

# RESILIENCE ACCELERATOR

# MONTEVIDEO

WORKSHOP REPORT APPENDIX

SYNTHESIS DRAWINGS  
CASE STUDIES  
FUTURE SCENARIOS  
MAPS



COLUMBIA

Center for  
Resilient Cities  
and Landscapes



Intendencia  
de Montevideo

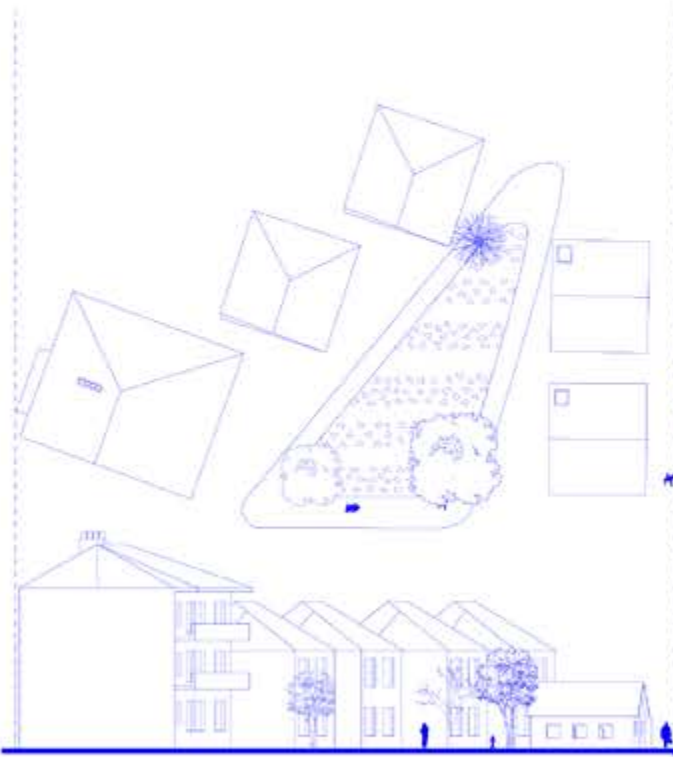
# APPENDIX 1

## SYNTHESIS DRAWINGS

### Maracaná

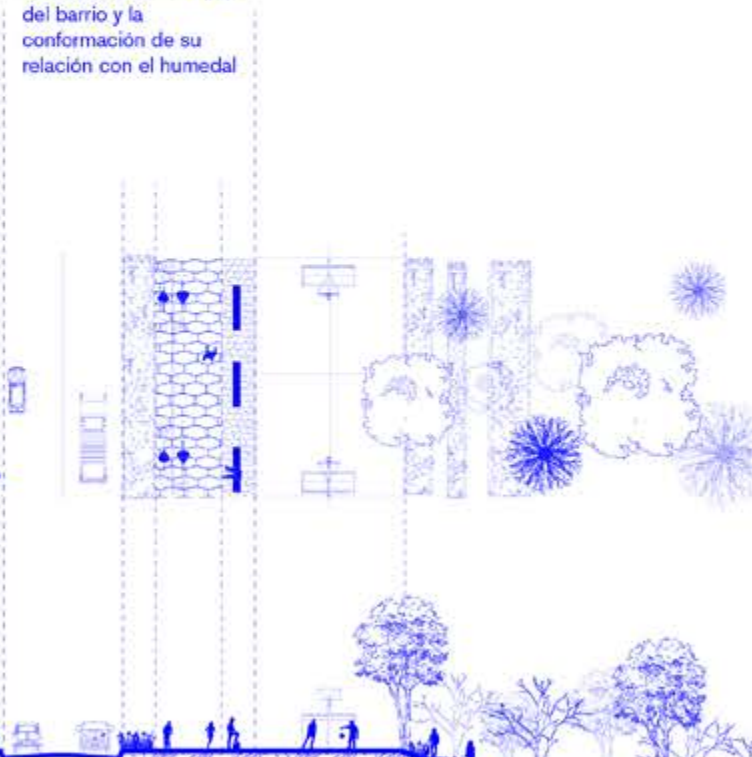
#### Densificación del tejido urbano

Para los nuevos procesos de urbanización de Maracaná se incorporará unidades de vivienda de más de un nivel, así como usos mixtos en las planta baja para mejorar el acceso a servicios comerciales.



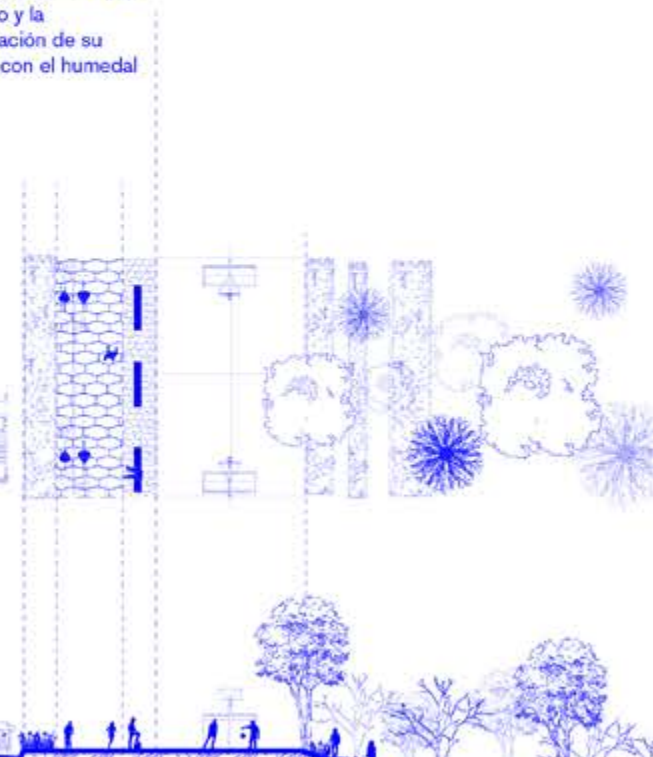
#### Eco rambla

Generar una superficie inspirada en la rambla que utilice diferente tipos de pavimentos para la construcción identitaria del barrio y la conformación de su relación con el humedal



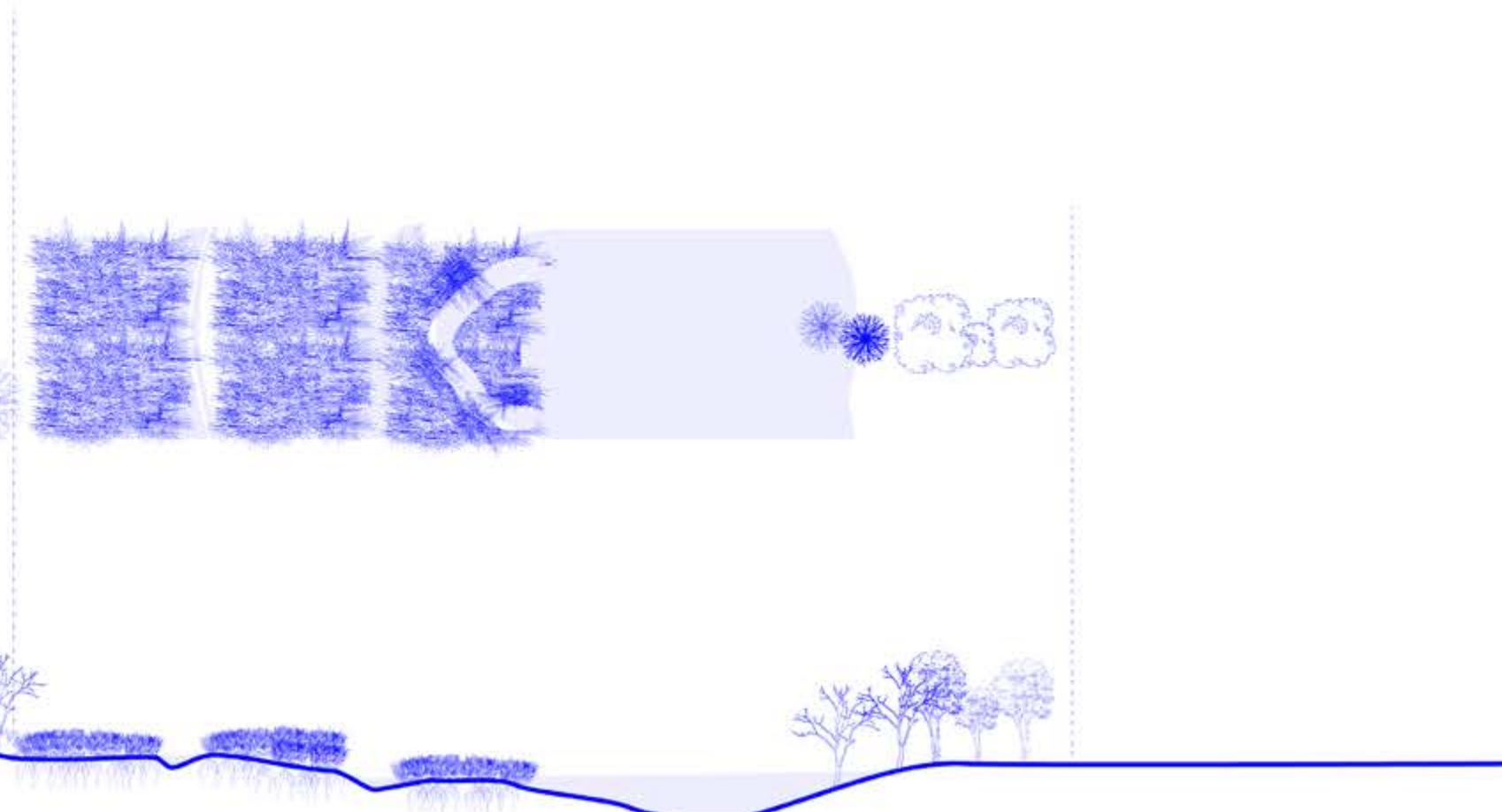
#### Cubrir rellenos

Remover basurales clandestinos y cubrir la superficie con vegetación nativa o implementar infraestructura deportiva para evitar las ocupaciones ilegales del humedal



#### Apertura de la planicie

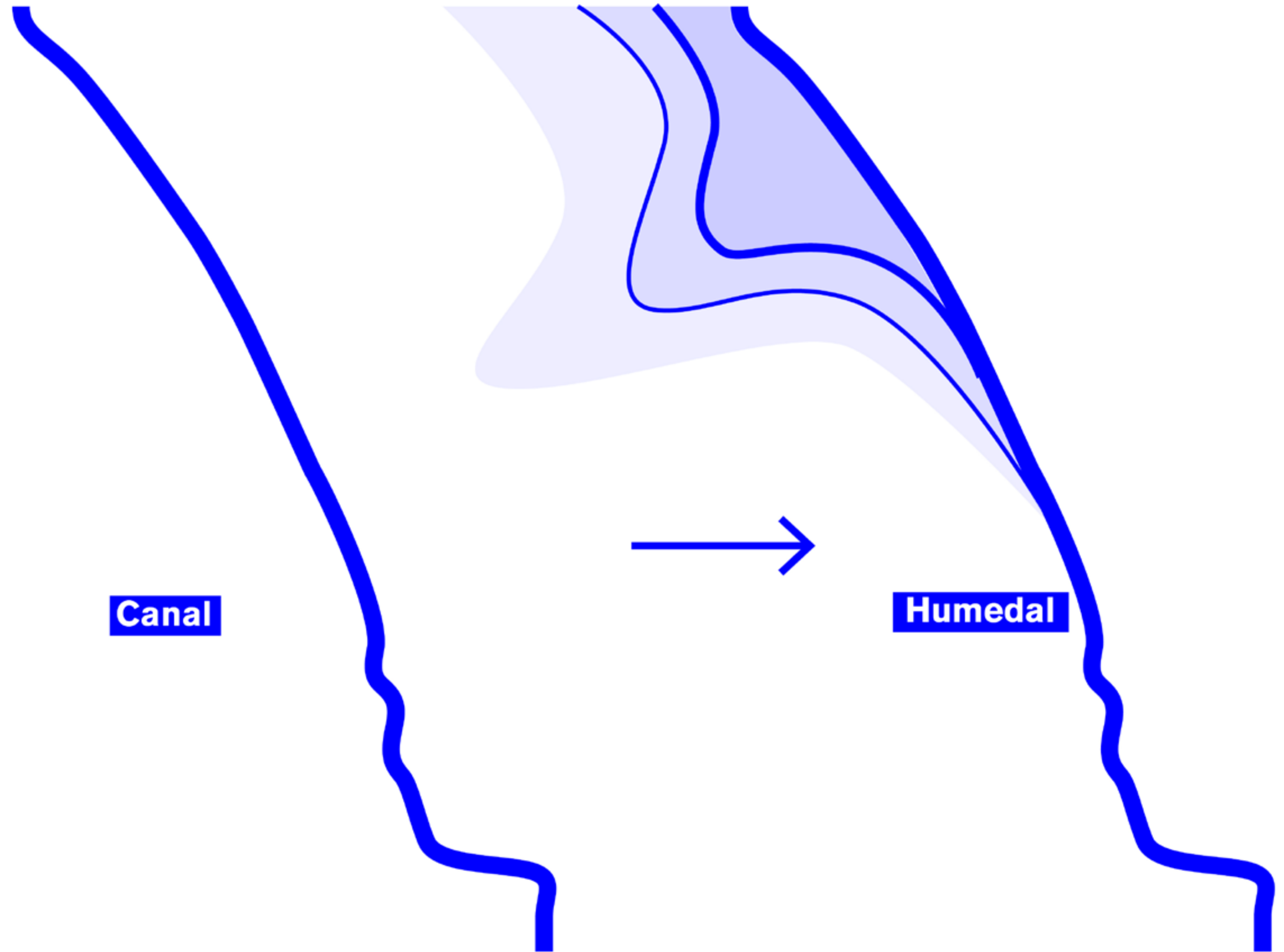
Mediante zanjas permitir que el Arroyo inunde nuevamente la planicie y revitalice el humedal



# Estrategia para recuperar el humedal

## Maracaná

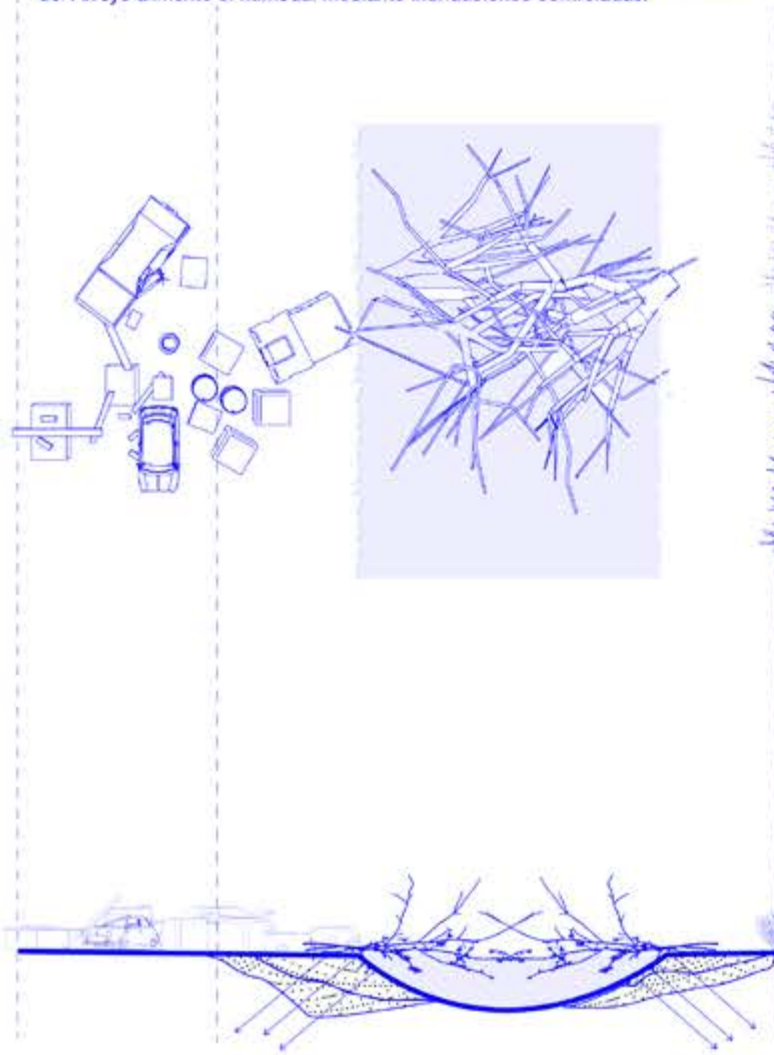
Facilitar el desborde del Arroyo mediante la construcción de zanjas que permitan una inundación controlada del humedal y que a la vez permitan generar un nuevo espacio verde para la comunidad.



# Cantera del Zorro /Cachimba del Piojo

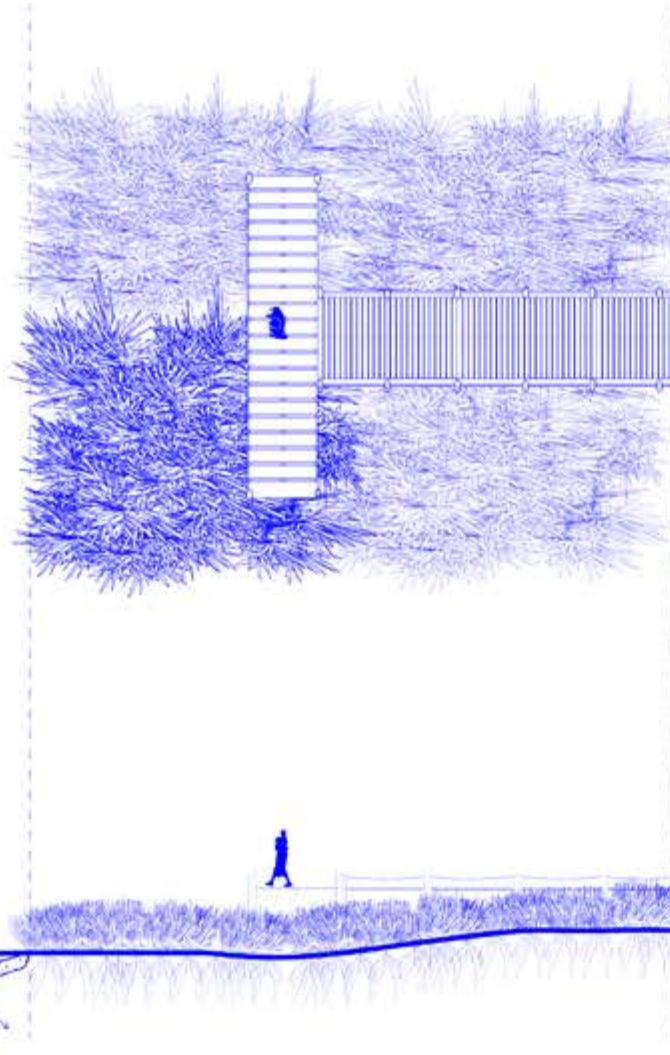
## Naturalización del borde

Retirar los desechos sobre el borde del Arroyo y el Humedal para restaurar el flujo natural del cauce del Arroyo.  
Desestructurar el borde generado por los procesos de dragado para recrear nuevamente la planicie de inundación.  
Generar mini represas de material orgánico para permitir que el agua del cauce del Arroyo alimente el humedal mediante inundaciones controladas.



