Water Drives the Motor City

INTRODUCTION

Located in one of the most polluted watersheds in the Great Lakes Region, the Detroit metropolitan region is in a unique position to challenge the course of its inherited system of water infrastructure. This paper examines current urban storm-water runoff management practices in the city and speculates on a paradigm of water-prone urbanism that addresses the functioning of natural systems, infrastructural intelligence, typological innovation, and culturally driven parameters.

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This project posits that altering design and construction practices so that storm water runoff is kept on site can reverse combined infrastructure failure, reintroduce natural processes in the city and engage the residents and other urban actors in the process. The specific condition of Detroit, currently undergoing a long-term planning initiative, presents a perfect ground to test how this approach can contribute to a more sustainable use of the land. It is also at the metropolitan scale that we can respond creatively to the needs of an aging infrastructure that serves an unevenly and scarcely populated geography.

THE GEOPOLITICS OF WATER

Through the lens of water, Detroit is situated at the confluence of the Rouge and Detroit Rivers, and drains to Lake Erie. This immediate and ubiquitous access to water granted Detroit a gateway status, relative to westward expansion efforts, and fueled the expansive growth of the city. The rivers also shaped the physical patterns of urbanization, first as a trade post and military fortification, then by nourishing French ribbon farms, and most recently as a manufacturing center and busiest land crossing of global flows in the United States. Their transformation over centuries reveals the underlying geo-political agendas fueling Detroit's global, economic ambitions.

In 1819 an Act of Congress declared the Detroit River a public highway and, in 1825, with the opening of the Erie Canal, the commerce flow to and from the Great Lakes region was no longer separated from the east coast by the Appalachian mountains. Water transportation would continue to advance the national and global importance of Detroit with the opening of the Soo Locks in the Saint Mary's River (connecting Lake Huron and Lake Superior), the Welland Canal (connecting Lakes Erie and Ontario), and the Saint Lawrence Seaway (connecting the Great Lakes system with the Atlantic Ocean).

Direct access to water supply and easy waste disposal made the waterfront a very desirable location for industries. As Detroit consolidated as an industrial center, the residential tissue created to house the newly arriving workers quickly expanded away from the riverfront. Because of their ease and speed of construction, single-family houses soon became the pervasive residential typology. Many factories with their associated housing sprang up throughout Detroit and expanded until the urban landscape became a blended pattern of indistinct boundaries. The expansion of these industrial nodes outpaced the crude methods of water supply and disposal and quickly led to serious public health impacts. Investment in a citywide wastewater infrastructure was critically necessary and needed to catch up to the frenetic pace of expansion already underway.

THE EMERGENCE OF INFRASTRUCTURE

The debate about how to handle the construction of a citywide sewerage system in Detroit was heavily influenced by systems in use throughout England at that time. The discussion centered around two important decisions—whether disposal mechanisms should be handled above or below ground and whether sewage and storm-water should be combined or handled separately.[1] In the end, the debate fell on the side of subterranean combined systems primarily because the construction technology and engineering calculations were readily available for application. The first sewer in Detroit was built in 1836, initiating the practice of combining systems underground by enclosing existing creeks.[2] Once waste was captured and removed it was directed toward rivers and other waterways, giving rise to the practice "dilution is the solution."

The assignment of administrative responsibilities and oversight of this quickly expanding citywide water infrastructure was made formal in 1853 through the creation of the Board of Water Commissioners. By 1873 the city housed 100,000 inhabitants and growth continued exponentially. Between 1880 and 1918, Detroit annexed large portions of the surrounding townships therein encompassing 139 square miles—a land area large enough to contain the contemporary city boundaries of Boston, San Francisco, and the island of Manhattan. As Detroit was undergoing its rapid expansion, it also drove the levels of pollution in its rivers to the point of being recognized as an international problem. This explains the formation of Joint Commission A 1914 Joint Commission study determined that it was no longer viable to direct all of Detroit's effluent to its rivers and initiated a massive public works project to construct a wastewater treatment plant.[3]

The high cost of this project led to many challenges and a twenty-year construction timeline. Upon completion, Springwells became the largest wastewater treatment plant in the world with a capacity of 300 million gallons per day designed to service to 2.4 million people.[4] Much like other national public infrastructure works constructed during the New Deal period, such as the dams of the Tennessee Valley Authority, Detroit's water infrastructure was constructed primarily in service of the promise of the positivistic city's industrial future. Unlike the TVA works, however, Detroit's wastewater infrastructure could never have been imagined to be a visible constructed component of the landscape. While the generation of hydro-electric power was tied to massive constructions sited within a visually powerful landscape, the fundamental aim of waste water infrastructure was expediency and invisibility. Furthermore, the swampy soils of Detroit shaped a fundamental attitude toward all landward water as a nuisance to be drained, diverted, and disposed.

