Recycling Houston

Song-Ya Huang

Bringing synergy between improving water safety, reducing energy consumption and reinforcing living quality in suburban

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Song-Ya Huang, 4317645
songyahuang@gmail.com

Delft University of Technology
Master of Architecture, Urbanism and Building sciences
Urbanism track
Delta Interventions

Mentor: H. Meyer, N. Tillie

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Acknowledgements

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For the data and field research, I would like to thank my friend, Emmanuel Oni, and the professionals from Texas A&M University and Rice University for their valuable knowledge and data. In this project, the studies from The Congress for the New Urbanism (CNU) are very precious reference for me, especially "Sprawl Repair Manual" from Ms. Galina Tachieva.

Special thanks go to my families for their support during my whole study; my boyfriend, Dennis, who always encourages me in my difficult moments; Sarah, MJ, Yuli, Xiao, Orsi, and all dear friends from Urbanism and Delta Interventions Studio, who I had wonderful time with and learned a lot from.


ARRIVE ON TIME
AND UNDER BUDGET.
OUTFRONT/

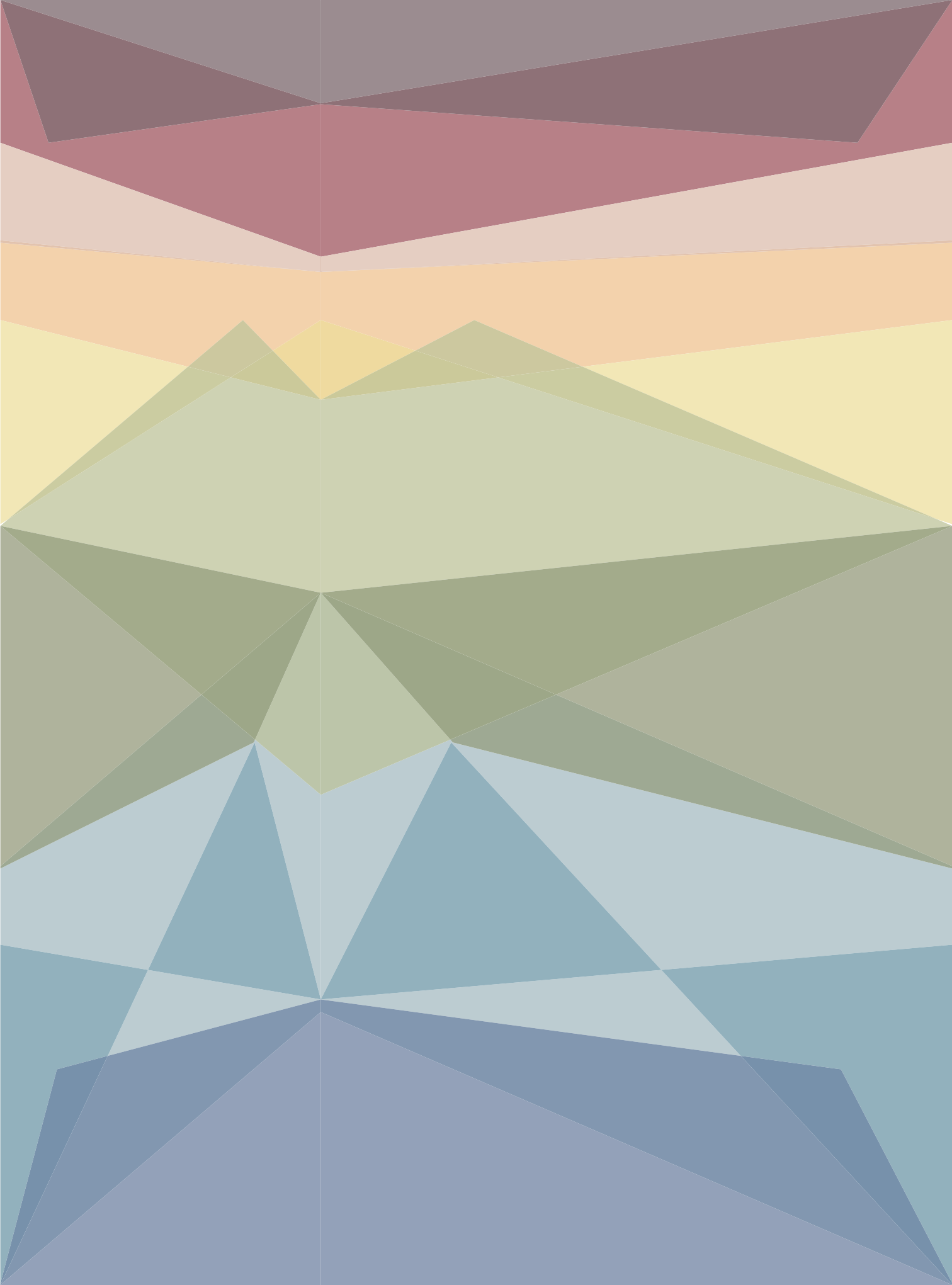

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Photo credit:
Alex Maclean

Chapter 1 Houston Context

Typical suburban

Very rich neighborhood

Very poor neighborhood

Downtown

Motivation

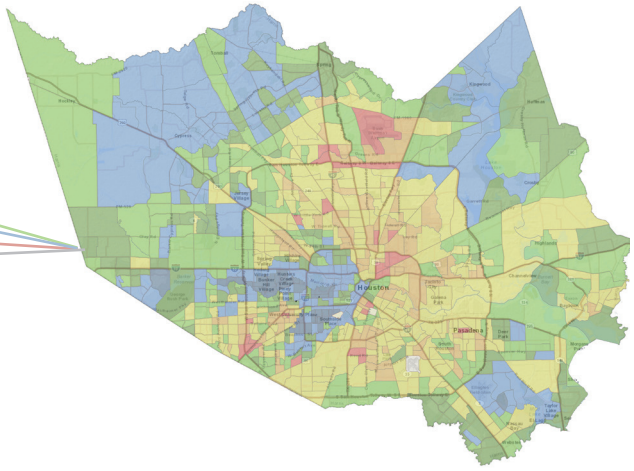
A friend, Emmanuel Oni, who was born and lived in Houston for 25 years, and living in New York currently, once told me his perception of Houston. " Basically, there are four types in Houston. They are **downtown**, the high-rise cluster, **very rich neighborhood**, **very poor neighborhood**, and the majority is the rest, typically **suburban**. I must, but really don't like to drive in Houston, especially after living in New York. Even when I'm very close to the place I'm going, it's hard to orientate myself. Most of the suburban looks almost the same. Everywhere is similar house with lawn and highway in the background." Emmanuel pointed out some very interesting urban phenomenon: the extreme mono-centric economic structure, the segregation of the social-economical classes, the fast-developed suburban that need to reinforce the identities, and the highly automobile dependence.

Growing up in the dense Asian country (Taiwan), the life in suburban is very unfamiliar, interesting and questionable for me. Why the big private open space (lawn) is needed, why don't use the parks? Isn't it very inconvenient and expansive to use the car to everywhere, even grocery? Without the public transportation, how can the kids go out before they can drive a car? But currently, the data from U.S. census bureau shows in last year: someone moved to Houston from elsewhere in the U.S. every 9.5 minutes.

Which means the suburban living style attractions are much more than disadvantages. And I'm curious to discover and experience these kinds of suburban living qualities.

The suburban life style has it's advantage but also results many issues for Houston. The energy consumption is a significant one. Texas flourishes because of the oil production and is also the biggest energy consumer in the U.S. The oil highly affected urban structure of Houston. The urgent question nowadays is how the city can be transformed in this post-oil era? Climate change, which is interconnected with energy use, is also a threat for Houston. Flooding is a worry for Houstonians for over 100 years, but it gets more serious in the recent decades.

In this project, I want to focus on the research for the three major issues of Houston: energy consumption, water safety and living qualities. And I will try to bring up some suggestions for **How Houston urban structure can be transformed in this post-oil era** by integrating the three aspects: energy, water and living qualities, especially in the suburban.



Houston context / Historical perspective: The City Based on Oil

Foundation of Houston: Railroad, oil and ship channel

Houston was established by the Allen brothers at the confluence of Buffalo and White Oak Bayous in 1836. At first, it was just 147 swampy acres in the middle of nowhere. In 1850s, because of its location, Houston became the railroad hub to transport inland products, cotton majorly, to the port of Galveston and Beaumont. Railroad networks grew bigger onwards. In 1890s, Houston was already the railroad center of Texas. After the huge storm in 1900, which destroyed almost entire Galveston including the port, Houston ship channel was constructed and took over the shipping business from Galveston. At the same period, oil was discovered in 1901. Railroad, oil and ship channel became three major factors influencing urban development in Houston.

Railroad network was the backbone of urban growth in Houston. In the 1940s, automobiles started to become the major transportation. Most of highways were built alongside railroads, and they reinforced the developments rapidly. The size of Houston grew into double in this period. Urban pattern in Houston is basically following the "Jefferson Grid", especially in the early development. (see the Houston wards map from 1920, p.12) Since oil was discovered and ship channel was constructed, energy (oil) and exports are engines drive the economy in Houston until today.

1836

The Allen brothers founded a new city at the confluence of Buffalo and White Oak Bayous.

1900s

The city grow to approximately 9 square miles and had a population of 44,000.

- 1901 Discovered oil

1910s

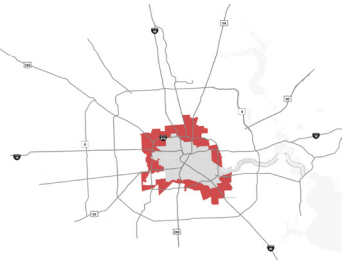
The population expanded beyond the central core, the city annexed area along the ship channel for controlling navigation and wharfage.

- 1914 Ship channel constructed

1940s

The city expanded double of it's size and reached nearly 600,000 population.

- 1942 Ship industry and medical center established (because of WWII)
- 1948 First highway was constructed (reaching Galveston)



Bottom
The maps show the urban growth of Houston. Infrastructure lines are the current situation, only used to indicated the location (source: City of Houston, Planning & Development Department)

Energy shapes the economy, environment and society

The report, 2015 Houston Employment Forecast, published that the region now ranks as the top U.S. export gateway, overshadowing New York, Los Angeles, Seattle and Detroit. A study by the Brookings Institution found that the number of export-supported jobs likely exceeds 400,000 today. The U.S. Bureau of Economic Analysis estimates that mining (in Houston, almost entirely oil and gas extraction) and energy industry (chemicals, refining, oil field equipment manufacturing, fabricated metal products, pipelines and engineering) accounted for $186.6 billion, or 38.1 percent of Houston's GDP, in 2013.

While Houston grows strongly in the economic perspective, oil also influences other sides of Houston significantly. Job opportunities and relatively low living cost continuously attracts huge population not only inside U.S. but also oversea. Fast expansion (almost without limits from geographic features) overwhelms nature environment. The cheap oil price also affects the human behaviors on transport. This kind of sprawl urban form and the high car-usage shape Houston as a high automobile dependence city today.

1950s

By the end of the decade, Houston was 350 square miles with nearly 1 million residents.

- 1956 Lake Houston is created to supply fresh water

1960s

Several important annexations took place in the 1960s, such as expansion of Lake Houston and international airport

- 1961 NASA established

1980s

Throughout the 80s, annexation was considerably more limited than it had been in the past. But still, the city's population had grown to 1.6 million residents

- 1974 Oil crisis

2000s

Despite slower growth in size, the city's population continues to grow. In 2012, more than 2.1 million people called Houston home.

- 1999 Texas law governing annexations changed and general purpose annexation became more difficult.

Houston context / Societal perspective: The Most Sprawling, Least Dense, Most Automobile Dependent Major City in America

Wards of Houston:
legal entities in the past, cultural entities today

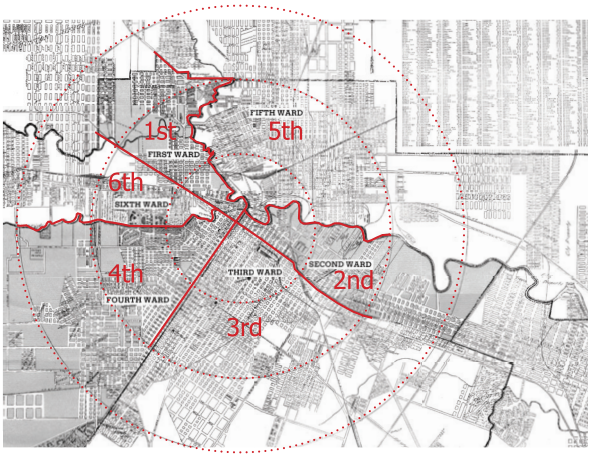
When the city of Houston was founded in 1836 and incorporated in 1837, its founders—John Kirby Allen and Augustus Chapman Allen—divided it into political geographic districts called "wards." The ward system, a precursor to today's City Council districts, was a common political tool of the early 19th century, and is still used in some American cities. Historically the wards reflected geographic boundaries, without consideration of the population density within the wards. Betty Chapman, a historian, said "They really were mixed societies in the early days. Where you worked dictated where you lived, not who you wanted to live around."(City Savvy Online, 2008)

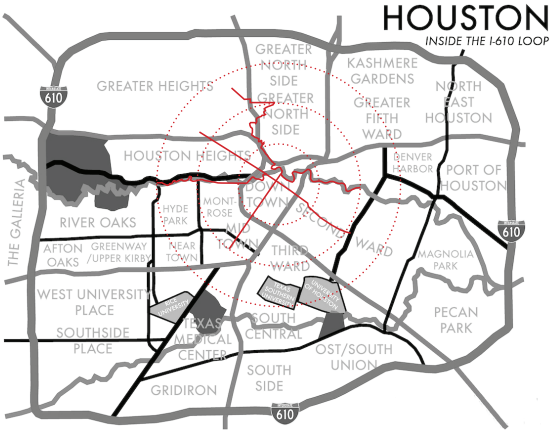
The City of Houston abolished the ward system in the early 1900s. While the wards no longer exist legally, area residents still identify certain communities, especially that have been a part of the city since incorporation, as being "wards" of the city. The ward identification appears on signage and in casual conversation from Houstonians. Will Howard, an assistant manager of the Texas and local history department of the Houston Public Library, said during that year "They are cultural entities today, not legal entities, and like any culture, they are almost obligated to change." (Houston Chronicle, 2004)

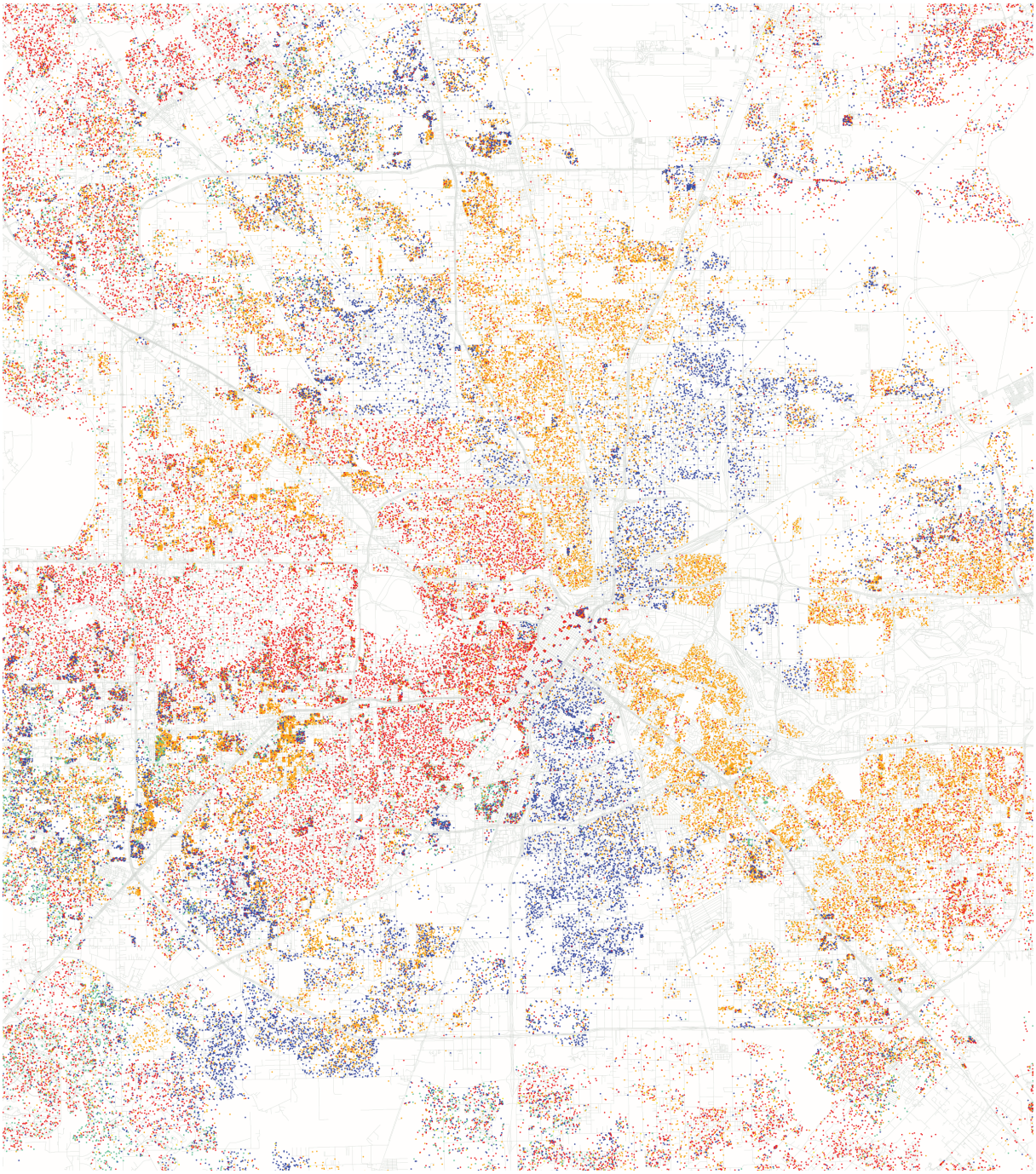
Todays, the wards become a more obvious division in the societal aspects. If we compare to the racial/ethnic distribution map on the next page, it can be seen that each wards has their majority groups.

Left
Street map of the City of Houston, 1920 (source: Texas Map & Blue Printing Company)

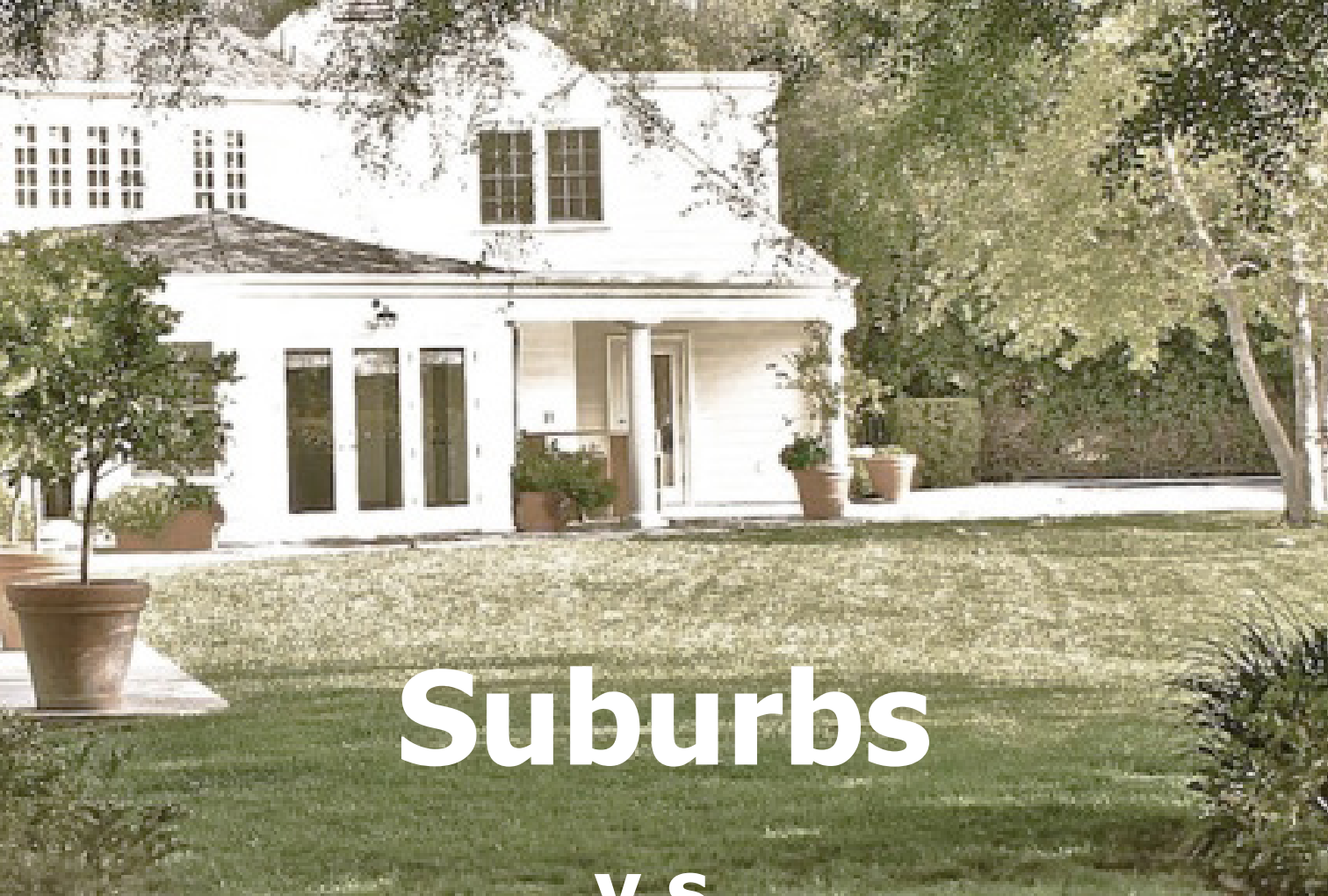
Right
Current neighborhoods in Houston (source: Urbane, www.mapurbane.com)







Map of racial/ethnic distribution in the city of Houston, 2010 census. Each dot represents 25 people. Red dots represent White people, orange dots represent Hispanic people, blue dots represent Black people, green dots represent Asian people, and gray dots represent other people (source: Data from Census 2010. Base map © OpenStreetMap, CC-BY-SA)



Suburbs

v.s.

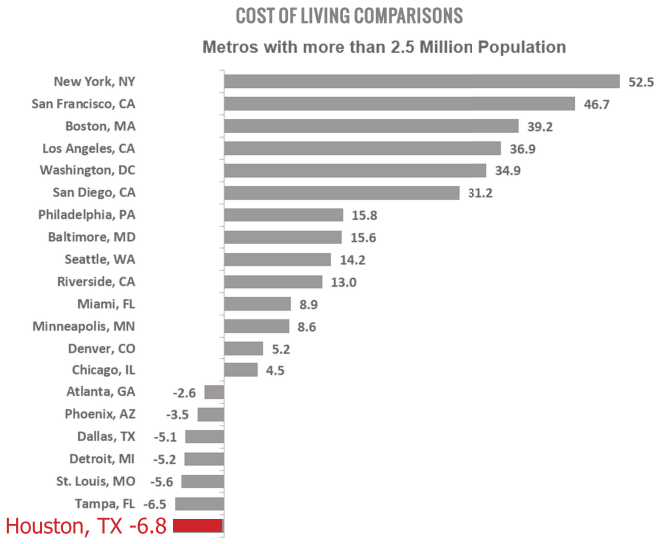
Urban

Expanding city: attractions of living in Houston

The Houston-The Woodlands-Sugar Land Metropolitan Statistical Area (MSA) added more residents last year than any other U.S. metro area. That's according to the U.S. Census Bureau's recently released estimates. The New York-Newark-Jersey City metro area ranked second in population growth while the Dallas-Fort Worth-Arlington metro ranked third. Someone moved to the region from overseas every 20.6 minutes, while someone moved to Houston from elsewhere in the U.S. every 9.5 minutes. (U.S. Census Bureau, 2013)

In U.S., New York and Los Angeles represent the two opposite sides of living style. Some people enjoy living in dense mixed-functions urban areas with convenient public transport systems. Other people like to own a bigger house with nice yard for kids to play in. For the people who are attracted by Houston, here is some main factors. The flourishing economy provides job opportunities. Although comparing to the income in New York, the salaries are lower. But if people also consider the living cost, they can actually save more money and afford to buy their own houses in Houston.

