RECLAIMING VACANCIES:
A COMMUNITY REVITALIZATION AND RESILIENCE STRATEGY

A Thesis

by

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ABSTRACT

Socially vulnerable populations are often concentrated in flood vulnerable urban areas, resulting in multiple cultural, economic, and ecological issues. Sunnyside, a 4096 acre historically African-American community in Houston, Texas, faces the issues of flooding hazards, high percentage of vacant lands, and low quality of life. Sixteen percent of the neighborhood falls within the 100- and 500-year floodplains, with frequent stormwater settling and ponding; 22% of the neighborhood lots are currently either vacant or abandoned due to population migrations. In addition, there is a significant lack of open spaces and community facilities in the vicinity. Thus, the study explores how urban regeneration of vacant lands can seek to enhance revitalization and resilience in the community.

Through four months of public engagement, this research-design study incorporates citizen-driven decision making for identifying the existing issues and future goals. The study then develops a toolbox to reclaim existing vacant lands, depending on each lot's type, size, location, and flood vulnerability. An ArcGIS land suitability analysis with the parameters of elevation, slope, land cover, and existing building footprint is conducted to identify the most suitable vacant lands for future green infrastructure. A 202 acres site is used as a case site to apply Low Impact Development urban design facilities for regulating stormwater and providing active and passive recreation. Integrating green infrastructure within a majority of vacant lands in the neighborhood allows for absorption and infiltration of stormwater before channeling it to

the nearby Sims Bayou, and creates an open space network for a healthier community. The rest of the vacant lands are transformed into spatial functions according to identified community needs.

For design implementation, the first phase focuses on creating a green infrastructure skeleton to alleviate flood issues, the second phase implements major community facilities as anchor points to spur future development, and the third phase concentrates on infilling housing and new job creation. The design impact analysis projects a significant increase in regeneration of the existing underutilized spaces and decreases in impervious surfaces in the neighborhood, and allows for building capacity and involvement in the community planning process as well.

DEDICATION

To Sunnyside, Houston, and the underserved communities around the world.

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Contributors

This work was supervised by a thesis committee consisting of Assistant Professor Galen D. Newman and Associate Professor of Practice John T. Cooper Jr. of the Department of Landscape Architecture and Urban Planning, and Associate Professor Koichiro Aitani of the Department of Architecture.

The data analyzed for Chapter I and Appendix was provided by Jaimie H. Masterson from Texas Target Communities. The analyses depicted in Chapter II were conducted in part by Qazi Aniqua Zahra, Gargi Singh, and Ethan Harwell of the PLAN 662 Master of Urban Planning Class in Fall 2016 of Department of Landscape Architecture and Urban Planning. The perspectives rendered in Chapter III were partly rendered by Sanjana Jasti, Rui Zhu, Dingding Ren, Yao Liu, and Xueqi Song of Department of Landscape Architecture and Urban Planning.

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NOMENCLATURE

AS	Abandoned Structure
EPA	US Environmental Protection Agency
GI	Green Infrastructure
H-GAC	Houston-Galveston Area Council
HUD	US Department of Housing Urban Development
LARA	Land Assemblage and Redevelopment Authority
LID	Low Impact Development
NVPC	National Vacant Properties Campaign
SCI	Sustainable Communities Initiative
TEZ	Texas Enterprise Zones
TIRZ	Tax Increment Reinvestment Zone
VL	Vacant Land
VLAS	Vacant Land and Abandoned Structure

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CHAPTER I

INTRODUCTION

1.1 Problem Statement

Socially vulnerable populations are recurrently concentrated in neighborhoods plagued with vacant lands and flooding hazards, resulting into multiple cultural, economic, and ecological issues. Several underserved communities in Houston, Texas have gradually lost their population due to "land speculation practices, disinvestment and the untended consequences of desegregation" (Longoria and Rogers, 2013). Often characterized by the predominant vacancies and hydrological risks in the neighborhood, these communities become exodus within their own cities with lower quality of life of the residents (Texas Organizing Project [TOP], Texas Low Income Housing Information Service [TLIHIS], 2016). Eventually, building on their existing problems, they fall into a vicious circle of neglect and decline. Thus, this design-research is an important starting point for investigating the opportunities of vacant land regeneration to enhance resilience and revitalization in the underprivileged communities.

1.2 Project Location

Located in south Houston, south of the 610 Loop and east of Highway 288, Sunnyside is the oldest African-American neighborhood in the area (Figure 1) (Rogers, 2013). Bounded by Sims bayou to the south, the neighborhood is frequently exposed to flooding hazards due to the aging infrastructure and inadequate drainage system (Ordoñez, 2015).

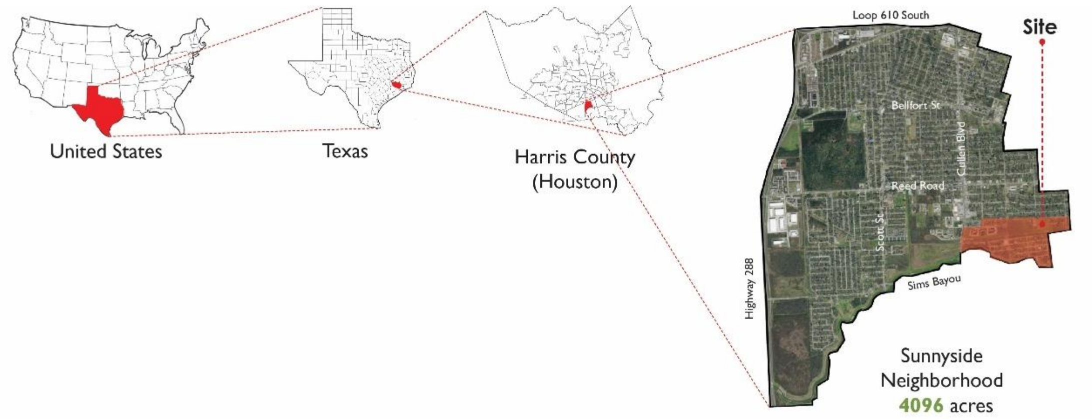

Figure 1: Project Location of Sunnyside Neighborhood, Houston, Texas.

As explained in the historical timeline of the neighborhood (Figure 2) and according to Texas Area Health Education Centers (AHEC) East (2012), originally platted as a government enforced racially segregated subdivision in 1915 outside of Houston's city limits, Sunnyside was annexed into the City of Houston in 1956. Established as a water district and a volunteer fire department in the 1940s, the neighborhood gradually developed in a low-density pattern comprised of single-family homes which exists to this date. Despite being annexed, Sunnyside did not receive the full benefits of water, drainage, sewer, sidewalks, street-lights, or other public services for a long time (TOP and TLIHIS, 2016). Moreover, it was overburdened with higher tax rates than the rest of the city and became the city's dumping ground when a 78-acre Redd Road landfill began its operation in 1964 as a temporary landfill, which expanded by another 38 acres in 1969 making it a permanent health hazard for the residents

(Bullard, 1983; Rogers, 2013). In 1967, Sunnyside saw an exceptional number of low-income housing over-concentrated within the neighborhood despite residents' protests. Unlike most neighborhoods in the City, Sunnyside lacked deed restrictions that would usually protect the homeowners from adjacent incompatible land uses (TOP and TLIHIS, 2016). In addition, the flooding events in 2010 put more residents living in the flood zone. In 2013, Sunnyside was labeled as the 8th highest crime-ridden neighborhood in the country (TOP and TLIHIS, 2016).

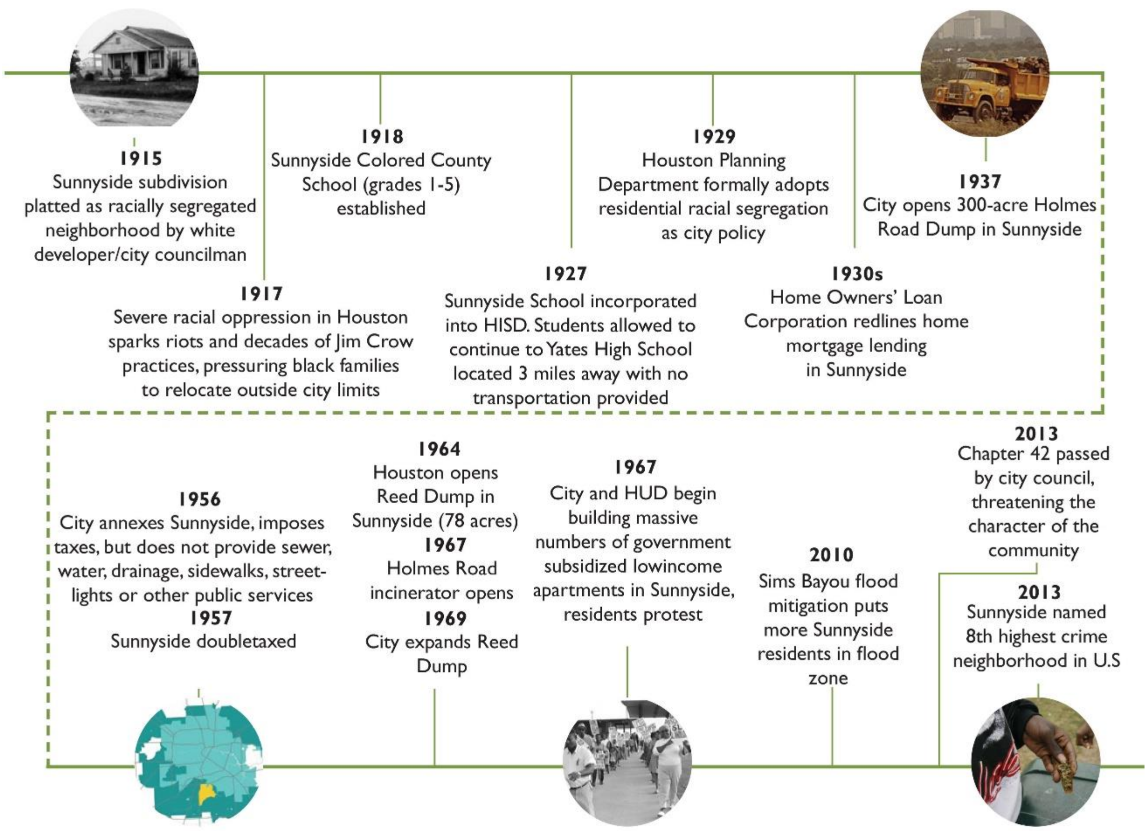

Figure 2: Historical timeline of government policies in Sunnyside.
Data source: Texas Organizing Project, Texas Low Income Housing Information Service. (2016). Sunnyside neighborhood plan.

1.3 Context

As discussed by Rogers (2013) and City of Houston (2014), Sunnyside neighborhood currently houses 21,158 people located within an area of 6.4 square miles. After several decades of population loss between 2000 and 2010, the population density of the neighborhood is approximately 3,342 people per square mile, slightly lower than that of the City of Houston (3,454 people per square mile) (Figure 3). 90% of the population is African-American with an increasing number of incoming Hispanic residents (8%), and the remaining population makeup is White (1%), and Asian (1%) in the neighborhood (Figure 4). A large percentage of the residents are over the age of 65 (16%) compared to Houston's 9% of senior citizens. On the other hand, 33% of the neighborhood population is residents under the age of 18 (Figure 4). In comparison to Houston's population increase by 29%, Sunnyside saw only 7.5% of population growth in those ten years. In addition, 346 tax delinquent parcels with approximately 461 acres of vacant lands take up 22% of the total land area in the neighborhood.

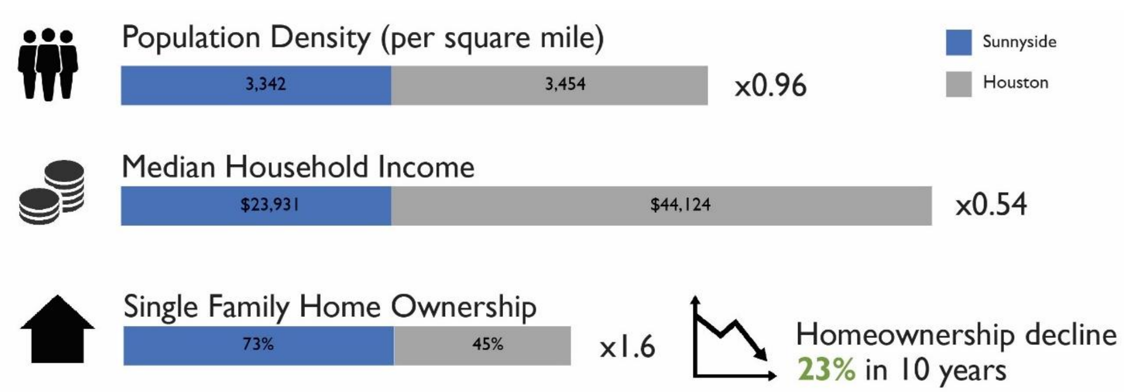

Figure 3: Demographic data of Sunnyside, Houston: Population Density, Median Household Income and Single Family Home Ownership.

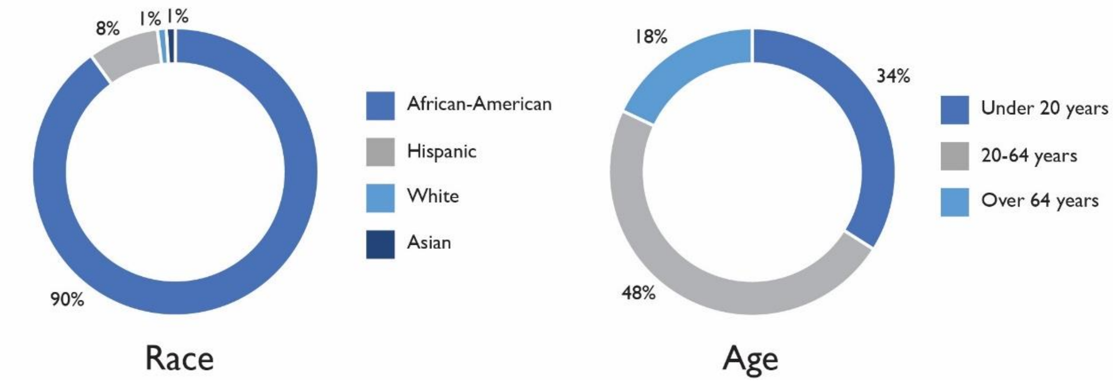

Figure 4: Demographics data of Sunnyside, Houston: Race and Age.

