Liquid Planning Detroit

Detroit Sustainability Indicators Project

Driven Detroit and the University of Michigan's Graham Institute

Principal Investigators:

Jen Maigret, Assistant Professor of Architecture, Taubman College

Maria Arquero de Alarcon, Assistant Professor of Architecture and Urban and Regional Planning, Taubman College

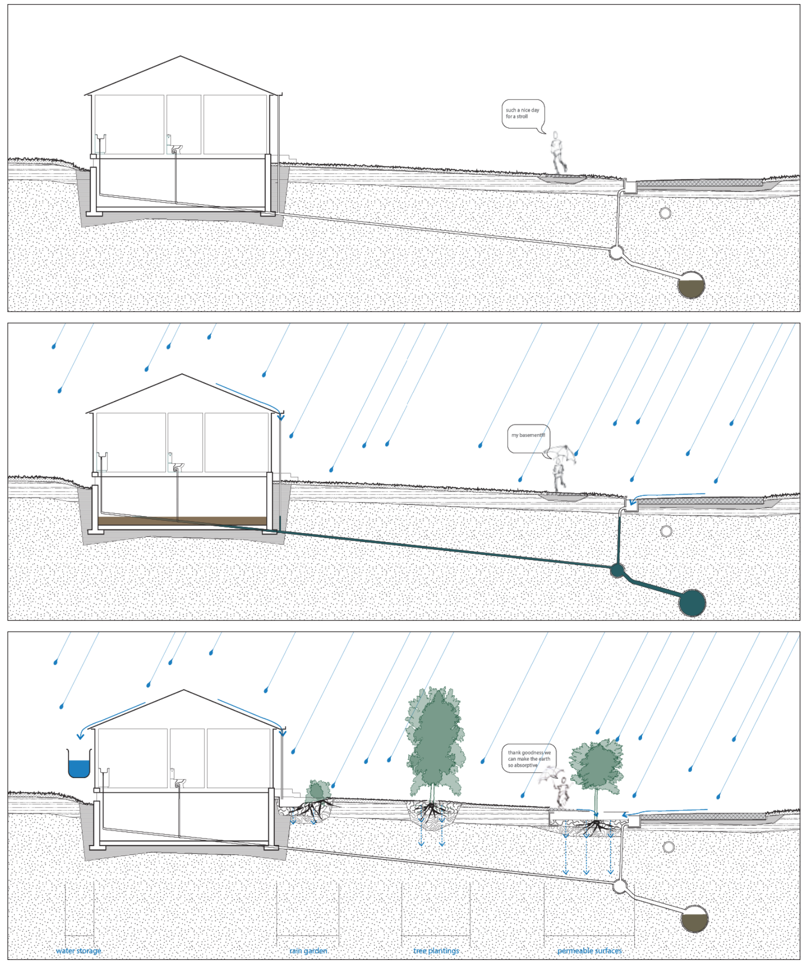
GIS Consultant:

Nicole Scholtz, Spatial and Numeric Data Librarian, University of Michigan

Research Assistants:

Meghan Archer, Catherine Baldwin, Caroline Bergelin, Maria Capota, Leigh Davis, Tara Mather, Laura Reading, Anna Schaefferkoetter, Peter Sotherland, Robert Yuen, Wen Zhong

December, 2013



Liquid Planning Detroit

Detroit Sustainability Indicators Project

Driven Detroit and the University of Michigan's Graham Institute

Liquid Planning Detroit fosters the imaginative capacity of visions for Detroit's future urbanism by understanding the city through the lens of water. Whereas current debate is mired in circular reasoning-the solution to Detroit's overwhelming vacancy is less vacancy—our work positions the consideration of urban storm water management as a key tool for generative design strategies that encourage nested, scalar approaches and interdisciplinary collaboration.

The research brings together regional analyses of the systems of water infrastructure, and the physical, regulatory and cultural forces that shape Detroit's contemporary urban condition.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

Water quality management, throughout the Great Lakes watershed, is an institutional effort handled across many disciplines, scales, agencies and individuals. Detroit's watersheds are no exception. This project, *Liquid Planning Detroit*, prioritizes a watershed biased research trajectory to tackle challenges in water quality throughout the metropolitan area. The project recognizes opportunities, arising from current dynamics of urban contraction, to repurpose vacant land toward the reversal of combined water infrastructure failure, and toward the establishment of cultural relevance as a key component of sustainable stormwater management practices.

Liquid Planning Detroit is one of seven projects awarded a Detroit Sustainability Indicators Project Grant through the partnership between the Graham Environmental Sustainability Institute at the University of Michigan and Data Driven Detroit. This initiative framed two goals:

1. To gather, assess and map data on relevant sustainability-related topics and make the findings available to the public, and

2. To create a sustainability index for Detroit to inform policy and decision making and serve as a model for other urban areas working on sustainable redevelopment.

Under this framework, Liquid Planning Detroit develops a two-fold approach: first, it develops a GIS database with a set of relevant layers to the study of storm water management across the geography of Detroit. This inventory registers infrastructural, physiographic, vacancy and demographic data, and is complemented by information on precipitation trends and approximated calculations of storm water runoff. Second, the project develops a typological approach to existing urban conditions to provide design synthesis. Toward this end, two representative areas are selected to develop site-specific responses to storm water management: a neighborhood with higher vacancy rates, and a repurposed rail line converted into a greenway. In both the inventory and the design synthesis, the project develops a strong stance on the role of visualization in the dissemination of the research to diverse audiences. The transition from the GIS inventory to the design proposals exemplifies the relevance of the visualization methods developed by the team. From the techniques of data visualization, to the three-dimensional representations of design proposals, this research contributes to the development of an imaginary around water today absent from the experience of the urban dwellers.

Liquid Planning Detroit aligns with current efforts to materialize approaches to transform traditional land use patterns into diverse and innovative urban typologies that have the capacity to address sustained population loss and improved quality of life. Our assumptions align with the Detroit Future City Framework's forecast that the demographic trend of population loss will not transition into significantly measurable growth within the scope of near term planning efforts. In this way, the framework departs from a "planning for growth" paradigm and prioritizes approaches supporting urban stabilization, consolidation, and renaturalization. This initiative, championed by a collection of powerful philanthropic foundations, aligns local public and private support to leverage multi-agency funding to guide future, implementable projects. Within this framework, one ambitious component is the Green and Blue Infrastructure section that identifies vacant land as an asset for future stormwater infrastructure.

Liquid Planning Detroit also recognizes ongoing efforts led by the Detroit Water and Sewage Department such as the CSO Long Term Control Plan. As part of the efforts to comply with EPA water quality regulations, the DWSD is partnering with SEMCOG, the Greening of Detroit, and other local constituencies to develop a Green Infrastructure Program. The relevance of this program is manifold: first, the locations of projects address weaker points in the CSO infrastructure system. Second, as projects are implemented, metrics are being used to assess the performance of the systems. Such metrics contribute to a more thorough understanding of the economic benefits that green, water infrastructure projects promise. Last, residents have been engaged in implementation of the projects and will continue to be an important factor in their long term success.

Finally, this report highlights, in more detail, some exemplary initiatives developed during the two-year grant cycle during which time Liquid Planning Detroit was developed. This serves to address one of the recommendations included in this report: the need for more collaboration among institutional actors, and the simplification and integration of regulatory frameworks operating in the city. It is in this spirit that Liquid Planning Detroit addresses the goals of the Integrated Assessment methodology and calls for innovative partnerships where design can amplify the role of policy making by engaging cultural values in the development of a new generation of urban landscapes.

2 OVERVIEW

"While knowledge defines all we currently know and understand, imagination points to all we might yet discover and create."

-Albert Einstein[1]

Responses to failing wastewater infrastructure, throughout the Great Lakes, will determine the future of water quality and the experience of contemporary public space in the most fresh water abundant region in the world. Contrary to Detroit's post-heavy-industrial media image, the largest detractor to swimmable water, in the Detroit and Rouge Rivers, is the city's failing wastewater infrastructure. Detroit's legacy of wastewater infrastructure is one of buried streams, combined sewer systems and vast territorial expansion. In the present condition, the confluence of these factors reaches a frequent tipping point when typical rainstorms shed water onto a city whose inhabited spaces are overwhelmingly constructed with impermeable materials and very little capacity to absorb water. Such tipping points, known as combined sewer overflows, release hundreds of millions of gallons of untreated sewage into Detroit's waterways each year.

And, yet, the Detroit wastewater facilities operate reliably during dry weather thereby signaling the importance and urgency of a paradigmatic shift in thinking about stormwater infrastructure systems. In moving from an attitude of stormwater as waste to an approach that conceptualizes rainwater as resource, the economic and intrastructural models at play throughout the city can be recalibrated to re-define new opportunities for a designed synthesis between nature and culture. The research covered in this report acknowledges the scale and complexity of the problem of combined sewer infrastructure failure in Detroit. Through an integrated assessment (IA) approach, this project addresses ongoing changes in the regulatory frameworks shaping green storm water infrastructure plans in Detroit and proposes the development of a more imaginative approach to the design of alternative, sustainable water infrastructural landscapes. Our primary contribution focuses on the reframing of the problem of wastewater management through the development of a mix of visualization methods that combine the display of data sets using a geographic information system (GIS)

2.1 Ronald W. Clark. Einstein: The Life and Times. New York: World Publishing Company; 1984. p. 201.

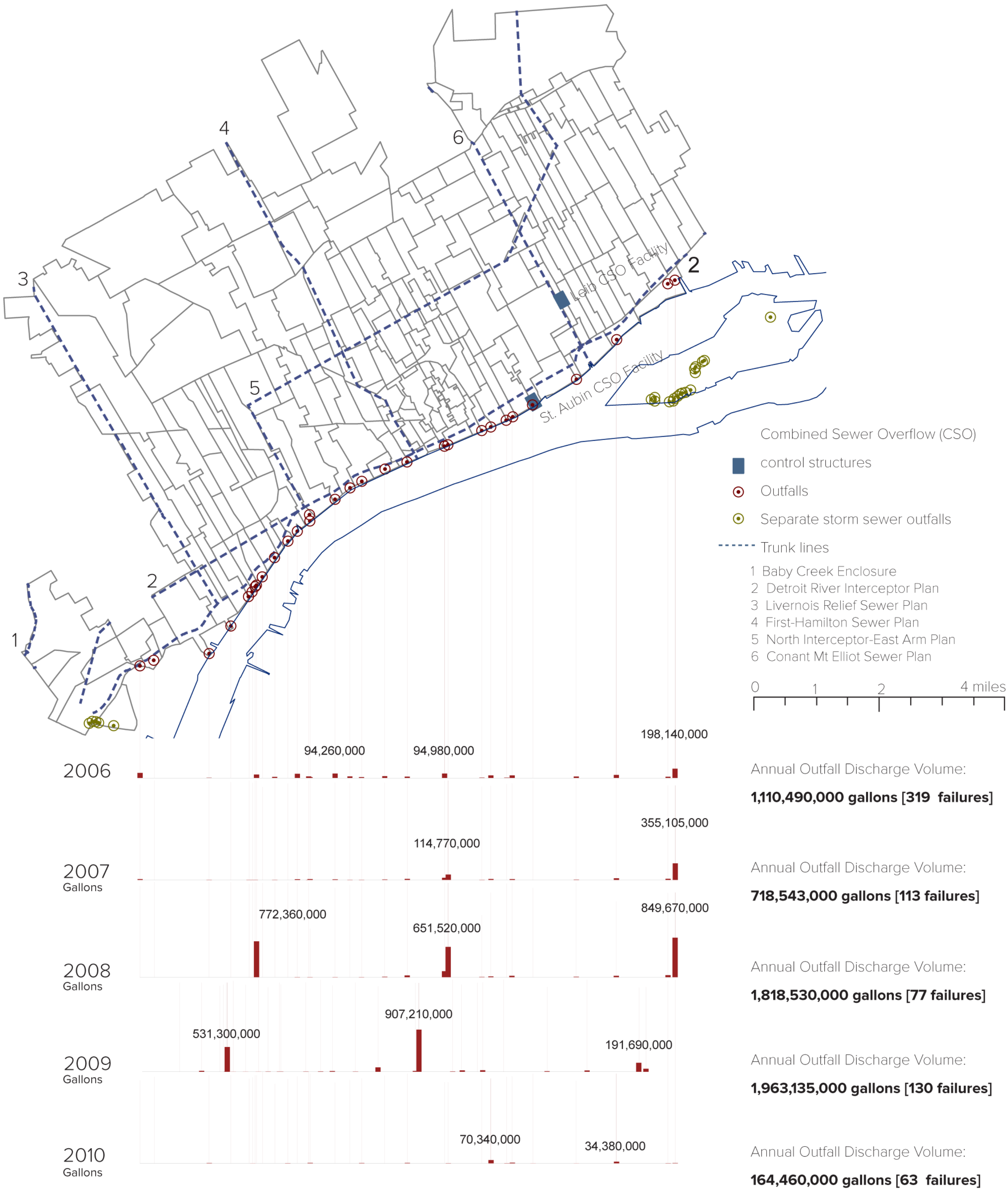


Figure 2.1: Central City water infrastructure.