While population keeps pouring into Houston, the city also shows the warming welcome to the people. Comparing to other suburban area, such as Los Angeles, Houston has relatively loose regulations in urban development, especially in previous decades. Highways support the suburban to grow further. The suburban does have it's living qualities, but also results serious urban issues for Houston.



Top
Source: Council for Community and Economic Research, Cost of Living Index, Second Quarter 2013

Bottom left
Suburban in Houston (Source: https://www.flickr.com/photos/nelsonminar/5343099039/)

Bottom right
Downtown and suburban (Source: http://3.bp.blogspot.com/)

Houston context / Geographic perspective: The Bayou City

Where the city was born: Buffalo bayou

Houston was established by the Allen brothers at the confluence of Buffalo and White Oak Bayous in 1836. The Bayous provides the transportation in the early years. People's life was highly related with the water in that period. After the port of Galveston was destroyed by the storm in 1901, people decided to protect the exports by moving into the edge of Galveston bay. Houston ship channel was constructed and opened in 1914. It locates at the month of Buffalo and White Oak bayous. Industries started to occupy the waterfront onwards. Today, the water is more disconnected with the urban fabric, especially near the ship channel.

Left
Source: Map of Galveston Bay, Houston, and vicinity (c. 1900), from the 10th edition of Encyclopædia Britannica.

Right
Houston, 1891 (Source: Perry-Castañeda Library Map Collection)

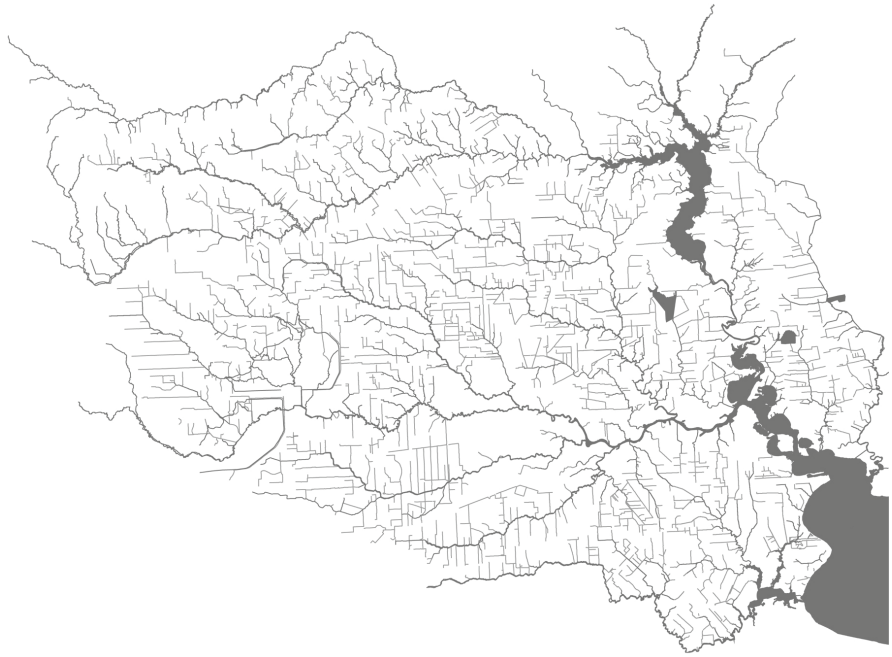
Flat plain and water system

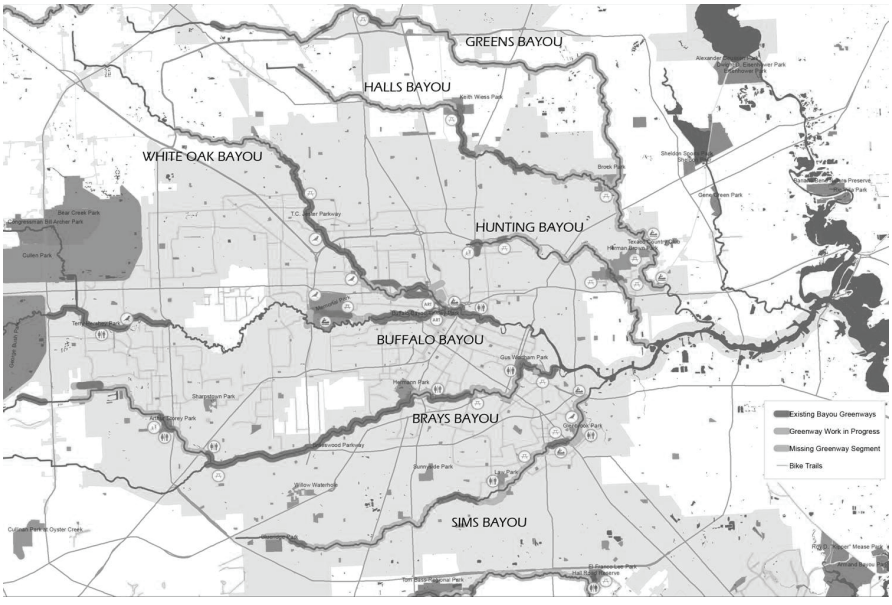
Houston is located on a flat plain with intertwining bayous. There are 2047 km of natural water system. The flat plain and heavy rain result another man-made city networked with 2285 km of drainage ditches and channels. Because of the small height different, the water are mainly very shallow and slow. The fresh water supply is supported by the lakes locating on the upper stream of Galveston watershed.

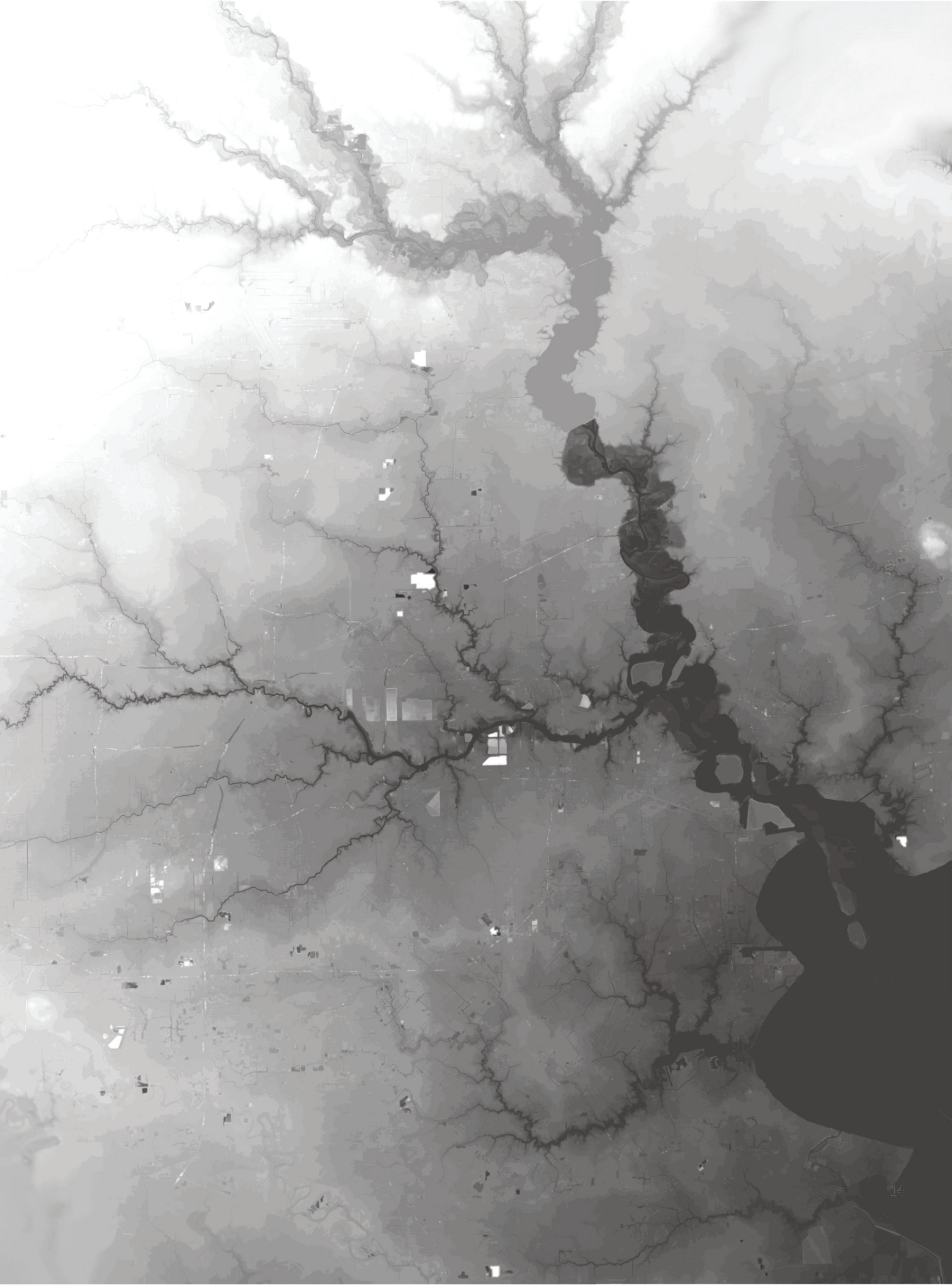
Right
Galveston water shed height map (Source: GIS datafrom Texas A&M)

Left top
Natural and man-made drainage system in Harris County (source: Susan Rogers, Super Houston)

Left bottom
Bayous in City of Houston (Source: Houston Park Board)





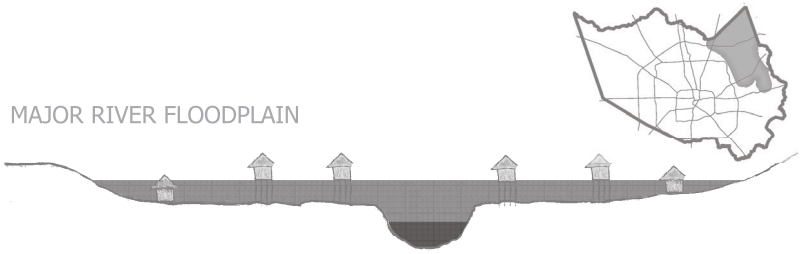


Living with water: flood risk

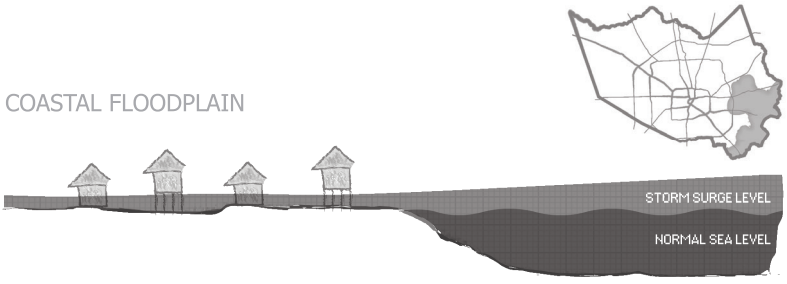
Life of houstonians are highly effected by water. Because of the geographic features, almost every properties are facing the flooding risks. According to the locations, there are several types of floodplains.

Floodplain types in Harris County (Source: Harris County Flood Control District, 2015)

It's a specific area at the east-north side. The floodplain is large, deep and swift. The flood conditions may last a week or more.

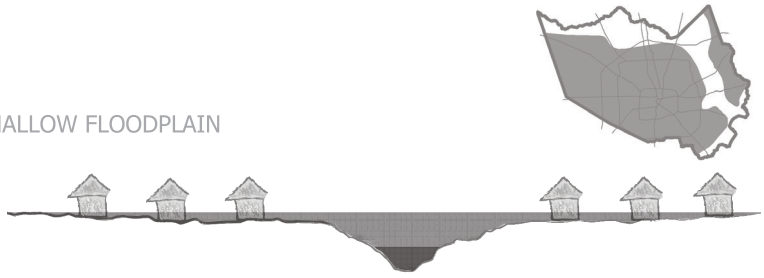


Coastal flooding happens when unusually high tides or hurricane surge occurs. It can flood low-lying structures.



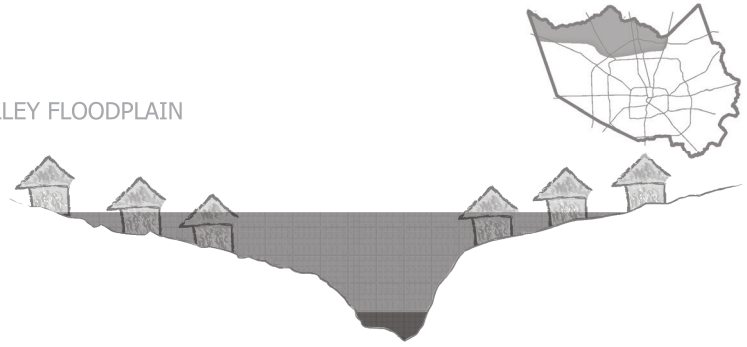
Shallow floodplain: It exist throughout much of the county and affect thousands of residences and business. When the channel capacity is exceeded, flooding begins, but lasts hours, rather than days.

SHALLOW FLOODPLAIN



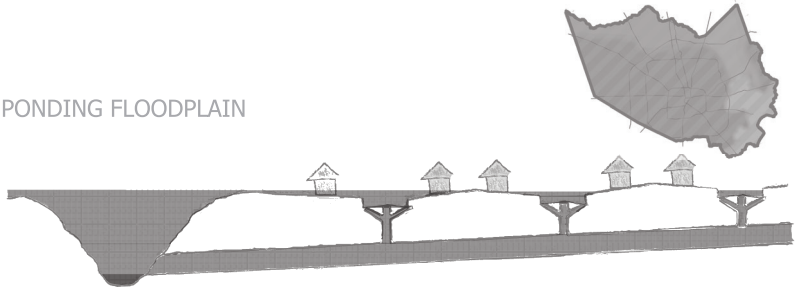
Valley floodplain: It's generally located in the northwestern portion of the county. Flooding can be very deep and extends for a few days.

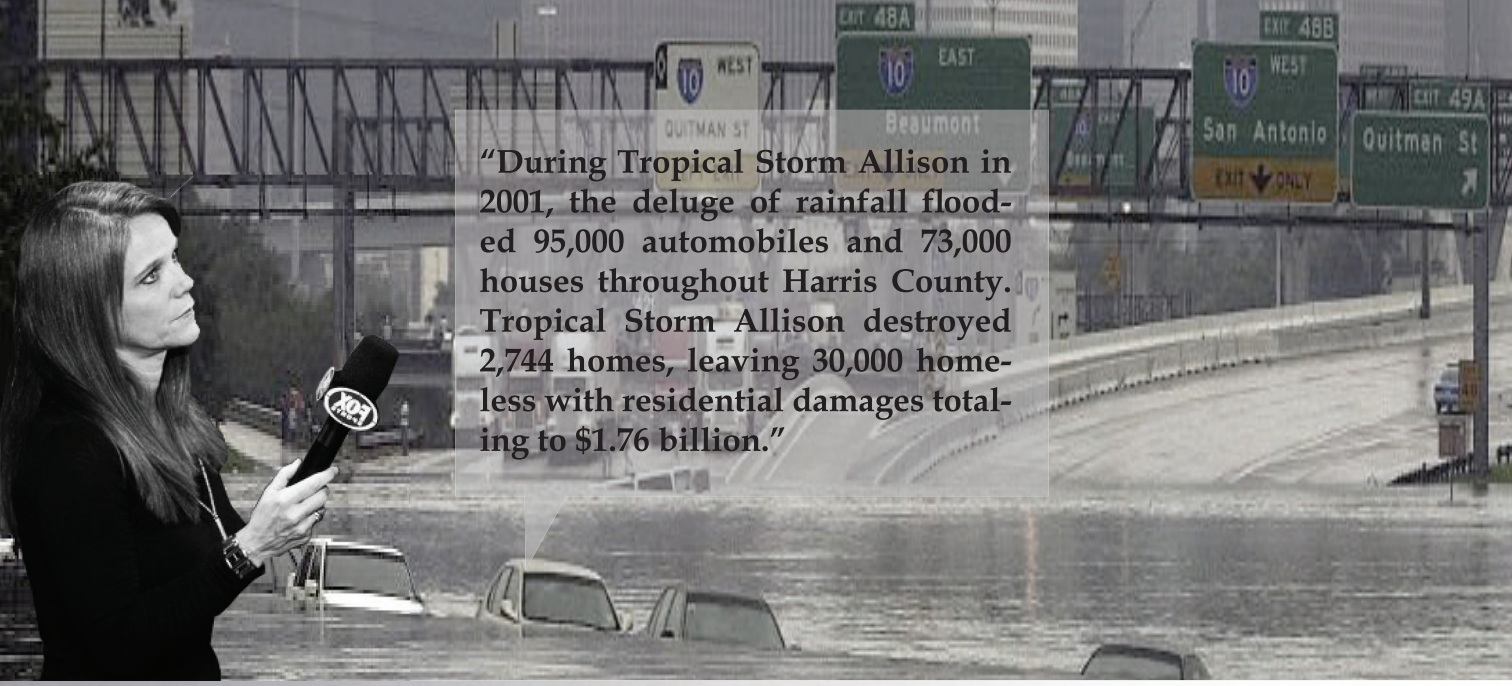
VALLEY FLOODPLAIN



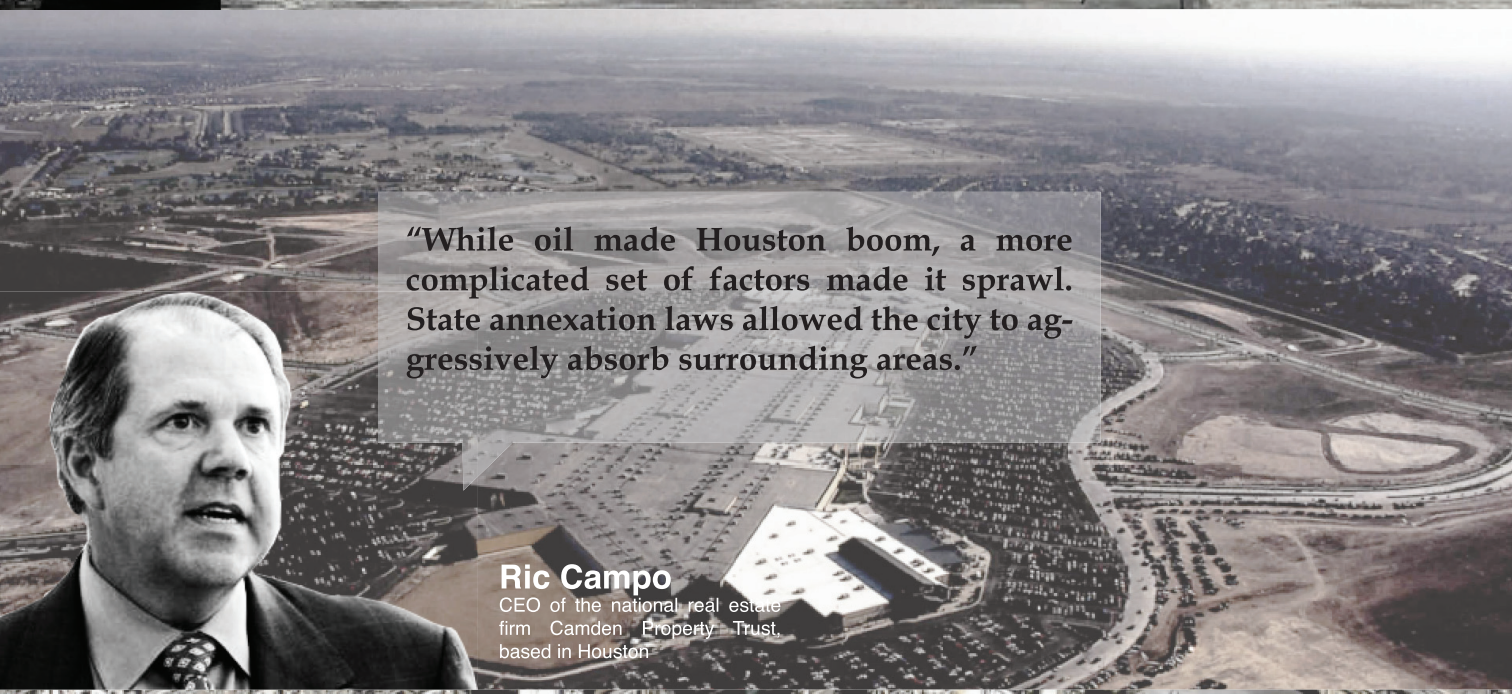
Ponding floodplain: This type of flooding doesn't restricted to any one area of the county. When intense local rainfall exceeds storm sewer or roadside ditch capacity, the water can pond in streets deep enough to flood residences that are not even near a creek or bayou.

PONDING FLOODPLAIN



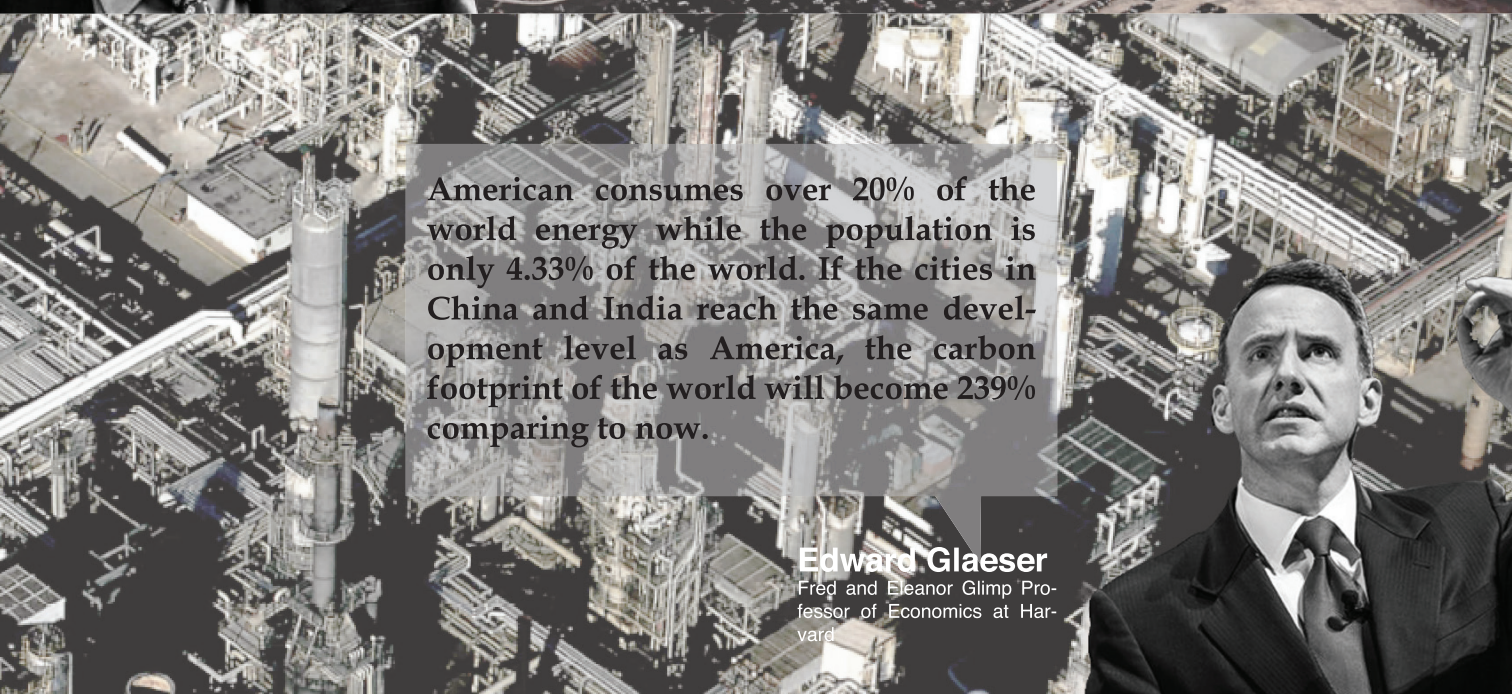


"During Tropical Storm Allison in 2001, the deluge of rainfall flooded 95,000 automobiles and 73,000 houses throughout Harris County. Tropical Storm Allison destroyed 2,744 homes, leaving 30,000 homeless with residential damages totaling to $1.76 billion."