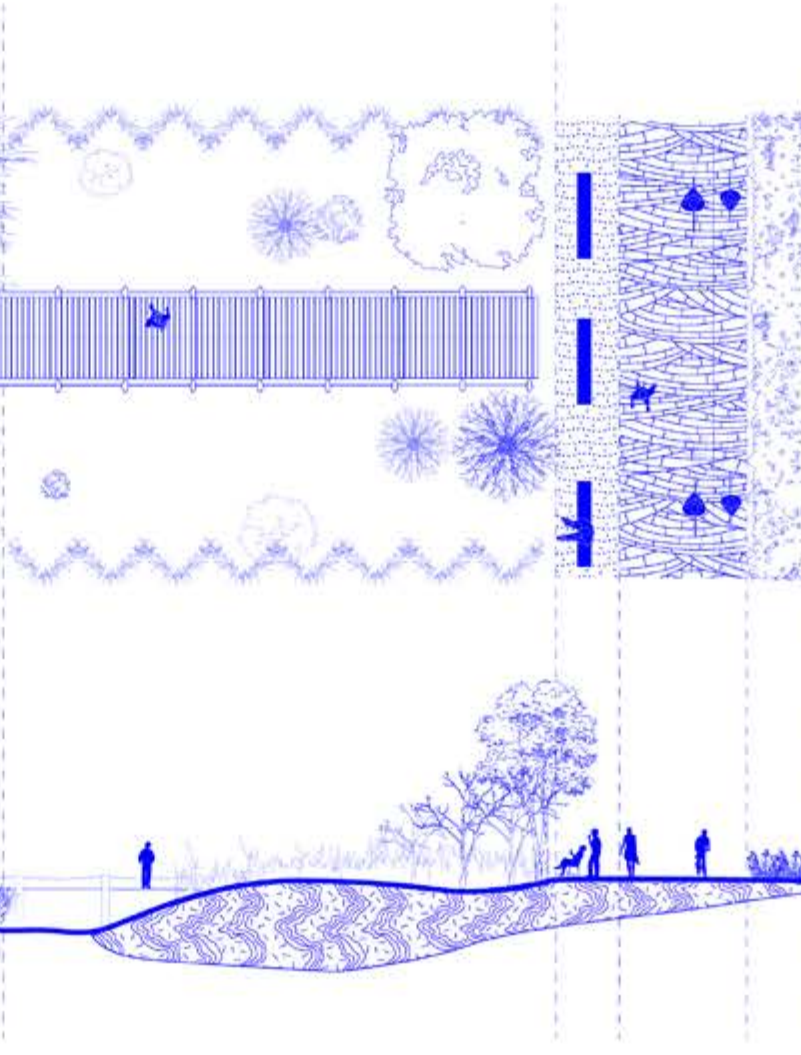
## Protección del bañado

Considerar una intervención sobre el bañado que apoye actividades educacionales en la cual la presencia humana no arriesge la integridad del humedal



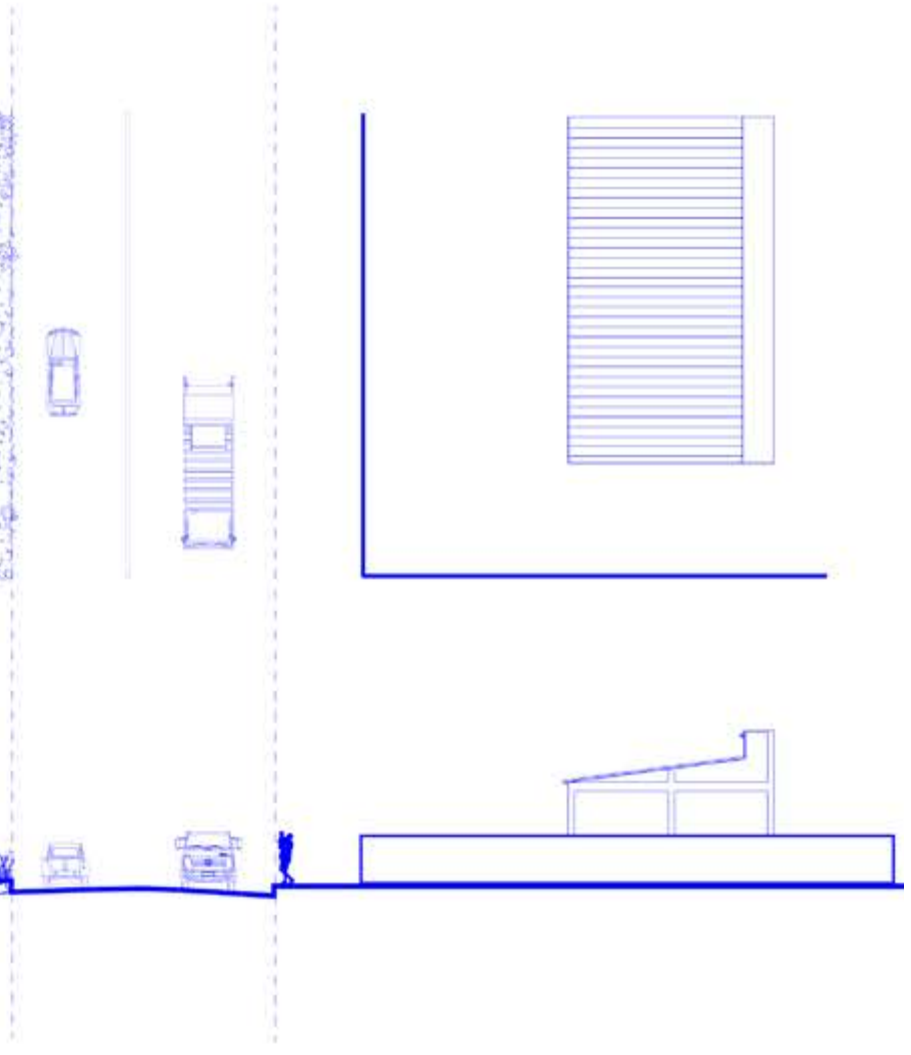
## Cubrir rellenos

Remover basurales clandestinos y cubrir la superficie con vegetación nativa para evitar las ocupaciones ilegales del humedal



## Eco rambla

Generar una superficie inspirada en la rambla que utilice diferentes tipos de pavimentos para la construcción identitaria del barrio y la conformación de su relación con el humedal

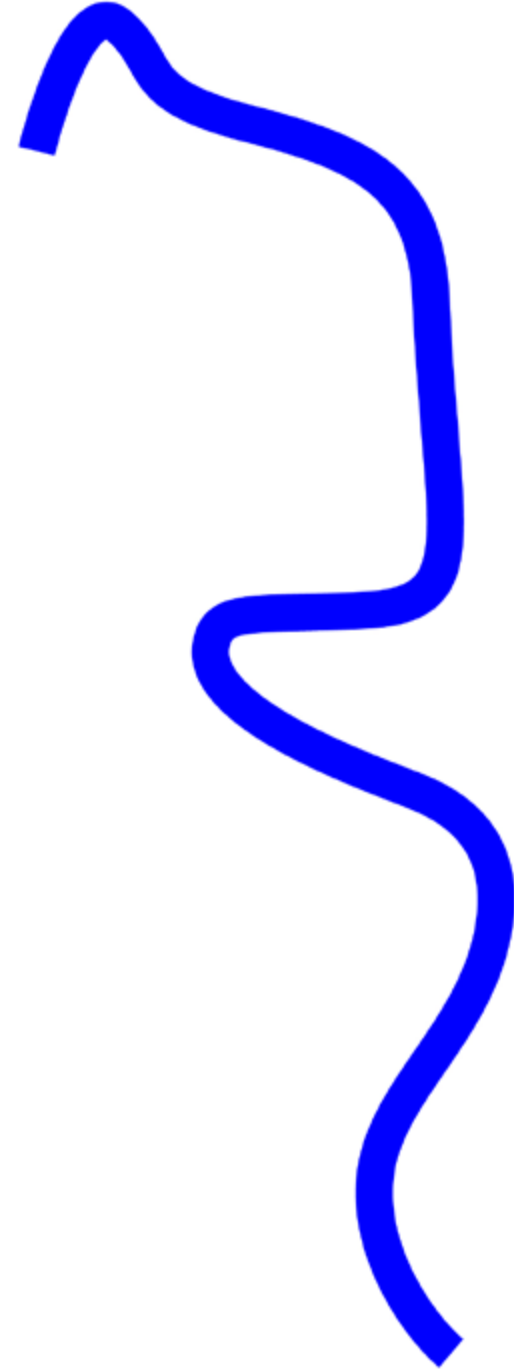


# Estrategia para recuperar el humedal

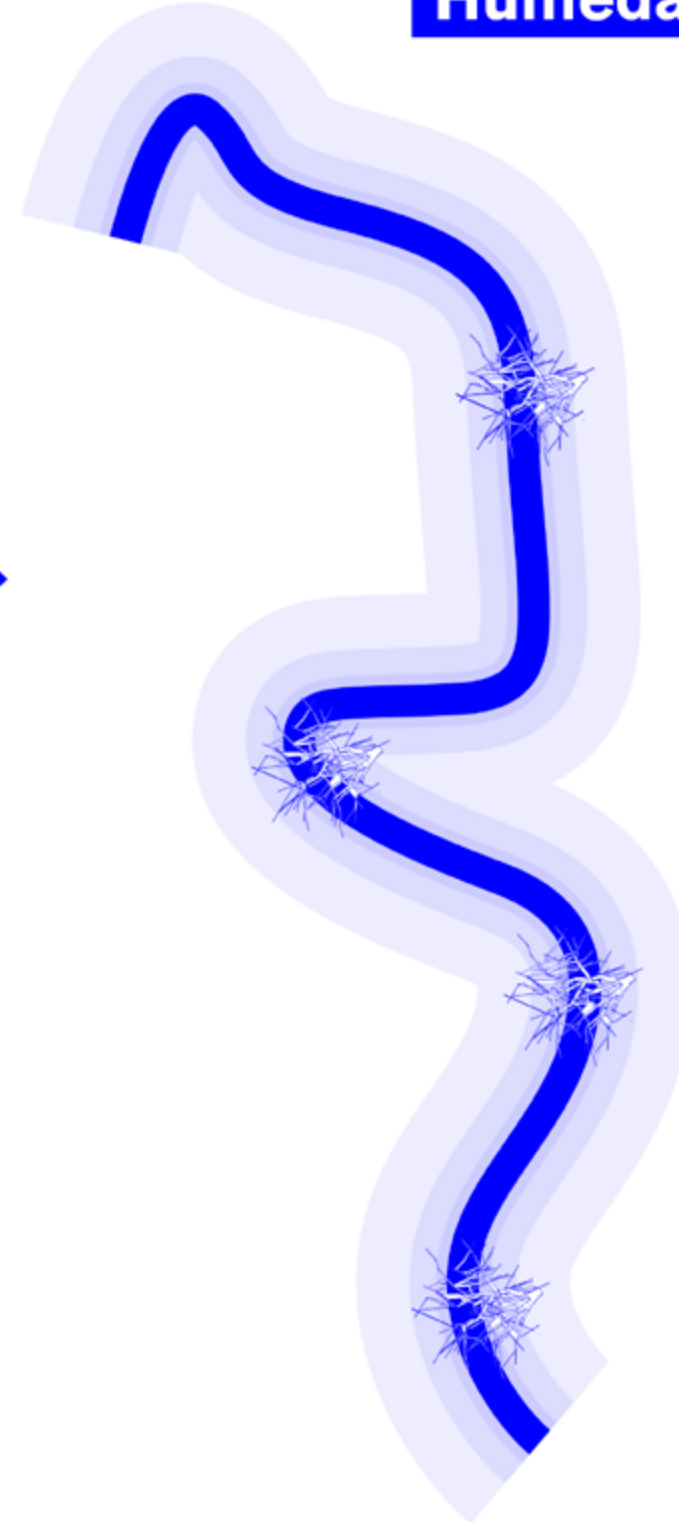
## Cantera del Zorro /Cachimba del Piojo

Naturalizar el borde del Arroyo para llevarlo de la situación actual de canal a una de humedal con inundaciones controladas mediante represas de material orgánico

**Canal**



**Humedal**



# APPENDIX 2

CASE STUDIES



**Pantanosos wetland**  
Montevideo, Uruguay

3 kilometers / 1.8 miles





**Tootgarook wetland**  
Victoria, Australia

3 kilometers / 1.8 miles



# TOOTGAROOK WETLAND

## VICTORIA, AUSTRALIA

### BACKGROUND

The Tootgarook Wetland is the largest groundwater-dependent ecosystem and freshwater marsh in Victoria, Australia. The wetlands have experienced significant change since colonization. The indigenous people, the Boonwurrung, once lived with the landscape surviving on its plentiful natural resources. Europeans transformed the landscape through agricultural practices and later peat extraction. With growth and a demand for housing, the swamp was drained to develop residential units, diminishing the landscapes conditions and available natural habitat. The local government, Mornington Shire Peninsula, has struggled to manage the land because now over 80 percent of the wetland is privately owned. Fragmented ownership has limited the amount of public access to the natural asset. Concerned residents of the Mornington Shire Peninsula have demanded more public access, environmental improvement, and the preservation of the indigenous cultural heritage of the Tootgarook Wetlands. As a result, the Shire Council developed a comprehensive Tootgarook Management Plan. (1)

### PROCESS

The Mornington Peninsula Shire government, sought a community led and co-owned process. Over three years, local government, engaged the community through public open sessions. They also formed a Project Working Group with representatives from multiple agencies and a Stakeholder Advisory Committee with representatives from the community, private landowners and private sector stakeholders. As a result of this three-year engagement process, the Shire created a the Tootgarook Management Plan in partnership with the consulting firm BMT and Conservation Volunteers Australia. The Plan was adopted by Shire Council in May, 2018.

### OUTCOMES

The plan includes recommendations to protect, conserve and promote the area. Actions include the creation of a land holding trust; rezoning city-owned land; an agreement between the government and community groups to coordinate environmental monitoring; an ongoing community reference group to share information and coordinate development of a community participation plan; as well as regular field surveys to establish ecological

data sets and evidence-based benchmarks which will act as a baseline to evaluate the progress of the Plan. Many of the actions outlined in the Plan will take several years to implement, the Mornington Shire Peninsula will need to continue working with stakeholders to determine the effectiveness of the process

1. "Tootgarook Wetland Management Plan." Mornington Peninsula Shire. Accessed March 08, 2019. <https://www.mornpen.vic.gov.au/Building-Planning/Strategic-Planning/Strategic-Planning-Projects/Tootgarook-Wetland-Management-Plan>.



**WHO** *Mornington Peninsula Shire Council, private landowners, the private sector, community groups, local schools, recreational clubs, government and agency departments*

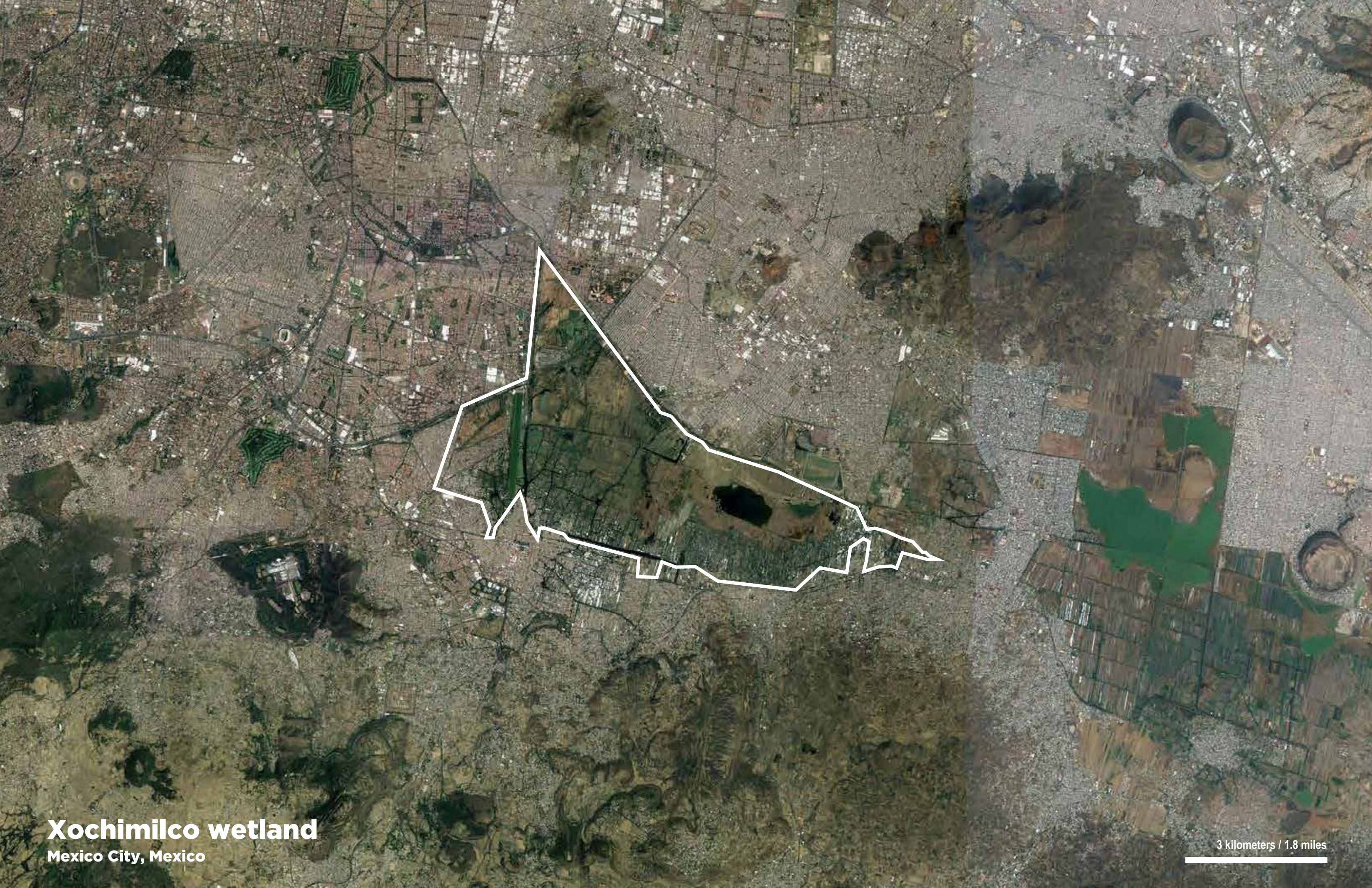
**WHAT** *Tootgarook Wetland Management Plan*

**WHERE** *Mornington Peninsula. Victoria, Australia*

**WHEN** *Feb 2012 through May 2018*

**WHY** *Private ownership and development of wetlands has reduced biodiversity, cultural heritage and ecological services of landscape. Residents demanded action*





**Xochimilco wetland**  
Mexico City, Mexico

3 kilometers / 1.8 miles





**“WITHOUT A RADICAL RECONSIDERATION OF THE MARKET PROCESS – WITHOUT A FORCEFUL CHALLENGE TO CAPITAL’S POWER – NEITHER PROGRESSIVE CHARTERS NOR LEGAL INSTRUMENTS WILL PRODUCE AN EQUITABLE AND SUSTAINABLE CITY.”**

**– DIRECTOR OF COMMUNICATION ,  
TECHO**

*Xochimilco informal housing. Source: xochimilco.org*

## XOCHIMILCO WETLAND

### MEXICO CITY, MEXICO

#### BACKGROUND

Xochimilco is a wetland in a historic lake basin in southern Mexico City with cultural significance to the Aztec people. The lake was drained by the Spanish to reduce regular flooding. Xochimilco today is the largest remaining ‘green’ space in Mexico City. It is rich in biodiversity and is a vital recharge zone for the aquifer, providing 50 percent of the city’s fresh water.