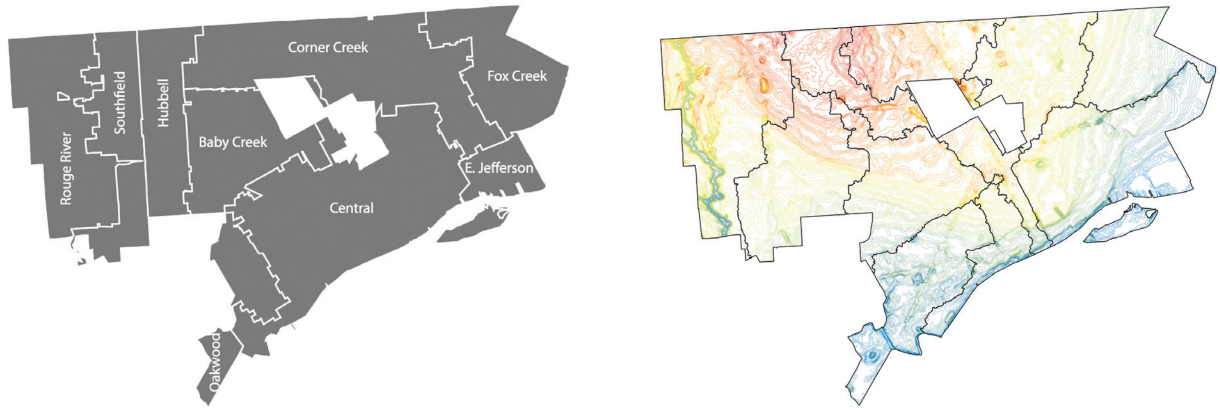


Figure 2.2: Water Boundaries in Detroit: Nine Sewersheds versus Ten Watersheds

inventory, with site-specific representations of imagined scenarios in prototypical locations in the City. The agency of these visualizations includes: (1) the redrawing of territorial boundaries within the city of Detroit thereby shifting from an infrastructural logic to water-driven one (from sewersheds to watersheds), (2) the identification of areas with a high concentration of vacancy in low-lying topographic areas as priorities to target green infrastructure, and (3) the reimagination of specific sites, to claim the the capacity for major civic projects in the city to simultaneously address storm water management and revitalization efforts. In these ways, Liquid Planning Detroit enables data to foster a cultural imagination for an alternate paradigm of wastewater infrastructure that focuses on rainwater as a resource and ties the collection and absorption of this resource to the development of "green" public spaces.

Methodologically, the use of design proposals serve to demonstrate the potential for a typological approach to green, stormwater infrastructure in Detroit. Two sites, Brightmoor and the Dequindre Cut, represent development patterns common within the fabric of Detroit, single family residential lots interspersed with varied degrees of vacancy and abandoned post-industrial transportation corridors, respectively. From the vantage point of rainwater resource management, each "type" represents specific opportunities and challenges tied to designing system continuity. In the case of residential fabric, vacant lots offer an opportunity to insert green infrastructure within a pre-existing condition, while the challenge emerges from the difficulty of overcoming water fragmentation in such systems. In the case of post-industrial corridors, such as the Dequindre Cut, both capacity and connectivity are inherent to the nature of conduits therefore the challenge resides in establishing partnerships to integrate the design of stormwater management strategies with the redevelopment of urban, recreational greenways. Both cases offer specific approaches to moving data into design and into the realm of urban experience.

3 METHODS, ANALYSIS

3.1 Overview of Methods

Liquid Planning Detroit combines qualitative and quantitative techniques in the geospatial research and the development of design scenarios. The data sources driving the graphic representation of the project are described below.

The intention of the GIS dataset is to establish an approach toward stormwater management that enables design decisions to be influenced by an analytical understanding of the complexities that trigger combined sewer infrastructure failure in the city of Detroit as of 2011-2013. In this regard, some of the data collected is organized within a geodatabase whereas other data is not strictly geographic and/or is primarily utilized to produce visualizations and therefore can be accessed through software platforms other than those intended explicitly for GIS applications. The use of mix visualization methods in this research is central to the development of policy recommendations.., This responds to the belief that better regulations will emerge from a better understanding of the complexities of urban stormwater dynamics, and this requires to reveal the operative of a system long ago hidden from the experience of the users. While a continued presence of technical expertise within the realm of civil engineering will play an important role in the evolution of stormwater management, the use of technical calculations alone has proven not to be enough to solve the problem at hand. Rather, it has become increasingly evident that "wicked" problems, which elude existing modes of inquiry, require adjustments in research approaches that enable broader participation between inquirers, decision makers and the broader society that has contributed to the genesis of the problem and therefore must also be a part of proposed resolutions.[1] It is, therefore, our contention that the development of visualization tools, such as a website platform, are as methodologically important as those more quantitative methods that were employed during the development of this research.

Collectively, the information is organized following a scalar approach: from the regional area of service of the DWSD, to citywide overlays, to sub-city units of analysis (sewersheds and watersheds), and, finally,

3.1 Valerie A. Brown, Peter M. Deane, John A. Harris and Jacqueline Y. Russell. Tackling Wicked Problems: Through the Transdisciplinary Imagination. London: Earthscan; 2010. p. 4.

site-specific focus areas. Our analysis has primarily focused on the city of Detroit as the largest scale, although we acknowledge that this has some limitations given the extent of the DWSD service area in comparison (which is over 6.5 times larger than the size of the city). The decision to focus on Detroit and the scales of consideration within

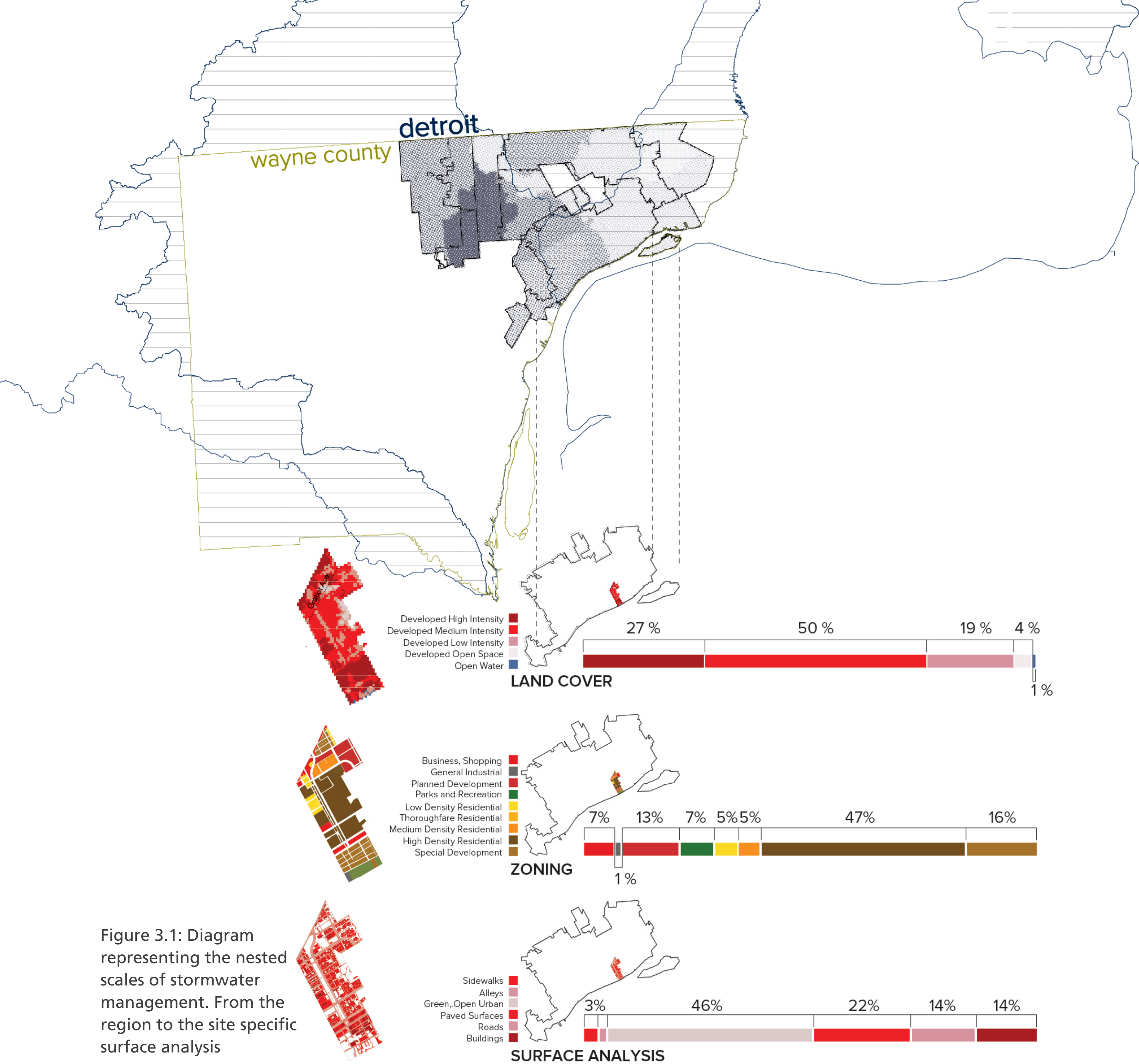
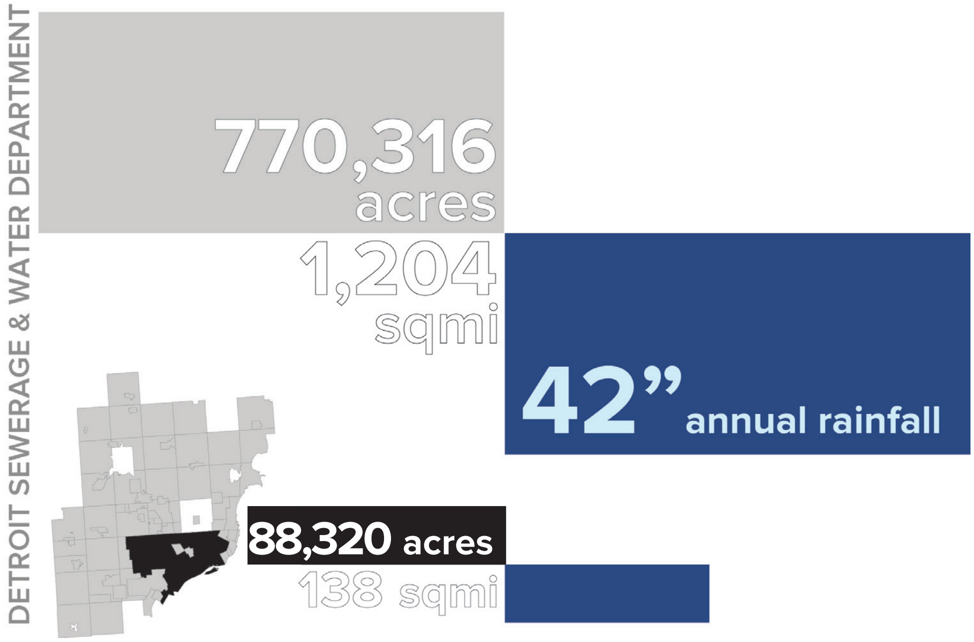