"While oil made Houston boom, a more complicated set of factors made it sprawl. State annexation laws allowed the city to aggressively absorb surrounding areas."

Ric Campo
CEO of the national real estate firm Camden Property Trust, based in Houston



American consumes over 20% of the world energy while the population is only 4.33% of the world. If the cities in China and India reach the same development level as America, the carbon footprint of the world will become 239% comparing to now.

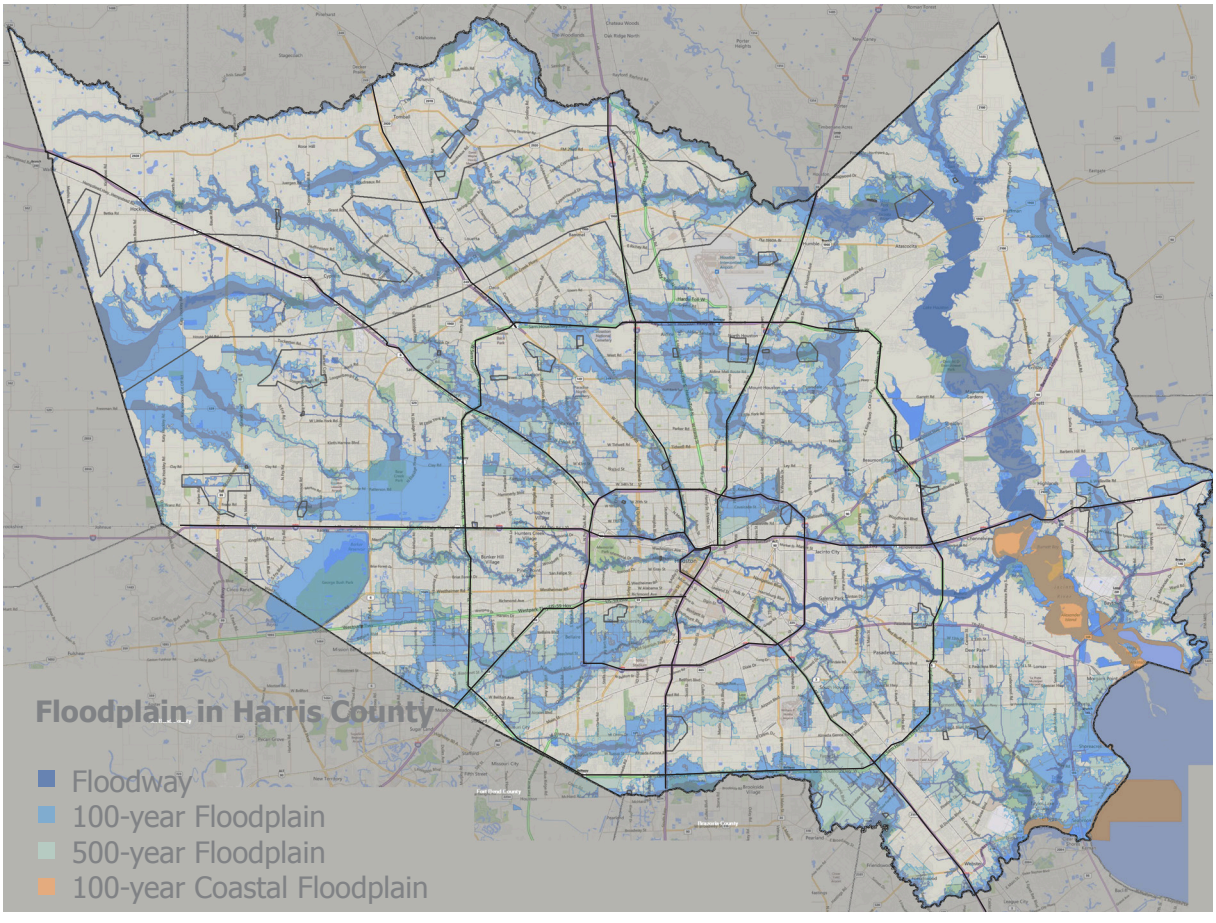
Edward Glaeser
Fred and Eleanor Glimp Professor of Economics at Harvard

Chapter 2 Three challenges

Challenge /
Flooding with heavy rainfall

Flat plain and heavy rainfall result the city with 4332 km of drainage ditches, channels, and bayous, but they are still not efficient to protect the city from flooding. During Tropical Storm Allison in 2001, the deluge of rainfall flooded 95,000 automobiles and 73,000 houses throughout Harris County. Tropical Storm Allison destroyed 2,744 homes, leaving 30,000 homeless with residential damages totaling to $1.76 billion. (National Hurricane Center, 2001)

Floodplain in Harris County
(Source: http://mycity.maps.arcgis.com/)

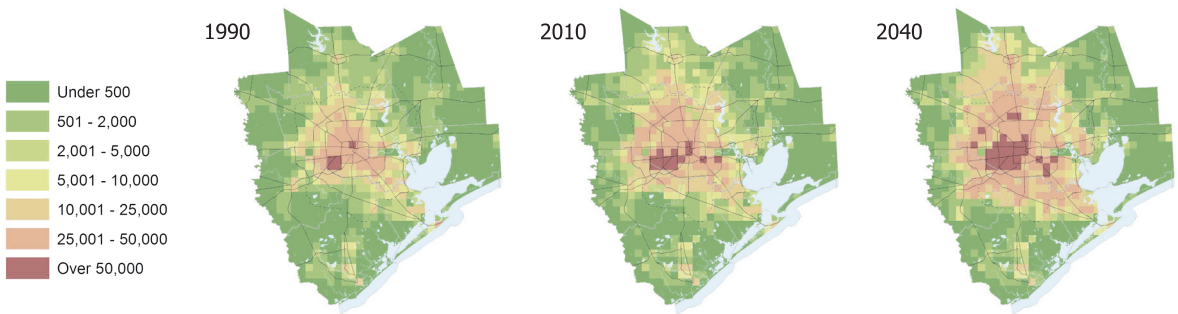


Challenge / Rapid population growth & urban sprawl

"While oil made Houston boom, a more complicated set of factors made it sprawl. State annexation laws allowed the city to aggressively absorb surrounding areas… Meanwhile, it's always been cheaper for developers to build horizontally than vertically, and because Houston faces few physical impediments such as rivers, lakes or mountains…there isn't any physical reason stopping them. "It's all about land availability and cost…." says Ric Campo, CEO of the national real estate firm Camden Property Trust, based in Houston. "(Governing, 2013)

Sprawl is central to the wasteful use of water, energy, land, and time spent in traffic. Sprawl has been linked to increased air and water pollution, greenhouse gas emissions, loss of open space and natural habitat, and the exponential increase in new infrastructure costs. Social problems related to the lack of diversity have been attributed to sprawl, and health problems such as obesity to its auto-dependence.

Historically, Houston has been viewed as "the most sprawling, least dense, most automobile-dependent major city in America." But an annual survey in 2014 from University's Kinder Institute for Urban Research pointed out in that half the residents of Harris County, of which Houston is part, would prefer to live in an area with a mix of development, including homes, shops and restaurants as opposed to a single-family residential area. Not only people having the wills and also government is trying to move toward denser and more livable urban life by proposing an endless list of plans and policies. But still, Houston is looking for a stronger solution and vision to "go urban".

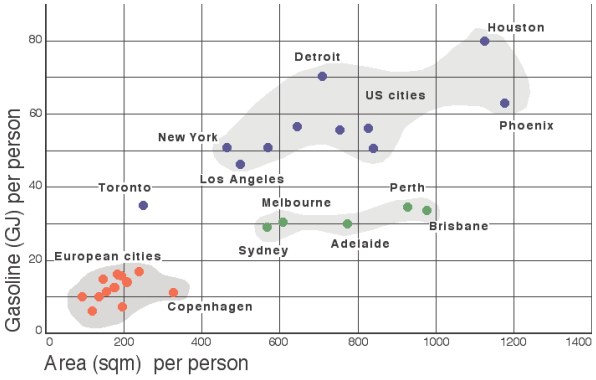


2040 population growth and urban sprawl prediction (Source: United States Census Bureau, 2014)

Challenge /
High energy-consumption

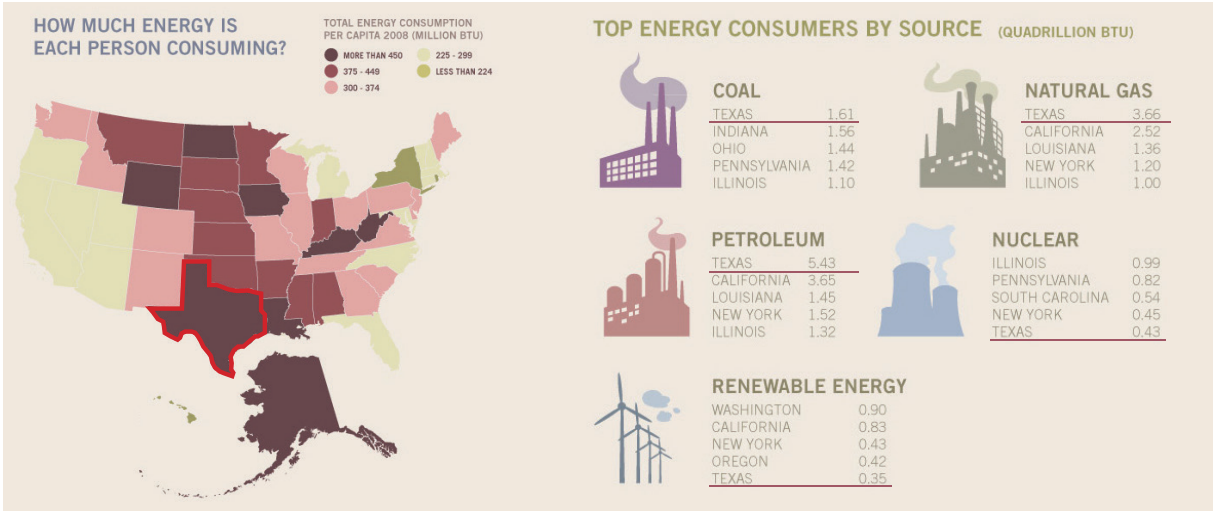
American consumes over 20% of the world energy while the population is only 4.33% of the world. Texas is the biggest energy consumer in the total energy use, and also has highest energy consumption rate per person. Cooling /heating system and transportation are the two main factors of personal consumption, which strongly depend on the coal, natural gas and petroleum, the non-renewable resources.

In Houston, People are used to drive 2-3 hours everyday to work (also because of the traffic jams). The data from Census Bureau's 2012 American Community Survey shows that 77% of the people drive alone to work everyday, 10% carpool, and only 2% use public transportation.



Top
Source: Newman and Kenworthy, 1989, Gasoline consumption and cities: a comparison of US cities with a global survey

Bottom
Statistic evidence of high energy-consumption in Texas (Source: http://magazine.good.is/)



Interrelations between three challenges

"The relative intensity of land use in the ten US cities is clearly correlated with gasoline use overall and in the inner and outer areas. The strongest relationship is with the population density in the inner area… These patterns suggest that urban structure within a city is fundamental to its gasoline consumption" (Newman & Kenworthy, 1989, p.25).

In the midst of the post-World War II building boom, researchers and government agencies started noticing the stormwater impact of rapid, sprawling development. Surveys in the late 1950s found that suburban development practices and patterns led to more frequent and serve flooding than regulations had anticipated. (Aurbach 2010; Rome 2001)

Scientific evidences have proved energy consumption and flooding are highly related to the sprawling urban pattern. Theoretically, if the sprawling pattern is repaired, the energy consumption and flooding issues can be improved. Hence, the intention of this project is to research how to repair sprawl by intensifying suburban area while improving energy consumption and flooding risk. The theoretical framework in next chapter will review the theories and methodologies according to the three themes: reduce automobile dependency, sprawl repair, and stormwater management, in order to develop integrated strategies to improve the three challenges in the intensification process.

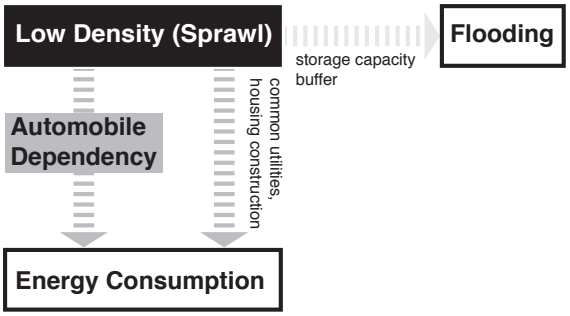


image credit:
unknown artist from
Kashmere Garden
community center

Chapter 3 Theoretical framework

Overview

Why intensification

Urban intensification is seen as a way to deliver sustainable development. It has been suggested that denser communities have the potential to support walking, cycling and public transport, lessoning the reliance on the car (Banister et al., 1997). Denser development within the city boundaries also saves greenfield land from development (Breheny, 1996). Intensification is also proffered to have social and economic benefits: goods and services are more equitably distributed (Elkin, 1991), infrastructure costs are lowered (Newman, 1992) and there is the possibility for increased vibrancy, vitality and social interaction on the streets (Katz et al., 1994).

Review themes

The intention of this project is to research the suitable strategies for Houston suburban intensification, while also consider the solutions for improving energy consumption and flooding risk during the transformation process. Following theories and methodologies are reviewed according to these three themes: reduce automobile dependency, sprawl repair, and stormwater management. The review will further discuss the difficulties of integrations between compact development and stormwater water management within current American context, which lead to the challenges and research focus of this project.

Review structure

- Reconstructing an automobile dependent city

- Sprawl repair - Defining repair target
  - Regional scale: sector mapping
  - Community scale
  - Block scale

- U.S. stormwater management

- Conflicts between compact development and stormwater management

- Project challenge and further research focus:
  Develop integrated strategies between intensification and stormwater management within different process and scale (regional strategies, community intervention, spatial principles & toolbox)

Reconstructing an automobile dependent city

"The relative intensity of land use in the ten US cities is clearly correlated with gasoline use overall and in the inner and outer areas. The strongest relationship is with the population density in the inner area… These patterns suggest that urban structure within a city is fundamental to its gasoline consumption" (Newman & Kenworthy, 1989, p.25).

Reducing automobile dependence in order to address issues of viability and sustainability is one of the top priorities when discussing urban development of Houston. Car dependence and large ecological footprints as well as the loss of many urban qualities including walkability, viable public transport, jobs access, and other urban amenities have been tied together. Now, obesity levels, stress levels and children's mental health development have been linked to automobile dependence (Newman & Kenworthy1989: Gee and Takeuchi 2004; Hillman 1997).

Top
Ped Sheds for Different Scale Center: The Local Center is defined by its 10- minute Ped Shed and the Regional Center by its 30-minute radius (Source: Newman & Kenworthy, 2006)

Ped shed:
Urban center viability & size of population/ jobs

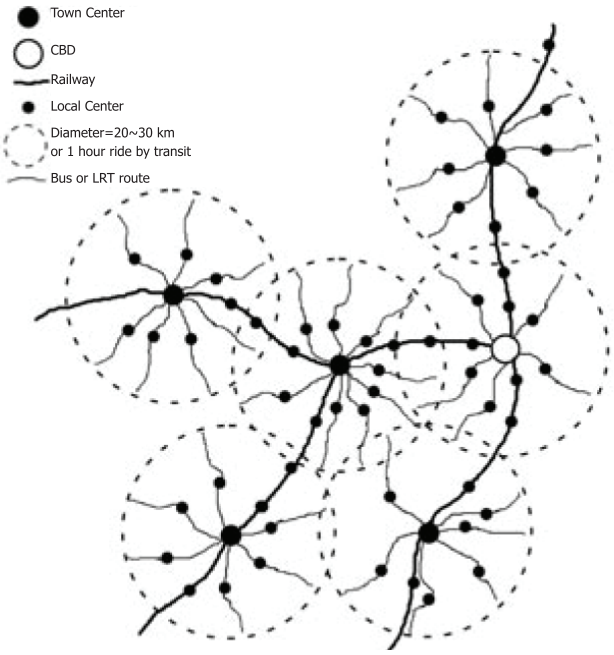
Time constraints mean that people will arrange their location and their mode of travel accordingly. In particular for an urban center, it becomes whether the time available for car travel is less than the time it would take to access the urban center using a bike, walking, or riding public transit. This element can be assessed using the Ped Shed model to create circles of activity for 10 minutes of walking or 30 minutes of walking. Ten minutes is the accepted time people will take to get to public transport or to a local amenity. Thirty minutes covers the whole travel-time budget for those walking to urban services, and particularly jobs, within the Ped Shed. Thus two types of centers can be examined using this technique. The Local Center is essentially a Transit-Oriented Development with sufficient intensity of activity to make it an effective and viable transit center, supported by local services that bring people there as part of its multiple urban functions. The Town Center (Regional Center or Sub Center) is a place providing viable services for a region within a city.

Long-term data from cities around the world appear to show that there is a fundamental threshold of urban intensity (residents and jobs) of around 35 per hectare where automobile dependence is significantly reduced. Which means there is a threshold of approximately 10,000 residents plus jobs within this 10-minute walking area. The range would be from about 8,000 to 19,000, with jobs and residents being interchangeable for transport demand. This suggests the approximate minimum base of people that appears to be necessary for a reasonable Local Center – and a public transport service to support it (Newman & Kenworthy 2006). If a 30-minute Ped Shed for a Town Center is used, then the range again is from around 70,000 to 175,000 people and jobs. This number could be the basis of a viable Town Center based on standard servicing levels. Any less than this means services in such a center become impractical.

Intensification model: Amenity, density and transport

If amenity is high then density can be easily created. If amenity is low, density generally is hard to provide. However, there is a chicken and egg issue, as amenity often is not provided without a minimum of density to support it. Urban amenity is enhanced if there is sufficient intensity of urban activity. If some urban amenities are provided first, they can attract increased urban development. Density creates amenities, but also amenities attract density. This is particularly obvious when the amenities are associated with a public transport node. (Newman & Kenworthy, 2006)

An urban rail node can provide faster access and quieter urban environments than a bus node. Rail nodes attract large pedestrian flows. The attractions for people and jobs are thus vastly increased around urban rail centers (Newman 2001; Dittmar and Ohland 2004). For automobile dependence to be overcome, Ped Sheds with an urban rail node will have the potential for much higher densities. If only a bus node is provided, medium densities need to be designed across the Ped Shed. Transit cities are 20 to 30 kilometers in diameter. It is best to try to create a series of these with a rail and bus service that feeds into a Town Center. Along the lines feeding in to the Town Center would be a number of Local Centers. The whole city would be made up of transit cities joined together and linked by a fast rail service. Most people in the city could then live within the framework of local services in the Local Center. Main services, including work, would be located in the Town Center. This theory recently has been applied to the development of the Metropolitan Plan for the Sydney Region (www.dinpr.nsw.gov.au).



Top
A Conceptual Plan for Reconstructing an Automobile City (Source: Newman & Kenworthy, 2006)

Suburban intensification target / Suburbs typologies in America

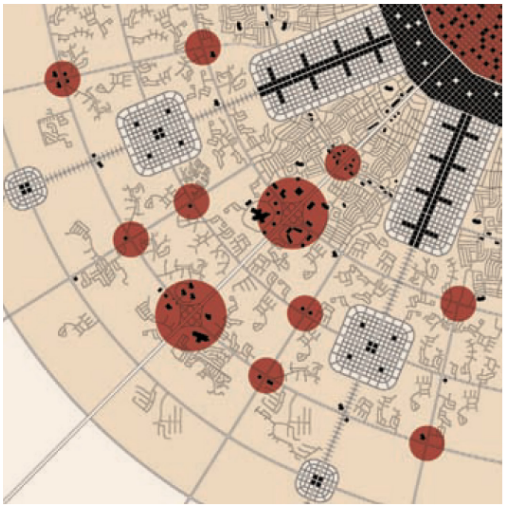
Clarify intensification target

To identify the proper targets for repair, it is essential to understand the form and structure of sprawl in the American built environment. Sprawl can take place in intensely urban areas, but most is found in suburban areas. There are three generations of suburbia that vary in form as related to urbanity and walkability: prewar suburbs, post-war suburbs, and the late 20th-century exurbs. While the pre-war suburbs are often complete communities, the latter two types abandoned the pedestrian-centered neighborhood structure in favor of auto-centric dispersion.

Project focus : post-war suburbs

The second generation of suburbs was single-use, low-density development spurred by new incentives from the federal mortgage system and the increase in automotive infrastructure and use. The second-generation suburbs began to develop in the 1920s, but flourished after the end of World War II, when, under the auspices of national defense, the federal government created the interstate highway system, the largest infrastructure project the country had ever seen. Ironically, the main achievements of this monumental effort were to facilitate personal mobility and undermine the fundamental walkability of American urbanism.

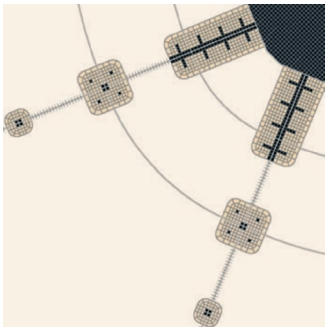
This project chose to focus on this type of suburbs in Houston base on several reasons. In Houston, the inner city within Loop 610 is mostly cover by this suburbs typology. Due to the fast expansion and social-economic status of residents, basic common facilities (such as sewer system, parks and traffic infrastructure) ad private properties weren't well constructed or maintained in some districts. These districts lost the population gradually and led to decay. This phenomenon brought out a serious metropolitan consequence: increasing development in the outer periphery while decreasing population in the inner core. (see p.51 "Houston population change" for further information)

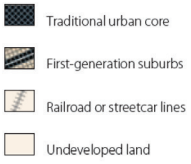


Contents and drawings of this section (p.29-33) are cited from, "Sprawl repair manual", Tachieva, 2010

Generation1:
Prewar suburbs

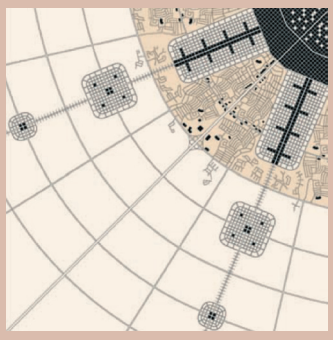
- In the U.S., the first suburbs sprang up in the nineteenth century along the newly built railroad lines
- Compact, middle-class communities assembled around stations (were modeled after the suburbs built in England in the eighteenth century)





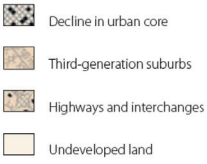
Generation2:
Post-war suburbs

- Started in the 1920s, but flourished after the end of World War II
- Single-use, low-density development spurred by new incentives from the federal mortgage system and the increase in automotive infrastructure and use.