In the context of Harris county, Sunnyside shows both strengths and weaknesses in terms of social and physical vulnerability. According to the Sunnyside Neighborhood Plan (2016) in Figure 5, the median household income of Sunnyside is below Houston's median, where 54% of residents are considered extremely low income with less than $25,000 annual income. This contributes to the increased economic hardship and reduced employment resources. The percentage of population over 25 years with a High School Diploma is above Houston average, although only three out of eight schools in the neighborhood met standard according to Texas Education Agency Accountability Ratings (2013). As for the community health profile, Sunnyside has a high obesity rate (46-58%), although lower than Houston (63%). This phenomenon is related to the poor walk score and lack of grocery stores in the neighborhood (Longoria and Rogers, 2013). The percent of homeowners in Sunnyside has declined steeply by 23% over last twenty years, contributing to the gradual disinvestment in the neighborhood (Rogers, 2013). Although the park areas in the neighborhood has a large number (241 acres), the existing five parks are located near the edges of the neighborhood, making them underutilized and less accessible (Rogers, 2013). The regional bicycle plan does not propose any bikeway in the neighborhood, making the Sims bayou waterfront a missed opportunity (H-GAC, 2015). According to the City's Community Health Profiles (2014), the neighborhood faces violent crime (22.7 per 1,000 population annually) almost twice that of Houston as a whole.

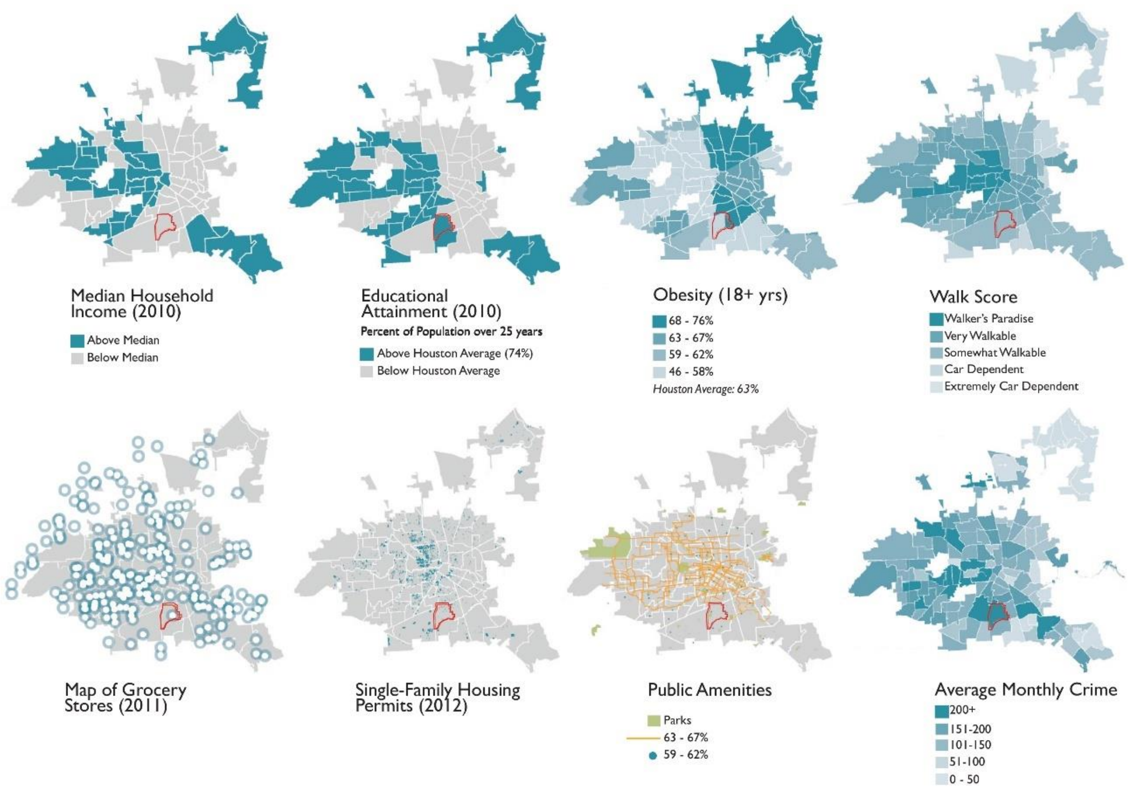

Figure 5: Context maps of Sunnyside, Houston.
Map source: Rogers, S. (2013). Sunnyside: Healthy Community Design Ideas Book.

1.4 Issues

Despite being a community with rich culture and shared values, Sunnyside has been suffering from a myriad of problems including inadequate infrastructure, economic resources, affordable housing, quality open spaces, standard education, transit options, food security, public safety, and increased vacant lands, and hazard risks (Figure 6). The longer the imbalance of resources was present in the neighborhood, the more harm it did in terms of multigenerational problems (TOP and TLIHIS, 2016). This research has identified high rate of vacant lands and flood vulnerability as the two most pressing issues in Sunnyside. 461 acres land (22%) of the neighborhood are vacant with 5.5 acres (6%) with abandoned structures, giving the neighborhood the appearance of blight and neglect (Figure 7) (H-GAC, 2016).

Figure 6: Economic, social and ecological problems in Sunnyside Neighborhood.
Image source: PLAN 662 Fall 2016 Class, Master of Urban Planning, Texas A&M University.

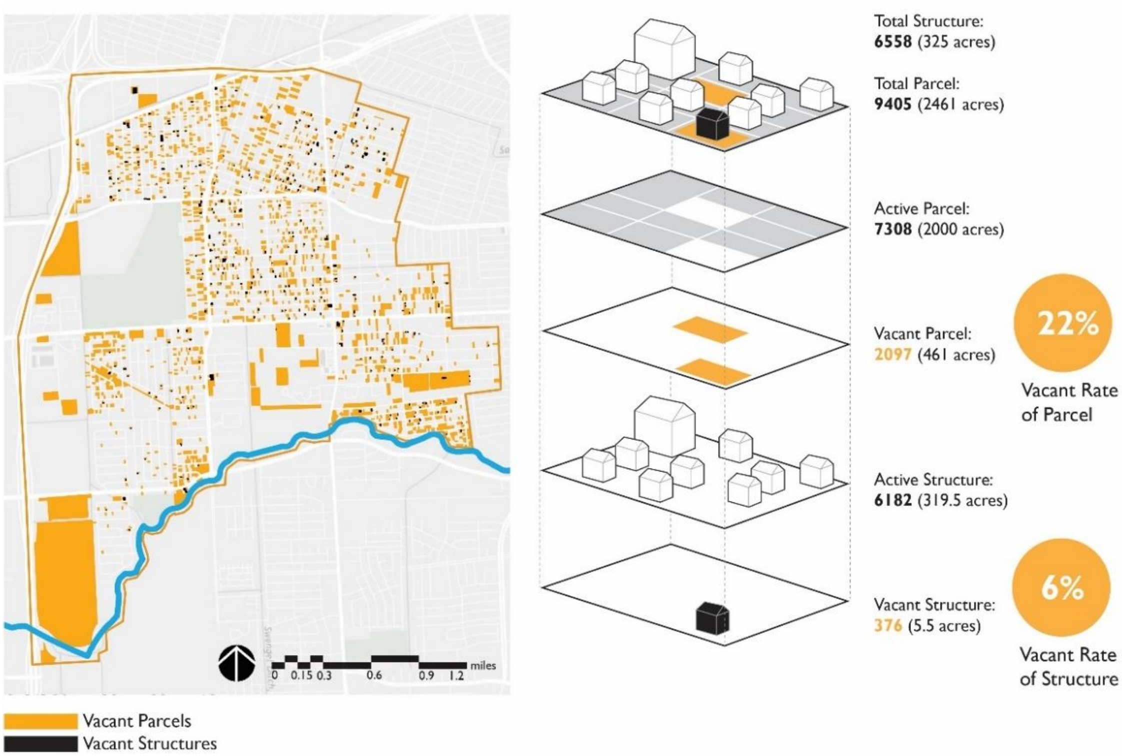

Figure 7: High rate of vacant land and abandoned structure in Sunnyside.

At the same time, a large portion of the neighborhood falls under 100- and 500-year floodplains with frequent ponding issues after heavy rainfall or storm events (Figure 8) (TOP and TLIHIS, 2016). The Draft Action Plan for Disaster Recovery (2016) estimated $545 million of housing and infrastructure damages from the 2015 Memorial Day and Halloween storms combined. By mapping the existing open ditch drainages in the city, the Draft Plan (2016) shows that the flooding events coincided with the open ditch locations in Sunnyside. The National Land Cover Database (2011) shows how the impervious surface (90%) of the neighborhood and the inefficient placement of existing parks make it difficult to absorb the water into the ground and channel the water to the Sims bayou. The combination of open ditches and vacant lands exacerbates the ponding problem while making these grounds susceptible to disposal of waste, broken furniture, discarded appliances and debris (Texas AHEC East, 2012) (See Appendix 1). On the other hand, the existing vacant lands offer a great transformative opportunity for strategic spatial planning by creating a network of green infrastructure and spatial functions that will act as storm buffers to adjacent properties as well as potential places for economic development and social interaction.

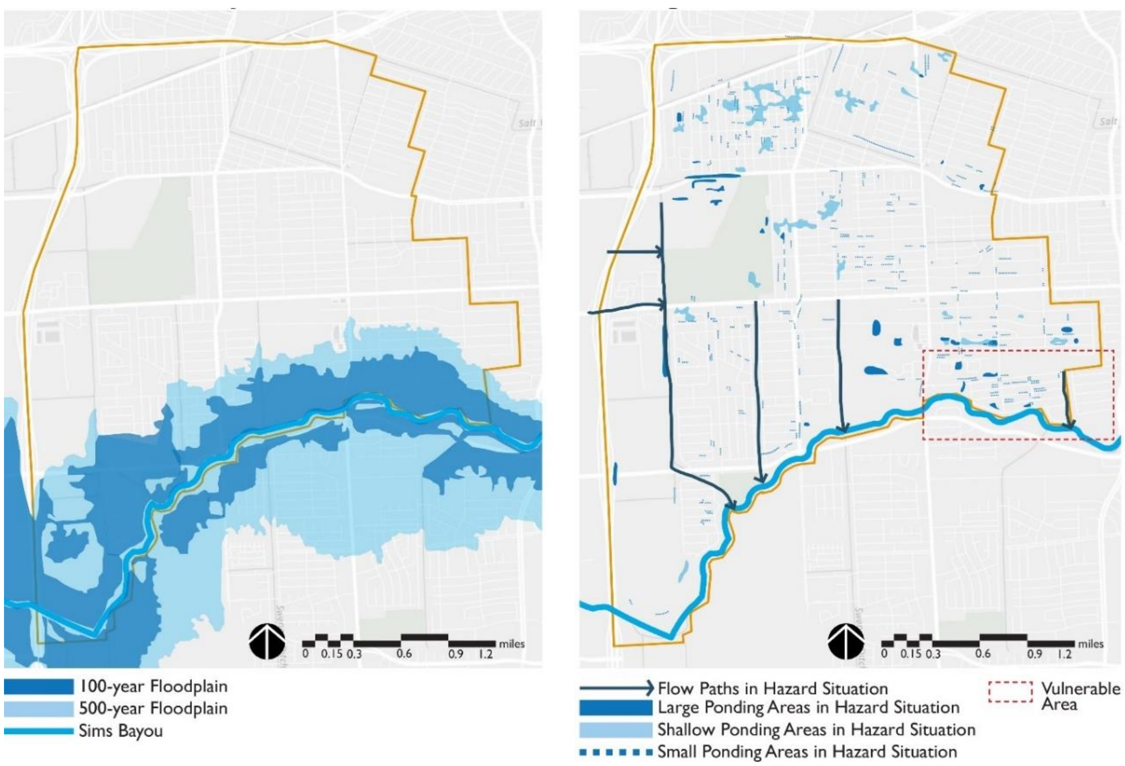

Figure 8: Flood vulnerability of Sunnyside-a) Floodplains, and b) Ponding map.
Data source: Harris County Flood Education Mapping Tool. (2017).

1.5 Research Objectives

The purpose of this research is to examine the design strategies for urban regeneration of vacant lands to enhance revitalization and resilience in the community. Taking Sunnyside as a case study, this study attempts to achieve the following research objectives:

1. Understand the problem of existing vacant lands and abandoned structures (VLAS) in in Sunnyside, Houston.
2. Explore the best planning and design strategies, and funding options to reuse VLAS for flood alleviation, economic development, active living, and social interaction in Sunnyside, Houston.
3. Examine the economic, social and ecological impacts of green infrastructure design to decrease impervious surfaces and stormwater runoff in Sunnyside, Houston.

CHAPTER II

LITERATURE REVIEW

2.1 Vacant Land and Abandoned Structure (VLAS) Problem Overview

2.1.1 Defining and Classifying Vacant Land and Abandoned Structure

With no nationally standardized definition yet, the term Vacant Land (VL) is both broad and imprecise with inadequate data on them across the municipalities (Bowman and Pagano, 2004); (Newman et al., 2016a). VL refers to the parcels in a city or neighborhood, either abandoned, underutilized, or empty for various reasons and owned by different entities. Similar meanings are included in the terms under-utilized land, urban void, urban wastelands, abandoned property, remnant parcel, derelict zone, dead space, brownfields, TOAD (Temporarily Obsolete, Abandoned, or Derelict Sites), in rem foreclosure property, terra incognita, lost space, drosscape, etc. (Aruninta, 2005); (Berger, 2007); (Bowman and Pagano, 2004); (Coleman, 1982); (Greenberg et al., 1990); (Leonard and Mallach, 2010). An omnipresent problem for decades in American urban, suburban and rural communities, VLAS can range from residential, commercial and industrial properties (Leonard and Mallach, 2010).

Building on urban economist Ray Northam's classification, Bowman and Pagano (2004) has categorized the vacant parcels in U.S cities as a) Remnant parcels that haven't been developed in the past, b) Unbuildable parcels with physical limitations (steep slope, floodplains, wetlands), c) Corporate reserves for future expansion, d) parcels held for speculation in anticipation of a profitable market sale at a later time, and

e) Large tracts of institutional reserve parcels. In addition to these VL types, there are also Abandoned Structures (AS) that are deserted, or neglected due to financial constraints or flight of population, often times one or multiple parcels adjacent to other homes or lands. Depending on the location of the VLAS, they can be single gap lots, consecutive lots, blocks, or corridors (Figure 9) (Wilkinson, 2011).

These classifications suggest that VLAS is mostly transient in nature with potential for a productive future (Newman et al., 2016a). But unfortunately, they are usually at the bottom of a land-use cycle, making them the most undesirable parcels to develop in a city or community (Greenberg et al., 1990). However, surprisingly, many cities are more concerned about an undersupply of VL than an oversupply, which is related to the accommodation of future growth of the city (Bowman and Pagano, 2004).

Figure 9: Vacant Land in Sunnyside.
Image source: Google Maps, accessed on 06/02/2017

2.1.2 Causes of Increase, Types and Characteristics

Although the exact number of VLAS in the United States is difficult to estimate, the number of them have been steadily increasing in last 40 years, particularly since 2000 (Wilkinson, 2011). Collected data from United States Postal Service (USPS) portrays a rather bleak picture for a number of cities across the country (Newman et al., 2016a). Historically, older industrial cities in the Northeast and Midwest with fixed territorial sizes (inelastic/legacy) have experienced urban shrinkage due to declines in the manufacturing industry, and thus sustained employment and population loss. On the other hand, sprawling cities with expanding boundaries (elastic/magnet) depend heavily on developing their urban peripheries, leaving the internal frontier unused and leftover (Mallach, 2014); (Newman et al., 2016a) and (NVPC, 2005). Both legacy cities and magnet cities have shown different trends in attracting college-educated millennials depending on the city policies and strategies for intentional demographic shift (Mallach, 2014). Interestingly and contrary to popular belief, the elastic/magnet cities have a higher rate of increased VLAS due to their aggressive urban expansion than those of the inelastic/legacy cities who seek more infill development (Newman et al., 2016c); (Bowman and Pagano, 2004). A study carried out by Newman et al. (2016a) shows southern cities have the highest average of VL (23.5%) in the nation and cities in Texas "report an average of more than one-quarter of their land area as vacant".

