Urban Ecology

Soft natural borders against flooding in Houston

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Presentation Structure

1. problem Statement & Houston in context

2. research and strategies

3. Site Analysis & design strategies
Buffalo Bayou // urban patterns
Suburb // Culs-de-sac

Downtown // square grid

Industry // linear

Water as hidden system
No interaction
Hidden

Water as secondary system
Indifferent
Visible

Water as main system
Interaction
Visible
Flood by rainfall
Bayou Wilderness Today
Bayou Wilderness before
“There is an increasing evidence suggesting that mental health and emotional stability of populations may be profoundly influenced by frustrating aspects of an urban, biologically artificial environment.

It seems likely that we are genetically programmed to a natural habitat of clean air and a varied green landscape, like any other mammal. The specific physiological reactions to natural beauty and diversity, to the shapes and colors of nature, especially to green, to the motions and sounds of other animals, we do not comprehend and are reluctant to include in studies of environmental quality. Yet it is evident that in our daily lives nature must be thought of not as a luxury to be made available if possible, but as part of our inherent indispensable biological need.”

Prairie landscape
Settlement (1836)

Source: https://www.birdseyeviews.org/zoom.php?city=Houston&year=1873&extra_info=
Oil was discovered (1901)
Houston // Growth

1836 // The Allen Brothers settle Houston at the confluence of the Buffalo and White Oak Bayou.

1900 // Houston grew 9 square miles (population 44,000). In 1901 oil was discovered.

1910 // Houston grew beyond the centre core, and made a connection with the Ship Channel. In 1914 the construction of the Ship Channel was started.

1940 // Houston doubled in size and reached a population of nearly 600,000. In 1942 the Medical Centre was established, and in 1948 the first Highway towards Galveston was constructed.

1950 // Houston was 350 square miles with nearly 1 million residents. In 1956 Lake Houston was created to supply the city with fresh water.

1960 // Lake Houston further expands. In 1961 NASA established in Houston. In 1968 the second ring highway was constructed. In 1969 the George Bush Intercontinental Airport was built.

1980 // The cities population grew to 1.6 million. In 1974 there was the oil crisis.

2000 // Despite the slow growth, the cities population grew to in 2012 more than 2.1 million residents.
Soil and not native vegetation

Cultivated turf
Clayey surface
Sand
Groundwater

Source: Google Earth and Google Streetview
Soil and native vegetation

Clayey surface

Loamy surface

Loamy & clayey sub surface

Sand

Sand

Groundwater

Groundwater

Source: https://plotsquared.files.wordpress.com/2013/02/soil-native-vegetation.jpg
Houston // The Bayou city

Natural and manmade drainage systems

Houston // The Bayou City

Shallow Floodplain

Floodway
100-year Floodplain
500-year Floodplain
100-year Coastal Floodplain

Source: Shallow floodplain covers the majority of Houston // Harris County Flood Control District

Harris County's 4 Types of Floodplains

Source: Floodplains in Houston // http://mycity.maps.arcgis.com

Valley Floodplain
Shallow Floodplain
Major River Floodplain
Coastal Floodplain

Source: Floodplains in Houston // Harris County Flood Control District
Oil made Houston boom / car oriented city

How do Houstonians get to where they’re going?

- **Automobile**: 66% drive to the park.
- 78% drive to work.
- 86% drive to the bar.
- 95% drive to the grocery store.
- 97% drive to their place of worship.
- 99% drive to the mall.

Source: [http://www.gensler.com](http://www.gensler.com)
“Cities around the world are highly fragmented. The fragmentation of the built-up area and the open spaces interpenetrating them is a key attribute of urban-sprawl. And sprawl as fragmentation, as distinct from sprawl as lower-density development, is now a universal feature of cities.”


"Cities are expanding, and as they do urban sprawl—low-density urban development outside the urban core—is expanding even more rapidly. In some regions, expansion of suburban habitats as a result of shifts to automobile-dependent living has led to increases in the urban footprint even where populations have not shown large increases. These changes have a variety of effects on species and ecosystems, including impacts to water pollution, disturbance dynamics and local climate. Urban sprawl will also, almost certainly, influence the ability of species to respond to climate change, in as much as it creates barriers to the movement of species that cannot survive in cities and corridors for those who can."

Source: The Southern Megalopolis: Using the Past to Predict the Future of Urban Sprawl in the Southeast U.S

“Studies have shown that sprawl is damaging to both physical and social health, isolating people in car dominated environments where they are deprived not only of the physiological benefits of walking, but also of the natural human interaction typical of complete communities. “

Source: Tachieva, 2010, p 2-3
Fragmentation

Main Infrastructure Fragmentation

Secondary Infrastructure Fragmentation
Fragmentation

Lonely over Christmas: a snapshot of social isolation in the...
theconversation.com/lonely-over-christmas-a-snapsh...
9 dec. 2014 - Social isolation and loneliness are becoming common in our large cities.
... We know that social isolation can thrive in the suburbs - so how can ...
U heeft deze pagina bezocht op 24-8-15.