Generation3:
Late 20th-century exurbs

- flourished from the 1980s through the early 2000s
- highly competitive and in good physical shape, due to owners' associations
- reachable only by automobile



Maps
Existing sprawl patterns in Houston
Source: Google earth

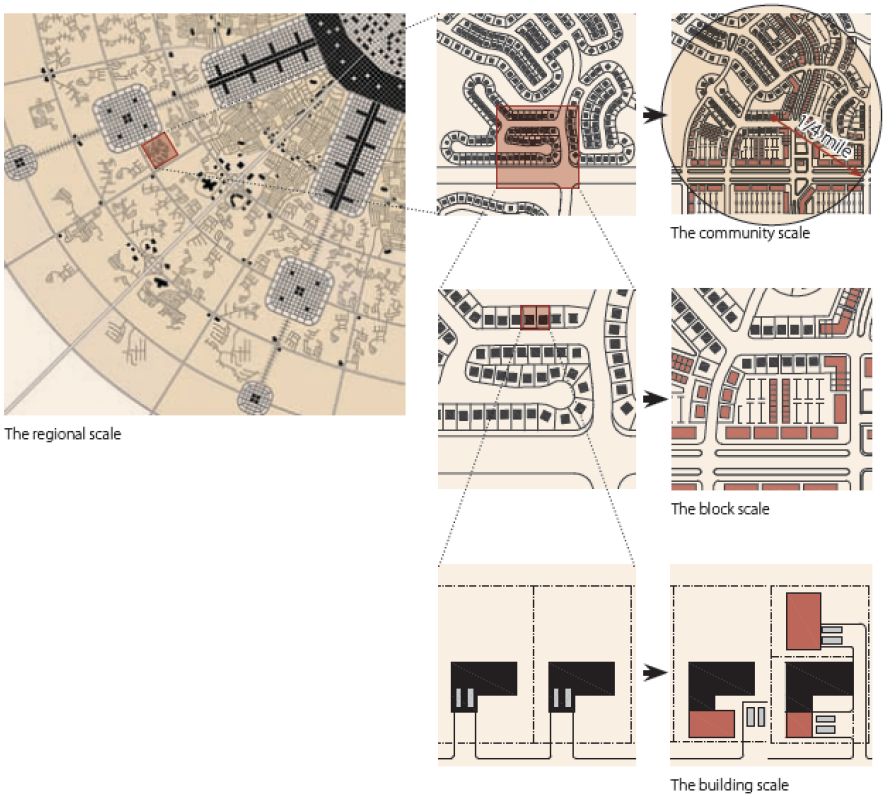
Suburban intensification: Sprawl repair

Tactic of sprawl repair

The primary tactic of sprawl repair is to insert needed elements – buildings, density, public space, additional connections – to complete and diversify the mono-cultural agglomerations of sprawl. By systematically modifying the reparable areas (turning subdivisions into walkable neighborhoods) and leaving to devolution those that are irreparable (abandonment or conversion to park, agricultural, or natural land), sprawl can be reorganized into complete communities.

Sprawl repair: regional, community and block scale

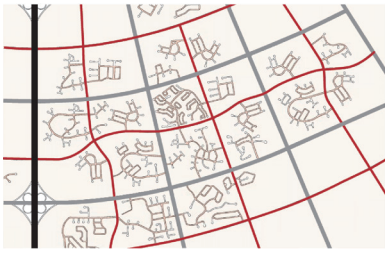
Sprawl repair should be designed at all urban scales, including repair of a regional domain, transforming sprawl elements at the community scale, and reconfiguration of conventional suburban blocks and the reuse, expansion, and adaptation of single structures.



Regional scale: sector mapping

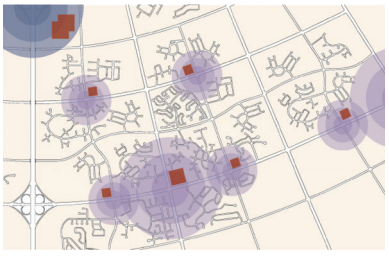
The design method at the regional scale includes several steps that produce a document mapping the structure of sprawl repair. The steps determine the physical boundaries of the regional domain, delineate the areas to be preserved and reserved, prioritize the salvageable commercial and employment nodes, determine the potential transit and infrastructure networks, identify the sprawl repair targets, and, after the transfer of development rights, assemble the final sector map.

Step 1:
Determine sprawl repair domains



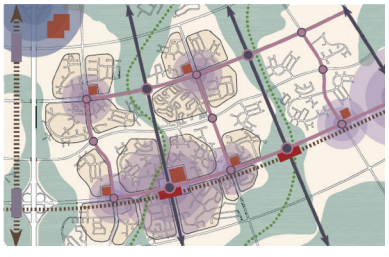
Step 2:
Delineate preservation and reservation area

Step 3:
Prioritize commercial and employment nodes



Step 4:
Identify sprawl repair targets

Step 5:
Assemble sector map



Community scale

Urban design at the community scale concentrates on restructuring sprawl into neighborhoods, transit corridors, and well-balanced districts that have short walking distances to daily needs and provide healthier environments to a multigenerational population. The pedestrian shed discussed previously is a simple but essential tool in the pursuit of order and walkability in auto-oriented suburban environments.

After the pedestrian sheds are determined, the neighborhoods and town centers are shaped using a range of urban design techniques. They include introducing new building types to allow a greater mix of uses, connecting and improving thoroughfares to be more pedestrian friendly, and rationalizing parking to accommodate future urbanization and eliminate underutilized parking.

Defining open and civic space is an essential urban design technique that involves the creation of a hierarchy of well-defined spaces for common use. The integration of local food production is becoming a predominant trend and is recommended for all repair sites, as they can easily accommodate gardens and allotments, even while their urbanism is being redesigned.

The repair at the community scale is closely interrelated with the redesign of suburban thoroughfares. Designed exclusively for cars, with only velocity and capacity in mind, suburban thoroughfares must be repaired into complete streets, meaning they safely and comfortably accommodate pedestrians, bicyclists, public transit, and vehicles.

Block scale

Urban design at the block scale deals with techniques for transforming blocks into smaller urban increments and preparing them to become part of a future pedestrian-friendly urban fabric. Large suburban megablocks are broken down into a finer grain of smaller blocks by introducing new streets and passages, thereby establishing a coherent pattern for further redevelopment.

Community scale principles

- Determine pedestrian sheds
- Introduce new building types to allow a greater mix of uses
- Rationalize parking to accommodate future urbanization
- Involves the creation of a hierarchy of well-defined spaces for common use, ex. local food production
- Repair thoroughfares into complete streets: safely and comfortably accommodate pedestrians, bicyclists, public transit, and vehicles.

U.S. stormwater management

Current U.S. stormwater management

In the midst of the post-World War II building boom, researchers and government agencies started noticing the stormwater impact of rapid, sprawling development (Aurbach 2010; Rome 2001). Surveys in the late 1950s found that suburban development practices and patterns led to more frequent and serve flooding than regulations had anticipated. Impacts like erosion, landslide, and septic tank failure were also troubling.

In 1999, the EPA (United States Environmental Protection Agency) issued regulations for stormwater management for all municipally owned sewed system in the U.S. While the conventional approach to stormwater management emphasized water collection, piping, storage, and discharge, the EPA regulations advocated a more holistic and proactive set of techniques, known as best management practices (BMPs). These combine some or all of the following:

1. Local and regional planning to mange growth and protect ecologically sensitive areas
2. Site design to minimize land disturbance and paved surfaces, and to buffer water bodies with strips of vegetated land
3. Retention of stormwater with facilities such as detention ponds and dry basins
4. Allowing stormwater to percolate into the soil with infiltration faculties such as trenches and permeable or porous pavement
5. Vegetation that absorbs pollutants and assists percolation, used in facilities such as swales, constructed wetlands, and rain gardens

A subset of BMPs is low-impact design (LID) or environmentally sensitive design (ESD). The goal of LID is to emulate the stormwater function that a site had in its natural state, before it was touched by human. LID techniques can include green roofs, cisterns, rain garden, permeable pavement, and swales.

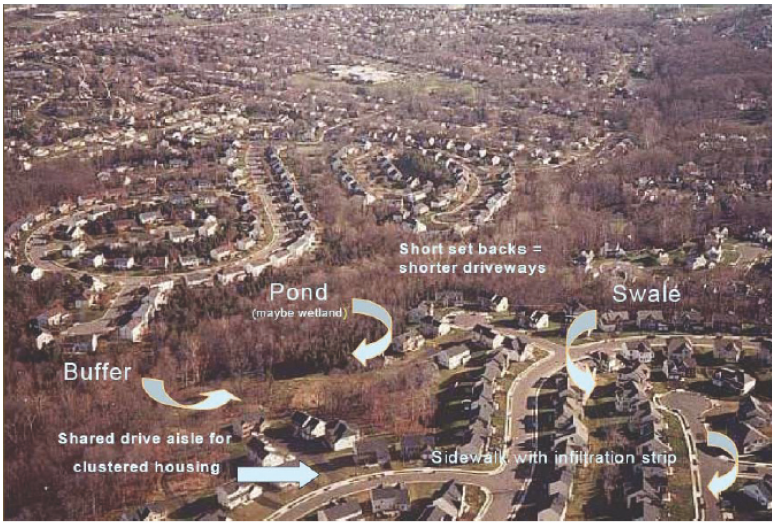
LID techniques are extremely popular in the field of landscape design today. They are usually les costly than conventional practices and often perform better. But the universal and inflexible application of BMPs and LID can have negative consequences on quality of urban places and the health of watersheds. LID purports to encourage smart growth and urban redevelopment, but as a rule this support is nominal. In general practice, LID put urban density at a competitive disadvantage. (Aurbach 2010) One of the critical shortcomings is that many standards and practices of LID involve lot-based, rather than block- or neighborhood-based, solutions; that increases the need for large lots. For instance, despite their environmental benefits, rain gardens located in front of houses increases the front setback significantly. To foster walkable urbanism, houses should be close to the sidewalk. (Low 2010)

The goal of low-impact design (LID) is to emulate the stormwater function that a site had in its natural state, before it was touched by human. LID techniques can include green roofs, cisterns, rain garden, permeable pavement, and swales. It purports to encourage smart growth and urban redevelopment. But in general practice, LID put urban density at a competitive disadvantage.

Conflicts between compact development & stormwater management

We have the technical know-how to create neighborhoods that are both compact and green. But sometimes standards and regulations don't recognize this, particularly stormwater standards. Well-intended stormwater standards and regulations can put compact urban development at a disadvantage. They may have the unintended consequence of promoting sprawl, which hurts watersheds more than compact development.

The best way to reduce stormwater impacts is well-designed urban density in conjunction with regional planning that preserves natural land, Compact, walkable urbanism is by far the best performer. But most stormwater standards and regulations pursue the Green City and disfavor the Compact City. They promote green-yet-low-density development---green sprawl.



Low-impact subdivision: LID in sprawl
Image credit: Lisa Nisenson

Integration of stormwater management & compact development

Work as a pair:
Stormwater management & compact development

In order to solve the conflicts between stormwater management and compact development, urbanists are trying to develop integrated techniques and regulations. The EPA report "Using smart Growth Techniques as Stormwater Best Management Practices" reviews a variety of smart growth practices and their relationship to stormwater management. The report describes how land preservation should be paired with compact development:

1. A first step is to **plan for strategic preservation** of continuous tracts of open space.
2. Second, **preservation of critical ecological areas** such as riparian corridors, stream buffers, flood plains, and wetlands is needed. These parcels are of critical importance in developed areas to absorb and filter stormwater.
3. Third, for land that is to be developed, smart growth strategies such as **higher density and more compact development** serve to disturb less land and accommodate more development.

Project challenge and research focus

Current theories have suggested and wide-tested clearly methods to improve the automobile dependency issue within the sprawl repair process. The challenge remains in the integration of stormwater management and compact development. According to the previous review, consideration of scales is the main reason of the conflicts. Water management techniques approach from the lot-based solutions. Quantitative criteria on small scale might lead to undesirable urban structure in the regional.

The research of the project will start from this point. The project tries to pair the stormwater perspective with the approach of sprawl repair. Elaborating from the framework of sprawl repair, regional strategies, community intervention, and spatial principles (block scale) are the three process the project will discuss the integration of two perspectives.

Photo credit: http://www.flickr.com/photos/23910074@N07/8592296523/

Chapter 4 Project aims & Research framwwork

Opportunity / Bayou Greenway

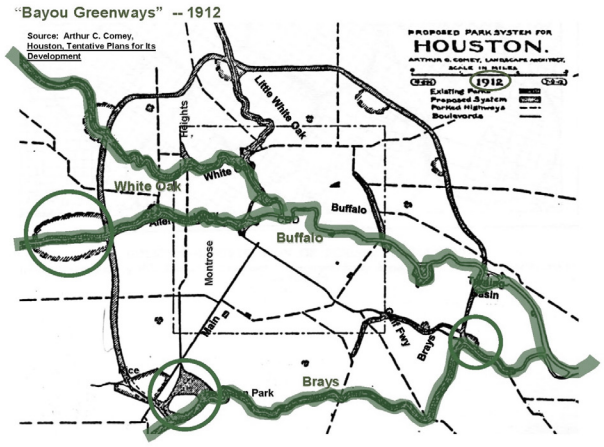
It was in 1912 that Arthur Comey, a visionary urban planner, laid out a master plan for Houston where its park system is organized around its bayou corridors.

"The bayou city of Houston is in store for one of the largest parks projects in the nation. As of now, the major bayous are disconnected from one another and leave many communities without access to green space. Houston has 75 miles of trails along the major bayous but has the potential to expand the trails to 150 miles in the city, connecting 77 parks with linear greenways along the banks of its bayous. Nearly 60 percent of all Houstonians would live within 1.5 miles of one of these parks or trails." (Houston Park Board)

"Ours is a city where currently the automobile creates our geography. We are connected by huge ribbons of concrete and pavement as far as the eye can see. Yet inside the concrete sprawl, we must create parallel connections at the human scale. …We may have a sprawling city, but the sprawl of our city is powerfully matched by the sprawl of our waterways." (Houston Water Board)

There are the main aspects that Houston wants to tackle with this project:

- Alternative transportation for commuting, ex. Hike and bike trails
- Wet-bottom detention areas flood prevention
- Natural water purification and runoff reduction
- Recreation opportunities
- CO2 sequestration
- Increasing property values along the corridor

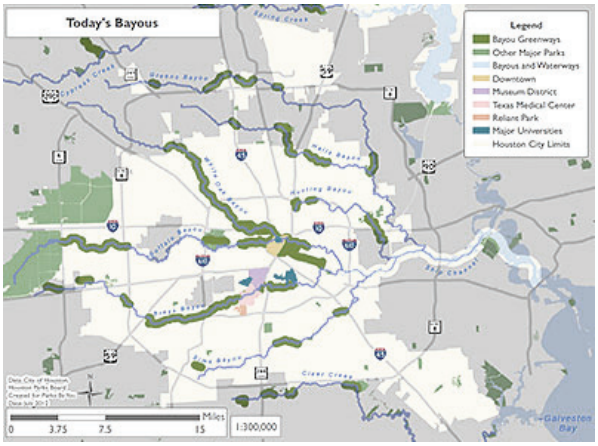


Left page
Master plan from Arthur Comey, 1912 (source: Houston Park Board)

Right page top
The two maps show the Greenway project the area alongside bayous into continuing green corridors (Source:Houston Parks Board)

Right page bottom
Photos show the section of buffalo bayou near downtown(Photo credit: http://www.flickr.com/photos/23910074@N07/8592296523/

Right page middle right
The plan shows how the Greenway project will connect the open space along bayou (Source: Houston Parks Board)


Today's Bayous
Legend
Bayou Greenways
Other Major Parks
Bayous and Waterways
Downtown
Museum District
Texas Medical Center
Reliant Park
Major Universities
Houston City Limits
Miles
0 3.75 7.5 15
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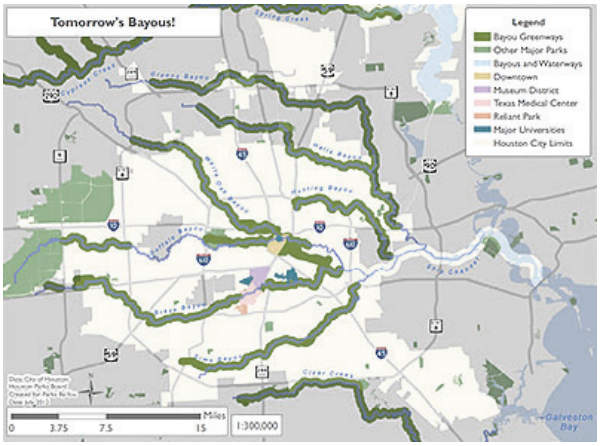
Galveston Bay


Tomorrow's Bayous!
Legend
Bayou Greenways
Other Major Parks
Bayous and Waterways
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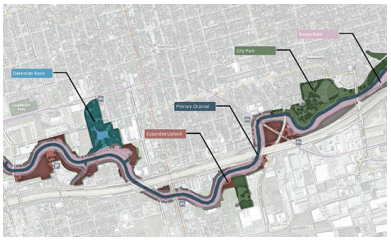


Opportunity /
Recyclable urban elements:
Parking lots, vacant lots, un-used public space

A major part of the strategies for intensification in this project focus on a better use of the existing built-up areas or in other words to 'build the city inwards'. Here are the three main urban elements that are considered with high potentials to be recycled.

Parking lot

The bottom graphics in the next page show the incredibly high percentage of land is occupied by the parking in the downtown Houston. This situation also happens in the other parts of Houston, while the parking need is actually lower than the provided parking space.

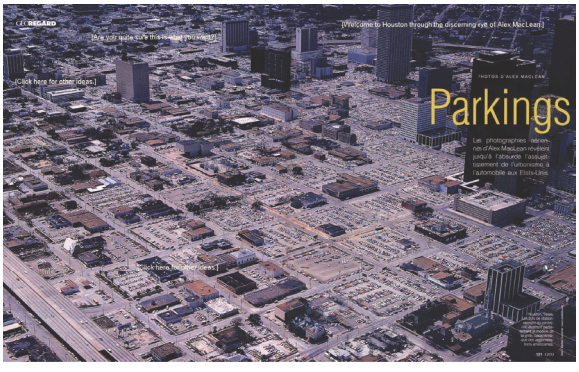
Vacant lot

The top map in the next page points out that while the city is still expanding outwards, some existing built areas are losing the population. Lots and buildings become vacant, especially inside the second loop.

Unused public space

While Houston is depending on a huge amount of motorways, the spaces alongside infrastructures are often only used as buffer. There are high potentials to provide other functions to support the nearby neighborhoods. This kind of un-used publics can also be found along the water system, rail tracks, etc.

Houston population change 2000-2010: Blue indicates the it increased more than double, red is decreasing ,and gray is stable (map credit: Stephen Von Worley at DataPointed)



Right
the map shows downtown Houston when taking out parking spaces (Source: Shuffle City)

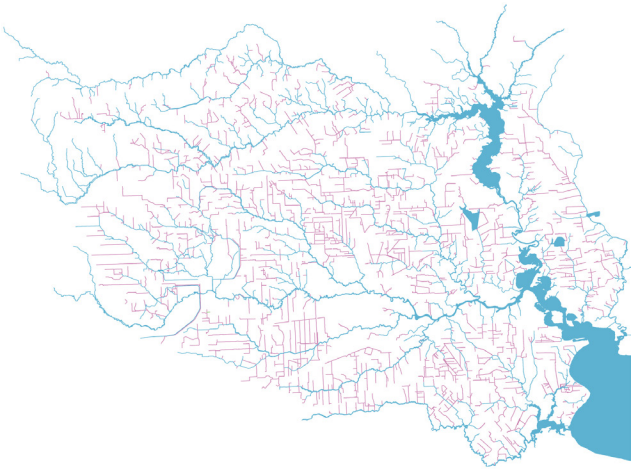
Left
downtown Houston (Photo credit: Alex Maclean)

Project aims

The Bayou Greenway project is mainly considering about the natural drainage system (blue), bayous, for improving the flooding damage from heavy rainfall. If we also take the man-made system (pink), ditches and channels, into consideration, the city can have a stronger water protection (from 2076 km to 4332 km). In the project, I elaborate from this point and discus how the water system can be transform into not only performing as flooding protection but also as crucial element in the intensification interventions in suburban.

The project tries to achieve the objectives in three scales: region, community and block. In regional scale, the aim is to reinforce the water system in different hierarchies, from watershed to ditches, in order to increase the storage capacity and channel efficiency. From the intensification perspective, urban system and flows (sewage, transportation, amenities, etc.) are reorganized and adjusted to higher the performance and reduce energy consumption. In community scale, the focus is to implement the regional strategies considering living qualities and cultural circumstances. The intention is to research the possibilities of design intervention according to water and intensification strategies that can bring up the most positive spatial qualities. In block scale, the intended achievement is to reflect the current urban development quantitative regulations and how can they be improved with spatial principles (physical design). The conclusion of this project is to provide a city vision for compact urban structure with the considerations for water safety and energy, in order to give suggestions for Houston to sustain in this post-oil era.

Natural and man-made drainage system (map credit: Susan Rogers, Super Houston)



Research questions

Main research question

In the intensification process, how to recycle existing urban elements and integrate them with bayou systems to bring synergy between reducing energy consumption and reinforcing living quality in Houston suburban?

The main research question can be elaborated into three sub questions that focus on achieving objectives in three different processes and scales:

Sub questions & research processes

1 How to intensify the suburban area by transforming the bayous and urban structure to reduce flooding risk and provide alternatives for individual automobile use?

First, flooding condition and urban systems (water, transportation, amenities, lot patterns, etc.) are analyzed. Based on the analyses, recyclable urban elements (intensification potentials) are defined and further developed into strategic plan with elaborations from methods discussed in theoretical framework (reconstructing an automobile dependent city, sprawl repair: regional sector mapping)

2 How to transform the suburban neighborhoods into mixed-use centers that can reinforce the living qualities, provide water storage capacity and still preserve the community characters?

One of the intensification nodes is selected based on the diversity of urban elements and urgency of the water and social conditions. The analyses in this section focuses on understanding the spatial conditions. Then the project demonstrates the strategies on the selected community with design interventions.

3 What are the spatial principles that need to be applied and replace current urban development regulations in order to implement the interventions, and further developed into general principles for other suburban area?

In this section, the project zooms in to the community intervention and extracts three critical locations to elaborate the spatial principles and toolbox. The current restrictions of urban development and undesirable conditions are first discussed; and the water and urban form principles are introduced as the solutions for improvements.

Project framework

Flooding

Urban sprawl

Energy consumption

3 Challenges

Stormwater management

Sprawl repair

Reduce automobile dependency

Theoretical analysis

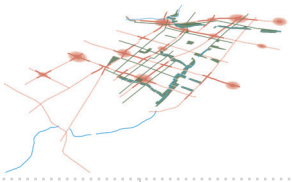
Research questions

In the intensification process, how to recycle existing urban elements and integrate them with bayou systems to bring synergy between reducing energy consumption and reinforcing living quality in Houston suburban?

Intensification
+
Water management

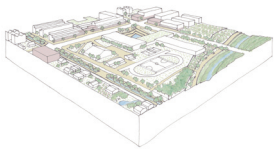
Project aim

How to intensify the suburban area by transforming the bayous and urban structure to reduce flooding risk and provide alternatives for individual automobile use?



