STAGING FRONTIER DYNAMICS
Interplay at the Periphery of Manaus

by
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SMArchS Architecture and Urbanism 2016

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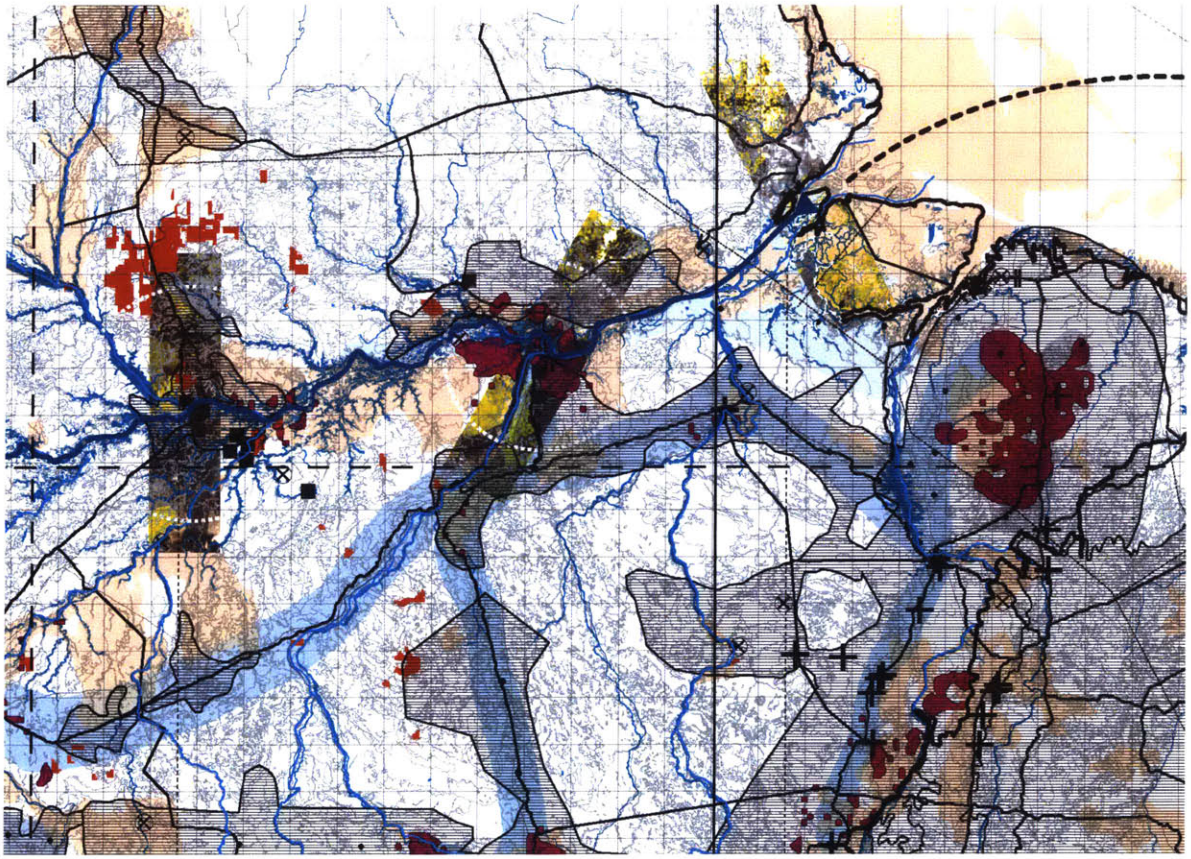

01
Image detail of the Amazon Basin mapping geographic conditions and nodes where global pressures are most present on the territory.

STAGING FRONTIER DYNAMICS

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Submitted to the Department of Architecture on May 19, 2016 in partial fulfilment of the requirements for the degree of Master of Science in Architecture Studies

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ABSTRACT

The Amazonia basin has been the protagonist of many large scale infrastructural and colonization ambitions that are closely tied to larger global economic pressures. These are mainly manifest along the peripheries and edges where both deforestation and land conflict have intensified alongside rapid rates of urbanization. Increased environmental awareness and the use of nature as capital make obvious that Nature can no longer be disregarded. This sets up a scenario where the Frontier has the potential for coupling and hybridization towards a new common project, one where built space and natural space are no longer mutually exclusive, but instead work within a systematic relationship that can adapt to land use transformations through time.

The Amazonian frontier is not a border or a purely linear development between settled and unsettled territory in the Turnerian sense, but a field of heterogeneity: where the interplay of actors and their interests produces a space where a series of articulated scales of temporalities and spatialities coexist.

This thesis investigates the territorial implications of urbanization patterns along the Amazonian frontier as a potential space for experimentation and creation of new hybrid zones. In order to establish a new hybrid periphery growth model at the frontier which incorporates natural and built space, the project explores ecological, agrarian, and urban tools and proposes strategies of addition and subtraction, sharing and exchange in order to: connect and link disarticulated forest fragments; contain and guide development; and provide alternative hybrid and collective models for new Productive Landscapes. In doing so, the project examines the dynamics and interplay between two entities, nature and development, in order to create strategies for a collective zone that capitalizes on the dynamic quality of the Amazonian frontier.

In a 2010 report, the World Bank estimated that the "tipping point" for the Amazon could be approximately 20% deforestation. If reached, this threshold could trigger a dramatic die-back of the Amazon rainforest. With 17% of the Amazon already deforested, the Amazon ecosystem and its important global contributions are at risk if current patterns continue. *

* Walter Vergara and Sebastian M. Scholz, editors. WORLD BANK STUDY: Assessment of the Risk of Amazon Dieback

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Finally, to my friends at MIT in the Slum Studio that made this process memorable

To my Family, for your unconditional love, support and understanding.

Unless otherwise indicated, images, diagrams and drawings included in this thesis have been created by the author.

STAGING FRONTIER DYNAMICS

Interplay at the Periphery of Manaus

STAGING FRONTIER DYNAMICS:
Interplay at the Periphery of Manaus

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INTRODUCTION

*"Imagine an entrepreneurial effort to create a property exchange focused on an interplay among properties... the exchange would rate not only properties themselves, but the benefits of changing use or swapping positions in their landscapes."**

("Keller Easterling — Subtraction Protocol 2 Water" 2016)

STAGING FRONTIER DYNAMICS: Interplay Investigations

This thesis emerged from the curiosity and fascination to investigate the opportunities created from temporal and dynamic systems where conflicting uses are not mutually exclusive, but instead have the potential to provoke alternative urban strategies that are able to adapt to different conflicting actors through time. Within the context of the Amazon, in which global, national and local interests combine to produce diverse and conflictive manifestations, an opportunity arises to radically rethink urban development along the Frontier.

The concept of the Amazon as the "Global Commons" has gained momentum in recent years, as discussions regarding climate change have come to the forefront and pressures economic development and demand for energy resources increases. The Amazon has been the protagonist of many large scale infrastructural and colonization ambitions that are closely tied to larger economic pressures. The thesis will take IIRSA, a large scale infrastructural strategy to integrate South America, as a starting point of departure to investigate the externalities of infrastructure and its spatial transformations on the territory. In the past, military geopolitical and economic concerns were at the forefront in establishing programs and settlement patterns that are still shaping the territory today. However, given the recent ecological concerns, the thesis sets off to explore alternative types of territorial occupation strategies.

The paradox of the Amazonian context raises another question regarding the relationship between natural space and development. Following the historical ecologist perspective that Natural Space as an integrated system, not an externalized object, this thesis investigates tools and strategies that can mediate and produce a third condition. Going against the conception that nature is a separate entity, which services the dualist view of an outside/ inside, wild/developed, nature/city. This duality finds new spatial realities within the context of the Amazonian Frontier, as the periphery produces an overlay and

play between different actors and temporalities. In this case, the Frontier has the potential for coupling and hybridization towards a new common project, one where built space and natural space are no longer mutually exclusive, but instead work within a systematic relationship that can adapt to land use transformations through time.

This thesis argues that the Amazonian frontier zone is a space to mix, share, exchange, add, subtract. In this case, the periphery transforms into a potential generative space- a source of innovation and adaptation, and the site for economic or social operations. Due to current political and economic situation of Brazil, development and growth is unavoidable and should be accounted for, but guide development to prevent uncontrolled expansion.

In order to establish a new hybrid periphery growth model at the frontier which incorporates natural and built space, the project explores ecological, agrarian, and urban tools and proposes strategies of addition and subtraction, sharing and exchange in order to: I. Connect and link disarticulated forest fragments; II. Contain and guide development; and III. Provide alternative hybrid and collective models for new Productive Landscapes.

I. The Connect proposal gives remaining natural forest fragments priority in the effort to link them through two main strategies: a. An exchange/swap strategy which aims is to concentrate deforestation and development along main roads, which will then allow for secondary growth succession in order to reconnect forest fragments. B. An Interplay strategy which targets new development in the region and proposes a interdependency model which will tie new development and reforestation processes together

II. The Contain strategy, proposes The 'Mediator' as the design intervention which takes the form of a new organizing structure within 1km buffer of the road. This connecting open space framework serves as a social and physical buffer to guide development and accommodate the growing dense development, while also hosting a series of collective and social services.

III. Add: The hybrid productive zone, capitalizes on the hybrid, dynamic and disarticulated landscape to drive the economic and productive zone. Proposes a shift to agroforestry as an effective strategy linking environmental opportunities with economic realities. Within this negotiation area, the objective is to encourage the best use of already deforested areas, considering technological innovation and alternative hybrid production systems.

The project examines the dynamics and interplay between two entities, nature and development, in order to create strategies for a collective zone that capitalizes on the dynamic quality of the Amazonian frontier.

01

THE ECONOMIES OF NATURAL SPACE

The Global Commons

"In every region of the globe, erstwhile "wilderness" spaces are being transformed and degraded through the cumulative socio-ecological consequences of unfettered worldwide urbanisation. In this way, the world's oceans, alpine regions, the equatorial rainforests, major deserts, the arctic and polar zones, and even the earth's atmosphere itself, are increasingly interconnected with the rhythms of planetary urbanisation at every geographical scale, from the local to the global."

("Implosions/Explosions: Towards a Study of Planetary Urbanization: Neil J Brenner" 2016)

02
Amazon as the Global Commons

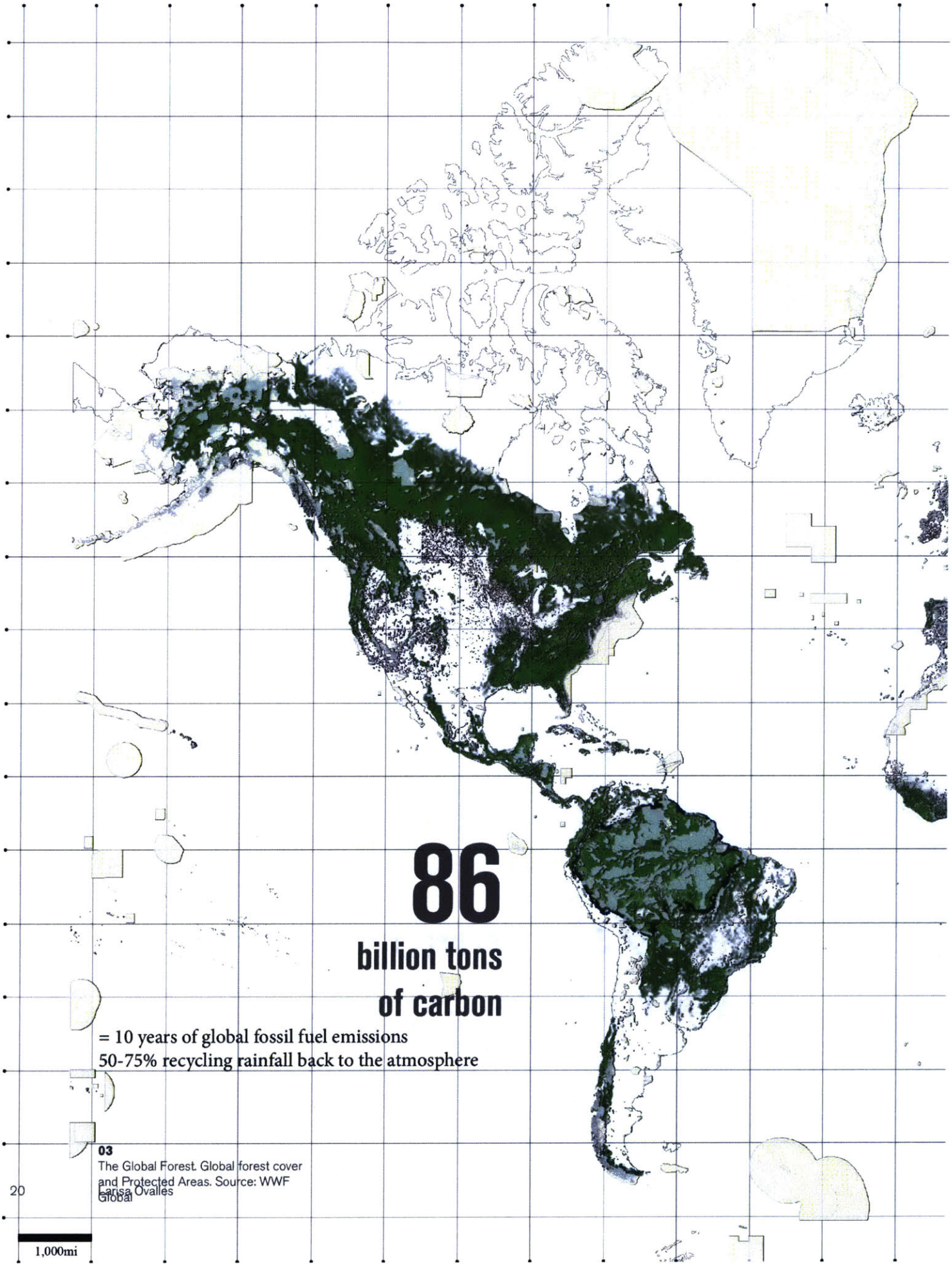
THE GLOBAL COMMONS

"Contrary to what Brazilians think, the Amazon is not their property, it belongs to all of us"

Senator Al Gore, 1989

Along with Antarctica, the oceans and the atmosphere, the Amazon is usually seen as part of the 'Global Commons" since their inherent properties and services have major global significance. The Amazon Basin serves as the world's carbon storage, storing about 86 billion tons of carbon, which is equal to 10 years of global fossil fuel emissions. Its forests also recycle about 50-75 per cent of annual rainfall back to the atmosphere, helping regulate rainfall in key agricultural regions, especially in Brazil and Argentina. Global forest cover is about 31%, while only 7.7% is currently protected under strict conservation categories.

The Amazon basin is also the largest freshwater basin, holding 1/5 of the world's fresh water. These main global contributions have pushed forward the idea of the Amazon as 'the Global Commons." This concept has gained momentum in recent years, as discussions regarding climate change have come to the forefront and pressures economic development and demand for energy resources increases. There is a direct conflict between global economic pressures and the environmental contributions of the Amazon basin.



03
The Global Forest. Global forest cover and Protected Areas. Source: WWF Global

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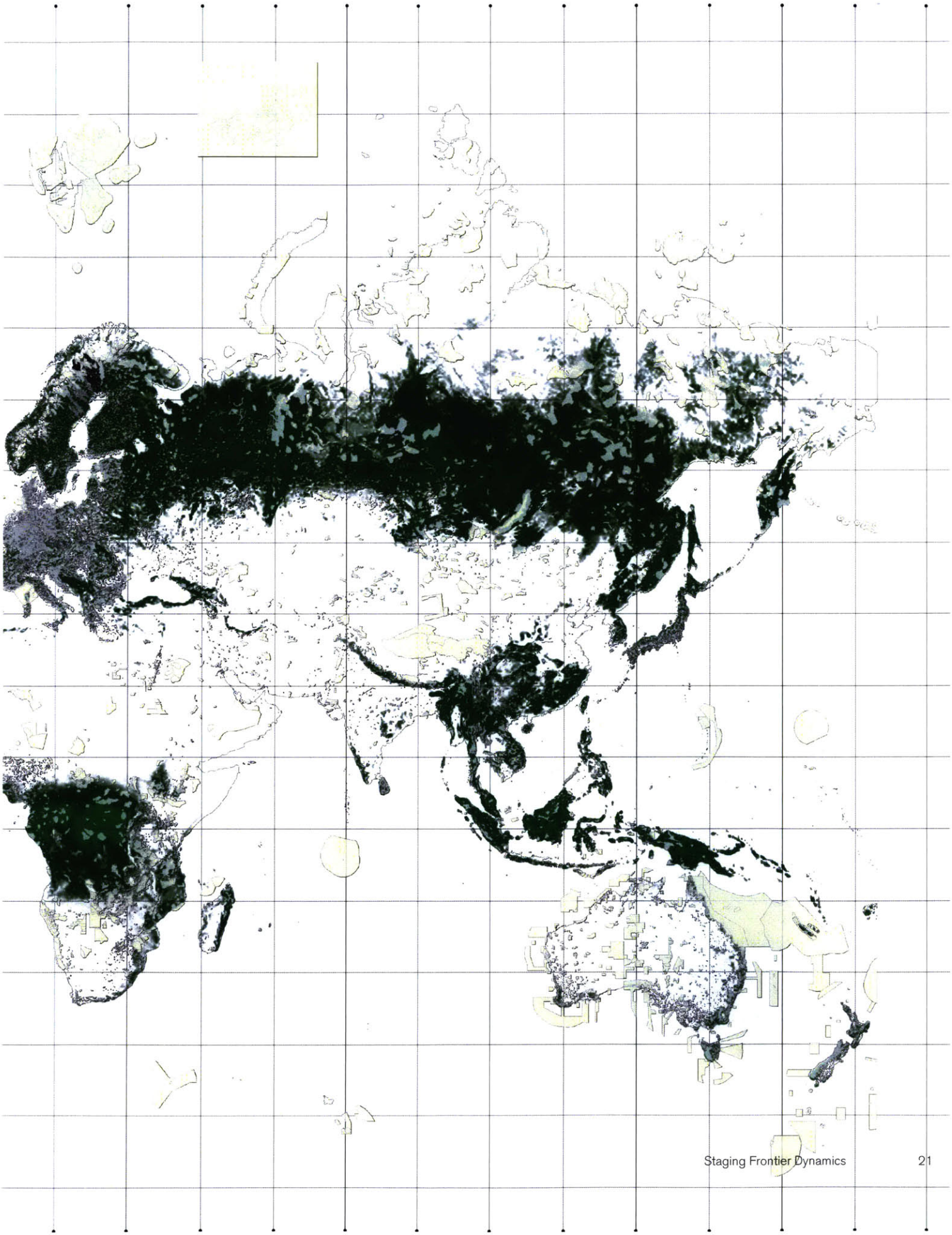
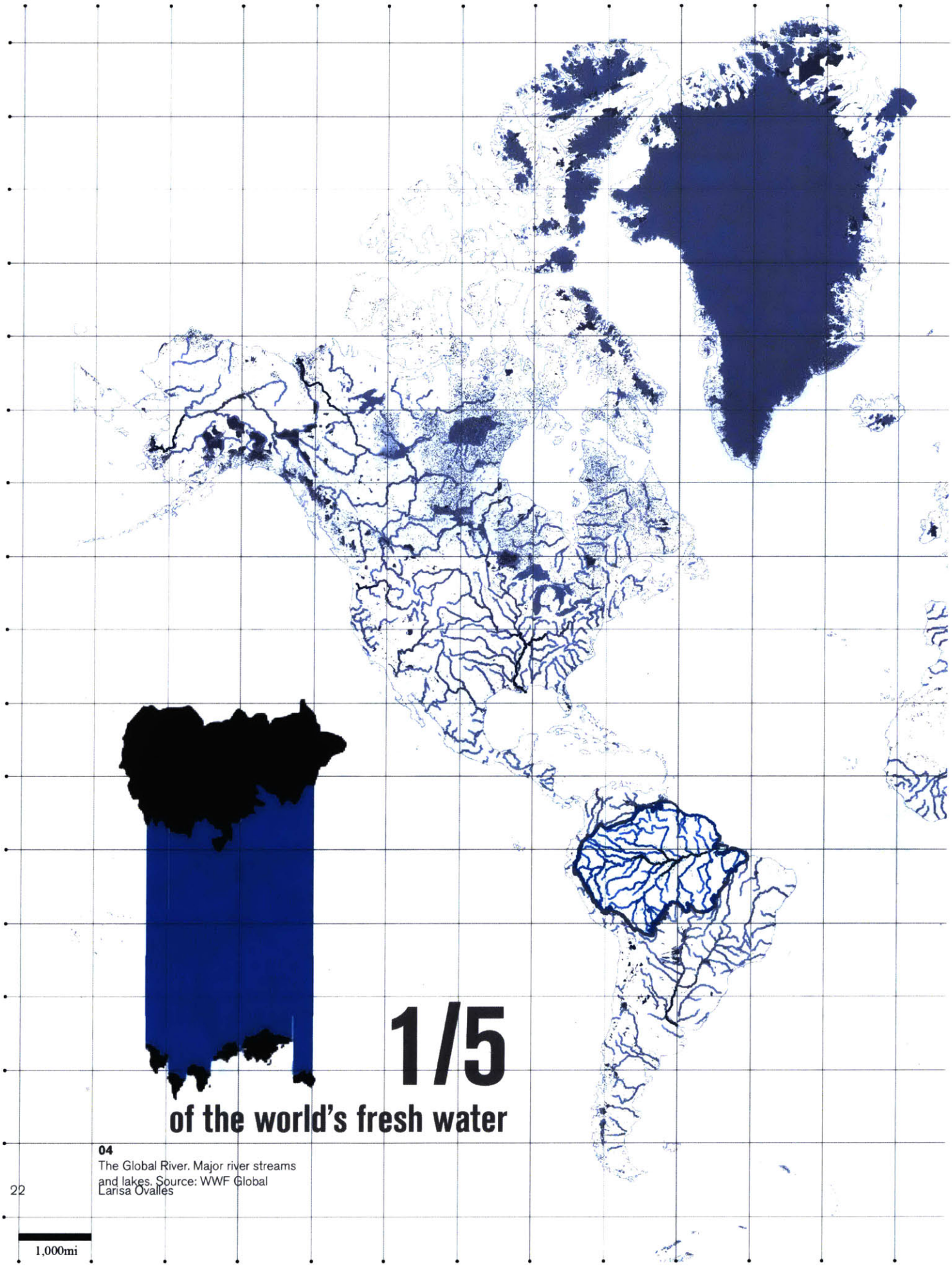
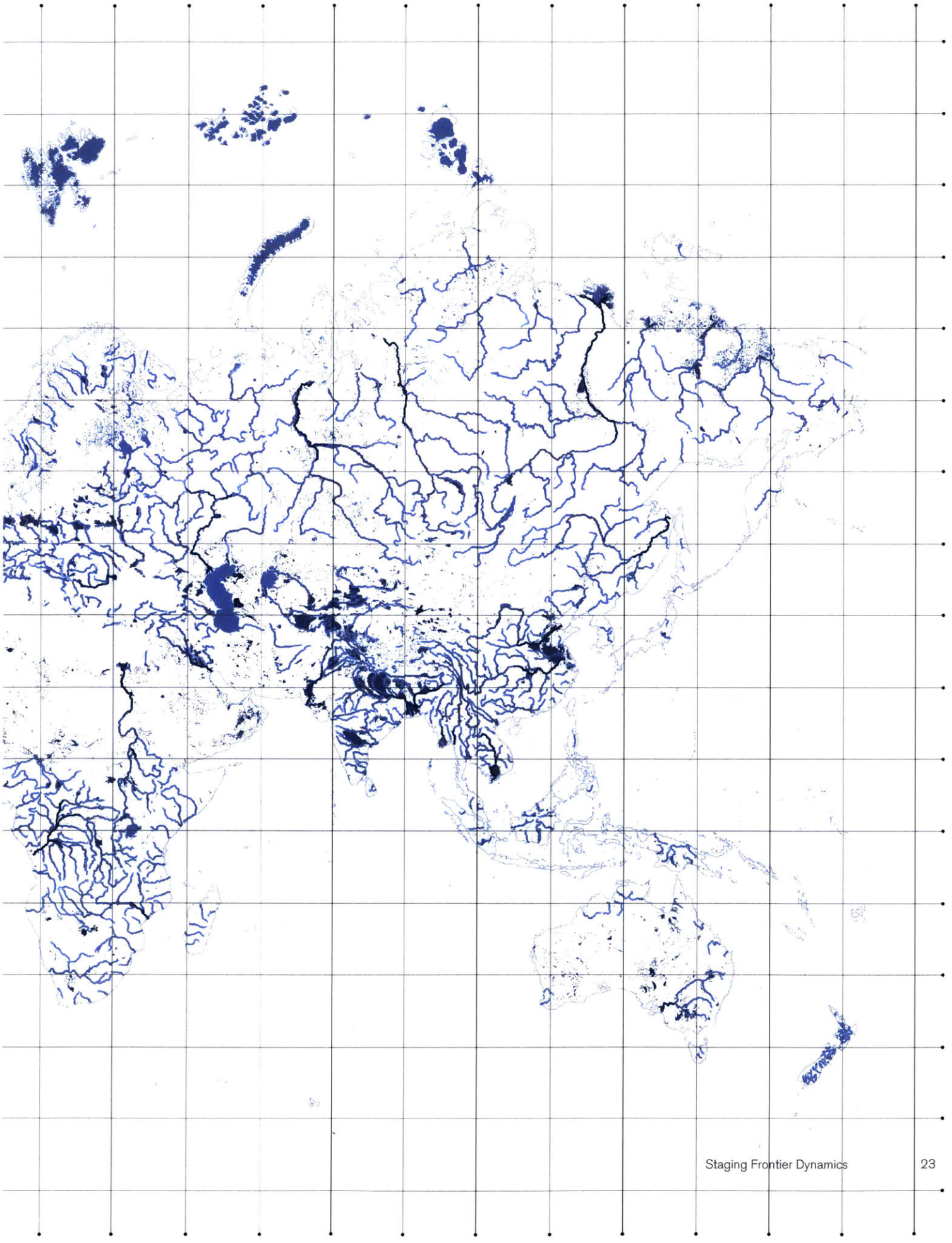




04
The Global River. Major river streams and lakes. Source: WWF Global
Larisa Ovalles



05
Amazon Rainforest, Brazil. Source:
WWF Global

"...forested landscapes were assigned an infrastructural function."

NATURE AS CAPITAL: Forest Economies

There is an inherent production and consumption of nature, whether it is through carbon credits, harvesting and raw materials. In "Nature as infrastructure: Making and managing the Panama Canal watershed," Ashley Carse has closely examined the relationship between techno-politics and environmental politics through the case study of the Panama Canal and its watershed management. Through the Panama Canal there was a realization that the role of ecosystems and nature possess infrastructural functions and should be thought of as an essential piece in the successful operation of the canal and other large scale hard engineering systems. Before there was an assumption that the environment had no economic value, however, the only way to restore and stabilize the capacity of the canal was through forested landscapes and also taking into consideration their land-use, not through fixed civil engineering. In this case, "forested landscapes were assigned an infrastructural function"* thus acquiring environmental value as natural capital.