Figure 3.1: Diagram representing the nested scales of stormwater management. From the region to the site specific surface analysis



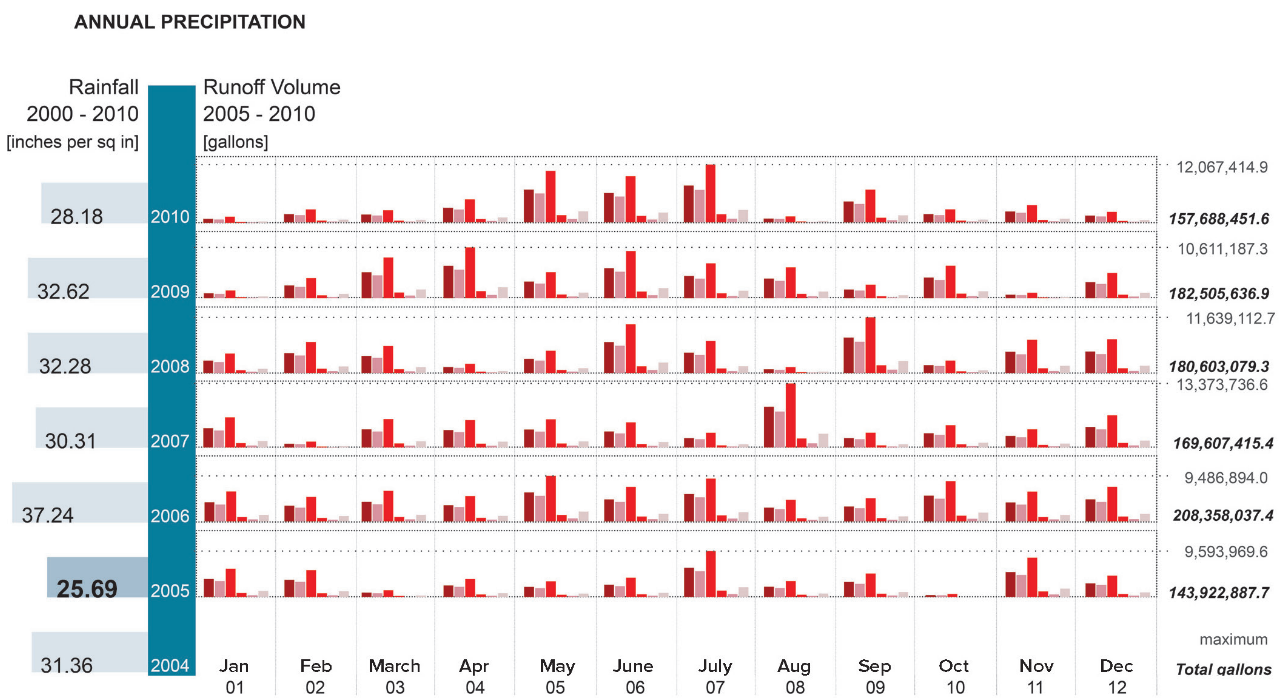


Figure 3.2: The Scale of Operation of the Detroit Sewage and Water Department , and the City of Detroit (above).
2004 - 2010 Precipitation Data from the National Oceanic and Atmospheric Administration (below).

the city was pragmatic (it enabled us to do more in depth analysis given the time and scope of the grant), however, the methodologies developed have broader application potential and could be replicated for areas outside of the city boundaries that contribute to the overall understanding of the system of infrastructure. At the scale of Detroit and smaller, the research has made significant efforts to bring together data that describe a variety of "upstream" conditions that contribute to the more measurable moments of failure such as administrative,

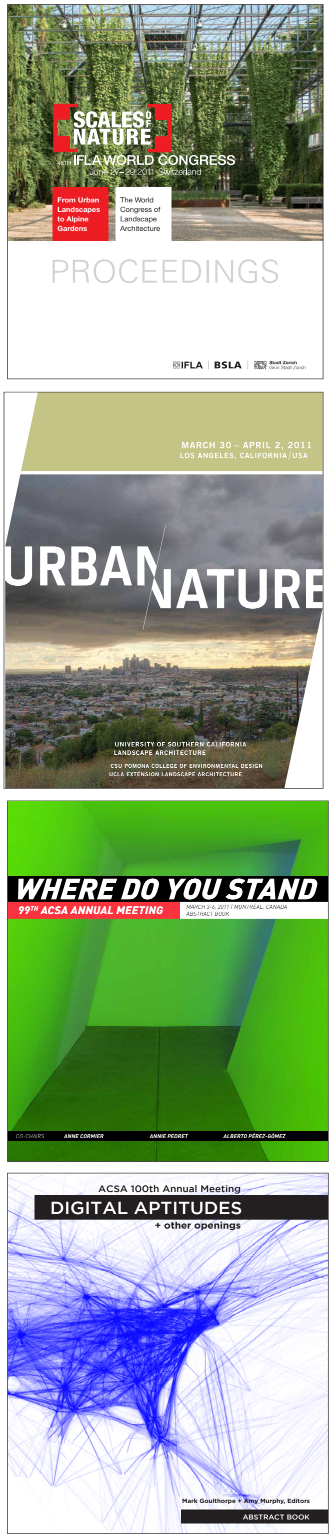


Figure 3.3: Academic Dissemination: peer reviewed conferences and proceedings.

infrastructural and physiographic information.

Therefore, at the scale of the city, the data set includes Topography, Transportation Infrastructure, Vacancy, Land Cover, Outfall locations, Combined Sewer Infrastructure Lines (partial data), Land Use, Tree Canopy and Flow Accumulation. This data is represented in more detail using two comparative sub-boundary demarcations: sewersheds and watersheds. Sewersheds were derived using data obtained through an engineering firm working as a subcontractor with DWSD (as described in more detail below). Watersheds were derived through flow accumulation anaylses of existing topographical conditions throughout the city (as described in more detail below). A watershed model of the city was important to the research in order to study "natural" subbasins and to visualize where water moves and drains across the existing topography of the city. In addition to the data (as collected in a geodatabase), the research findings include the use of comparative drawings that enable a visual comparison between each of the data layers as seen through the organization of sewersheds versus the newly proposed understanding of watersheds.

Building on this further, two focus areas were analyzed more deeply, as representatives of the extension of a geographic database as applied at the level of a site of intervention. Additionally, the site–specific focus areas aim to provide synthesis through design speculations—and, in so doing, expanding the realm of disciplinary discourse to include design disciplines and the expertise they bring to the consideration of redefining civic, public spaces. To this end, the use of design speculations has been a successful approach for peer review and comment (to date, Liquid Planning Detroit has been the recipient of two nationally competitive design awards—an ACSA (Association of Collegiate Schools of Architecture) Design Faculty Award and a BSA (Boston Society of Architects) Unbuilt Award—and has been accepted for presentation to several, national and international conferences including ACSA (Association of Collegiate schools of Architecture), ACSP (Association of Collegiate Schools of Planning), CELA (Council of Educators in Landscape Architecture) and IFLA (International Federation of Lanscape Architects)). The techniques employed to produce these visualizations, and therefore extend the conversation into the realm of design, included linking ArcMap analyses to three-dimensional digital modeling (Rhinoceros), and drawing tools (Illustrator, Photoshop and InDesign). The goal is to provide realistic representations of the proposed interventions introducing green infrastructure in order to make the civic possibilities associated with the development of green infrastructure both understandable and compelling.

The two sites that were considered more closely were the Dequindre Cut and the Brightmoor neighborhood. The Dequindre Cut was selected owing to its ability to lend the specificity of a site already under redevelopment, as well as its ability to establish a methodological approach more broadly applicable to post-industrial infrastructural corridors throughout the city. It is representative of the simultaneous conditions of continuity, within the boundaries of the rights of way of rail line conduits, and fragmentation in regard to establishing ties within the fabric of the city separated by the insertion of the rail line. Our sectional speculations propose a new integrated corridor, within the metropolitan abandoned rail system, that strategically expands into adjacent, vacant parcels in order to increase connectivity and space for residents and water alike. The physical expression of this new “water civitas” is manifested through the designed expansion of the right-of-way through five tactical interventions, each offering a unique typology of expansion and a model of replicability for other sites throughout the city.

Brightmoor was selected owing to its ability to represent the field condition characteristics of a traditional Detroit residential neighborhood with varying rates of vacancy. Here, the design research speculates on future scenarios of guided, civic re-naturalization (lowlands) and neighborhood consolidation (highlands), building on a better understanding of the physiographical conditions and water presence on site. Additionally, this work developed visualizations of potential aggregations of vacant parcels, and representations of sectional, three dimensional views of the underlying function of infrastructure within a typical neighborhood to reveal the level of reliance and interconnectivity that single family homes have to one another and to the greater functioning of city infrastructure.

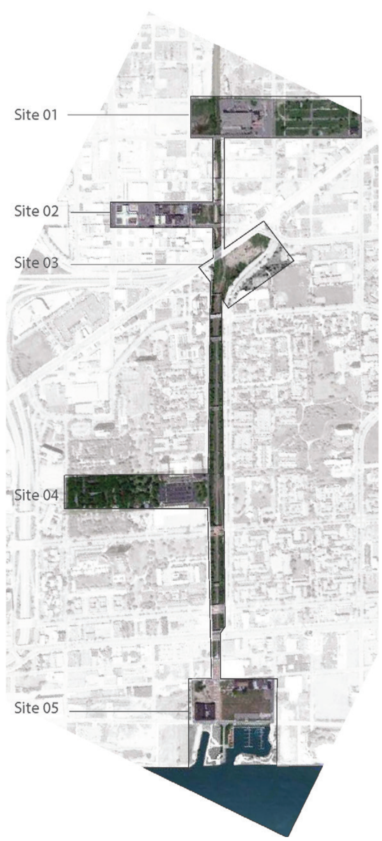
In the development of the visualizations, the project uses several software platforms:

01

02

03

04)4



05

Figure 3.4: The Dequindre Cut: visual site inventory in the five selected areas of study (above).

Figure 3.5: Design Scenarios along the Dequindre Cut at Lafayette Park and the Detroit Edison Public Academy.