With urban growth in the 1950’s, Xochimilco was developed for housing, this was accelerated in the 1960s in advance of the 1968 Summer Olympics. Today, despite its declaration as a Natural Protected Area by the Mexican Government (1992), its recognition as a RAMSAR site (2004) and as a World Heritage Site (1987), Xochimilco’s land and water are under intense urban pressure and are polluted by untreated sewage and waste. (1)

#### PROCESS

In 1994, residents of Xochimilco agreed to self-limit expansion into the conservation area through Zero Growth Agreements. These agreements were signed by community members and local authorities. The terms of the agreement prohibited housing expansions of these communities into the wetland (2) . Residents

and community members believed these agreements were a step towards acknowledgment by local authorities of their community.

In addition to Zero Growth Agreements, Mexico City completed a housing assessment in Xochimilco and categorized homes by access to water, basic services, household size, and construction standards. This helped inform specific actions the city then took to upgrade homes and provide services in communities.

#### OUTCOMES

The approach to housing and land conservation in Mexico City lacked an integrated strategy to address social equity and legal frameworks. Because there was little incentive and no legal standing the Zero Growth Agreements were not upheld. At the same time, programs to improve access and services to housing encouraged densification and growth in certain nodes. Today, Xochimilco is a tourist site but the water quality is poor and native species are under threat.

1. Yair Merlin-Uribe , Armando Contreras-Hernández , Marta Astier-Calderón ,Olaf P. Jensen , Rigel Zaragoza & Luis Zambrano (2013) Urban expansion into a protected natural area in Mexico City: alternative management scenarios, Journal of Environmental Planning and Management, 56:3, 398-411, DOI: 10.1080/09640568.2012.683686

2. Wigle, Jill. “The ‘Graying’ of ‘Green’ Zones: Spatial Governance and Irregular Settlement in Xochimilco, Mexico City.” International Journal of Urban and Regional Research 32, no. 1 (2008): 573-89. doi:10.1111/j.1468-2427.2008.00786.x



*Xochimilco Wetland area (2,657 hectares, 6,565 acres) 1:100,000*



*Informal Settlements encroaching into the wetland 1:10,000*

**WHO** Mexico City and local communities/residents

**WHAT** A bottom up approach to preserving conservation land from urban encroachment through Zero Growth Agreement’s

**WHERE** Mexico City, Mexico

**WHEN** 1994

**WHY** International recognition of Xochimilco’s cultural heritage, ecosystem services and biodiversity and threat from unregulated growth created momentum for a collaborative approach to environmental regulation.



**East Kolkata wetland**  
Kolkata, India

3 kilometers / 1.8 miles





**“THE RESTRICTIONS IMPOSED ON THE WETLANDS IN 1992 DID NOT CONSIDER THE REALISTIC NEEDS OF THE ORIGINAL INHABITANT... THE RULES NEED TO BE RELAXED FOR THEM, AS THESE LOCAL RESIDENTS ARE AN INTEGRAL PART OF THE ECOSYSTEM”**

**- DR DHRUBAJYOTI GHOSH**

East Kolkata wetland. Source: thebetterindia.com

## EAST KOLKATA WETLAND

### KOLKATA, INDIA

#### BACKGROUND

The East Kolkata Wetlands is a unique ecosystem in the city of Kolkata in the Bengal region of India. The wetlands water originates from the Himalayas, feeds into the Ganges River and eventually bifurcates to form the Hooghly River. Streams from the Hooghly River feed into canals that run through the city, where sewage and storm water runoff is combined, treated through the wetlands and eventually discharges to the estuaries at the mouth of the Bay of Bengal. Originally a wetland of salt marshes and silted rivers, east Kolkata today is an extensive network of green embankments and channels. In Kolkata, wastewater is routed through a series of small inlets, through gravity and pumps, eventually leading to fishponds. At these ponds organic waste settles at the bottom, and naturally filtered water flows out. Fish feed off the organic waste left in ponds. In addition to providing natural based wastewater treatment, the East Kolkata Wetlands support the livelihood of over 30,000 residents through fish and agriculture production.

the city. To convey the economic benefit of the wetlands to politicians, policy makers and civil society Mr. Ghosh created visualizations for the wetlands and held a series of meetings. After ten years of advocacy, in 1992 Kolkata's high court created a conservation area to preserve fishing and farming on the wetlands. In 2002, the Wetlands were designated as a Ramsar site despite growing pressures from the government and developers to develop the land. (1)

#### OUTCOMES

As a result of the advocacy work of Dhrubajyoti Ghosh and others, the ecosystems benefits of the East Kolkata are recognized, documented and celebrated. However, there has been criticism of stiff regulation, bureaucratic processes, conflicts between new residents and police enforcement and a lack of planning for future urban growth. Approximately 70 square kilometers have been developed in and around the wetlands particularly from the west as the city center of Kolkata expands eastwards. The future of the wetlands is uncertain with urban growth.

1. Bhattacharya, Snigdhendru. "Dhrubajyoti Ghosh, Ecologist Who Introduced East Kolkata Wetlands to the World, Passes Away." <https://www.hindustantimes.com/>. February 16, 2018. Accessed March 08, 2019. <https://www.hindustantimes.com/kolkata/dhrubajyoti-ghosh-ecologist-who-introduced-east-kolkata-wetlands-to-the-world-passes-away/story-3hGeLXYD6lZ-P2M5bQHjnzH.html>.

#### PROCESS

Dr. Dhrubajyoti Ghosh, a sanitation engineer, helped promote and highlight the ecosystem services the wetlands provide to

**WHO** PUBLIC (People United for Better Living in Calcutta), sanitation engineer Dhrubajyoti Ghosh, the City of Kolkata, the government of West Bengal.

**WHAT** Environmental advocacy for the world's largest nature-based wastewater treatment

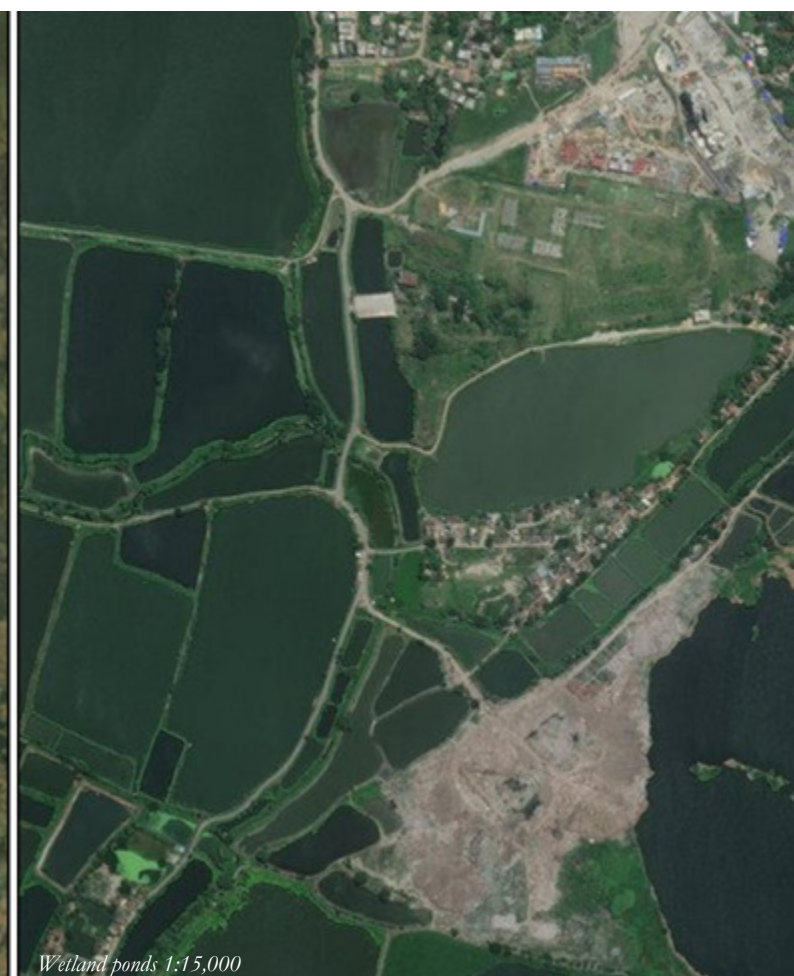
**WHERE** East Kolkata, India

**WHEN** 1992

**WHY** Real-estate pressure and population growth threatened an important ecosystem that provides natural based wastewater treatment, livelihoods and stormwater capture



Wetland area (12,500 hectares, 30,890 acres) 1:150,000



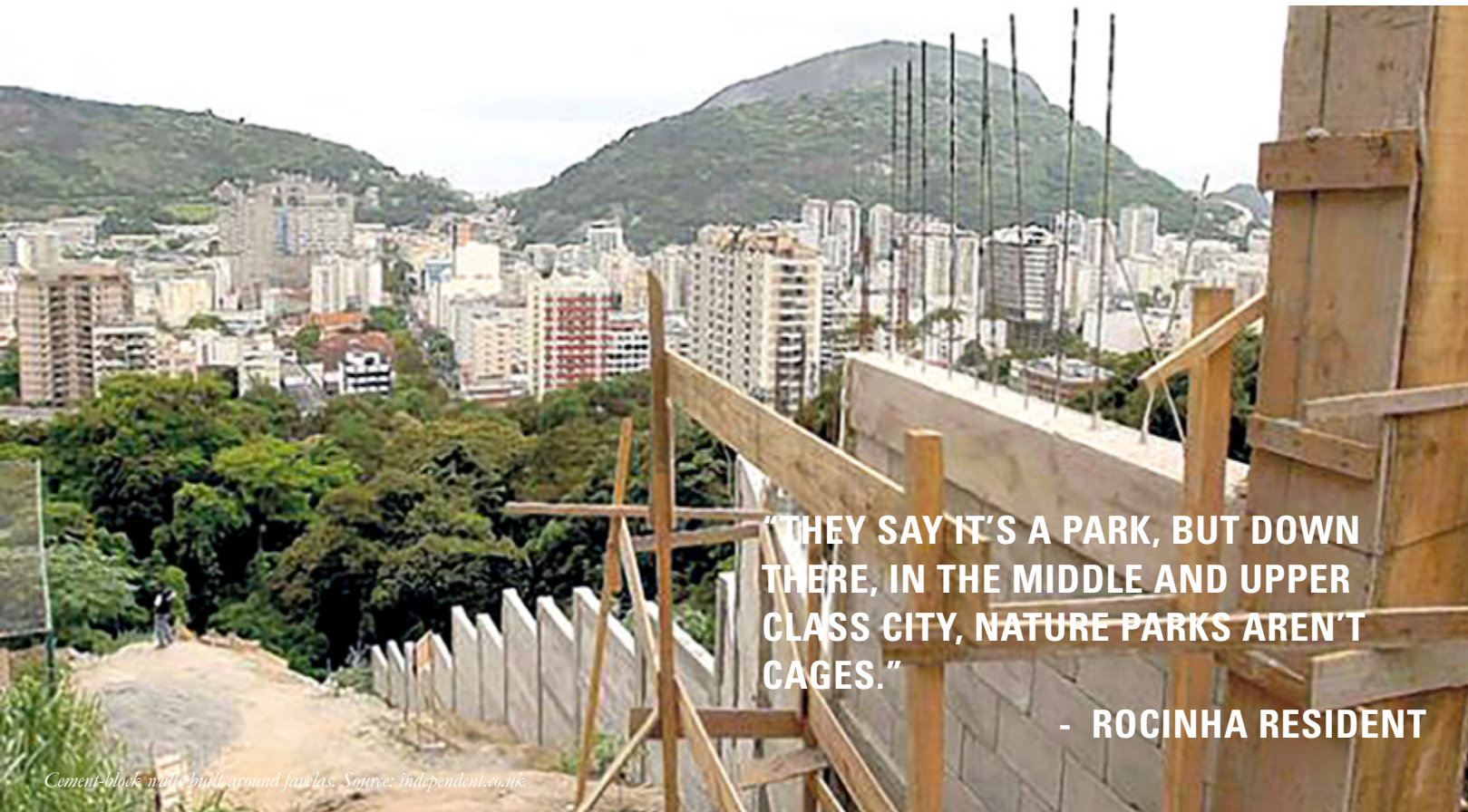
Wetland ponds 1:15,000



**Eco wall, Atlantic Forreast**  
Rio de Janeiro, Brasil

3 kilometers / 1.8 miles





“THEY SAY IT’S A PARK, BUT DOWN THERE, IN THE MIDDLE AND UPPER CLASS CITY, NATURE PARKS AREN’T CAGES.”

- ROCINHA RESIDENT

*Cement block walls built around favelas. Source: independent.co.uk*



*The Atlantic Forrest 1:150,000*



*Rocinha slum encroaching into the Atlantic Forrest. 1:15,000*

## ECO WALLS

### RIO DE JANEIRO, BRAZIL

#### BACKGROUND

The Atlantic Forest in Brazil is recognized by UNESCO as a Biosphere Reserve and by the Brazil Constitution as a National Heritage site. It is a precious piece of land with rich biodiversity and great ability to regulate climate. Because of logging and urban development, the Atlantic Forest is under threat. Brazil’s largest cities are adjacent to the Forest and their favelas push into it. Deforestation increases risk to landslides and people living in these zones exacerbates risk. Río de Janeiro sought to build a wall around the favelas to conserve the forest.

#### PROCESS

The Atlantic Forest Pact of 2006, a coalition of governmental agencies, the private sector, NGOs and research institutions, sought to restore 15 million hectares of degraded and deforested lands by 2050. The pact garnered support for the national government to create the Municipal Plan for the Conservation and Recovery of the Atlantic Forest, which asked municipalities to work proactively to protect native vegetation, by: creating protected areas, recovering areas that put residents at risk, protecting water supply, and creating tools for strengthening municipal environmental

policy (1).

As a result, in Río de Janeiro the city built three-meter-tall concrete walls around favelas under the “Eco Walls” projects. The projects received criticism from both local groups and human rights groups who said the projects were a way to perpetuate class division and isolate communities.

The Rocinha Neighbourhood Association along with the Favela Federation of Río de Janeiro negotiated with authorities to implement programmed areas with pedestrian, bicycle and skating trails and playgrounds. In Rocinha, walls were built at a smaller scale, no higher than 3 feet. Where there was high landslide risk, the city opted to build walls 10 feet high (2). In addition, the Rocinha Neighborhood Association sought to train forest rangers from the community to enforce boundaries

#### OUTCOMES

Residents of the favelas felt the approach did not consider their needs and weakened trust between authorities and residents. Some communities were successful in participating in the design process, but overwhelmingly the approach lacked a

participatory process. In addition, the projects were not part of a comprehensive strategy to address housing affordability and policies, falling short of the cities root challenges.

1. “Atlantic Forest Municipal Plans.” SOS Mata Atlântica. Accessed March 08, 2019. <http://www.sosma.org.br/en/project/atlantic-forest-municipal-plans/>.

2. Frayssinet, Fabiana. “BRAZIL: Nature Paths Instead of Wall for Rio Slum.” Ipsnews. June 12, 2009. Accessed March 08, 2019. <http://www.ipsnews.net/2009/06/brazil-nature-paths-instead-of-wall-for-rio-slum/>.