However, the reasons behind the occurrence and rise of VLAS are complex, unique, and sometimes contradictory, especially because the effects often become the causal factors of its increase in a vicious loop (Newman et al., 2016b). Surprisingly, for a long time, VLAS was not seen as a problem but a symptom to a disease (Accordino and Johnson, 2000). Changing economic conditions such as market speculation, the foreclosure crisis, and fiscal downturn contribute to the destabilization of housing market and subsequent VLAS (Wilkinson, 2011). Ill-conceived federal policies and existing land use laws that favor development in greenfield sites can lead to further degradation of VLAS (Accordino and Johnson, 2000). A vacant parcel's non- or underutilization may be a result from its physical properties such as steep slope, irregular shape, or previous environmental contamination that makes it difficult to develop. The study by Newman et al. (2016a) listed the following factors as the most common reasons of increased VLAS in the 79 surveyed cities: disinvestment (29%), changing urban boundary due to suburbanization (16%), annexation (16%) and deindustrialization (13%). Physical properties such as land assembly problems (9%) and contamination (6%) affected the VLAS increase less. But the lack of clear consensus on a mapping inventory method among the cities across the country makes it difficult to measure the causes and impacts of VLAS in a standard way.

On the other hand, in an argumentative article, Coleman (1982) refuted the most popular hypotheses that presume that 'Dead space results from the fact that the inner city is dying', 'Dead space exists in the inner cities because greenfield sites are cheaper to develop', 'Dead space persists because people do not want to live in the inner cities', etc. Instead of following these assumptions, a multiplicity of land owners and innovators in a less bureaucratic local authority process can perhaps dissolve away the VLAS blight.

In traditionally African-American neighborhoods like Sunnyside, abandonment often results from the dilemma among the residents who are attached to their place and those who choose to leave the neighborhood. The first group is vulnerable to restricted housing choice due to income, real or perceived discriminatory practices, lack of private transportation etc., and the second group does so for better employment, housing and quality of life opportunities (Accordino and Johnson, 2000); (Longoria and Rogers, 2013). A large portion of VL in Sunnyside, especially the larger tracts, are owned by public and private entities for future reserves as well (See Appendix 2 and 3).

2.1.3 VLAS: A Detriment to Communities

The true costs of VLAS in a community are manifold, while the expense keeps growing every year a property remains vacant or abandoned (NVPC, 2005). In addition to the property tax loss, it also lowers the property values in the adjacent properties (a net loss of $7,627 in value within 150 feet of a VLAS), higher homeowner's insurance, policy cancellations, etc. that encourage further abandonment (Greenberg et al., 1990); (Wilkinson, 2011). According to Kelling and Wilson's (2011), "The Broken Window Theory", "If the first broken window in a building is not repaired, then people who like breaking windows will assume that no one cares about the building and more windows will be broken…The disorder escalates, possibly to serious crime." VLAS greatly strains the resources of local police, fire, and public maintenance. The National Vacant Properties Campaign (2005) has listed cities like St. Louis has spent $15.5 million to demolish vacant buildings, and Philadelphia spends $1.8 million per year to clean VL over the span of five years from 2000 to 2005. In Austin, Texas "blocks with unsecured [vacant] buildings had 3.2 times as many drug calls to police, 1.8 times as many theft calls, and twice the number of violent calls" compared to the blocks without vacant buildings. A staggering amount of $73 million property damage is annually instigated by more than 12,000 fires breaking out in vacant structures each year in the US (PD&R and HUD, 2014).

In addition to the fiscal loss, VLAS also takes a hefty toll on a community's aesthetic impact, social fabric, sense of community, environmental feature, health and safety concerns as well as the perceived image of decay and blight in the neighborhood (Bowman and Pagano, 2004); (Greenberg et al., 1990); (Newman et al., 2016b). Unmanaged VLAS is indicative of urban failure in people's minds (Burkholder, 2012). In many cases, if left alone, the existing VLAS in a city can create a spiral of blight in an already economically, socially and ecologically strapped area (Mallach, 2010); (NVPC, 2005).

2.2 Reclaiming VLAS for Revitalization and Resilience

2.2.1 Economic, Social and Ecological Benefits to Reclaiming VLAS

Intentional green reuse of urban vacancies reaps the benefits of ecological and social values as an aspirational and alternative way of reclaiming vacancies instead of only economic gain (Leonard, 2015). Strategic reuse of VLAS is a major opportunity to fill the gaps in the urban fabric and to transform the neighborhood for improved quality of life (Newman et al., 2016a). Reclaiming the vacant lots and transforming them into useful functions can bring manifold advantages in different sectors that include-

a) Environment & health sector, by remediating the contaminated sites in a neighborhood that opens up the opportunity to have better land, water, and air quality (Leonard, 2015); (Mallach et al. 2016). The true potentials of VLAS are recognized as its ability to restore urban ecosystem and supplement essential resources of clean water, food and biodiversity (Burkholder, 2012). The reuse of abandoned buildings, roads, and public infrastructure minimizes the overall energy use instead of building new ones that also reduces the amount of demolition waste in a community (Wilkinson, 2011). Targeted infill on vacant parcels can create a pedestrian-oriented development that promotes active living and health benefits (Anderson and Minor, 2016). Providing basketball courts, playgrounds, and recreational trails in a neighborhood can significantly increase the physical activity of populations with limited park space as well as act as preventive healthcare. They also encourage for continued usage of children's play and increased social interaction (Dolash et al., 2015).

b) Housing & community development, where existing vacant parcels, be it residential and commercial, can be redeveloped to accommodate the housing demand as well as attract new investors and residents in the neighborhood (Wilkinson, 2011). Investment on these sites can act like a catalyst for urban regeneration and a lead to a better mix of land uses to serve both the existing and future residents (Mallach, 2016). The new use for the vacant parcels can be prioritized based on the existing assets and needs of the community, i.e. grocery store, healthcare facilities, park, community club, etc. (Leonard, 2010); (Mallach, 2010).

c) Economic development, by redeveloping VL into businesses – providing office, retail, or manufacturing space for industries geared toward the skillset the neighborhood has. This will provide more jobs in the area with existing resources and investments (Mallach, 2010). These sites can also provide incentive to raise the quality and availability of education in the community to match employer demands (PD&R and HUD, 2014); (Wilkinson, 2011).

d) Increased public safety, as statistics correlating to vacant lots and crime is significant and convincing, thus the redevelopment of them prevents public nuisances such as arson, accidental fire, littering, water leakage etc. (Mallach et al. 2016); (Wilkinson, 2011).

e) Improved sense of community and awakening of community spirit by engaging the locals in VLAS transformation strategies and maintenance (Kim, 2016).

2.2.2 Sustainable Reuse Strategies & Recommendations

"Behind every vacant property there is a story. The trick is to find that story and address the underlying issues." (Mallach, 2010). In order to carry this out, the range of strategies that cities across the country applies to combat the VLAS problem is quite broad. The overarching goals are to prevent abandonment, gain control and foster reuse through leadership actions and community-driven initiatives (Hexter et al., 2008). The strategies include a) Code enforcement process allowing community residents to identify and complaint against VLAS, b) Punitive sanctions for building code violations, c) Advice and assistance to landowners for rehabilitation financing sources, d) Property stabilization measures by hanging blinds in windows, repainting, repairing doors and windows, mowing lawns, cleaning debris, etc., e) Demolition of dilapidated properties, f) Acquisition and sale of tax-foreclosed and vacant properties to right-size the city or neighborhood through selling VLAS to land banks, adjacent property owners and non- or for profit developers, g) Financial assistance to homebuyers in purchasing VLAS properties, and h) Innovative brownfield programs to redevelop commercial and industrial vacant properties (Accordino and Johnson, 2000); (Hexter et al., 2008); (Leonard, 2015). In addition to the before-mentioned policies, the 10 principles of Smart Growth mention development within existing neighborhoods, encouraging compact design and collaboration between community and stakeholders (Wilkinson, 2011).

2.2.3 Reimagining VLAS as Green Infrastructure

Reclaiming VLAS by creating stormwater systems that include Green Infrastructure (GI), also known as Low Impact Development (LID), effectively control flood, improve air and surface water quality, reduce urban heat island effect, and reduces the need for air conditioning (Anderson and Minor, 2016); (Burkholder, 2012); (Flynn and Davidson, 2016); (Kirnbauer et al., 2013). GI also supports urban biodiversity, wetland plant communities, urban ecological corridors that consequently improves public health and provides recreational and educational space for neighborhood residents (Kim, 2016). VLAS as public open space, community garden, adventure playgrounds, bikeways along waterfront, etc. accommodate easy access to different open space choices for the marginalized groups in a neighborhood as well. These spaces are perceived as “public” to the socially underserved people due to their “loose space” quality (Anderson and Minor, 2016); (Kim, 2016).

Several innovative reuse strategies for GI have been identified by exploring multiple case studies:

- New Orleans Redevelopment Authority (NORA) launched NORA Green-Green Infrastructure program in 2014 to develop pilot rain gardens and Growing Green program for neighborhood-scale urban agriculture (Leonard, 2015).
- Detroit Water and Sewerage Department’s Green Infrastructure program that reused vacant lots throughout the city by planting trees and creating meadows that noted a 17 percent reduction of stormwater runoff in 2012 (Leonard, 2015).
- The Reimagining Cleveland Vacant Lot Greening Program launched in 2008 implemented a variety of neighborhood-driven uses including community gardens, orchards and vineyards, green infrastructure, pocket parks, street edge improvements, etc. (Mallach et al., 2016).
- Philadelphia’s Green City Strategy introduced in 2004 facilitated community-based greening strategies as part of land stabilization effort (Wilkinson, 2011).
- Milwaukee has redeveloped multiple brownfield sites by implementing a vegetated “treatment rain” that captures and filters stormwater runoff from the properties (Kim, 2016).

- A study by Kim et al. (2015) has assessed a carbon capture of 97,500t ($7.6 million) by growing trees on the vacant lands of the City of Roanoke, Virginia.

Despite the numerous benefits of GI, a complex array of social and biophysical factors often affects the GI implementation that include funding, property rights, ordinances, building codes, organizational capacity etc. (Brody et al., 2009); (Flynn and Davidson, 2016).

2.2.4 Possible Programs and Funding in Houston, Texas

To deal with the large number of vacant lots scattered throughout the city, an initiative by the City of Houston is the Land Assemblage Redevelopment Authority (LARA) (2017) program, collaborated with Harris County, and Houston Independent School District. The goal is to provide the tax delinquent lots (2,750 sqft-15,000 sqft) for little to no cost ($3,000-$8,855) to homeowners of adjacent properties to the VLAS and who have been living in their homestead for past three years. While the program is focused primarily on affordable housing, it also provides for five-year leases for community gardens in temporary basis. A total of 12 LARA lots are available on this program in the neighborhood of Sunnyside (Appendix 4).

The long-term reuse strategies include bringing in investment and employment generation to revitalize an area. Both private and public funds and resources are available for such strategy implementations. Private funding could be available through individual foundations, donors, churches, etc., whereas several sources of public funding are Texas Enterprise Zones (TEZ), Tax Increment Reinvestment Zone (TIRZ), Product

Development & Small Business Incubator Fund (PDSBI), Skills Development Fund, Self-Sufficiency Fund, Adopt-a-lot program etc. According to Texas Economic Development Corporation (2017), the criteria to be eligible for these programs are as follows:

a) Texas Enterprise Zones (TEZ) program is created by the State of Texas where a local community in an underinvested area can nominate a company as an Enterprise Project by offering tax incentives that will eventually result into private investment. If located within a zone, the company must commit to allocate at least 25 percent of their new employees from the economically distressed population. The economic revival comes from the company's investment amount and the number of the jobs created.

b) Tax Increment Reinvestment Zones (TIRZ), or reinvestment zones are the areas with deteriorating structures, unsafe conditions, tax delinquent properties designated by the City Council to draw new interest in the area. Expenses for redevelopment and public enhancements are funded by TIRZ and inferred tax from new improvements that draw in other businesses and improvements. The municipality has the power to acquire blighted properties and install public facilities, sites, sidewalks, etc. or enter into agreements with bondholders to create and implement project plans in the area.

c) Product Development & Small Business Incubator Fund (PDSBI), has the primary objective of creating and retaining high quality jobs. In order to be eligible, applicants must have at least 3 years of operating history and have unencumbered assets available for collateral. But the communities or individual investors can assist as Guarantors as well. Preference for funding is given to the state's defined industry clusters including, but not limited to: nanotechnology, biotechnology, biomedicine, renewable energy, agriculture, and aerospace.

d) Skills Development Fund aims to assist companies and labor unions form partnerships with Texas public community and technical colleges finance customized job training according to their local business requirements.

e) Self-Sufficiency Fund aims to assist Temporary Assistance for Needy Families (TANF) recipients become independent of government financial assistance, by linking the business community with local educational institutions and is administered by the Texas Workforce Commission. Public colleges or to eligible private, nonprofit organizations can be eligible to obtain grants and provide customized job training and training support services for specific employers.

f) As part of the Green Infrastructure grant program US Housing and Urban Development (HUD) and Sustainable Communities Initiative (SCI) (2015), Houston-Galveston Area Council (H-GAC) won $3.75 million to implement GI as a sustainable triple-bottom-line tool and a lower-cost solution to protect key assets from hurricanes and flooding events. The "Our Great Region 2040" plan of H-GAC advocates for "incorporating green infrastructure facilities into parks to conserve public green spaces and assist with stormwater management in the coastal region."

g) In addition to developing comprehensive guidance for developers and property owners for a wide variety of green infrastructure measures, Houston aimed for higher monthly stormwater fees based on the percent of impervious cover on the property. The collected funds support "green and grey stormwater infrastructure and a variety of green stormwater education programs, rebates, and, subsidy programs." City of Houston (2017) also offers "reductions in monthly stormwater fees to property owners who install rain gardens, stormwater planters, or other green infrastructure on their property to reduce, slow, and treat runoff on-site."

In order to apply for and obtain these funds, a recommendation for the community of Sunnyside, Houston would be to have a representative committee who will strive to work with the City of Houston through constant communication and collaboration.

CHAPTER III

METHODOLOGY

3.1 Planning Process

The community planning process (Figure 10) is a cyclical loop of actions instead of a typical linear process. By identifying VLAS in the neighborhood, the residents can determine an activity with a simple program, finding a strategic location that requires little transformation, the management, and the framework of the reclamation process. Meanwhile, they must arrange for funding, collect resources and people, and gain social support while transforming the space. As for the stakeholders, the City of Houston, churches, schools, civic clubs, and community residents can be involved in different steps. By carrying out different part of the process at appropriate and convenient time, the reclamation process can be customized for different neighborhoods according to their resources.