*Carse, Ashley. 2012. "Nature as Infrastructure: Making and Managing the Panama Canal Watershed." Social Studies of Science 42 (4): 539–63. doi:10.1177/0306312712440166.

REDD+ (Reducing Emissions from Deforestation and Forest Degradation) is a more recent example of applying economic value to nature. It is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands.* REDD attempts to tie pressures of global consumption and industries to the preservation and conservation of forested land in exchange for carbon stocks for industries and companies looking to offset their carbon emissions.

* http://www.un-redd.org/aboutredd

06
Still frame from the 1982 film "Fitzcarraldo" by director Werner Herzog about an ambitious rubber baron crossing the Amazon River

PAST PROPOSALS

Past visions to develop the Amazon mainly consisted of large scale territorial and infrastructural ambitions that were closely tied to global economic pressures. Werner Herzog's film "Fitzcarraldo" from 1985, perfectly exemplifies the story of colonization, exploitation and ambition that have shaped the Amazonian territory throughout its history. Fitzcarraldo is an aspiring Irish rubber baron on a journey to tap into the last rubber concession.. He sets off to travel from the city of Manaus, and ends up pulling a steamship over the Andes mountains, despite the clearly problematic concept blinded by desire of wealth.

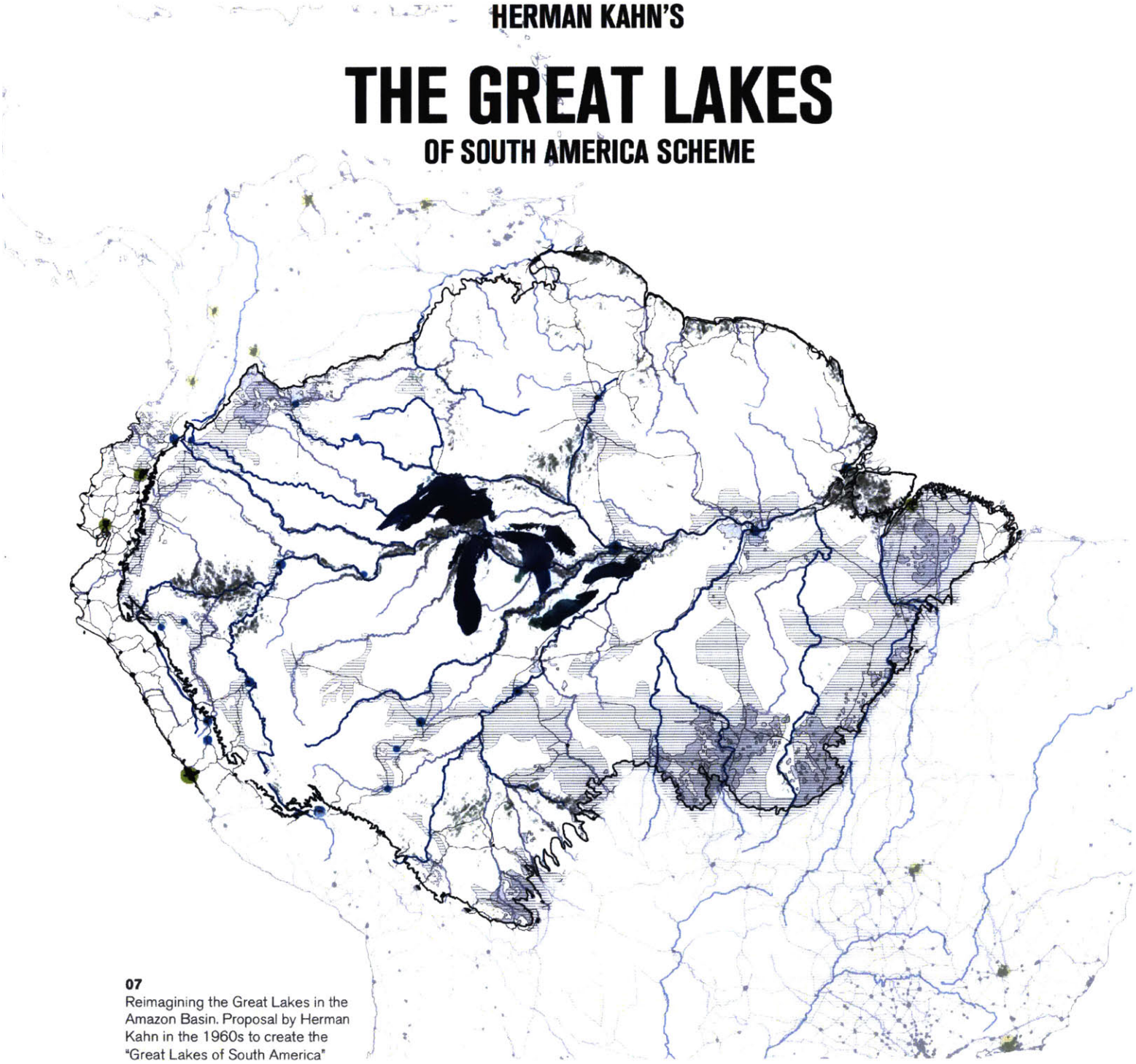
In the 1960s, Herman Kahn and Robert Panero from the US based Hudson Institute, proposed seven strategic dams that would create the equivalent of the Midwest industrial hub in hopes to encourage regional economic integration through waterways. This vision was also shared by Roosevelt during his travels to the Amazon. During World War II, Nelson Rockefeller, as head of Franklin D. Roosevelt's Office of the Coordinator of Inter-American Affairs, suggested turning the Amazon into a network of massive canals stretching from the Caribbean to Argentina and giving the United States, via the Mississippi, direct access to South America's interior markets and resources.*

*Goulding, Michael, Nigel J. H. Smith, and Dennis J. Mahar. 1996. Floods of fortune: ecology and economy along the Amazon. New York: Columbia University Press.pp47

HERMAN KAHN'S

THE GREAT LAKES

OF SOUTH AMERICA SCHEME



07
Reimagining the Great Lakes in the Amazon Basin. Proposal by Herman Kahn in the 1960s to create the "Great Lakes of South America"

From Herman Kahn's 1960s scheme to create "The Great Lakes of South America," to state support for agribusiness and mining industries and subsidies for cattle ranching initiatives- the Amazon is in a state of constant conflict between the interests of transnational companies and the local population. The disconnect between large scale infrastructural projects and the needs of local populations reveal the great disparities in the region.

08
UNASUR presidential meeting, 2000
Brasilia, BR

"South America has an enormous economic incentive to conserve the ecosystem services provided by the Amazon, along with achieving real and effective regional integration. These are not mutually exclusive goals."
(J. Killeen, Ph.D. 2016)

IIRSA

The most recent infrastructural ambition was The Initiative for Integration of Regional Infrastructure in South America (IIRSA) Launched in 2000 during the Brasilia summit, where the heads of state of all twelve South American countries met to discuss this open regionalism strategy, which aims to strengthen a comprehensive insertion of South America in world markets by improving connections of energy and transport related infrastructure.

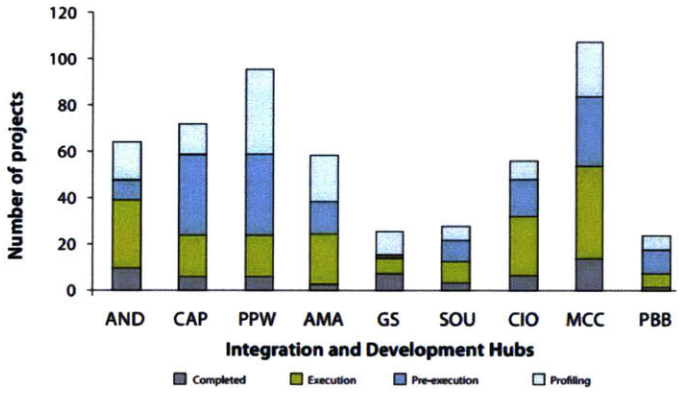
By 2010, there were over 525 projects and estimated investment of 96 billion dollars under nine main Integration and Developmental Hubs. Most projects were directed towards transportation infrastructure, 87%, followed by a focus on energy infrastructure and resources.* Development triggered by IIRSA will inevitably make previously remote lands accessible, leading to more land-use changes and exposing areas to deforestation, unleashing social and economic forces that will dramatically alter the territory.

* "IIRSA 10 Years Later: Achievements and Challenges 1a. Edición Buenos Aires: BID-INTAL, 2011 Internet ISBN 978-950-738-296-3 1. Integración Física. 2. Proyectos de Infraestructura. 3. Integración Regional. DDC 338.9." 2016. Accessed May 17. http://www.iirsa.org/admin_iirsa_web/Uploads/Documents/lb_iirsa_10_anios_sus_logros_y_desafios_eng.pdf.

IIRSA *(The Initiative for Integration of Regional Infrastructure in South America)*

09
All nine Integration and Development Hubs for IIRSA.

Integration & Development Hub	Number of Groups	Number of Projects[v]	Estimated Investment[iv]
Amazon Hub	7	58	5,400.9
Andean Hub	10	64	7,478.0
Capricorn Hub	5	72	9,421.4
Guianese Shield Hub	4	25	1,694.9
Paraguay-Paraná Waterway Hub	5	95	6,677.4
Central Interoceanic Hub	5	55	5,525.1
MERCOSUR-Chile Hub	6	107	35,836.2
Peru-Brazil-Bolivia Hub	3	23	21,402.3
Southern Hub	2	27	2,713.0
	47 groups	**524** projects	**$96,119** investment



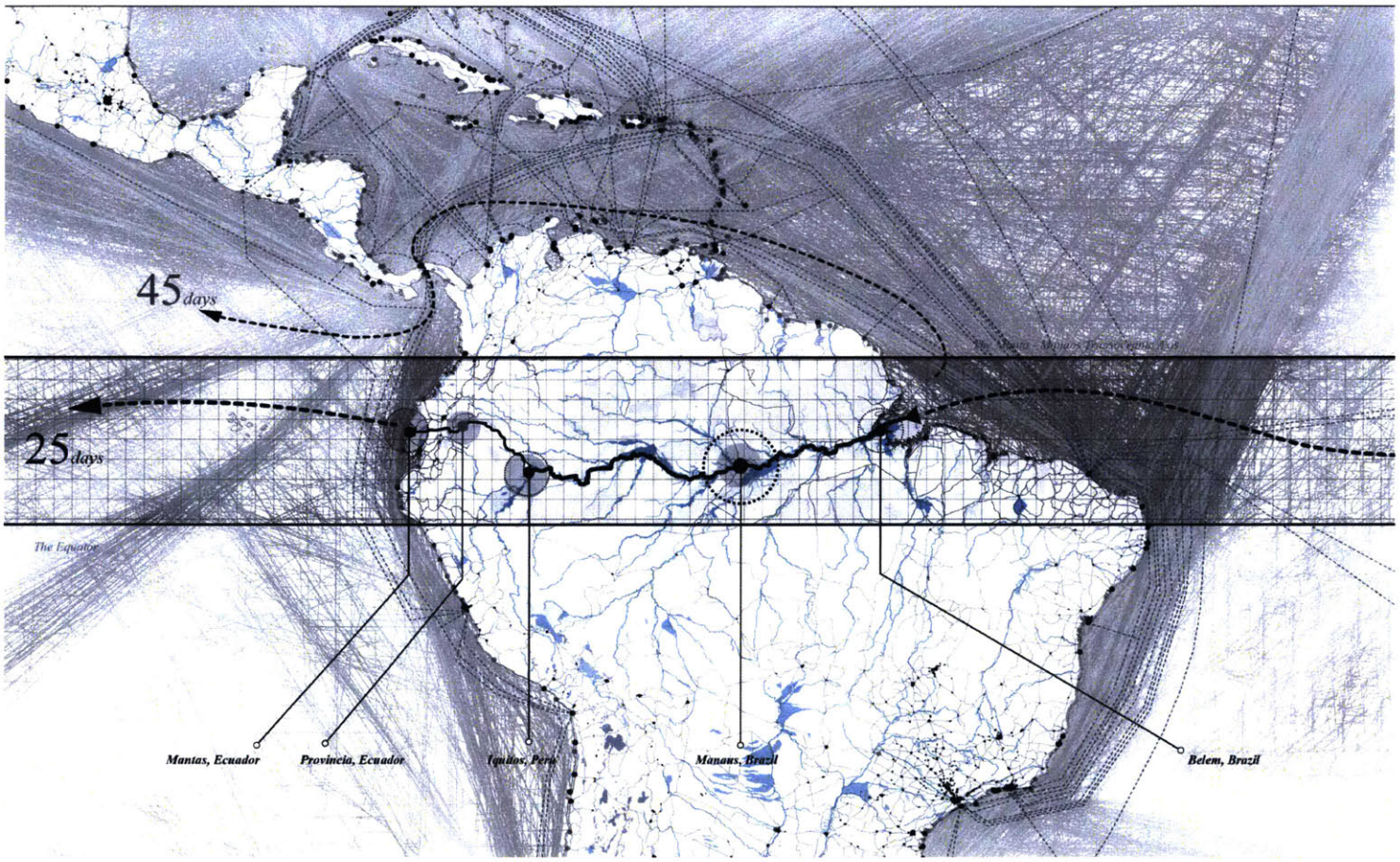
70% concrete advances
10% completed
38% being executed
20% preparatory stage

87% are transport projects

11% energy focused

2% communications

10
Summary of IIRSA projects, breakdown and status of execution
IIRSA Database as of June 18, 2010



11
IIRSA: The Mantas-Manaus Transoceanic Corridor.

IIRSA: Central Amazon Hub

The thesis will take IIRSA and other infrastructure investments through the "Manta-Manaus Corridor" which is part of the Central Amazon Developmental Hub, as a starting point of departure to investigate the spatial transformations in the territory. The axis consists of several projects to create a transoceanic connection through the Amazon River, completely transforming its surrounding urban context. This hydroway and road expansion opens up new routes and connections to the global market, sparking the interest of international corporations in order to gain greater access to much needed resources of the region. Inevitably pushing economies, while exposing local territories along the corridor to be colonized for industrial use and future urbanization. In an attempt to better integrate regional markets to the global economy, it was also seen as an alternative to the Panama Canal, claiming to cut travel time by 25 days, thus strengthening its connections to the Global South. Proposed projects through IIRSA will inevitably put pressure on the land, natural resources, and the Amazonian frontier, where alternative development and design solutions are needed in order to avoid further fragmentation of the landscape and the extreme reduction of forest cover.

* ""I.I.R.S.A." 2016. Accessed May 19. http://iirsa.org/Document/Detail?Id=4302.

12
Sawmills and other activities lead to more road infrastructure.
Image by RICARDO MORAES

Protection and Threats

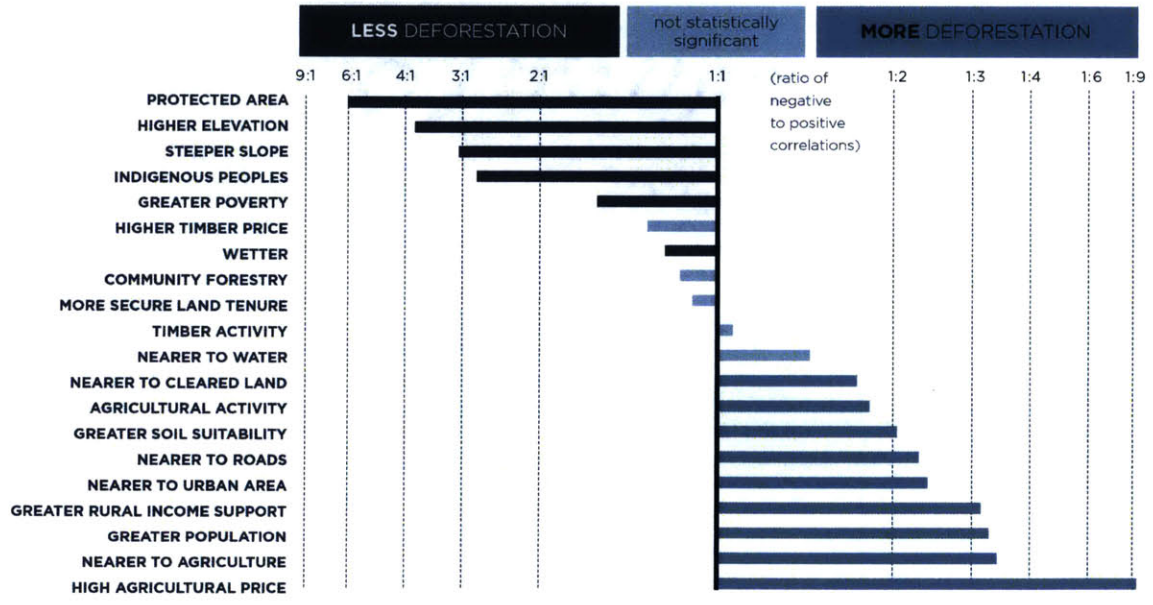
The Amazon Biome consists of 6.7 million km2 and is shared by eight countries: Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana and Suriname. A network of conservation areas and indigenous territories legally protects 56% of the Amazon Biome. Nature Protected Areas (PA) were formed in 1960, and there are currently 390 Protected Areas in the Amazon, representing 25% of the biome and totalling some 167 million hectares. In addition, about 31% of the biome consists of protected Indigenous Territories (IT)* However, large areas are still under extreme pressure due to soy plantations, mining and oil concessions, logging activity and cattle grazing- which on its own already accounts for 70% of deforested areas.

*WWF – State of the Amazon: Ecological Representation in Protected Areas and Indigenous Territories

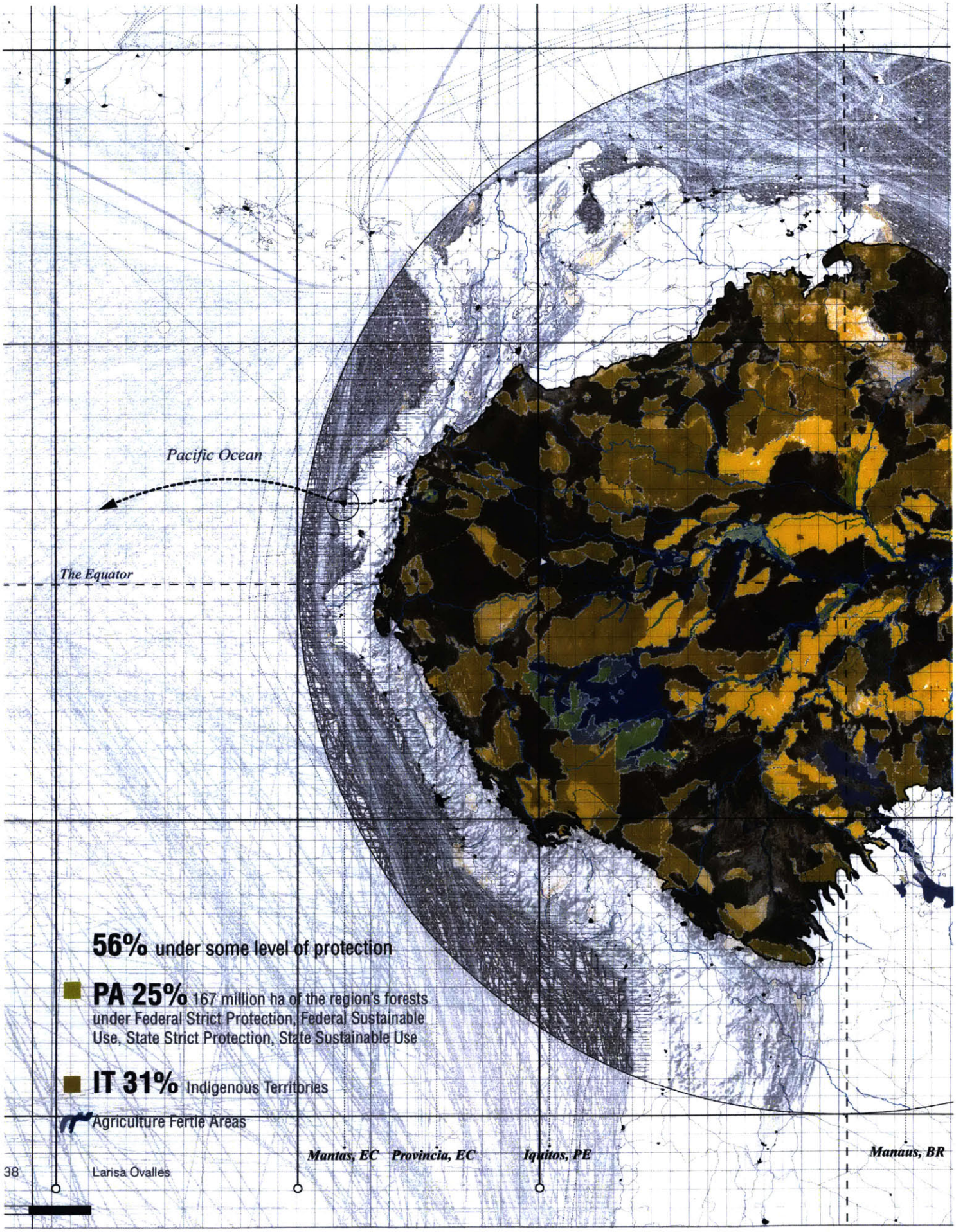
The major drivers of change are closely tied to economic growth and infrastructure investments.