WHEN IT RAINS, IT POURS

In 1956 the Board of Water Commissioners appointed a new superintendent and chief engineer. In this position, Gerald J. Remus, aggressively expanded the department's service area to include all of metro Detroit. The extent of the service region today can be directly attributed to Remus' leadership during this period of growth. The Board of Water Commissioners was renamed the Detroit Water and Sewerage Department (DWSD) in 1975 to reflect its metropolitan approach to the delivery of water and sewerage services and today it encompasses more than 1,000 square miles with 77 suburban communities contributing to wastewater and 125 suburban communities purchasing water supply.

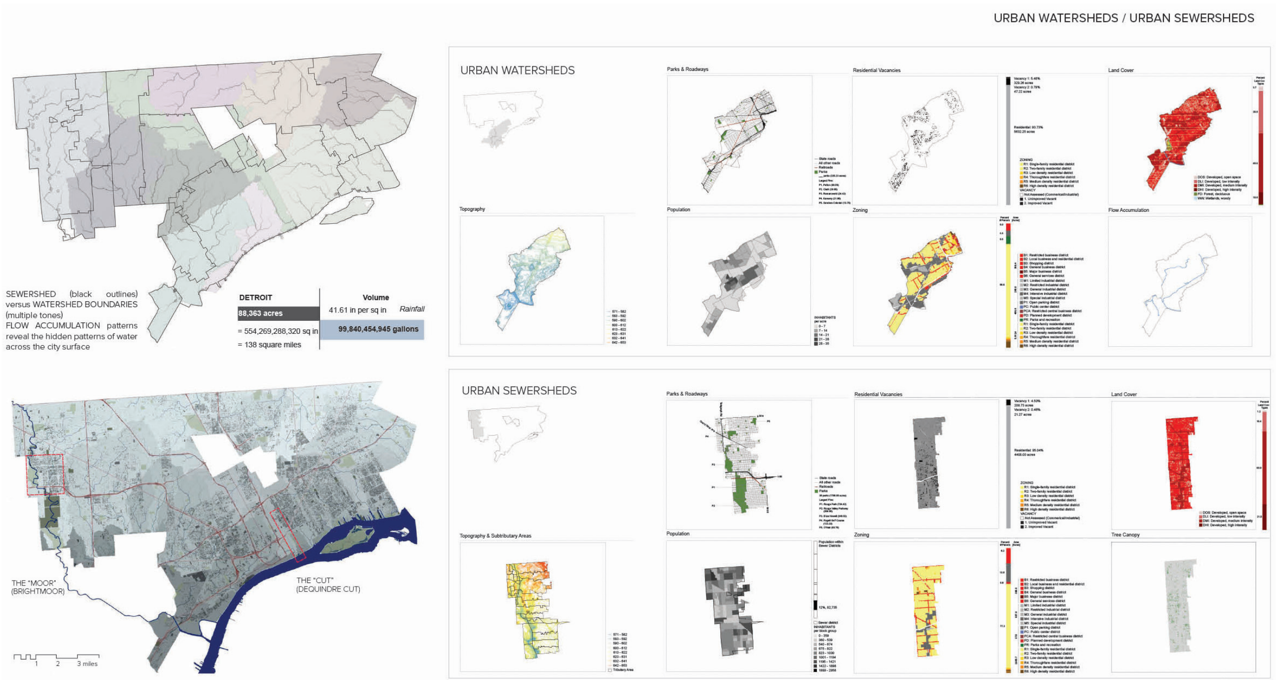
In spite of the enormity of any single component of wastewater infrastructure in Detroit, the scale of its metropolitan territory steadily outpaced the capacity for treatment. In its current condition, the city of Detroit is bounded by the Rouge and Detroit River, both identified by the Environmental Protection Agency as Areas of Concern, with severely compromised standards of water quality. Located at the very intersection of the two rivers, the Detroit wastewater treatment plant signals the end point of the Detroit's combined sewer infrastructure system, considered the most significant contributor to the ongoing challenge of water pollution.[5] The drawbacks of a combined system were understood and debated in the late 1800s, but the extent of the current situation was never imagined to be possible. Although the current Detroit wastewater treatment facility can process 700 million gallons of wastewater per day, making it the largest facility in North America, a single rain event can quickly amount to volumes that exceed this capacity. In response to this situation, the DWSD has invested in recent decades in massive CSO facilities, hidden infrastructural constructions to hold water under wet weather conditions, to release the pressure on the wastewater treatment plant. Even with the presence of these additional elements, on the occasions when Detroit's 3,400 miles of combined sewer lines are overwhelmed by storm-water flows, untreated sewage is discharged directly into waterways to prevent to the wastewater plant, called outfalls, and are permitted at 78 locations along the Detroit and Rouge Rivers.[6] The volumes of the outfalls themselves are telling. In the years 2008 and 2009 alone, nearly 40 billion gallons of untreated wastewater was released to the Detroit River.[7]