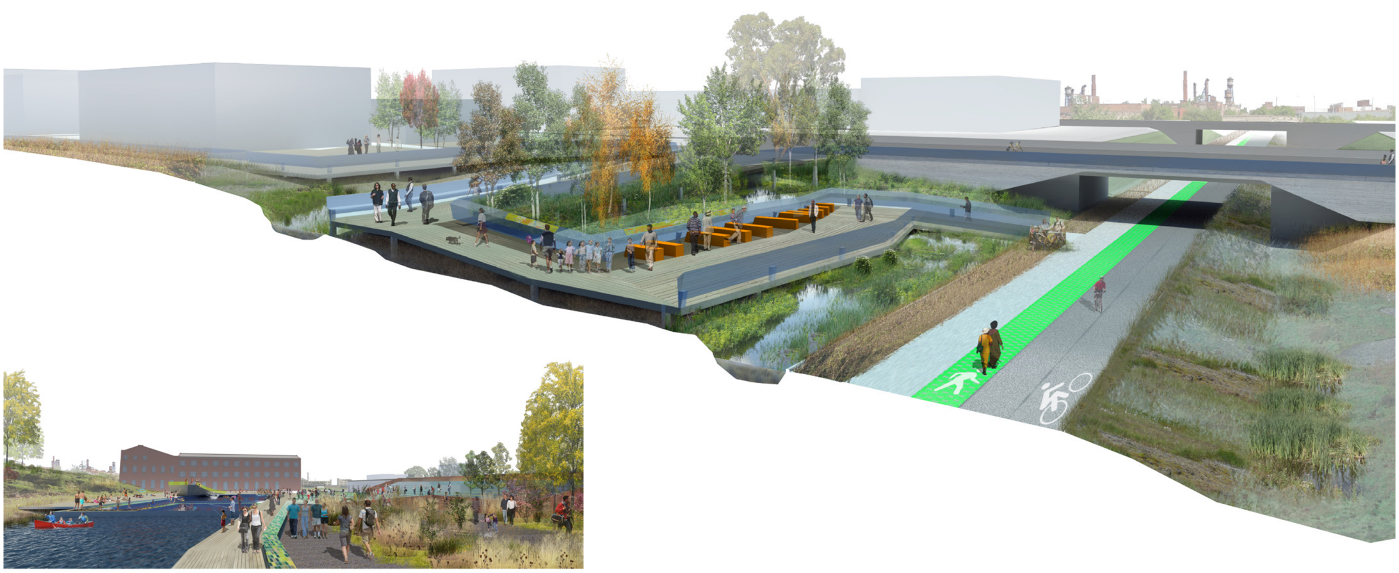


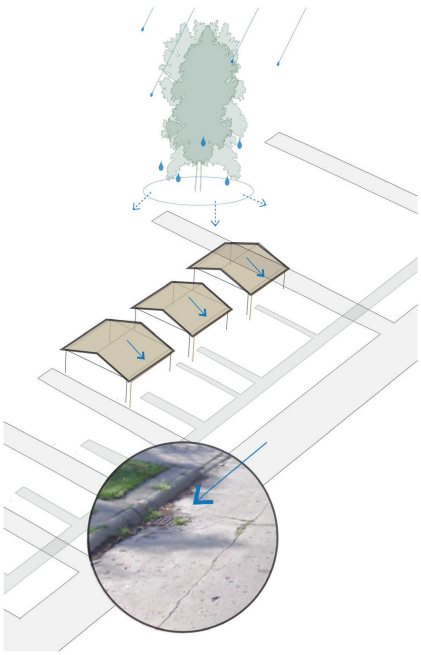
Figure 3.6: Design Scenarios along the Dequindre Cut at Eastern market and the waterfront.

1. ArcMap 10 was used to develop the geodatabase under a common projection. This is the base for the cartographic representations of the different spatial units of analysis. Arc Map also assisted with the delimitation of the urban watersheds through flow analysis.

2. Illustrator was used for the graphic edition of the maps exported from ArcMap10, and the formatting of graphic information. Ilustrator is the software used to combine numeric data with spatial references using more restrictive graphic standards than the ones offered by ArcMap.

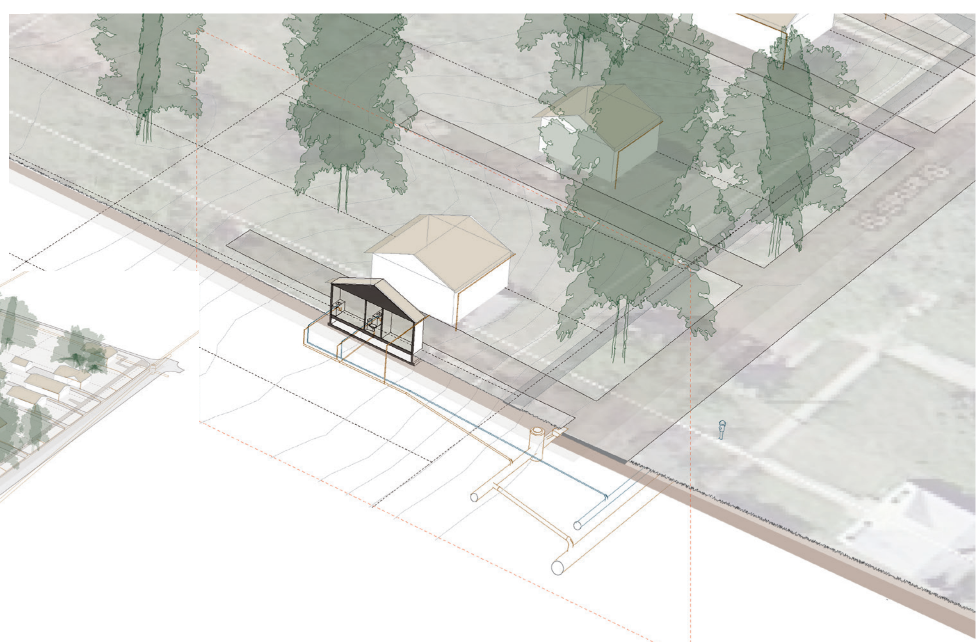
3. Rhinoceros assisted the development of the three-dimensional renderings for the design proposals. The based for these renderings is the cartographic information exported from ArcMap.

4. Photoshop was used for the realistic treatment of the design proposals over the three-dimensional Rhinoceros outputs, or the collages over site photography.



3.2 GIS Data Structure

Throughout the geodatabase generated using geographic information



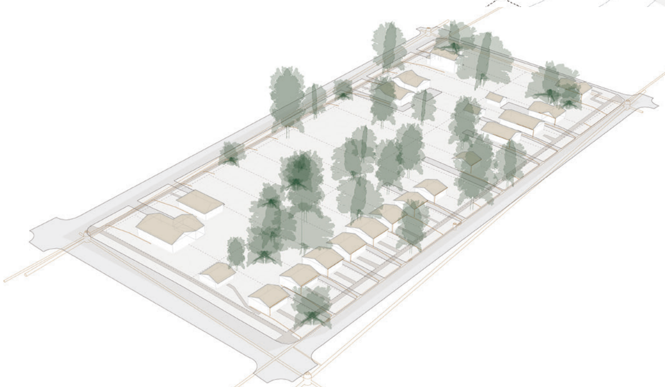
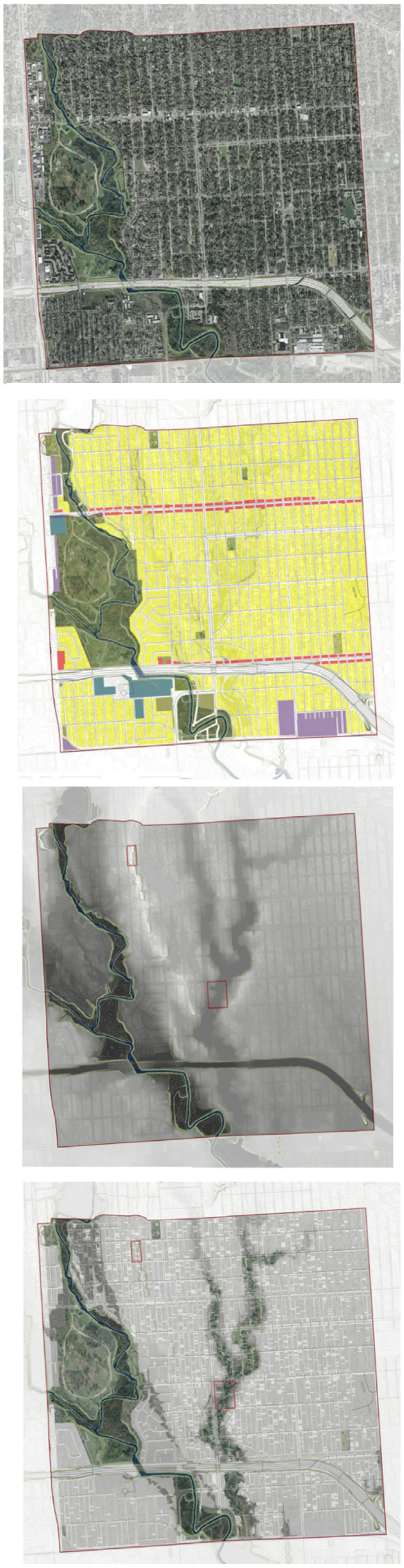
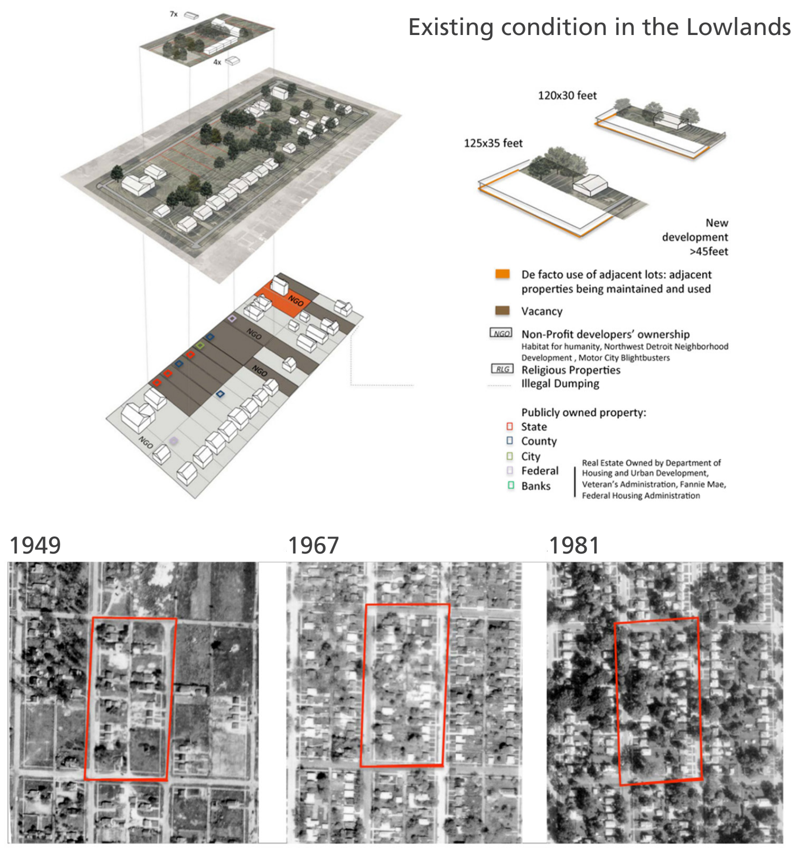


Figure 3.7: The combined sewage infrastructure in the residential urban block, Brightmoor. The three images represent the current conditions around stormwater.





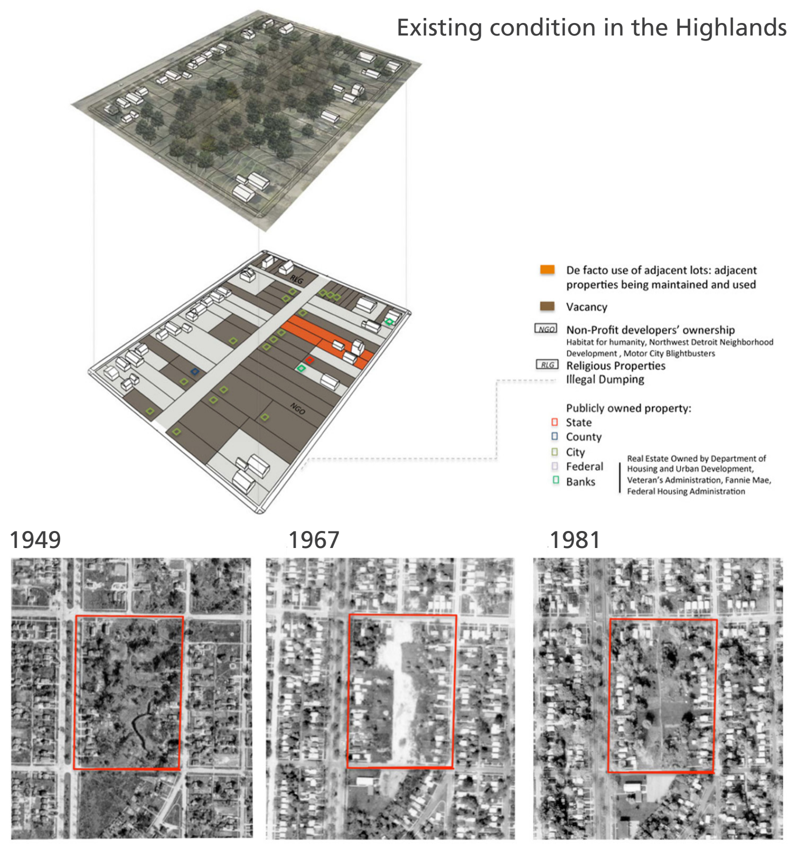


Figure 3.8: Brightmoor: aerial image, land use, DEM and overlay (above). The Lowlands and the Highlands: land ownership structure and historic evolution.