Soy plantations have already dramatically changed the landscape in southern

13 Diagram
Research reveals what drives and stops deforestation



Source: Busch and Ferretti-Gallon, CGD Brief, 2014



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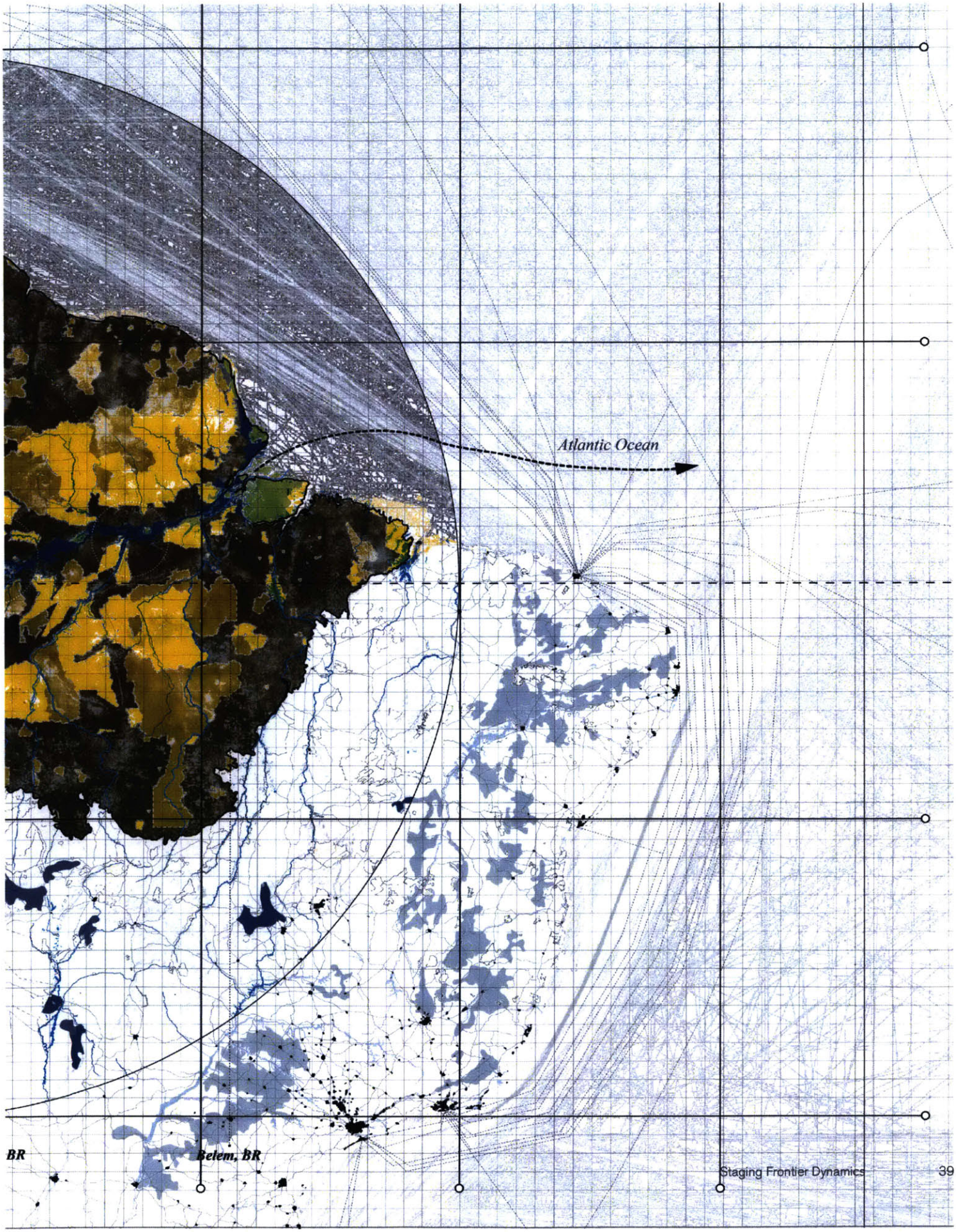
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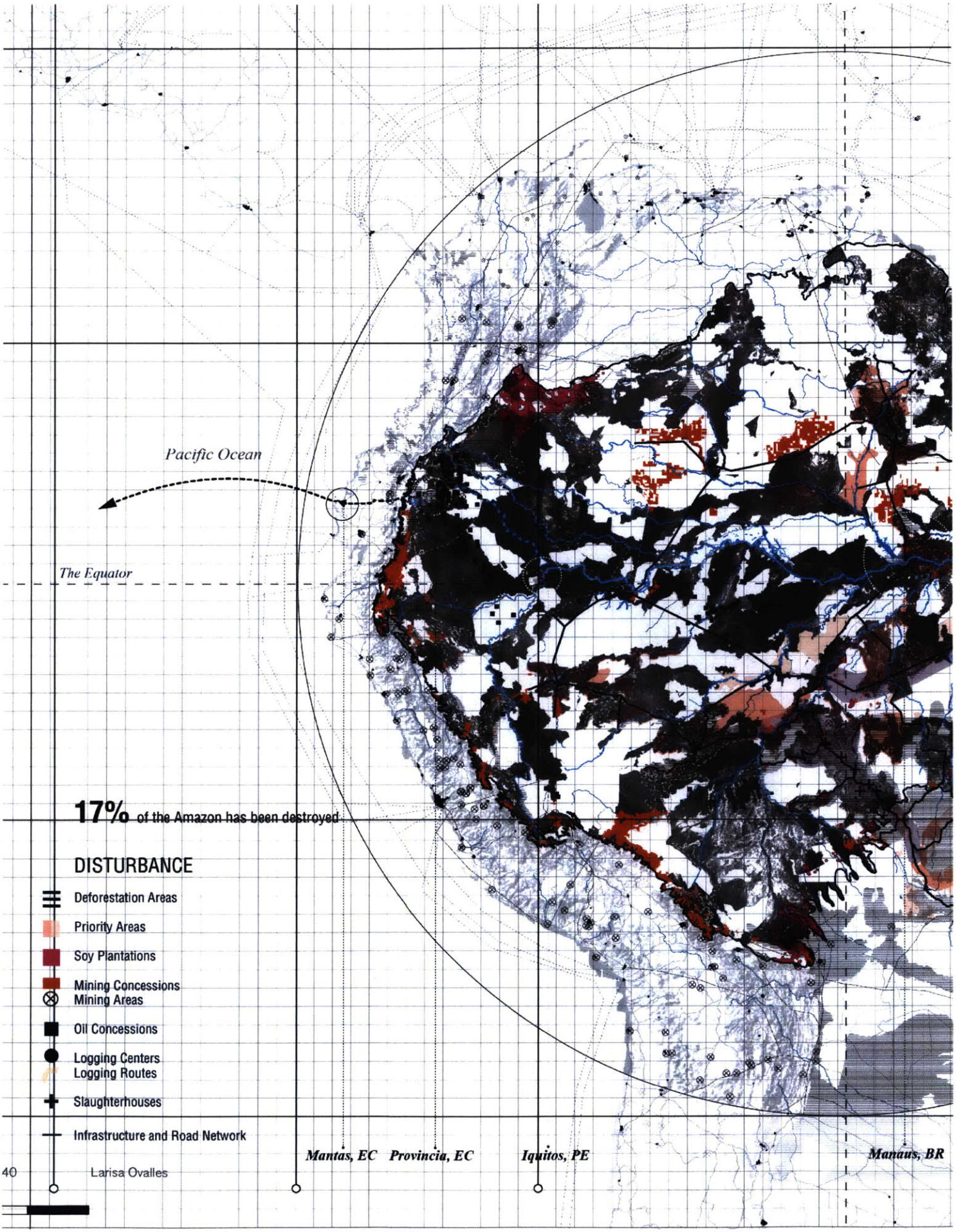
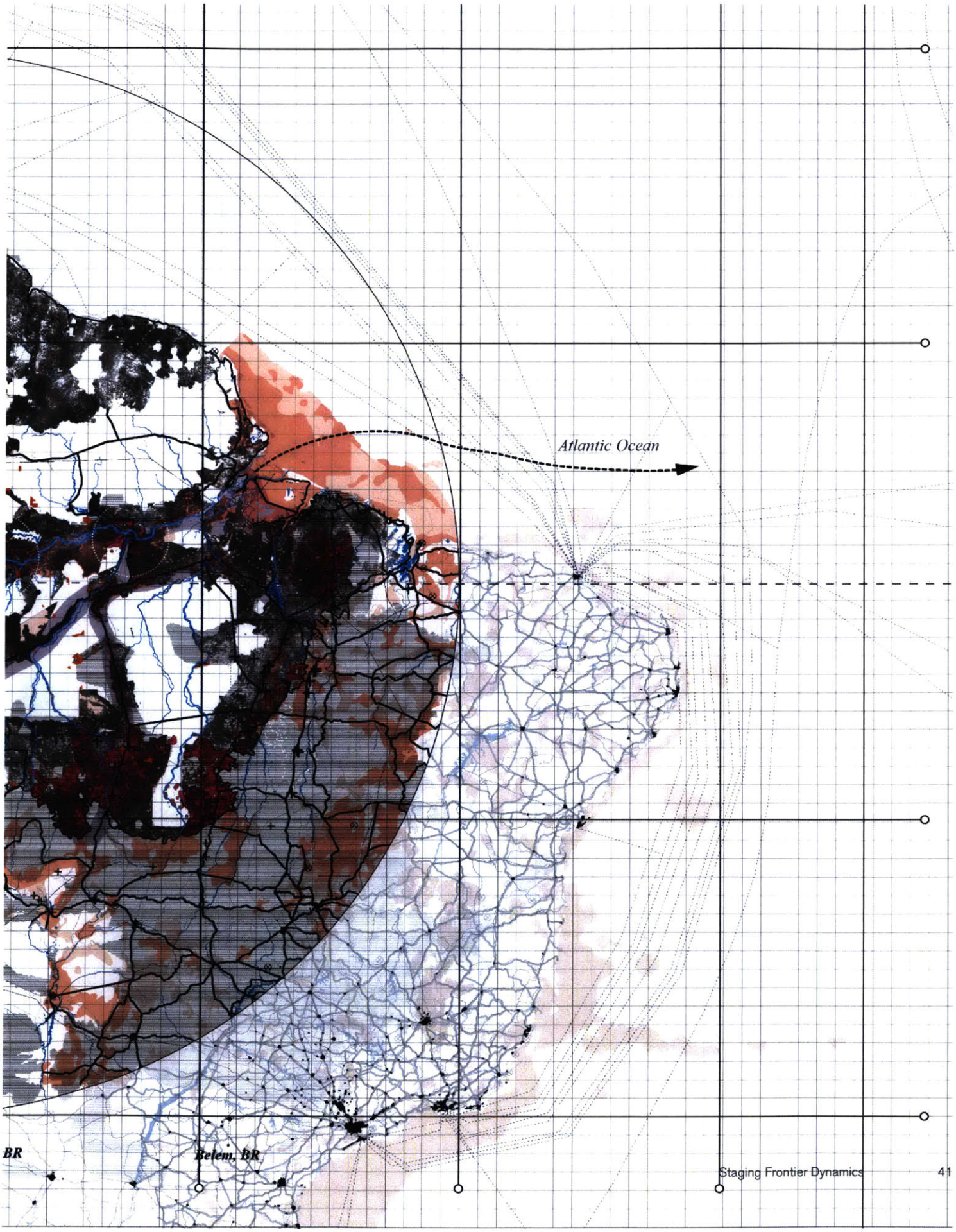

Pacific Ocean
The Equator
17% of the Amazon has been destroyed
DISTURBANCE
Deforestation Areas
Priority Areas
Soy Plantations
Mining Concessions
Mining Areas
Oil Concessions
Logging Centers
Logging Routes
Slaughterhouses
Infrastructure and Road Network
Mantas, EC
Provincia, EC
Iquitos, PE
Manaus, BR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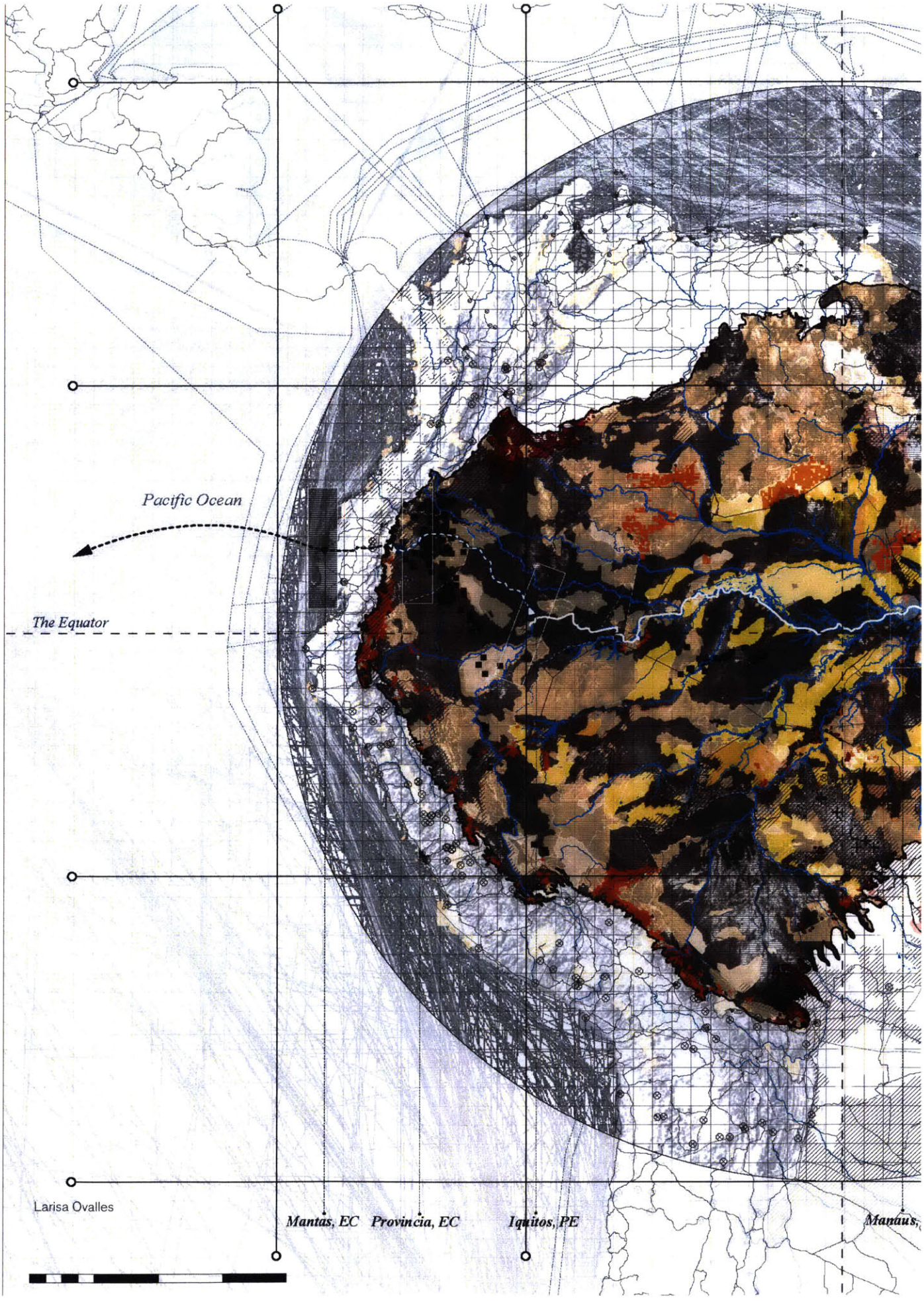

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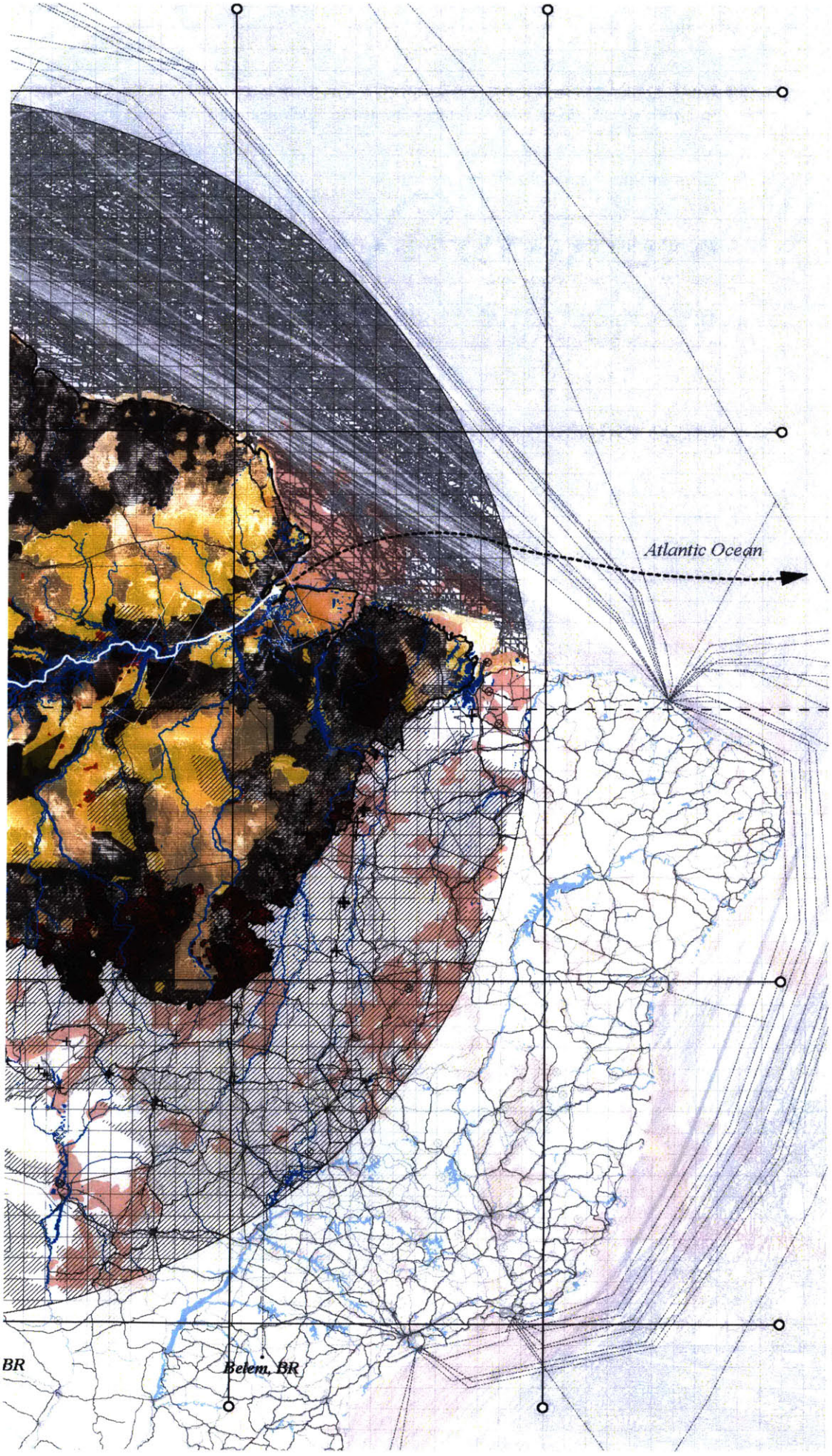
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Belem, BR

Amazon, contributing what is referred to as the "Deforestation Arc", where there has been a complete loss of forest cover and land turnover for cattle ranching and industrialized soy production.

Oil concessions and mining is most prevalent in the Western Amazonia, where conflicting interests between oil reserves and biodiversity hotspots occupy the same landscapes. These conflicting territories are the site of current economic and non-development models, which for the first time are prioritizing ecological areas and assigning economic value to nature over oil reserves. (ie. Yasuni-ITT Protocol in Ecuador)

FUTURE PROJECTIONS: Scenarios

17% of the Amazon has already been destroyed coming closer to the "tipping point" of the Amazon when it reaches 20%. If so, this threshold could trigger a dramatic die-back of the Amazon rainforest, putting its important global contributions to at risk if current patterns continue.*

Simultaneous demand for increased development and global environmental awareness, positions this thesis in a time where we should consider alternatives to current developmental trends, design playing a role and having agency.

Three main scenarios can be identified:*

The Utilitarian Scenario follows the assumption that climate change and land use turnover dynamics interact to create a territory where the natural forest ecosystems in the Amazon is largely replaced by tree plantations and mechanized agriculture. In this case, technology will allow the agricultural sector to adapt to climate change, fulfilling a economic growth base model under plantation forestry and agricultural services. The Amazon becomes the ultimate agro-industrial territory, providing food and biofuels, where technological resilience allows the management of a complete productive landscape.

The Utopian Scenario takes the conservationist approach. This will be dependent on an economic and policy model that creates a payment system for the conservation of natural ecosystems. In addition, national governments will adopt mechanisms to use these payments in exchange for investments in social services and social infrastructure. Deforestation will also be contained by the enforcement of a land use model to maintain 80% forested land cover while the other 20% is used for development. Subsidized credit will be provided to those who follow this 80:20 ratio and the effectiveness of this

* Walter Vergara and Sebastian M. Scholz, editors. WORLD BANK STUDY: Assessment of the Risk of Amazon Dieback. Feb 2010

* J. Killeen, Ph.D., Timothy. 2016. "A Perfect Storm in the Amazon Wilderness: Development and Conservation in the Context of the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA)." Accessed May 18. http://www.bioone.org/doi/pdf/10.1896/978-1-934151-07-5.8.

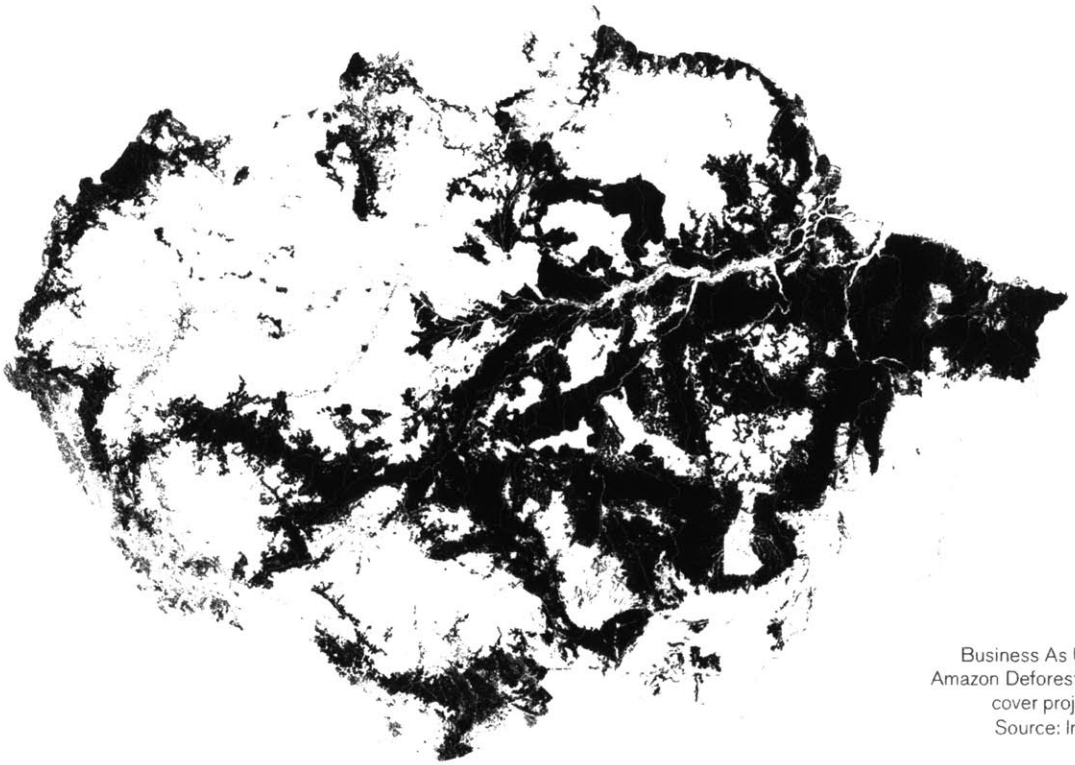
*"Human-induced climate change, if left unchecked, may soon cause the Amazon to emit more carbon into the atmosphere than it absorbs. Scientists predict this change could occur as Amazonian forests become less able to absorb atmospheric carbon as climate warming slows down plant growth in the region and causes trees to die more rapidly. Such was the case in 2005, when a prolonged drought in the Amazon released close to one billion tons of carbon dioxide into the atmosphere, more than it simultaneously removed through absorption"**

* Walter Vergara and Sebastian M. Scholz, editors. WORLD BANK STUDY: Assessment of the Risk of Amazon Dieback. Feb 2010

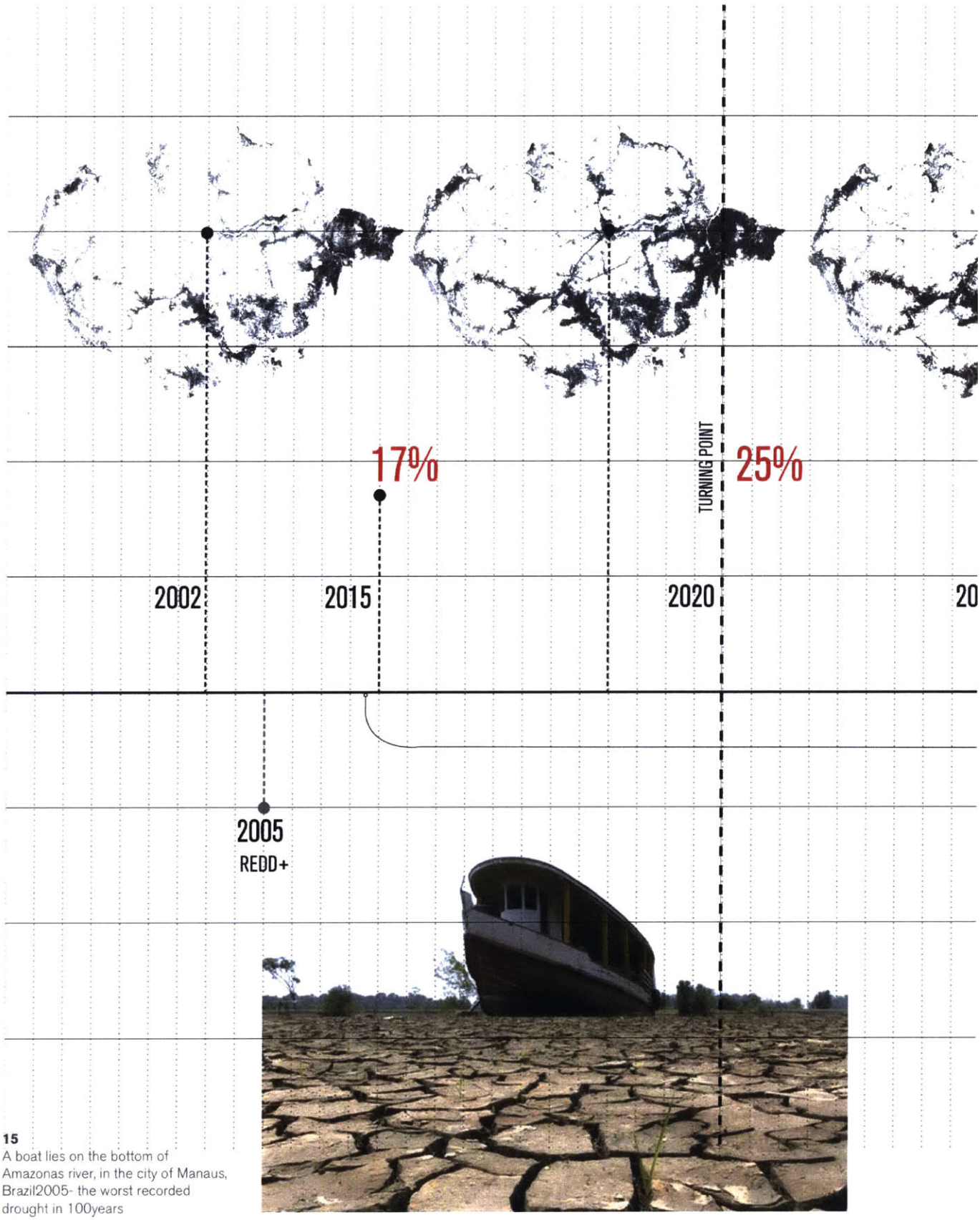
model will depend on the the advancements in technology satellite imagery to monitor land-use transformations.

Business as Usual Scenario, follows the current trends, and there is no significant change in current land use development and deforestation patterns. The Amazonian landscape will be radically altered, where only some fragmented native forest patches remain. In addition to these threats, the effects of drought and climate change will also result in changes in the hydrological cycles. It is estimated that under a "business as usual" scenario, nearly half of the jungle will be destroyed by 2050 and it could be almost entirely gone by 2100.*

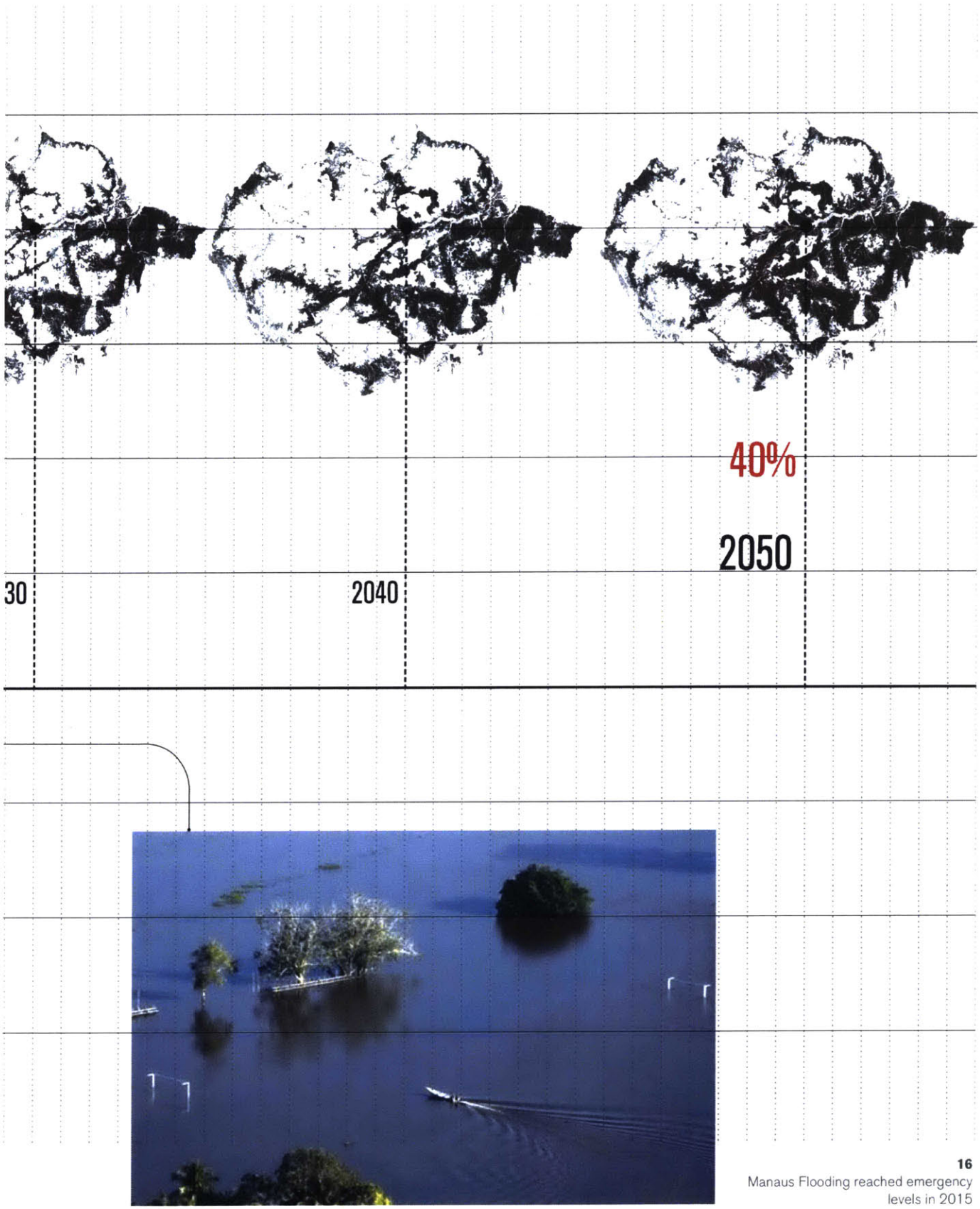
* "CO$TING NATURE: A Mapping Tool for Ecosystem Services." 2016. Accessed May 18. http://infoamazonia.org/projects/coting-nature-a-mapping-tool-for-ecosystem-services/.



