

Green Infrastructure for a New Pinheiros River

The metropolis of São Paulo was characterized by a population densification process reaching 21.5 million inhabitants and intense urban uses.

The city's sprawling mode of development and the adoption of conventional gray infrastructure systems by occupying flood plains, river and creeks channelization, causing flooding, jeopardizing its watersheds, promoting heat islands and withdrawing from the population the use of these spaces cause environmental damage and landscape degradation.

In 2019, the São Paulo State Government - who is in charge of the rivers - initiated a major effort for cleaning the waters of the Pinheiros River, one of the City's main waterways that cross its most valued section.

The Program has five lines of action: sanitation, maintenance, solid waste treatment, revitalization and communication and environmental education (SIMA, 2019).

The current state of degradation of the Pinheiros River does not allow the existence of aquatic life and precludes uses for water consumption, recreation and even navigation.

The goal is to restoring the River by improving the quality of its waters and allowing the development of its surrounding areas.

Faced with the official Program goals, it is proposed a network of Green Infrastructure spread throughout the watershed, designed as nature-based solutions, as a backup plan that would promote greater resilience to the Project.

Associated with conventional infrastructures, adding multifunctional benefits as stormwater management, restoration of degraded areas, food production, landscape revitalization, biodiversity enhancement, social, recreational and educational uses.

Using landscape approach by using natural and built elements, this contribution offers a possible network of green infrastructures elements integrating geocological elements with land uses and existing and proposed infrastructure.

This area is characterized by diverse housing and services uses, with governmental and private facilities, corporate headquarters and high end condominiums and malls, expressing the inequality of its reality.

The IGC 2020 project explores a study area of 5 square kilometers covering the sub-watershed of the Antonico Creek allowing the preliminary sizing of the LID devices as part of the proposed GI.

Requirements and Assumptions

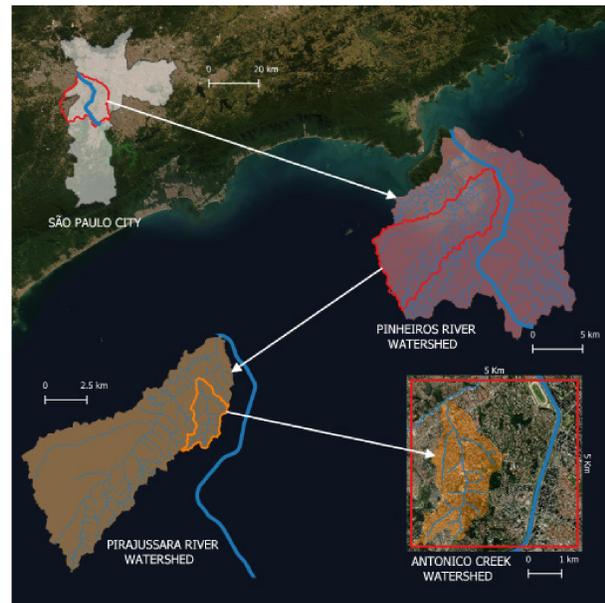
Ensure greater sustainability of water quality through the use of green infrastructure elements to assist the water treatment and procedures adopted by the official project

Favor greater urban resilience in the face of extreme weather events by adaptation and mitigation using landscape based solutions

Facilitate urban mobility, outdoors activities, ecosystems and public health.

Major Innovations Employed

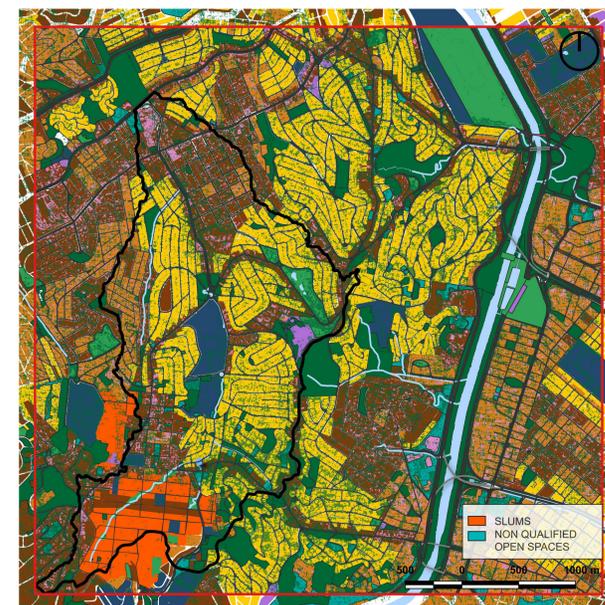
- WAT 1 Water Crisis: Address Access to Clean Water
- WAT 8 Bioretention
- GRN 1 Resilient Landscape Infrastructure
- GRN 3 Integrated Vegetated Stormwater Infrastructure
- GRN 4 Linear Vegetated Corridors as Linear Parks
- GRN 10 Green Urban Streets
- GRN 12 Green Roofs
- TRAN 20 Permeable Pavement for UHI And Stormwater Management



