residents to connect to it. The municipal government had to compel its residents by law to connect to it and this they did with the passage of the first Sewer Ordinance of 1913 (Hamilton 1913). Within a few short months, the City had made great progress on extending the existing system and 11 miles of sewer line had been added to the sewer system with funding from the bond (Austin Statesman 1913). In addition to operating the former Austin Sewerage Company system in downtown Austin, the City gradually absorbed the State and Federal systems, although it is unclear if any money exchanged hands when ownership was transferred.

The Value of History to the Sustainability Discourse

The emergence of Science and Technology Studies (STS) in the last three decades and more specifically the Large Technical Systems (LTS) approach has been extremely helpful in understanding infrastructure systems. From an LTS perspective, the issues facing Austin infrastructure systems were not merely technological but also economic, social, and political (Moss 2000). The original compilation of three different sewer systems in Central Austin resulted from a lack of available financing, a lack of understanding as to the economic and health benefits of these systems by Austin residents, and a lack of political will by those in power to create a comprehensive system. The piecemeal system would last for almost three decades until the political system, economic environment, and social views allowed for sewerage to become a public service as opposed to a private luxury. The gradual evolution of sewer systems in Austin consisted of a transformation from isolated artefacts to parts of a larger whole over a period of three decades (Summerton 1994).

While the LTS analysis of Austin can provide us with a richer understanding of the history of infrastructure development in Austin, what can it tell us about the future of infrastructure in Austin or elsewhere? Certainly it tells us that context is crucial. The formation of the sewer service in Austin had political, economic, and social aspects that together formed the system and the development was particular to this community. Future infrastructure changes will undoubtedly be directed by these some of these same factors that created the systems in the first place. But the LTS approach and STS in general does little to provide a course of action for a sustainable future and instead, merely provides theory that can be tested on historical and present examples.

So how might we be instrumental in creating sustainable infrastructures for the future? Urban planning scholar Scott Campbell describes sustainability as the resolution to conflicts between three competing interests: environmental protection, economic development, and social equity (Campbell 1996). His presentation of the sustainability triangle does not focus on the interests themselves but on the conflicts that arise between them. Thus, he does not idealize the concept of sustainability but instead sees it as an inherently social discourse. The challenge of sustainable development then is to negotiate these competing interests with the planner in the ideal position to mediate these conflicts.

Campbell's model is helpful in understanding sustainability in a more productive context but it has a significant drawback. He defines the centre of the triangle as the ideal position where all of the conflicts have been resolved and a utopian state has been achieved. This is analogous to the modern concept of the "master narrative" that has been debunked by post-modernists for several decades. The problem with the "master narrative" or a utopian future is that it imagines a single future state and does not allow for a contingency or the contemplation of multiple futures. To be sure, a sustainable infrastructure system can be defined in multiple ways depending on the technology employed, the cultural or economic contexts, and so forth.

Instead of attempting to define a desired utopian future, the focus of sustainability should be to understanding and solving problems. This line of reasoning is adapted from the American Pragmatist tradition and the writings of John Dewey, Charles Peirce, William James, and Richard Rorty (Rorty 1998). The pragmatist tradition favours action over theory, emphasizing 'what works' as opposed to what is the 'absolute truth'. A pre-determined future is a sterile and uninspiring goal while solving an immediate problem can give people hope for a better future. Thus the pragmatic approach to sustainable infrastructure is blatantly optimistic.

Pragmatism links the concepts of history and sustainability by highlighting the contingency of both the past and the future. The world is not defined as a historic arc of events but a series of decisions that could have turned out differently. By understanding the circumstances of Austin sewer development, we foster a deeper understanding of how the system came to be and then how we might change it in the future. Pragmatism adds to the LTS discourse by suggesting that we can capitalize on change (Hickman 2001). Change is not a condition of infrastructure that merely requires understanding but can instead be actively harnessed and used in a positive way to realize sustainable goals. To be sure, all infrastructure changes are not positive as demonstrated by the work of authors such as Simon Guy, Stephen Graham, and Simon Marvin. However, if we can understand the reasons for change from a number of perspectives, we might then be able to affect change in a particular direction that will lead us towards a sustainable future. In the case of Austin, understanding how the political system works historically might lead to particular forms of sustainable infrastructure that would be successful in Austin but inappropriate or unsuccessful in other contexts.

Finally, the adoption of pragmatism to the study of infrastructure systems changes the role of the academic. With pragmatism, the focus is on action and not reflection and therefore, it is not longer sufficient to theorize on infrastructure change as this is merely a spectator position (Rorty 1998). Instead, the academic should be an active participant in problem solving, employing the knowledge he or she gains from studying a historic instance of infrastructure change to create more sustainable infrastructure systems for the future. Thus, the academic becomes the translator of infrastructure issues and is tasked with solving the problems of current infrastructure, in effect becoming the sustainability moderator that Campbell describes.

Conclusion

The case of sanitary sewer development in Austin in the late 19th century is an example of how multiple perspectives inform infrastructure emergence and development. The piecemeal approach employed by the city for three decades was due to economic necessity, a social understanding as to the value of sanitary sewers, and the political realities of the community. The description is an example of how the LTS approach can be used to describe a richer history of technological development and what it means to the society that it serves.

When contemplating future infrastructure systems for Austin and other communities, it is helpful to understand the multi-faceted issues that inform historic infrastructure development. The LTS approach tells us that it is not enough to merely understand the technological components of these systems but how these components relate to the organizations, institutional rules, and cultural values in place (Moss 2000). Likewise, it is helpful to recognize the inherent contingency in both the past and the future. Infrastructure systems emerge and change due to a multitude of pressures and understanding this fact will allow us to control changes in infrastructure and more effectively direct it towards sustainable goals. Such a pragmatic approach for examining infrastructure systems allows us to address sustainability in practical terms and dispense with theoretical debates over the meaning of sustainability and get on with creating built environments that can flourish economically, environmentally, and socially.

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