14
Business As Usual Projection
Amazon Deforestation and forest cover projection for 2050.
Source: Imazon Database



15
A boat lies on the bottom of Amazonas river, in the city of Manaus, Brazil2005- the worst recorded drought in 100years



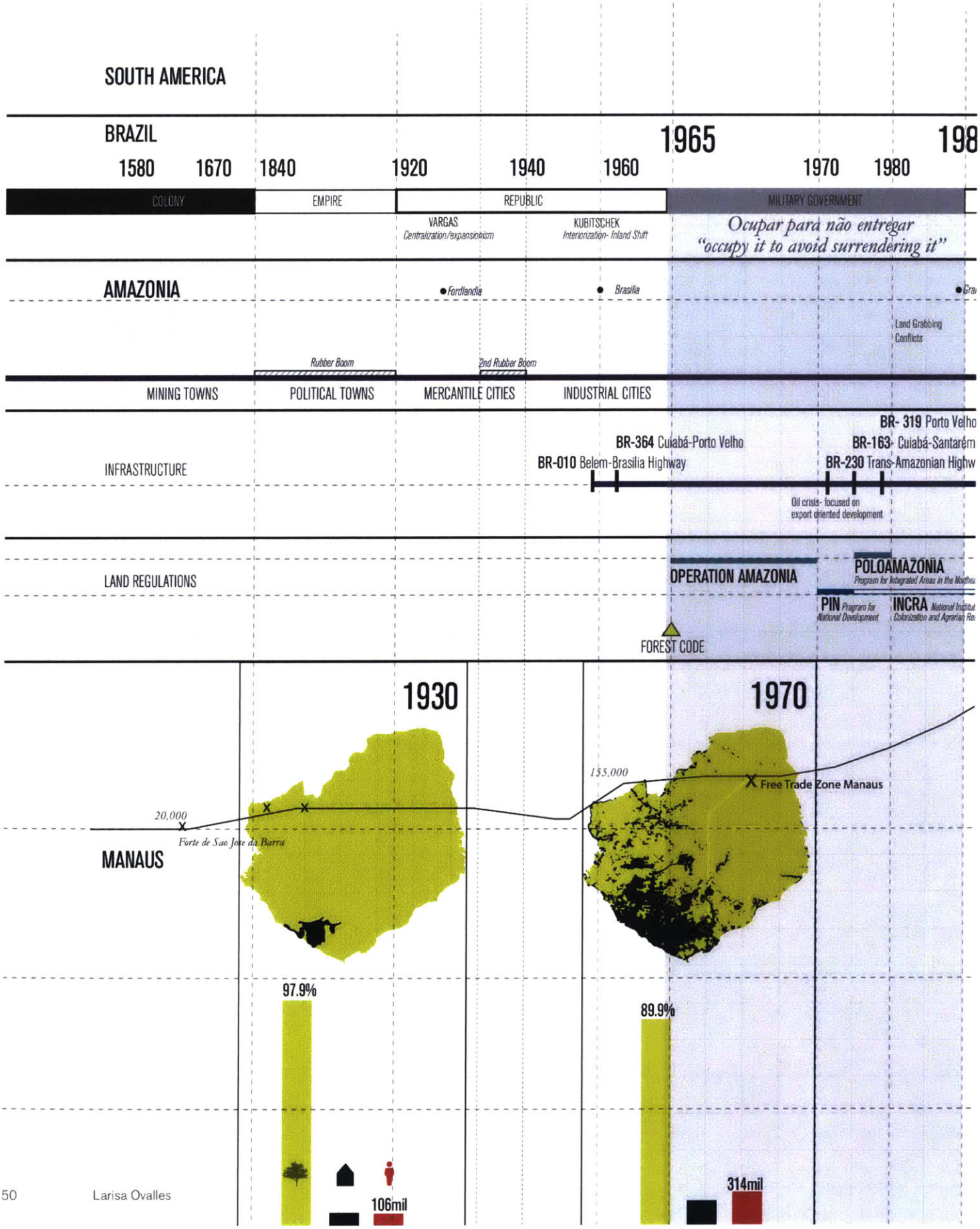
16
Manaus Flooding reached emergency levels in 2015

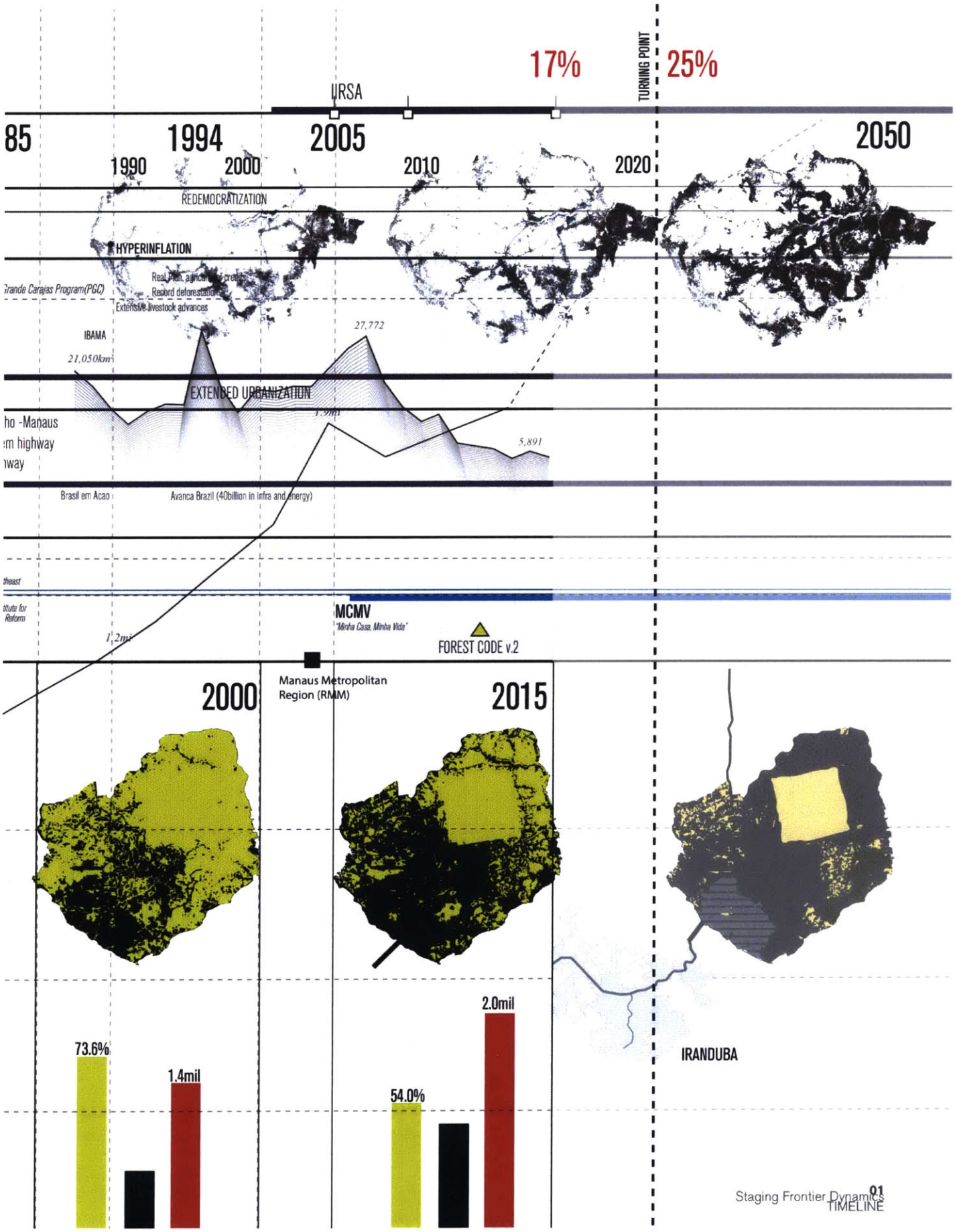
02

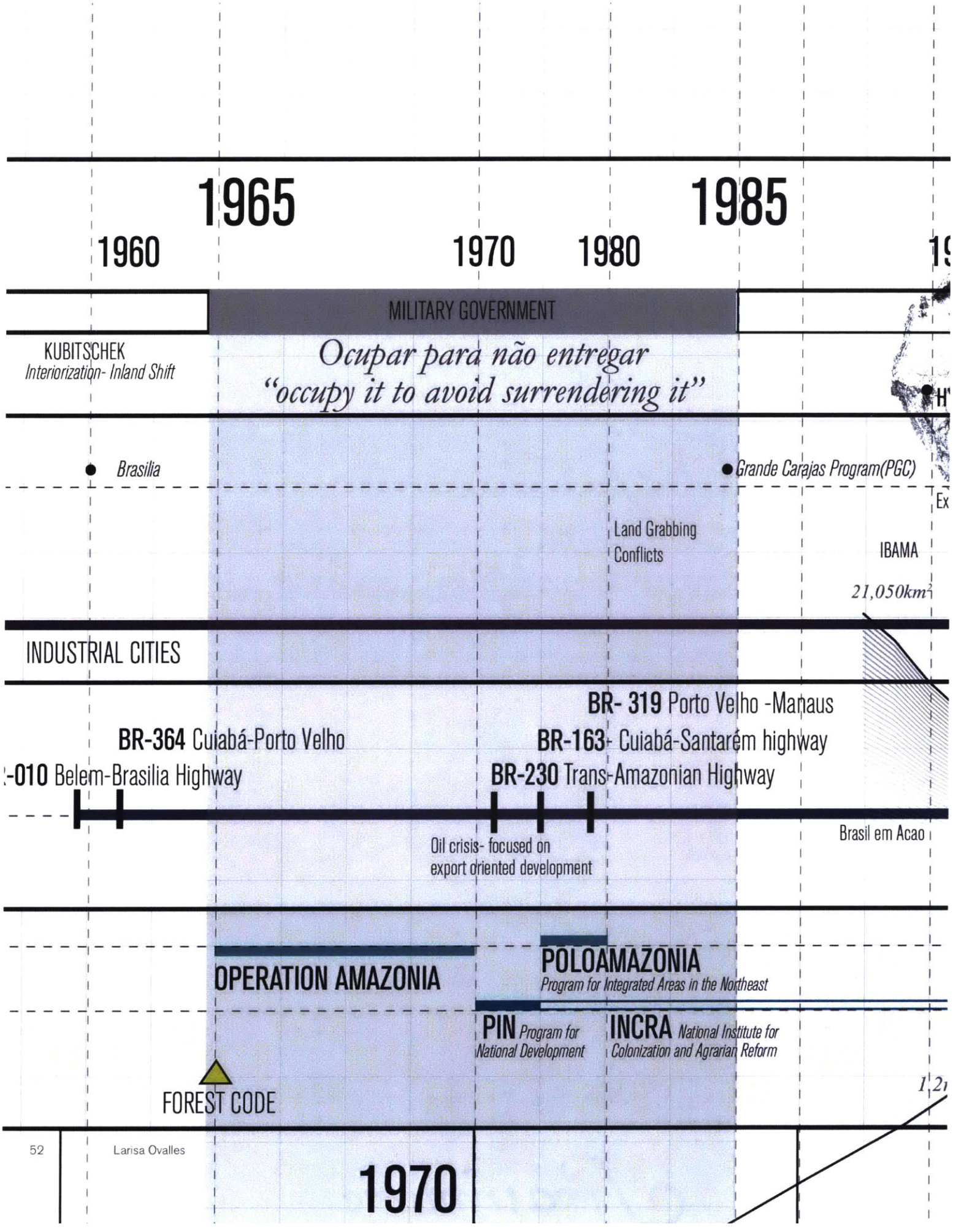
THE AMAZONIAN FRONTIER

Territorial Occupation

"Limits- spaces of tension, areas of transformation, new formations- the frontier always points to a third position, an area open to possibilities for re-inventions and redefinitions."
(Monte-mór 2016, p17)


SOUTH AMERICA
BRAZIL
1580
1670
1840
1920
1940
1960
1965
1970
1980
198
COLONY
EMPIRE
REPUBLIC
MILITARY GOVERNMENT
VARGAS
Centralization/expansionism
KUBITSCHEK
Interiorization- Inland Shift
Ocupar para não entregar
"occupy it to avoid surrendering it"
AMAZONIA
Fordlandia
Brasilia
Land Grabbing
Conflicts
Rubber Boom
2nd Rubber Boom
MINING TOWNS
POLITICAL TOWNS
MERCANTILE CITIES
INDUSTRIAL CITIES
INFRASTRUCTURE
BR- 319 Porto Velho
BR-364 Cuiabá-Porto Velho
BR-163- Cuiabá-Santarém
BR-010 Belem-Brasilia Highway
BR-230 Trans-Amazonian Highw
Oil crisis- focused on
export oriented development
LAND REGULATIONS
OPERATION AMAZONIA
POLOAMAZONIA
PIN Program for
National Development
INCRA National Institut
Colonization and Agrarian Re
FOREST CODE
1930
1970
155,000
Free Trade Zone Manaus
20,000
Forte de Sao Jose da Barra
MANAUS
97.9%
89.9%
106mil
314mil


17%
25%
TURNING POINT
URSA
85
1994
2005
2050
1990
2000
2010
2020
REDEMOCRATIZATION
HYPERINFLATION
Grande Carajas Program(PGC)
Real Plan, agricultural credits
Record deforestation
Extensive livestock advances
IBAMA
21,050km²
27,772
EXTENDED URBANIZATION
1.9mi
5,891
ho -Manaus
em highway
way
Brasil em Acao
Avanca Brazil (40billion in infra and energy)
theast
titute for
Reform
1.2mi
MCMV
"Minha Casa, Minha Vida"
FOREST CODE v.2
2000
Manaus Metropolitan
Region (RMM)
2015
73.6%
1.4mil
54.0%
2.0mil
IRANDUBA


1965
1960
1970
1980
1985
MILITARY GOVERNMENT
KUBITSCHEK
Interiorization- Inland Shift
Ocupar para não entregar
"occupy it to avoid surrendering it"
Brasilia
Grande Carajas Program(PGC)
Land Grabbing
Conflicts
IBAMA
21,050km²
INDUSTRIAL CITIES
BR- 319 Porto Velho -Manaus
BR-364 Cuiabá-Porto Velho
BR-163- Cuiabá-Santarém highway
-010 Belem-Brasilia Highway
BR-230 Trans-Amazonian Highway
Brasil em Acao
Oil crisis- focused on
export oriented development
OPERATION AMAZONIA
POLOAMAZONIA
Program for Integrated Areas in the Northeast
PIN Program for
National Development
INCRA National Institute for
Colonization and Agrarian Reform
FOREST CODE
1,21
1970

"Occupy it to avoid surrendering it"

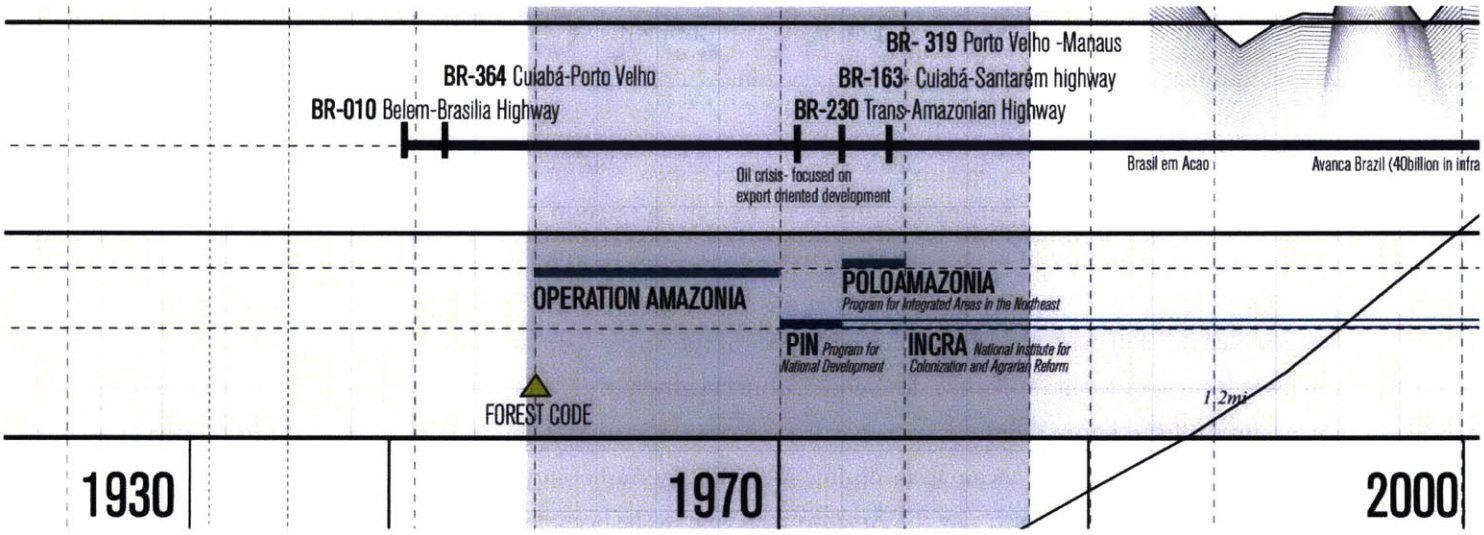
Occupying the Void

The Amazon underwent big rapid urbanization process during the "Rubber Boom" industrialization in the 1820s, and then again in the 1940s, promoting a great influx of migrants to the area.

Infrastructure is one of the main catalysts for occupation. During the administration of President Kubitschek, the focus was on integration and interiorization, signified by the move of the federal capital from the coast in Rio de Janeiro to the newly constructed Brasilia. The Belem-Brasilia highway inaugurated in 1960 marked the beginning of drastic changes in the territory, followed by major road networks like the Transamazonia Highway, the Cuiba-Santarem road and Porto-Velho.

This attitude was further encouraged during the Military-Authoritarian period from 1964-1985, which saw the Amazon as a 'void' to be occupied,' evident in their slogan "Occupy it to avoid surrendering it" Since the 1960s the focus was on Interiorization and the occupation of frontiers had a strategic geopolitical and socio-economic role within national security policies. Many experiments were carried out in spatial planning, since the Amazon was seen as an empty space for occupation.

02
Three posters produced by the Swiss artist Chabloz for SEMTA "Soldados da Borracha". Recruiting Rubber Soldiers to move to the Amazon to work on rubber plantations through the Special Service Workers Mobilization for Amazon (SEMTA) program



03
The 1960s and 70s were defined by expansion of major road networks, in addition to a series of governmental incentives and policies to transform the territory

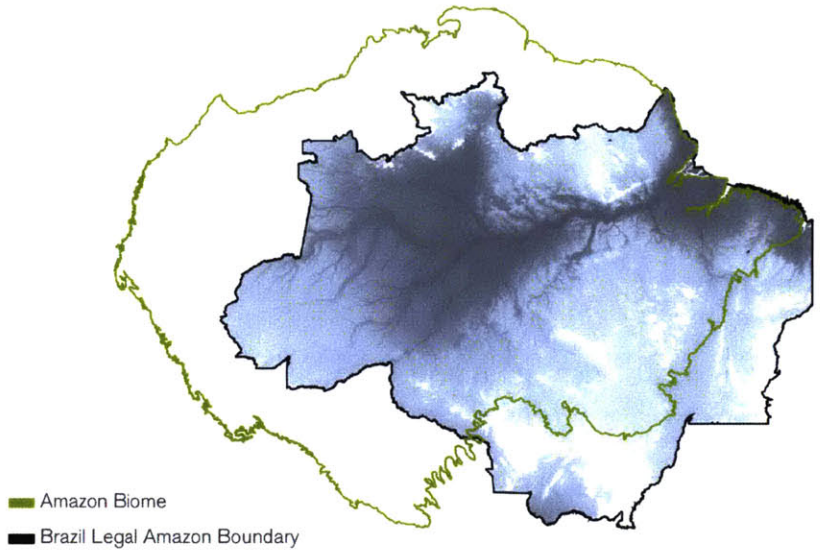
FRONTIER OCCUPATION: STRATEGIES AND PROGRAMS

Due to expansion of the road network, in addition to a series of governmental incentives and policies, patterns of settlement changed and deforestation rates increased. These strategies and programs sponsored by the Government are responsible for the patterns of colonization that are still shaping the territory today.

For the first time, the Amazon basin was converted into a detached jurisdiction under direct control of the National government. This lead to OPERATION AMAZONIA (1966-1970) a large-scale program of regional development, which sought to convert the entire basin into a territory of resource extraction and agricultural expansion by providing companies credits and tax breaks. The plan was based on developmental poles which were connected to the large infrastructure road network under construction.

The other main program was POLOAMAZONIA (Program for Integrated Areas in the Northeast) developed in 1975-1979, which mainly offered fiscal incentives to encourage corporate investments in the region, lead to the popular company town settlement typology.

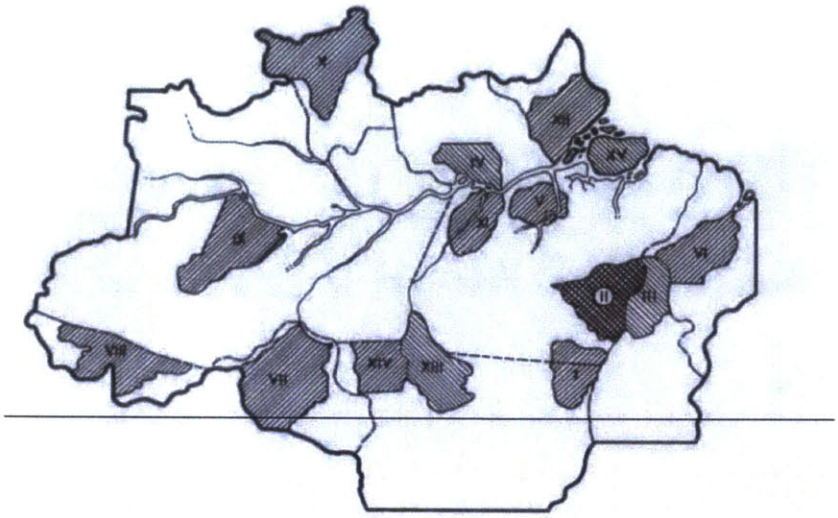
04
1966-1970 Operation Amazonia Converted the Amazon Basin into a detached jurisdiction under direct control of the national government.



However the program that had the biggest expansion and affect across the territory was INCRA (National Institute for Colonization and Agrarian Reform) as part of the populist expansion that occurred in 1970-1974. The focus shifted towards a more social integration model through the creation of PIN (Program for National Development)

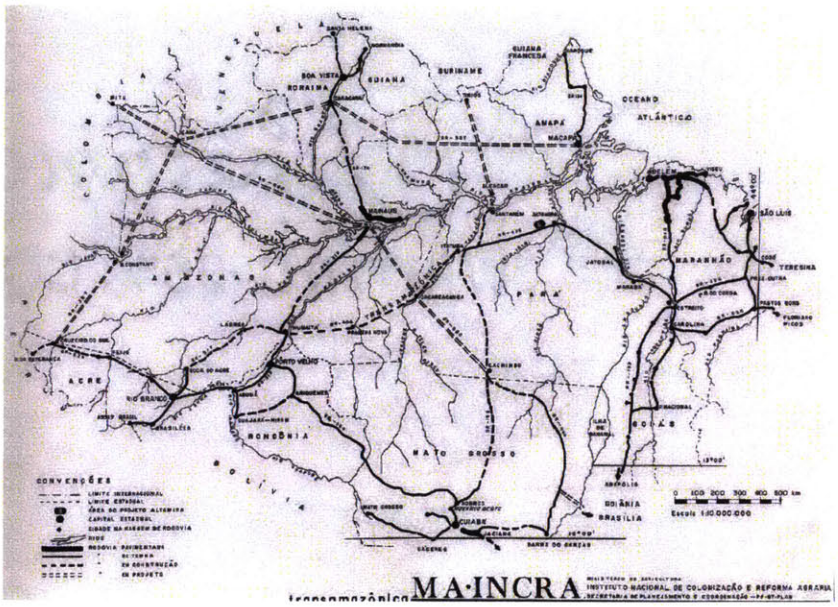
This agrarian reform program was developed by the architect Jose Geraldo Camargo. The design was an urban mechanism based on an abstract diagram of occupation that could potentially extend infinitely throughout the road network, regardless of the specificities of each location.* This model adopted the concept of 'rural urbanism' (urbanismo rural) which followed a hierarchy with three degrees of urbanity: Ruropolis, the Agropolis and the Agrovilla. The Ruropolis where urban centers organized around major road infrastructures every 350km from each other and was able to provide better infrastructure

* Paulo Taveras, Modern Frontiers: Beyond Brasilia, the Amazon. Real, Patricio del, and Helen Gyger. 2013. Latin American Modern Architectures: Ambiguous Territories. Routledge.