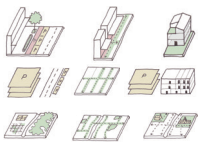
Regional strategies

How to transform the suburban neighborhoods into mixed-use centers that can reinforce the living qualities, provide water storage capacity and still preserve the community characters?



Community interventions

What are the spatial principles that need to be applied and replace current urban development regulations in order to implement the interventions, and further developed into general principles for other suburban area?



Spatial principles & toolbox

Conclusions

Relevance

Scientific relevance

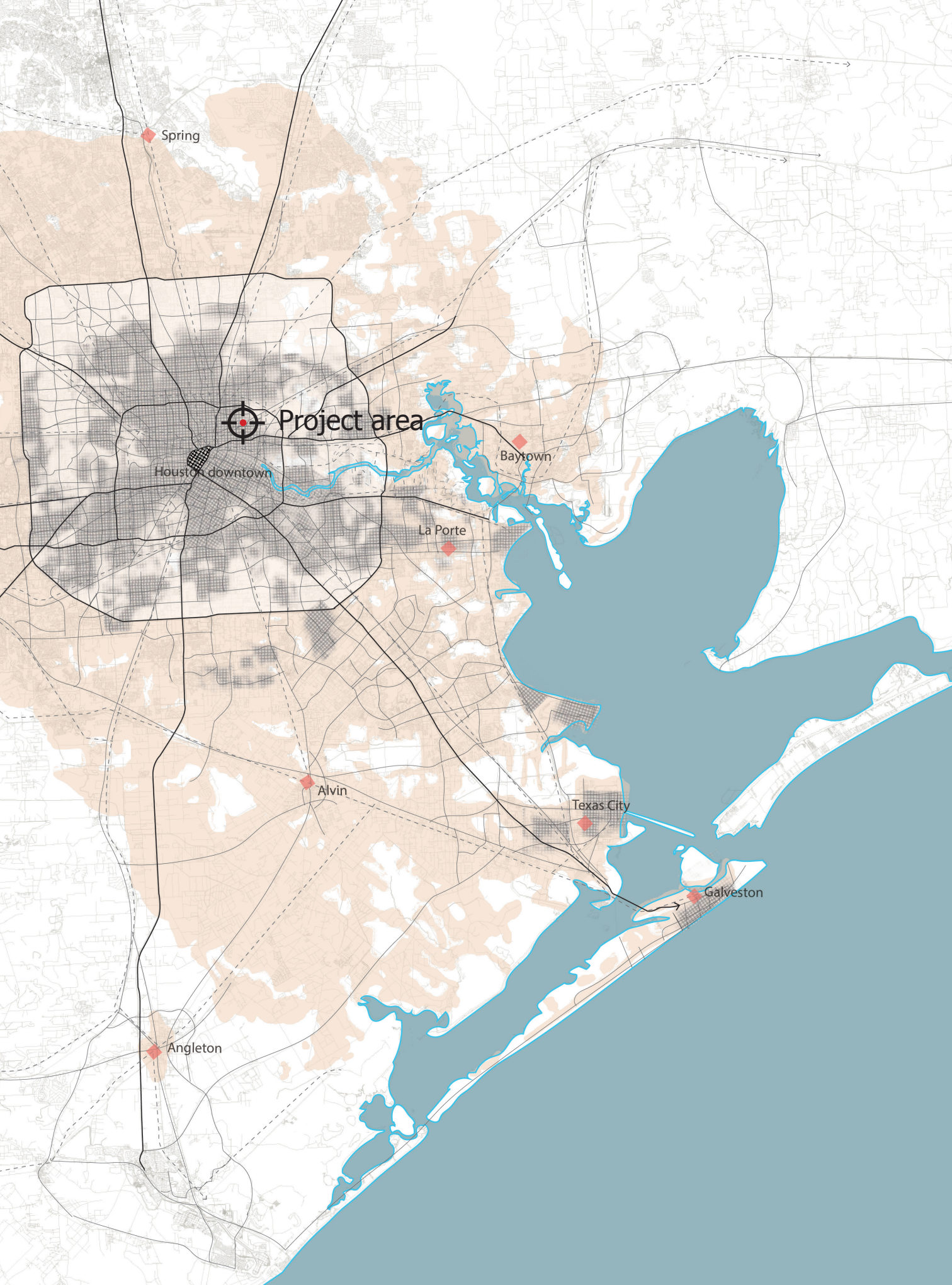
Climate change which is interrelated with flooding and energy consumption in on the high agenda for not only urbanists but also many professions in other fields. Being a high automobile dependent city and facing serious flooding risks, Houston suburban is an ideal model to do the integrated research on intensification with water and energy aspects. This project is trying to review the current theories from different fields. By discussing Houston suburban, the aim is to coordinate the theories, data and my observations to provide overall remarks for the integrated research on intensification, energy and water. The research is focusing on Houston but still shares common issues with other suburban areas over the world.

Societal relevance

The selected site of this project is especially focuses on the suburban area with serious flooding problems and low economic-social conditions. One of aims in the project is to provide strategies for the area that is neglected by the government or investment flows. With more considerations, small individual changes can also have big influences for their living environments.

image credit:
unknown artist from
Kashmere Garden
community center

Chapter 5 Spatial analysis


Spring
Project area
Houston downtown
Baytown
La Porte
Alvin
Texas City
Galveston
Angleton

Project area

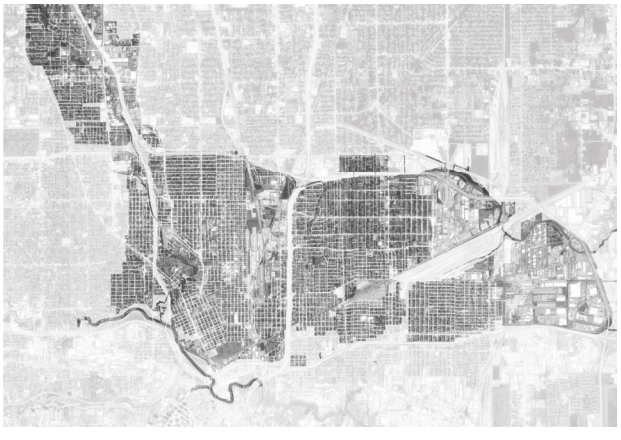
Why Here

The site is chosen because of several reasons. The area is cover by one of the biggest floodplain within the inner city. The region locates right above Houston downtown but has the lowest social-economic status comparing with other regions. Furthermore, the area is consisted with the typical post-war suburban pattern (shown as gray area in the map on left page), which the project intended to focus on.

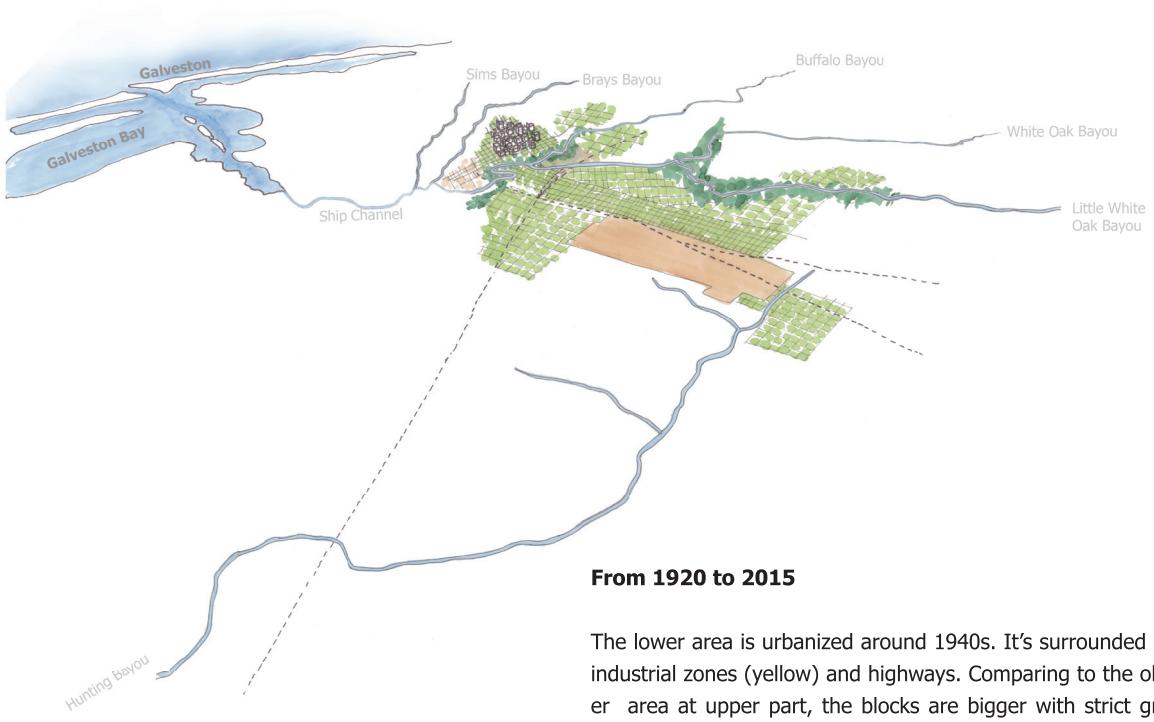
Rotterdam

13.20 km

Site



14.25 km



From 1920 to 2015

The lower area is urbanized around 1940s. It's surrounded by industrial zones (yellow) and highways. Comparing to the older area at upper part, the blocks are bigger with strict grid pattern.

Urban form : 1940s-1960s suburbs

Neighborhood condition

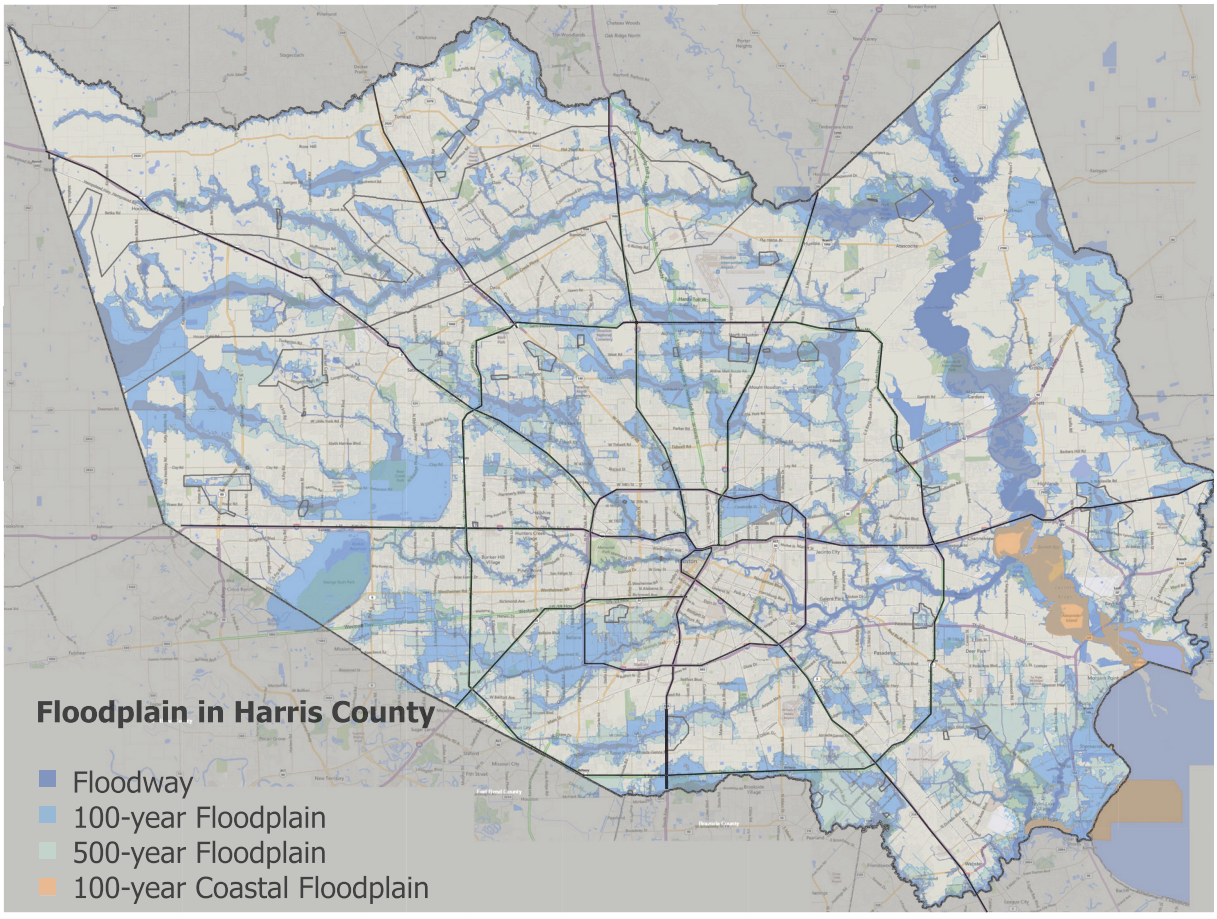
The social-economic conditions are almost the lowest comparing with other parts of Houston. The density is also lower, and a lot of residential lots remain vacant, especially near the water front. Most of the housings are 1-2 floors single houses, except a small percentage of multi-family houses (bottom).

Most of the area is covered by this type of residential lot: 1-2 floors single house standing on huge lawn with around 50 feet setback in the front.

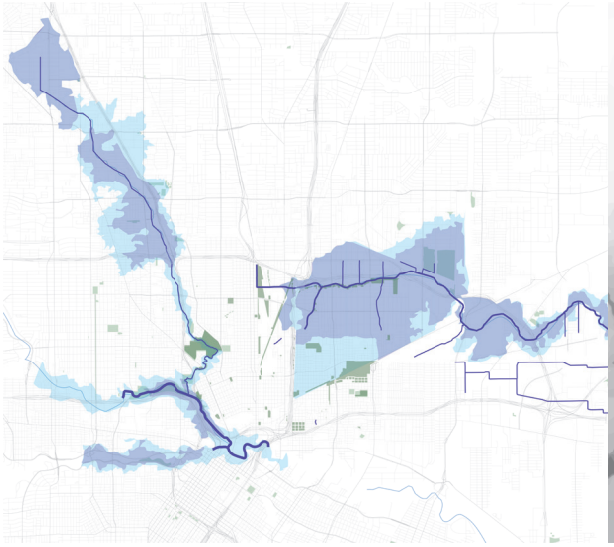
This pattern is located nearby the water. 30-50% of land are vacant.

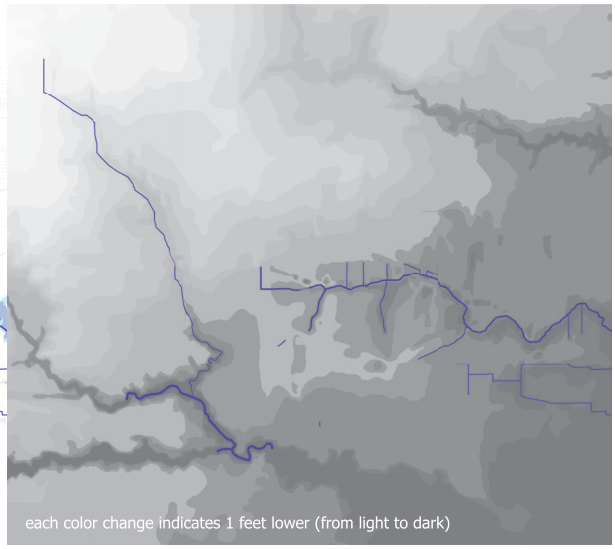
Multi-family apartment cluster can also be seen in the area. They mostly function as rental housing.

Flooding risks



Floodplain in Harris County
(Source: http://mycity.maps.arcgis.com/)

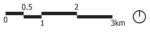




Water and open space

The two bayous are almost parallel with the highways with some bigger open space in between. There are two major floodplains. These floodplains are formed by the height difference.

Legend



500 years flood plain

100 years flood plain

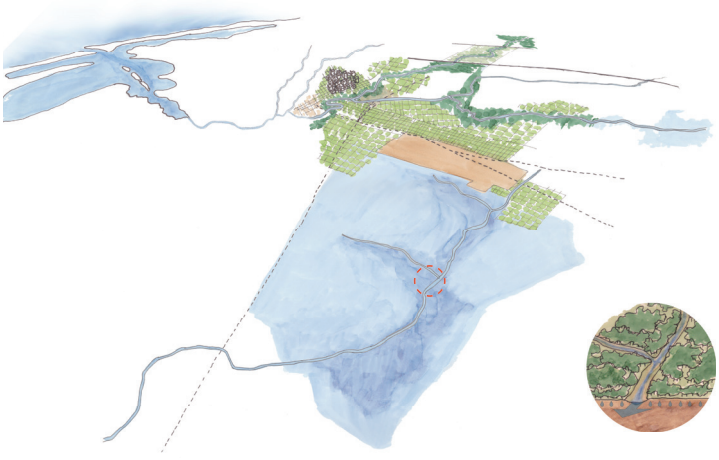
open space

Cause of flooding

Flooding conditions on site

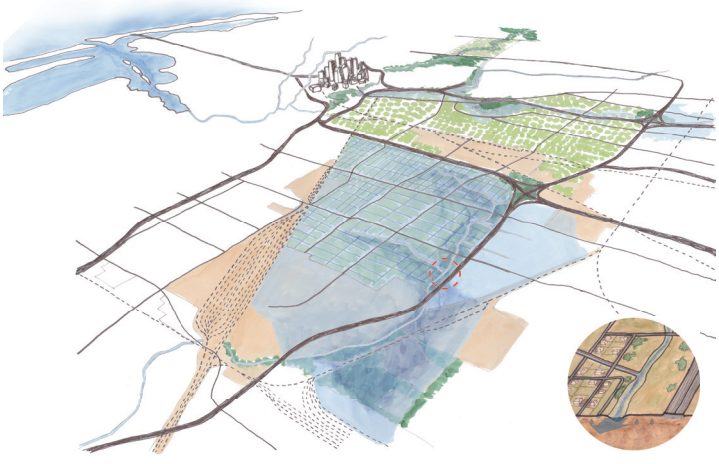
The first image shows the flooding during Tropical Storm Alison in 2001. The water level can be up to 3 meters. Most of the house are flooded entirely. The second and third image are taken after a heavy rainy day. They shows that the infrastructures, such as sewage and pavement, are inefficient. Even just a regular rainfall can create inconvenient for the residents.

Top
Sourece: Harris County flood control district



Houston North, 1920

This floodplain is created by the height difference. Before the urbanization, the floodplain should already exist. Bayou, soil and stormwater consists a balanced cycle in the natural state.



Houston North, 2015

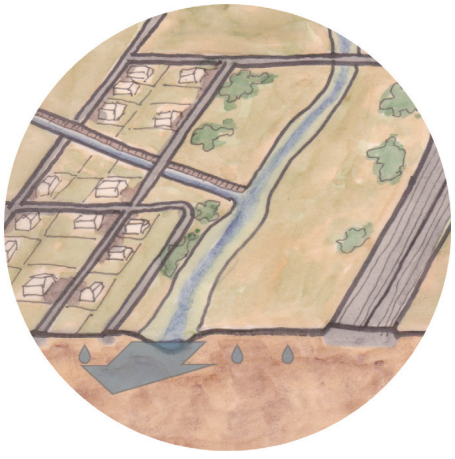
After the urbanization, most of the permeable surface are replaced by concrete. Part of the waterway was transformed with concrete bank to increase the discharge speed. But it does not solve the problem. Most of the stormwater on impervious surface can not be contained and channeled to the waterway.

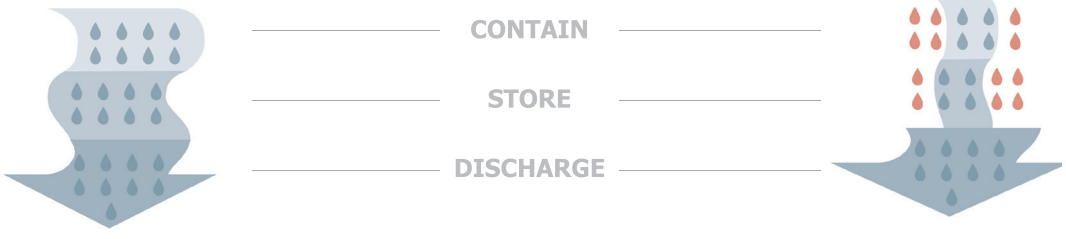
Before urbanization

Balanced water system in the natural condition

Current

Discharge capacity increased by concrete river bank, but flooding still occurs because of insufficient permeable ground to contain, store and transport water to the water way





Soil profile H1: 0-18cm_silty clay loam
H2: 7-20cm_clay
H3: 50-180cm_clay

Depth of water table: 16-48cm

Saturated hydrologic conductivity (Ksat): 1.5mm/hr

source: Natural Resources Conservation Service, National Cooperative Soil Survey, 2015

Bayou characteristics : Hunting Bayou

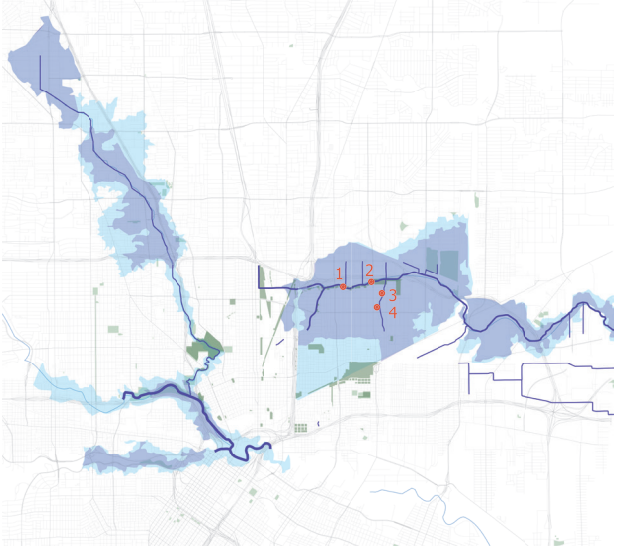
1
The upper stream of Hunting is different from Little White Oak Bayou. It is deep and wide. The waterfront is developed as a park, but people don't really use it.

2
The bayou becomes less deep and wide when it goes east.
The intersection of Hunting bayou and it's branch.

The main stream of Hunting Bayou has been partly reconstructed by Houston government. The waterway and the buffer are wider and the waterfront has been developed as a linear park. But the park is not a successful investment. The facilities and accessibility are poorly designed, which make the park into a new un-used space.

3
The branch is canalized, and it goes through the neighborhoods with very small buffer in between.

4
Crossing between branch and main road. It's about 2.5m high and 8m wide.



Potentials for intervention / Priorities of recyclable targets

1st target :
Pubic own property & vacant lot

This category consists water/ infrastructure buffer, reducible thoroughfare, and the vacant lot. Public own space is considered as the easiest target to be recycled. Water buffer and thoroughfare have the linear character that is suitable to create structures in the first place.

2nd target :
Private own public space

Second targets are over-size parking lot, setback, and commercial property. Parking and set back regulations creates wide strips between buildings and street. This linear space has potentials to be transformed to improve street qualities, such as slow traffic connections. The commercial property is considered in this phase because it is easier to recycle comparing to residential property. In suburban area, these stores are mostly fast-built and low-cost boxes.

3rd target :
Private own property

The last step of recycling is the over-size residential lot. Restriction of minimum lot size results huge amount of unmaintained lawn covering the whole area. These lands have the potential to be combined and in crease the urban density.