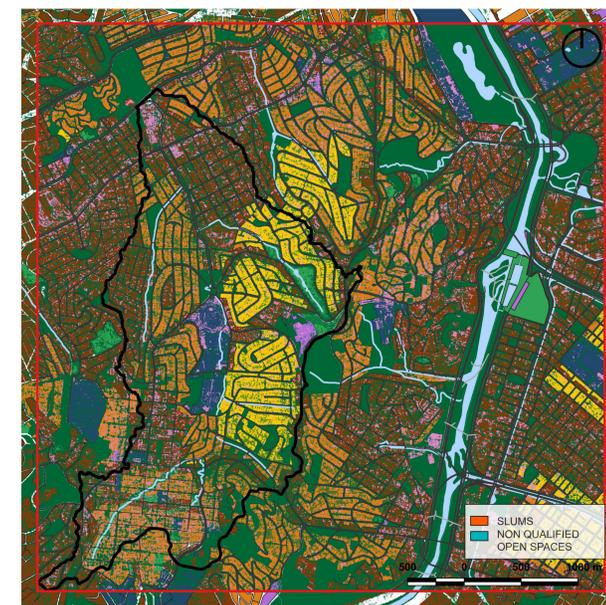
Project Area 5 km x 5 km



Existing 2020



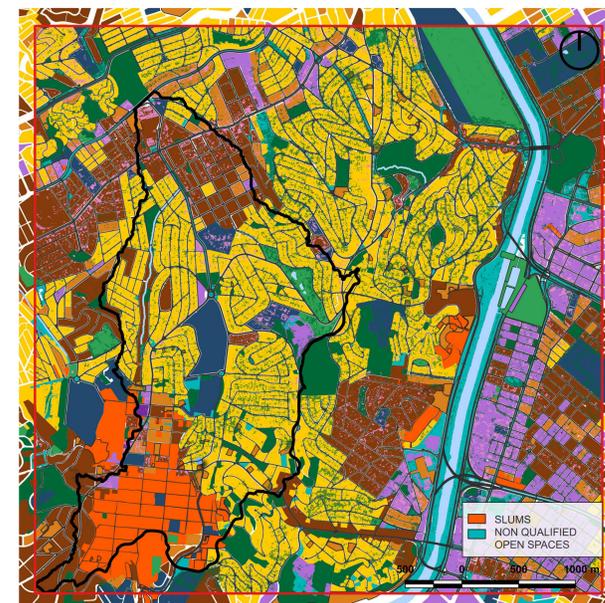
Early Adopter 2035



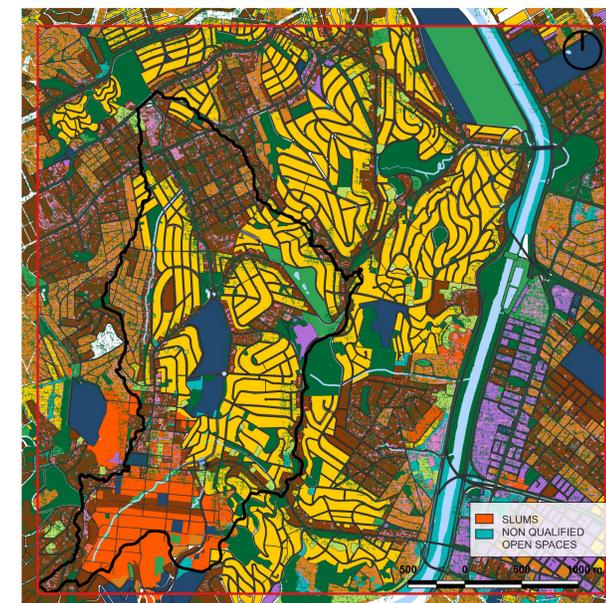
Early Adopter 2050



Project Surroundings



Non and Late Adopter 2035



Late Adopter 2050

To achieve these goals the following actions must be implemented as soon as possible: complementing the City Master Plan densification along public transit corridors, open spaces must be added offering multifunctional uses as stormwater management, using bioretention tools, allowing the expansion of the tree canopy and the water surfaces as possible to abate the heat absorbing surfaces.