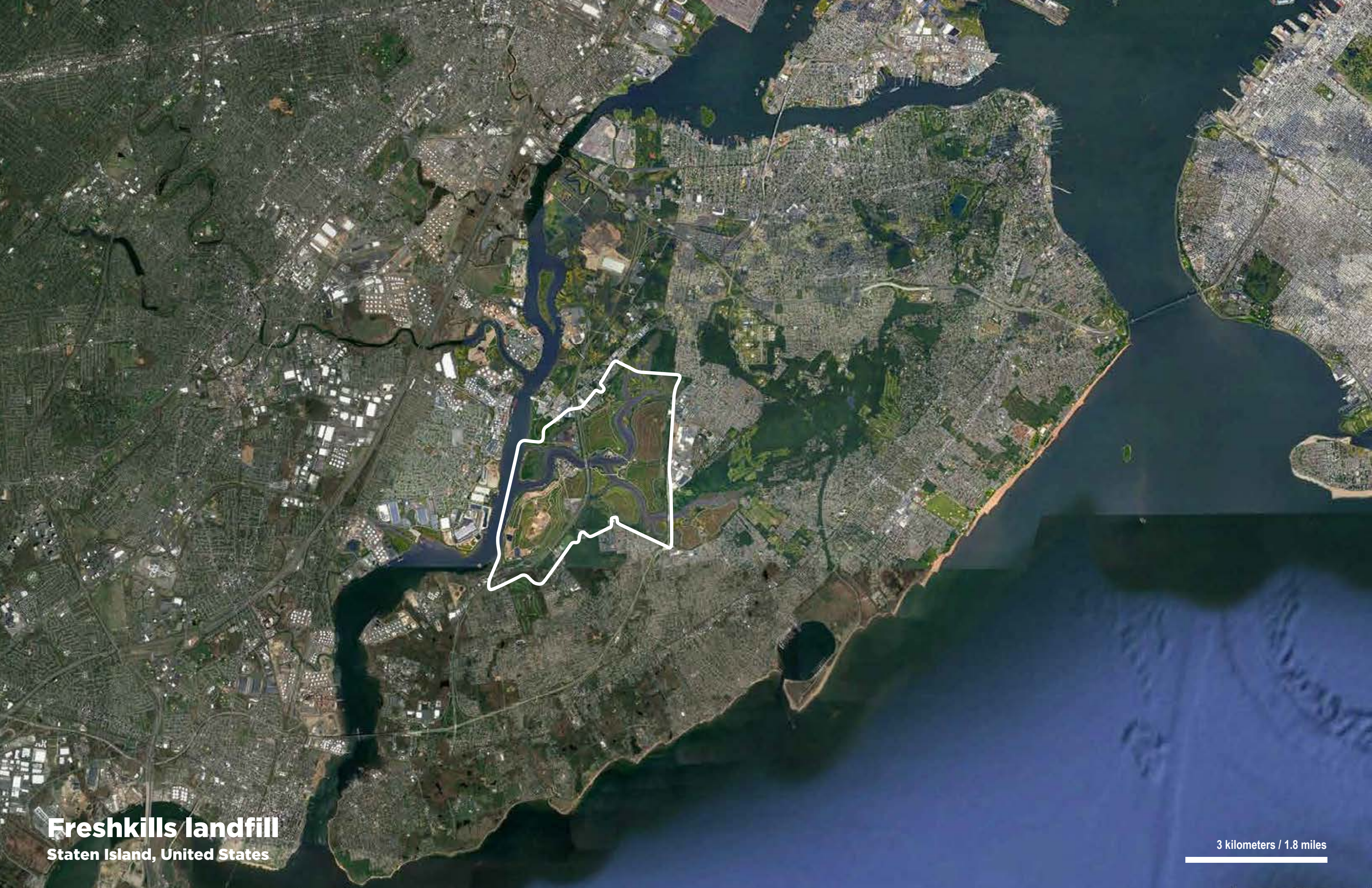
**WHO** *The City of Rio de Janeiro, Brazil*

**WHAT** *11 kilometers of concrete walls bordering Rio de Janeiro’s favelas*

**WHERE** *Favelas in Rio de Janeiro, Brazil*

**WHEN** *2009*

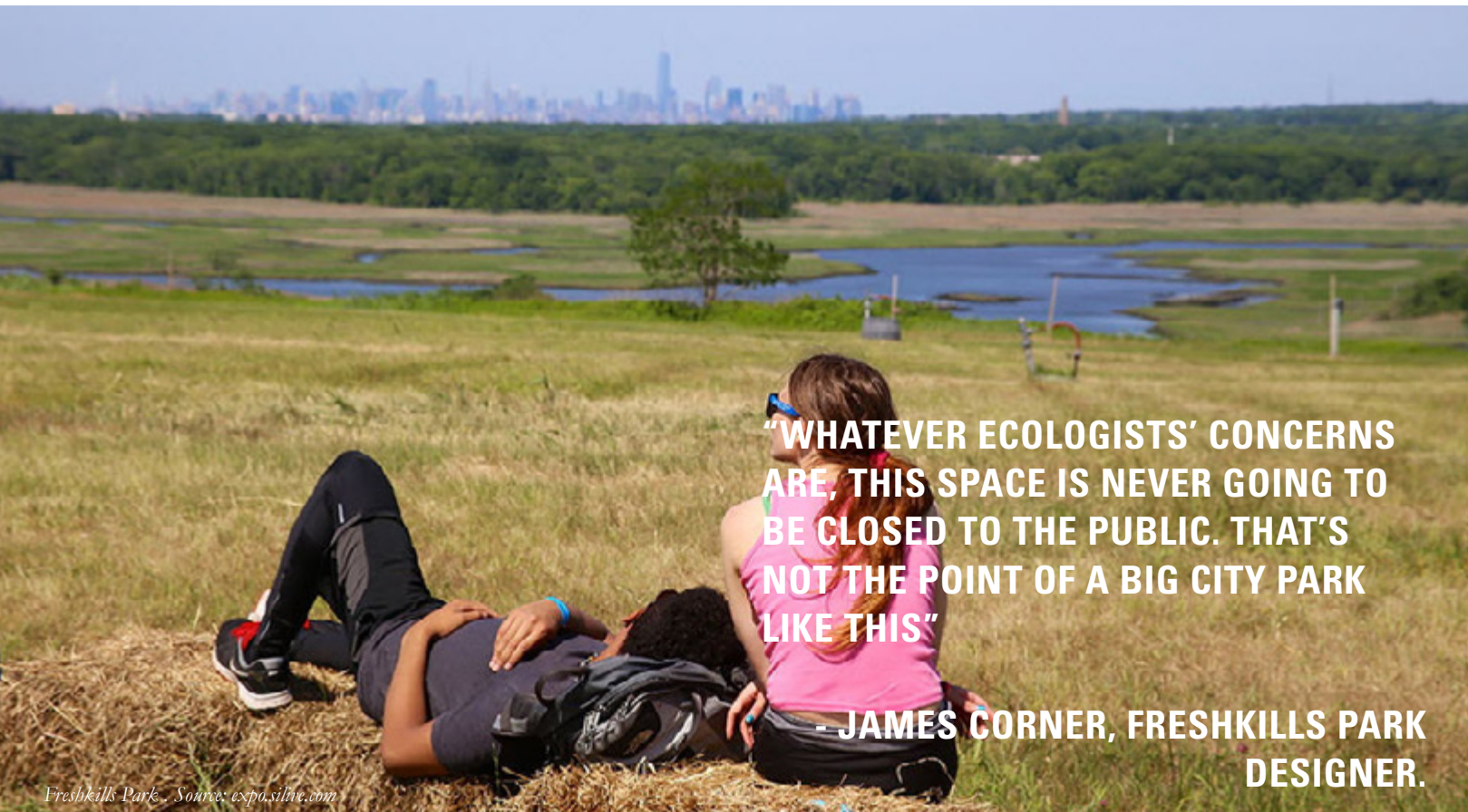
**WHY** *A physical barrier to protect the Atlantic Forest and to reduce risk of landslides and protect forest in advance of the Summer Olympics and World Cup*



**Freshkills landfill**  
Staten Island, United States

3 kilometers / 1.8 miles





Freshkills Park. Source: espn.silver.com



Freshkills Park (890 hectares, 2,200 acres), 1:100,000



Freshkills Park facilities, 1:10,000

# FRESH KILLS

## STATEN ISLAND, UNITED STATES

### BACKGROUND

In 1948 a wetland in Staten Island was made into New York City's principal landfill by Robert Moses. By 1996 the landfill was considered the largest landfill in the world, with up to 30,000 tons of garbage dumped daily. The tidal wetland was extremely contaminated by food waste, plastics, and electronics. Residents and the Environmental Protection Agency pressured the City to close Freshkills Landfill. The Landfill was closed in 2001 (1).

### PROCESS

In 2001, the New York City Department of City Planning called an international design competition to create a public park at Freshkills. The competition's first round was open, and in August 2001, six landscape architecture proposals were chosen as finalists. In 2003, the City selected James Corner Field Operations for the park design.

The park's design aims to change over time as the site's ecology changes. The Fresh Kills Landfill is covered with a landfill cap, which is made of different layers of soil, geotextiles, and a geomembrane. These layers cover and stabilize landfilled waste, separate the waste from the environment

and park visitors and prevent the release of landfill gas to the atmosphere. Along with the landfill cap, a collection of swales, down chutes, and retention ponds collect and manage stormwater to prevent erosion to the cap caused by rain water. For more information on landfill engineering:

<https://freshkillspark.org/landfill-engineering/covering-stabilizing-maintaining>

The park has been designed for five major sections that accommodate a range of uses, including cultural, athletic, and educational programs. The Freshkills Park Alliance, was created to ensure financial resources, promote ecological stewardship, create environmental research opportunities, and implement cultural programming throughout the different project phases. Most of Freshkills Park is closed to the public with few pilot projects opened around the perimeter.

### OUTCOMES

The Park creation is an ongoing process due to the complexity of working with 45 different City agencies on environmental restoration projects. The site large scale offers a unique opportunity to test different approaches to restoration.

**WHO** *New York City, United States Environmental Protection Agency, James Corner Field Operations, the Freshkills Park Alliance, the public*

**WHAT** *Landfill turned into a recreational park*

**WHERE** *Staten Island, New York*

**WHEN** *Park design began in 2001 and will be opened in phases, through 2036*

**WHY** *The opportunity to restore lost environmental services, create habitat for native species, create a public amenity and cultural programming*

1. Bliss, Laura, and CityLab. "Once the World's Largest Landfill, Now a Man-Made Paradise For Wildlife." CityLab. February 17, 2017. Accessed March 08, 2019. <https://www.citylab.com/solutions/2017/02/the-wild-comeback-of-new-yorks-legendary-landfill/516822/>.





**Minghu Wetland Park**  
Liupanshui, Guizhou Province, China

3 kilometers / 1.8 miles





**"WITH LITTLE FUNDING, THE DESIGNERS OF THIS WETLAND RESTORATION PROJECT WERE STILL ABLE TO MAKE SOMETHING POETIC. . . IT JUST DOESN'T LOOK LIKE A WETLAND – YOU CAN SEE THE HAND OF THE DESIGNER. YOU CAN TELL THEY'RE ACTUALLY CLEANING THE WATER WITH THE DESIGN"**

**2014 ASLA AWARDS JURY**

*Liupanshui Minghu Wetland Park fishing ponds. Source: asla.org*



*Liupanshui Minghu Wetland Park project area (90 hectares, 222 acres), 1:100,000*



*Meandering paths and ponds for water filtration, 1:10,000*

# MINGHU WETLAND PARK

## LIUPANSHUI, GUIZHOU PROVINCE, CHINA

### BACKGROUND

The City of Liupanshui, China experienced rapid urban growth in the 1960's. In 1970's the City started the Shuichenghe River Reconstruction project which channelized the Shuichenghe river to protect the expanding urban areas from flooding. The city is susceptible to flooding during monsoon season and has potential for extreme drought in the dry season. Channelization reduced the river and wetlands to small amounts of fragmented wetlands, ponds and farming fields with water and soil pollution. As a result, the city was unable to manage flood waters, naturally store and clean water, and lost habitat for bird and fish species.

### PROCESS

The City created a Comprehensive Basin Management strategy to create green infrastructure. The Liupanshui Minghu Wetland Park is the first phase of a regional commitment to change the City's approach to water management. The City identified the following goals (1): reduce water pollution, prevent flooding, restore the river and create public space.

### DESIGN

The park used the following design strategies:

1. Remove concrete river edge and create terraces to improve flow and oxygenation. This helps limit algae growth and provide healthy habitat for species.
2. Create terraces to for wetlands and retention ponds to slow water flow during heavy rainfall.
3. Introduce plant species for phytoremediation to remove toxic soils.
4. Design meandering walking paths and bicycle routes through the wetland terraces.

### OUTCOMES

The project has been celebrated for it's multipurpose design where each element also performs an ecological function. By slowing down the water through terraced wetlands and bio swales that merge and follow the existing topography, the design seeks to clean the water from upstream and nonpoint source pollutants, offer flood control through its water holding capability,

as well as offering a recreational space for the city's residents. The project has been critique by its top-down approach and limited community engagement.

1. "Slow Down: Liupanshui Minghu Wetland Park." American Society of Landscape Architects. Accessed March 08, 2019. <https://www.asla.org/2014awards/002.html>.

**WHO** *City of Liupanshui*

**WHAT** *Concrete river embankment turned into a wetland park*

**WHERE** *Liupanshui, Guizhou Province, China*

**WHEN** *2012*

**WHY** *Environmental improvement campaign carried out by the city's government*

# APPENDIX 3

## FUTURE SCENARIOS

### PURPOSE

To better understand the range of actions for the Pantanoso Basin and their intended and unintended consequences the Accelerator team drafted possible scenarios and futures. These scenarios are short stories and visualizations. The purpose is to open a discussion among different groups of people in Montevideo who may be impacted or a part of the Pantanoso Basin transformation. These possible futures drafted are not likely to come true exactly as described and do not reflect the existing Plan Pantanoso, but they let us think in broader terms about the impacts of the plan and choices. These scenarios are the beginning of an ongoing debate and discussion.

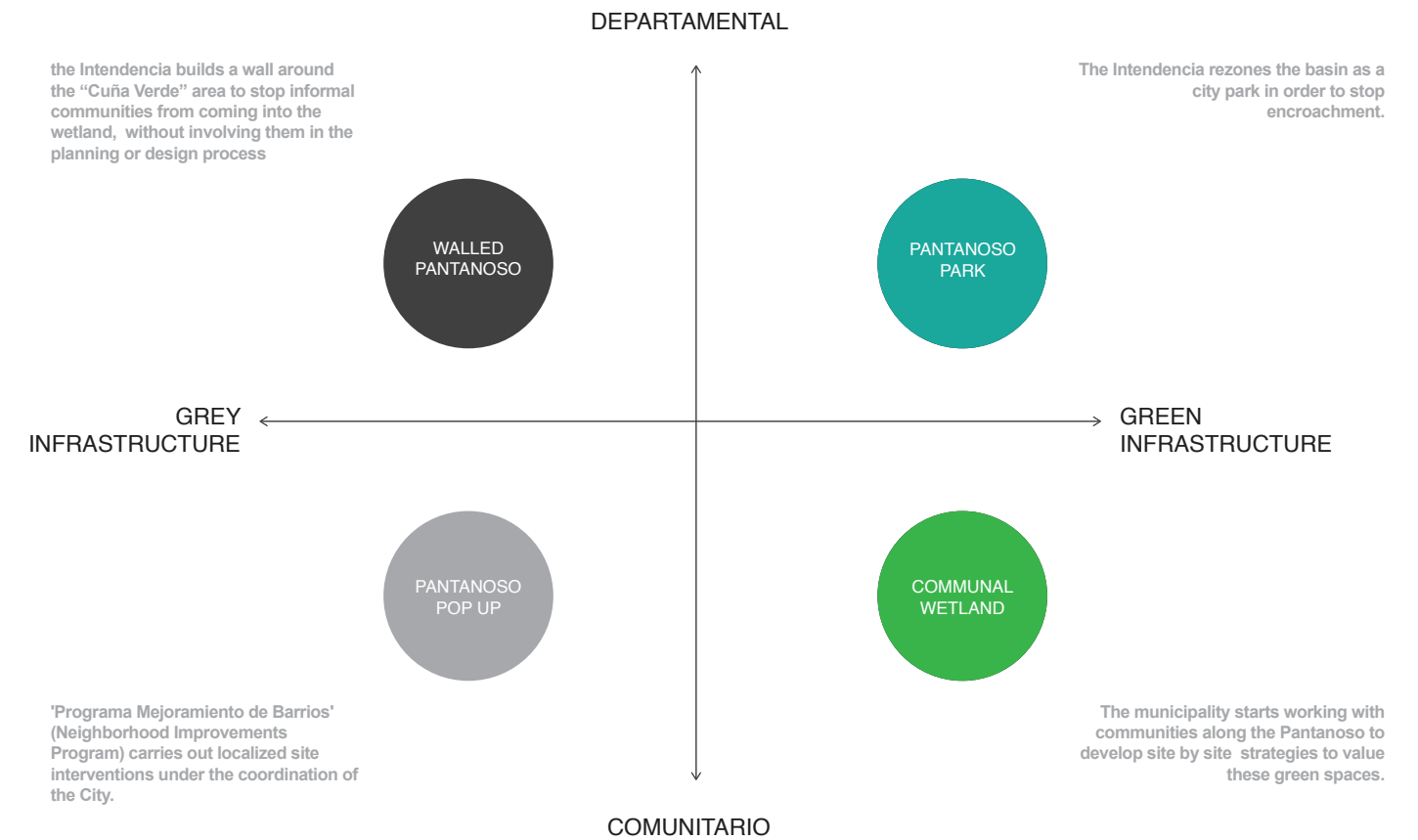
### PROCESS

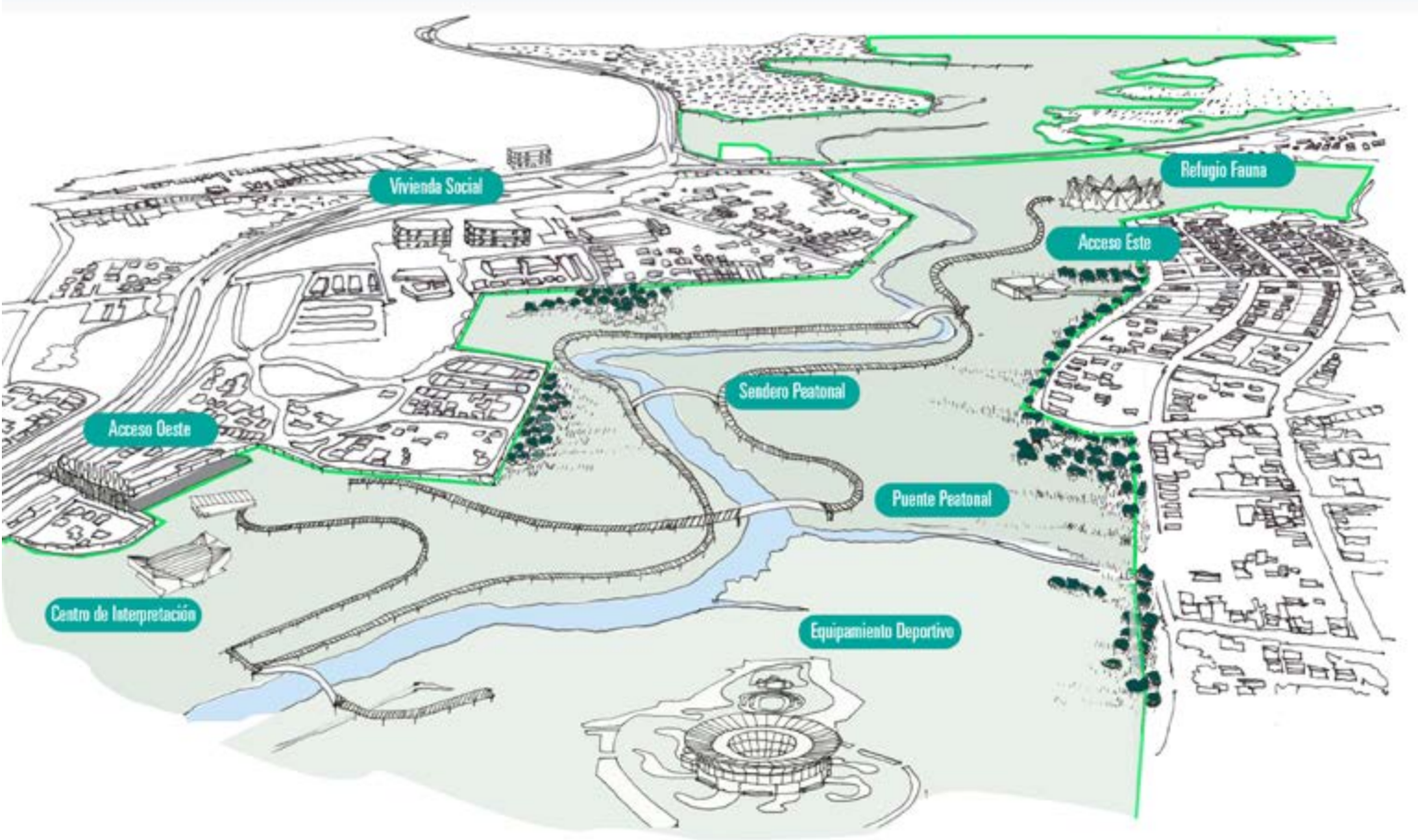
The Accelerator team looked at past and current conditions (demographic trends, climate projections, development patterns, etc) and then identifying key uncertainties, vulnerabilities of the region, and president research. Case study research was applied to the conditions of the Pantanoso basin to evaluate potential consequences. The team then sought feedback local leaders and experts in order to revised and prompt a detailed conversation about actions and their intended and unintended consequences. It is our hope that these scenarios are further refined and can be a helpful tool in building resilience and social networks, bringing the community into the conversation building trust and social capital that is basic to enhancing resilience.