FOR
SALE


DONUTS
DONUTS

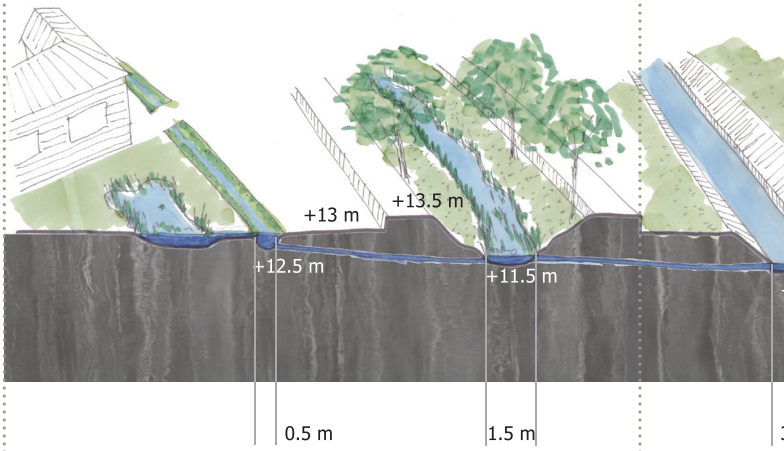
Chapter 6 Strategies & Toolbox

Strategies /
Water system & toolbox

Add two layers to support current water system : Lot and street profile

As mentioned in the previous chapter, the cause of flooding is the insufficient contain and channel capacity in the urban fabrics. Before stormwater can reach the bayou, the flooding occur. The strategy for improving this condition is to add two layers into the current water hierarchy. The layers are the street profile and private lot. In the project, the intervention on street profile is referred as secondary greenway. It is considered as a supporting network for the current bayou greenway. The layer of private lot contains individual water storage and can be channeled with ditches and collected by secondary greenway, and further transported to the bayou system.

Add 2 layers to support existing system: lot & street profile

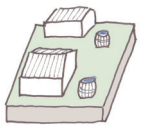


Residential lot

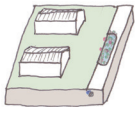
Secondary Greewnway

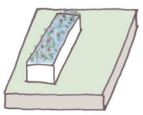
5 Hunting

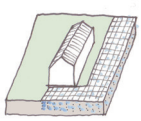
Water toolbox: Lot

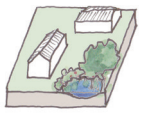

water barrel


pond / spare

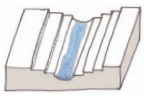

bioswales

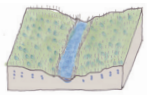

green roof

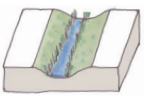

porous pavement

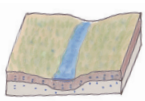

rain garden

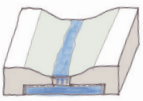
Water toolbox: Secondary greenway

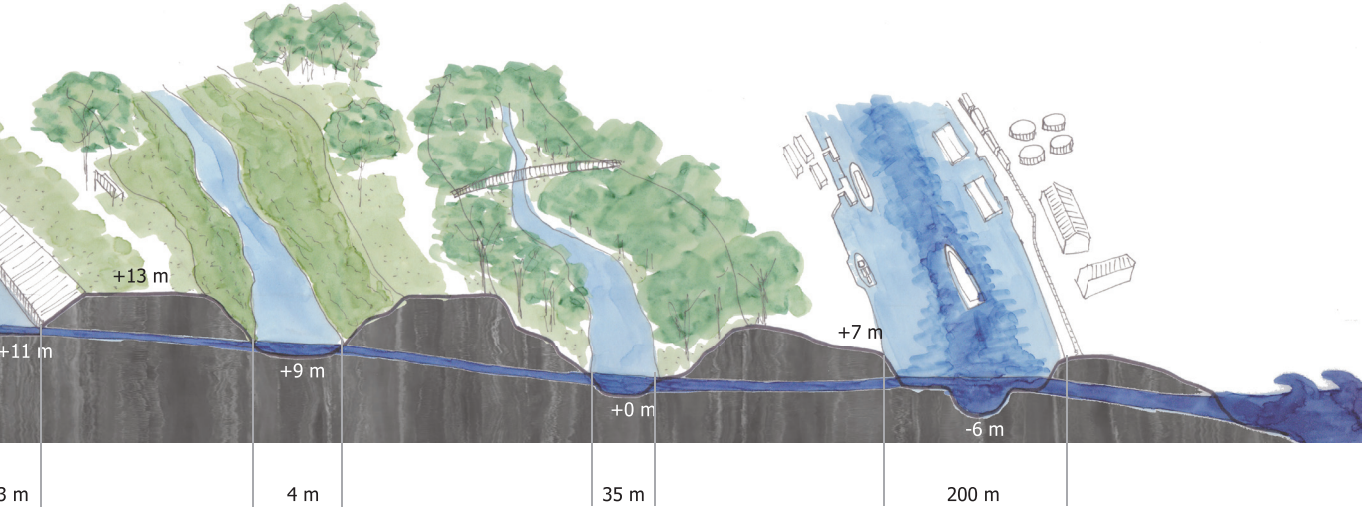

flexible water level


flexible water level + infiltration


helophyte filter

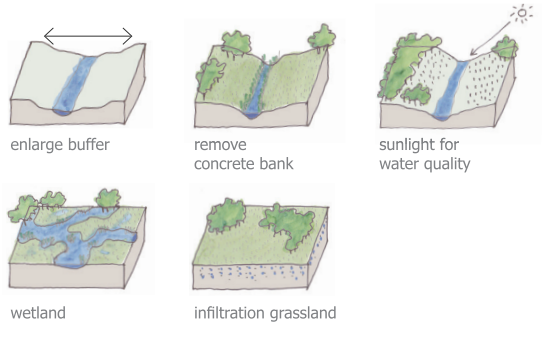

soil filter

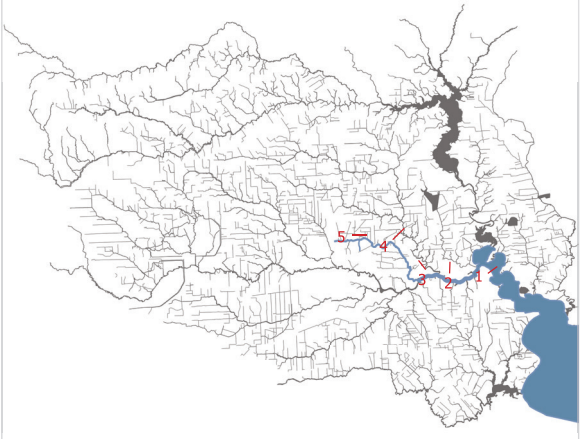

underground water storage



g Bayou branch **4** Hunting Bayou **3** Buffalo Bayou **2** Ship Channel **1** Galveston Bay

Water toolbox: Bayou

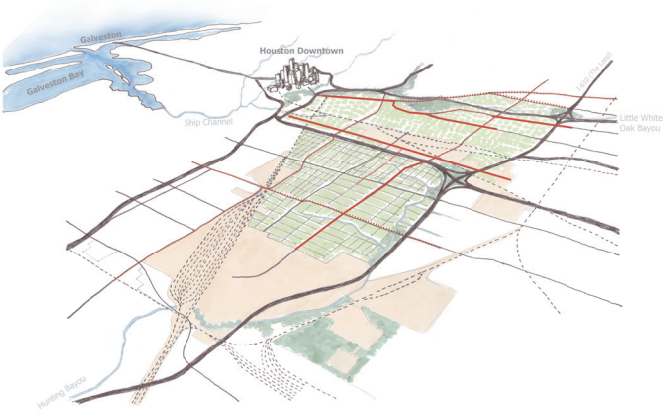




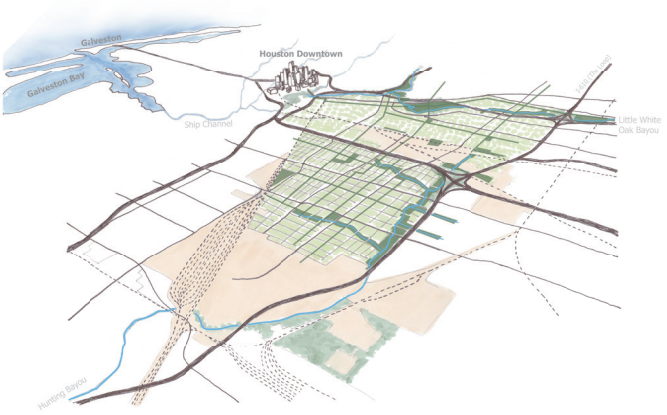
Strategies /
Regional structure developing steps

The regional structure developing steps are based on the reviewed theory: regional sector mapping (sprawl repair manual, Tachieva 2010). It is further elaborated according to the site conditions and including water strategies mentioned in the previous page. The first step points out the current amenities, which are along the main thoroughfares, as the potential axis to provide mixed-use development. The second step map the current open space and define preserved area. In this case, the preserved area are the waterfront. The third step is defining the intensification center points. The fourth step considers current open space with the preserved area to establish green network: secondary greenway. The fifth step assembles and adjusts the intensification structure (red axis) with secondary greenway network (green axis) to accomplish the regional structure.

Step 1:
Existing amenity analysis

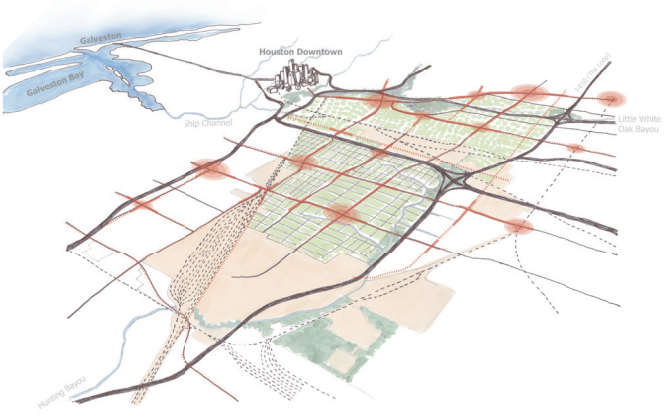


Step 2:
Defining preserved areas and current open space

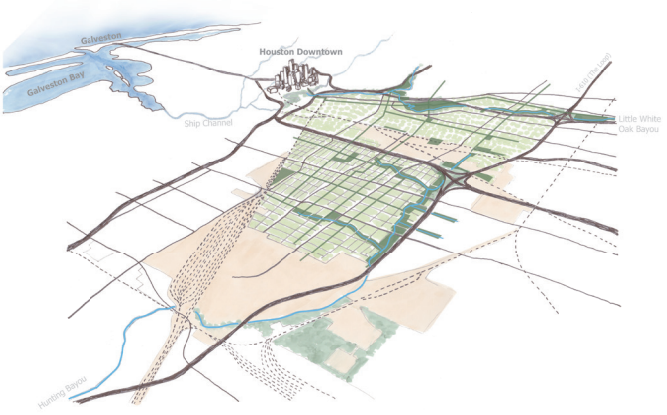


Step 5:
Proposed regional structure

Step 3:
Densification center



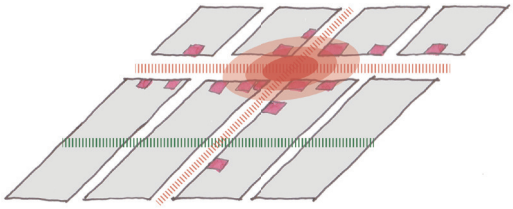
Step 4:
Providing secondary greenway



Strategy explanation /
Green & red axis : backbone of intensification

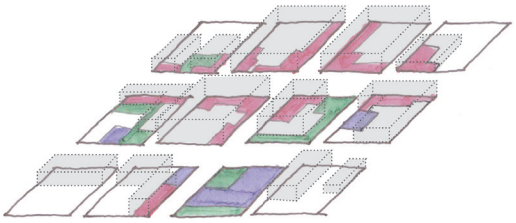
Target : intersection of commercial strips

The intensification center points are chosen based on the current density of amenities and the position within the regional structure. The centers usually locate at the intersection of commercial strips. The current commercial amenities spread as fragments along the thoroughfares with far distance between each other.



Strategies and intended outcomes

Along the red axis, commercial amenities should be centralized into continuing zone. Public facilities (purple) and open space (green) are organized along green axis. In some cases, green axis is used to divide over-size blocks into smaller size that is suitable to increase street vitality. The crucial strategy is to arrange the red (intensification) axis and green (secondary greenway) axis parallel with each other, which will generate the development of in-between area. The in-between area will be considered for high intensity development, such as fully block redevelopment, to highly increase density.

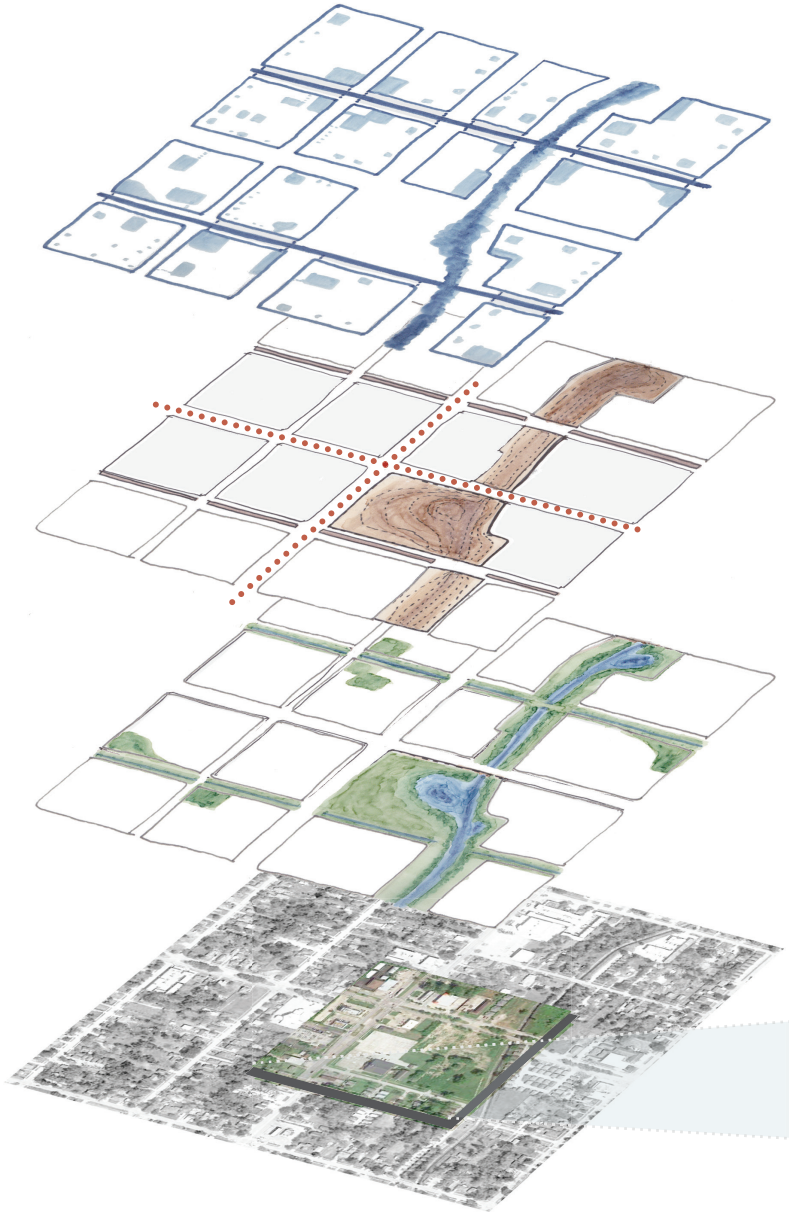


Regional vision 2040

The vision shows the urban structure when the regional strategies are applied. Density is increased in the selected nodes. These nodes perform as local or town centers with hierarchy. The network between the centers are the backbones for the further development, and they can adopt different capacity of public transportation based on the population range. Green corridors are integrated with the intensified area connecting urban open space with the waterfront. The green corridors, referred as secondary greenways in this project, also work as a support system for bayou that increase the stormwater contain and channel capacity. Intensification axis and secondary greenways are the spines to arrange urban density and open space. The volume of density and green can be adjusted according to future conditions.

image credit:
unknown artist from
Kashmere Garden
community center

Chapter 7 Intervention: Kashmere Garden



- Water discharge system
  from blocks to bayou

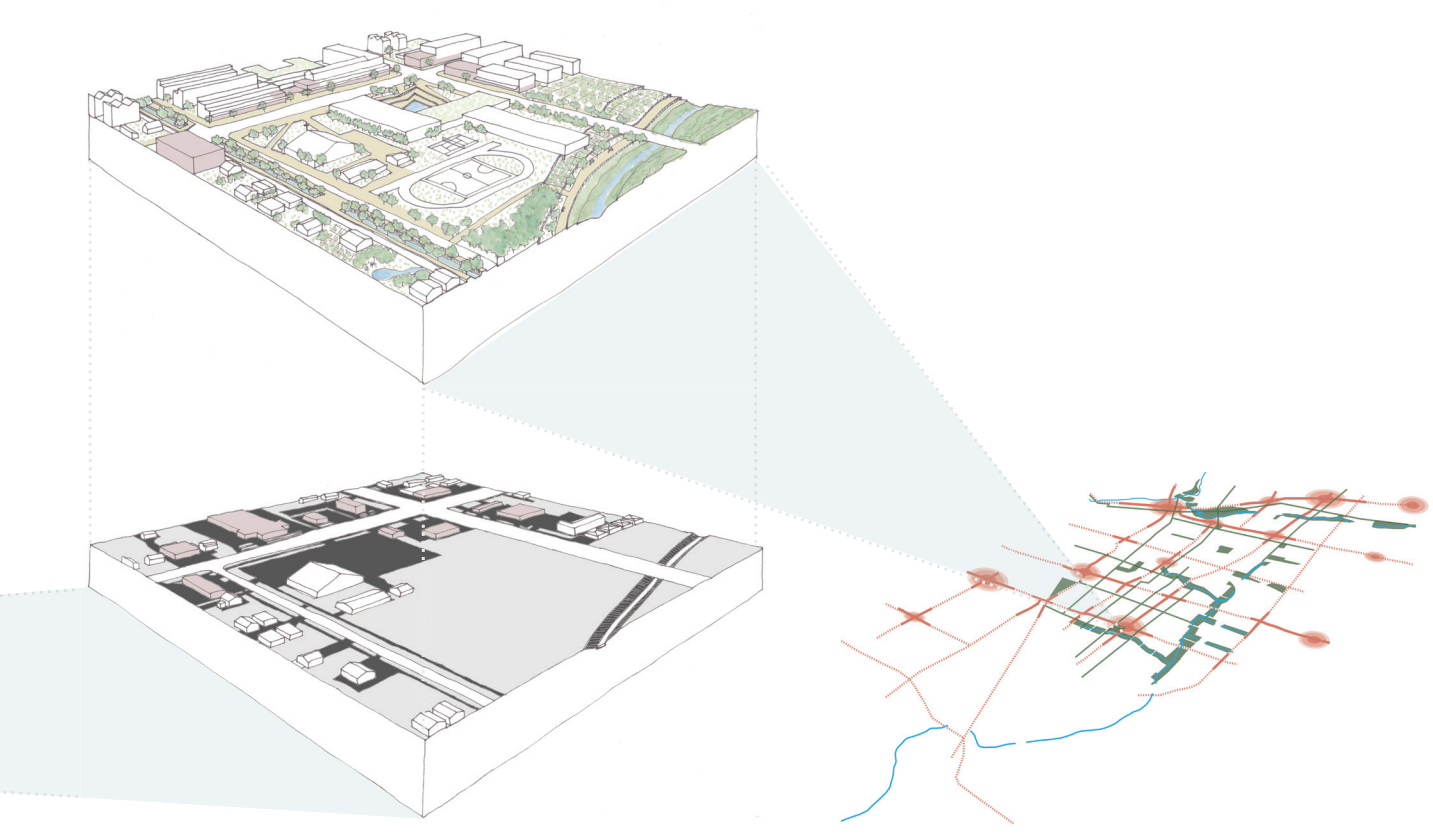
- Recycle soil from waterfront
  construction
- Elevate and rebuild blocks
  along densification axis

- Enlarge waterfront
- Divide blocks by secondary greenways

- Existing site : Kashmere Garden

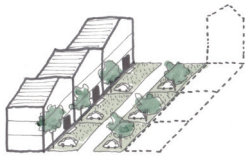
Strategies implementation : Community scale

In this chapter, one of the intensification nodes is chosen to demonstrate the strategies. It consists with three crucial subjects the project wants to discuss: bayou, secondary greenway, and intensified center. The site is at the intersection of major thoroughfares with high percentage of commercial lots. The current bayou is constructed with concrete banks. Along the waterway, most of the land remains vacant. The waterfront is almost unaccessible by inhabitants. The maps on left page shows apply the strategies and transform the current condition into dense walkable urban environment with highly performing open space.



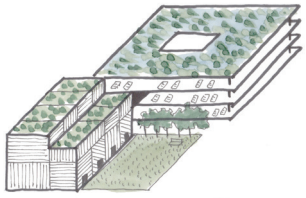
Row house

+ Private garden
+ Limited parking space



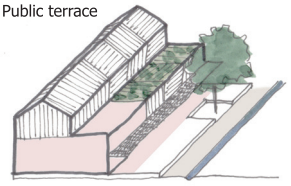
Apartment community

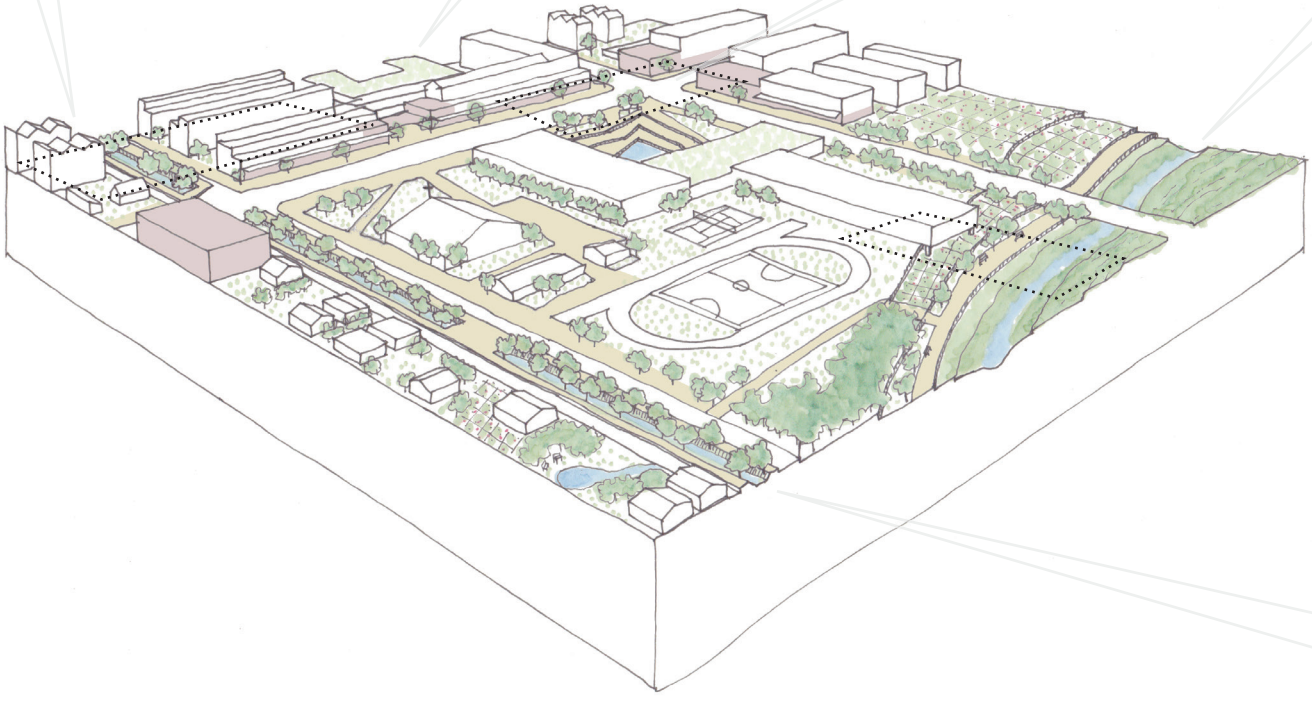
+ Varieties of units size and types
+ Common parking building
+ Shared garden / terrace



Commercial strip

+ Continuing sidewalk
+ Public terrace

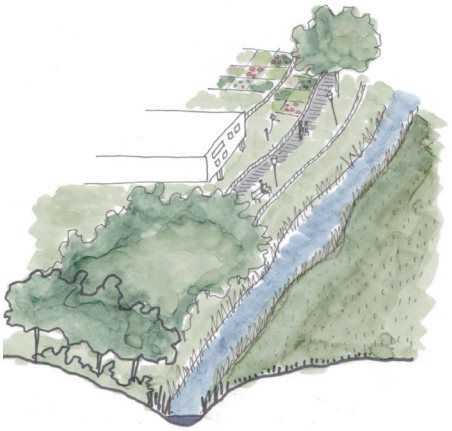




Community intervention : Kashmere Garden

Bayou waterfront

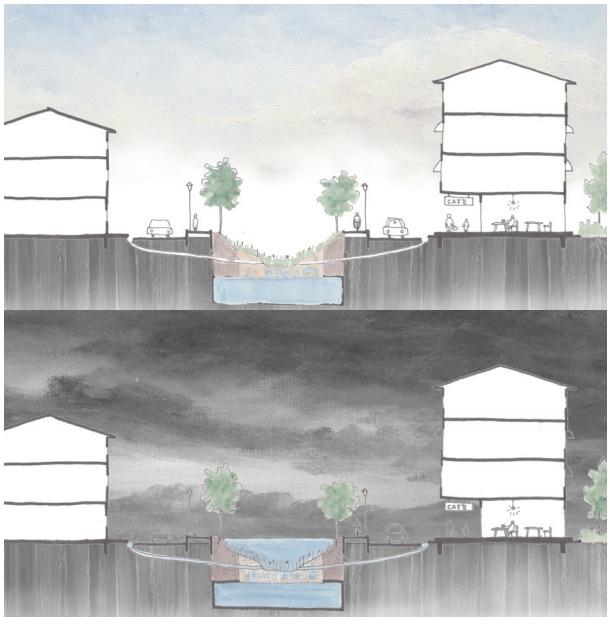
+ Flexible water level with functions. ex. linear park, agriculture
+ Extended open space into urban fabric
+ Provide enough sunlight to increase water quality
+ Arrange public facilities alongside waterfront



The site shows two types of block intensification: fully redevelopment and build within existing housing. Fully redevelopment is applyed at the in-between area of intensification axis and secondary greenway. This area provides higher density with apartment clusters. To build within existing housing, row houses are applied. By recycling and assemble over-size lots, small row houses can be located and increase the block density.