This will help rehabilitate social degraded areas, will provide LID for first flush treatment, green roofs, and will bring more socially balanced urban life: better quality of life and interaction; economically: income generation; ecologically: improvement of ecosystems. UN goals: 1, 8, 11 and 15.

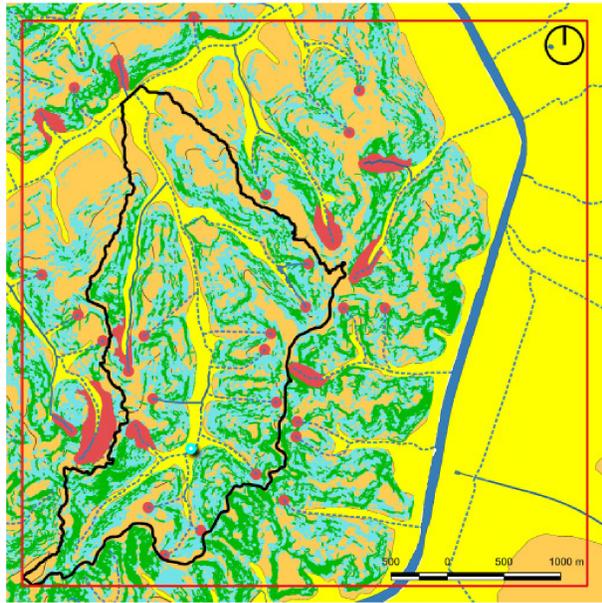
By 2050, there will be greater densification, but more open spaces with GI, with water features inserted in urban life, and naturalized water bodies, new versions of reservoirs and waterfronts will be adopted to allow people access and nature regeneration.

A new Pinheiros river, bordered by causeways and paths will bring appropriation of public spaces, enjoyment by benefits and involvement in the management of the urban ecosystem by the population and increase mobility in the planned axes.

If the premises of this project are adopted only from 2035 onwards, the scenario towards urbanization trends such as 2020, should be seeing the continuity of the reduction of street afforestation; "unqualified" vacant areas unoccupied will be of medium density occupation.

Some bodies of water will remain buffered, the neglected neighborhood will have neither re-urbanized axes nor naturalized streams. Pinheiros river shore will continue with several unqualified areas not harnessing their full potential as GI and development areas. There will be increased densification in the neglected neighborhood. Solar energy use will be restricted to real estate developments with strong commercial appeal.

In the 2050 scenario, with measures beginning in 2035, we will have some increased urban afforestation, fewer unqualified open spaces available for receiving green infrastructure, partial naturalization of water bodies, commencement of rehabilitation, and naturalization of water bodies in the neglected neighborhood area. The edges of the Pinheiros River will be seeing significant changes, but not in the scale that could bring the full potential that it can have on the Early version.



LID distribution by geomorphology

- Floodplain and valley bottom - potential for water storage
- Tabular areas - infiltration predominance good percolation
- Steep slopes - between 10 and 20% infiltration predominates but in heavy rainfall runoff increases
- Steep slopes more 20% - predominance of runoff
- Permanent Protection Areas and Spring Amphitheatres

Flood plain: rain planter no infiltration, built wetland, recovered stream, greenway, and urban afforestation.

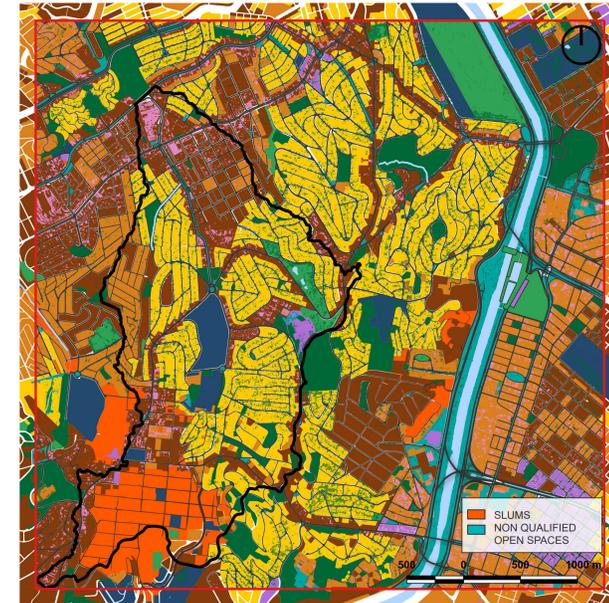
Tabular areas: rain gardens, rain planters with infiltration, bioswales, porous pavement.