“Scenarios are not predictions of what will happen. They are an exploration of what might happen. They are structured narratives about the possible future paths of social-ecological systems. Rather than forecasting the future, they involve a group of experts working together with a representative cross section of local residents to explore what might happen to the region if certain trends are followed”

- Brian Walker and David Salt Resilience Thinking

## SCENARIOS





# Pantanoso Park

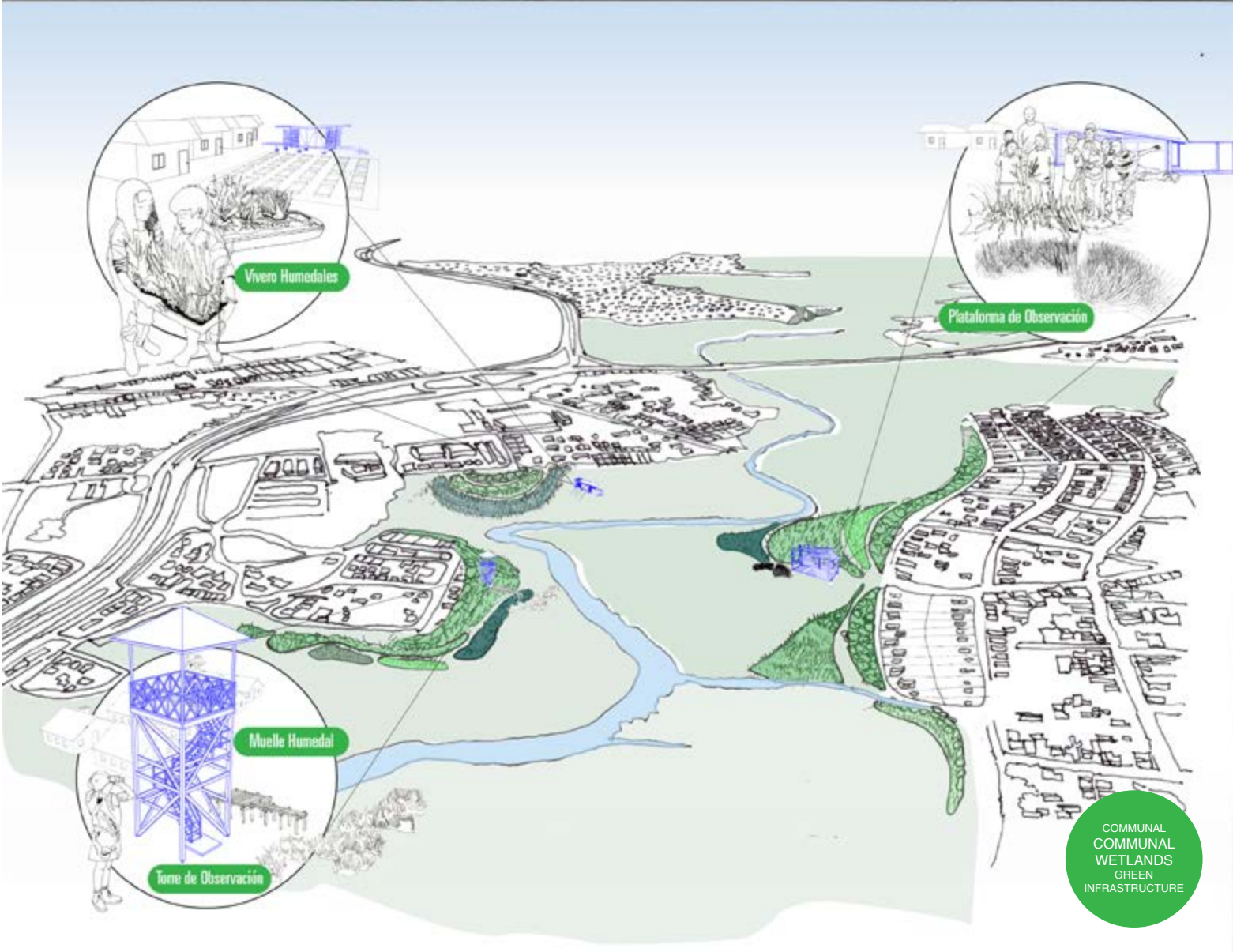
The Intendencia rezones the basin as a city park in order to stop encroachment. The city enforces the new zoning by strengthening the scope of the Territorial Police unit (Policia Territorial) to keep settlers out of the park area. At the same time, MVOTVA begins a Relocation Program to resettle 2,088 households currently occupying former wetland areas in a process set to take 5 years. The Intendencia struggles to find appropriate land and budget for relocation, when the Mayor is inspired to leverage investments that will be made as bid for the World Cup in 2030 to solve multiple problems. An international design competition calls for a masterplan for the Pantanoso Sports and Wildlife Park that will include sports venues and supporting infrastructure, and a long term wetlands remediation and restoration project. The competition brief is drafted by a team of specialist hired by the Department of Planning. New climate projections anticipate extreme rainfalls in the future influence the City to update design standards. City officials conduct an assessment to determine which parts so the park and surrounding infrastructure can flood or need to be redesigned.

## Benefits

- Ecosystem**  
The comprehensive strategy avoids ecosystem fragmentation and allows for long term ecological benefits like nutrient cycling and flood water storage as well as a higher chance of ecological species dispersal in this endangered ecosystem. It also maximizes the carbon sequestration.
- Social**  
New housing for at-risk populations will be located in close proximity to restored landscapes, recreational facilities, and job opportunities.
- Economic**  
The Park will be a major economic generator at regional, city and local scales; attracting major corporations and also providing more opportunities for small businesses. It will also create local jobs in construction, maintenance and environmental stewardship.

## Disadvantages

- Ecosystem**  
Coordinating different Intendencia departments and agencies will necessarily take time while waste dumping and informal settlement encroachment could still be happening in the meantime. Without the right design controls, an intensely used urban park may be limited in its ability to support habitat.
- Social**  
The success of the plan depends entirely on just representation and forefronting the concerns of the relocated communities, who may be displaced from livelihoods and social networks. They will also be moving from small homes to apartments. Without an assisted transition into the new housing and training and opportunities for new livelihoods, this plan risks creating new social problems. There could also be community backlash from the heavy-handed, top-down approach. Future spatial segregation problems might arise due to gentrification of the area.
- Economic**  
This plan requires massive public spending which will include policing, planning, design, construction, and maintenance and operations. The economic value of this expense may take decades to recover.



## Communal Wetlands

The municipality starts working with communities along the Pantanos to develop site by site strategies to value these green spaces. Communal Centers (Centro Comunal Zonal) lead public information campaigns on ecological value and the benefits of halting illegal dumping and settlement. The municipality designates communal wetland (humedal comunal) areas that encompass as much uninterrupted wetland area as possible. They also conduct a survey to establish land ownership. Households on privately own land are relocated nearby via a rent subsidy. Households inside the city owned the land are given tenure and assistance with improvements. In exchange the CCZ enlists homeowners to monitor the ecological health of the wetland and guide a program for its remediation and maintenance. The Intendencia via the municipality pays the homeowners for the ecosystem services provided to the city. The homeowners alert the municipality that the health of the ecosystems of the lower basin is increasingly threatened by the saline intrusions from the Atlantic Ocean due to sea level rise.

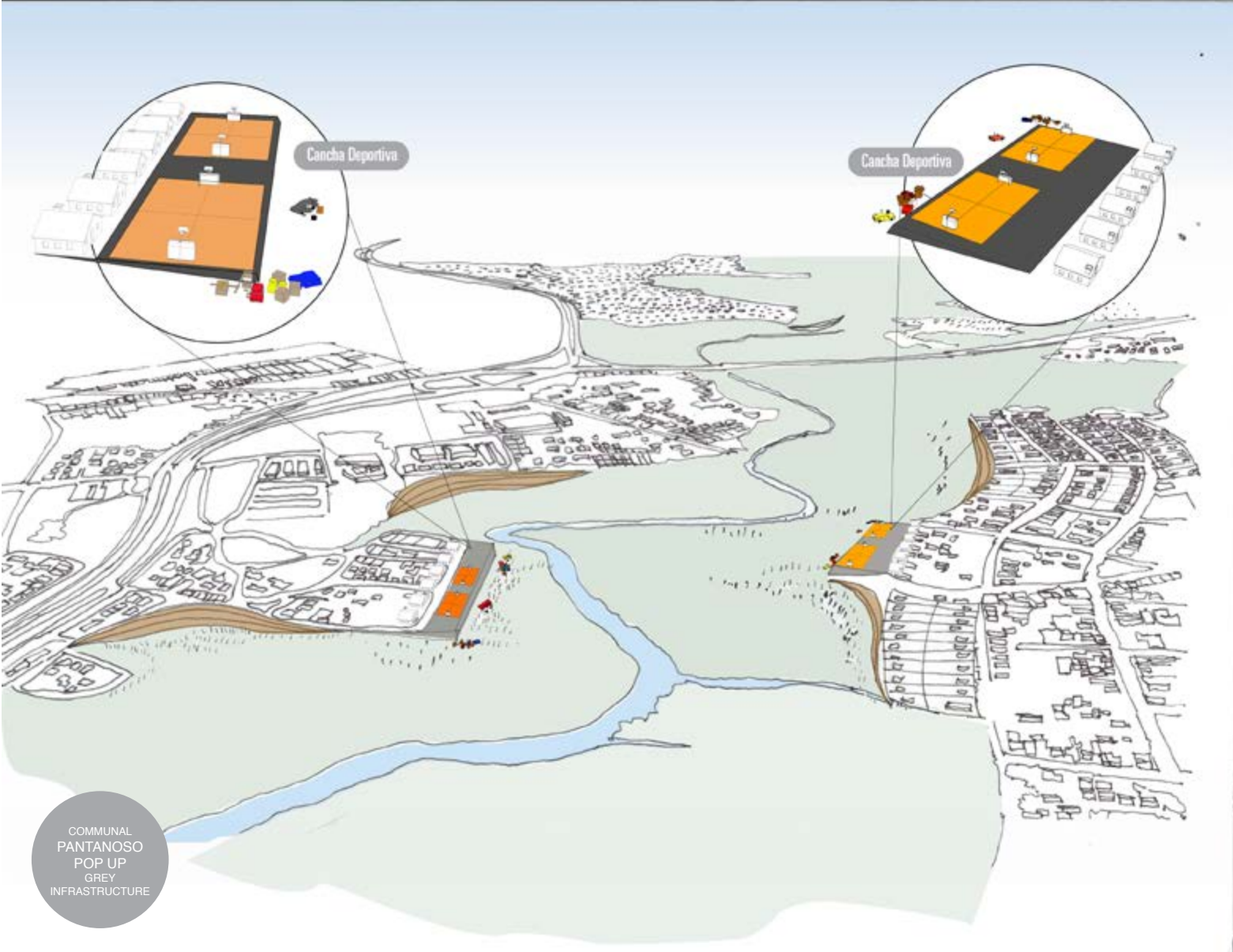
### Benefits

- Ecosystem**  
Site by site approach can target specific local issues and would mean shorter implementation times. Like the park approach, communal wetland would help to absorb water and reduce frequent flooding for adjacent low-lying communities.
- Social**  
Fostering ecological stewardship in the informal communities creates a sense of agency, accountability, community and civic pride. The restored wetland becomes a public space enriching the lives and improving the health of the whole community.
- Economic**  
Stewardship, monitoring and bioremediation creates jobs, but training will be needed.

### Disadvantages

- Ecosystem**  
Fragmenting the wetland is not ideal for ecosystem management.
- Social**  
Success relies on the sustained involvement of each community which is a challenge when dealing with a disenfranchised population.
- Economic**  
The city will have to invest in housing, local sewerage connections and recycling facilities.





## Pantanosos POP UP

'Programa Mejoramiento de Barrios' (Neighborhood Improvements Program) carries out localized site interventions under the coordination of the City. These interventions have a dual purpose: they create community facilities such as parks and playing fields and they prevent dumping and settlement, at least in their near vicinity. The open space interventions—which generally consist of capping contaminated soil and building ball fields on top and remediating nearby wetlands—are often paired with housing improvements developed by the MVOTMA for groups of up to 50 families. In planning for extreme rainfall events, the interventions are also designed as levees to protect the immediately-surrounding community from flooding.

### Benefits

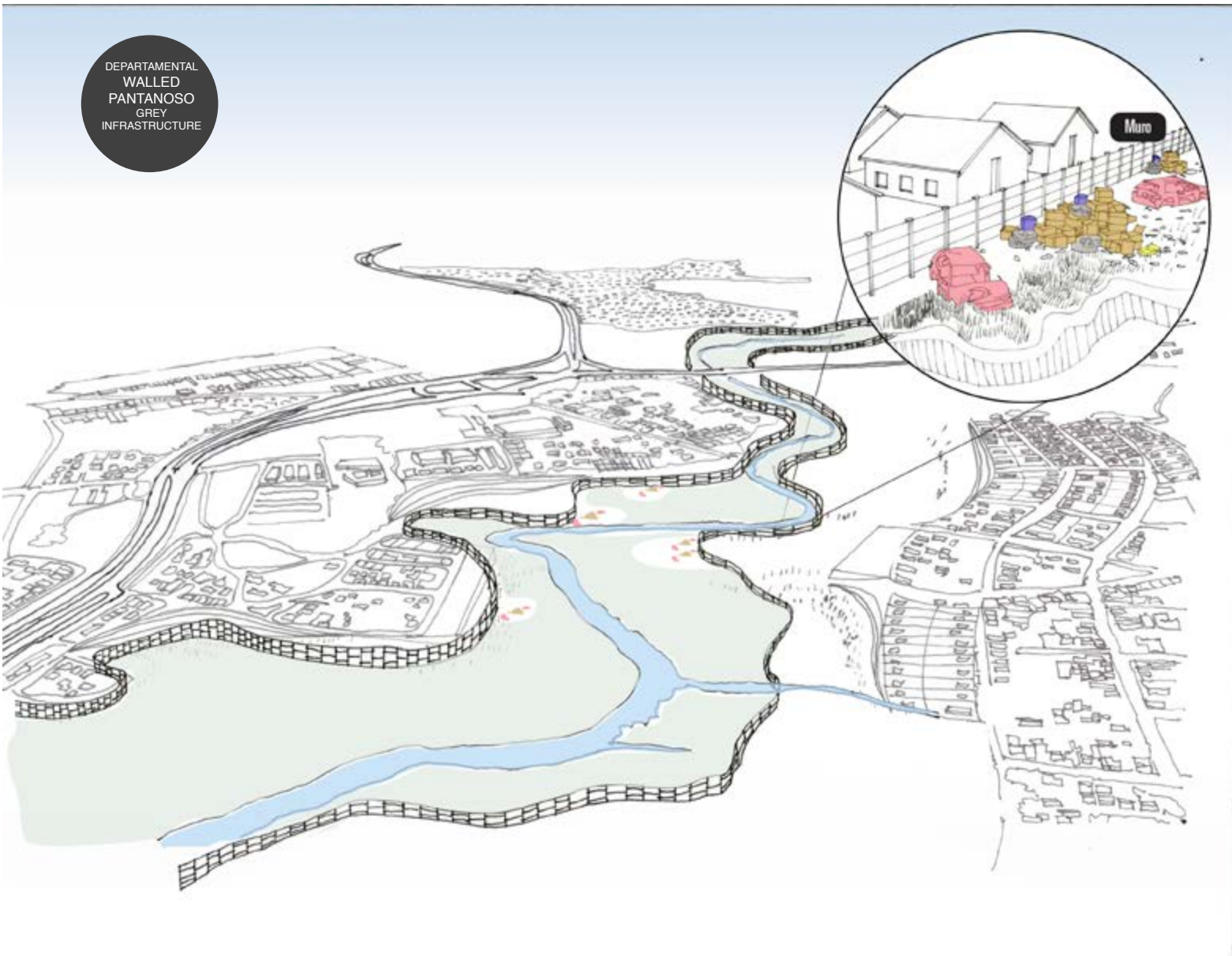
- Ecosystem**  
This approach would be a quick solution to stop encroachment and remediate the side effects of illegal dumping and at each site
- Social**  
The adjacent communities would benefit from a playground space design overlooking the natural asset that is the wetland.  
The intervention would offer site-specific flood protection for the community.
- Economic**  
By directing some of the funding from the 'Programa Mejoramiento de Barrios' (Neighborhood Improvements Program) to create the platforms attached to each encroachment site, the costs would already be embedded in the budget.  
Communities have their material possessions safeguarded against flooding.

### Disadvantages

- Ecosystem**  
This approach of fragmented capping would constitute a permanent intrusion into the wetland area by a concrete slab that would increase impervious surfaces and reduce infiltration vital to wetland survival. Less wetland area would reduce the rate at which the wetland captures and holds water in storm events putting the adjacent communities at risk from flooding
- Social**  
No stewardship values are included in this approach which would benefit the neighbors of the Pantanosos
- Economic**  
The municipality will have to implement a protocol to monitor the discharge points over the Pantanosos in order to keep them free of waste and sewage to ensure the platforms don't compromise the hydrological cycle of the wetlands.



DEPARTAMENTAL  
WALLED  
PANTANOSO  
GREY  
INFRASTRUCTURE



DEPARTAMENTAL  
WALLED  
PANTANOSO  
GREY  
INFRASTRUCTURE

## Walled Pantanoso

Drought in the countryside forces more people into the City who settle along the banks on the banks of the Patanoso, joining those being expelled from the City Center. In reaction the Intendencia builds a wall around the "Cuña Verde" area to stop informal communities from coming into the wetland, without involving them in the planning or design process. The wall succeeds in stopping encroachment but fails to put a stop on waste dumping activities slowly becoming a curtain to all the waste dumped, this time out of sight. Although the wall was not engineered for flood protection, it becomes a defacto flood barrier during heavy rainfalls. During one extreme rainfall event, the wall collapses and flood the adjacent neighborhood.

### Benefits

#### Ecosystem

A quick solution to stop encroachment protecting the wetland ecological services of carbon sequestration and water holding capabilities.

#### Social

Neighborhoods in low lying areas are safe from current flooding events.

#### Economic

Jobs creation during the construction stage employs labor from the nearby neighborhoods.