The unique conditions of Sunnyside have prompted multiple studies and research within last few years. Through participatory process and building on previous data, Community Design Resource Center (CDRC) from University of Houston, in partnership with Houston Department of Health and Human Services, identified the pressing issues in the neighborhood in their “Sunnyside Ideas Book” (2013). The participatory process involved design charrettes with Sunnyside residents that came up with seven community design strategies. Reusing the VL as community gardens and urban farming in order to obtain food security in the neighborhood was one of the strategies in the book by CDRC.

In Fall 2016, PLAN 662 Master of Urban Planning (MUP) class of Texas A&M University, with collaboration with Texas Target Communities, took the study from where CDRC had left off. Within a three-month period, participatory engagement was initiated five times (Figure 10). First, an introductory meeting was set up with the neighborhood representative to allow the MUP students get familiar with Sunnyside and its hardships, followed by a site visit and a second meeting. The third and fourth meetings involved presentation of findings and analysis to neighborhood representatives for their feedback as well as getting the word out on local radio. The fifth community breakfast meeting comprised of presentations from the students on the topics of priority that included, a) Reclaiming vacancies, b) Affordable housing, c) Walkability, d) Transit connectivity, and e) Brownfield redevelopment. During this meeting, a great interest in reclaiming the vacancies in the neighborhood as well as redeveloping the landfill site in Sunnyside as a community park was noted from the residents' feedback as well as the invited community members of other distressed neighborhoods in Houston with similar conditions. It was stressed on developing a common toolbox for redeveloping VLAS as part of a comprehensive community design approach that could be customized for different neighborhoods.

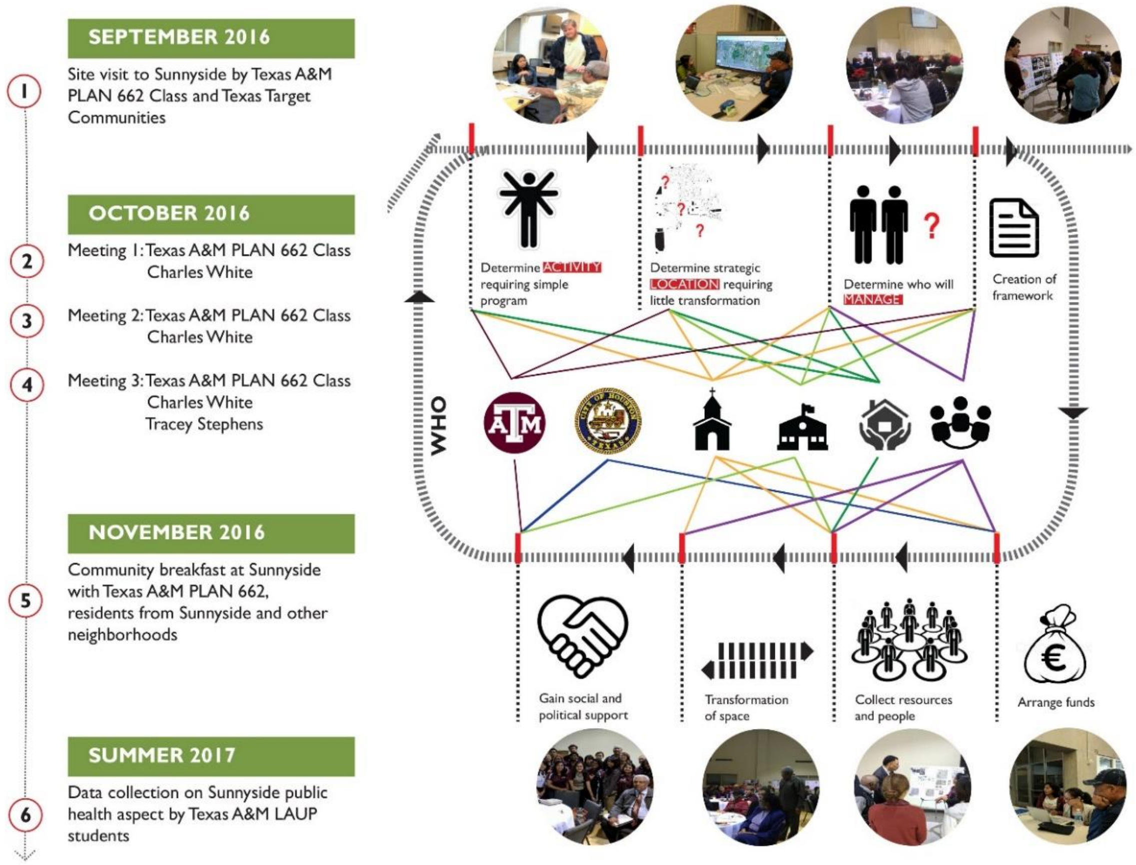

Figure 10: Timeline and planning process of reclaiming vacancies in Sunnyside.

3.2 Planning and Design Goals

The overarching goal of the project is to "Revitalize neighborhood and increase flood resilience through Green Infrastructure network in underutilized vacant parcels." The final design has four planning goals (Figure 11): a) Increase local economy, b) Increase connectivity and walkability, c) Encourage active and healthier neighborhood, and d) Strengthen flood resilience, by LID urban stormwater management. Local economy can be boosted by redeveloping and reactivating the vacant spaces with new employment, affordable housing, healthcare and community facilities, and compact development. Transit connectivity and walkability in the neighborhood can be achieved by introducing new bus route, eco-boulevard, Shared Streets design policies, and interconnected pedestrian trails by reusing the vacant parcels. Active and healthy living among the residents can be encouraged by designing and developing Green Infrastructure network of open spaces, community spaces and recreational facilities on the existing vacant parcels. These functions can be temporary in nature to build momentum in the neighborhood until the new development comes in the VLAS. LID approach of urban stormwater management on the reclaimed vacant parcels can strengthen flood resilience and alleviate ponding issues.

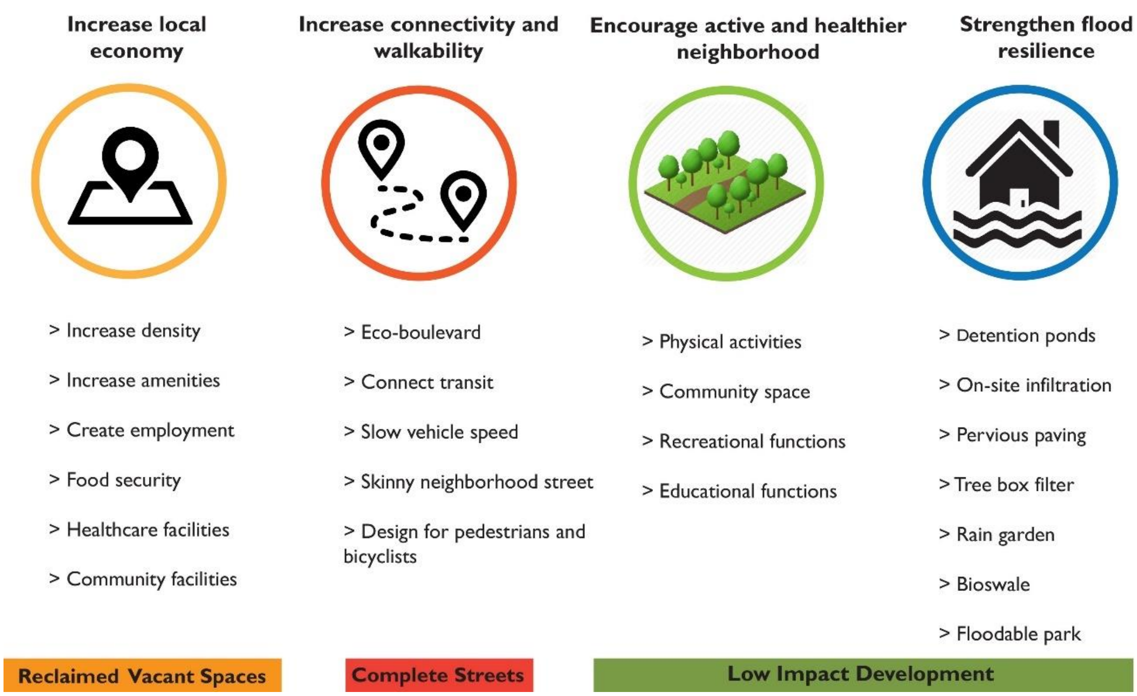

Figure 11: Planning and design goals from community feedback.

3.3 Toolbox for Reclaiming Vacancies

Transforming large numbers of vacant parcels at the same time is immensely challenging, so the study develops a toolbox for reclaiming vacancies in the neighborhood (Figure 12). The toolbox can be applied to identify the priority parcels for targeted community improvement and strategic infill for different design programs. Conditional on where on the matrix a vacant lot falls under, the neighborhood can decide on the spatial function it can have, tied back to the broad planning goals identified previously. The flood potential of the parcels is essential to determine the type of proposed function and the proximity to church and school is important for potential partnership with these entities.

Depending if the parcel is VL or AS, single or a cluster of multiple parcels, situated in a flood- free or potential area, located on a site either near a corridor, intersection, church, school, bus stop or bayou; the parcel can either be a) Community open space, b) Urban farming, c) Infill, d) Ecological landscape, or e) Stormwater detention. For example, if there is a cluster of multiple undeveloped VL in the neighborhood in a flood potential zone and located near a church; following the matrix, it can either be a nature park, equestrian park, trail, small detention pond, infiltration park, bioswale, rain garden, or plantation. If the same parcel is in a flood-free zone, it can be transformed into any spatial function from Community open space or Urban farming.

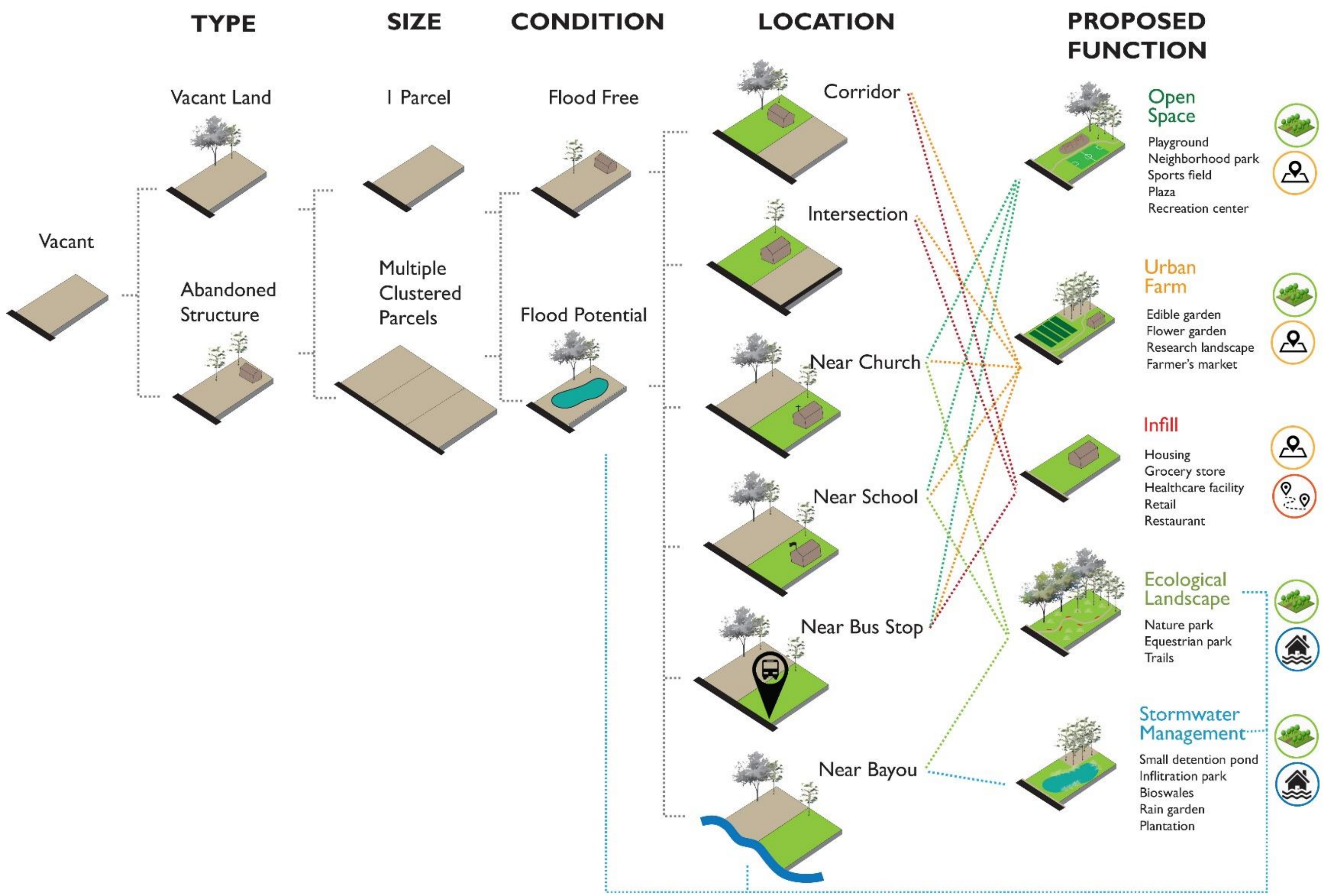

Figure 12: Toolbox for reclaiming vacancies.

3.4 Study Area Selection

The disastrous flood events on Memorial Day and Halloween in 2015 in Houston prompted the City of Houston to draft an Action Plan for Disaster Recovery (2016). The Plan lists Sunnyside as one of the most impacted Low-Medium Income (LMI) areas during the floods. The city identified that most damages were repeated in the same communities, due to infrastructure inadequacies that called for long-term solutions. A large portion of these flooding events were caused by the open ditches scattered throughout the neighborhood (See Appendix 1) that need major infrastructure improvement. The idea is to create a Green Infrastructure (GI) network in the neighborhood that would protect the natural hydrology of the site by capturing and filtering stormwater volume through the use of engineered systems that mimic natural hydrological systems (Flynn and Davidson, 2016). Instead of acquiring new lands, the existing vacant parcels in the neighborhood are a great resource for developing the GI system (Anderson and Minor, 2016).