A snapshot of social isolation in the suburbs - CityMetric
www.citymetric.com/...citymetric-advent-22-snapsh...
22 dec. 2014 - Social isolation and loneliness are becoming common in our large cities.
Our cities are sprawling, housing is becoming more unaffordable, ...

(PDF) Mental Life and the Metropolis in Suburban America:
www3.nd.edu/~adult/.../oliver-hapconf_000.pdf
In conclusion, I suggest that the social isolation that accompanies the economic segregation of many suburban communities is an important source of suburban ...

Suburban Isolation - Amerika
www.amerika.org/social-reality/suburban-isolation/
9 aug. 2011 - ... but it's important for kids to learn social rules outside the home. ... Part of the isolation in our quiet, suburban lives is due to removing the idea ...
Habitat fragmentation (greensystem)

- Buffalo Bayou divides Houston in two
- Bayous as connector of fragmented habitat (greensystem)
1. Habitat fragmentation
2. Isolation of greensystem
3. No interaction and or movement between the greensystem is possible.
Arthur Storey Park (A)
1. No connections from urban fabric towards park.

2. No connections from urban fabric towards park.

3. Entrance from main road to park.

4. Dead end street towards park.

5. Dead end street towards park.

Source: Google Earth & Google street view
Challenges

1. Flood problems with heavy rainfall
   "Tropical Storm Allison (2001) devastated a large portion of Southeast Texas with an incredible amount of rainfall. Resulting in 22 deaths in the Houston area, more than 48,000 homes damaged (11,000 with major damage and 3,600 completely destroyed) and more than 70,000 automobiles flooded during the storm. Leaving 30,000 homeless with a residential damages of $1.76 billion."
   Source: http://www.srh.noaa.gov/hgx/?n=severe_weather_awareness_flashflood

2. Degradation of the ecosystems
   "The greater Houston-Galveston Gulf Coast region provides numerous acres of pristine and diverse ecological habitats, but these intact ecological areas are becoming increasingly threatened and fractured due to land and water development, expansion of the region, and built infrastructure to accommodate the growth of the region."
   Source: http://houstonwilderness.org

3. Lack of connectivity
   "So areas that were sprawling in the past seem to be continuing to sprawl more today," says Millard-Ball. "It’s more difficult to build a walkable neighborhood if there’s nowhere to walk to."

Source: Google maps
Source: https://altamnesiac.wordpress.com/tag/houston/
**Project aim & research question**

**Main research question:**
How can soft natural borders between the existing urban patterns, solve the flood risk in Houston, while restoring the ecosystems?

**Aim:**
Creating soft borders from the Buffalo Bayou into the urban fabric and visa versa, can strengthen not only the features of the ‘Bayou City’ but solve the flood risk while restoring the ecosystems. Creating a more sustainable and healthier environment for both humans and wildlife.
*greenway* (*grēn'-wā*) *n.* 1. A linear open space established along either a natural corridor, such as a riverfront, stream valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, a scenic road, or other route. 2. Any natural or landscaped course for pedestrian or bicycle passage. 3. An open-space connector linking parks, nature reserves, cultural features, or historic sites with each other and with populated areas. 4. Locally, certain strip or linear parks designated as a parkway or greenbelt. [American neologism: *green + way*; origin obscure.]
“The backbone for a park system for Houston will naturally its bayous and creek valleys... [which] furnish opportunities for parks of unusual value within a comparative short distance of most of the residential areas.” (Comey, 1913, p 9)
Research and theory
Theoretical framework

1. **How to transform the borders between (bayou) water system and suburban areas in order to implement the urban ecology framework and reduce flood risk?**

2. **How to integrate neighborhoods with soft natural borders: greenways and blue/green interventions, while reinforcing local characteristics and social conditions?**

3. **How to create strong new path systems (for biking, hiking and walking) to enhance the connectivity between the existing green systems, new greenways and blue/green systems?**
**Habitat // Hubs & Corridors**

Problems associated with habitat fragmentation:

(a) The patch size may decrease
(b) Between the patches the distance may increase
(c) Distribution of prey may change
(d) Productivity may increase, due to increased light penetration
(e) Habitat quality may decrease
(f) The importance of edge effects may increase


A corridor can also connect smaller patches with hubs.
**Linear Corridor**
Habitat corridors that provide a continuous connection of favoured habitat.