Lying at the crux of this detrimental feedback loop are Detroit's patterns and materials of urbanization. Even with the higher rates of vacancy that define the city today, Detroit's urbanized landscape is best described as highly impervious from a hydrological standpoint. The loss of urban tissue in recent decades has left behind highly compacted and polluted soils where the appropriate hydrological functions are severely compromised. Detroit is also located "downstream" of a vast network of paved roadways and asphalt rooftops served by the DWSD. Consequently, the Department commissioned the expertise of civil engineering firms to model the differences between dry weather operations and wet weather (rain event) flows following the standards set up by the EPA. An assumption that shapes the model's predictive power is the assigned relationship between the rooftops of Detroit's residential fabric and the sewer system. The majority of residences constructed in Detroit were built with their downspouts connected directly to underground sewer lines. In a neighborhood of 100 houses, this amounts to up to 2.5 million gallons of rain water. Given the extent of this type of residential land use throughout Detroit, the magnitude of the volume of water contributed by connected downspouts is significant. Even so, downspout disconnection is a small piece of a larger set of tools that could be enacted at the scale of individual parcels that collectively represent important considerations often overlooked. Taken to a logical conclusion, if storm-water did not enter the infrastructural system, then municipal wastewater treatment plants would be able to consistently and effectively deal with dry weather flows. Preventing storm-water from entering the loop equates to the reduction and potential elimination of outfalls.

PROTOTYPING THE URBAN GEOGRAPHY

Given the current state of Detroit's wastewater infrastructure, the single most important change to be made is paradigmatic. Continuing to "problem solve" and respond to failures in the existing system through the engineering of "larger capacity" systems does nothing more than perpetuate an already exhausted model. Instead, returning to the original conceptual framework of how to design infrastructure to handle wastewater within urban areas reopens two fundamental decisions: (1) should the system be designed above or below ground and (2) should rain water runoff be combined or handled separately from waste water?

It is now widely accepted that combined systems offer an initial construction, and therefore financial, efficiency but little more. Cities, like Detroit, that have attempted to engineer their way out of the problems of combined infrastructure through CSO facilities and other major infrastructural "band aids" are now considering the reality of converting to a separate system, having already depleted increasingly strained financial resources. There are many indications that the Detroit Water and Sewerage Department is making this conceptual shift and it is also clear that, as it stands, the department is severely lacking in expertise and imagination to bring design intelligence to the shaping of a new infrastructural paradigm for the twenty-first century.