Through land suitability analysis (Figure 13) in ArcGIS, the study identifies the most suitable vacant parcels in the neighborhood for GI. The slope and elevation of Sunnyside is created by taking US Geological Survey's (USGS) National Elevation Dataset (NED) for Digital Elevation Model (DEM)10m as input, and clipping it by Sunnyside Super Neighborhood boundary. The projected coordinate system for the data is Texas South Central FIPS 4204_feet. Four parameters are chosen in the suitability analysis. a) Elevation (40% weight) gets from high to low as it nears the Sims bayou to the south of the neighborhood, b) Slope (40% weight) is mostly high on the landfill site

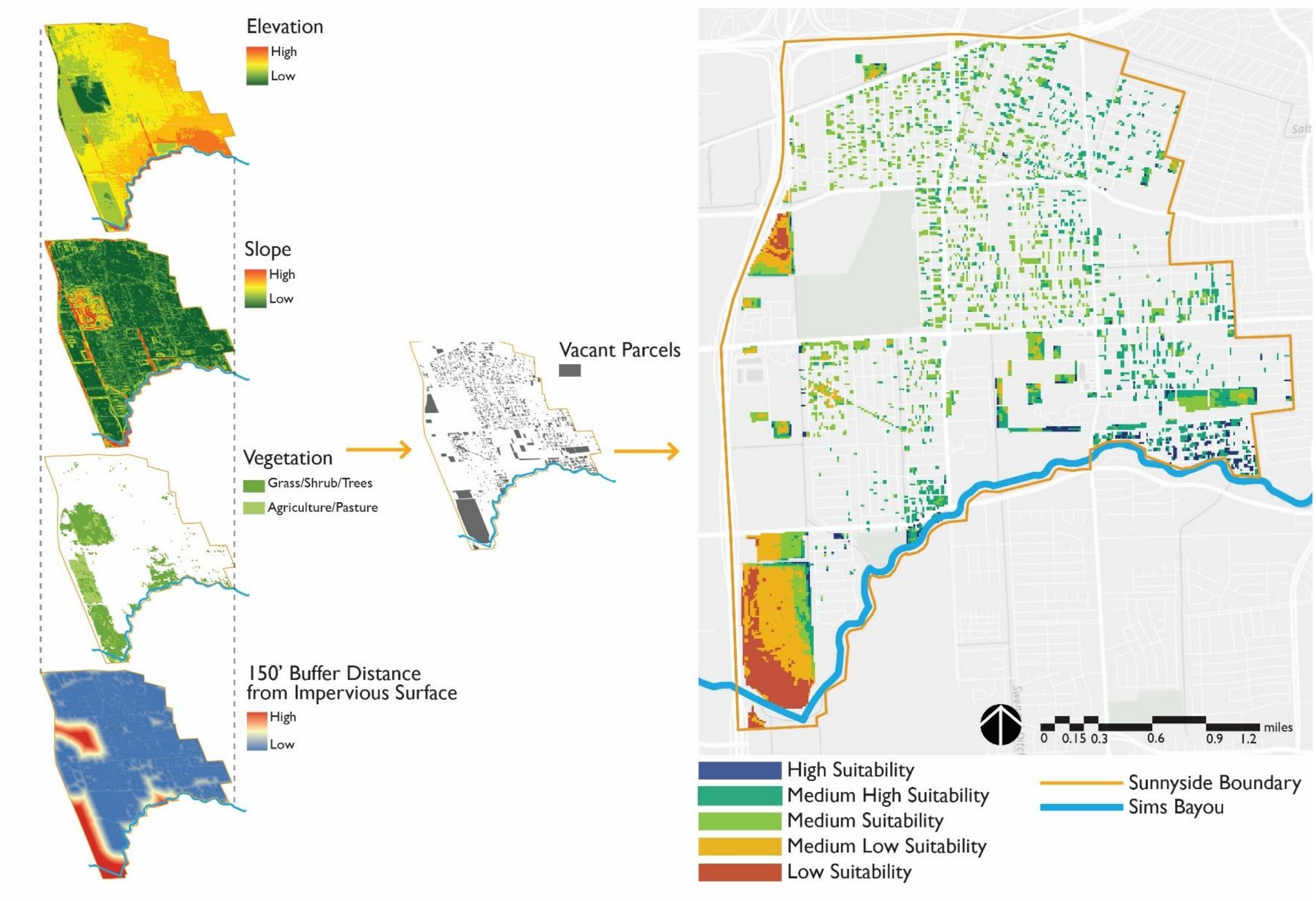

Figure 13: Land suitability analysis for Green Infrastructure plan.

and the edges of the open ditches, c) Existing Vegetation (10% weight) comprised of cultivated crops, pasture, shrub, wetlands, deciduous forest. Evergreen forest and mixed forest, and d) 150’ buffer distance (10% weight) from the existing building footprint that translates into impervious surface. In the next step, the four parameter layers were converted into raster and masked by the layer of vacant parcels to identify the vacant parcels suitable for GI network development. According to the weightage given to the parameters, the final suitability map is categorized into five suitability types: a) High Suitability (stromwater detention), b) Medium High Suitability (ecological landscape), c) Medium Suitability (community open space), d) Medium Low Suitability (urban farming), and e) Low Suitability (infill).

From the final suitability map, a site is selected to demonstrate the physical redevelopment of VLAS in the neighborhood. The selection is based on four criteria, a) Major concentration of vacant parcels in one area, b) Affected by flooding and ponding issues, c) Lack of public amenities, and d) High to medium high suitable parcels for Green Infrastructure network. Based on these criteria, a 202-acre site in the southeast portion of the neighborhood is selected as the design-research study area (Figure 14).

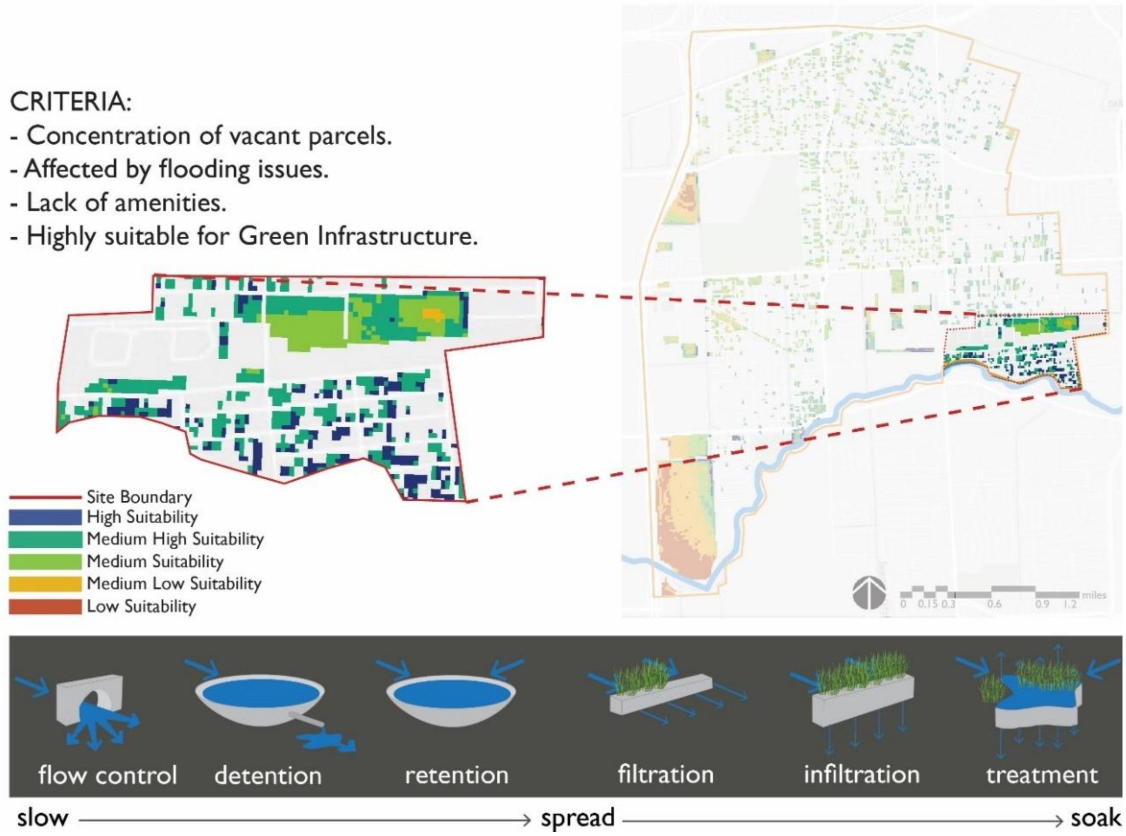

Figure 14: Map of selected project site showing suitability of Green Infrastructure.

3.5 Site Inventory and Analysis

A detailed site inventory and analysis are carried out in order to assess the existing conditions of the site in terms of transit connectivity, sidewalks, grocery store, vegetation, canopy, park, imperviousness, building footprint and vacant parcels. The analysis (Figure 15) shows that the only two bus stops fall on the edge of the site, making only 18% of the area accessible to bus stops within a quarter mile radius. This associates with the walk score and health factor of the residents in the area. There is not only zero existing sidewalk in the site, but also the open ditches along the narrow streets makes them a health and sanitary hazard. No restaurant or grocery store is located in the site making it a food desert, making it difficult to access fresh and healthy food. Around 9% of the site is filled out with leftover and underutilized scrub space with no particular community use. Existing tree canopy covers 36% of the site, but there is no public green space or park facility in the site despite being located near the Sims bayou. Proximity to the bayou can be a great opportunity to develop greenway along the waterfront as well as provide outdoor event space for the community. 90% of the site has existing impervious surface where only 5% is existing building footprint and 50% of the parcels is vacant or abandoned.

In a nutshell, this 202-acre site is a quintessential example of an underserved community burdened with multi-faceted problems in economic, ecological and social aspects. Thus, this site makes a great study area for the design-research of implementing the toolbox to reclaim vacancies and transform them. The transformation into spatial functions and Green Infrastructure can meet the current needs as well as steer the community growth in a constructive way.

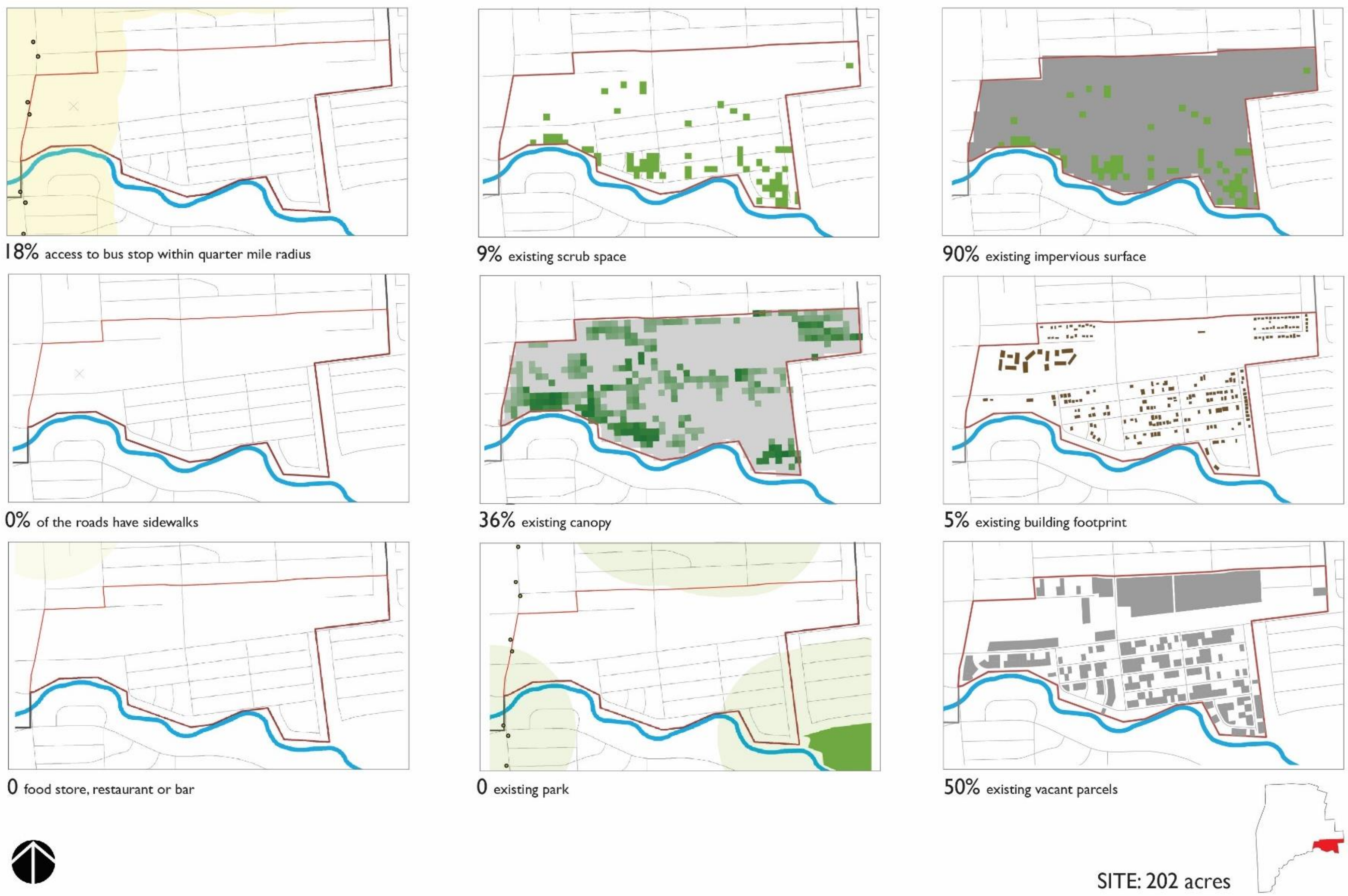

Figure 15: Site inventory and analysis maps.

3.6 Master Plan Schematics

Before delving into the design of the site, four design schematics are developed to create a framework of the master plan. They give a general view of the components and define the scope of work in each component. The components are:

a) Green Infrastructure Network (Figure 16) is an encompassing network of open space network for urban stormwater management. Taking the results from the suitability analysis map, highly suitable vacant parcels are selected for the design and development of GI. The parcels are chosen in such a way so that each block has at least one of them within quarter mile distance from the impervious surface. The GI network is then broken down into four types that accommodates for active recreation, passive recreation, water conveyance and water detention. The Sunbeam St running across the site is reimagined as an eco-boulevard that accommodates stormwater filter and absorption to the ground through green infrastructure technique.

b) Transportation Hierarchy (Figure 17) is the mobility and connectivity framework for the area. Three main arterial roads run along the three sides of the site, Cullen Boulevard on the west and Martin Luther King Boulevard on the east connecting to Downtown to the north and Sam Houston Tollway to the south, Airport Boulevard to the south connecting to Hobby airport to the east. Sims bayou runs along the south of the site. Sunbeam St as an eco-boulevard runs in the middle of the site connecting the area to the main arterial roads to the west and east. New transit route is proposed along this road with frequent bus stops. The collector roads are connected to the north and south for improved connectivity. The local roads run in a gridiron pattern apart from the waterfront along Sims bayou that follows the water flow path.

c) Trails Network (Figure 18) is an interwoven web through the Green Infrastructure for pedestrian access to the adjacent places and facilities. Instead of building new sidewalk infrastructure along the narrow streets with open ditches, an interconnected pedestrian trails network that follows the natural paths can provide access to most places. The trails culminate to the multi-use trail along the Sims bayou waterfront that provides recreational facilities.

d) Land Use (Figure 19) of the site caters for VLAS redevelopment and community revitalization. A large portion of the vacant parcels is proposed as parks and open spaces to provide recreational facilities and physical activity spaces. Along the proposed eco-boulevard are neighborhood office, neighborhood mixed-use, and higher density housing that can take advantage of the bus stops along the eco-boulevard. To the north of the site, existing higher density housing remains, along with proposed private institutional land use that include medical and campus for healthcare facilities. Public institutional and civic clubs are scattered throughout the site as community anchor points. Cluster of neighborhood commercial land use is also dispersed in the site to provide access to essential amenities within walking distance instead of concentrating them in a massive tract. The rest of the land use is low density single family housing that is supported by the surrounding land use and a network of open spaces all over the site. In ArcGIS map, the percentage for each land use is drawn and calculated (See Appendix 5).