**Corridor with Nodes**
Habitats that assist movement through an inhospitable environment.

**Stepping Stones**
Habitats that assist movement through an inhospitable environment.

**Landscape Mosaic**
Managing the entire landscape mosaic to facilitate movement.
GREENWAY PLANNING STRATEGY

A. Desired network elements are identified and protected through planning policy and land use control in advance of negative landscape matrix changes.

B. Isolated core area in non-supportive landscape matrix is subject to isolation from disturbances to corridors and to incremental reduction in size of the core area over time. The defensive strategy defines a core area that can be protected through a new buffer zone.

C. Isolated core area is protected with a buffer zone and linked into a greenway network with corridors that are newly developed within a non-supportive landscape matrix context. The offensive strategy employs a range of tactics, including nature development, to achieve a desired landscape configuration.

D. Isolated core area is linked with an existing corridor, buffered, and a new supporting landscape matrix is developed. The opportunistic strategy takes advantage of unique circumstances that may only support some greenway uses, e.g. recreation.


INTEGRATION IN SURROUNDINGS

A “butter” design
1. Continuous vegetated corridor maintained through backyards of houses
2. Housing setbacks at minimum distance from road/maximum from corridor
3. Use of native vegetation/minimal threat due to spread of exotic species

A “source” design
1. Vegetated corridor narrow and broken; less movement of key species
2. Housing setbacks maximum from road/minimum from forested corridor
3. Increased threat of disturbance to natural vegetation due to use/spread of exotics

Source: Schematic applications // Landscape Ecology principles (1996) Dramstad, Olson & Forman
**Patch - Corridor - Matrix Model**

- **Buildings (matrix)**
- **Woodlands (patch)**
- **Individual trees (patch)**
- **Parkland (patch)**
- **Row of trees (corridor)**
- **River (corridor)**
- **Brownfield site (patch)**
- **Gardens (patches)**
- **Roads (corridor)**

Source: Urban Ecosystems (2013) Francis & Chadwick
A. DEFICIENCY: LACK OF WALKABLE BLOCK STRUCTURE

B. REMEDIAL TECHNIQUES: CONNECT AND REPAIR THOROUGHFARES

C. OUTCOME: WALKABLE NETWORK AND BLOCK STRUCTURE

A. DEFICIENCY: SPRAWL THOROUGHFARE

B. OUTCOME ONE: CLOSE

C. OUTCOME TWO: ROAD

A. DEFICIENCY: SUBURBAN FABRIC WITH CUL-DE-SACS

B. REMEDIAL TECHNIQUES: CONNECT CUL-DE-SACS WITH PEDESTRIAN AND BICYCLE NETWORKS

C. OUTCOME: PEDESTRIAN AND BIKE PATHS
1. Identify and retain existing habitat

2. Native plants should be used to extend the existing natural boundaries -> native wildlife

3. Boundaries should be curvilinear and coves and lobes should be present

4. Create tiny patches to soften the boundaries -> allow animal movement along the edges

5. Create a stratification of vegetative structures across site

6. Create a buffer between the greenway and the surrounding urban fabric

7. Create areas that provide human - animal interactions and areas that provide separation of spaces.

8. Create and maintain connections to other patches to aid animal movement through the design area.

9. Specific key ingredient for Houston
SITE ANALYSIS & DESIGN STRATEGIES
1. Isolation of greensystem

2. No interaction and or movement between the greensystem is possible.

3. The green-blue network connect the isolated green systems and movement is possible between them again.
Middle strip of the street will be used for:

a. Slow traffic
b. Water discharge towards the bayous (biowales/spring garden)
c. Natural buffer (native vegetation) between slow traffic and car (two way street on both sides)

This will provide movement for people, animals and vegetation between the greenways around the bayous and connect the existing green systems (parks etc.)
Middle strip of the street will be used for:
- Slow traffic
- Water storage (ponds)
- Natural buffer (native vegetation) between slow traffic and car (two way street on both sides)

Front yards:
- Native vegetation
- Add ponds for extra water storage

This will provide movement for people, animals and vegetation between the verticle streets towards the greenways around the bayous and connect the existing ecosystems (parks etc.)
Connectivity // path systems
Connectivity // Dead end streets
Buffalo Bayou // Interaction

Woodway Dr

Chimney Rock Rd
Connectivity // Bridges
Existing parks are now mostly covered with non-native turf. Change as much as possible into native vegetation and add water elements like a pond for extra water storage.

Dead-end streets towards a park should be extended towards the park edge, create a clear, appealing entrance that is recognizable as a park entrance.