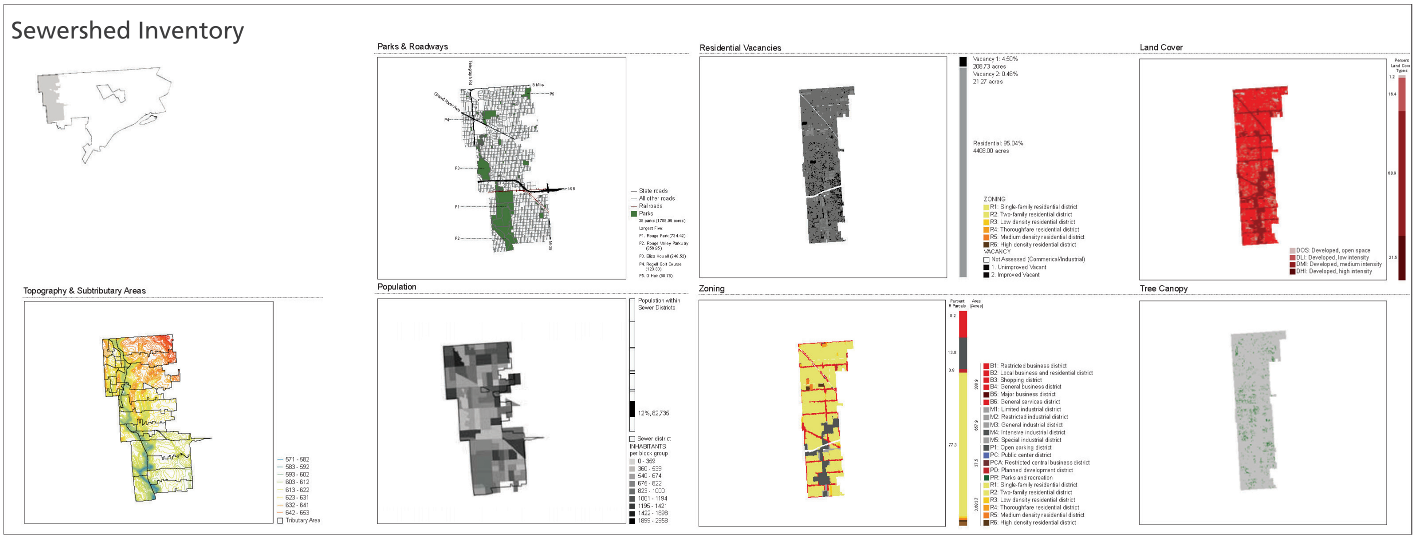


Figure 3.9: Sewershed Inventory: Rouge River Sewershed

systems, the projection used is NAD_1983_Michigan_GeoRef_Feet_US.

3.2.1 Sewer System and Wastewater Infrastructure Data

The Detroit Water and Sewerage Department's (DWSD) regional sewer system and wastewater treatment plant serves 78 communities and covers over 900 square miles of service area in metropolitan Detroit. Flows are measured throughout the system through the use of 60 sewer meters.[2] The Greater Detroit Regional Sewer System (GDRSS) program was initiated in 1992 in response to litigation stemming from permit disputes between DWSD and the Michigan Department of Environmental Quality (MDEQ). The Technical Committee that oversees this program consists of members from five major organizations (DWSD, Macomb County, Oakland County, Wayne County and the City of Dearborn) and many of the project's technical considerations are coordinated by the consulting firm Camp Dresser & McKee (CDM).

Geographic data describing the definition of wastewater infrastructure districts, as used within GDRSS, were obtained through the cooperation of CDM during August of 2011. While GDRSS utilizes an abstracted model of the locations, volumes and flow velocities of infrastructural trunk lines, interceptors and smaller conveyance pipes, this information was not available to use via GIS, therefore the data within our geodatabase that in is line with GDRSS is concerning the definition of land area subbasins contributing to the infrastructure system. Whereas the overall hydrologic model is intended to simulate the relationship of rainfall to runoff and inflow to, subbasins define an area "upstream" of

3.2 CDM Michigan Inc. Quick Start Guide to GDRSS. 2011. Available from: https://www.cdm-mich.com/gdrss-a4/FMTF101_n3%20&%20Map.pdf. Accessed on 2013 Nov. 21

flow inlet points that likely impact the system's hydrology. Throughout this report and the documents describing the work of Liquid Planning Detroit, we have selected to use the term "sewershed" to be the equivalent of "subbasin." Furthermore, from the larger model (that extends to include the wastewater service area of DWSD) we isolated only those subbasins within the political boundaries of the City of Detroit and throughout the report.

The sewersheds are: Baby Creek, Central, Conner Creek, East Jefferson, Fox Creek, Hubbell, Oakwood, River Rouge, Southfield.

3.2.2 Land Cover and Impervious Surface Calculations

The National Land Cover Database (NLCD) 2006 follows a 16-class classification scheme at a spatial resolution of 30 meters. It can be accessed at this link[3]. The classification system can be accessed at this link[4].

Figure 3.10: Stormwater runoff studies in the Dequindre Cut: land cover delimitation and precipitation data (below)

GIS data layers were utilized to perform calculations to estimate volumes of stormwater runoff entering into Detroit's combined sewer system. Quantitative research has established direct causal relationships between the degree to which developed land is impervious and resulting decreases in water resource quality.[5] Of particular importance in the study of water quality issues within urban settings is the work of Tom Schueler from the Center for Watershed Protection. Schueler's research established a classification system, later adopted by SEMCOG that divides urban streams into three categories of impact based on the analysis of levels of imperviousness of the contributing watershed area: (1) Stressed streams (1 to 10% impervious surfaces); (2) Impacted streams (11 to 25% impervious surfaces); (3) Degraded streams (26 to 100% impervious surfaces). While the majority of developed conditions (even low density development) exceed 26% imperviousness, and therefore contribute to degraded water quality conditions, these quantitative indices provide important measures to assess priority areas as well as to influence performance standards in the development of policies intended to improve or protect surface water quality.

3.2.3 Assignment of Impervious Values

Impervious values were assigned to areas analysis based on land cover values. Land use categories and percent imperviousness values followed a set of values utilized by SEMCOG and originally determined based on a number of Southeast Michigan studies of the Rouge and Huron River Watersheds.[6] As described in Perry and Harmann's paper, the Rouge River National Wet Weather Demonstration Project (RPO) performed a comprehensive study addressing impervious areas within the Rouge River Watershed that produced a method to determine subarea values that, in turn, were fed into watershed models. The RPO study furthermore analyzed and grouped 66 Michigan Resource Inventory System (MIRIS) land use categories into a system compatible with a series of 1990 SEMCOG aerial photos and consistent with land use categories used in national studies of pollutant loads. The result was a table (Table 1) that established the land use categories and percent imperviousness that was utilized in all of the stormwater runoff calculations reported in Liquid Planning Detroit.

3.3 National Land Cover Database (NLCD). Available from: http://www.mrlc.gov/nlcd06_data.php.

3.4 National Land Cover Database (NLCD). Available from: http://www.mrlc.gov/nlcd06_leg.php

3.5 Tom Schueler. The Importance of Imperviousness. Watershed Protection Techniques, 1994; 1(3)

3.6 Steve Perry and Amy Harmann. ESRI. Utilizing GIS as a Tool in Mapping Impervious Surfaces and Protecting Southeast Michigan's Headwaters. Available from: http://proceedings.esri.com/library/userconf/proc98/proceed/to450/pap448/p448.htm

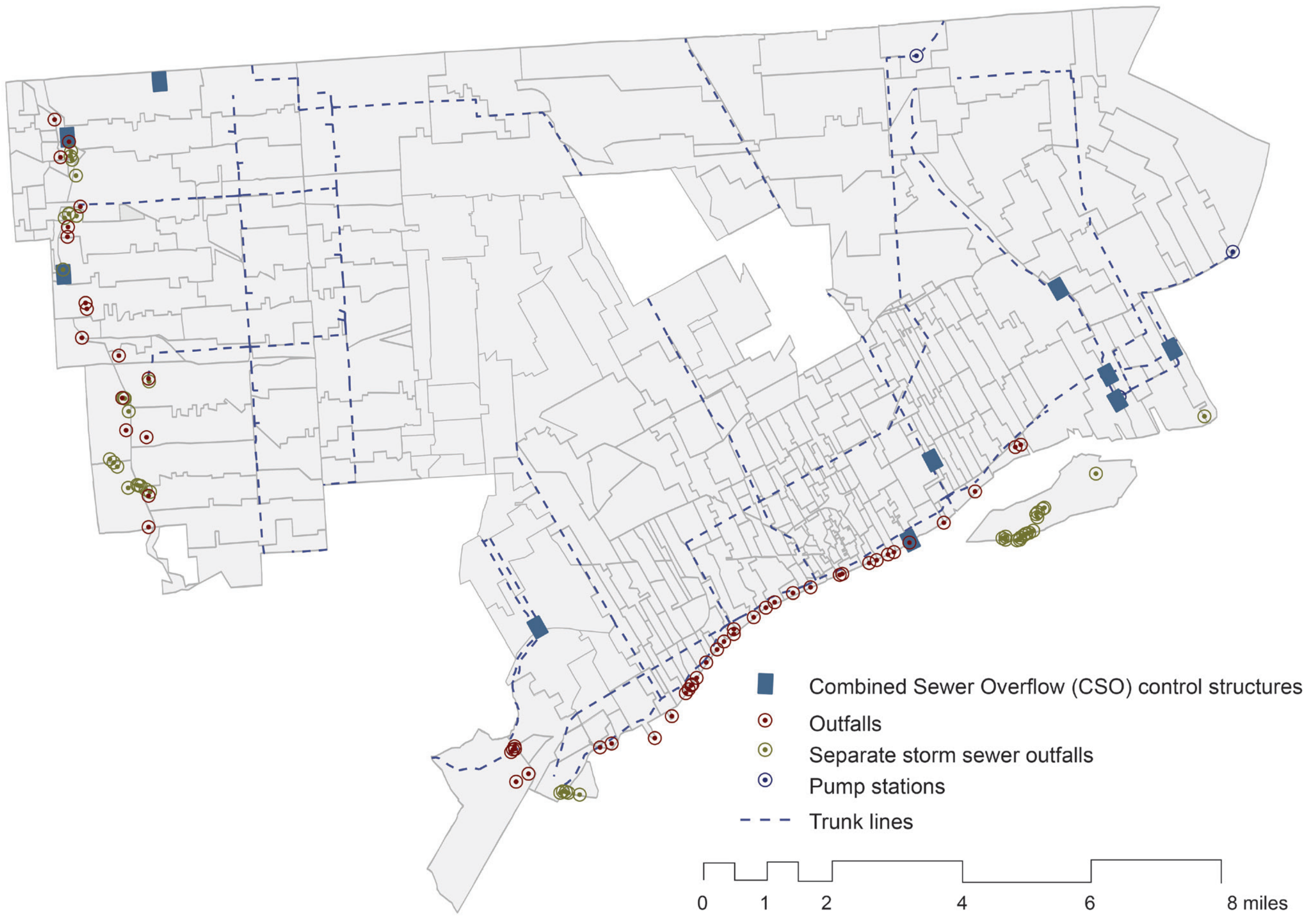


Figure 3.11: Diagram with the Combined Water Infrastructure in the City of Detroit.

3.2.4 Outfall Data

Sanitary Sewer Discharge Information was obtained in August 2011 from the Michigan Department of Environmental Quality.[7] Outfall locations were added to GIS using latitude and longitude locations provided by the MDEQ. We obtained an excel file summary of outfall events, from the DEQ, to facilitate data collection (data include events recorded from 2004 to July 2011). Individual discharge events are required, by law, to be reported to the MDEQ who then posts these events on their website. Individual events can be viewed online (the website currently enables access to over 2100 outfall events), however, it cannot query or view multiple events simultaneously, therefore is limited in its ability to facilitate comparisons or to track changes over time.