Along the intensification axis, ground floors are arranged with continuing commercial functions. They are developed with well-design sidewalks that provide comfortable walking condition and combine with biking and temporary parking needs.

Public facilities, such as schools and churches, are located between the center and waterfront to increase the connectivities and performance of open space. Along the bayou, elevation is designed with multi safety lines. Functions, such as agriculture and linear park, are designed with the different height levels.



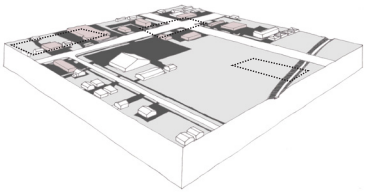
Secondary greenway

+ Channel water from blocks to bayou
+ Water storage
+ Pedestrian and biking route
+ Transparent open space for emotional security

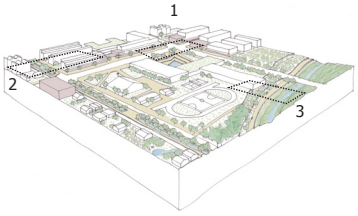
Community intervention : Spatial principles explanation on three critical locations

Three critical locations

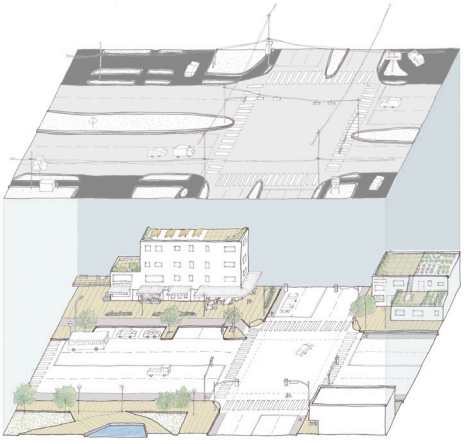
Three critical locations are zoomed-in in the following pages to show the details of interventions. Spatial (building + water) principles are concluded as the essential rules to improve the current conditions created by urban development regulations. The three transformations between existing and intervention are: main street intersection/ intensification node, Hunting Bayou branch/ multi-function waterfront, and residential lot/ secondary greenway.



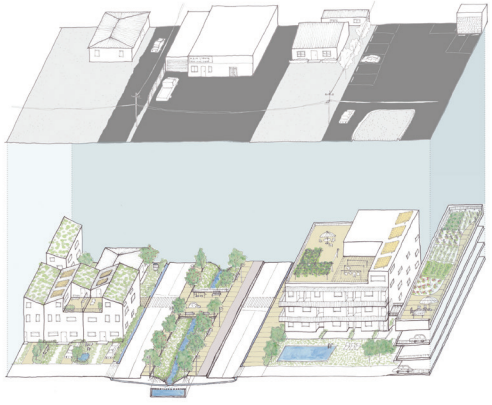
Current sites :
1 main street intersection
2 residential lots
3 hunting Bayou branch



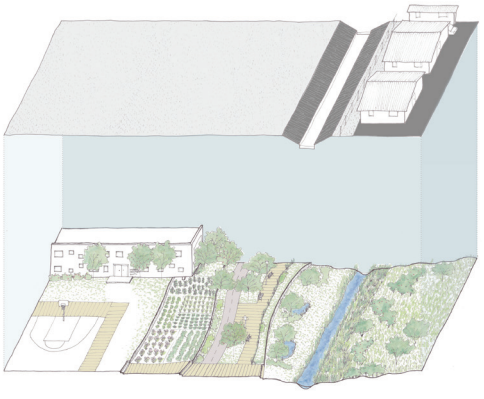
Interventions :
1 intensification node
2 secondary greenway
3 multi-function waterfront



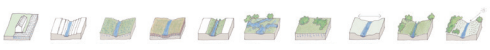
intervention : intensification node



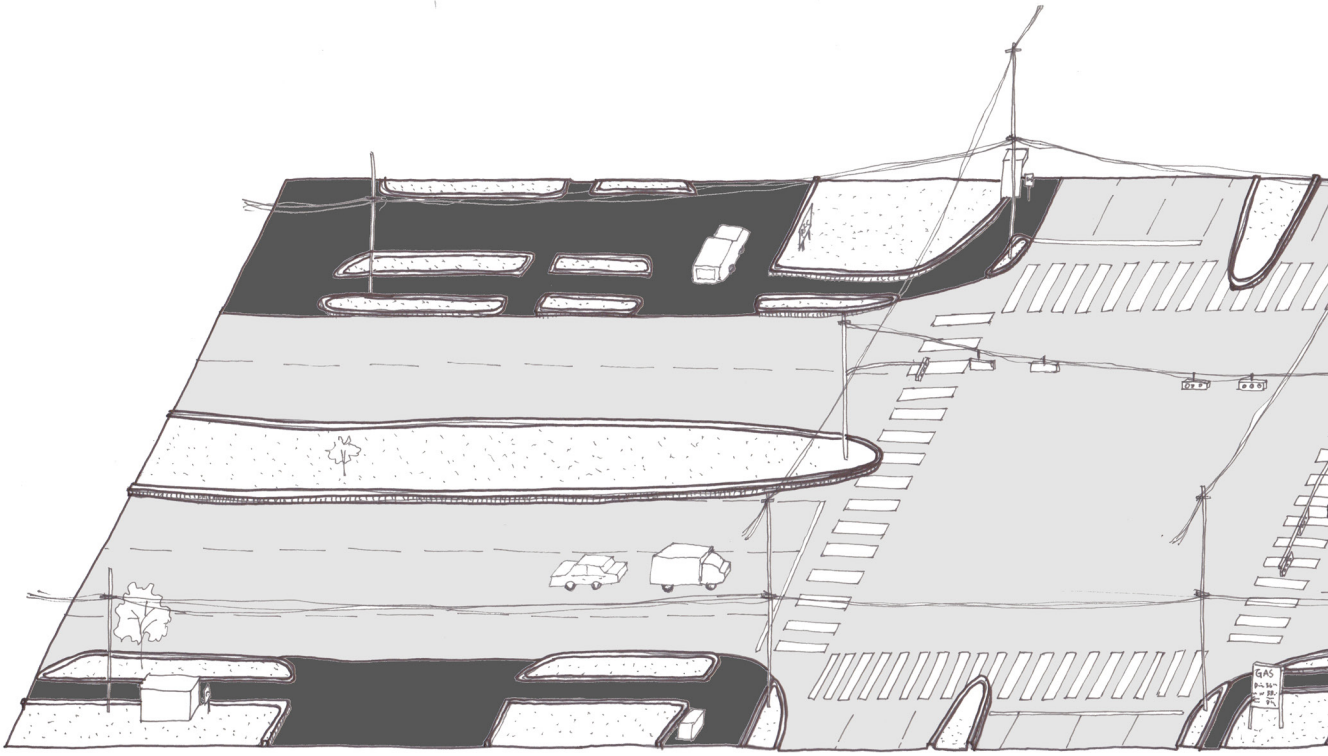
intervention : secondary greenway

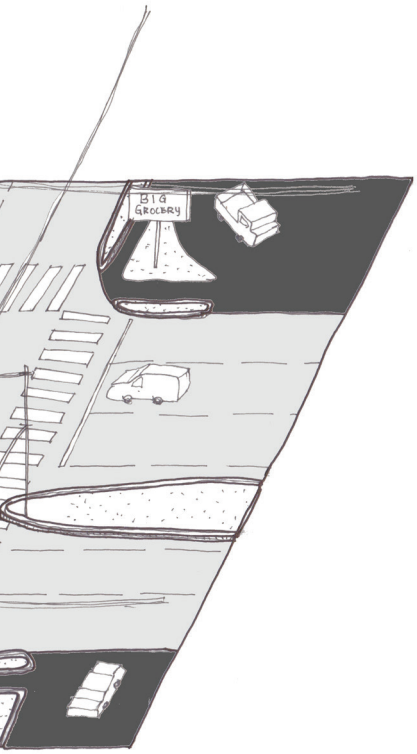


intervention : multi-function waterfront



current site : main street intersection



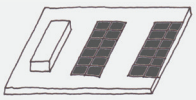


Lawn plot as buffer

- road: middle island separating two direction traffic
- lot: separating pedestrian, parking and building

Minimum parking space

- supermarket : 5 per 1000 ft2 GFA
- restaurant : 8 per 1000 ft2 GFA



Setback

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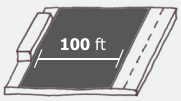
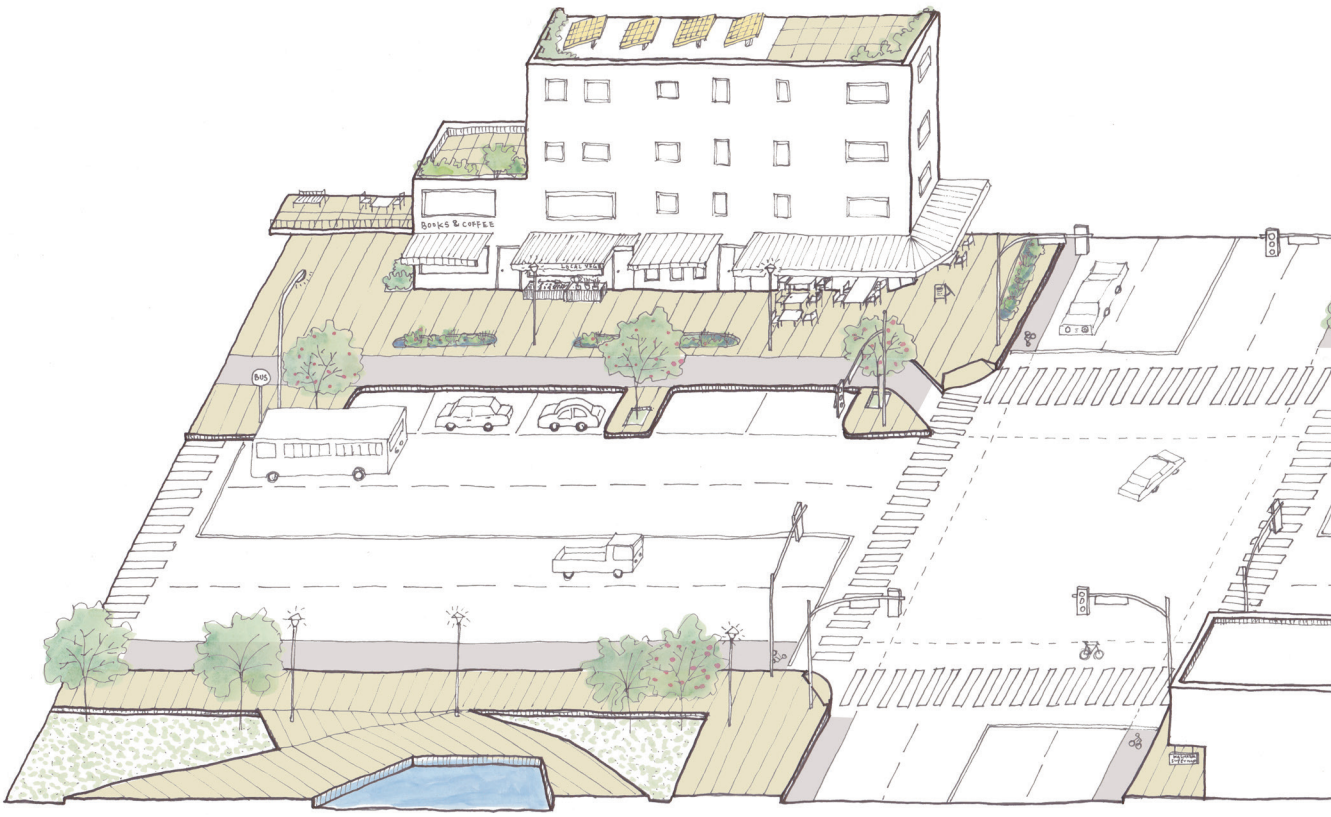
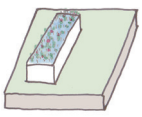
- residential road : 50-60 ft

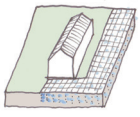




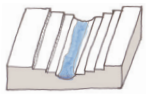
intervention : intensification node


green roof

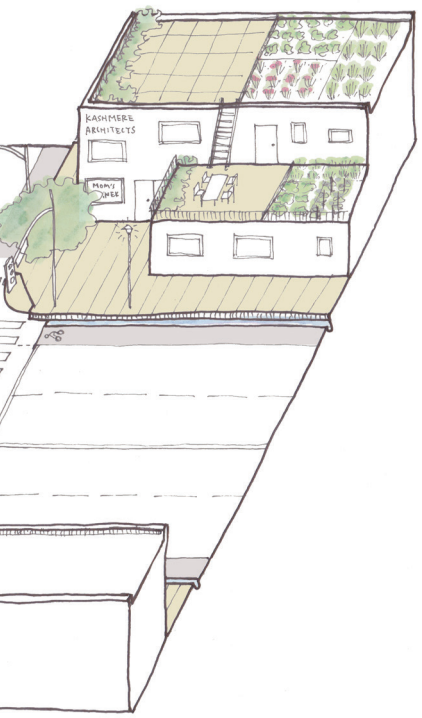

pond / spare


porous pavement


bioswales


flexible water level

current site conditions



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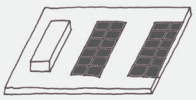

Setback

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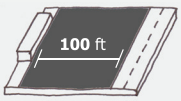
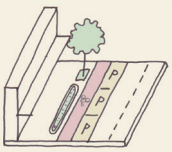


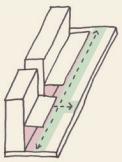


Multi-function buffer

- reduce unnecessary buffers
- arrange street elements (biking path, bioswales, street parking...) to replace lawn plots as buffer

Share parking space

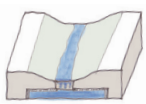
- consider parking needs by neighborhood scale; not restrict by each lot
- arrange time limit street parking
- incentive for vertical parking



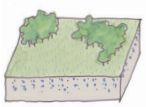
Sidewalk connectivity

- continuing shaded sidewalk
- arrange continuing amenities (shops, public facilities) along intensification node

proposed building + water principles



underground water storage

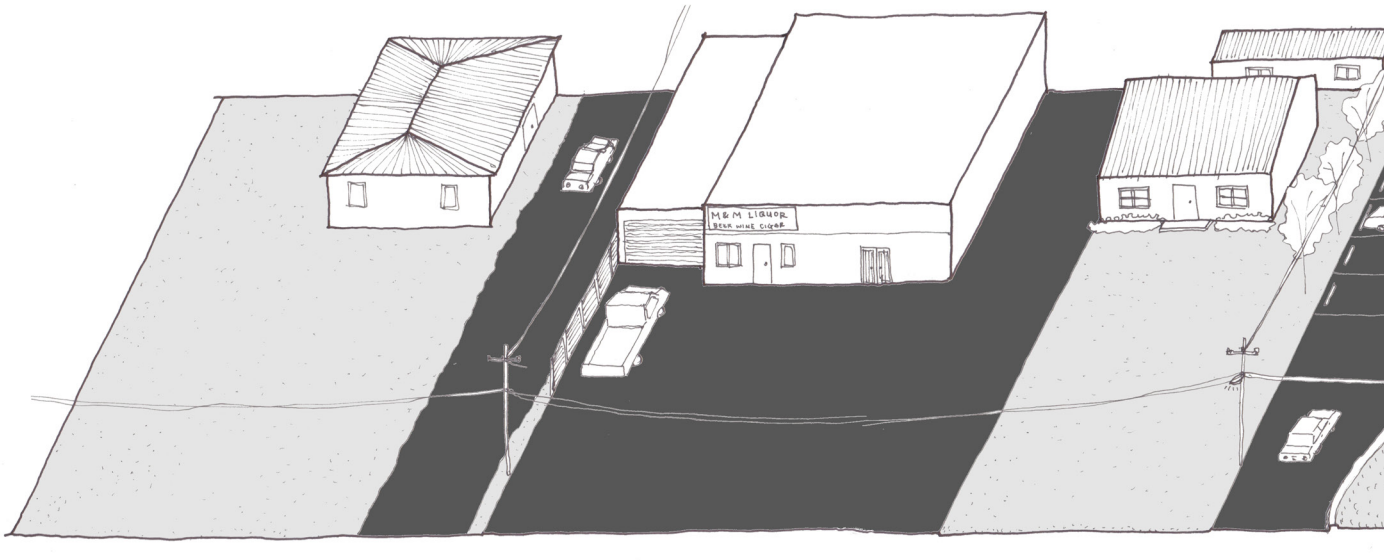


infiltration grassland

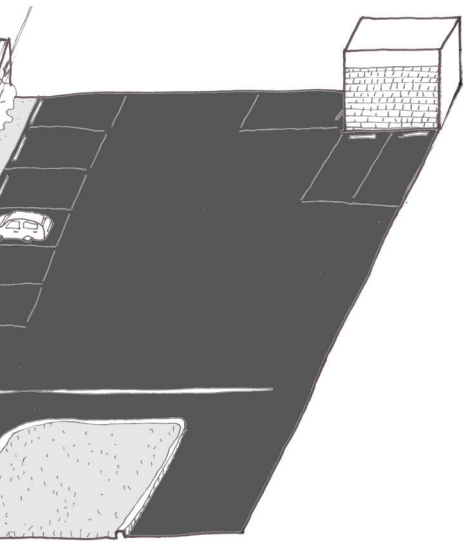
street water filtration & channel capacity

- commercial street should equip continuing open/underground ditches to channel the runoff from blocks
- open ditches should be designed as landscape-filtration elements, such as bioswales

current site : residential lots



current site conditions

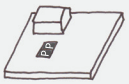


Minimum lot size

- 5000 ft2

Minimum parking space

- apartment : 1.25 - 2
- dwelling : 2



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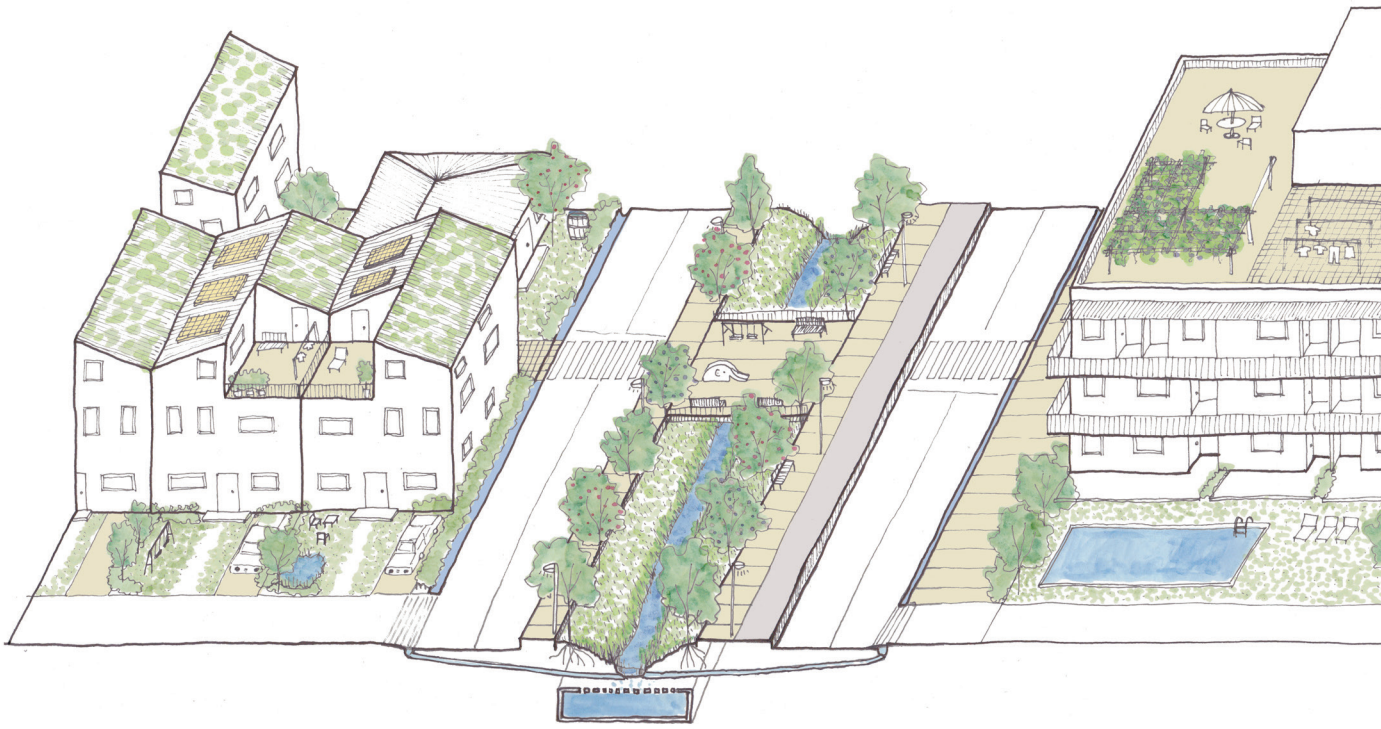
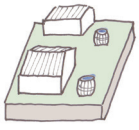
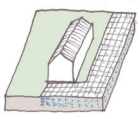