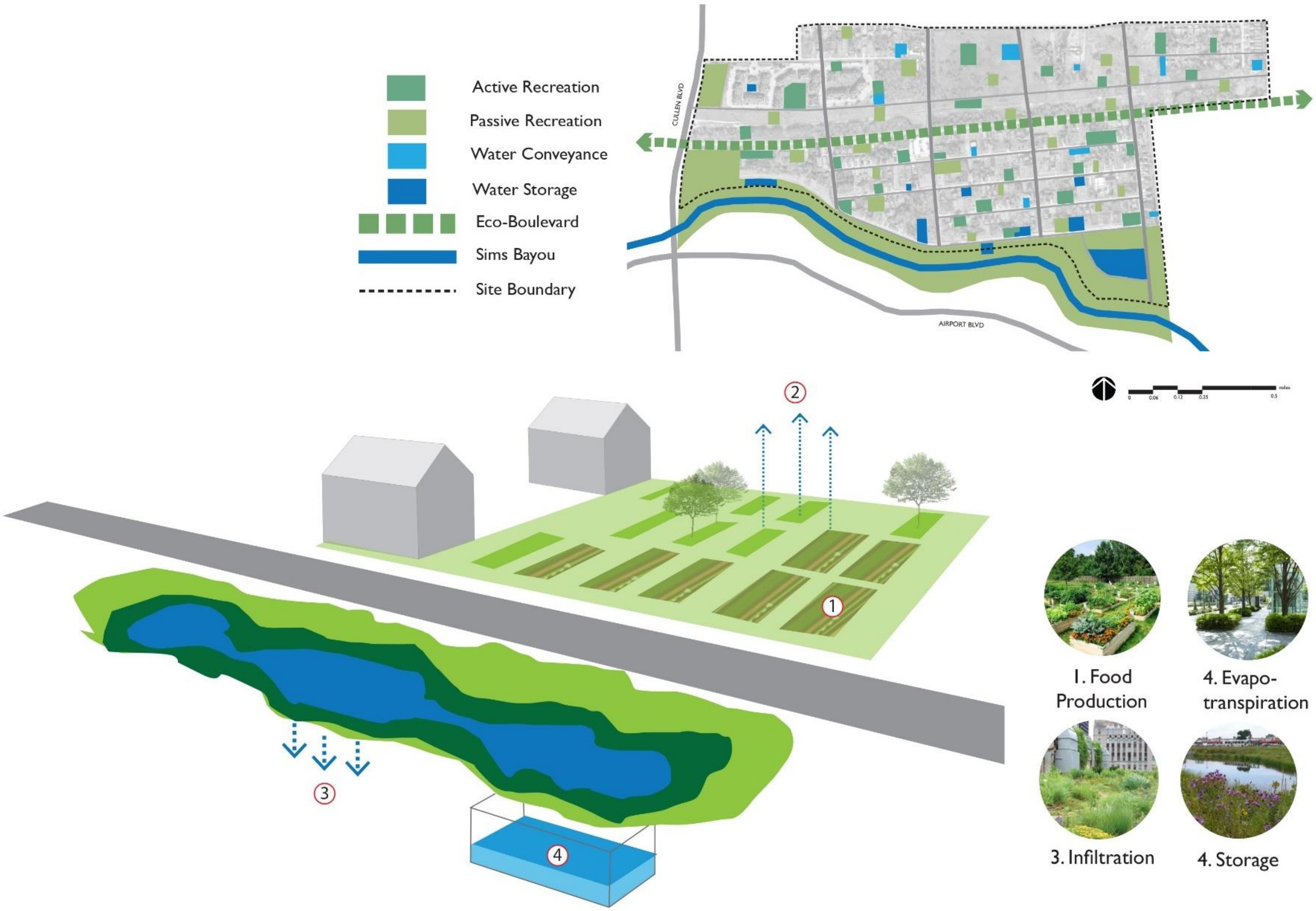

Figure 16: Master plan schematics 1: Green Infrastructure Network. Conceptual section.

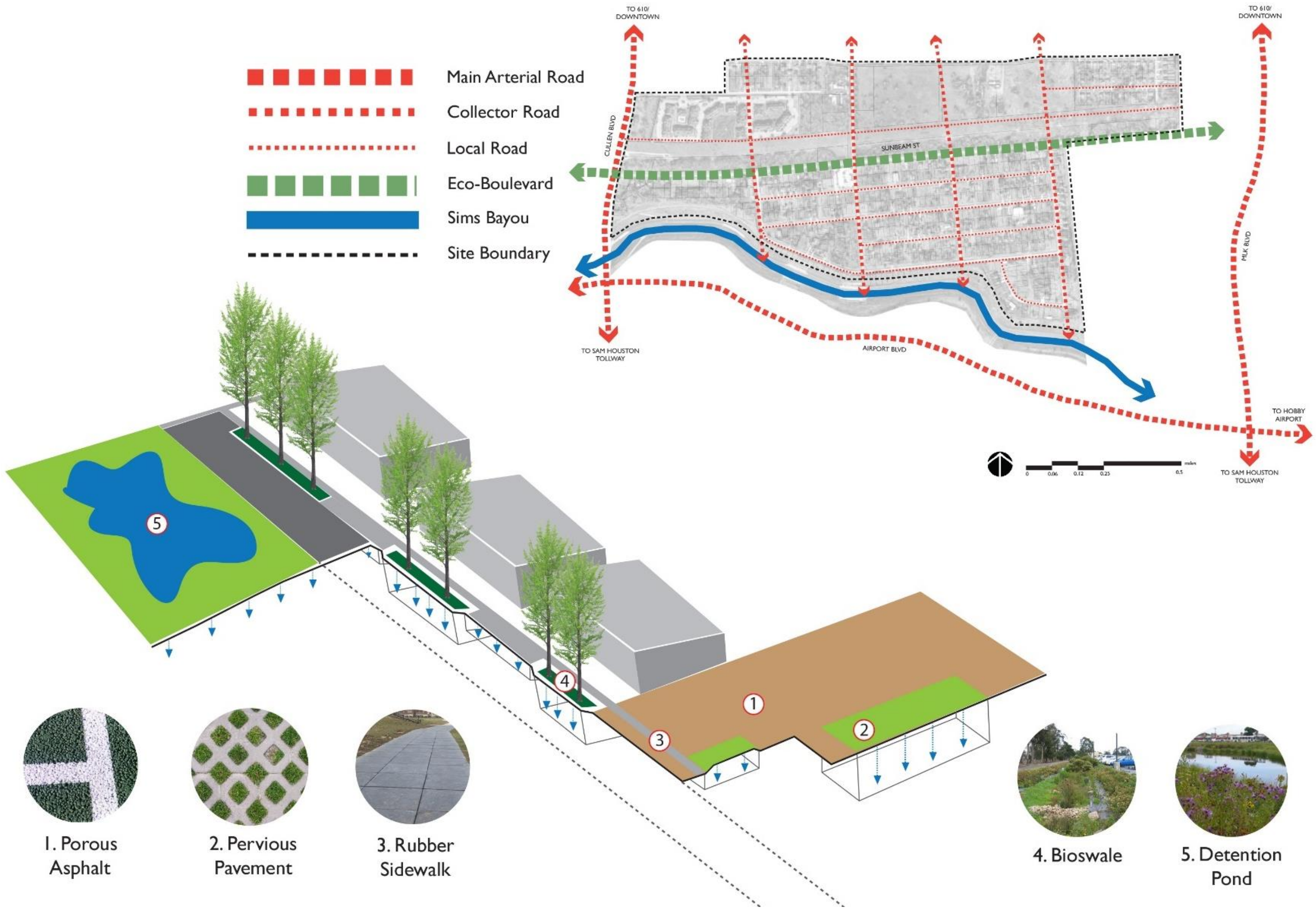

Figure 17: Master plan schematics 2: Transportation Hierarchy. Conceptual section.

Figure 18: Master plan schematics 3: Pedestrian Trails Network. Conceptual section.

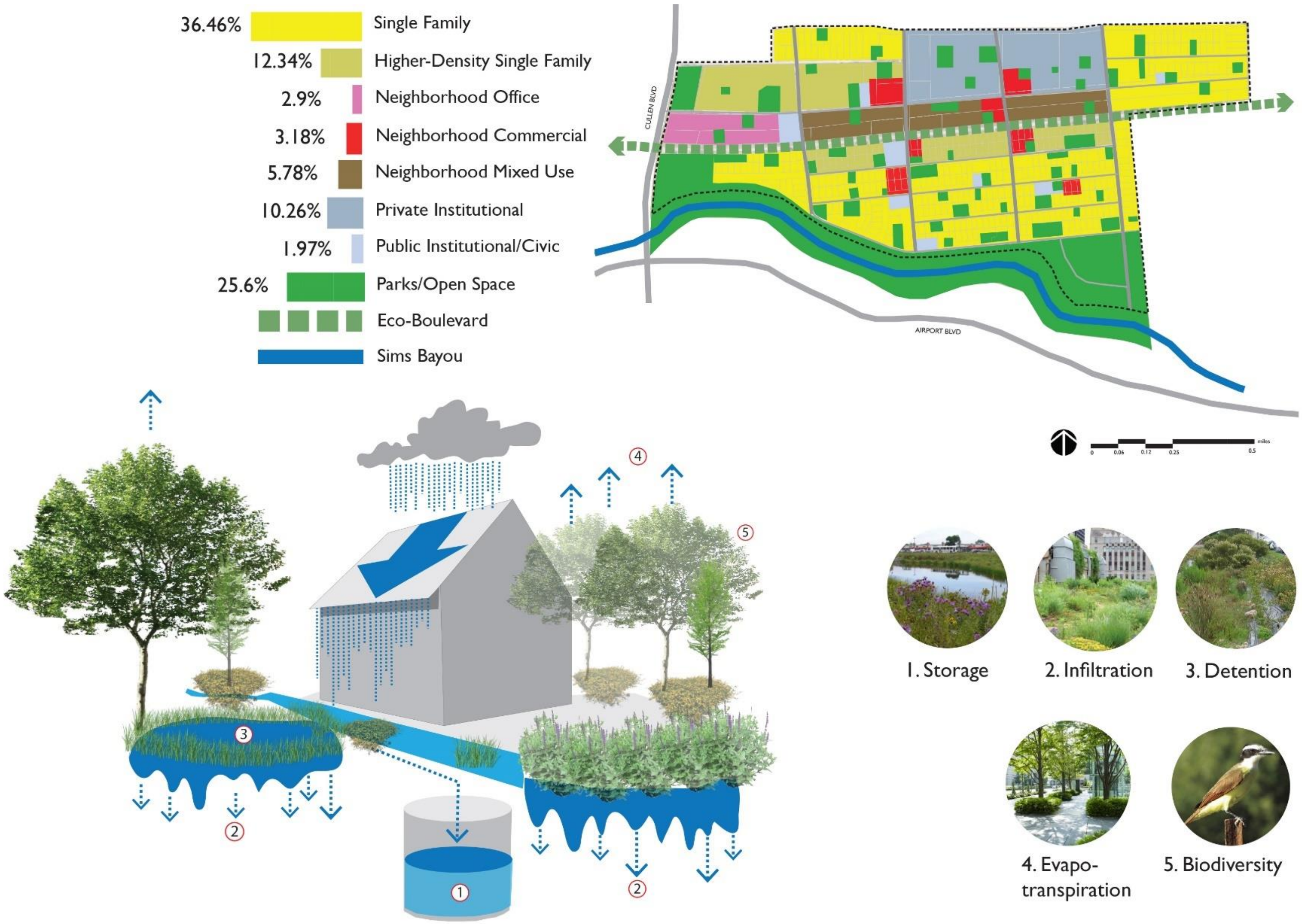

Figure 19: Master plan schematics 4: Land Use Map. Conceptual section.

3.7 Master Plan

Supported by the literature, the design program stresses on developing the community spaces as a means to reinforce community spirit. According to PD&R and HUD (2014), small-scale reuse on small single lots can stimulate demand necessary to retain in the area. On the other hand, large swaths of VLAS require large-scale repurposing that can spur economic revitalization and attract new residents to the area. During this process, constant community outreach and engagement initiatives should be carried out to leverage the local knowledge and skills of multi-sector stakeholders, learning exchange and VLAS maintenance (Leonard, 2015).

As Figure 20 shows, with 50% of the site as VLAS, much of this area is repurposed as GI network or job/housing opportunities. The design program is in two parts: a) Green Infrastructure, and b) Spatial Function. Based on the community feedback and research support, the Green Infrastructure network converts the vacant parcels into stormwater management system (floodable riparian park, rain garden), recreational facilities for active living (bikeway, fitness park, playground, tennis court, basketball court, dog park, event plaza), and urban farming (edible garden, flower garden). Fitness gardens are incorporated in each residential block to promote healthy lifestyle. The spatial functions include a wide array of housing options (single family, duplex, row house, multi-storied, affordable housing), community facilities (community center, book club, senior club), employment opportunities (farmer's market, office, campus, medical, mixed use), and amenities (restaurant, retail, grocery, bus stop). The community facilities cater for the demand of various age groups, whereas the employment and amenities are dispersed within the site to meet the needs of the residents. The housing options satisfy the demand for different choices for housing as well as affordable housing. The main arterial road is envisioned as an eco-boulevard that allows rainwater infiltration by the use of bioswale, tree planters, and pervious pedestrian trails. The rest of the VLAS is kept as ‘flex space’ that can be redeveloped according to the future demand. The GI network is interconnected by a pedestrian trails system allowing pedestrians access to nearby facilities without having to get in a car.

The four perspectives portray the ambiance of the proposed design elements in the site. Figure 21 shows the activated waterfront near the bayou, with a small amphitheater for outdoor events, a multi-use trail for walking, biking, jogging, skateboarding and other non-motorized vehicles, and a hang-out space for the residents. Figure 22 shows the proposed Community Center with a multipurpose open space for food trucks, seating spaces, and celebrating African-American culture and festivals such as jazz and Juneteenth (oldest known celebration commemorating the ending of slavery in the United States). Figure 23 illustrates how infill of row housing on the vacant parcels near existing single-family housing can add housing options for old and new residents, yet preserve the residential character by introducing Shared Streets on the residential streets. Fitness gardens in the proximity to the living add to the livability aspect of residents’ life. Figure 24 visualizes a segment of the proposed eco-boulevard with bioswale and mixed-use development along the road, community garden, and pedestrian trail connected with each other.

Figure 20: Proposed Master Plan of the site.

Figure 21: Perspective 1, Floodable Riparian Park.