There are 2727 total events recorded in the original Outfalls_Volumetric_Prj.shp file. The majority of discharge data include a record of volume and additional information describing if wastewater was

3.7 Department of Environmental Quality. Available from: http://www.deq.state.mi.us/csosso/

discharged without treatment or with partial treatment (such as physical screening or the addition of treatment chemicals, such as bleach). Some data records had to be removed from the table due to errors including missing locations, missing volumes or suspect volume reports. 60 items had latitude and longitude recorded of 0,0 and, therefore, could not be geographically located. Some events contain partial or incomplete data (if the event was not properly reported) and we removed events that had no data or had suspicious volume data reported (such as volumes reported of 999999999 as compared to a more typical range of volumes between several million to 600 million gallons).

3.2.5 Watershed Delineations

For this analysis, stream networks and watershed boundaries were delineated from the U.S. Geological Survey (USGS) Digital Elevation Model (DEM), the National Elevation Dataset (NED). This data is available for Detroit at a resolution of 1/9 arc-second (about 3 meters), the highest resolution of the NED. Stream networks were delineated using the output from the Flow Direction and Flow Accumulation tools.

Flow Direction uses the DEM to determine the direction of flow from every cell in the raster. Flow Accumulation counts the number of upslope cells that flow into each cell. Selecting cells that have 1,000 or greater upslope cells produced the stream network. This defines the stream network as cells with a contributing area of at least 9,000 square meters (1,000 cells that are 3 meters by 3 meters) or about 2.2 acres.

The output of the Flow Direction tool was then used to delineate watersheds that were at least 9,000 square meters, the minimum area contributed to the stream network. 9,000 square meters was chosen as the threshold value for stream network and watershed delineation based on visual comparison of the generated stream network and the DEM.

For watershed delineation, we utilized the ESRI support website.[8]

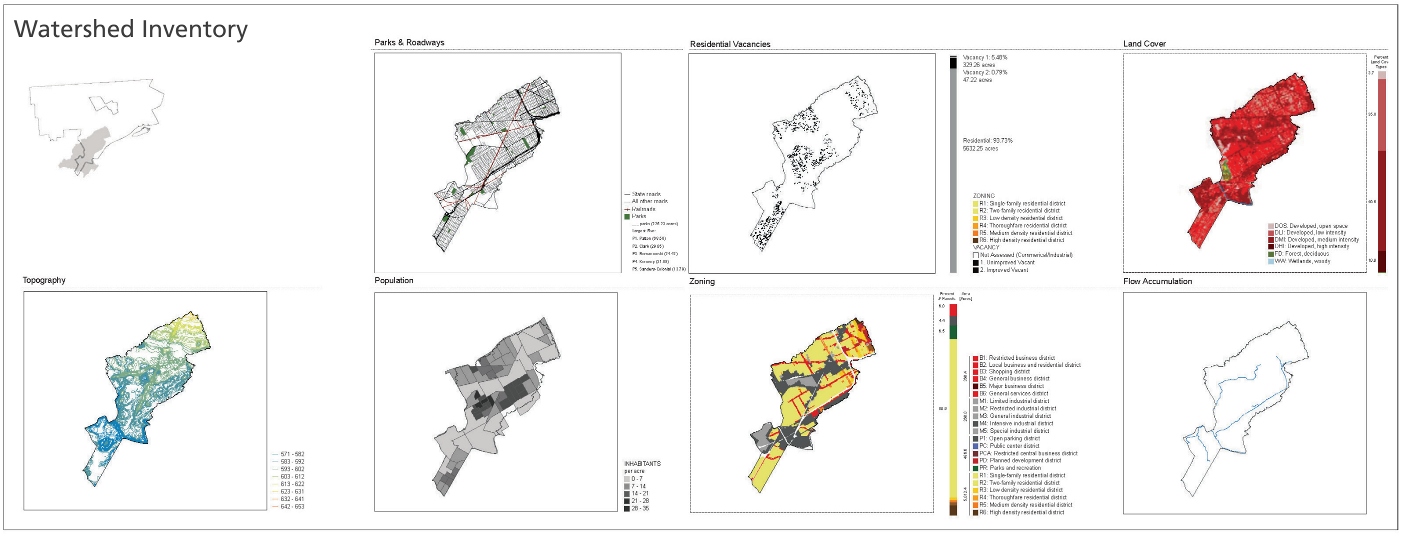


Figure 3.12: Urban Watershed Inventories.

3.2.6 Vacancy

The vacancy layer was derived from the University of Michigan Inventory of Residential Vacancy dated in 2009. More updated information on vacancy may be required to address smaller scale interventions given the changes in this matter in the last four years. Updated vacancy data used in the Brightmoor site study can be found at this link.[9] This inventory offers up to date information of vacancy across the city.

3.2.7 Transportation Infrastructure and Parks

Transportation infrastructure (roads and rail lines) and parks were obtained through SEMCOG.[10]

3.2.8 Topographic information

The topography is derived from DEMs from the USGS website. The contour lines are derived at a frequency of 1 foot and color-coded to ease legibility.

3.2.9 Population Data

Demographic data was obtained from the US Census 2010. More recent estimates could be obtained as of July of 2012.

3.2.10 Precipitation data

The data on monthly historic precipitation records can be accessed from the National Weather Service Weather Forecast Office.[11]

3.8 ESRI. Available from: : http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//009z00000059000000.htm

3.9 Detroit: Why Don't We Own This? (WDWOT). Available from: http://whydontweownthis.com/

3.10 South Michigan Council of Governments (SEMCOG). Available from: http://www.semcog.org/GIS.aspx, and the City of Detroit website, at http://www.detroitmi.gov/DepartmentsandAgencies/PlanningDevelopmentDepartment/Planning /Information Service and Mapping /Community Information and Mapping / Advanced Maps / DownloadGISFiles.aspx.

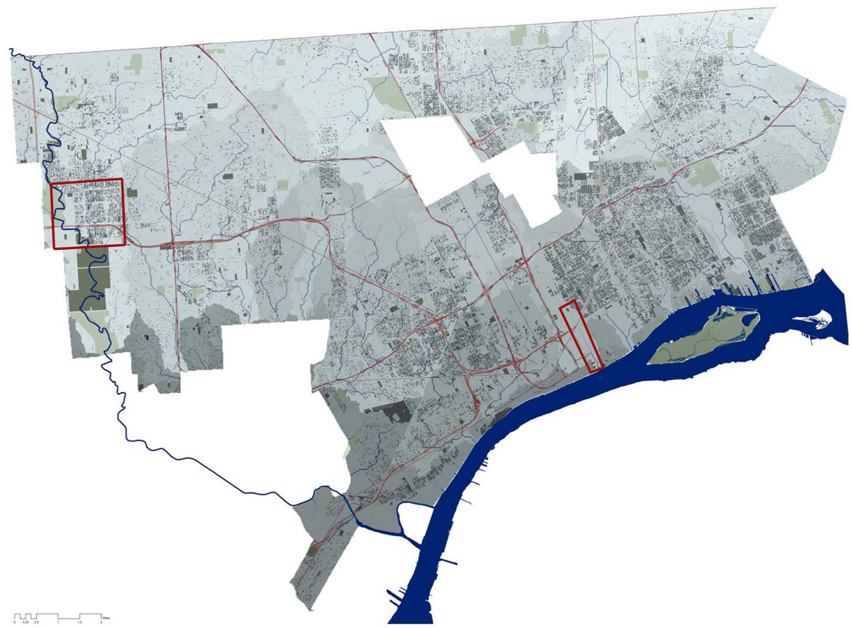


Figure 3.13: Map overlay with the residential vacancies, the transport infrastructure, and the outline of the urban watersheds.

3.2.11 Current Land Use

Land use data was obtained through the City of Detroit official website.[12]

3.3 Other Sets of Data

The selection of the sites for design scenarios required multiple site visits to gather on site information and track users presence and other programmatic opportunities. The team collected numerous photographs during the site visit of Brightmoor and the Dequindre Cut.

Additional research informed the design development. For instance, the selection of the site in Brighmoor responds to research on historical map sources that identified a predevelopment water ditch along this area. Further cartographic research using maps and historical aerial imagery, allow the tracking of the development of the area over time. The historical aerial imagery is part of the online collection by DTE.[13]

LiDar data for Wayne and Washtenaw Counties in southeastern Michigan was used to develop the tree canopy in the visualizations of the urban block water infrastructure in Brightmoor.

Similarly, the selection of the Dequindre Cut builds on past, present and future opportunities linked to the greenway redevelopment. The design speculations trigger a stronger presence of green infrastructure in the second phase of the development that will incorporate direct

3.11 National Weather Service Weather Forecast Office. Available from: http://www.crh.noaa.gov/dtx/climate/dtw_summary_2004.php (example of 2004)

3.12 City of Detroit official website. Available from: http://www.detroitmi.gov/Departments and Agencies/PlanningDevelopmentDepartment/Planning /Information Service and Mapping/Community Information and Mapping / Advanced Maps/DownloadGISFiles.aspx

3.13 DTE. Available from: http://www.clas.wayne.edu/photos/ap_index.htm.

Figure 3.14: Images of Brightmoor.
Source: Google Earth, 2012

access to Eastern Market. The extension is part of the Link Detroit Project, funded through various sources including a $10 million TIGER grant.

The historical information on the legacy of the water infrastructure system was accessed in the DWSD webpage. This data traces some of the CSO facilities and interceptors in the GIS geodatabase. The DWSD webpage also offers updated information on the Alternative Rouge River CSO Control and Green Infrastructure Program progress report for 2013.

SEMCOG provides a wealth of information on the Green Infrastructure initiatives in its area of service. References to the Detroit Future City Framework Green and Blue Infrastructure can be accessed online.[14] More detail on the Green and Blue Infrastructure component developed by Stoss Landscape Urbanism can also be accessed online.[15]

3.14 Detroit Future City Framework Green and Blue Infrastructure. 2012. Available from: http://detroitworksproject.com/wp-content/uploads/2013/01/The-DFC-Plan.pdf.

3.15 Stoss Landscape Urbanism Green and Blue Infrastructure. Available from: http://www.stoss.net/projects/12/detroit-future-city/ and http://landscapeurbanism.com/article/wild-innovation-stoss-in-detroit/

4 FINDINGS

1. In the contemporary condition, the Detroit Water and Sewerage Department is faced with a system of wastewater infrastructure in a critical state of failure—driven by an outdated combined sewer system combined with one of the largest service areas in the nation (the land area of the city of Detroit is approximately 143 square miles whereas the wastewater service area of DWSD is over 6.5 times larger, covering 946 square miles).[1]

   Furthermore, it is evident that this challenge cannot be solved through standard civil engineering approaches alone.

   This realization is most convincingly illustrated by the canceled Upper Rouge Tunnel (URT) combined sewer overflow project. Designed to reduce the frequency of 17 CSOs along the Rouge River from an average of 1.3 billion gallons to 250 million gallons annually, the tunnel consisted of a 7 mile long, 30-foot diameter pipe buried 160 feet below grade. The scale and complexity of this project resulted in an estimated cost that the EPA determined would exceed their legislated infrastructure affordability index. By 2009, the DWSD canceled the project and since this time has been placing more emphasis on alternative approaches to stormwater management, specifically targeting the implementation of green infrastructure solutions.

   We, therefore, contend that continued efforts to move toward green infrastructure are appropriate, however, the consideration of scale is critically important. While designing a single, engineered pipe intended to work as a "silver bullet" is neither affordable nor desirable (spending this much money on infrastructure that continues to treat rainwater as waste rather than resource is unsustainable economically, environmentally and culturally). The shift toward green infrastructure should not make a scalar mistake in shifting too far to small, distributed point interventions. In other words, solutions such as rain barrels are useful interventions for homeowners to become involved in the issue and make small contributions to water collection, however, it would be a mistake to

4.1 DWSD Fact Sheet. Available from: http://www.dwsd.org/downloads_n/about_dwsd/fact_sheet/dwsd_fact_sheet.pdf. Accessed on 2013 Nov. 29

target any single technology as a "solution." Rather, we find that green infrastructure efforts must integrate small scale, homeowner participation programs (such as downspout disconnection and rain barrel hook ups) with larger scale (such as block wide or neighborhood wide), connected interventions that can scale up more quickly and offer larger water absorbing capacities. Furthermore, such efforts should also prioritize cooperation across the city of Detroit, and equally important, across the entire DWSD wastewater service area to systematically limit the amount of rain water that enters the infrastructure during wet weather events. As has been clearly demonstrated in stream bank restoration efforts across the country, the area of the system that fails cannot be successfully restored without efforts that target the upstream contributors and the source of the failures. The same is true of Detroit's wastewater infrastructural system.