When the parks are not connected with the new street profiles of street type 1 or street type 2, the roads towards the park should be change in street type 3, this to connect the park within the green/blue network and to establish movement between the green systems.
// Arthur Storey Park (A)

// Bendwood Park (B) & Houston Audubon Society (C)
3. Vertical tertiary street profile

Part of the front yards along the street will be used for:

a. Slow traffic
b. Water discharge towards the Bayous (bioswales/raingardens)
c. Native vegetation

This will provide movement for people, animals and vegetation towards the main entrances of the greenways around the Bayous. These streets are connected with a type 1 or 2 street profile.
4. Street:
   a. Add slow traffic network

   Front yard:
   a. Native vegetation

   Neighborhood park:
   a. Native vegetation
   b. Water storage (pond)

These streets will provide a connection with type 1 or 2 street profile, and integrate the existing green system with the green blue network.
Site // focus areas

A. Area within a 500 year floodplain
B. Area within a 500 & 100 year floodplain
C. Area with no floodplain
Focus area A // With 500 year floodplain

Focus area B // With 500 & 100 year floodplain

Focus area C // With no floodplain
Zoom in focus area's

Area A

Area B

Area A

Area B
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<th>Area A</th>
<th>Plot</th>
<th>Building Type</th>
<th>Border / Edge</th>
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Programme
Natural playgrounds

Once children were exposed to less plastic and more nature, some amazing results occurred:

- Children became more active overall.
- Children appeared to use their imagination more while playing.
- Children more than doubled the time they spent playing overall.

Source: research published by inhabitots // http://www.inhabitots.com

Source: http://www.space2place.ca/garden-city-play-environment/
Mapping the potentials
**Design Principles**

- Use part of the plots for greenway
- Use whole plot for main entrance for the greenway -> expropriate plot
- Use part of one or two plots for secondary entrances for the greenway -> expropriate part of the plots
- Around the Bayou in time the private plots can be merged into one shared plot, were the new houses should be built on poles with their orientation towards the Bayou.

- Extend dead end streets and cul de sac as secondary entrances to the greenway
- Connect dead end streets on both sides of the Bayou with a slow traffic bridge
- Plots situated at the dead end of the streets which needs to extend to the greenway will partly be used for this extension
- Plots situated on the street towards the main entrance of the greenway expropriate part of the plot for extra space for slow traffic and for bioswales for rainwater discharge towards the Bayou.

- A dense shared plot (no gardens) gradual transition into the greenway
- Plots within a floodplain should use as much as possible native vegetation
- When houses in a high dense area are decayed and need to be rebuilt, green roofs are desirable to decrease the paved surfaces (or impermeable soil surface)
- Plots situated outside of the a floodplain would be suggested to introduce ponds in the garden for water storage
- Hard border towards greenway -> secure privacy or safety residents
- Soft border towards greenway -> for more open character
Design Principles

Both paths are curvy for a more natural character and experience.

Main path system has a closed character:
- Concrete provides uses for biking and running
- Can be used extensively

Secondary path systems have an open character:
- Vegetation can grow in between strips
- Less heavily used (more closer to urban fabric)
- Less paved surface

Main entrance bridges wide and easy to bike and run (concrete??)

Secondary bridges smaller (less wide) more open character

Heightened path when natural habitat needs to be protected. So habitat is visible for people but do not interrupt with natural processes

Use as much as possible the native vegetation and related vegetation patterns

Additional space for the Bayou apply in floodplain areas and as possible create a natural habitat (wetland)

Children's waterplay park can work with water storage under the playing field
Area A with activities, paths and ecology
Area B with activities, paths and ecology
Area C with activities, paths and ecology
Figure 3: Prospectur for a Healthy Houston (2012) Crompton
Thank you for listening. Questions?
Site // Focus area A // sections

Focus area A // Open space & potential greenway space
Site // Focus area C // section

Focus area C // Open space & potential greenway space
Fragmentation on site

1. Division by infrastructure

2. Between infrastructure network ‘islands’ appear

3. The ‘islands’

4. Secondary infrastructure are connecting the ‘islands’ in between

5. The Buffalo Bayou is a connector which connect a string of ‘islands’

6. Adding a greenway around the Buffalo Bayou can create a wider connection

7. Dead end streets towards the Buffalo Bayou

8. Adding a trail and or path systems for slow traffic along the Buffalo Bayou

9. New trail or path system provides the opportunity to connect the dead end streets over the Buffalo Bayou
Impermeable surfaces

Impermeable surfaces (paved surfaces like roofs and roads)
The Riverway section of the Muddy River under construction in 1892

View upstream shows the Riverway of the Muddy River in 1920

Source: http://www.muddyrivermoc.org

The Muddy River nowadays

Source: https://kathrynwarmstrong.files.wordpress.com/2014/10/muddy-river-sun.jpg
Rio Madrid (2007 - 2011) // West 8

Banks of the Meurthe Raon-l’Étape, France (2012) // Atelier Cite Architecture

Design Parameters

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Nature: Urban
Red Ribbon (2007) Qinhuangdao, Hebei, China

// Turenscape

• Pollution
• Floodrisk
• Repair ecosystems