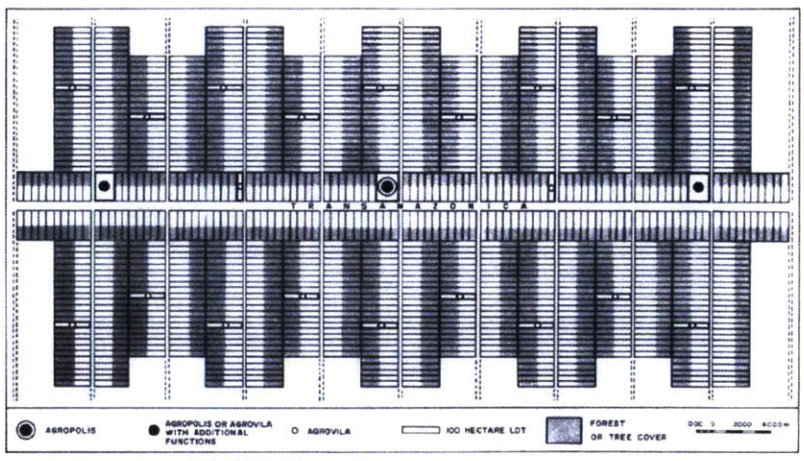
05
1966-1970 PoloAmazonia program of fiscal incentives to encourage corporate investments in the region. Total of 15 development poles in the region

06
Amapa Company Town Settlement



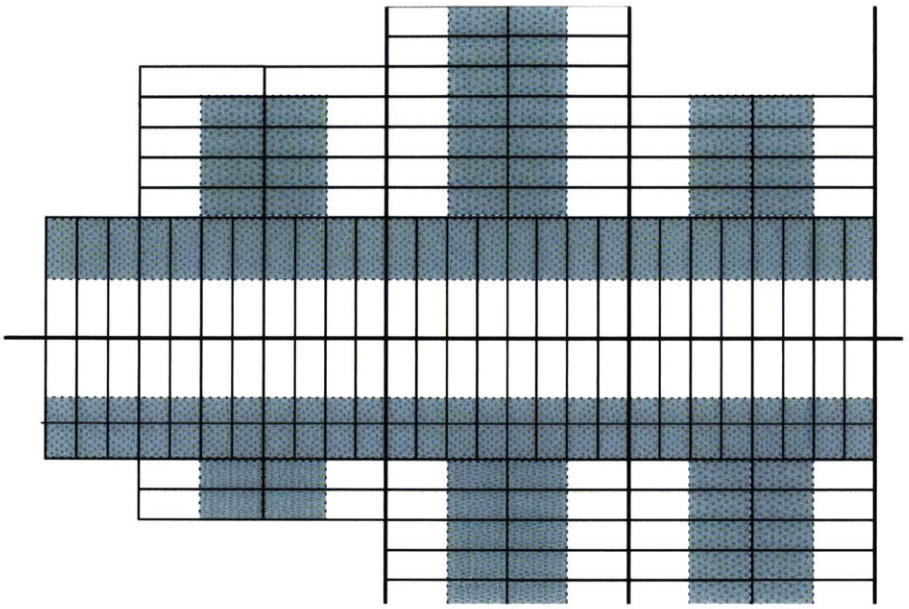
07
1970-1974 PIN/INCRA proposed plan for the territory

SCHEMATIC PLAN OF PORTION OF PIC ALTAMIRA



Adopted from Ministerio da Agricultura, INCRA, ALTAMIRA - I (Brasilia, 1972)

08
Schematic plan design for PIC in Altamira, Para.



09
Jose Geraldo Camargo, design as an urban mechanism based on an abstract diagram of occupation. 100 hectare lots (2kmx0.5km)

and services. The Agropolis consisted of a group of 20 agrovillas located 40km from each ruropolis, which served as an intermediate urban center with secondary services. Finally, the Agrovilas, were located on secondary roads about 20km away from the ruropolis centers and consisted of 100-300 families The agrovilla was the least successful settlement type since it lacked main infrastructure and social services.*

* Barbieri, Alisson F., Roberto L. M. Monte-mór, and Richard E. Bilsborrow. 2009. "Towns in the Jungle: Exploring Linkages between Rural–urban Mobility, Urbanization and Development in the Amazon."

The military geopolitical and economic concerns took the forefront in establishing the models by which occupation took place in the Amazon. Entrepreneurial groups, multinational companies and eagerness to offer up cheap land for expansive territorial occupation, took precedence over the needs of the land and the local population. Most highways were built during this time, and Brazilians were offered incentives to inhabit the land in the Amazon and transform it in the name of development. Around 1.2 million people have been resettled since the 1970s,* when the government encouraged migration into the Amazon

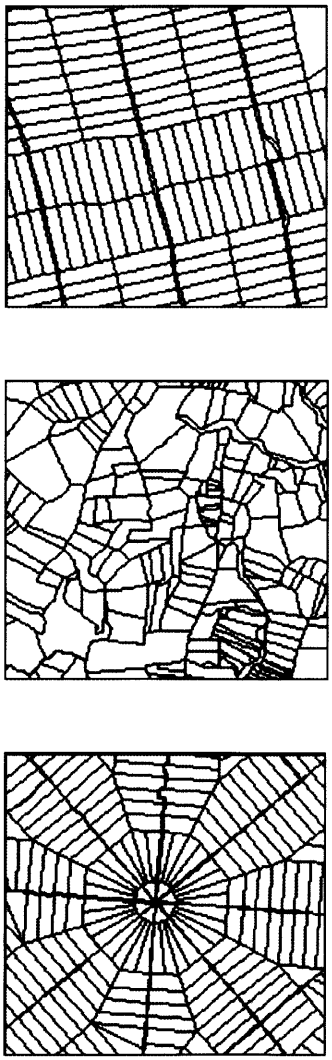
* Environmental Costs of Government-Sponsored Agrarian Settlements in Brazilian Amazonia. Maurício Schneider#1,2,* and Carlos A. PeresRunGuo Zang, Editor

SETTLEMENT DESIGN AND PATTERNS

The Amazonian frontier faces extreme pressure from increased migration due to government settlement programs. The role of planning and design for these settlement schemes have shown to have effects on land use and land cover change.*

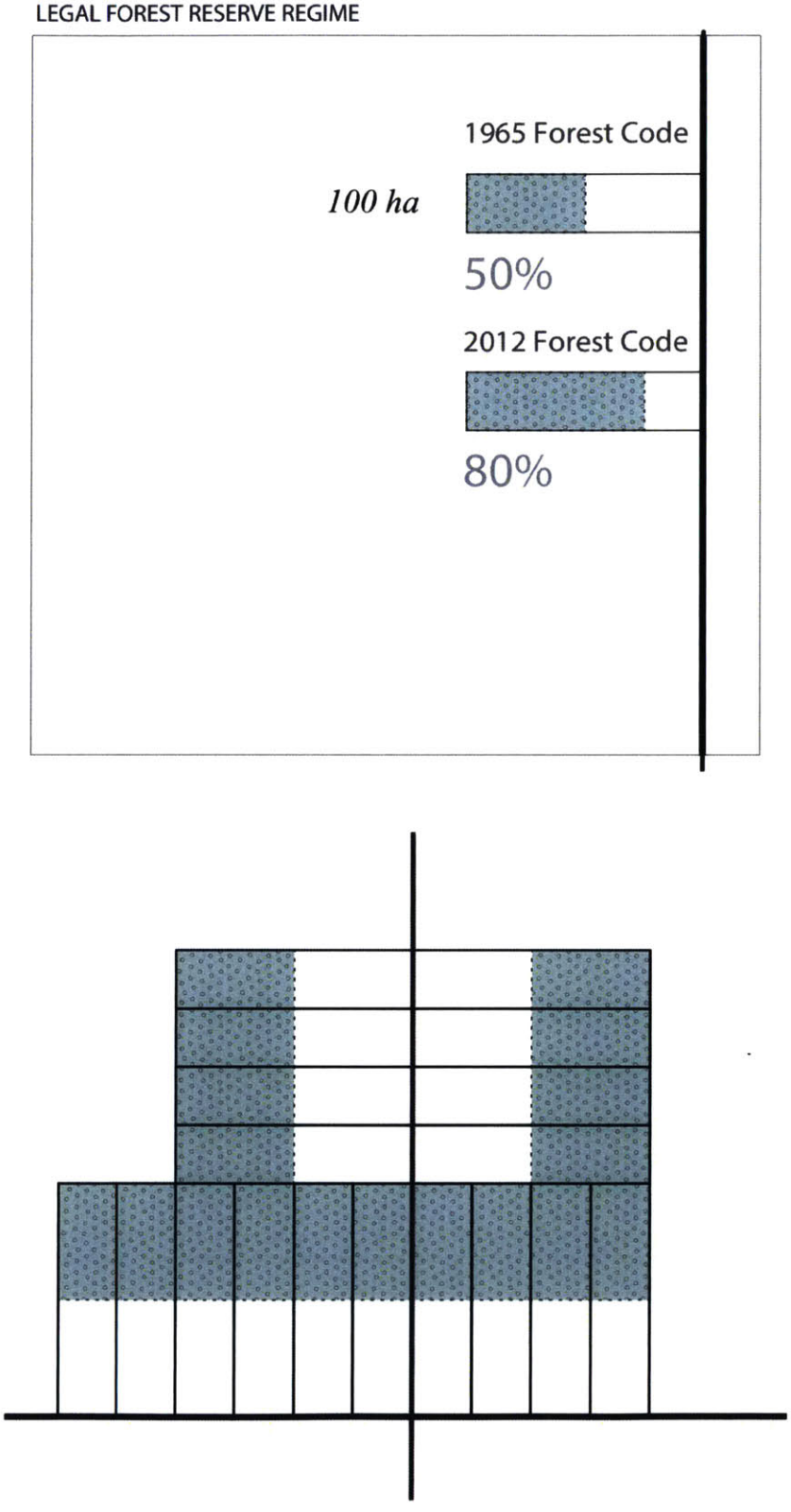
The INCRA model has had the most over arching effects on the landscape. The INCRA scheme relies mainly on major road networks, which become the main catalysts for occupation. Land partitioning and lot size are also significant factors to take into consideration. While the dominant settlement scheme is the original orthogonal design pattern, there are two other alternative designs implemented in the Amazon region to address some of the limitations to the orthogonal design, these were the watershed and the radial schemes.

* Jill Caviglia-Harris and Daniel Harris. The Impact of Settlement Design on Tropical Deforestation Rates and Resulting Land Cover Patterns. Agricultural and Resource Economics Review 40/3 (December 2011) 451–470



10
Settlement design and patterns: Orthogonal, Watershed, Radial

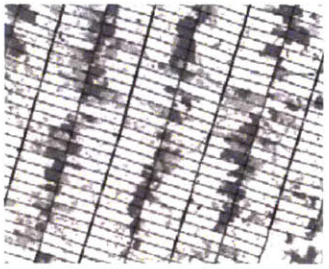
11
Orthogonal 'Fishbone' Pattern. Lot unit dimensions and settlement pattern



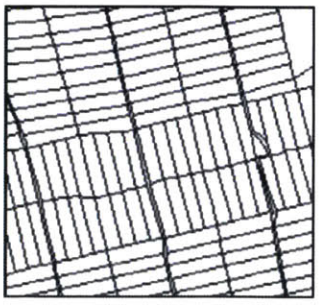
Orthogonal Pattern: "Fishbone"

The INCRA model developed by Camargo, mainly known as 'the fishbone' pattern, consisted of a 100 hectare lot size, measuring 2km deep by 0.5km wide where the short end was cleared for occupation alongside the road infrastructure. The visual fishbone pattern is a result of the Forest Code requirement first implemented in 1964, where 50% of the lot should be preserved for forest cover,* while development followed the main road infrastructure as its main organizing structure. However many settlements failed in this orthogonal settlement pattern due to lack of consideration of suitable agricultural soil for production. It followed a straight grid pattern and partitioning system without considering the geographic and geologic conditions. The selection and distribution of the settlement overlooked the natural or physical properties of the site, but instead followed the road as its main organizing factor. This eventually lead to high turnover rates, resulting in increased population mobility and deforestation rates. The distances between each lot also resulted in an endless linear arrangement with little access to social services.

* "Brazil's New Forest Code: A Guide for Decision-Makers in Supply Chains and Governments | Publications | WWF." 2016. World Wildlife Fund.

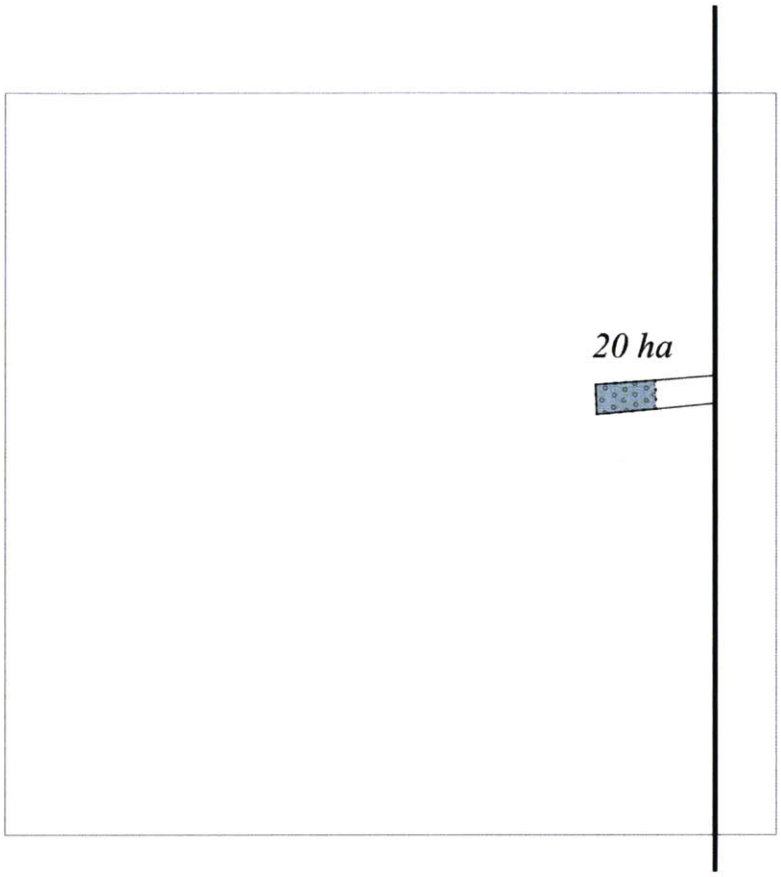


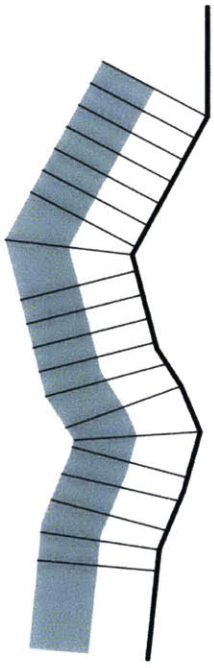
Fishbone



12
Settlement design and patterns: Orthogonal, "Fishbone"

13
Watershed Pattern. Lot unit dimensions and settlement pattern

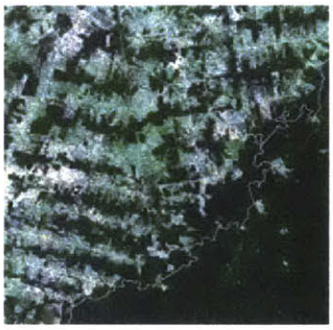




Watershed Pattern

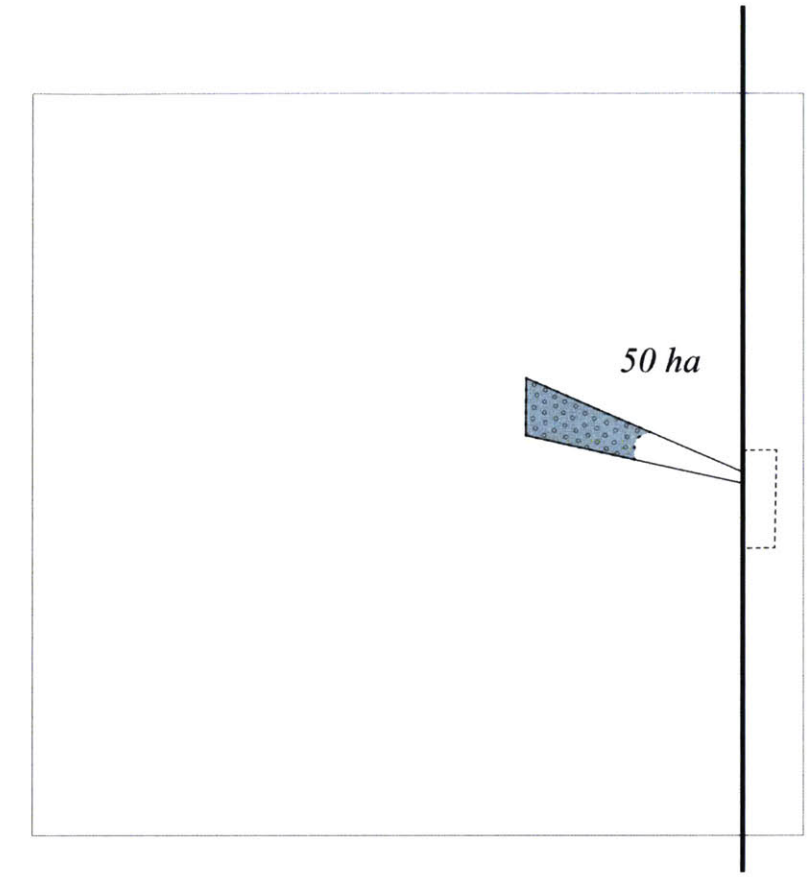
The watershed design was developed as a response to the failures of the orthogonal pattern to adjust to existing context conditions. The property lines followed drainage basins and had a better understanding on the geologic conditions of the site. Instead of following the road networks in a straight line grid, the watershed pattern was intended to organize around water waterways.

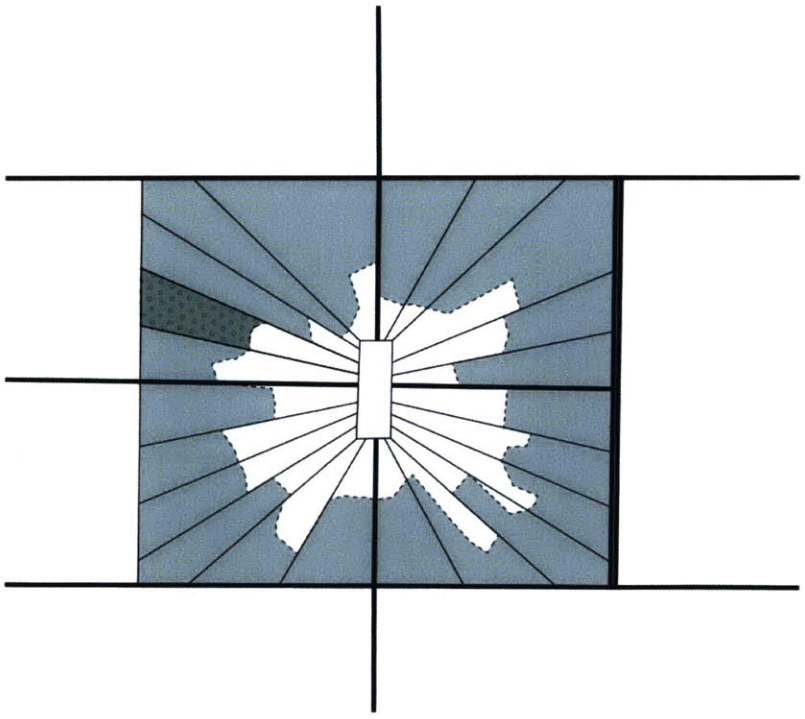
Thus, the watershed design pattern allowed greater access to water and by utilizing smaller plot sizes, there was more social contact between families.



14
Settlement design and patterns: Watershed

15
Radial Pattern. Lot unit dimensions and settlement pattern





Radial Pattern

The Radial settlement design alternative was mainly implemented to meet social goals as its main priority, compared to the watershed pattern which had a more environmental approach. The intention of the radial pattern was to encourage social interaction, increase contact between families and access to markets and services. This is the most recent settlement design experimentation introduced in the region, which took influences from the Israeli kibbutz, where the lots were arranged in around a common central area with shared public services. However it had a negative impact on land cover and land use transformation, due to small plot sizes of 12 hectares.

Jill Caviglia-Harris and Daniel Harris' research on the effects of settlement design in deforestation rates provide significant conclusions which provoke alternative design solutions for new settlement patterns along the Amazonian frontier. Another important factor to take into consideration is not only the pattern of development that is produced by these occupation patterns, but the condition of the remaining forest fragments. In both the orthogonal and watershed models, the remaining forest cover result in long linear forest corridors. With better enforcement, the radial settlement pattern could potentially also create connecting forest cover at its perimeter, thus combining both social and environmental priorities within one settlement design.

It is evident that plot dimensions and settlement patterns are an active form and multiplier of change. Studies reveal that settlement design and urban planning have significant impacts on land cover transformation, and deforestation rates. Alternative planning models which take into consideration landscape ecology and spatial patterns should be implemented moving forward.

16
Settlement design and patterns: Radial

17
Fordlandia, Para, Brasil
Henry Ford, 1926

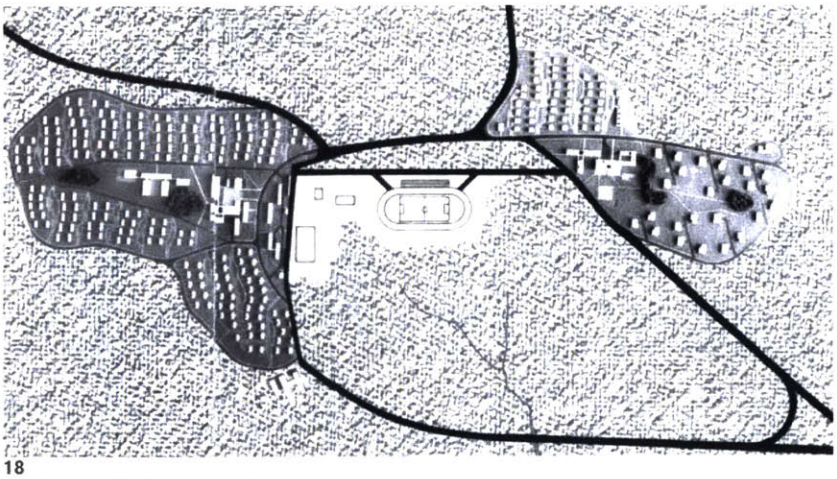
Urban Enclaves: The Brazilian Company Town and MCMV

Other forms of settlement typologies include the company town, which saw its beginnings with the industrialized landscape of the Rubber boom era. Among them, Henry Ford established Fordlandia in 1927. However, this urban typology was mainly triggered by the program POLOAMAZONIA from 1975-1979. This corporatist frontier under the influence of major national and multinational institutions encouraged the formation of the planned corporate cities and its spontaneous settlements that spurred in its periphery. Some of the most popular examples of this corporatist form of urban settlement was The Greater Carajás Program, in Parauapebas and Vila Serra do Navio (VSN) by architect Oswaldo Bratke (Bethlehem Steel + ICOMI) both sponsored by extractivist and mining economies.

18
Vila Serra do Navio, Amapa, Brasil
Oswaldo Bratke, 1955

19
Nucleo Urbano de Carajas
1985

20
Loteamento Nova Carajas,
Parabuebas, 2015



18
Vila Serra do Navio, Amapa, Brasil
Oswaldo Bratke, 1955

The newest form of urban enclaves are the housing estates developed by the housing program Minha Casa Minha Vida (MCMV) in 2009 by the federal government. The program was designed not only as a housing policy but also as an economic strategy to sustain Brazil through the international economic crisis of 2008 by fueling businesses related to the construction industry. These settlements are usually established within remote areas, on the edges and peripheries, with limited connection to urban area and following a suburban repetitive pattern of development.

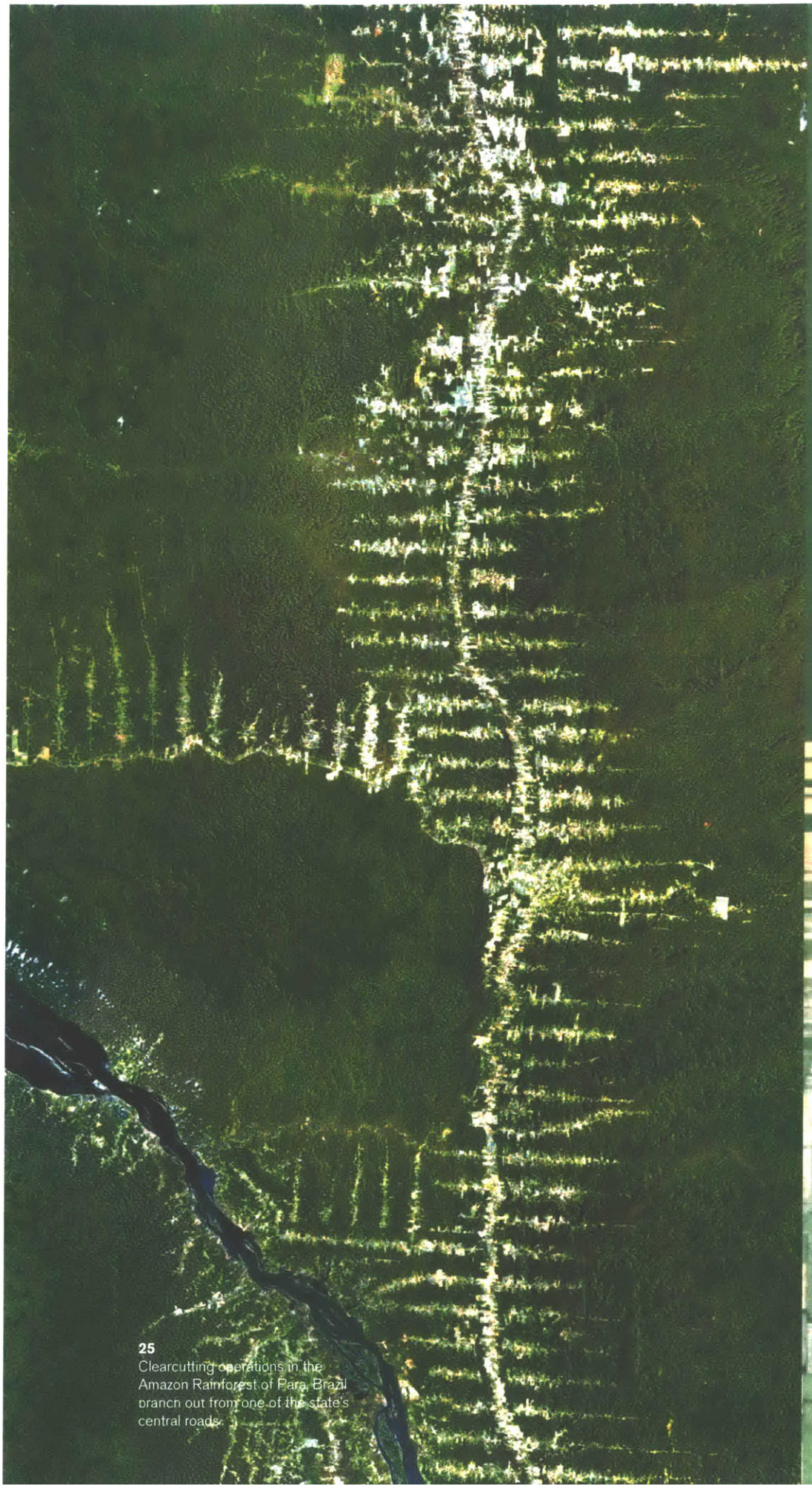
In both cases, these urban enclaves follow a similar development pattern, where native forests are completely cleared for occupation. This process of development contributes to a lack of urban forestry and propagates the duality of development and nature as two separate and conflicting entities. This trend of cleared forested land also resonates with illegal occupation tendencies throughout the territory. Cleared forested land is commonly perceived to have more value and as a strategy to claim land. However, in the revised Forest Code of 2012, rural settlers are allowed to legally register land and access credit without having to clear forest and graze cattle to demonstrate ownership.