### Disadvantages

#### Ecosystem

Heavy metals from unregulated junk yards over the wall boundary lead to groundwater and soil contamination which puts the wetland health, and ecological services it provides, at risk.

#### Social

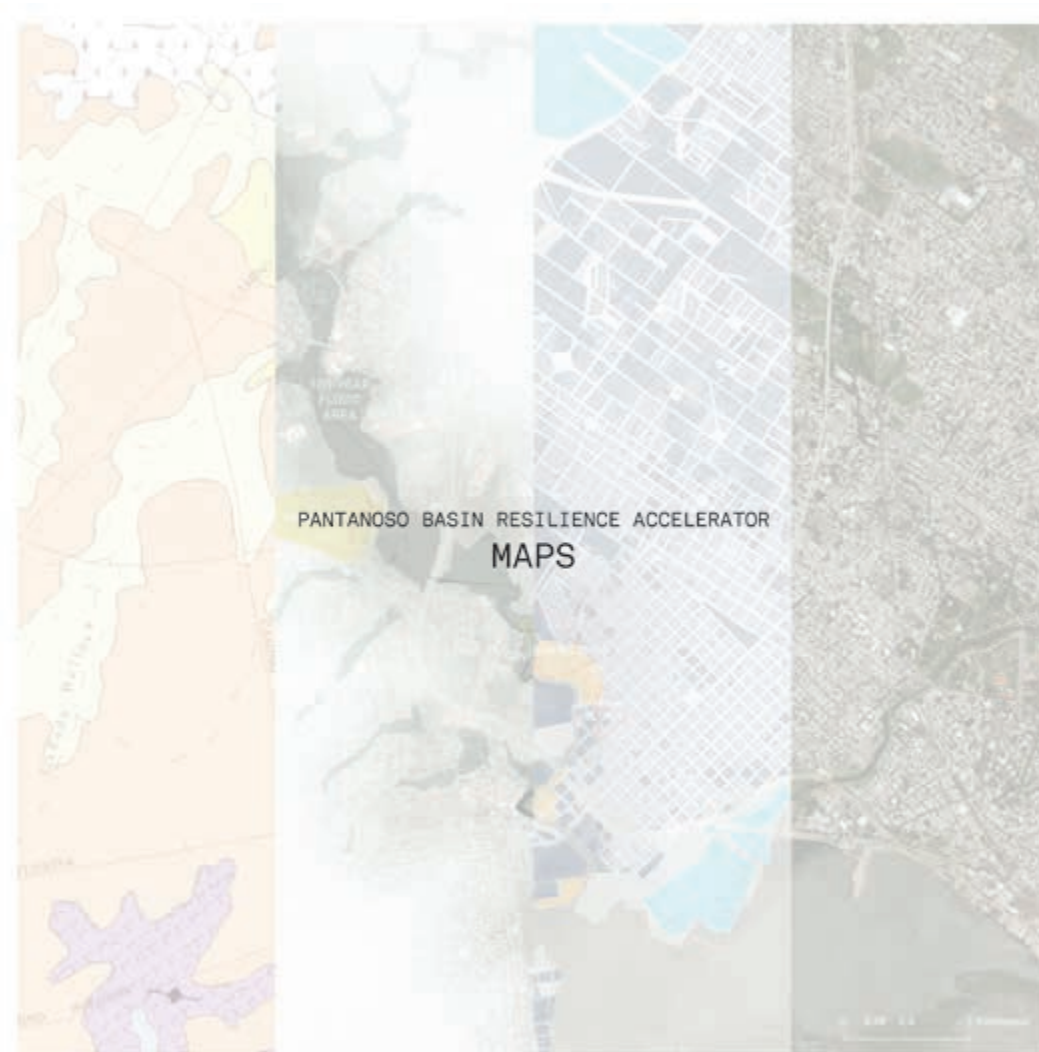
The wall does not consider any recreational areas or programing for the community, making the project unpopular amongst the residents of the basin.

#### Economic

The city will have to implement a new tax for the construction and patrolling of the wall to keep residents from going into the wetland to settle or dump waste.

# APPENDIX 4

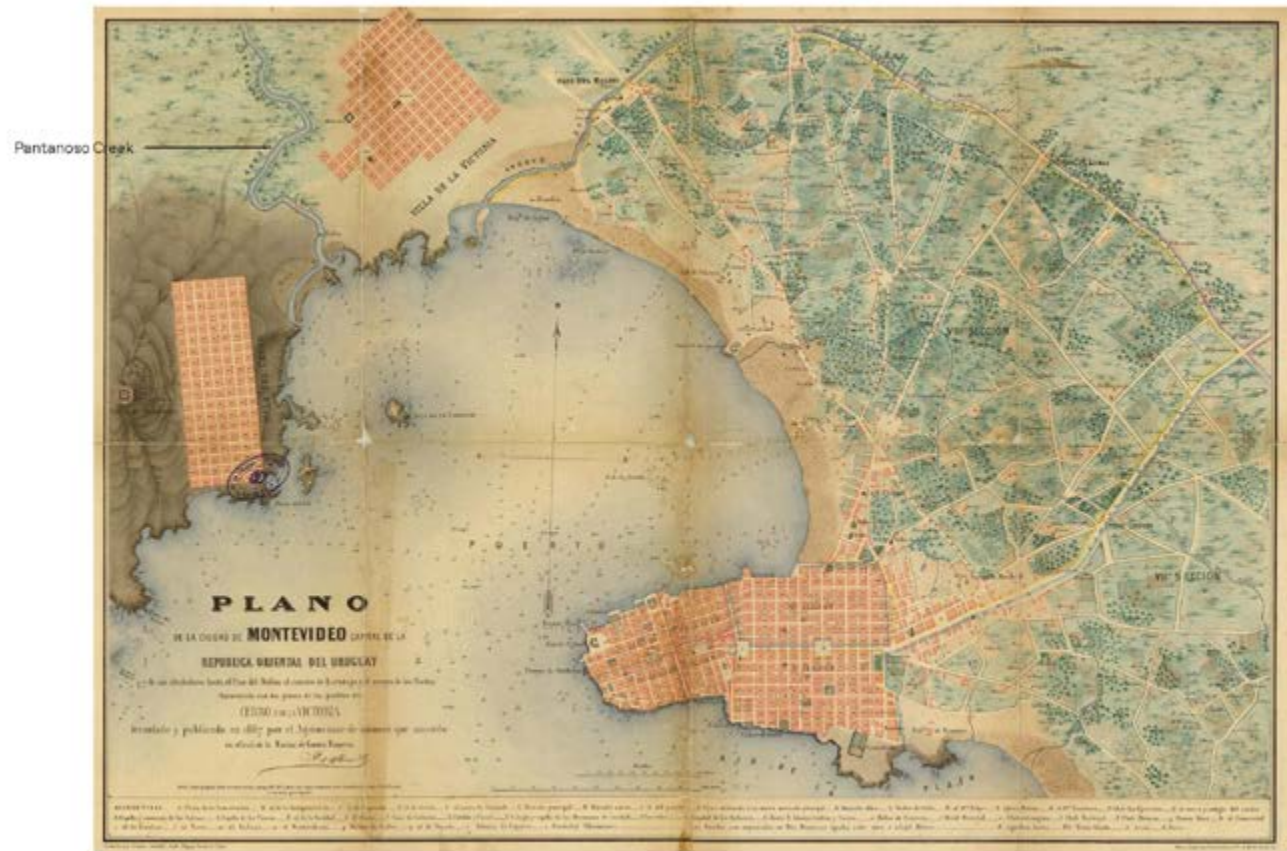
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13. Water Map - Sites
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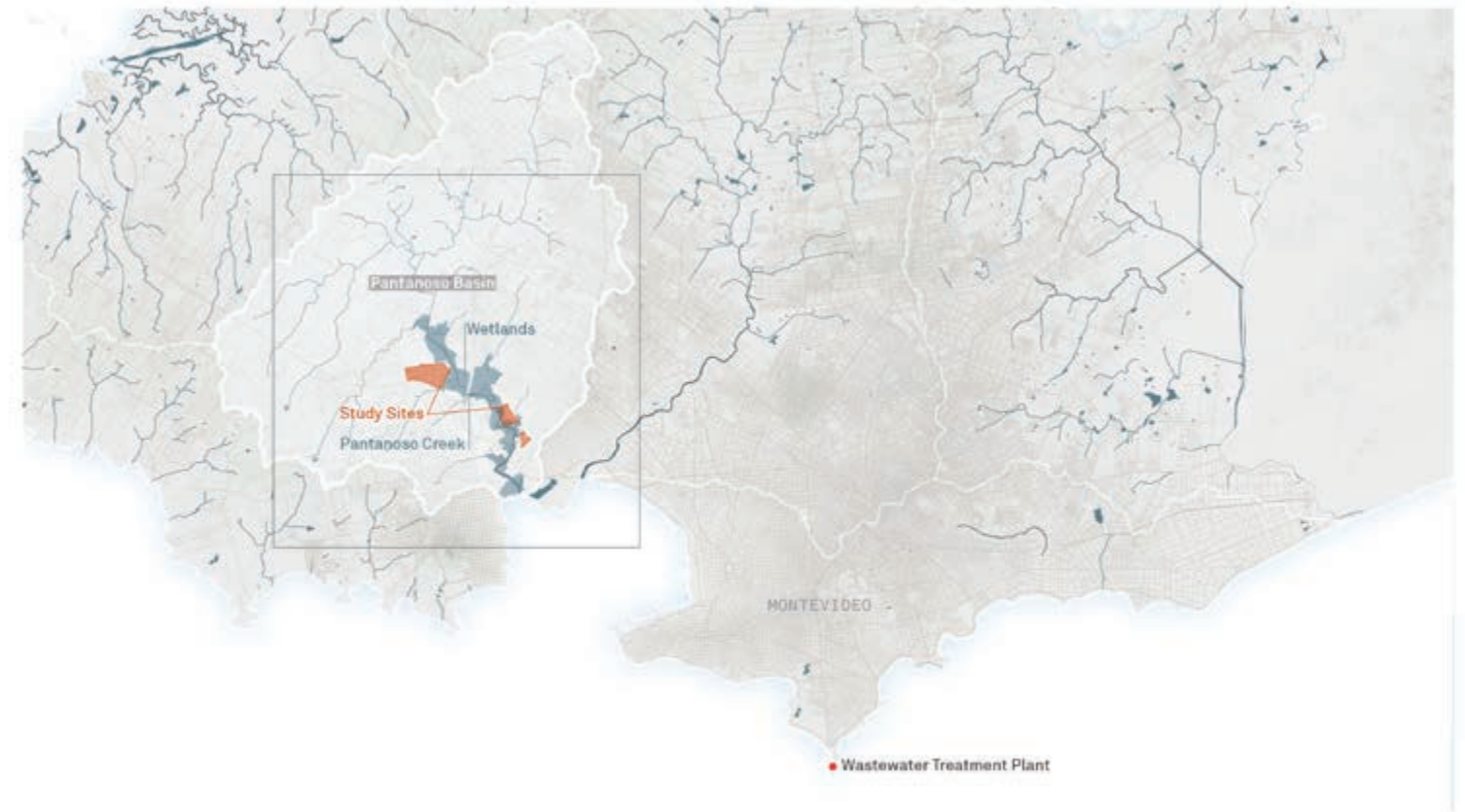