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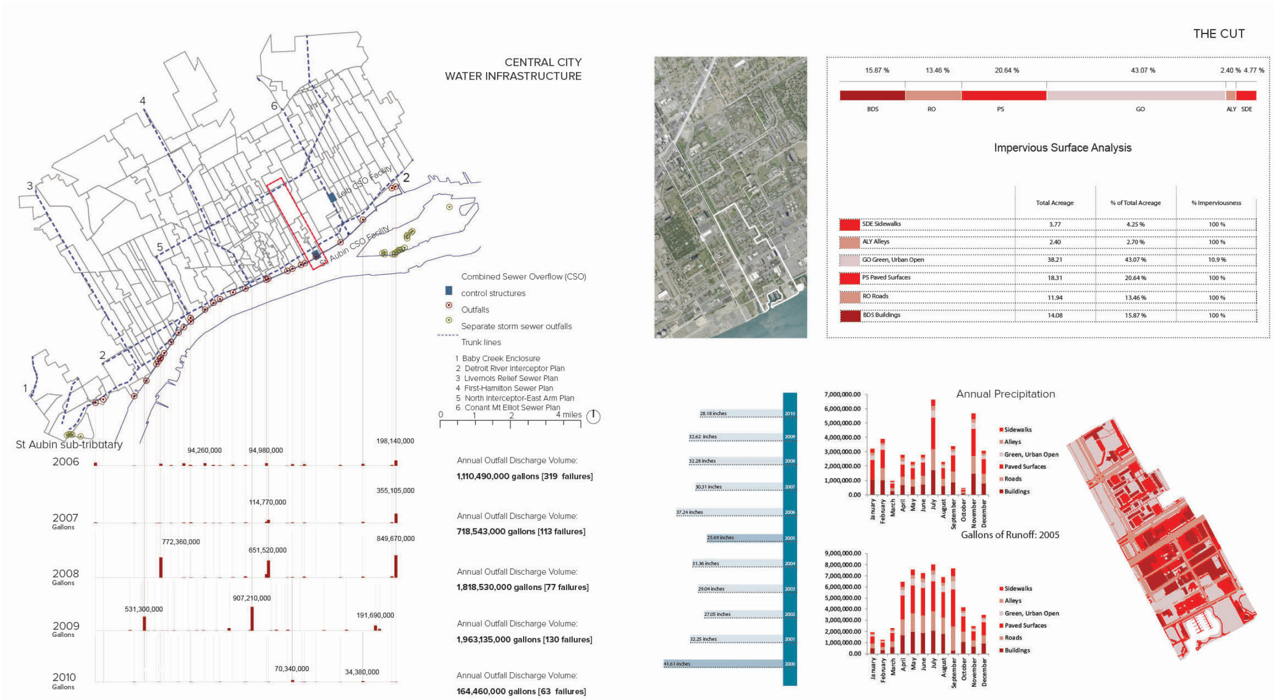
If combined systems are no longer desirable or viable, then the challenge of conversion becomes the infrastructural question of our time. Accepting the following assumptions, (1) it is too expensive to rebuild the entire system "tabula rasa," (2) It is unlikely that Detroit will experience a significant increase in tax revenues over the next decade and (3) something must be done in a short time frame, we must return to the question of infrastructure's relationship to the ground. Instead of posing the question in terms of "either/or," we can alternately ask, "How can the system be designed to integrate watershed systems that function above ground with the current set of infrastructural sewer systems in place below ground?"

Once we allow water to reclaim the capacity to move above ground, our cities must be understood through the logics of watersheds rather than sewersheds. If Detroit is redrawn to reveal how water flows across its surfaces, we can identify highs and lows as well as areas of fragmentation or continuity. Understood in combination with other readings of the city, such as patterns of vacancy, land use, zoning and rights of way,, cartographies of water become a valuable tool toward a more integrative approach to infrastructure (Figure 1). Furthermore, while this expanded understanding of site presents designers with a vast array of unique circumstances to work with, Detroit can also be understood as a patchwork of repeated conditions.

Much like the history of water infrastructure, Detroit's neighborhoods are closely tied to the development of its industrial corridors. And, similarly, Detroit's patterns of land use and occupation are undergoing a fundamental reconsideration as its legacy of industrial production is reimagined. In this reterritorialization, the city of Detroit can be depicted as a collection

Figure 1: Analysis Detroit's sewer and watershed tributary areas.



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of watersheds threaded with post-industrial corridors along transportation lines that tie together patches of residential fabric, alternatingly vibrantly occupied or heavily vacated. Within this matrix of nodes and corridors, our work examines two particular sites of study that illustrate two fundamental approaches to designing for an alternate infrastructural paradigm.