Figure 22: Perspective 2, Community Center.

Figure 23: Perspective 3, Infill Housing on vacant parcels.

Figure 24: Perspective 4, Eco-Boulevard on Sunbeam Street.

3.8 Phasing Strategies

In order to attain an effective design application, the plan is to be implemented in three phases. The design is to be implemented in three phases with new job creations at every phase (Figure 25).

The first phase focuses on the development of Green Infrastructure skeleton to alleviate the flooding and ponding issues. The goal is to encourage healthy behavior and active living through the design and development of ecological landscape. The GI not only mitigates flooding issues, but also provide open public spaces for the use of the residents. As the flow paths and ponding areas were mostly located along the streets, streetscape improvements and new stormwater mitigation facilities along the existing open ditches will help attenuate the impacts of proposed development. A combination of pervious surfaces on streetscape will let stormwater infiltrate the ground and replenish it with groundwater instead of letting it flood the roads. Strategically located curb cuts are proposed to direct the stormwater to bioswale along the roadways. Excess rainwater that cannot be retained by bioswale will be dispersed around the neighborhood through small-scale rain gardens. The floodable riparian park along the Sims bayou acts as a recreational community space for the neighborhood as well as for nearby residents. The multifunctional open space allows for events, outdoor movie shows, music shows etc. to celebrate the traditional cultural festivals that strengthen the community spirit. The bikeway along the bayou offers active recreation services for the bike enthusiast. The edible gardens and flower gardens provide productive green space while creating new employment opportunities for the residents. They can be started with existing gardening equipment of the residents with their own schedule. In this way, they can solve the problem of food desert as well as increase a sense of community ownership. Community gardens can generate around 100 jobs in the neighborhood.

Phase two aims at targeted development of housing options and community facilities to accommodate the needs of the residents. Various housing facilities including single family housing, multi-stories housing, duplex, and affordable housing are proposed to cater for the needs of different ages and economic groups. By creating community support services as anchor points, phase two will set the stage for future economic development. A new community center, library and book club will be built to improve the social interaction and educational facilities for the children and the aged. A farmer’s market will begin its operation to take advantage of the produces from the edible gardens. Local and green industries are proposed as mixed-use development to provide the amenities the site is currently lacking. This includes bar, restaurant, saloon, bank, post office, neighborhood retail, etc. 1,834 jobs are projected during this phase.

Phase three steadily builds on the previous phases to spur development and attract new employments. Two large employers will be the new hospital and medical campus on the large vacant lands reserved for private institutions. These two employment generators will be able to employ the locals as many residents in the neighborhood have specialized skill in healthcare industry, producing 4,114 jobs in total. They will also provide healthcare facilities for the locals themselves. Frequent bus stops along the eco-boulevard will connect the site to the surrounding area and make the facilities accessible to people without cars.

Within the span of 20 years, the proposed design programs will create 6,048 new jobs in three phases in the project area. That translates into 30 new jobs/acre compared to the existing 1.3 jobs/acre (TOP and TLIHIS, 2016). As illustrated in Table 1, the calculation of projected jobs is carried out by first identifying the proposed functions that can generate new employment category. The standard area (sq.ft) per employee for each employment category is then identified and converted into acre. From the ArcGIS map of proposed master plan, area in acre for each employment category is given as an input. By dividing the total area of each employment category with the standard area per employee for that employment category, total number of jobs is calculated.

	Employment	Area (sq.ft)/Employee	Area (acre)/Employee	Area (acre)	Total jobs
Phase I	Edible Garden	2000	0.046	3	65
	Flower Garden	2000	0.046	1.56	34
Phase II	Book Club	405	0.0092	0.45	49
	Senior Club	405	0.0092	0.3	33
	Farmer's Market	463	0.01	1	100
	Community Center	405	0.0092	0.6	65
	Library	405	0.0092	0.4	43
Phase III	Office	228	0.0052	5.82	1119
	Mixed Use	383	0.009	13.9	1544
	Campus	405	0.0092	11.18	1215
	Restaurant	100	0.0023	0.38	165
	Retail	383	0.009	4.88	542
	Grocery	588	0.013	0.69	53
	Medical	372	0.009	9.18	1020
	TOTAL				**6048**

Table 1: Employment density calculation by building area per employee by business type.
Data source: US Green Building Council (2017). Building area per employee by business type.

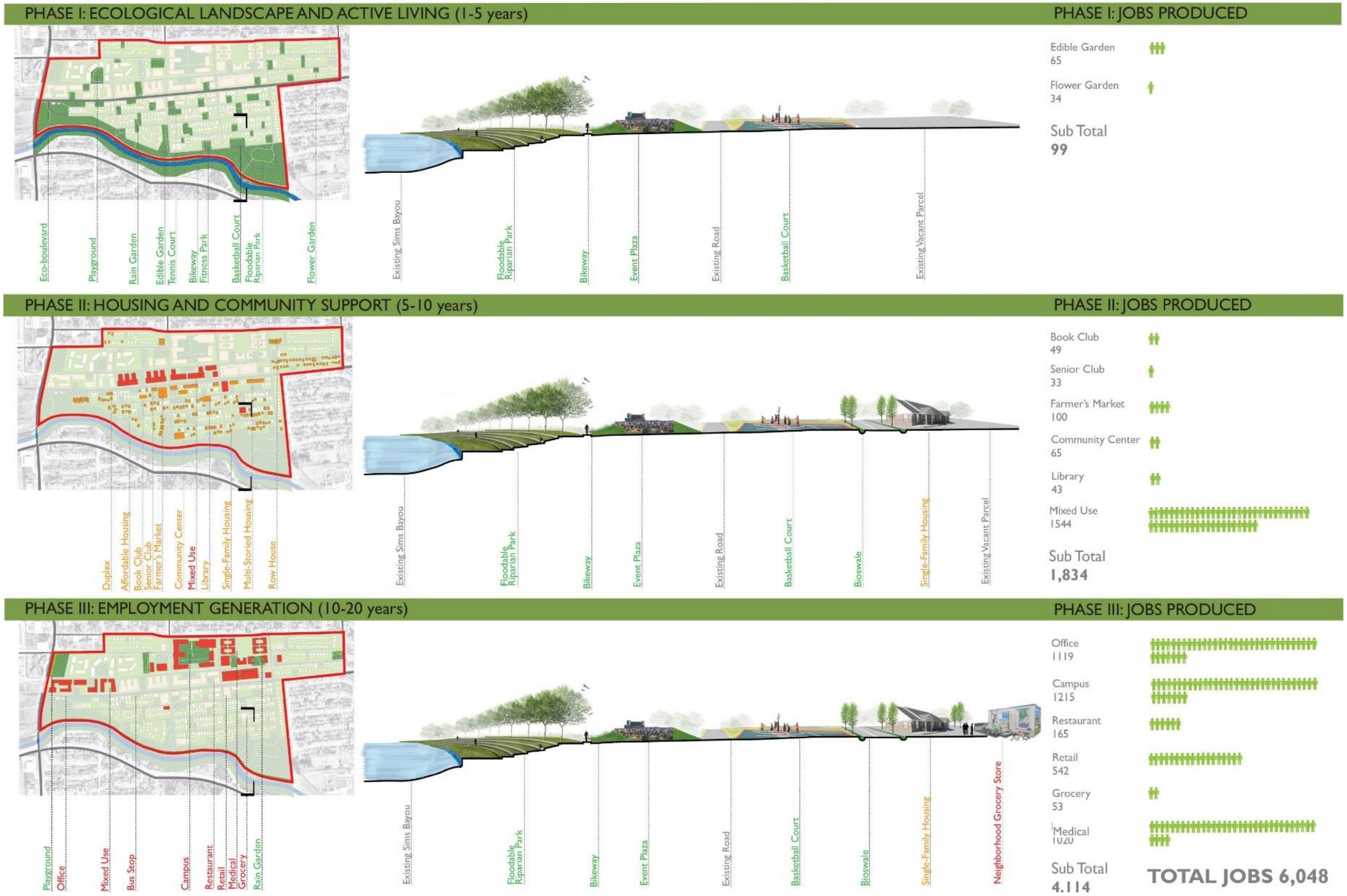

Figure 25: Phasing strategies for Master Plan implementation.

CHAPTER IV

RESULTS

4.1 Design Impact Analysis

A majority of the existing VLAS will be regenerated as both spatial and GI functions, after the design is implemented. By calculating the area of the proposed land use in each phase, the design impact of the master plan is examined (See Appendix 4). As Figure 26 shows, the existing 50% of the underutilized space will reduce to 6%, leaving some flex space for future development. The green space will increase from 9% to 26%, while increasing percentage of pervious surface for absorbing stormwater. The developed area will increase from 33% to 58% to provide the basic amenities to the residents.

In order to quantify the stormwater runoff retained from the GI, following variables have been used by the guide of Center for Neighborhood Technology (2010):

- Average annual precipitaton data (in inches) for the site,
- Square footage of the green infrastructure feature, and
- Percentage of precipitaton that the feature can retain.

The following equation calculates the amount of runoff reduced with the use of two conversion factors. The 144 sq inches/square foot (SF) that converts the precipitation over a given area into cubic inches. Another is the factor of 0.00433 gal/ cubic inch (i.e. the number of gallons per cubic inch) that converts that volume of precipitation into gallons, which is needed to quantify the amount of runoff reduced.

Total runoff reduction (gal) =

*[annual precipitation (inches) * GI area (SF) * % retained] **

*144 sq inches/SF * 0.00433 gal/cubic inch.*

By using Houston's data of 49.7-inch rainfall per year and 50% retention rate of stormwater, the site projects to infiltrate up to 35 million gallons of water per year. In addition, the GI network contributes to reduced grey infrastructure needs, reduced water treatment needs, increased groundwater recharge, improved water quality, and reduced flooding.

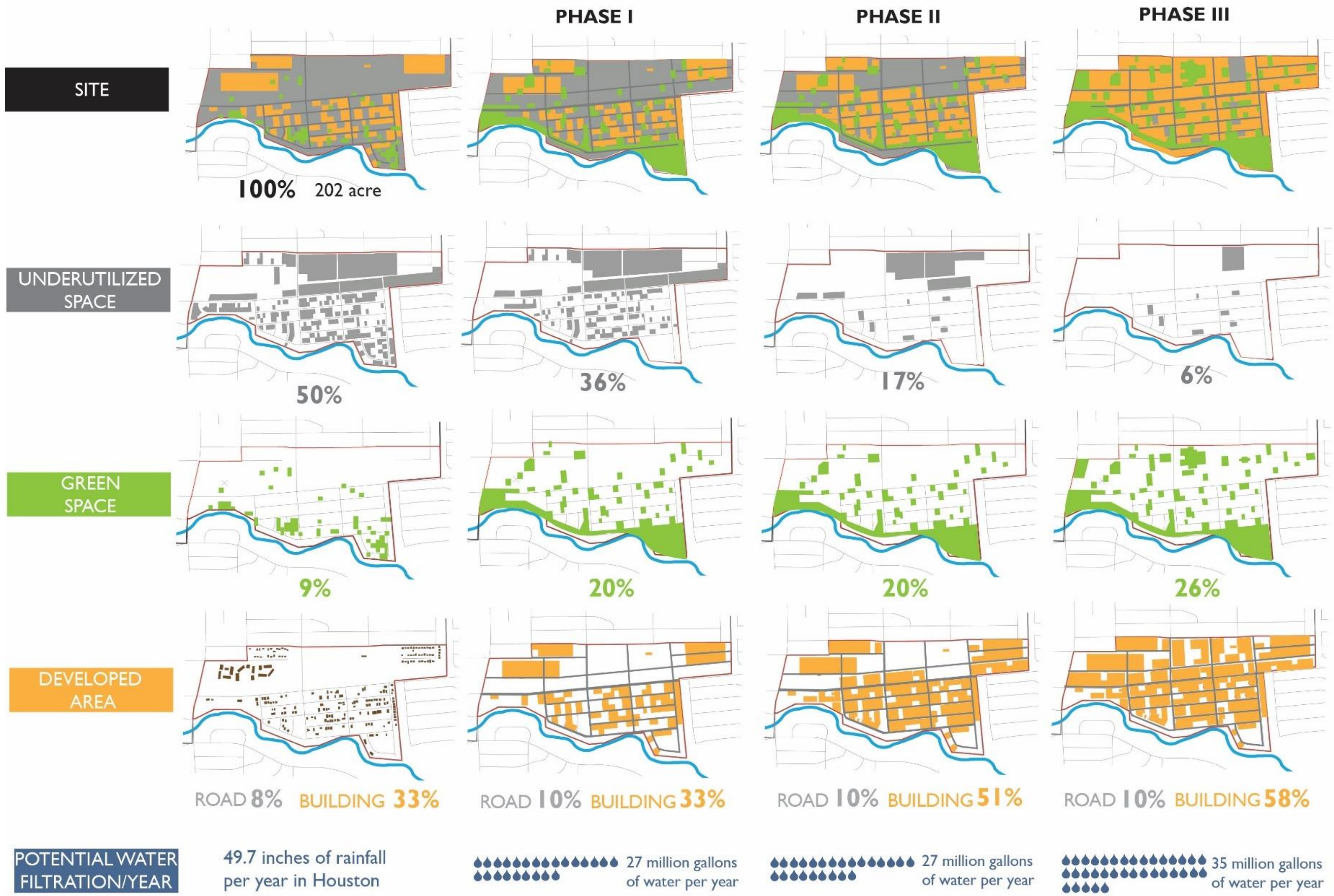

Figure 26: Design impact analysis for the proposed Master Plan.

CHAPTER V

CONCLUSIONS

Vacant lands and abandoned structures present themselves an excellent opportunity to capitalize on the full benefits of investing in the revitalization of a neighborhood as well as increase resilience among hazard vulnerable population. The potential that vacant parcels hold for uses such as affordable housing, community gardens, parks, schools, small businesses, etc. is endless. Developing on a VLAS can improve the community economy, health, environment, and culture while benefitting the property owner and surrounding neighbors. Keeping Green Infrastructure as the encompassing design framework for redeveloping VLAS also opens up the potential funding opportunities from Federal and State governments. While the process for developing VLAS is not simple, the community building process that occurs from a desire to build on these lots is part of the benefits.

This design-research study should be considered as a starting point to redevelop VLAS in a systematic way. As a whole, this study gained an understanding of the toolbox to transform VLAS with the combination of community planning and landscape architecture process. Future steps can be taken in order to make improvements to the toolbox, adjust the master plan and phasing strategies, and drill down to the funding options to implement the design.