1 Montevideo 1867

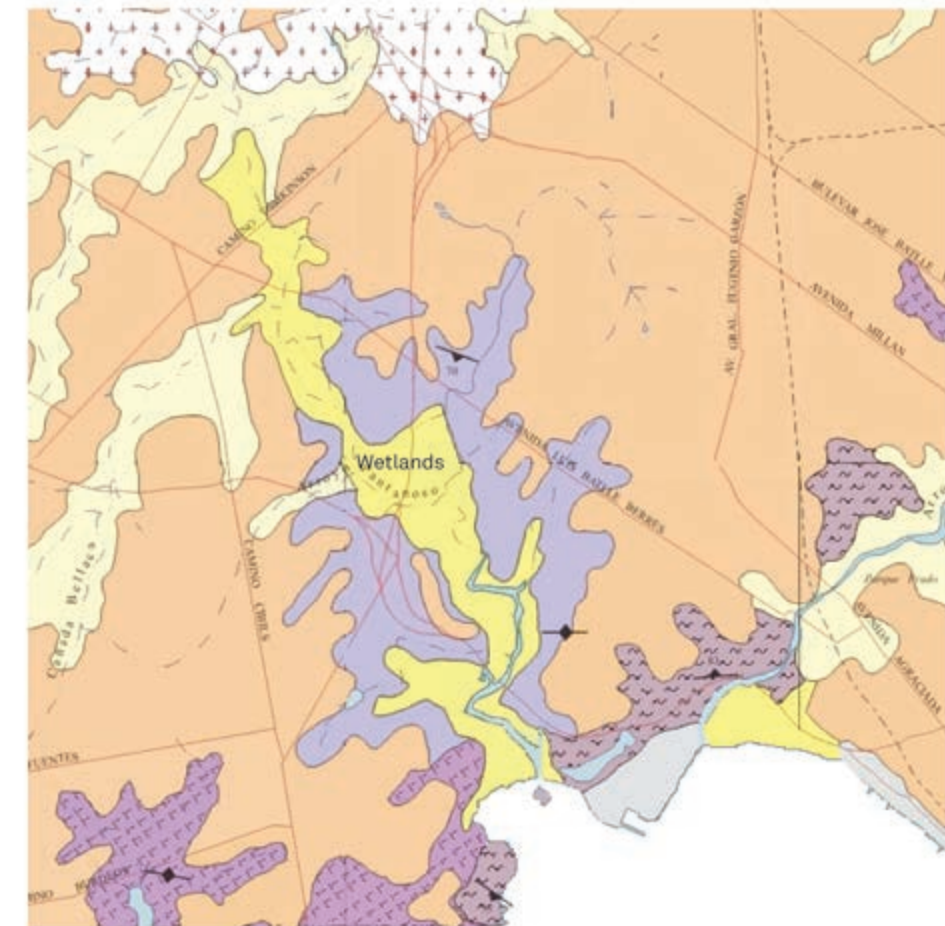


2 Montevideo 1924



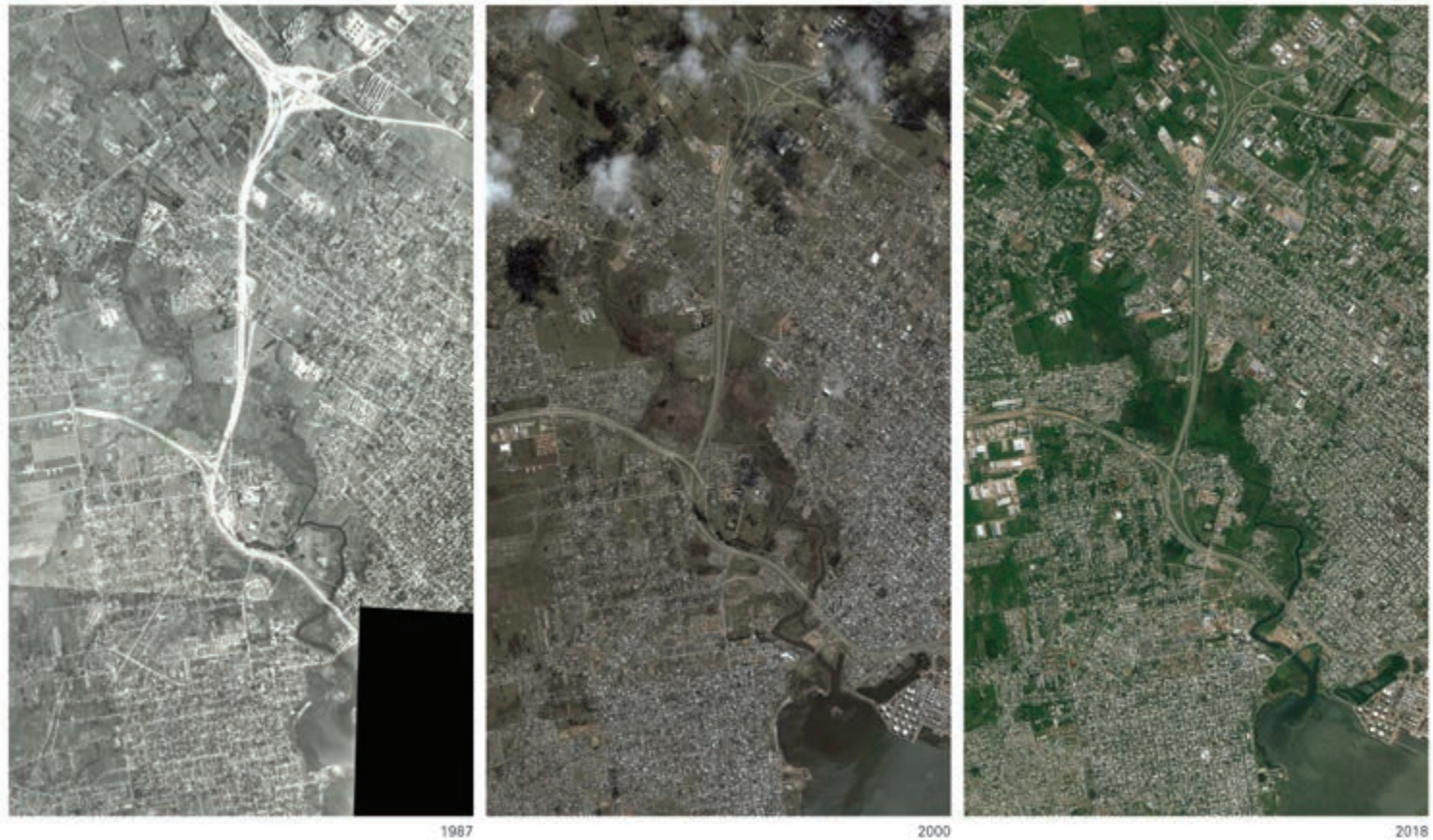
3 Pantanos Basin

0 1 2 5 Km



4 Pantanos Geology

0 1 2 Km



1987

2000

2018

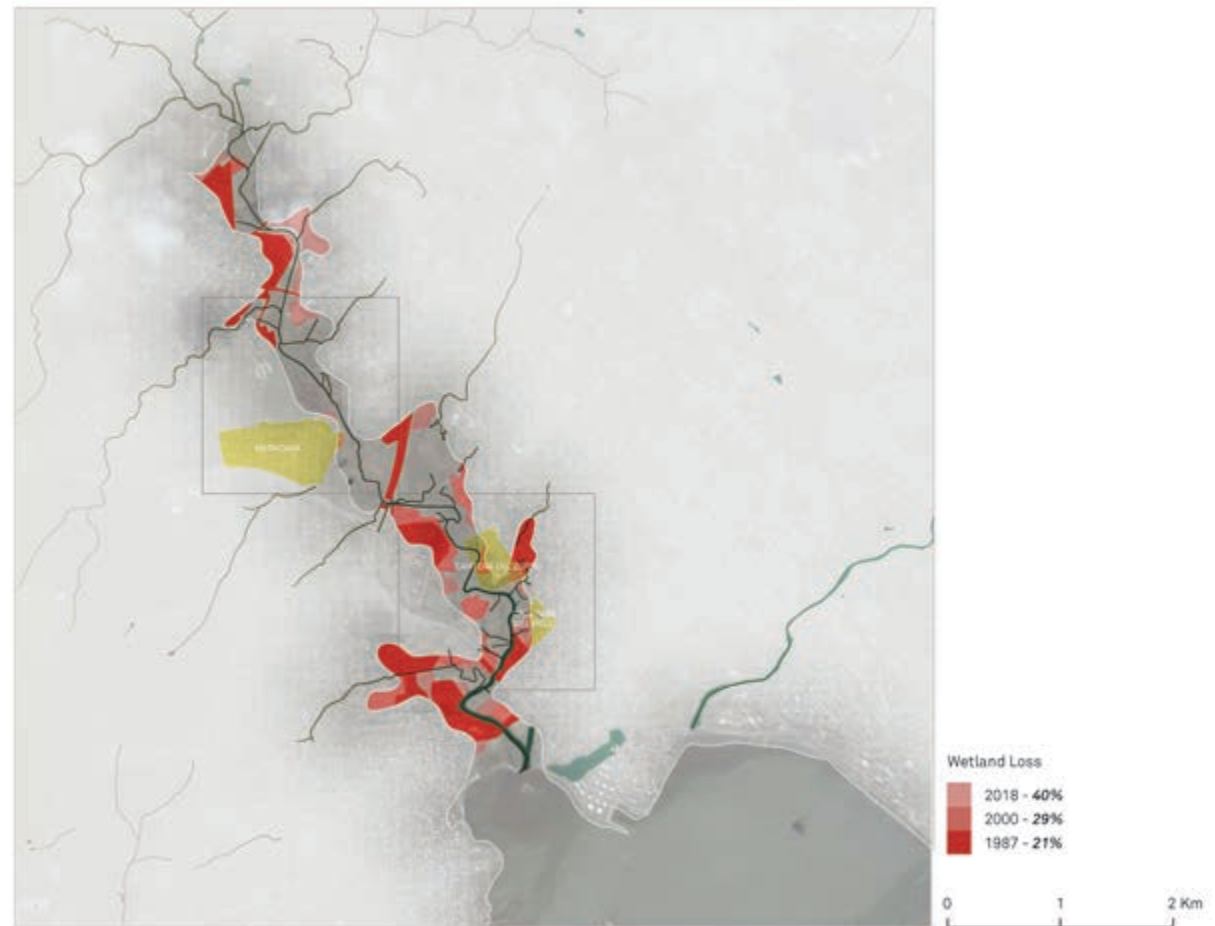
0 1 2 Km

5 Historic Imagery



7 1987

0 500 m



Wetland Loss

2018 - 40%

2000 - 29%

1987 - 21%

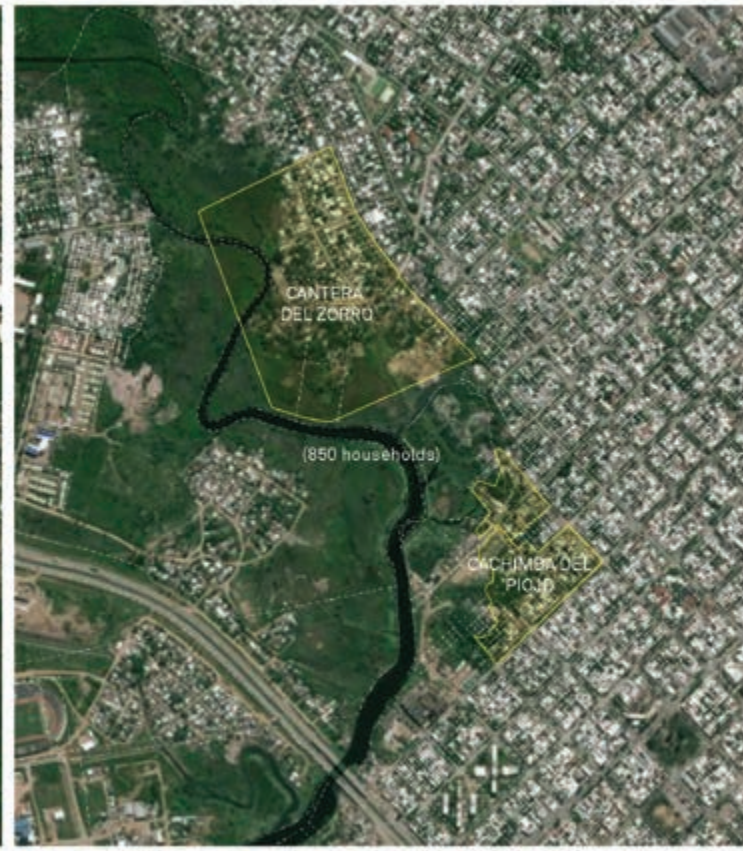
0 1 2 Km

6 Encroachment & Wetland Loss



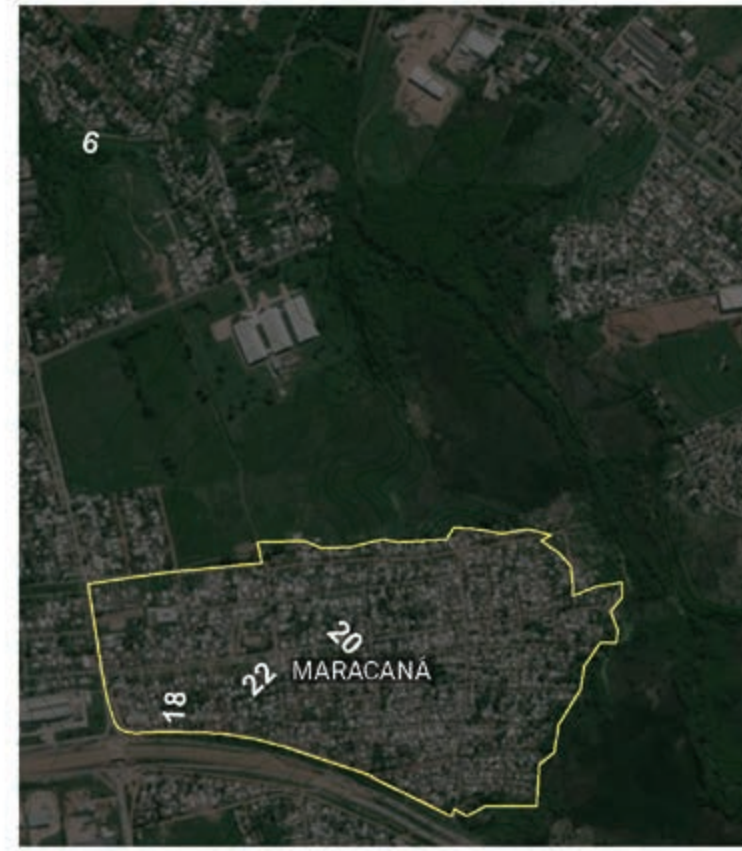
8 2000

0 500 m



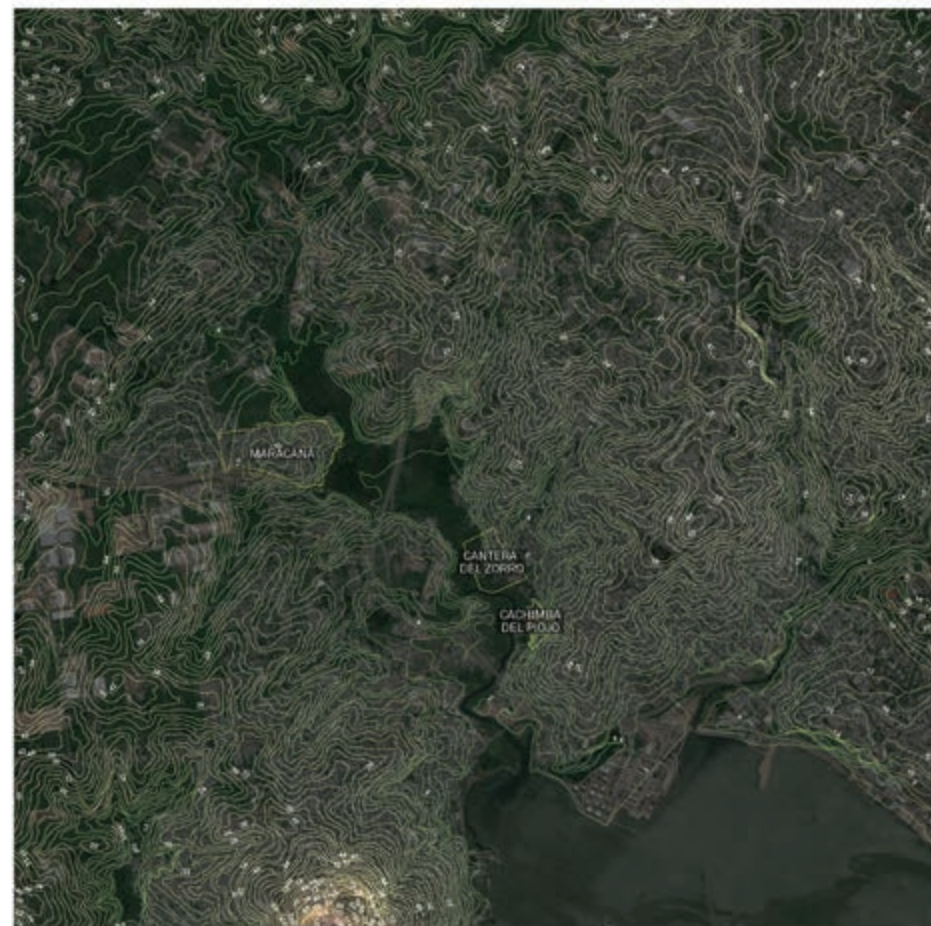
9 2018

0 500 m



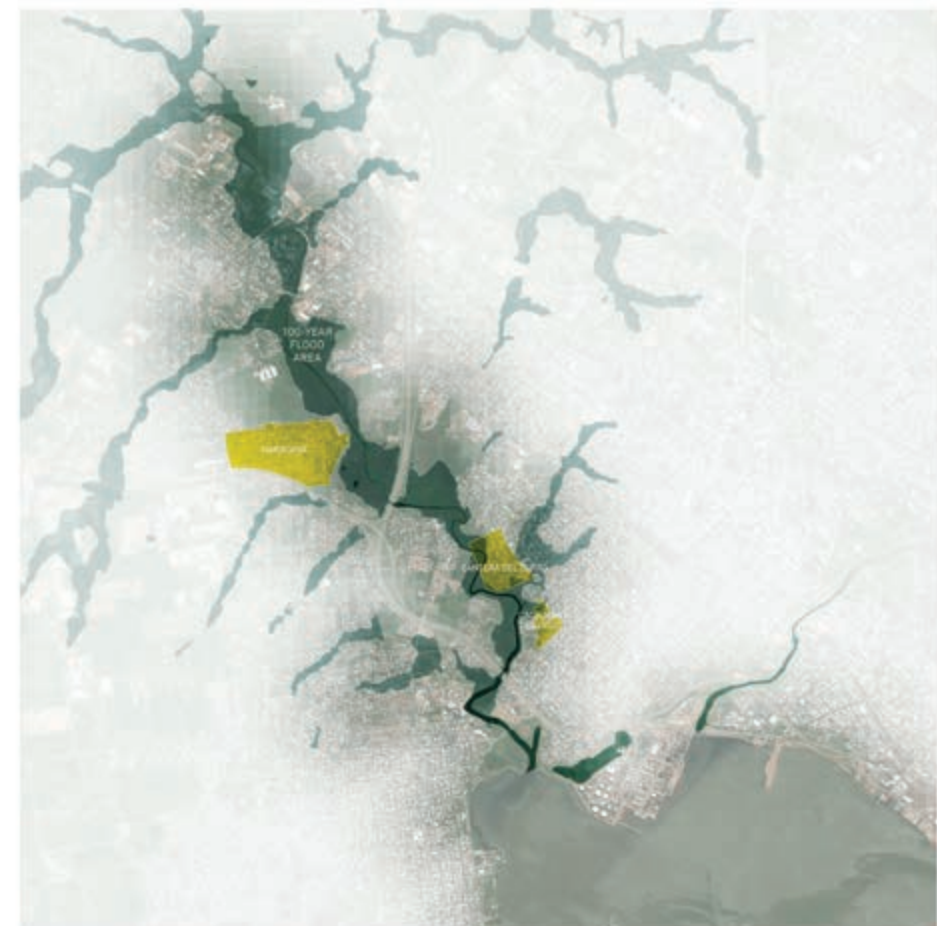
Topography – 2m contours

0 500 m



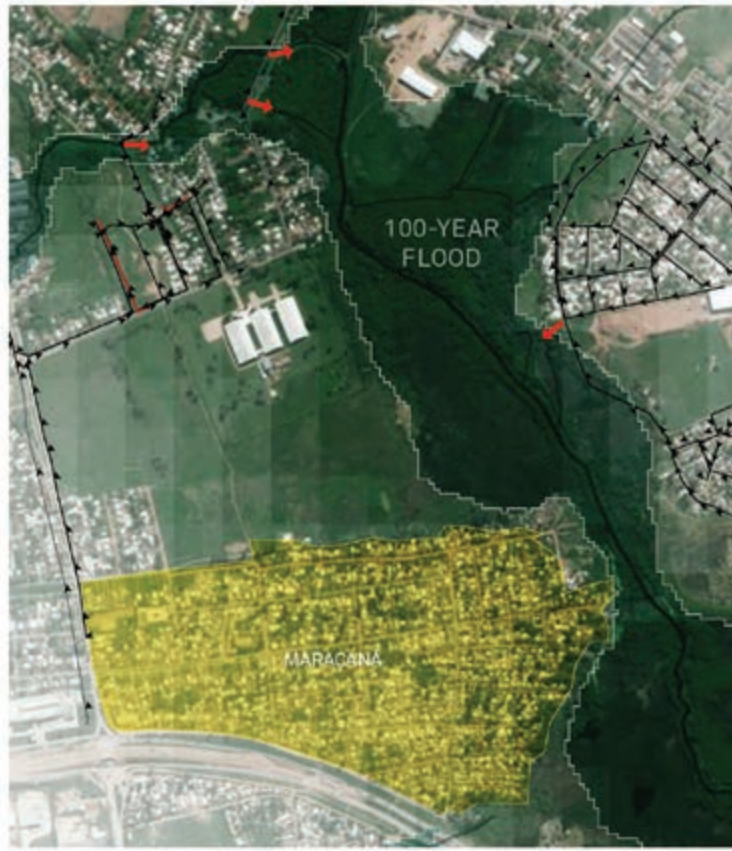
10 Topography  
2m contours

0 1 2 Km

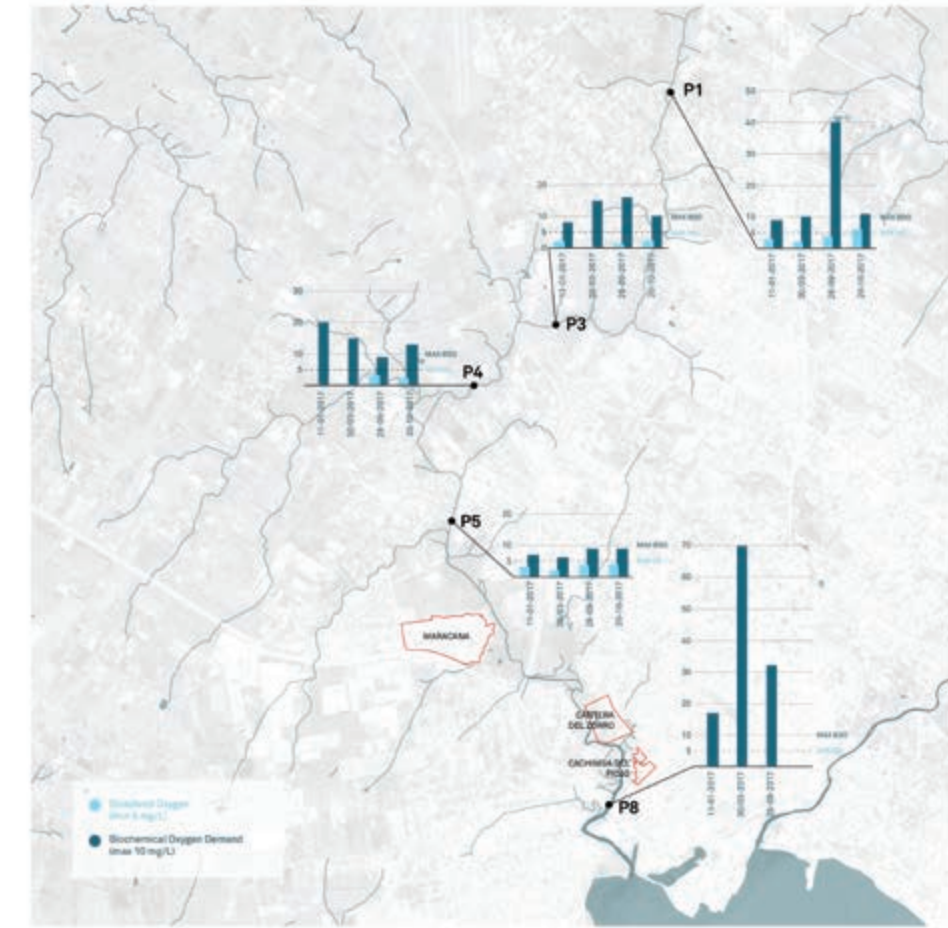


12 100-year Flood

0 1 2 Km



13 WATER – 100-year flood, wastewater network



Dissolved Oxygen & BOD



Monitoring Stations



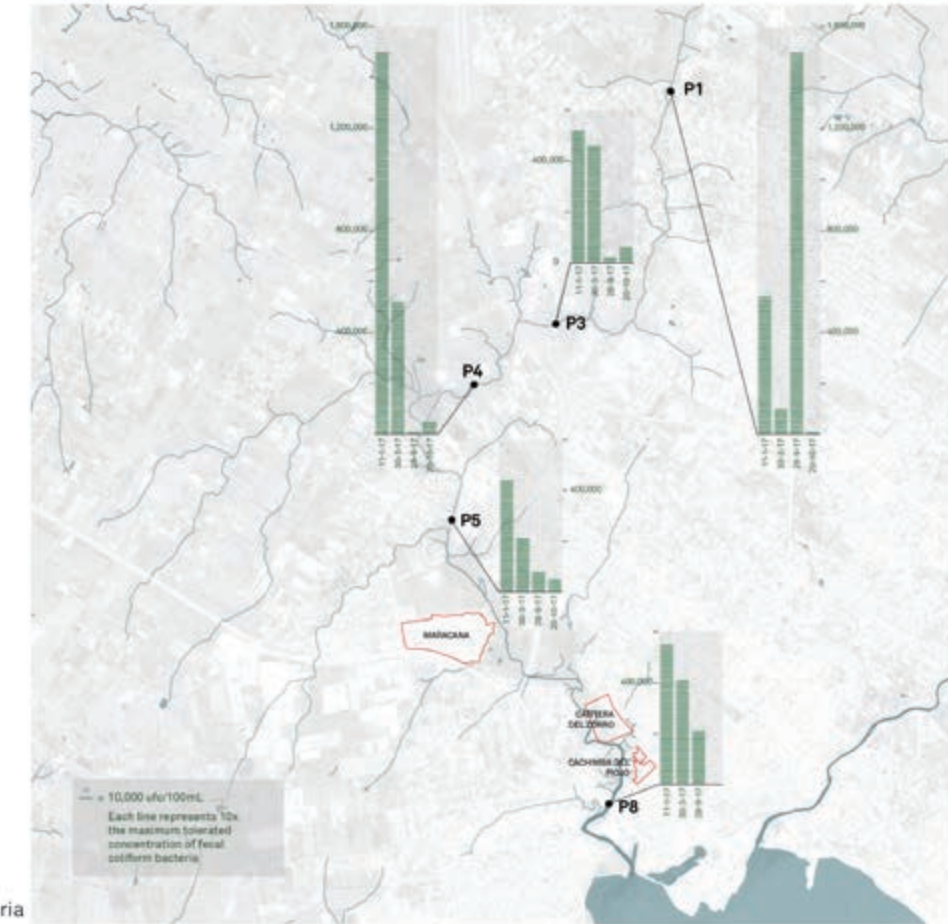
Tabla 6.2.1. Concentraciones de OD, DBO<sub>5</sub>, PT, NT, NH<sub>4</sub><sup>+</sup>, Cr, Pb, Cr, A° Pantanoso (2017)