The resulting speculation proposes a system of urban watersheds as spatial and functional units to guide urban stabilization, and the deployment of new building and urban block types. The research focuses on two prototypical conditions that could be replicated and scaled to cover the geography of the entire city: (1) the Line represents the conditions of linearity and continuity associated with former rail line conduits, and (2) the Moor represents a patch system characteristic of a traditional Detroit residential neighborhood with high rates of vacancy. Informed by a careful analysis of the physical and cultural components of the urban landscape that these prototypes represent, the study speculates on future scenarios of guided re-naturalization and neighborhood consolidation, building on greenway continuities (the line) and residential patches (the moor).

THE LINE

> Factories, shops and neighborhoods blurred together indistinguishably, enmeshed in a relentless grid of streets and a complex web of train lines … Rail lines formed the thread that tied the city's industries together. Automobile manufacturing and railroad transportation were inseparably bound in a symbiotic relationship. Every major automobile factory had its own rail yard. Trains brought raw materials and parts to the auto

Figure 2: Central City sub-basin area in relation to land cover and combined sewer overflow events.

> plants and carried the finished products to distributors throughout the country (Sugrue, 1996, 18, 19)

One of the great opportunities emerging from the adaptive reuse of abandoned railway corridors is the integration of ecological continuity within the public spaces of cities. Commonly called "greenways," the reuse of rail corridors is widely recognized to positively impact recreation opportunities, economic redevelopment, property values, environmental protection, and local and regional connectivity within communities.[8] Detroit's history of industrial production has left the city with an extensive rail network, much of which has been abandoned over the past several decades and now represents an opportunity to transform old industrial corridors into new, civic forms of infrastructure.

The most extensive study of this corridor system was published in 2002, prepared by Rails-To-Trails Conservancy for the GreenWays Initiative, a program of the Community Foundation for Southeastern Michigan. The report identifies ten railway corridors and classifies five of these as target projects, due to their potential to link together and form a continuous loop within Detroit. In total, the five targets represent roughly twenty-five miles of potential greenway space, not including an additional five segments that would be required to establish uninterrupted continuity. While the specificities required to resolve ownership, contamination, safety, and access challenges to transform each of these segments are unique, it is also necessary to establish a clear vision to guide the reuse of aging infrastructure while designing for novel linear, urban systems.

The legacy of linear infrastructure is one of directionality and efficiency. While the rail lines required tight tolerances derived from the constraints of the slopes and turning radii that limit train operation, the new programmatic components of greenways have the capacity for slack. In terms of water, it is tempting to pair conduit typologies that facilitate rapid transport within the length of the rail corridor simply out of habit. Aqueducts, channels, pipes, culverts, ditches, canals, sluices, and troughs are all familiar forms of water transport infrastructure that are commonly coupled with other linear systems including railway corridors and roads. The occupation of a greenway does not necessitate this approach, yet it is common to find culverts running within these "restored" corridors.

When water is the focus of restoration, such as in the case of stream daylighting projects, one of the primary methods for improving water quality is to bend straight lines in favor of elongated, meandering paths of travel. A meander prioritizes slowness over speed and facilitates oxygenation and infiltration. Meanders require space and have dynamic boundaries, the very qualities that linear water systems were designed to "straighten out." If greenways, therefore, are to live up to their hydrophilic potential, the challenge is to design meanders that can occupy linear spaces. This is a distinctly spatiotemporal challenge that requires innovative approaches to more agile and malleable visions of water infrastructure that have the capacity to foster social and ecological functions fluently.