2. Detroit's wastewater infrastructural system is so large and complex (in part owing to is age and inaccessibility to survey for function, leaks and damage) that modern, engineering, computational models cannot accurately predict the functioning of the system during wet weather events. While the DWSD continues to contract expertise to develop a model of its wastewater infrastructure system, efforts to address stormwater collection, retention and (most importantly) absorption should continue concurrently. It is unclear if, and when, the GDRSS will be complete and given the necessity to abstract the system in order to make the model computationally viable, its completion will enable specific calculations to occur but will not provide a holistic view of the factors influencing the functioning of the system (such as rates of impermeability, etc).

   Moving beyond the legacy of wastewater infrastructure, that has resulted in the failure of the system as experienced today, requires a paradigmatic shift in thinking about boundaries that conceptualizes infrastructure as an integrated part of the inhabited spaces of our cities. Approaches to stormwater management must embrace a watershed approach to decision making, rather than conceptualizing infrastructure as a layer divorced of the topographic, impervious and other physical characteristics that define how water moves.

3. An important ongoing effort that lends an understanding of the role of non-profits and foundations is the development of alternative storm water management practices is the Green Infrastructure Program (NPDES Permit MI0022802). In the last progress report prepared for the Michigan Department of Environmental Quality in August 2103, SEMCOG provides an update of the most recent initiatives. The DWSD's Alternative Rouge River CSO Control Program has a timeline of 25 years with a mix of green infrastructure and "right-sized" conventional CSO control facilities. The report outlines the main partnerships and activities under development. The list of stakeholders is impressive, and the leadership of SEMCOG in the efforts of coordination and dissemination even more so. Among the partners leading the implementation of green infrastructure is the Greening of Detroit; this organization is supporting the massive tree planting in priority areas, coordinating all downspout disconnection workshops, facilitating community engagement for the Vacant Lot Treatment Program and implementing greening treatments on vacant lots. Addressing the areas of priority identified in previous years, the projects under development focus in the Rouge/Cody, Grandmont Rosedale and Brightmoor. Among several important tasks in progress, the report identifies the need to establish a tracking system to measure green infrastructure installations and performance in runoff reduction and calculation methodologies, the development of policies for green infrastructure installation in lieu of stormwater fees, incentivize and develop policies for loans or grants; and outreach efforts.

   According to the report, green infrastructure is designed to manage rain events up to a 2-year; 24-hour event. The cumulative runoff reduction estimate for the green infrastructure program to date is 454,400 gallons. The cumulative expenditures for green infrastructure implementation are approximately $2,518,325.

   The report can be accessed online.[3]

4. Stormwater management is also dependent upon thinking in terms of continuity in order to build capacity within green infrastructural systems and establish resilience within a dynamic system. Toward this end, we have identified two primary typologies of development

4.2 DWSD. Storm Water Management Program Plan. 2013. Available from: http://www.dwsd.org/downloads_n/about_dwsd/npdes/cod_smpp_2013.pdf patterns that can be approached from the point of view of water: (a) patchwork systems such as single family residential and (b) conduit systems such as roadways, and railways—many of which are changing use (such as converting railways to greenways) and can be renovated with stormwater capacity in mind.

5. Within the city of Detroit, vacancy is a condition that is present across a wide range of zoning and land cover conditions and is an important consideration through the lens of stormwater management. A condition of vacancy does not directly correlate with a predictable degree of imperviousness nor is it implicitly desirable for water retention and absorption. Rather, vacancy offers an opportunity to design interventions that are larger than the scale of a single parcel and can, therefore, enable the design of surface water connectivity and areas of water loving vegetation. The evaluation of the appropriateness of a particular parcel or collection of parcels must continue to account for soil conditions, knowledge of historical uses for the site and relative topographical relationship to adjacent conditions. Additionally, ownership is a complex part of this layer (which we have briefly touched upon with the Brightmoor analysis). Finally, vacancy matters in terms of shifting a perception of boundaries and beginning to see vacant ground as an asset (not just as undeveloped land) but as something that can take responsibility for holding water and for re-establishing civic spaces integrated within functioning natural systems.

4.3 SEMCOG. Green Infrastructure Program Progress Report. 2013. Available from: http://dwsd.org/downloads_n/about_dwsd/npdes/dwsd_green_infrastructure_progress_report_2013-08-01.pdf

5 RECOMMENDATIONS

Our strongest recommendation is that the use of this research, and more broadly the work being initiated throughout the city of Detroit and its metro areas, continue to support and foster a broad view of the interconnectedness between infrastructure and our built environment. We recommend that this inventory be utilized to augment efforts already underway and, hopefully, to inspire approaches that strive to find ways to couple opportunities for cultural engagement with surfaces and spaces designed with rainwater in mind. In this way, our work is aligned with efforts underway in other cities that have experienced success in their own infrastructure transitions (such as Philadelphia and Cleveland). The coupling of civic space and water function also enable new investment opportunities that simultaneously improve infrastructure function while transforming place and the experience of the city. If public spaces are improved in concert with improvements to stormwater management, then continued IA efforts can engage a wide range of stakeholders that represent a diverse set of interests relative to the development of these spaces. Such efforts can build stakeholder advocacy surrounding issues of water quality and urban quality of life, which is ultimately the key to implementing systems of green infrastructure that possess the potential to transform the everyday experience of the city.

Secondly, green storm water Infrastructure requires the incorporation of a wide array of disciplinary expertise. Creating the regulatory frameworks to enable the implementation and operation of these systems represents a challenge to traditional approaches to sectorial policy-making. For example, the implementation of green infrastructure projects requires partnerships that are capable of navigating the complex institutional and financial landscape of Detroit, that currently biases development projects that deal primarily with new or renovated buildings. While green infrastructure can be integrated within the design and construction of buildings, many of the projects and sites throughout Detroit that are excellent candidates for green infrastructure are landscape projects and do not fit cleanly within preconceptions of "redevelopment." Therefore, the formation of new partnerships among "non-traditional" providers of infrastructure is necessary to extend and expand the realm of expertise devoted to the implementation of these projects. Successful green storm water infrastructure projects require integrated responses involving, at least, land use and environmental planning, transportation and zoning, neighborhood and landscape planning, civil engineering and urban design. This reflects the multilayered nature of these systems that also operate at different temporal and spatial scales and engage multiple governance levels.

Finally, Liquid Planning Detroit foregrounds several, additional recommended considerations: (1) it questions the right Unit of Analysis in the geography of storm water in the City; (2) it challenges the legacy of [storm] water management techniques inherited from a 20th century engineering paradigm of centralization and technologic positivism, (3) it provides synthesis among disciplinary expertise through design. The relevance of design in the implementation of innovative storm water management projects lies in its capacity to act as a medium to integrate multiple disciplinary expertise and provide a vision to guide collective action. This is an important consideration when addressing the financial constraints surrounding the implementation and operation of green infrastructure, a very different model from the traditional Public Works approach.

5.1 Recommendations for Data Use:

It is important to note that the data included in this research has limits in terms of its precision both in space and time. In other words, the complexity of the wastewater infrastructure system of Detroit is vast and eludes the ability to describe it in terms of computational, predictive models (the most robust of which is still under development by CDM who has been working on the development of this model since 1985). The model is now enabling DWSD to begin to identify priority areas but cannot accurately describe the path a raindrop will follow through the infrastructural system in the event of a heavy storm. In other words, the accuracy of data available to date cannot make direct links between specific areas of the city and the exact outfall locations that they trigger.

While DWSD has made, and continues to make, an investment in increasing the predictability and precision of its understanding of the "behavior" of its infrastructure, the solution to this computational puzzle is not a solution to the challenge of stormwater management. In fact, our recommendations support efforts that frame questions that can be informed by data but are not encumbered by an overly technocratic view of it. Given this, the following are several recommendations for the types of questions and approaches that can be enabled with the use of the data provided:

- To plan from the street to the neighborhood, the district, the city and the region, developing new block typologies and land use definitions to address decreased impermeability.

- To prioritize infrastructure investments in time and scale, aligning publicly owned vacancy, areas of maximum impact in the combined water infrastructure, and leadership and stewardship from local organizations.

- To improve public health indicators with the improved water and air quality resulting from the implementation of green storm water infrastructure.

5.2 Recommendations for Future Site-specific Project Definition:

Building on the site-specific work done surrounding the Brightmoor neighborhood and Dequindre Cut stormwater design, we recommend that the use of the data can continue to identify locations where the design of green stormwater infrastructure can produce simultaneous conditions of water continuity and of improved public space. In addition to the data, we recommend that the use of the visualizations of both projects can facilitate discussions with stakeholders regarding desired outcomes and cultural imagination surrounding place making. While the technologies of green stormwater infrastructure have a number of common expressions (swales, pervious paving, raingardens, etc), the organization and assemblage of those technologies relies upon design experts to facilitate approaches that produce spaces greater than the sum of the parts. As continued partnerships emerge around the issue of stormwater management, we recommend that design professionals continue to be included in the development of those ideas and in the translation of data into site specific, materially rich, places. In summary, we recommend that a clear agenda be established based on use, history and cultural desires for a particular site in order to frame a clear agenda and point of view from which to analyze data.

5.3 Recommendations on the Value of Visualization As A Tool for Design Advocacy:

Liquid Planning Detroit provides an inventory of layers that are relevant and necessary when approaching stormwater management synoptically. The data provided through this study is, perhaps, most relevant to enable the visualization of the complexity and magnitude of the challenge of stormwater management posed to a city reliant on an outdated, combined sewer system. Although the infrastructural system fails regularly (nearly every time it rains), the degree to which the citizens of Detroit are aware of the degree to which water quality is compromised by this system is limited. Therefore, one of the most important uses for this data (and the motivation behind visualizing the data in the form of a website) is to facilitate public awareness and education to build a desire for alternate approaches and to build support for test projects aimed to introduce systems of green infrastructure throughout the city. Therefore, we recommend that the use of the data continue to be paired with the other forms of visualization that are provided as part of the overall inventory, both to facilitate the education of a broader audience as well as to challenge the implicit assumptions about what stormwater management is that arise from expertise and habit but can expand to include collaborative thinking toward the innovation of more holistic and sustainable paths forward.

6 POTENTIAL POLICY DIRECTIONS

"Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water."

-EPA[1]

Building from this definition of green infrastructure, by the Environmental Protection Agency (EPA), we identify several policy options that foster opportunities to re-engage urban nature, inhabit functioning ecological systems and redefine the potential for vibrancy of place. As is often the case with emerging policies, debate is likely to arise surrounding perceived conflicts between individual rights and collective protections. This is true regarding stormwater management policies as well, as illustrated by a recent (September, 2013) case in Cleveland, Ohio where an appellate court barred the Northeast Ohio Regional Sewer District from collecting storm-water fees. Storm-water fee programs (such as the stalled program in Cleveland) are but one example of potential policy approaches aimed to encourage the development of pervious development patterns and to collect fees from those areas that contribute to issues that threaten the quality of water in our communities. In order for more ambitious policies to be realized, we must also facilitate policy options that help shape public opinion, in order for broadly held desires for clean water to be linked with efforts that can accomplish this.