Estación de Muestreo	Fecha de Muestreo	OD (mg/L)	DBO <sub>5</sub> (mg/L)	Fósforo Total (mg/L P)	Nitrógeno Total (mg N/L)	Amoníaco Libre (mg N/L)	Coliformes Fecales (ufc/100mL)	Cromo (mg/L)	Pomo (mg/L)
P1	11/01/2017	2.85	9	2.32	15.8	0.08	5.4E+05	0.005	0.006
	30/03/2017	2.19	10	1.44	25.0	0.06	1.0E+05	0.005	0.005
	28/09/2017	3.68	140	2.77	16.1	0.07	1.5E+06	0.005	0.005
	20/10/2017	6.04	11	0.74	8.2	0.01	2.0E+03	0.005	0.006
P3	11/01/2017	2.04	8	3.44	13.4	0.04	5.2E+05	0.005	0.007
	30/03/2017	0.05	15	2.48	33.1	0.12	4.8E+05	0.005	0.005
	28/09/2017	1.38	16	2.41	13.7	0.06	2.4E+04	0.005	0.005
	20/10/2017	2.31	10	3.58	21.1	0.05	6.4E+04	0.005	0.005
P4	11/01/2017	0.07	20	1.98	13.9	0.03	1.5E+06	0.005	0.007
	30/03/2017	0.01	15	3.82	34.0	0.13	5.2E+05	0.005	0.005
	28/09/2017	3.18	9	2.85	23.7	0.07	4.5E+03	0.005	0.005
	20/10/2017	2.42	13	3.15	27.9	0.07	5.1E+04	0.005	0.005
P5	11/01/2017	3.17	7	13.00	12.3	0.05	4.4E+05	0.005	0.005
	30/03/2017	2.25	6	12.90	31.8	0.13	2.1E+05	0.005	0.005
	28/09/2017	3.71	9	2.49	18.2	0.06	7.8E+04	0.005	0.005
	20/10/2017	3.97	9	3.40	29.9	0.06	5.4E+04	0.005	0.005
P8	11/01/2017	0.07	17	1.73	16.2	0.03	5.5E+05	0.002	0.006
	30/03/2017	0.04	170	3.83	36.1	0.08	4.2E+05	0.114	0.005
	28/09/2017	0.12	32	2.00	31.8	0.14	2.1E+05	0.006	0.005

Nota: los números en **negrita** significan valores menores que dicha concentración.

	Estación de Muestreo	Fecha de Muestreo	OD (mg/L)	DBO <sub>5</sub> (mg/L)	Fósforo Total (mg/L P)	Nitrógeno Total (mg N/L)	Amoníaco Libre (mg N/L)	Coliformes Fecales (ufc/100mL)
Cafedra Belica	BE1	01/03/17	5.43	8	0.45	9.41	0.017	4.3E+05
		16/08/17	8.33	6	-	-	-	6.0E+04
	BE2	01/03/17	7	3	1.09	9.15	0.030	5.4E+04
		16/08/17	4.15	7	-	-	-	9.1E+04
Cafedra Lecoq	LE1	01/03/17	1.33	13	0.92	15.78	0.148	1.1E+06
	16/08/17	2.31	32	-	-	-	7.2E+05	
Cafedra de la Higuera	H1	16/08/17	2.09	134	-	-	-	5.6E+08
		01/03/17	20	3	2.35	3.88	0.100	2.2E+04
Cafedra Jesús María	JM2	16/08/17	20	7	-	-	-	1.0E+04

16 Fecal Coliform Bacteria



17 Nitrates  
(max 10 mg N/L)



18 Ammonia  
(max 0.02 mg N/L)

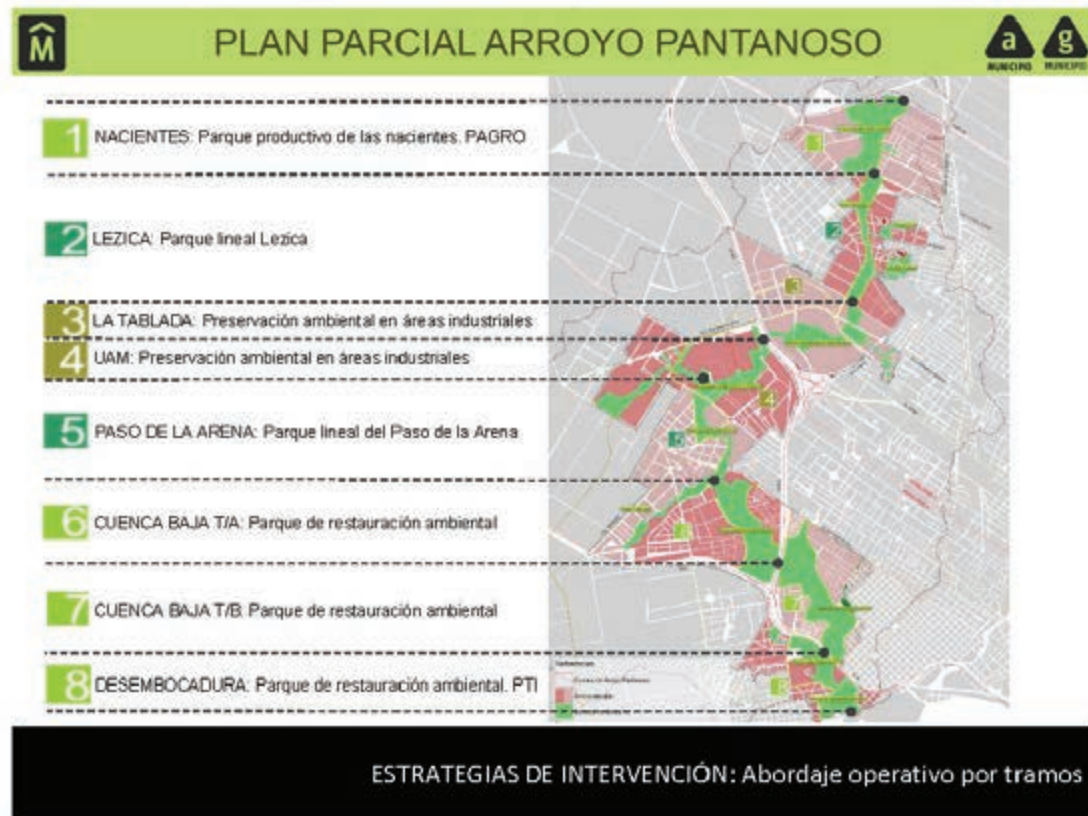


19 Parcels & Land Use

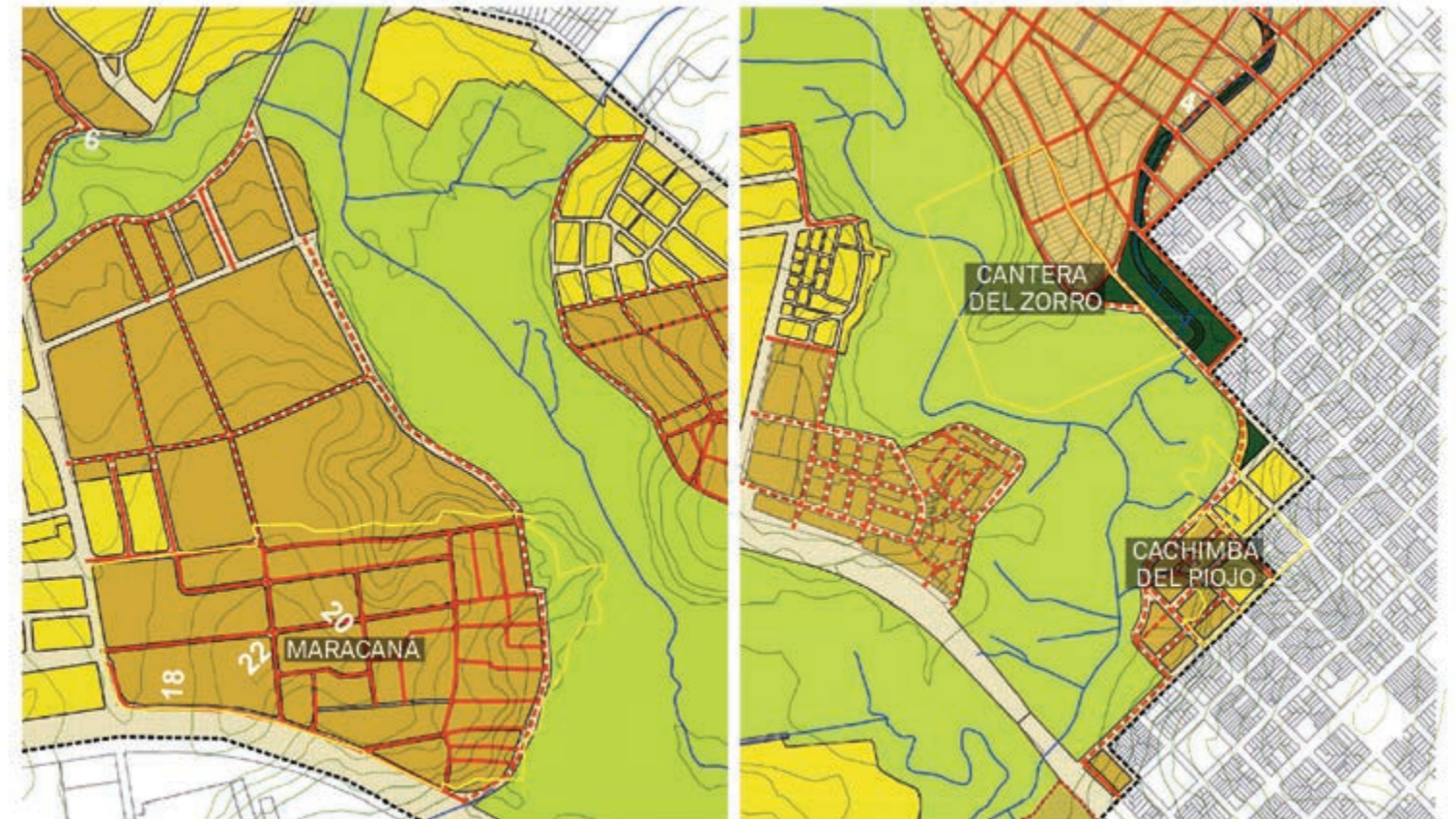


20 Parcels & Land Use

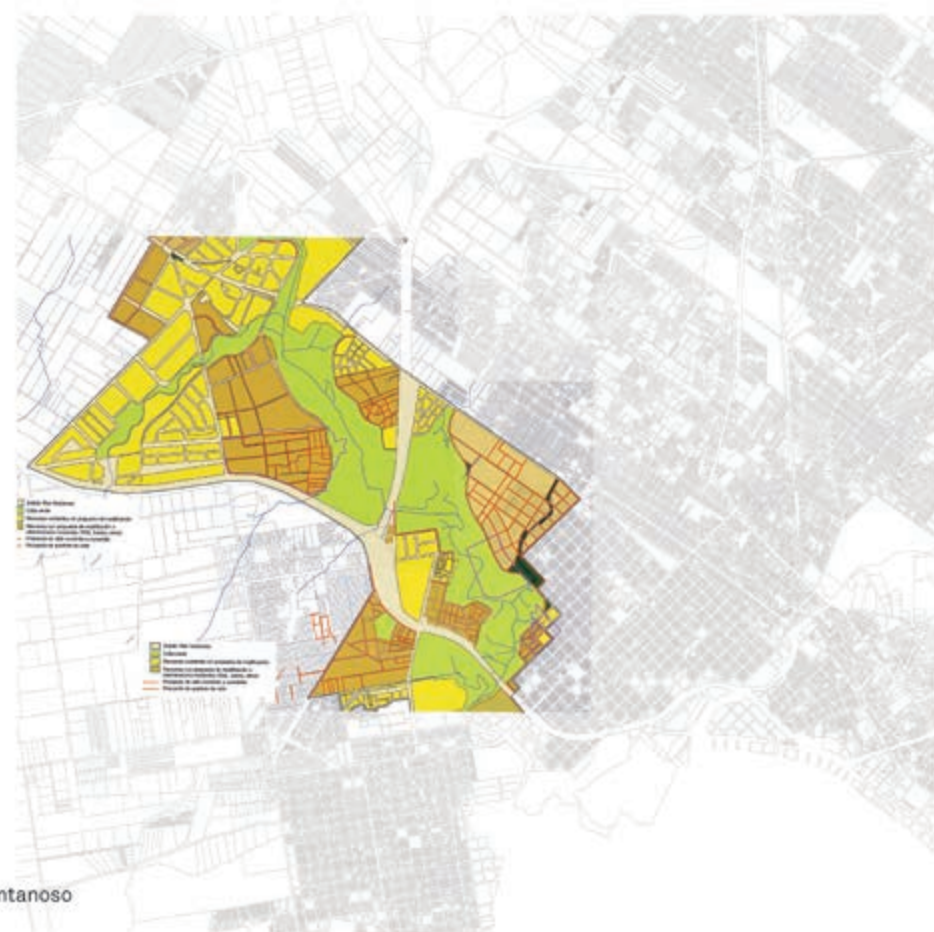




21 Plan Parcial Arroyo Pantanoso – Sections



23 Plan Parcial Arroyo Pantanoso



22 Plan Parcial Arroyo Pantanoso  
Sections 6 & 7



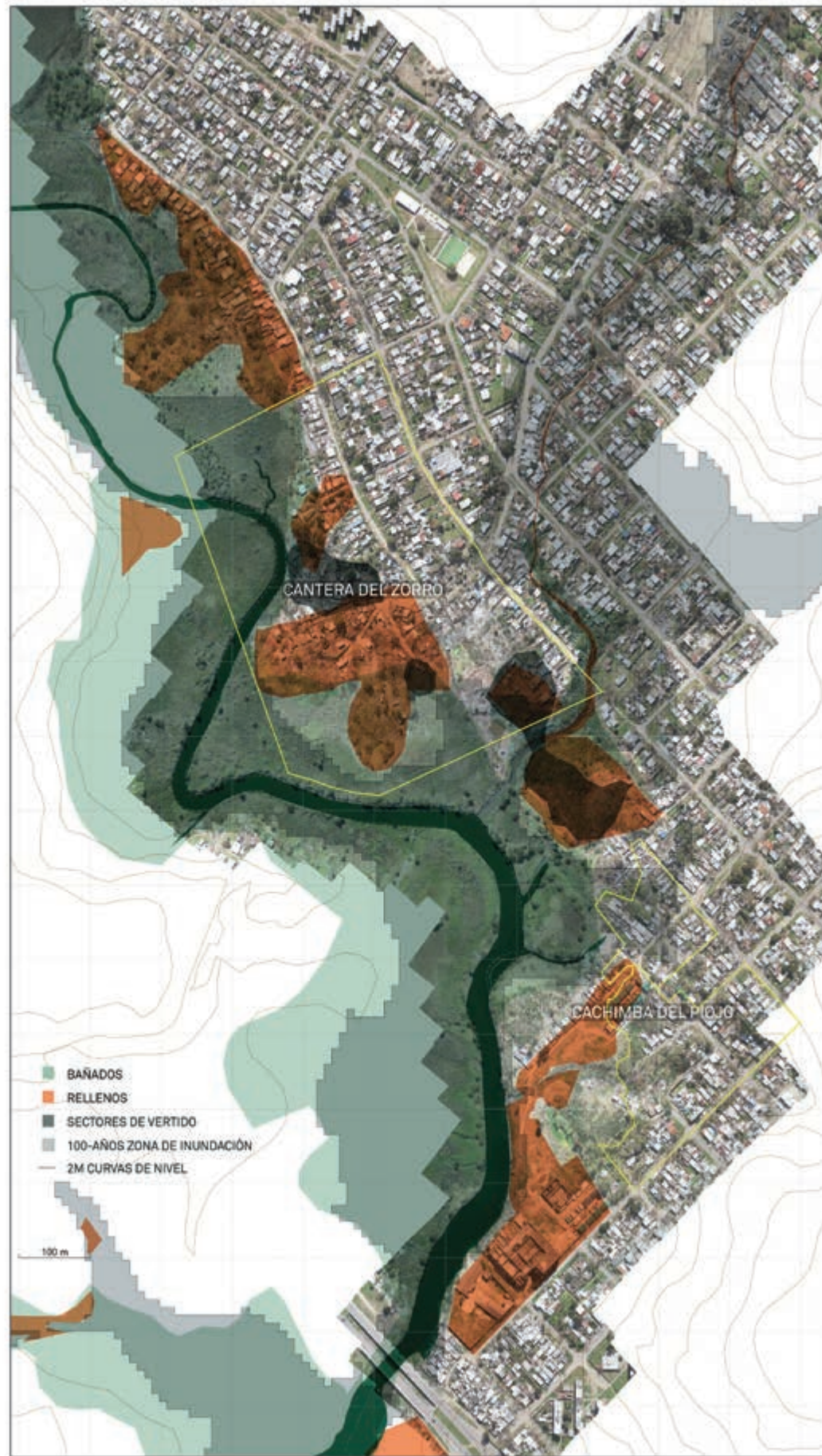
Cantera del Zorro



25 Cachimba del Piojo

26









29



31



30