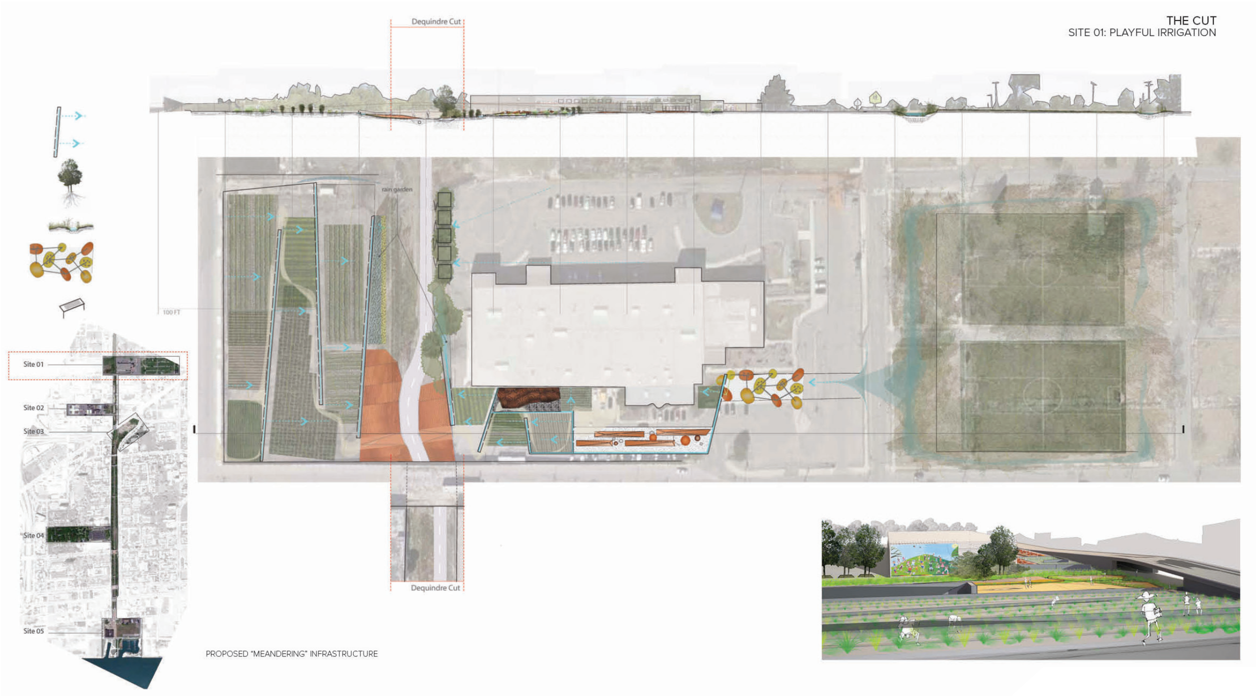
Within the current context of urban greenways in Detroit, the Dequindre Cut represents an exemplary opportunity to establish a model hybrid greenway system (Figure 2). From its industrial origins to its active reinvention, the Dequindre Cut is already attracting the attention of investors and community members because of its initial success after opening a 1.35-mile paved pathway to the public in May of 2009. This segment connects the Detroit Riverfront with a series of residential neighborhoods and the Eastern Market successfully but does little to advance the need for innovative approaches to integrated infrastructure, especially those responsible for storm-water management. Through a series of sectional speculations, our work breaks the boundary of the rail line corridor and uses borrowed, vacant territories to construct a civic infrastructure that weaves water and public space together. This cross-grain approach designs the pockets of access to the Dequindre Cut that imagine it to be more than a paved path alone while providing the space necessary to allow a continuous, meandering storm-water system to become re-established in concert with public activities (Figure 3). The close coupling of infrastructure, ecological systems, and public space is imperative yet distinct from the monumental history of Detroit's water towers and pump stations. Rather than concentrating investment in singular, heroic works, the infrastructure of our time is multiple, shape-shifting, and distributed. It is no less substantial than its historic counterpart yet it transforms expectations from something removed and uninhabited to something integrated and spatial.

THE MOORS

Brightmoor, a four-square-mile area in northwest Detroit, encapsulates the entire range of conditions encountered in the residential landscapes city-wide. The site, as a case study, offers the challenge of designing for continuity within a condition of fragmentation. The importance of physical continuity in the implementation of multi-scalar storm water techniques lies in its capacity to augment the efficiency of the system beyond the contribution of a single parcel or block.

While Detroit's neighborhoods each possess a unique and important set of physical and cultural attributes, this paper presents a prototypical site-analysis approach derived from the study of Brightmoor but applicable across all of Detroit's neighborhoods, "The Moors." In this scenario, a moor, defined as a tract of open and uncultivated land, represents the prototypical approach to the current condition of vacancy engrained within the residential fabric across the city. The extent of this type of landscape across Detroit's geography bears a tremendous responsibility in the potential alterations of current storm-water management practices. "The Moors" approach de-urbanization and re-densification by cross-registering water analyses with patterns of vacancy. In this way, vacant parcels are seen as opportunities for soft, water infrastructure rather than points of weakness.