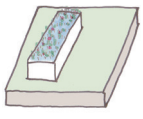
intervention : secondary greenway

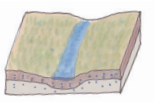

water barrel


pond / spare


porous pavement

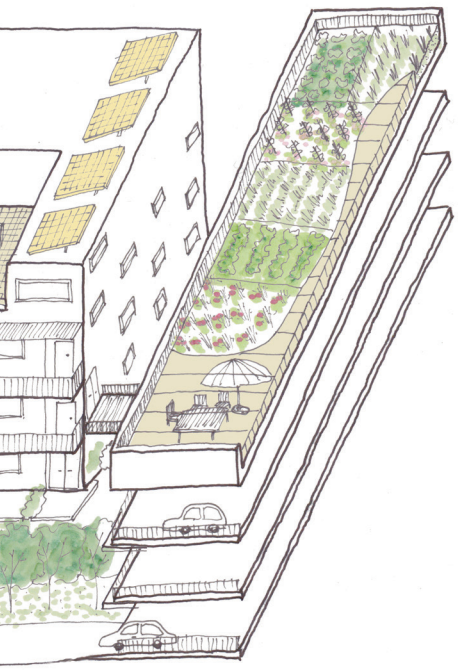

rain garden


green roof


soil filter


underground water storage

current site conditions



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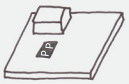
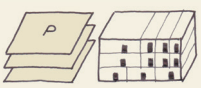


Setback

- major road : 100 ft
- residential road : 50-60 ft

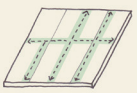
Open space / GFA ratio

- should not restrict the lot size, but control the ratio of open space and gross floor area
- open space consists garden, terrace, accessible rooftop



Minimum parking space

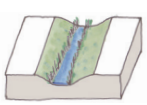
- only apply for apartment complex
- parking lot should reserve partly area for common parking in the neighborhood
- incentive for vertical parking



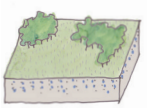
Sidewalk connectivity

- continuing sidewalk through secondary greenway/ block edge

proposed building + water principles



helophyte filter



infiltration grassland

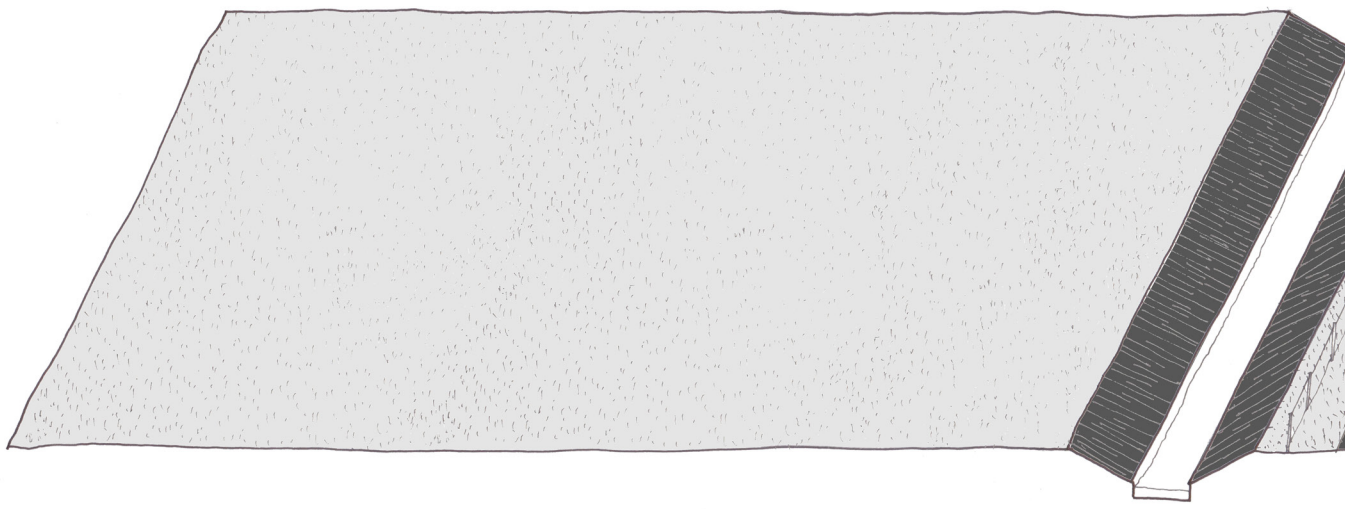
water storage / Open space ratio

- individuals (private house owner, apartment community) should equip certain water storage capacity based on the size of open space

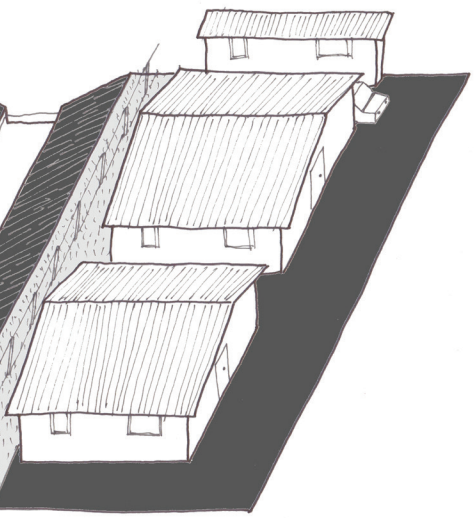
street water storage & channel capacity

- street should equip facilities (underground water tank, channel, porous surface...) to contain stormwater and collect runoff from blocks

current site : Hunting bayou branch



current site conditions

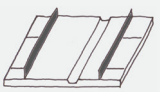


Mono-function waterfront

- covered by grassland with low use of people and low natural values

Unaccessible waterfront

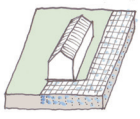
- mostly surrounded by private lots with few hidden access from streets



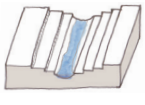
Vacant lots beside waterfront

- high flooding risk leads to low development alongside water

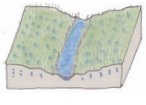
intervention : multi-function waterfront



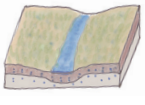
porous pavement



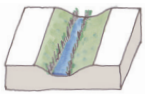
flexible water level



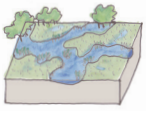
flexible water level + infiltration



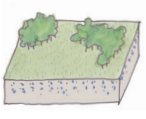
soil filter



helophyte filter



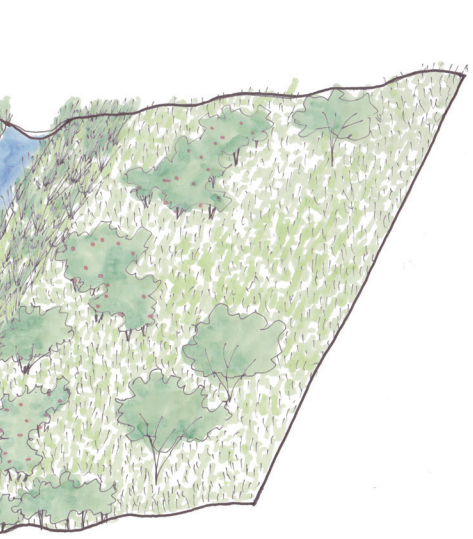
wetland



infiltration grassland

enlarg

current site conditions



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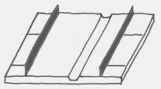


Vacant lots beside waterfront

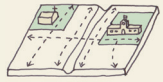
- high flooding risk leads to low development alongside water

Multi-functions development

- waterfront development should be specific about purposes of open space: preserve for natural values, providing public open space...
- purposes should be decide by the needs of neighborhood, and prove efficient facilities

Network connectivity

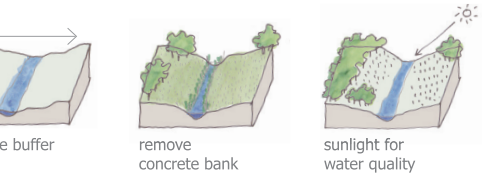
- waterfront should be considered as spine organizing nearby open space with green connections
- green connections should function as soft transportation and ecosystem network that also indicate the direction of waterfront



Public accessible facilities beside waterfront

- arranging public facilities alongside waterfront to increase the accessibility and use of the land

proposed building + water principles



e buffer

remove
concrete bank

sunlight for
water quality

Vegetation for water quality and natural values

- provide diversity of vegetation for preservation area to increase natural values
- implant helophyte filter along lowest water front
- control heights of vegetations to secure water quality by providing sufficient sunlight

Bank typologies according to functions

- replace concrete bank with soft edges
- apply multi-layers to adopt different water level according to the functions

Chapter 8 Conclusions

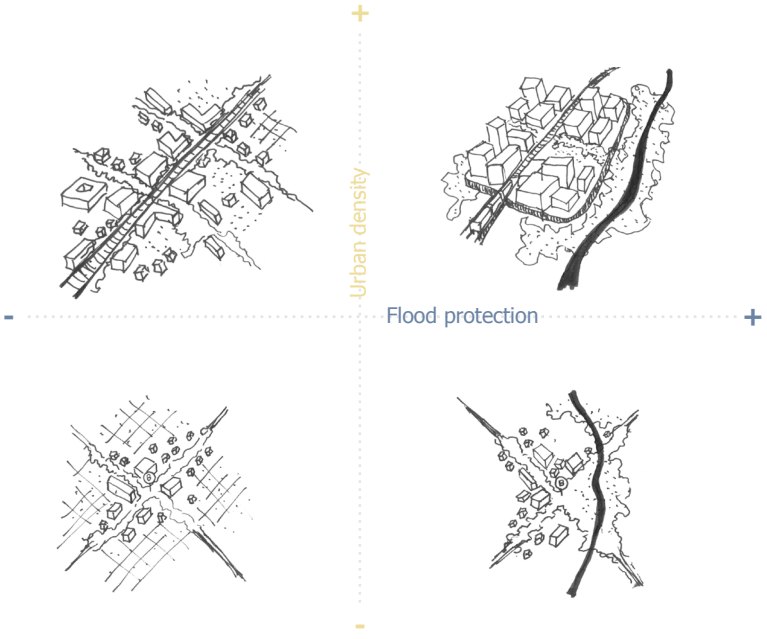
Scenarios: urban density & flood protection & metropolitan vision

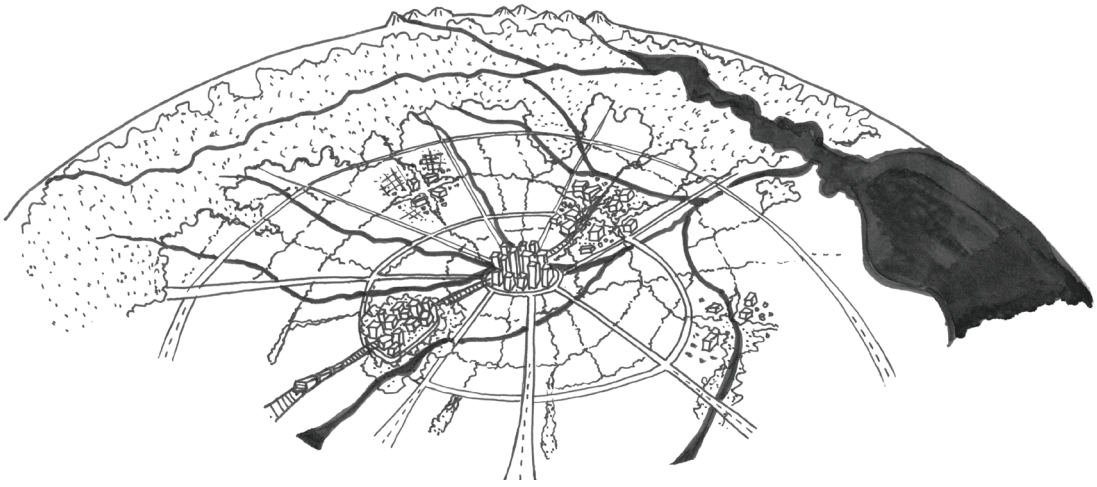
Scenarios : urban density & flood protection

The scenarios try to discuss the dynamic balance of water and urban form. Using design interventions at Kashmere Garden as the standard point, the scenarios explore four possibilities in the extreme conditions, according to the locations and future climate change. But still, the changes are based on common principles. The centers are all organized at the joints of green networks. In the high-density + high-flood-protection scenario, the buildings need to be compact and develop the volume vertically to reserve space for water and secured by elevated land. If the flood risk is low, high density can be formed with middle-rise buildings with more public space in a larger area. In the high-density scenarios, transportation with high capacity can be established. Low-density + low-flood-protection scenario is considered as local (sub) center. Intensification is applied linearly along green connections, and the remained land can be considered for local productions.

Metropolitan vision

Green network is established to serve as the backbone of intensification. Population is centralize in the centers at the joints of green network. Centers generated their own identities and perform as different roles to support each other. Public transportations are established in hierarchy between connections of centers. Periphery is preserved for natural value and restrict the sprawl expansion.





Houston metropolitan vision 2050
The vision shows conceptual ideas for reconstructing sprawling city into compact urban environment. Four scenarios for center do not indicate specific locations.

Reflection /
Project review from quantitative outcomes

The three main objectives this project are repaired sprawl patterns, low flooding risk, and reduction of automobile dependency (reduction of energy consumption). In this page, the design intervention on community scale is reviewed with the quantitative outcomes, in order to examine if the strategies are affective to achieve the objectives. The review consists two questions as below.

Based on the theoretical analysis: Ped Shed /" Reconstructing an automobile dependent city" model, does the area have sufficient population and amenity to perform as a center?

The necessary amount for a reasonable local center (and a public transport service to support it) is approximately range from about 8,000 to 19,000 residents plus jobs within this 10-minute walking area (300 ha). The range is from around 70,000 to 175,000 people and jobs within 30-minute walking area (3000 ha) for a town center. Any less than this means services in such a center become impractical (Newman & Kenworthy 2006).

Due to the time limits, the intervention doesn't cover whole the 10-minute walking area, only demonstrates the central part. The designed area is around 10 ha and can accommodate approximately 1000 residents. But this location is covered with a high percentage of waterfronts, which is not the common pattern. The calculation should only counted the residential area, which is about 3.5 ha. This means this degree of intensification increases density 23 times. The average density in this region is 5; so current population should be around 1450 (5 x 290ha) of the un-designed area. To reach the essential population (8,000) of a town center, the un-designed area should increase the density about five times (into 7,000 person), which seems to be possible. To sum up, although the calculation is not precise, from the rough assumption, this degree of intensification is possible to transform the suburban into a reasonable center. When more centers are formed in the regional structure, strong public transportation network can be established. Sprawling pattern can be restructured into compact urban form, and the automobile dependency will be gradually reduced.

What degree of flooding can be prevent with the designed water storage capacity ?

Long-term data from Harris County Flood Control District shows the area has the average of 1-2 days with short but strong rainfall per year. The maximum amount is 11.78 cm per day approximately. Serious storms also occurred sometimes. During the tropical storm Allison in 2001, the heaviest rainfall per day is 23.95 cm in the area.

During the heavy rainfall, the area needs to contain around 12,000 m^3 of water (11.78cm x 10 ha). The estimation of water storage capacity for the designed area is 24,900 m^3, which is two times more than the need. To consider the general condition, bayou storage capacity should not be counted. As mentioned in the previous chapters, the urban fabric should be able to contain and storage water before the water can be transport to the bayous to prevent flooding. To calculate more accurately, if we only consider the residential area, the street profile (greenways plus ditches) can store 2,400 m^3 and the individual storage is around 1,000 m^3. The rainfall per day is 4,200 m^2 within 35ha, which means without any discharge the water interventions can contain and storage 81 % of rainfall. If the discharge is counted, theoretically, the interventions are sufficient to prevent flooding from heavy rainfall. Furthermore, the space for water is possible to be reduced and consider to use for increasing urban density.

Estimated quantitative changes

Water storage

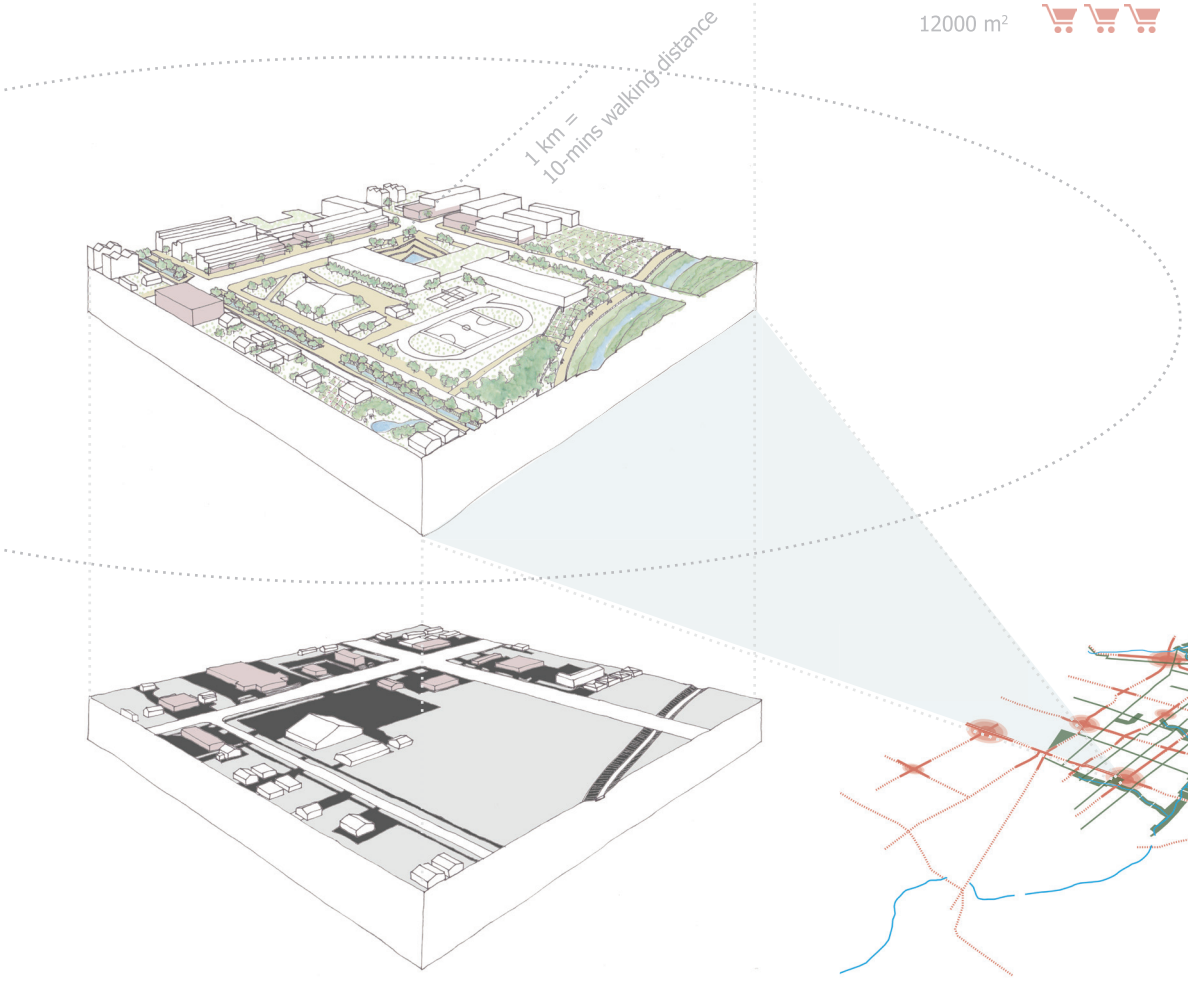
2350 m³ ▼ 24900 m³

bayou	17400 m³
secondary greenway	4800 m³
ditches	300 m³
water square	1400 m³
individual storage	1000 m³

Housing 16 houses ▼ 31 houses + 300 apartments

Population 43 inhabitants ▼ 1000 inhabitants

Commercial 8000 m² ▼ 12000 m²



Further research

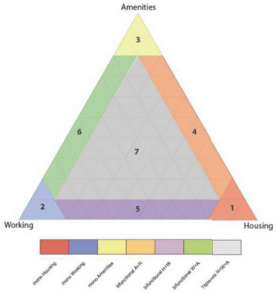
The project tries to include bigger range of research processes from transforming regional structure, implementing regional strategies on community scale with design interventions, suggesting regulations for urban development to providing future vision for the metropolitan. Due to the time-limit, some fast decisions were made according to general ideas from theories. Each process remains some parts that have the possibility to be researched further.

For the regional structure, detail mapping for functions (amenity) and building form can be made based on systematic methods. With these data, the intensified nodes and axis can be decided more accurately.

For the design intervention, it can include bigger area, in order to have deeper discussions for urban system. For example, how the density should distribute, what kinds of public transportation can be applied, What kind and how many amenities are needed in the specific area.

For the spatial principles, the project provide more conceptual ideas rather than specific rules. Quantitative data for water and urban forms are essential to improve the ideas into applicable regulations. But still, this is difficult subject to be developed in Houston. Houston urban development regulations are very complex. There are very few unified governmental regulations. Every area has their own rules decided by the real estate developers. This should be further discussed in the governmental level.

For the vision of Houston, the project suggested conceptual ideas for reconstructing this automobile dependent city and reducing the flood risks. It can be further elaborate in to strategic plan with thorough understandings for identities of districts .



- The seven functions:
- Residential
- Working:Offices
- Working: Industries
- Services
- Commercial uses
- Cultural & recreational uses
- Public & social functions

Systematic method for amenity mapping:
Categorizing mixture of function, MXI (Source: Van Den Hoek, 2011)

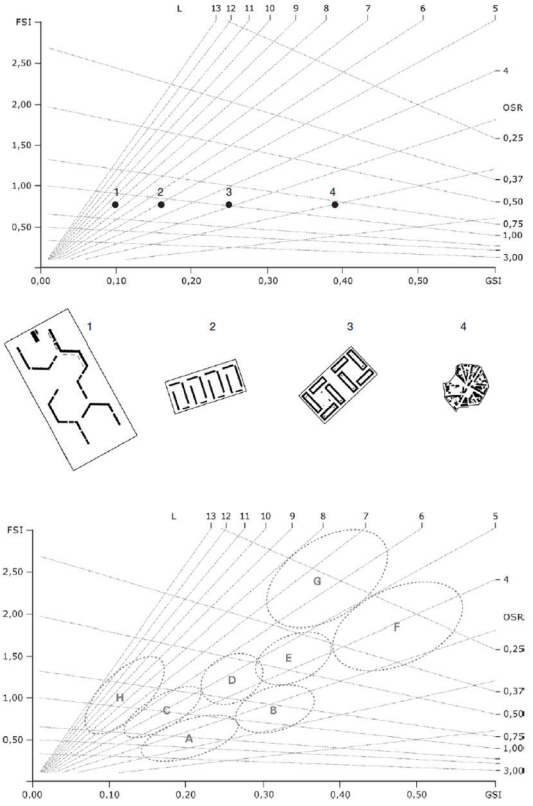


Figure 6. Land development typologies:

A. Low-rise spacious strip developments blocks
B. Low-rise compact strip developments blocks
C. Mid-rise open building blocks
D. Mid-rise spacious building blocks
E. Mid-rise compact building
F. Mid-rise closed building
G. Mid-rise super blocks
H. High-rise developments

Systematic method for building form mapping and research: the Spacemate (source: Berghauser Pont & Haupt, 2006)

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