21
MCMV, Altamira, PA

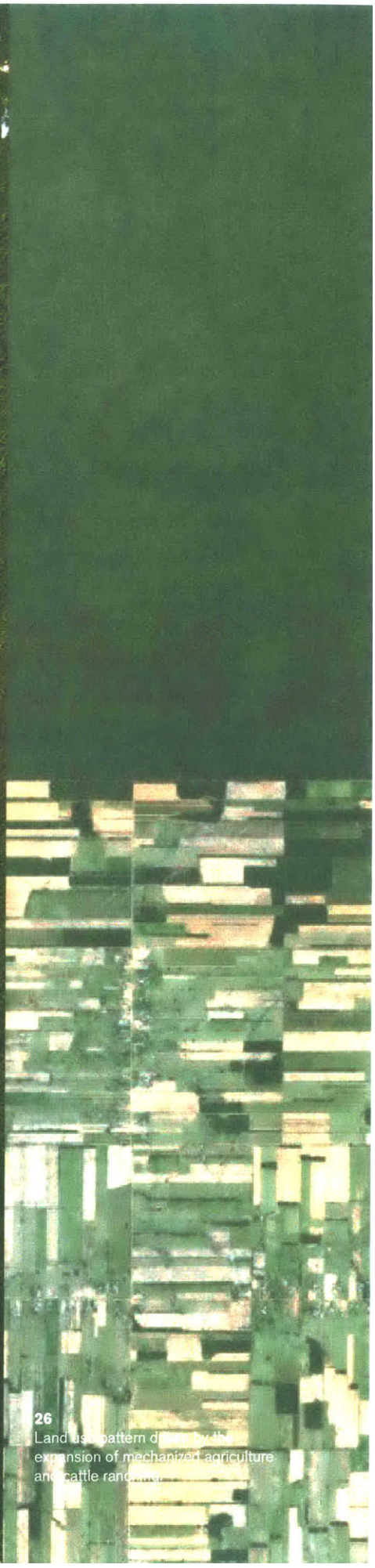
22
MCMV, Santarem, PA

23
MCMV, Belo Monte Dam Construction Site, PA

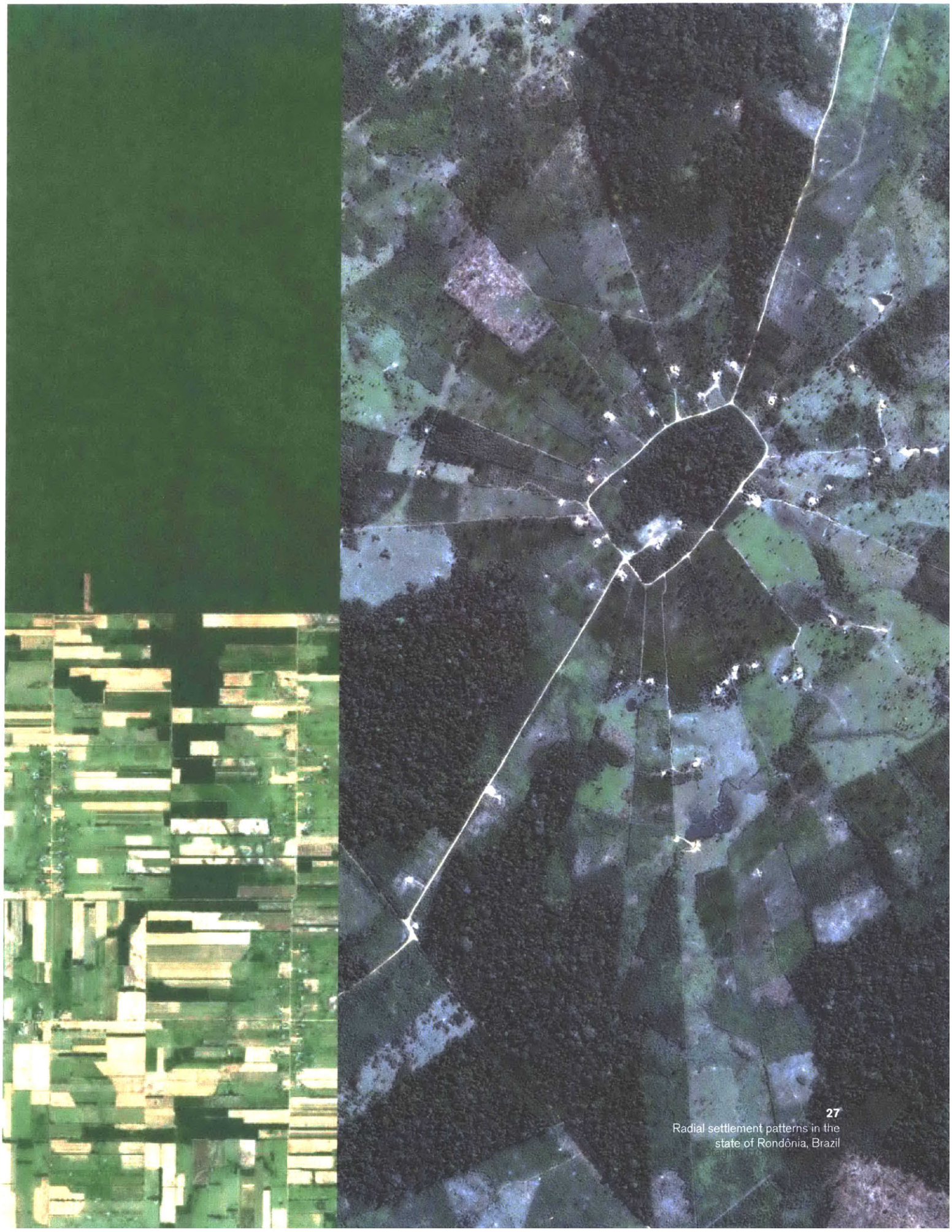
24
MCMV, Manaus, AM



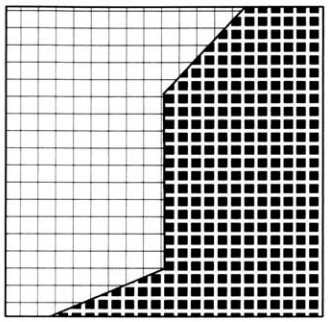
25
Clearcutting operations in the Amazon Rainforest of Para, Brazil branch out from one of the state's central roads.



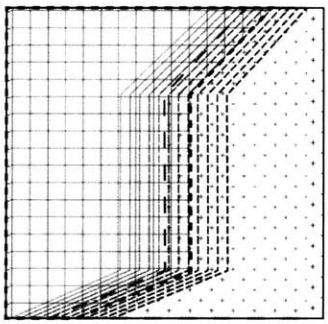
26
Land use pattern d[illegible] by the expansion of mechanized agriculture and cattle ranch[illegible]



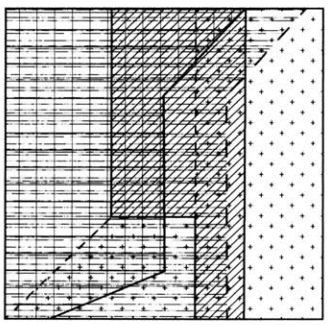
27
Radial settlement patterns in the state of Rondônia, Brazil



FRONTIER



TURNER'S FRONTIER



FRONTIER AMAZONIA

28
Types of Frontier Occupation

"Limits- spaces of tension, areas of transformation, new formations- the frontier always points to a third position, an area open to possibilities for re-inventions and redefinitions." (pp17, Monte-Mor)

THE FRONTIER ZONE

From the agrarian INCRA model, to the company towns and housing estates, these occupation patterns are predominant along the frontier, where most pressure due to increased population mobility, and rapid urbanization from global, national economic incentives.

The Frontier can be a controversial term given its common application to describe marginalized spaces to be conquered and colonized. Three main Frontier concepts have emerged: the frontier as limit, Turner's frontier and what has described by Monte-Mor, Becker, Browder and other Amazonian theorists as the unique condition of the Amazonia frontier. *

* Monte-mór, Roberto L. M. 2001. "New Urban Frontiers: Contemporary Tendencies in Brazil's Urbanization."

The Frontier Line

The concept of frontier can be described as a limit or border between two different conditions. In this case, the frontier line represents the boundary that separates legally and follows the narrative of border conflict and political concerns with territory.

Turner's Frontier

This concept of the frontier could be described as the stretch of land between settled and unsettled territory, usually referring to a condition where there is a dominant pattern that overtakes the other, creating a duality between two different worlds. This is the most common application of the idea of Frontier, which can be thought of as 'civilized' developed spaces in direct opposition with Nature, savagery or undeveloped territory. This concept was developed by Frederick Jackson Turner in 1893 when referring to the unsettled area of the Western United States. Turner's frontier theory describes the frontier as a space in a state of linear transformation towards capitalism. This moving frontier followed a linear evolution towards cities in a homogenous process where urbanization is the only outcome.

"The socio-spatial relations produced in Frontier Amazonia by colonization, cattle ranching, tap-mining, and extractive activities, their distinct and related socio-spatial relations and patterns, not at all mutually exclusive. On the contrary, these complementary and competitive activities mix and combine to produce complex socio-spatial forms and processes that are locally and regionally articulated with national and global urban-industrial capitalist centers

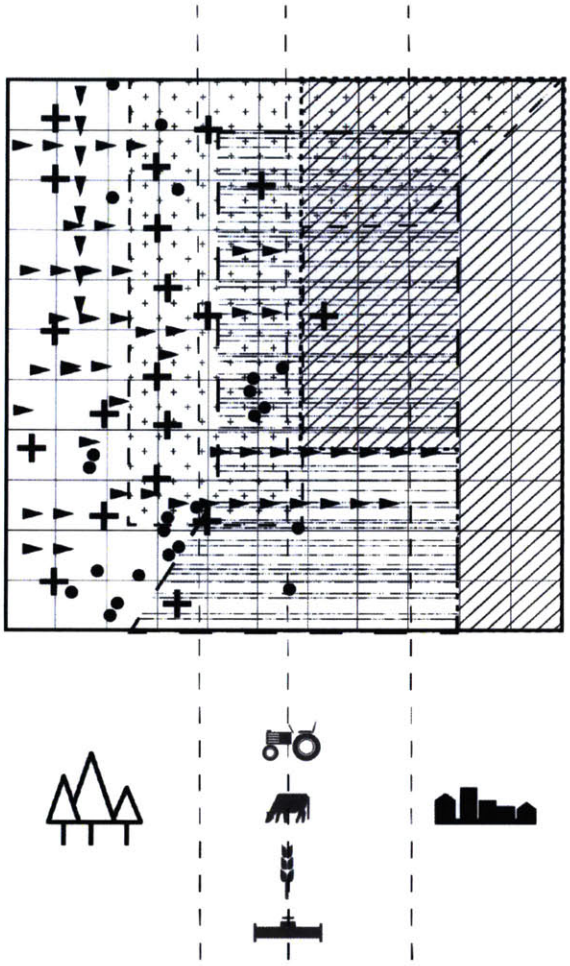
(Monte-mór 2016, p22)

Frontier Amazonia

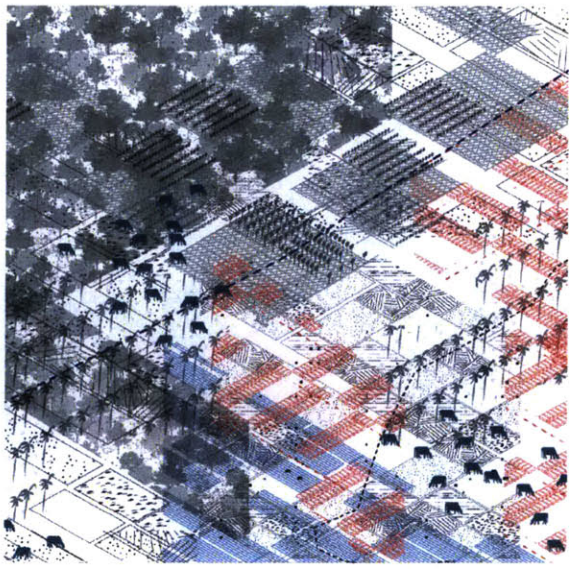
However, Monte-Mor describes the unique condition in Brazil, where there is a multiplicity of Frontiers, creating a heterogenous condition more complex than the linear transformation of Turner's Frontier. I will also argue that Frontier Amazonia disrupts the inherent duality between settled and unsettled, nature and city. Instead the it is able to host a complex combination of actors and interests producing different social appropriations of space and an array of articulated temporalities and spatialities.*

* Monte-mór, Roberto L. M. 2001. "New Urban Frontiers: Contemporary Tendencies in Brazil's Urbanization.

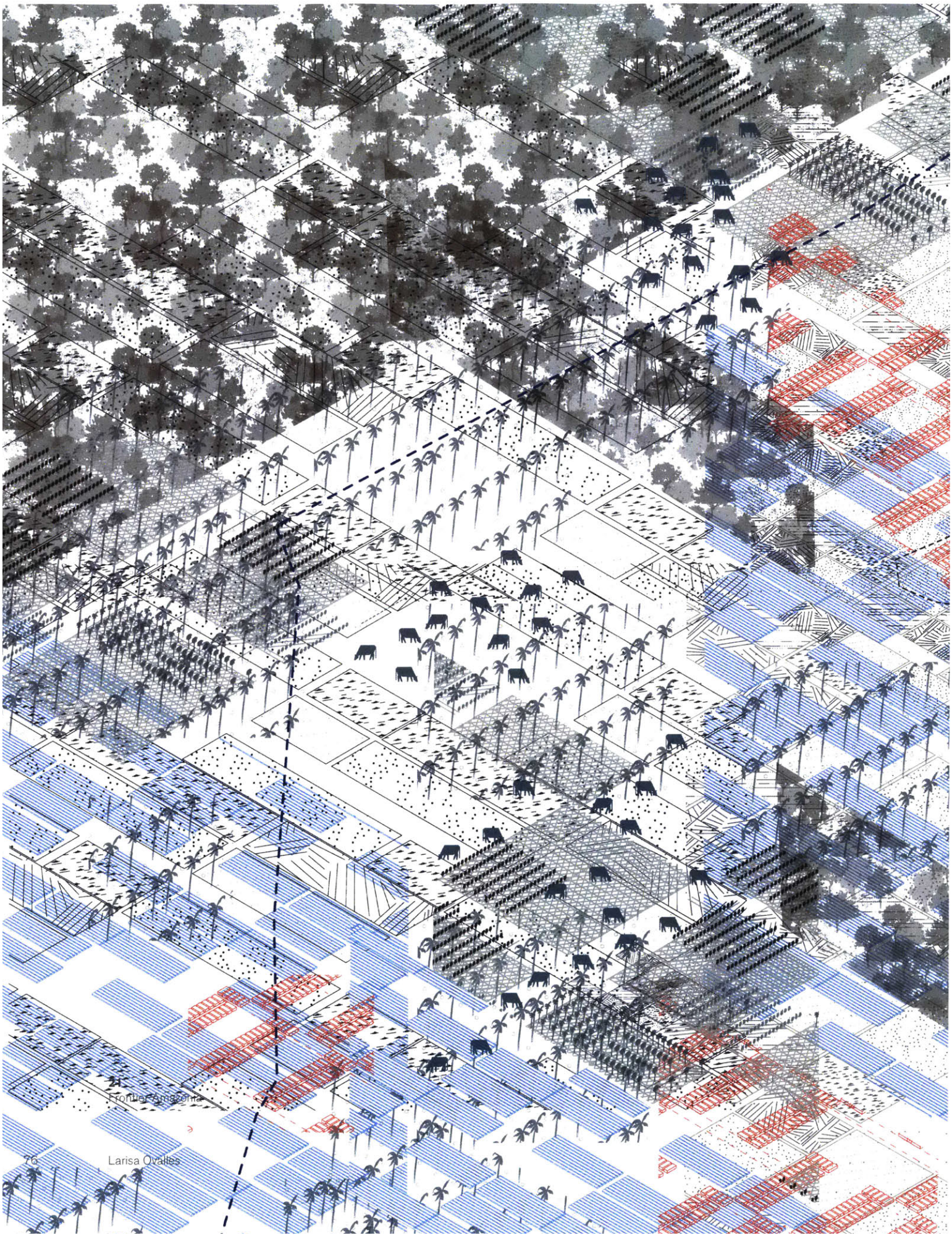
This thesis argues that the Amazonian frontier zone is a space to mix, share, exchange, add, subtract. In this case, the periphery transforms into a potential generative space- a source of innovation and adaptation, and the site for economic or social operations. Due to current political and economic situation of Brazil, development and growth is unavoidable and should be accounted for, but prevent uncontrolled expansion.

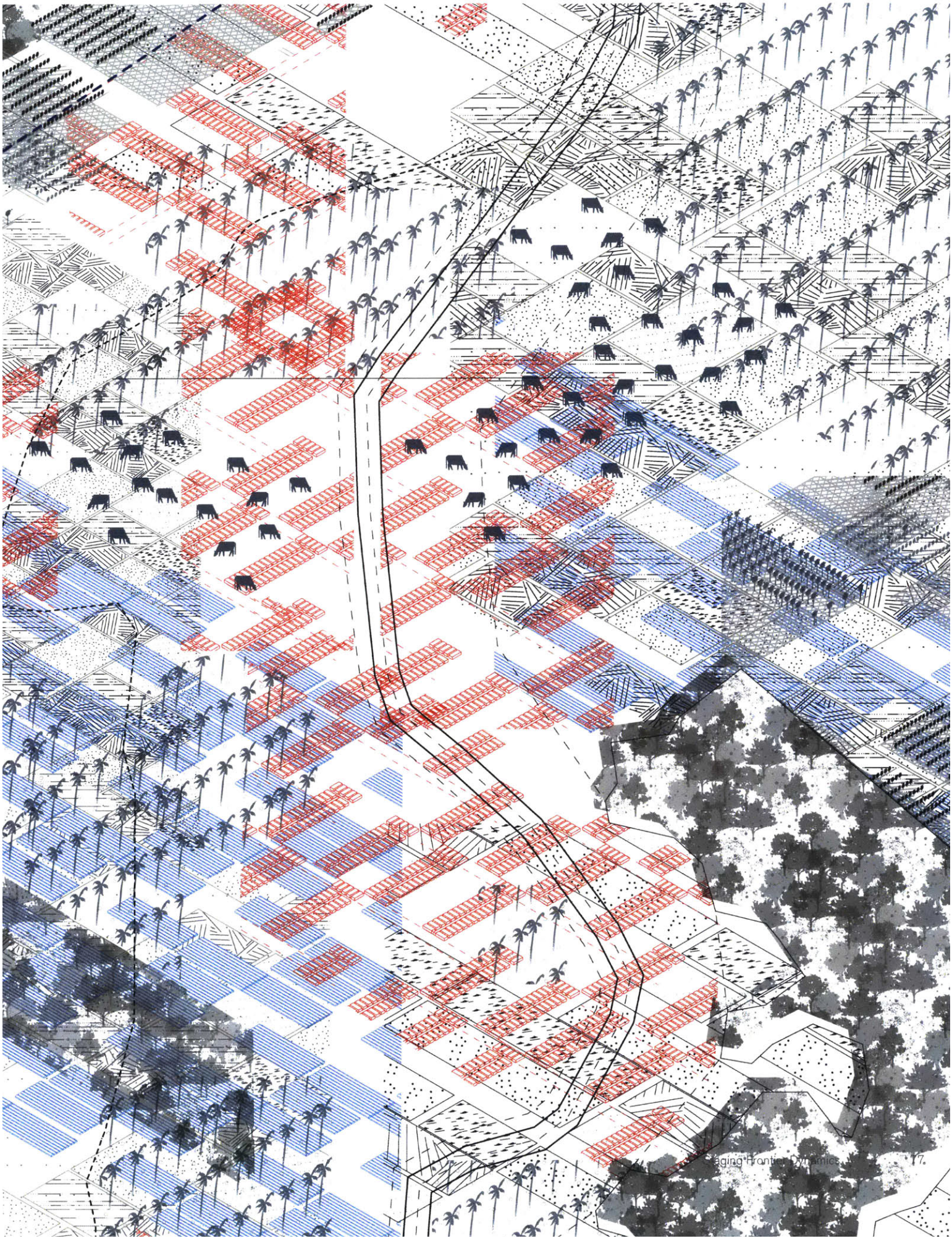


29
Frontier Amzonia and its varying land uses through time. A model for shared hybrid frontier zone



30
Frontier Amzonia





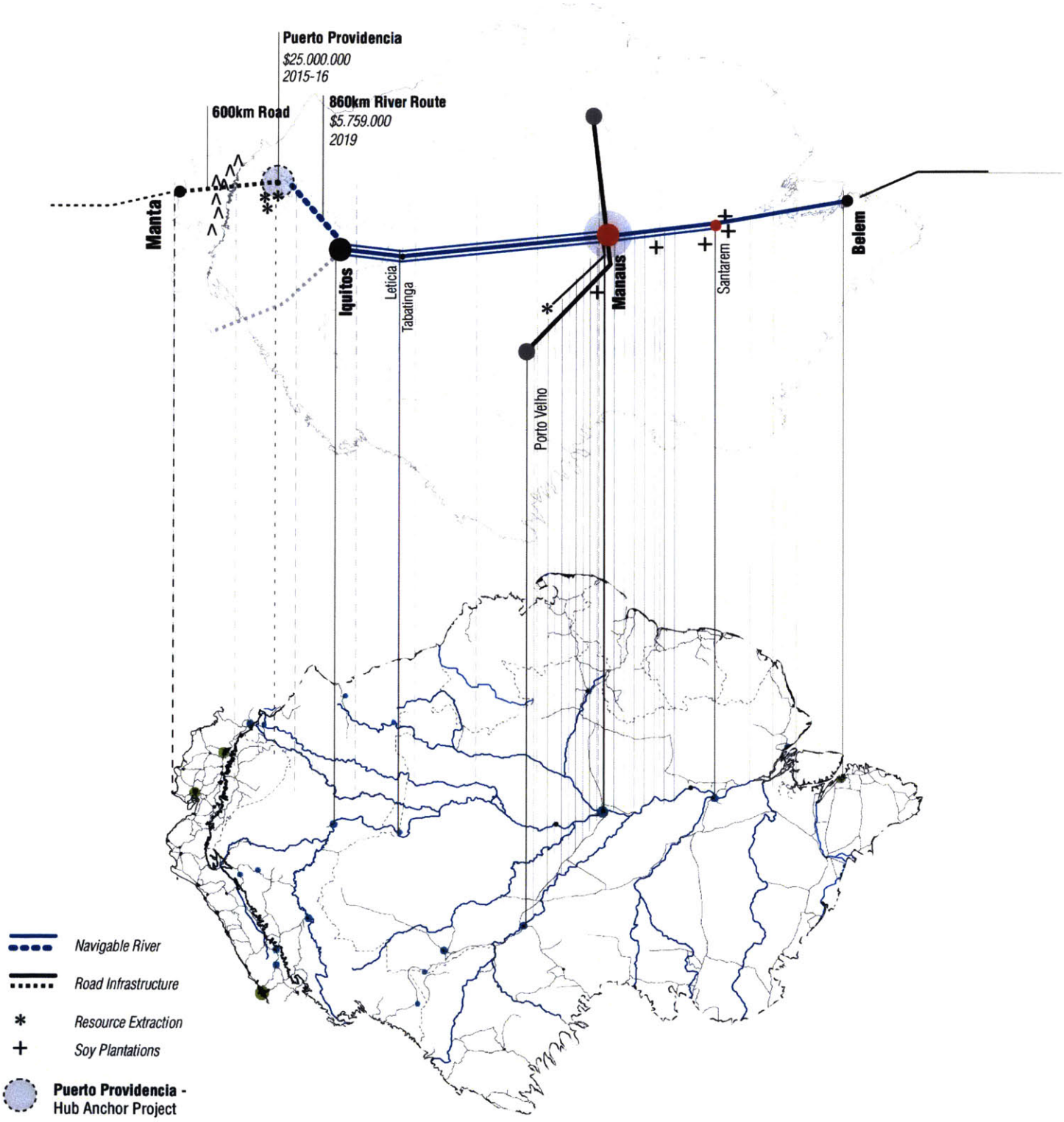
03

AMAZONIAN URBANITIES

The Case of Manaus

"The intense process of urbanization in the past decades produced a myriad of urban forms beyond cities and towns that have required new definitions beyond the traditional categories of city/country and urban/rural."

Roberto L.Monte-Mór,
Extended Urbanization in the Brazilian Amazonia, 2001



01
Manta-Manaus Corridor. Proposed Infrastructure and major cities

Amazonia Urbanities: The Urbanized Forest

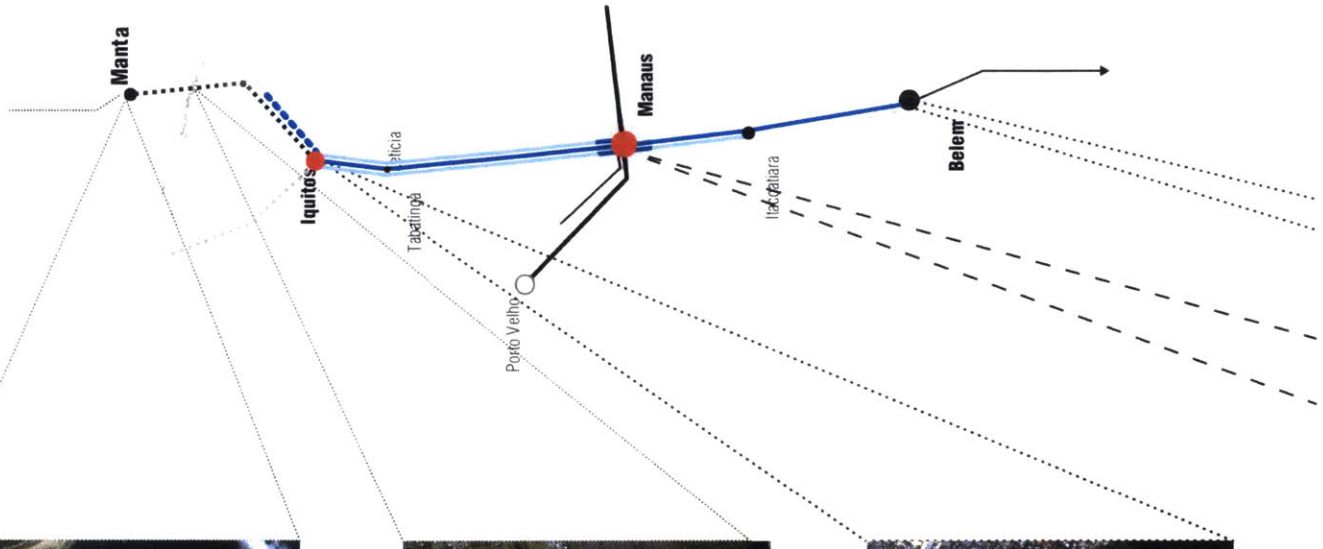
Contrary to the common perception that the Amazon is a mainly rural and undeveloped territory, it has actually transformed into one of the fastest growing regions in Brazil. The urban population of Legal Amazônia grew 430% since the 1970s, compared to 87% from the rest of the country This accelerated urbanization in the past decades, fostered by industrialization and government incentives, has led to an increasing migrant population.*

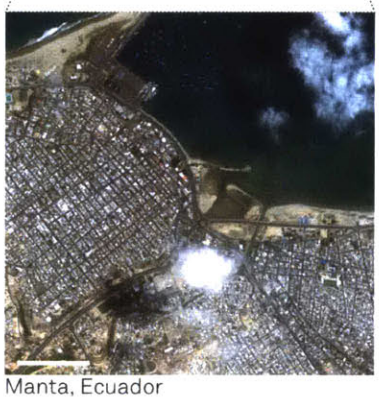
* Instituto Brasileiro de Geografia e Estatística (IBGE) 2007

Brazilian urban geographer Bertha Becker famously described all Amazonia as an "urbanized forest"(1985). Becker distinguishes two different and combined manifestations within frontier urbanization: the "urbanization of the population," referring to the urban migrants who come to the region; and "urbanization of the territory," referring to the urban- industrialization of the territory. (Becker, 1999)

Looking back at the settlements along the proposed IIRSA Manta-Manaus Corridor, Manaus is taken as a testing ground in search for a new type of frontier development.