An initial assessment of current physiographic conditions throughout Detroit revealed the hidden patterns of water flow. This analysis derives surficial topographic variations and maps relative high and low elevations,



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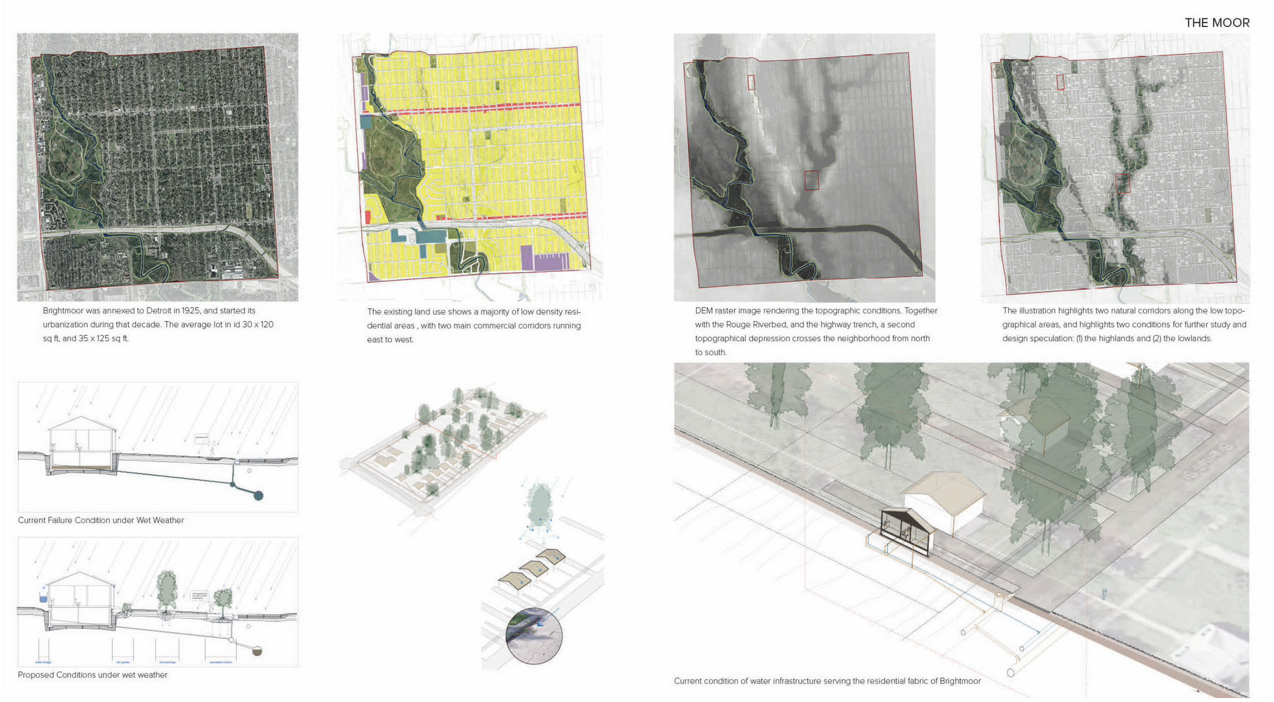
resulting in a visual representation of where water moves when it rains. When paired with historical maps and site observations, a new cartography is derived that reveals what is hidden in plain sight. In the case of Brightmoor, flow analyses visualized the remnant of an historic drainage ditch that traversed the site until the 1920s (Figure 4). Furthermore, it shows a distinct boundary between a portion of the area that occupies high, dry ground and another that occupies low, wet ground. The speculation emerging from this understanding reinforces what is working in this area and proposes to consolidate on high ground and re-naturalize the lowlands. This is further refined with an understanding of patterns of vacant land ownership, and other constituencies (residents, public and municipal entities, banks, non-governmental organizations) in place at the present time (Figure 5).