Steep slopes btw 10 and 20%: rain planters with or without infiltration, bioswale, porous pavement, tree canopy.

Steep slopes more than 20%: rain planters without infiltration, bioswale, tree canopy.

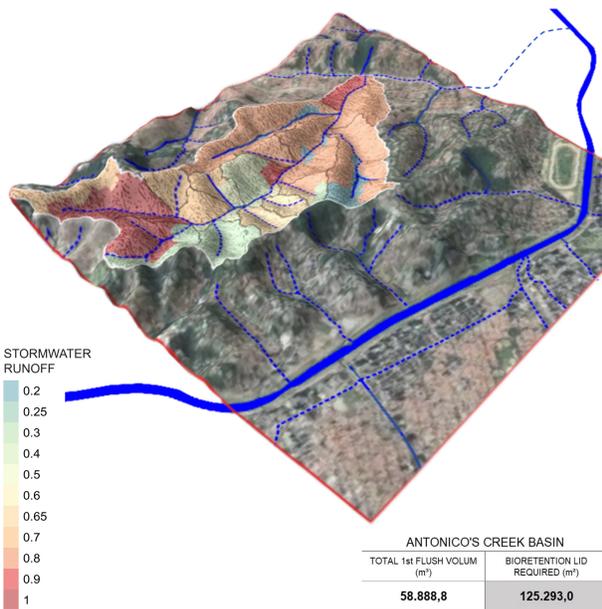
Springs: ponds, built wetlands, stream recovering, riparian forest, tree canopy.

(BONZI, 2014; SCHUTZER,2012)



Non Adopter 2050

Following the current trends and none of the green infrastructure proposals was implemented, even if the official conventional water treatment project for the River was implemented in its totality, the scenario for the year 2050 will be of greater environmental degradation: urban areas will be denser, with no plans for multifunctional green areas to increase; water bodies will remain poorly buffered and not protected from non-point source water pollution and solid waste will increase considerably; the lack of proper housing projects with environmental concerns will be greater, without nature based solutions or naturalization of water bodies; water scarcity will get worse; the local temperature and extreme events will increase, even if the use of some green roofs and walls. Floods will continue to punish the low areas as unstable hillsides will be in danger; the edge of the Pinheiros River will continue to be unreachable areas, except those improved by real estate enclaves developments, but independently of the technical tricks the water quality will always be in risk. The maintenance costs will increase until it becomes unreachable.



Sustainable Development Goals	Early adopter										SUM
	WAT	AGR	GRN	ENE	TRAN	IND	INST	RES	SLUMS	N.QUAL.P. O.SPACES	
1: No Poverty	1	1	1	0	1	1	3	3	3	1	15
2: Zero Hunger	1	3	1	0	1	3	1	0	0	1	11
3: Good Health and Well-being	3	1	3	0	1	1	1	3	1	3	17
4: Quality Education											
5: Gender Equality											
6: Clean Water and Sanitation	3	0	3	0	0	1	3	3	1	3	17
7: Affordable and Clean Energy	0	0	0	1	1	0	1	1	0	0	4
8: Decent Work and Economic Growth	3	1	3	0	1	3	3	0	1	0	15
9: Industry, Innovation and Infrastructure	3	1	3	1	1	1	1	0	1	3	15
10: Reduced Inequality											
11: Sustainable Cities and Communities	3	3	3	1	3	1	3	3	3	3	26
12: Responsible Consumption and Production	1	1	1	1	0	1	3	3	0	0	11
13: Climate Action	1	1	1	1	0	0	1	0	1	1	7
14: Life Below Water											
15: Life on Land	3	3	3	0	0	0	1	0	0	3	13
16: Peace and Justice Strong Institutions											
17: Partnerships to achieve the Goal											
	3	1	3	0	1	1	3	3	1	3	15