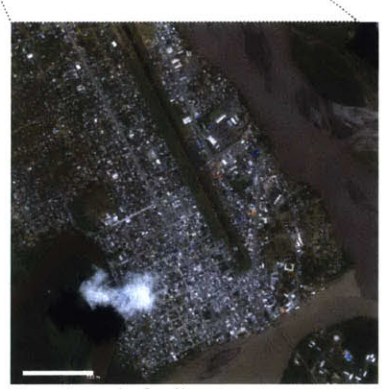
"Modernities in the Jungle: Extended Urbanization in the Brazilian Amazonia , 360 Pages." 2016. Accessed May 19. http://www.alwelaie.com/website/universitytheses_details_print.php?theses_id=26510.





Manta, Ecuador

226,477

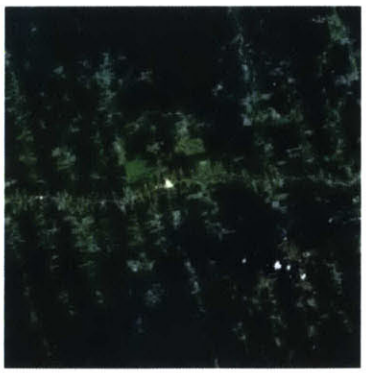


Francisco de Orellana

72,795

Iquitos, Peru

457,865



Settlement Pattern along Road

02
Population of main cities and settlements along Manta-Manaus corridor

MANAUS

Manaus, Brazil

2.3mi

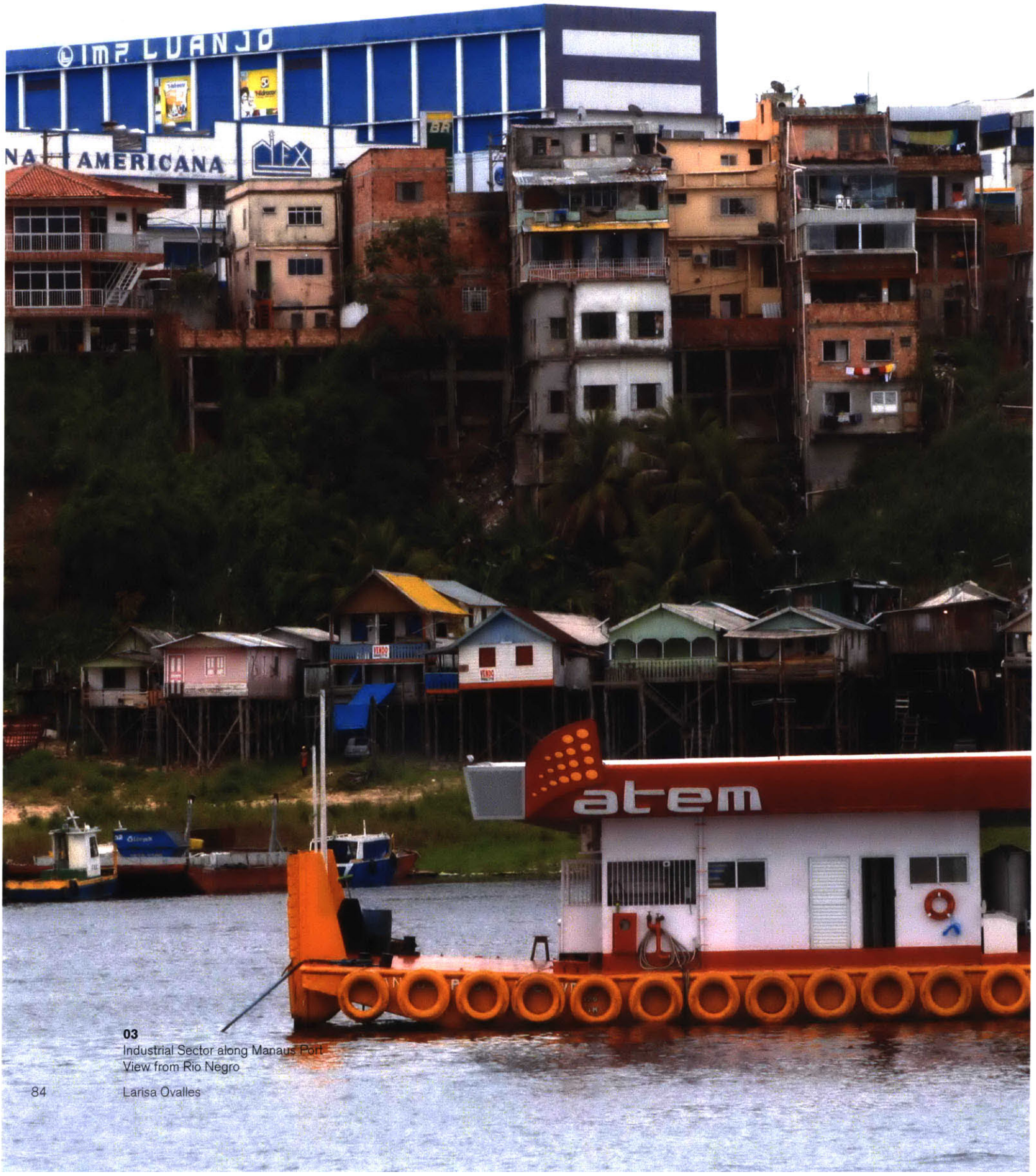
Belem, Brazil

2.2mi

Itacoatiara, Soy Agriculture

95,714

Fordlandia, Brazil



03
Industrial Sector along Manaus Port
View from Rio Negro

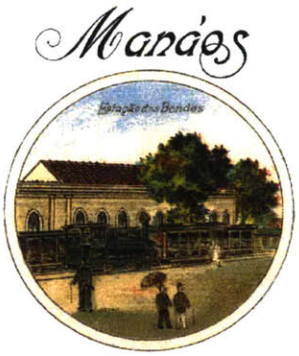
Larisa Ovalles

MANAUS: URBAN GLOBALIZATION

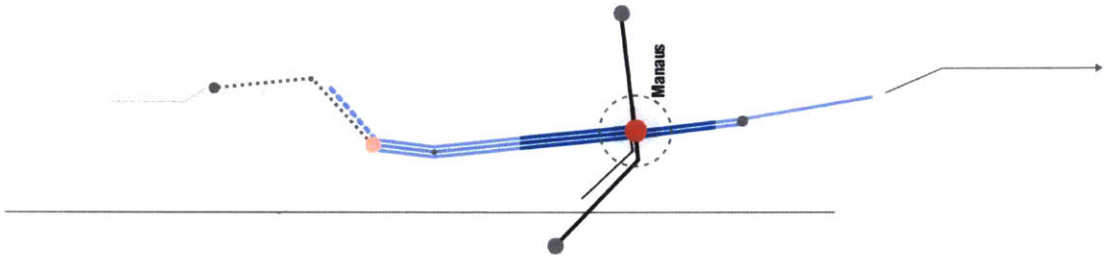
Manaus follows the exemplary narrative of state-sponsored urban globalization. The creation of the 1967 Free Trade Zone as part of the Operation Amazonia program is responsible for the rapid growth rate and the transformation of this remote enclave to a city with major regional and global connections. Population growth of Manaus is growing 10% above the national average. A city of nearly 2 million people, has grown the most in the past decade and is now Brazil's seventh-largest city. *

Private companies receiving subsidies from the government established export orientated industrial complexes, have contributed to the rapid economic expansion, and resulted in intensified social inequalities throughout the city. As the city continues to grow, it is quickly running out of space, producing the sparse and fragmented settlement patterns around its periphery.

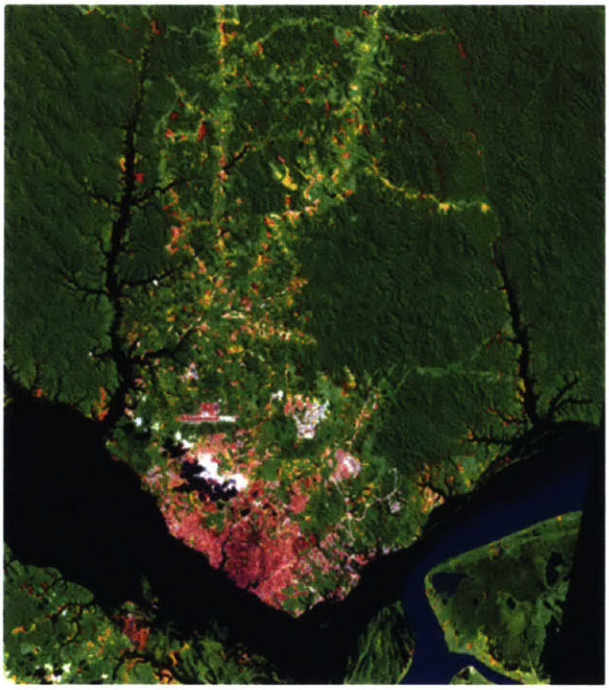
* Brazilian Institute of Geography and Statistics (IBGE) Am, G1. 2013. "Manaus Tem População Estimada Em 1,9 Milhão de Habitantes, Diz IBGE." Amazonas



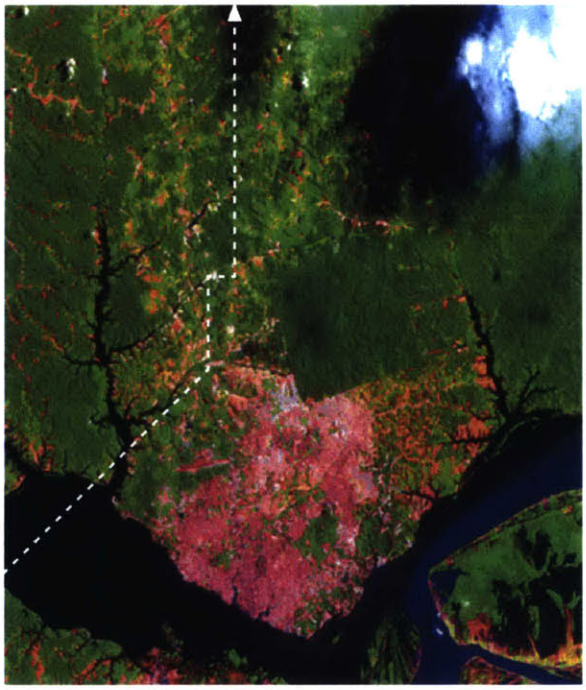
04
City of Manaus
05
Plan of the City of Manaus, 1852
06
Industrial Sector, Zona Franca de Manaus (ZFM) 1967



Manaus, Brazil

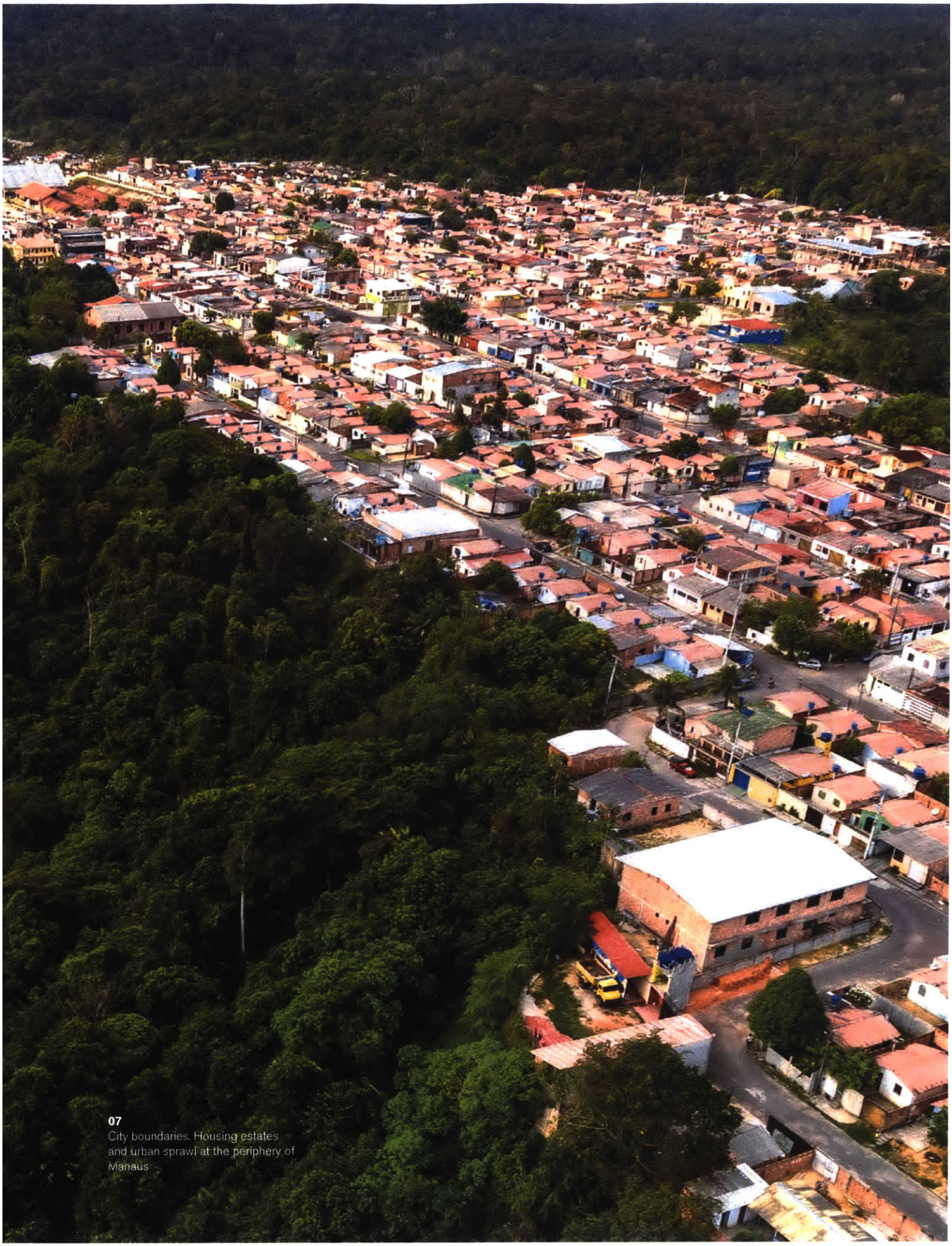


1985



1999

03
The growth of Manaus and Natural Reserve Adolpho Ducke



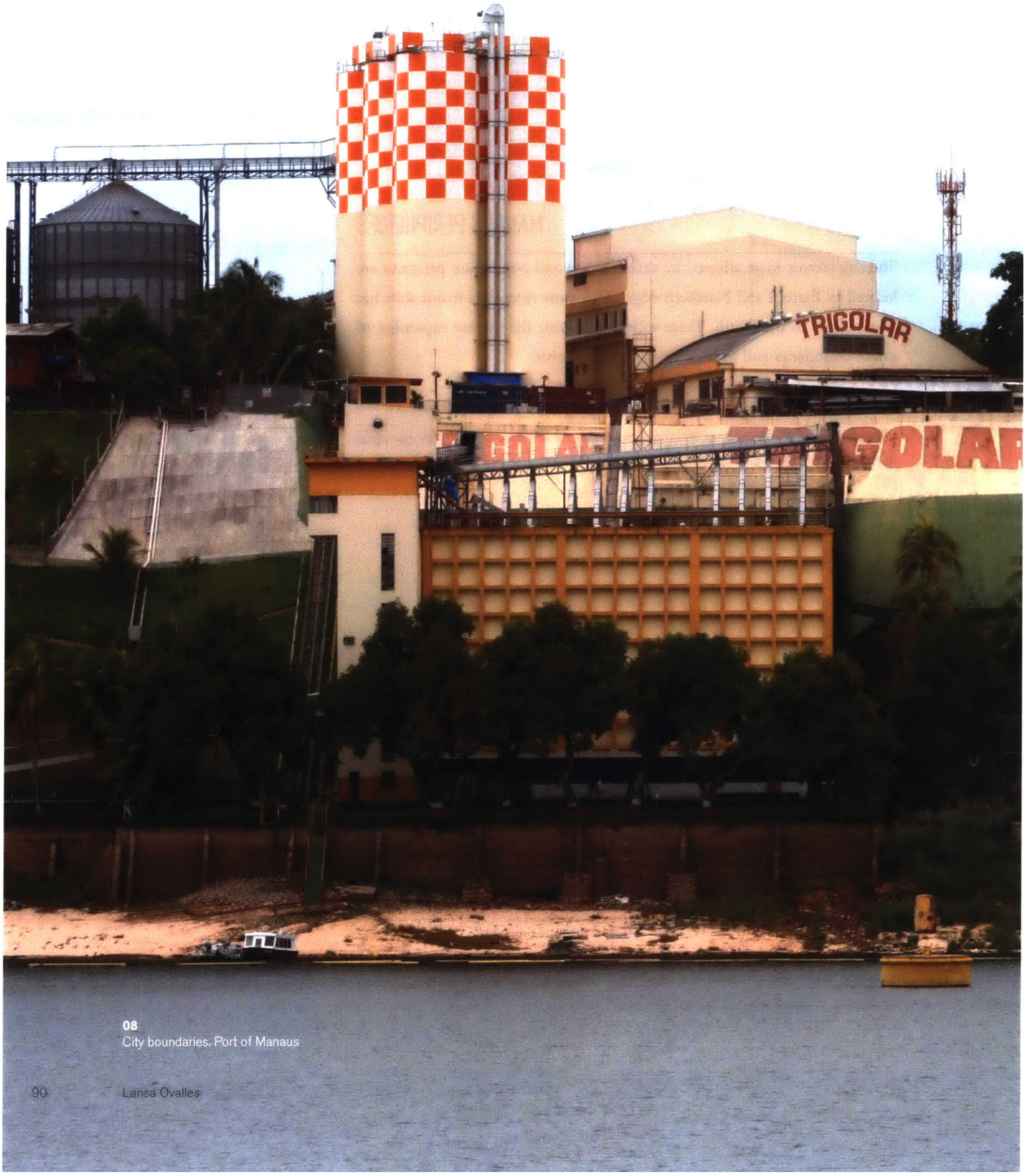
07
City boundaries. Housing estates and urban sprawl at the periphery of Manaus

MANAUS PERIPHERIES

The city sectors most affected by deforestation and population pressures are located in Eastern and Northern edges, and most recently a major shift has materialized in the South. These regions represent the intense expansion of urban boundaries and the density of occupied areas.

"The dynamics of emerging regional urbanization in the Amazon provide examples of hybrid and heterogeneous peripheries" *

*Juan Miguel Kanai. "On the Peripheries of planetary urbanization:Globalizing Manaus and its expanding Impact"



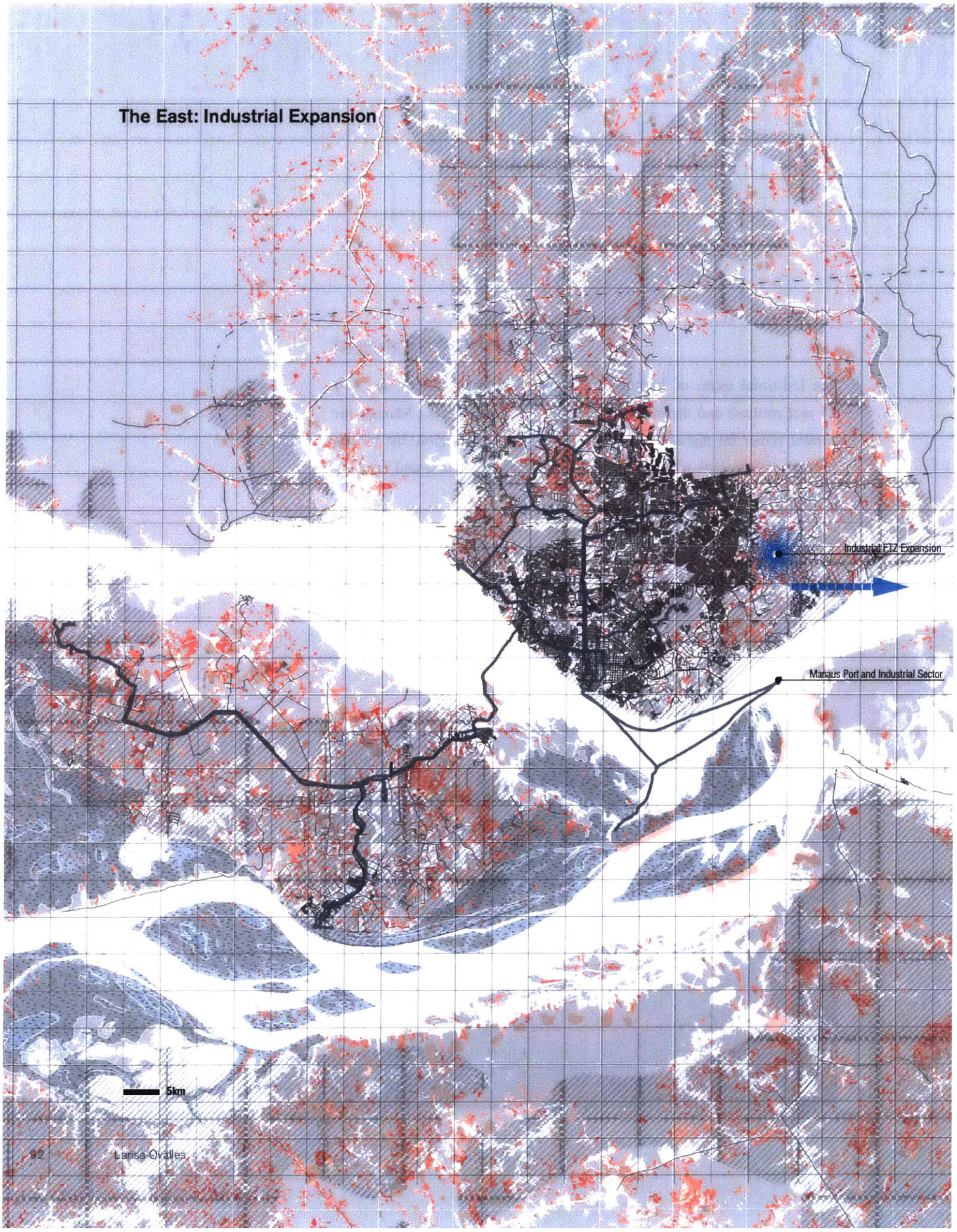
08
City boundaries. Port of Manaus

The East: Industrial Expansion

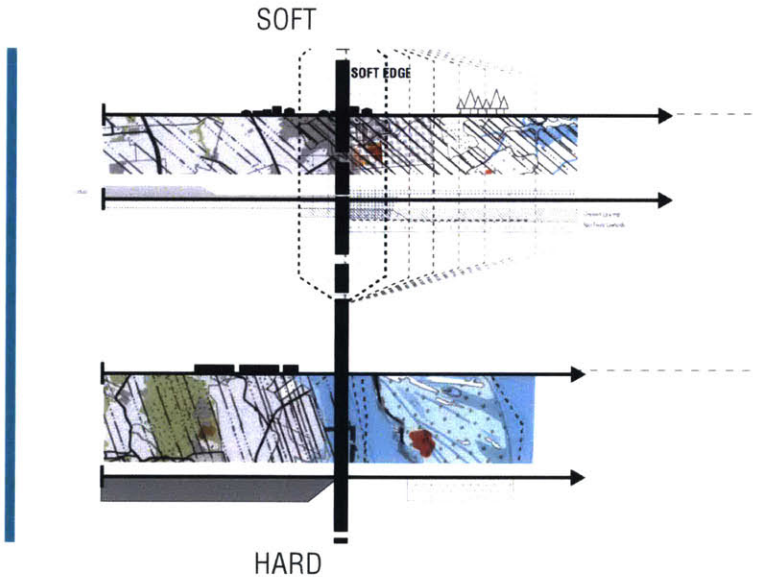
The Industrial sector of Manaus is the main economic activity, tied to a 25 year contract and dependent on external economic forces. Manaus the current center for manufacturing and logistics hub the region due to new package of incentives to stimulate high-tech electronics sector and research, biotechnology.

Their business is expanding the population further out into the outskirts of the city on the east, where the implementation of the new expansion of the industrial zone is taking place.

09
Industrial Sector of Manaus- Free Trade Zone


The East: Industrial Expansion
Industrial FTZ Expansion
Manaus Port and Industrial Sector
5km

EDGE CONDITIONS



Edge Diagram
Industrial Sector of Manaus- Soft edges towards expansion and sprawl on the east. hard edge preventing further growth because of the natural boundary of the River.