Resulting from this reconstructed reality is a design speculation that recognizes the existing dynamics in the low and high lands, and favors an urban watershed approach to the incremental re-naturalization and stabilization of these areas. Beyond the initial work, however, our long-term ambitions recognize that the realization of these physical frameworks necessitates the participation of people and their knowledge of place. Such a place-based approach to infrastructure pairs a rigorous analysis of landscapes with a historical vantage point and contemporary cultural identity and sense of belonging.

CONCLUSION

With this paper, we participate in current discourse surrounding the imagined future of Detroit's water infrastructure. Of particular interest is the

Figure 3: Study site 5 (farm linked to school linked to former vacant property) along Dequindre Cut.



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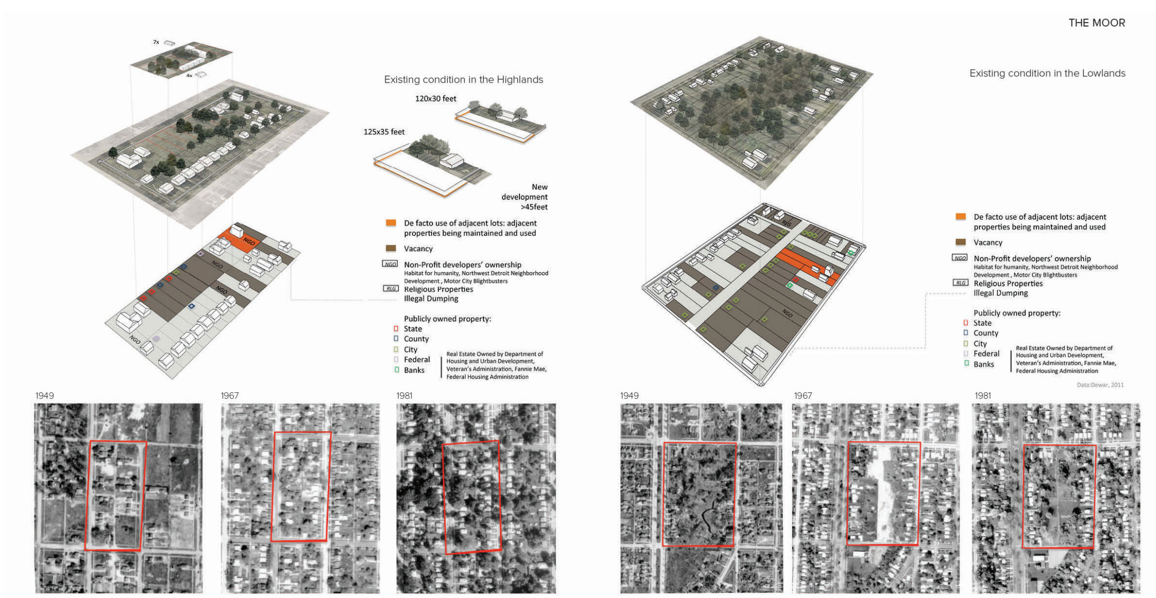

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Figure 4: Brightmoor (the moors) study site of flow analysis overlaid with patterns of vacancy.

Figure 5: Brightmoor (the moors) study site of ownership overlaid with patterns of vacancy.

spatial challenge of accommodating the dynamics of urban contraction while ensuring quality of life through an investment in public space. In this scenario, the case of the underground combined sewer infrastructure is a prime example to showcase the need of more sustainable practices of city making. As the Detroit Water and Sewer Department serves a region more than 6 times larger than the city itself, the failure of the system's performance has disproportionately large consequences that continue to challenge the federal standards of water quality. Inundated highways and streets, massive volumes of untreated wastewater draining into the Detroit River, and raw sewage flooding residential basements are common during wet weather.

To tackle the complexity of the urbanization processes in the region, this research moves across physical and temporal scales and considers the spatial, ecological, and cultural frameworks at play. We articulate a synthesis of disciplinary approaches integrating typological, formal and material studies of the existing urban fabric, the incorporation of urban green infrastructure to reintroduce natural processes in the city, and the consideration of participatory processes in city and place making. The tactics involved in developing scalar transitions across contested boundaries are driven by a careful study of both existing and prior conditions. Because our work recognizes "landscape" both as a physical reality and the representation of that reality, the research methods emphasize the role of different representational techniques as productive tools for inquiry into issues of design agency, interpretation, and identity. ◆

ENDNOTES

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