Sustainable Development Goals	Late adopter										SUM
	WAT	AGR	GRN	ENE	TRAN	IND	INST	RES	SLUMS	N.QUAL.P. O.SPACES	
1: No Poverty	0	-1	0	0	0	-1	1	0	0	0	-2
2: Zero Hunger	0	1	0	0	1	1	0	0	-1	0	2
3: Good Health and Well-being	1	0	1	0	-1	0	0	1	-1	1	2
4: Quality Education											
5: Gender Equality											
6: Clean Water and Sanitation	1	0	1	0	0	1	1	1	-1	1	5
7: Affordable and Clean Energy	0	0	0	1	1	0	0	0	-1	0	1
8: Decent Work and Economic Growth	1	0	1	0	-1	1	1	0	-1	0	2
9: Industry, Innovation and Infrastructure	1	0	1	1	0	0	0	0	-1	1	3
10: Reduced Inequality											
11: Sustainable Cities and Communities	1	1	1	0	1	-1	1	-1	-1	1	3
12: Responsible Consumption and Production	0	0	0	0	0	1	1	0	0	0	2
13: Climate Action	-1	0	0	0	-1	-1	-1	-1	-3	-1	-10
14: Life Below Water											
15: Life on Land	1	1	1	0	-3	-3	0	0	0	1	-2
16: Peace and Justice Strong Institutions											
17: Partnerships to achieve the Goal											
	5	2	5	1	-3	-2	4	0	-10	4	6



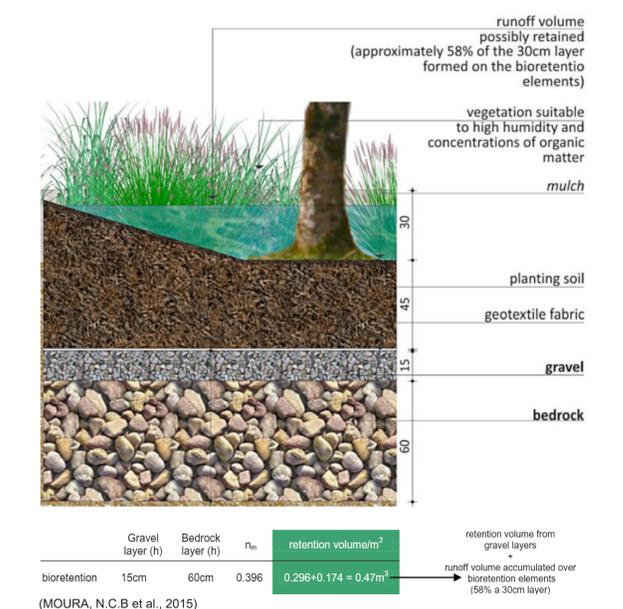
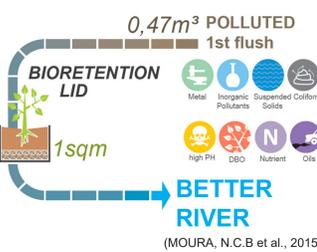
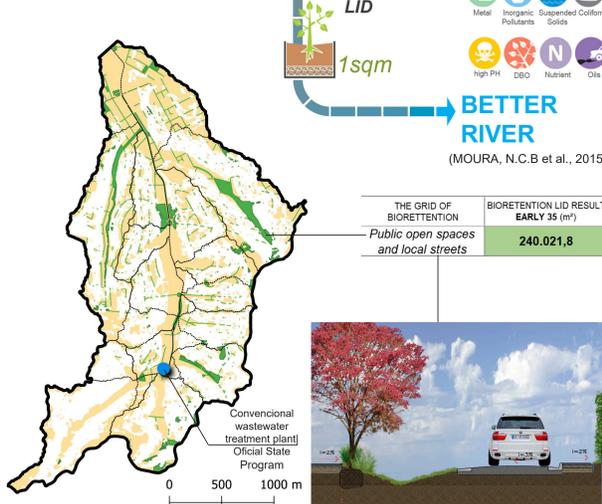
How do Scenarios address Sustainable Development Goals?

Green infrastructure: porous pavement, solar energy, green roof, cistern, rain garden, afforestation; rainbeds, bio-valleys, linear parks, rain ponds, constructed wetlands, clearing and naturalization of rivers and streams, community gardens and parks will meet UN sustainability goals:

- 1 (no poverty), because flooding will decrease;
- 3 (healthy living and well-being), because the green areas and the requalification of the water bodies will improve the temperature, health and social life;
- 6 (sustainable water management and sanitation), because sanitation will result from water pollution;
- 7 (affordable and clean energy), because the use of photovoltaics panels and solar heating water;
- 8 (decent work and economic growth), because green infrastructure will create jobs and innovation in commerce and industry;
- 11 (resilient and sustainable human settlements), because the environment will be healthier;
- 13 (climate action) because the green infrastructure improves the micro climate and
- 15 (protecting terrestrial ecosystems) because good soil, water and flora conditions will encourage the return of fauna to the area.

THE GRID OF BIORETENTION

High performance landscaping
Retrofit local streets | connected to remodelled public open spaces (EARLY 35 scenario)



Early Adopter Future scenario



Sources:

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