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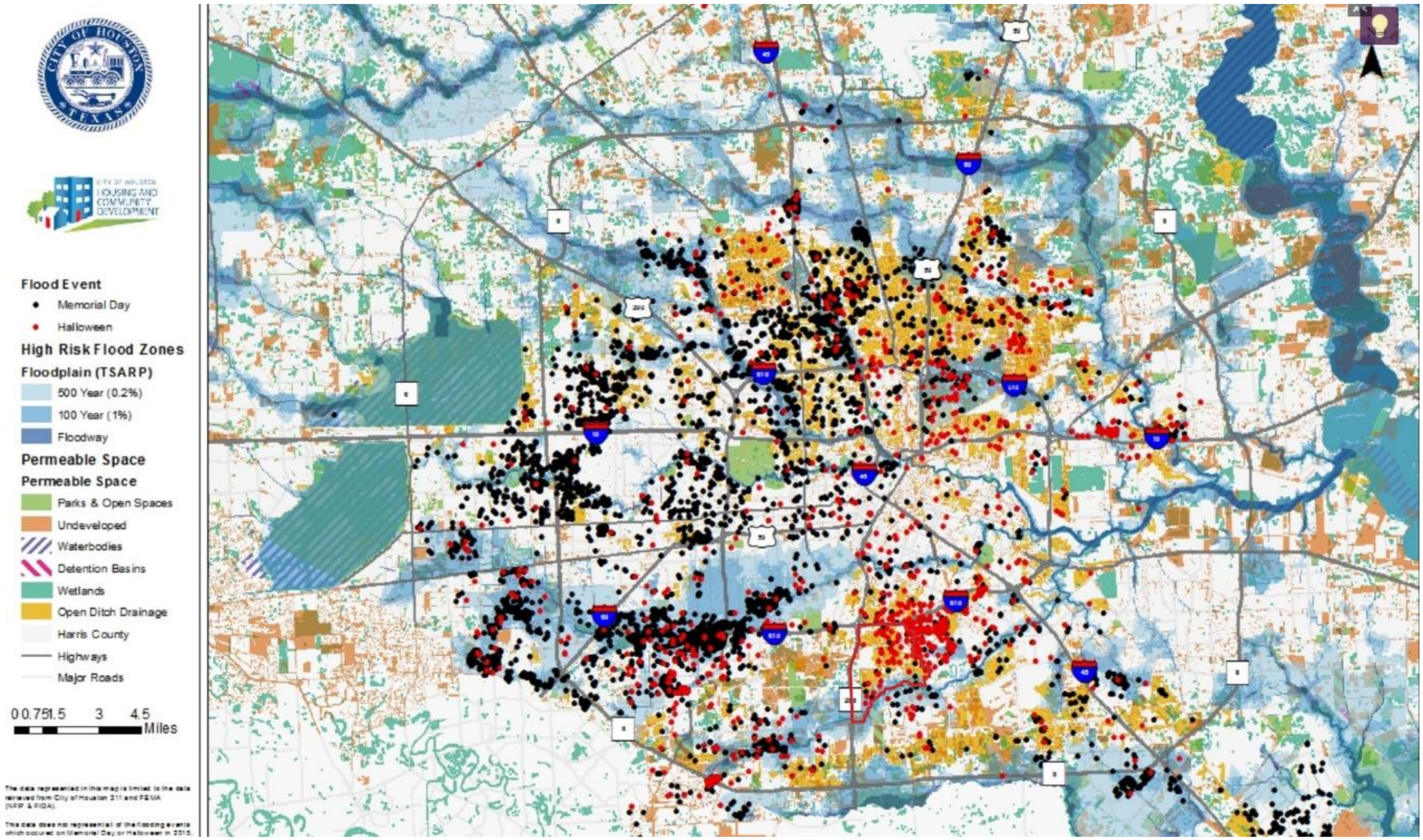
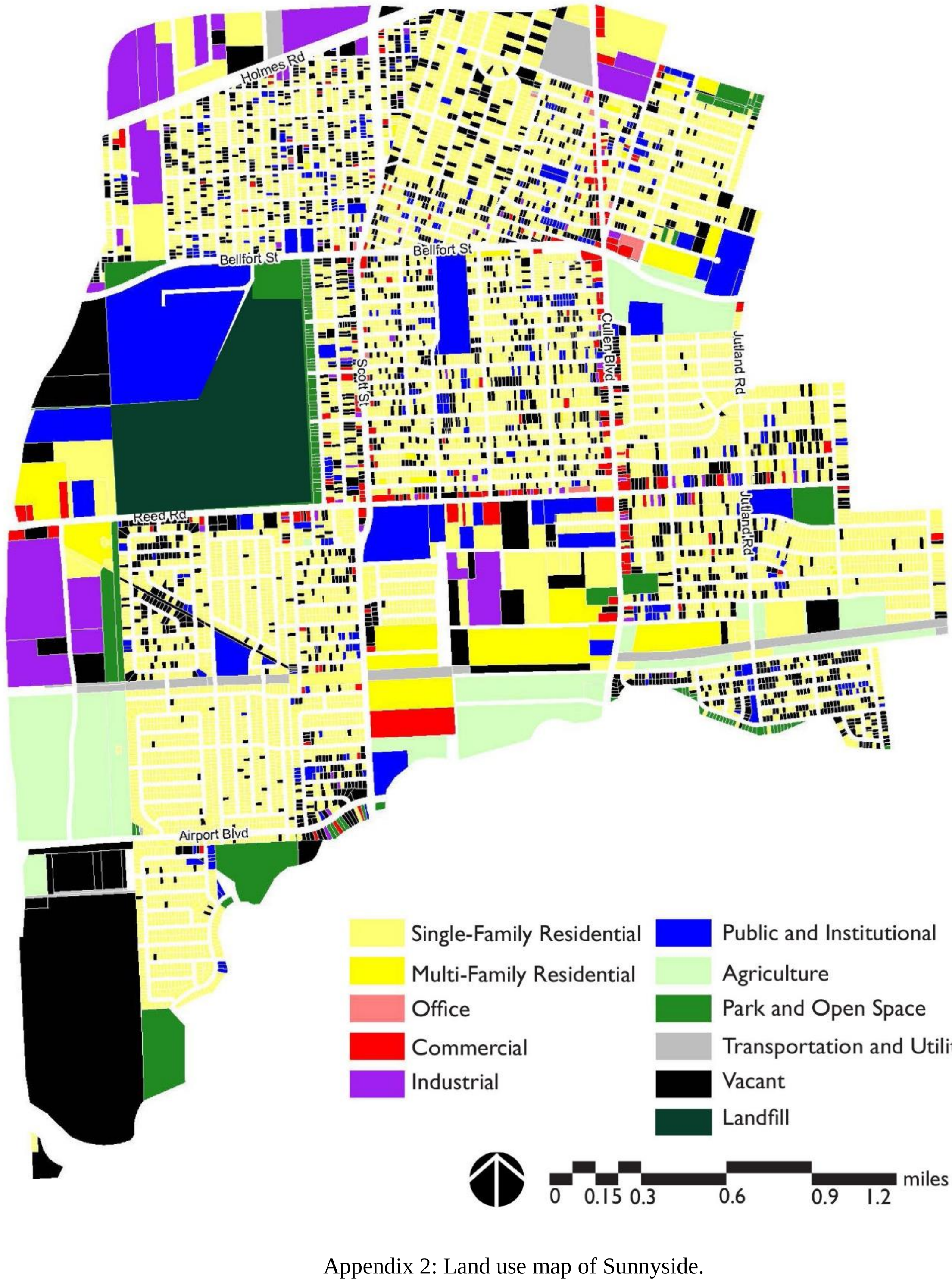
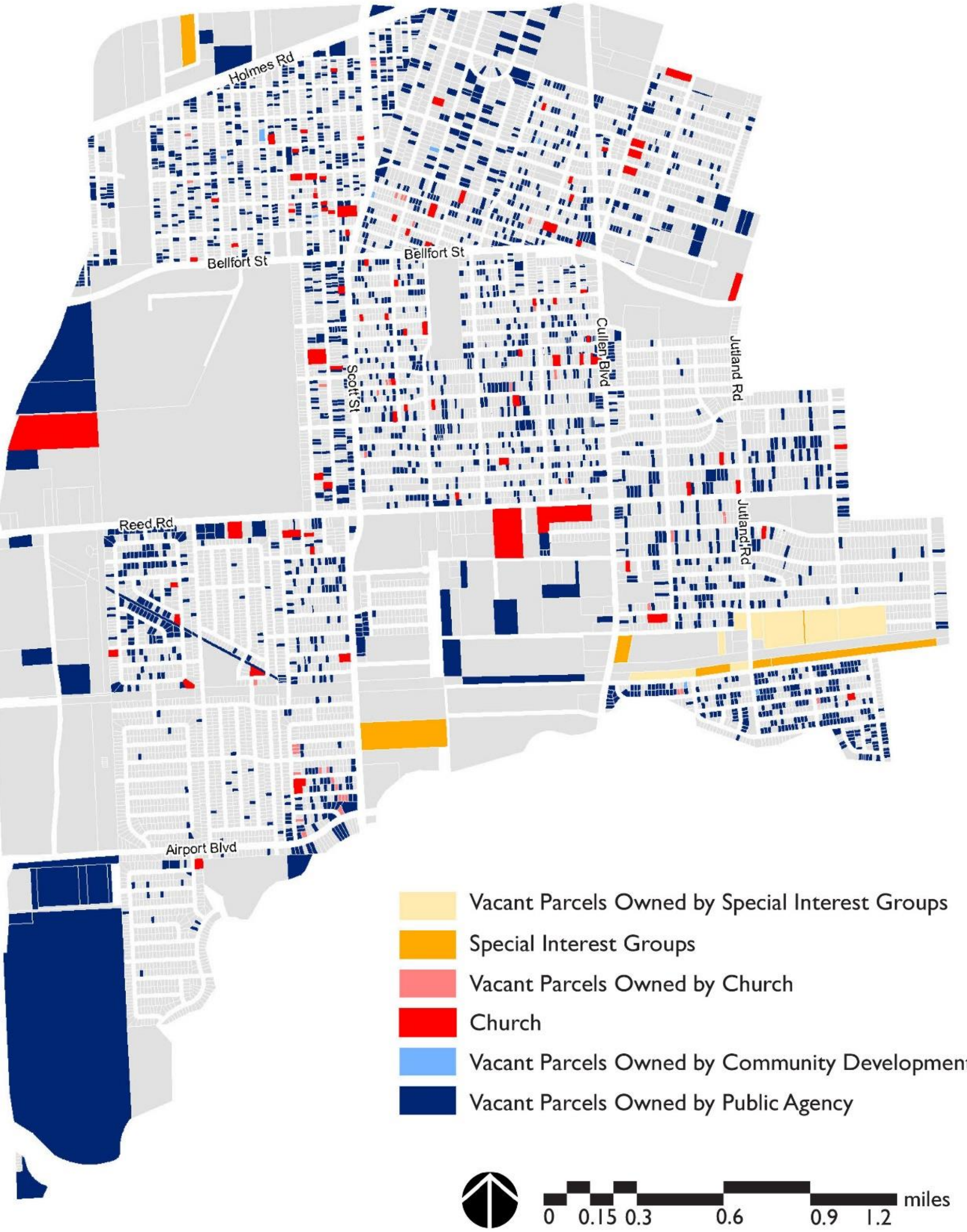
APPENDIX



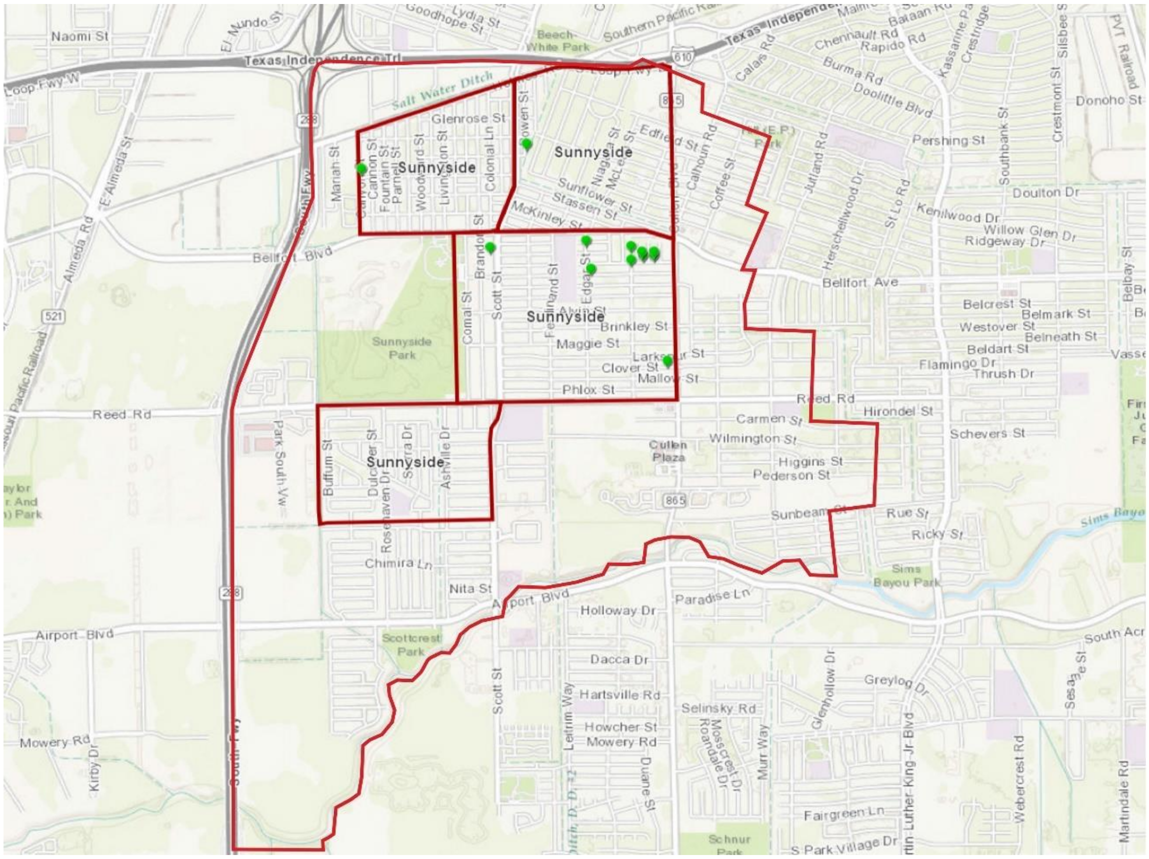
Appendix 1: Flooding event map of Memorial Day and Halloween Day flooding in 2016, City of Houston.
Map source: City of Houston. (2016). Draft Houston action plan for disaster recovery – 2015 flood events.



Appendix 2: Land use map of Sunnyside.
Map source: Ethan Harwell.



Appendix 3: Ownership map of vacant parcels in Sunnyside.
Map source: Ethan Harwell.



Appendix 4: LARA lots in Sunnyside, Houston.
Map source: City of Houston Land Assemblage Redevelopment Authority (LARA). (2017).

Land Use	Land Area (acre)	Percentage of area
Single Family	73.656	36.46
Higher Density Single Family	24.924	12.34
Neighborhood Office	5.87016	2.91
Neighborhood Commerical	6.44304	3.19
Neighborhood Mixed Use	11.68824	5.79
Private Institutional	20.72784	10.26
Public Institutional	3.9804	1.97
Parks/Open Space	51.8	25.64
Eco-Boulevard and Road	3.11	1.54
TOTAL		**100**

Appendix 5: Calculation of percentage of land use by area.