Ongoing work in Philadelphia signals many positive outcomes emerging from an ongoing institutional effort to prioritize green storm water infrastructure over traditional grey infrastructure. The "Green City Clean Waters "plan sets the goals for Philadelphia's 25-year Green Stormwater Infrastructure program. The plan targets the reduction of 85% of the sewer overflows, and addresses vacancy as an asset for the implementation of the projects. Apart from a message that addresses

6.1 EPA. Available from: http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm the sustainable benefits of green infrastructure (economic, social and environmental), the plan acknowledges the many partnerships necessary for the success of the program. Some interesting considerations in this program pertain to important policy considerations:

- the city targets a 45-year life span for the permanency of the projects, and requires city ownership, or a 45-year easement,
- the projects assume a 10:1 loading ratio (10,000 sf drainage area to be managed in 1,000 sf rain garden),
- in case of non-city ownership, maintenance agreements are required,
- There are $5,000 Green Infrastructure Adoption Grants for civic groups

At the same time that policies develop, there is a strong culture of design in the city. Under the SOAKITUP! Initiative, the EPA, the Philadelphia Water Department, and the Community Design Collaborative developed a series of activities that culminated with a Design Awards ceremony. The initiative drew tremendous attention from both design and academic communities.

Toward this end, Liquid Planning Detroit foregrounds two primary potential policy directions:

1. The need to increase collaboration and integration between Institutional and Regulatory frameworks:

    a. Create regulatory frameworks that better coordinate different governmental initiatives, and simplify existing ones. In the current climate, the legislation, funding and implementation of green storm water infrastructure occurs across several governmental levels including Federal (such as the Federal Highway Administration (FHWA), the Department of Transporation (DOT), the Environmental Protection Agency's (EPA) green infrastructure projects, and the U.S. Department of Housing and Urban Development's

(HUD) Sustainable Communities program), Regional (the Southeast Michigan Council of Governments (SEMCOG), the Detroit Water and Sewerage District (DWSD), State (the Michigan DOT's stormwater program, the Department of Environmental Quality's (DEQ) storm water program, the State of Michigan's Stormwater Management Guidebook), and Local (the Detroit Future City program and other policies and ordinances on storm water and complete streets).

This assemblage of departments and programs can be viewed as both a blessing (there is a tremendous wealth of information and training programs available) and a curse (there is an overwhelming array of sites to navigate and policies to track). While it is unlikely that any policy recommendations emerging from this report will have much influence on the landscape of federal and state policy and programs, the newly established Detroit Future City Framework (DFCF) offers a unique opportunity to position a policy approach toward stormwater management that possess the potential for real influence and applicability. Within the current DFCF, stormwater management issues are discussed within the topics of green and blue infrastructure. Developed by Stoss, a landscape architecture firm based in Boston, the importance of stormwater management is positioned as one of three city systems transformative ideas, "Landscape as 21st Century Infrastructure."

While we agree that the city will benefit from investments in alternative practices of stormwater management as described in DFCF including, "(1) to emerge as a leader in sustainable water management strategies and technologies, (2) to enjoy the multiple benefits blue infrastructure offers to a city (visual amenities, increased property values, and neighborhood stabilization) and (3) to capture funding opportunities that exist regionally (Great Lakes Restoration Initiative funds, and other grants)," the framework needs to go further in coordinating specific policies that build on the work that SEMCOG has been leading over the last two decades as well as highlighting successful local efforts, such as the Rouge River National Wet Weather Demonstration Project, which involves 48 communities and three counties in Southeast Michigan. Programs such as these demonstrate how a systematic watershed approach to issues of stormwater management improves water quality and the quality of life in neighborhoods (such as the recent Cody-Rouge green infrastructure project that brought together DWSD, SEMCOG, the Greening of Detroit and local Cody Rouge residents to transform 10 vacant lots into examples of demonstration green infrastructure projects). The inclusion of specific projects and partnerships will improve the ability of other community groups and interested parties to organize and understand the steps that are necessary to oversee the successful implementation of such projects. In this way, we recommend a form of policy advocacy, where the design and implementation of policies supporting green infrastructure not only regulate the steps toward this goal but also enable the successful completion of projects that may not otherwise be "required."

b. Capitalize and give more visibility to the work of Philanthropies, Foundations and NGOs already actively advocating for the improvement of water management and place making throughout the city. Two important projects, that illustrate this approach, have been initiated in the last few months. In both cases, the alignment among residents' hopes, community organization agenda and the mission of NGOs and other public partners has made the projects possible.

   i. The first is an ongoing collaboration between DWSD, SEMCOG and the Greening of Detroit established to identify partnerships for the establishment of green infrastructure in areas with the potential for high impact relative to Detroit's wastewater infrastructure system. As mentioned above, the Cody Rouge partnership is an exemplary case of collaborative partnerships that enabled an important demonstration project to be implemented. The Greening's Vacant Lot Treatment

Program at the Cody-Rouge neighborhood repurposed 10 vacant lots owned by the Michigan Land Bank into a variety of green infrastructure treatments, ranging from a low grow prairie grass, to perennial wildflower mixes to a combination of wildflower and tree plantings.

The partnership brought together the Detroit Water and Sewerage Department (DWSD), the Greening of Detroit, and the Southeast Michigan Council of Governments (SEMCOG), with the Cody Rouge Community Action Alliance and other residents and members of the community. The residents selected from a menu of low-maintenance treatment plans to be implemented in every lot and participated in the plantings. The importance of this initiative is manifold and cannot be understated: first, the program enabled residents to help tackle the problem of vacancy within their community. Second, by bringing residents together to select treatments, the program simultaneously educated participants about the performance values of landscape options while enabling cultural conversations to emerge around perception and preference for the type of occupation these spaces ultimately provided the neighborhood. Third, this intervention was particularly strategic owing to the work done by DWSD and SEMCOG in identifying lots that had the potential to act as "keystone" sites relative to a larger understanding of the infrastructural system beyond those sites. In so doing, the plantings on these sites has a more positive impact on the overall improvement of wastewater infrastructure than a similar effort on a non-strategic site would. Fourth, the improvement to these lots and the value to the larger system also helps alleviate the immediate experience of infrastructure within the community, such as flooding in the streets and basements during storm events. And finally, the Cody Rouge demonstration projects provide sites to study the implemented, measurable capacity of green infrastructure systems to hold storm water.[2]

ii. The second is a partnership between the Kresge Foundation and the Detroit Future City Framework to fund implementable projects. For example, the Lower Eastside Action Plan (LEAP) (developed in collaboration between the Warren/Conner Development Coalition and the Skillman Foundation) targets six Detroit neighborhoods for continued study (already in Phase II and ongoing since 2009) and for the development and implementation of actionable projects. A Stakeholder Advisory Committee (SAG) was established to evaluate potential projects based on their ability to support neighborhood stabilization, benefit to the community, economic benefits, positive environmental impact and a benefit to the city. Based on these criteria, six short-term development projects were identified. Of these, three projects are directly applicable as examples of policy implementation in line with the recommendations of this report.

The first is Dendroremediation, sponsored by The Greening of Detroit and proposes planting trees to draw toxins from soil over a period of 10-20 years, after which trees are removed and the soil is suitable for development (here we would include the consideration of green infrastructure as a potentially suitable form of development). The second is The Green Alleyway Pilot Project, sponsored by Genesis Hope Community Development Corporation and Detroit Workers for Environmental Justice (DWEJ). This project identifies green alleyways as a cost-efficient way to address stormwater related treatment and beautification within blighted alleyways. Two alleys between East Grand Boulevard and Field Street are identified as suitable and desirable sites to initiate a green alleyway network. Finally, the Greenway Plan for the Greater Riverfront East District, sponsored by the Greater Riverfront East Environmental Network (GREEN) Task Force developed a master plan for greenway development in the Riverfront East district

6.2 Detroit Works Project. Available from: http://detroitworksproject.com/2013/06/06/green-infrastructure-land-treatments-installed-on-10-vacant-lots-in-cody-rouge-neighborhood/#sthash.X1jcj4KB.dpuf of Detroit. The plan focuses on the expansion of the Detroit RiverWalk and promises the potential to tie the social and economic benefits of greenway development with environmental benefits. This plan is not explicit in terms of the potential stormwater initiatives that could be integrated into the design, although we see great potential for this to happen.

2. The need of innovative approaches to vacant land management:

   a. Currently, three land banks operate within Detroit's boundaries—Detroit, Wayne county and Michigan. The need for all three has been up for debate and there are many who favor a move toward consolidation. If consolidation were to happen, a single land bank authority could oversee a more direct management of Detroit's vacant lands. As we have noted earlier in this report, vacant lands offer many opportunities for the city of Detroit, and the capacity for green infrastructure and stormwater management is one that is significantly overlooked under the current land bank authorities. Policies should be adopted that facilitate the identification and prioritization of the value of vacant parcels not only from the point of view of building development potential and neighborhood stabilization, but also from the point of view of infrastructure networking. In particular, vacant parcels should be evaluated for (1) their capacity to retain and absorb stormwater in areas of the city where the combined sewage Infrastructure is more challenged, and (2) in low-lying topographical areas where water is already naturally collecting. In their role to repurpose vacant land for future development, the land banks should keep public ownership for parcels in these locations and should develop strategies of land aggregation and assembly to ensure the best and highest infrastructural use of the land. This may imply the aggregation of smaller parcels into bigger ones, and requirements in the continuity of the parcels to ensure the continuity of the system.

   b. Help transform the role of Community Development

Corporations (CDCs) from a position of “neighborhood-introverted expertise” to one of systems thinking wherein green infrastructure represents a viable and desirable opportunity to address the need of stronger continuities between neighborhoods alongside innovative repurposing of vacant lots, and the development of healthier urban landscapes. All in all, this requires shifting CDC’s traditionally redevelopment oriented priorities to a broader set of concerns that enable a variety of development densities to become economically, socially and environmentally desirable. Overall, the role of CDCs is important in relationship to middle scales of planning and project implementation (primarily at the neighborhood level) where an approach to using data to look for linkages is critically important from the point of view of environmental resilience and function. It is also at this scale where the experience of green infrastructure can have the greatest impact on residents’ life-styles. Turning residential vacant lots into tree- pockets or prairie-like grounds is a small scale demonstration of the power of green storm water infrastructure to serve as civic infrastructure too.

7 DEFINITIONS

Green Storm Water Infrastructure

Combined Sewer System – (a single pipe manage the sanitary waste from residences, industries and businesses, along with storm water drainage

Combined Sewer Overflow (CSO) – Overflow stormwater and sewage from a combined sewer to a receiving water.

Outfall – a point source as defined by 40 CFR 122.2 at the point where a municipal separate storm sewer discharges to waters of the United States and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.

Directly Connected Impervious Area (DCIA) – Impervious surface areas that are directly connected to the sewer system through catch basins, roof drains, downspouts, etc. DCIA is a primary concern in combined sewer areas.

Dry Weather Flow (DWF) – Base sewer flow that does not include any wet weather derived runoff, inflow or infiltration.

Hydraulic Model – Simulates flow routing, typically through channels and pipe networks.

LiDAR data – is a remotely sensed high resolution elevation data collected by an airborne platform. The LiDAR sensor uses a combination of laser range finding, GPS positioning, and inertial measurement technologies. The LiDAR systems collect data point clouds that are used to produce highly detailed Digital Elevation Models (DEMs) of the earth's terrain, man-made structures, and vegetation. This data was collected at a resolution of one point per square meter.

This task order consisted of LiDAR data acquisition and processing for Wayne and Washtenaw Counties in southeastern Michigan. The task order area of interest encompasses approximately 1324 square miles. The task required the LiDAR data to be collected at a minimum of one (1) point per square meter (1.0 meter GSD). The LiDAR data was collected to meet a vertical accuracy requirement of 18.0 cm (0.59 ft) RMSE, or better, so that when combined with breaklines, the data adequately supports the generation of two (2) foot FEMA compliant contours. The final LiDAR data was delivered as 5,000’ x 5,000’ tiles, aligned to even 5,000’ coordinates. The LAS files are comprised of the full class data

SEMCOG – was established in 1968 as a regional planning partnership in Southeast Michigan. SEMCOG is accountable to local governments who join as members. Membership is open to all counties, cities, villages, townships, intermediate school districts, community colleges, and public universities in Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties. Citizens are represented at SEMCOG through their local elected officials. Funding for SEMCOG is provided by federal and state grants, contracts, and membership dues.

LIST OF FIGURES

2 Overview

3 Methods, Analysis