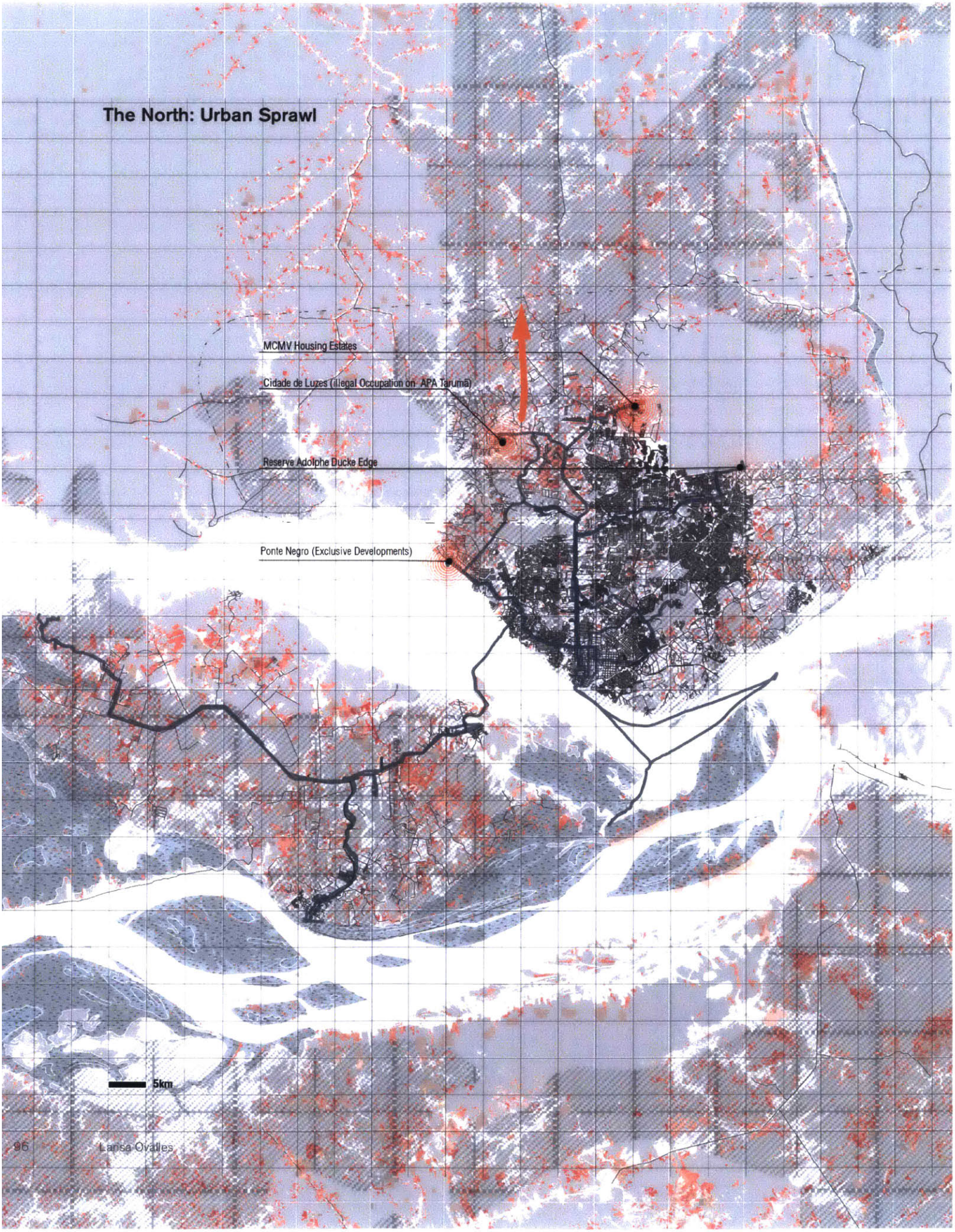
10
City boundaries, Housing Estate of 55,000, Residencial Viver Melhor, Manaus, AM

The North: Urban Sprawl

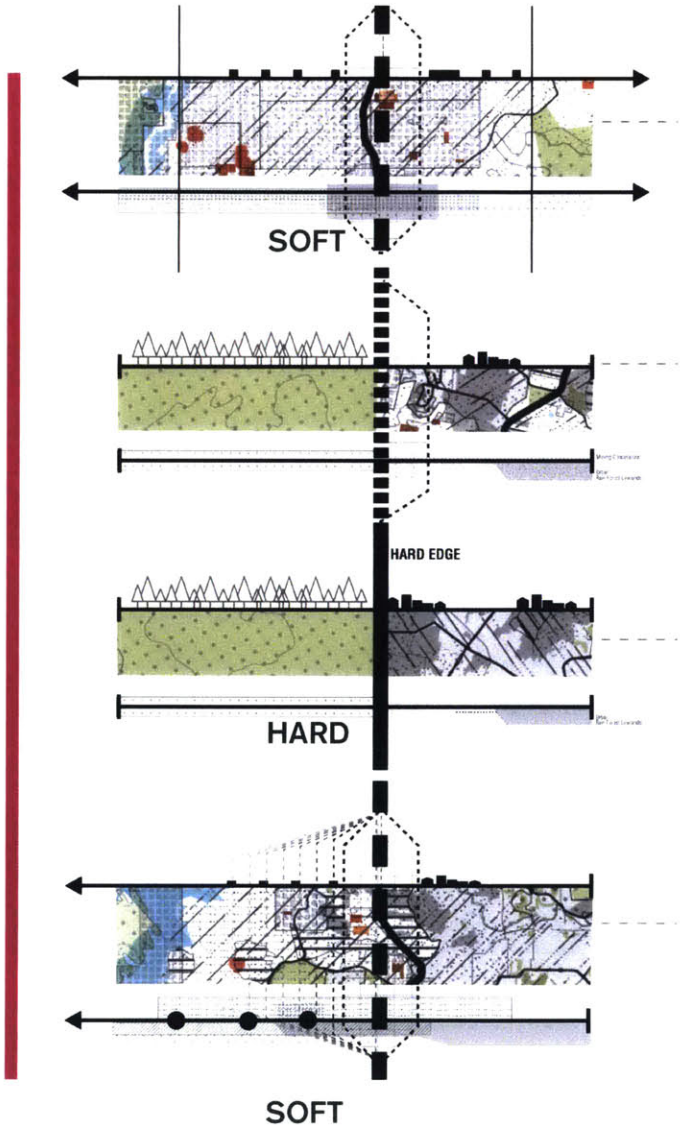
To the Northeast edge, as a result of the sprawled urban periphery where repetitive housing estates create a fragmented and disarticulated landscape. There is almost a total absence of urban forestry in Manaus, since it follows the popular development pattern where native vegetation is completely removed, contributing to the lack of open green spaces, the lowest ratio in all of Brazil despite of its location

According to local studies of the consequences of this deforestation process there is the fragmentation of the intra-urban forest remnants with impoverishment its biodiversity, and the threat to the continuity of existing forests of the Reserva Ducke and forests located north of the city of Manaus.

11
City boundaries. Illegal Occupation on Taruma Protected Area, Cidade das Luzes, Manaus, AM

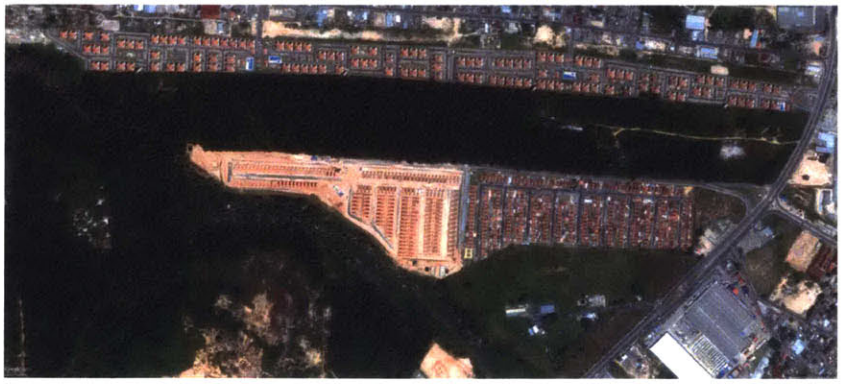

The North: Urban Sprawl
MCMV Housing Estates
Cidade de Luzes (Illegal Occupation on APA Tarumã)
Reserve Adolphe Ducke Edge
Ponte Negro (Exclusive Developments)
5km

EDGE CONDITIONS



12
MCMV Housing Estate, North Sprawl
13
Hard Edge next to Natural Reserve
Adolphe Ducke
14
Cidade das Luzes after site was
evacuated in 2015

15
MCMV, Residencial Viver Melhor
16
MCMV, Condomínio Residencial Villa Gaia
17
MCMV, Residencial
18
MCMV, Residential Eliza Miranda



19
MCMV, Residencial Viver Melhor
20
MCMV, Condomínio Residencial Villa Gaia
21
MCMV, Residencial
22
MCMV, Residential Eliza Miranda

23
MCMV, Residencial Viver Melhor
24
MCMV, Condomínio Residencial Villa Gaia
25
MCMV, Residencial
26
MCMV, Residential Eliza Miranda

27
Ponte Negro Bridge, View from Iranduba riverfront
Larissa Ovalles

THE NEW FRONTIER: Iranduba

However, the production of urban peripherality is most evident in Iranduba, where the fastest growth has been generated since construction of the Rio Negro Bridge began in 2007, the first to cross the Amazon River. Exposing this new territory to rapid land transformations. The sparsely settled territory is now susceptible to follow the same unplanned urban growth of Manaus and is at risk of succumbing to disorganized occupation.

The bridge cut travel time to 5min by car, compared to the 45min it took to cross the Rio Negro river by boat. Population is expected to triple in the upcoming years. While most of the territory falls under a state level Protected Area, 72.8% of native forest has already been lost.*

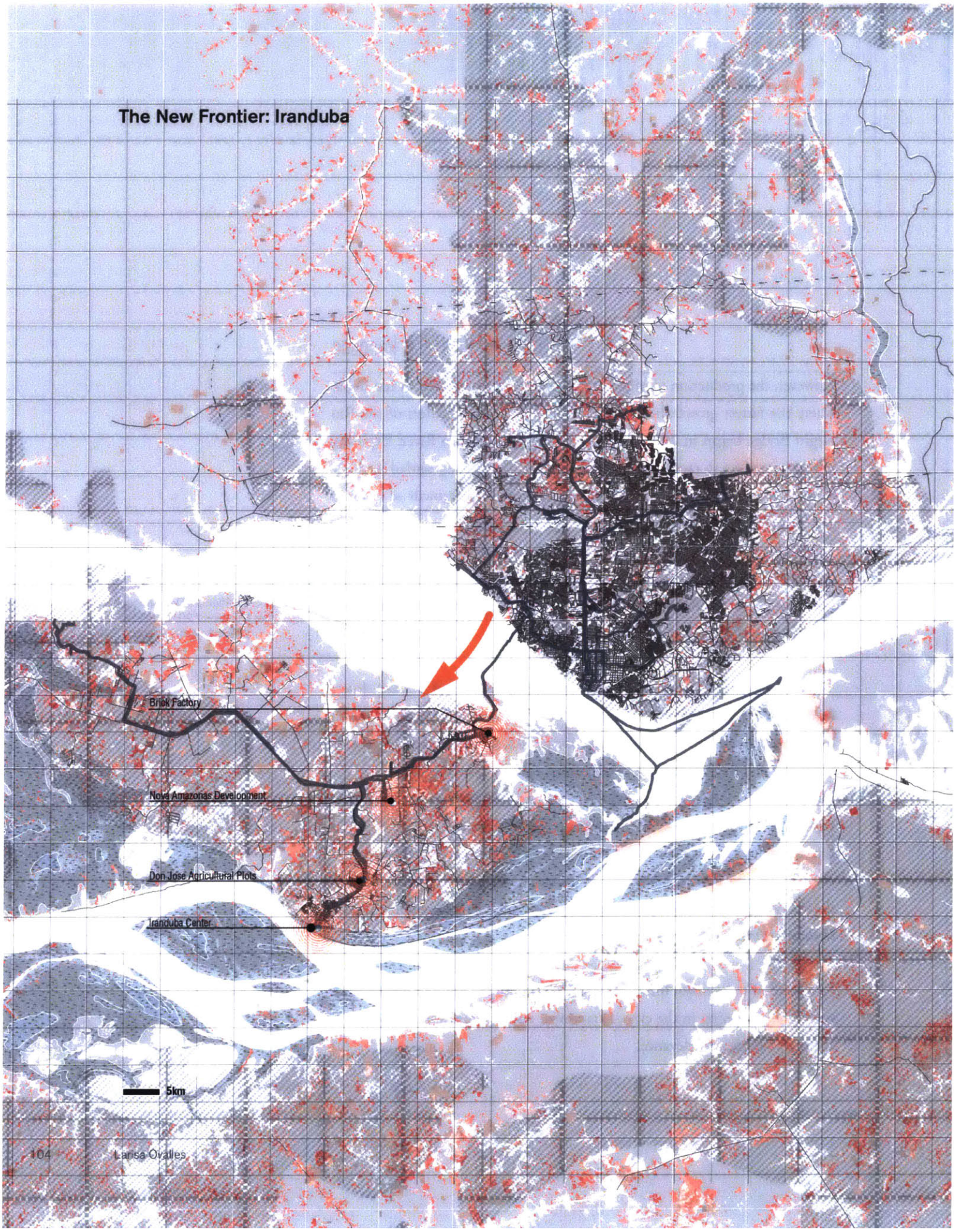
*"FVA Apresenta Diagnóstico Socioambiental de Iranduba Em Evento de Abertura Das Atividades No Município." 2015. Fundação Vitória Amazônica. June 30.

The municipality of Iranduba lost about 49,000 hectares of primary forest land according to the latest data from the National Institute for Space Research (INPE). Recent deforestation patterns since 2002, show that deforestation is occurring in a fragmented and uncontrolled random pattern.

Iranduba's main economic activity is still agricultural based serving as a significant agricultural pole of production for the Amazon.

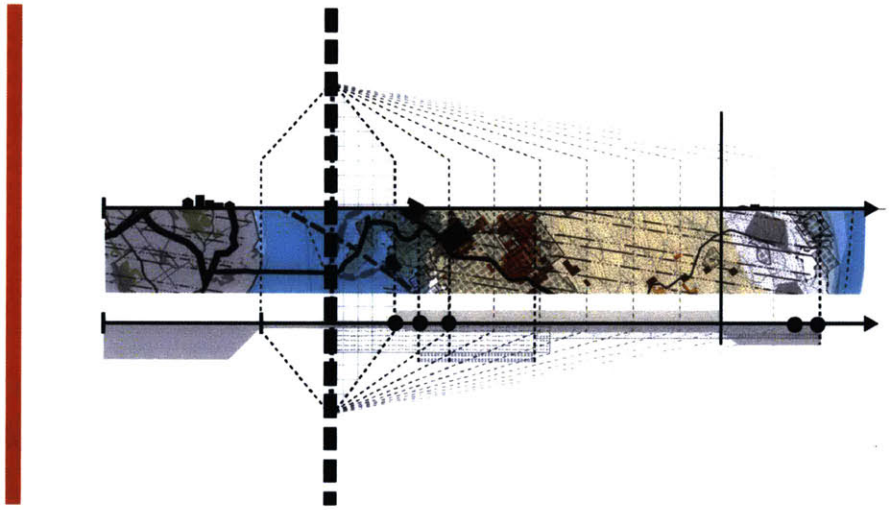
Due to its closeness to Manaus has begun an intense process of transformation of its social and natural landscape. We already see some drastic changes to the landscape- with road expansions, gas stations, housing developments and ubiquitous forest clearing activity.

As a result of these major infrastructure projects and the rapid transformation currently happening in the city of Iranduba, ecologic preservation begins to acquire a significant relevance.


The New Frontier: Iranduba
Brick Factory
Nova Amazonas Development
Don Jose Agricultural Plots
Iranduba Center
5km

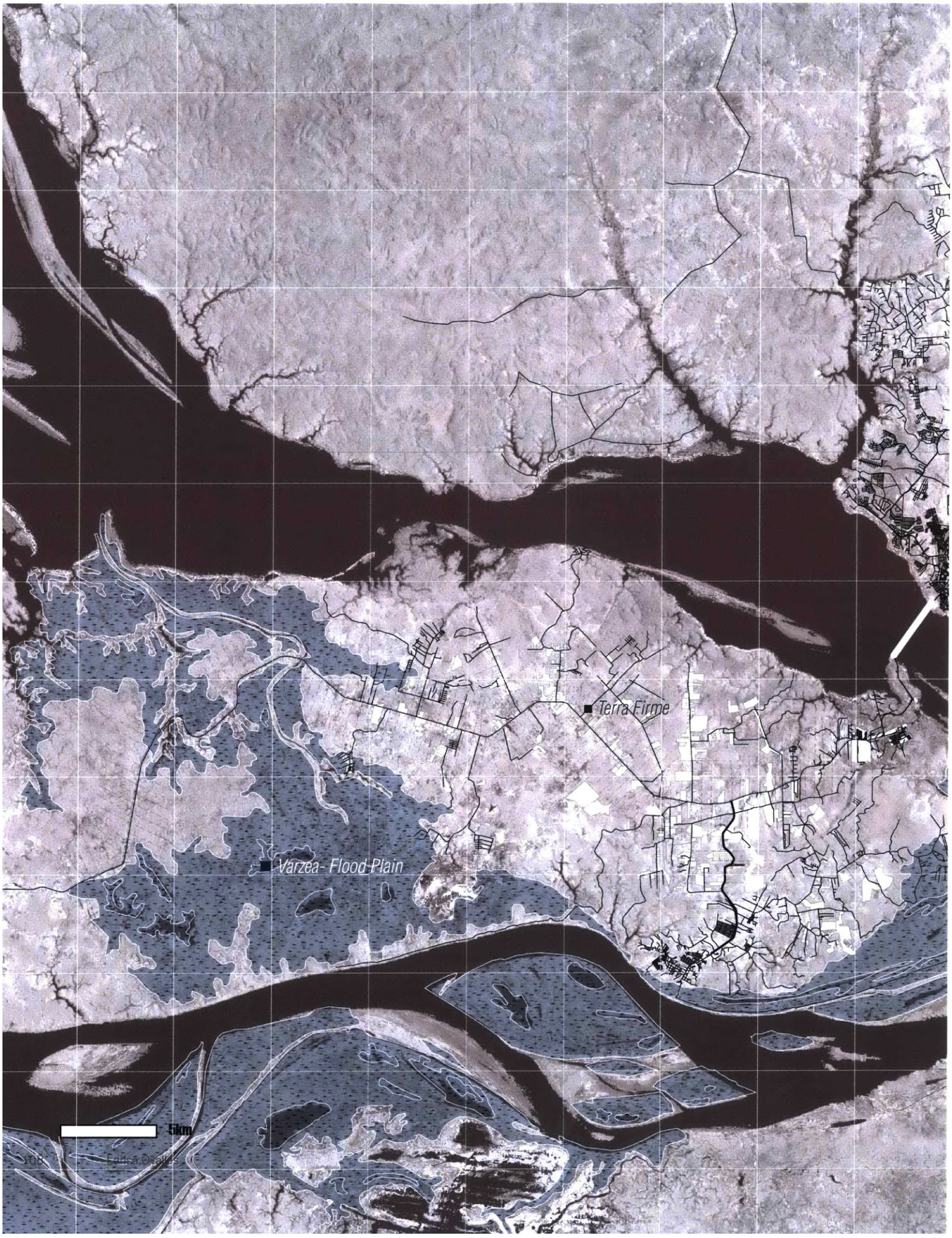
EDGE CONDITIONS

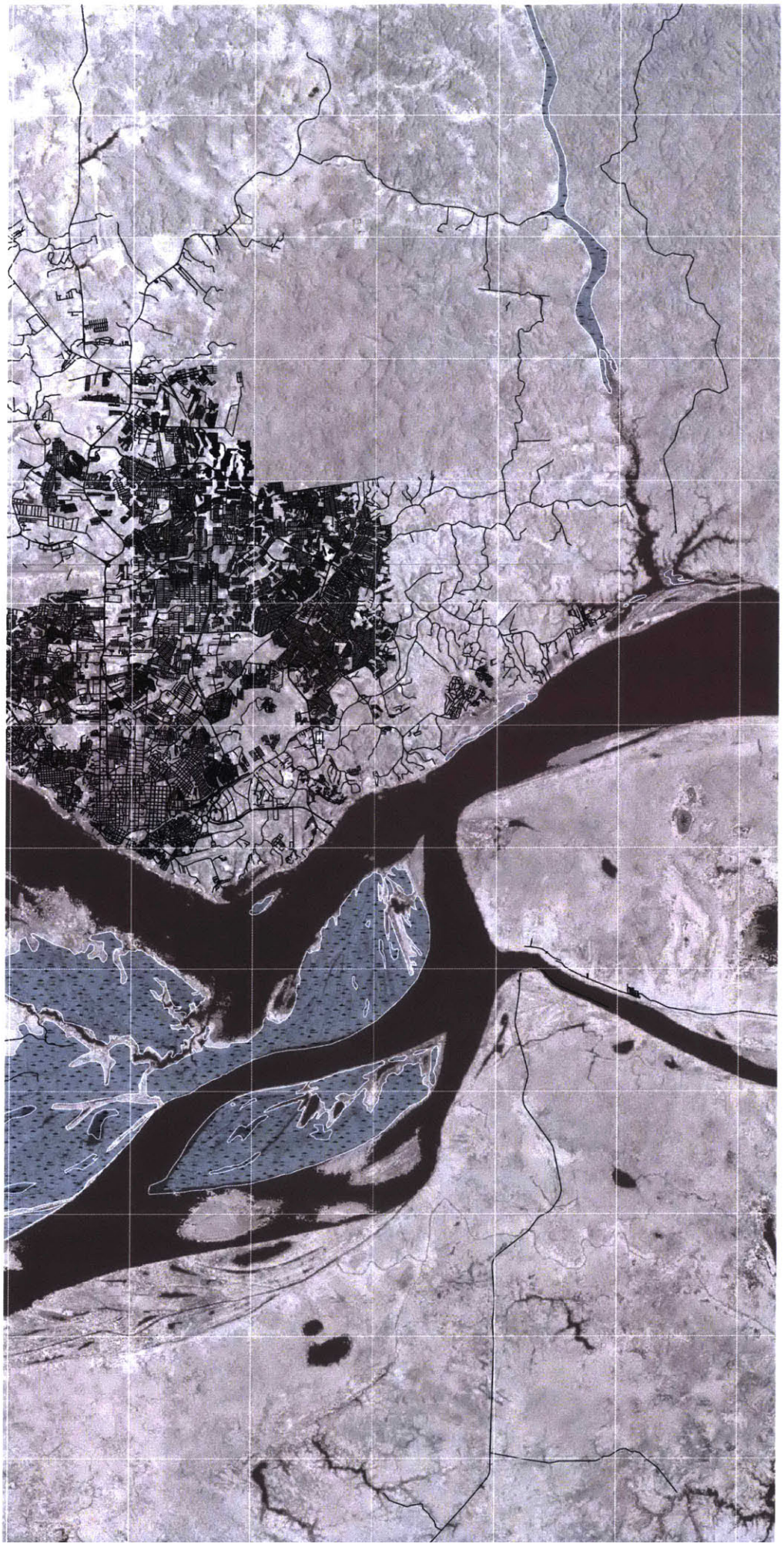
SOFT



Edge Diagram
Iranduba has been called the New Frontier, as radical expansion is projected to take place towards Manaus' Southern Periphery due to the construction of the Rio Negro bridge

28
View from Manaus Port toward the New Rio Negro Bridge
Larisa Ovalles


Terra Firme
Varzea- Flood Plain
5km



Ponte Negro Bridge, 2011

POPULATION

44,503

~157,333

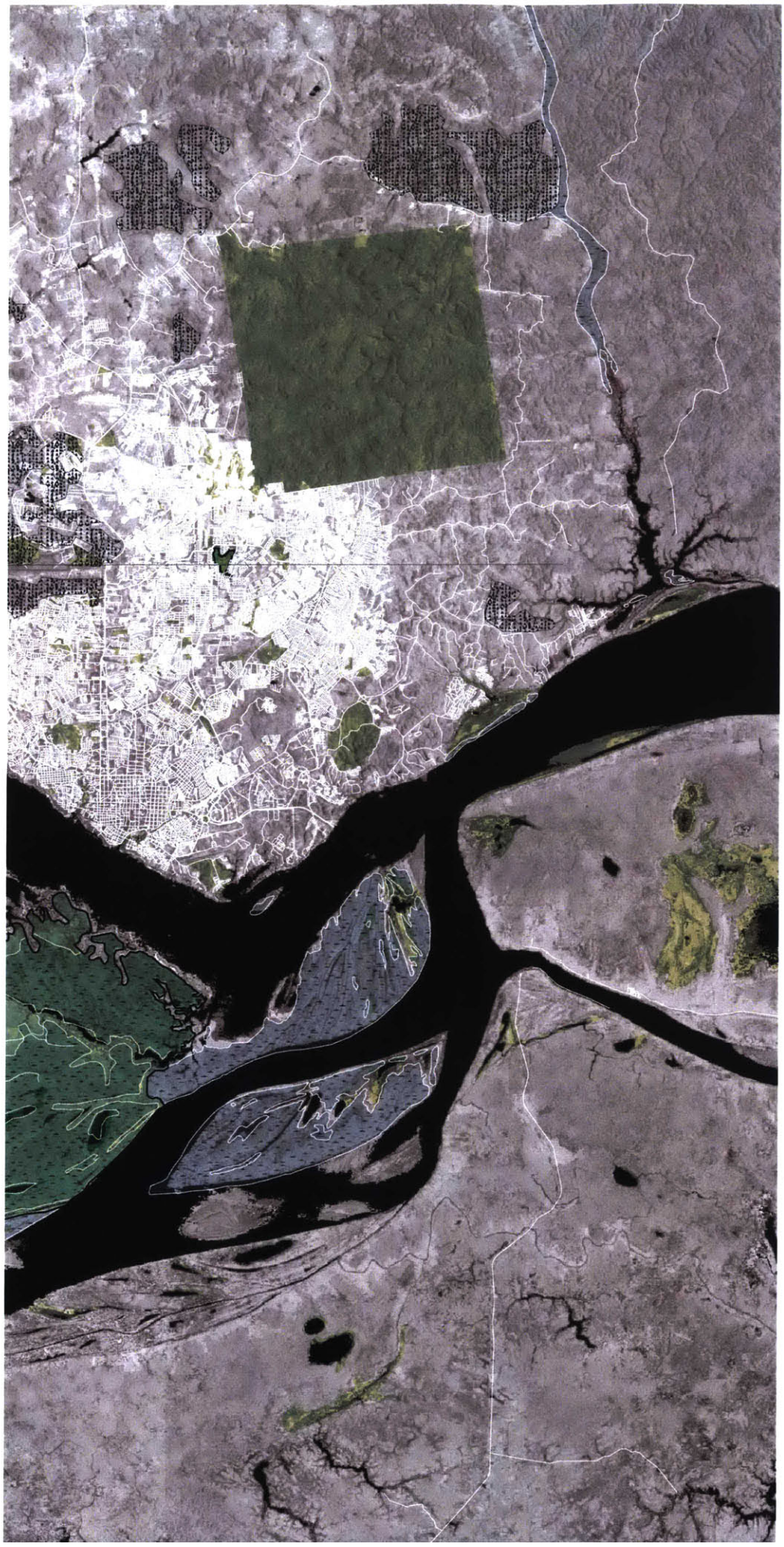
TRANSPORTATION

40min

5min

*"FVA Apresenta Diagnóstico Socioambiental de Iranduba Em Evento de Abertura Das Atividades No Município." 2015. Fundação Vitória Amazônica. June 30. http://www.fva.org.br/index.php/2015/06/30/fva-apresenta-diagnostico-socioambiental-de-iranduba-em-evento-de-abertura-das-atividades-no-municipio/.


5km



Protected Areas

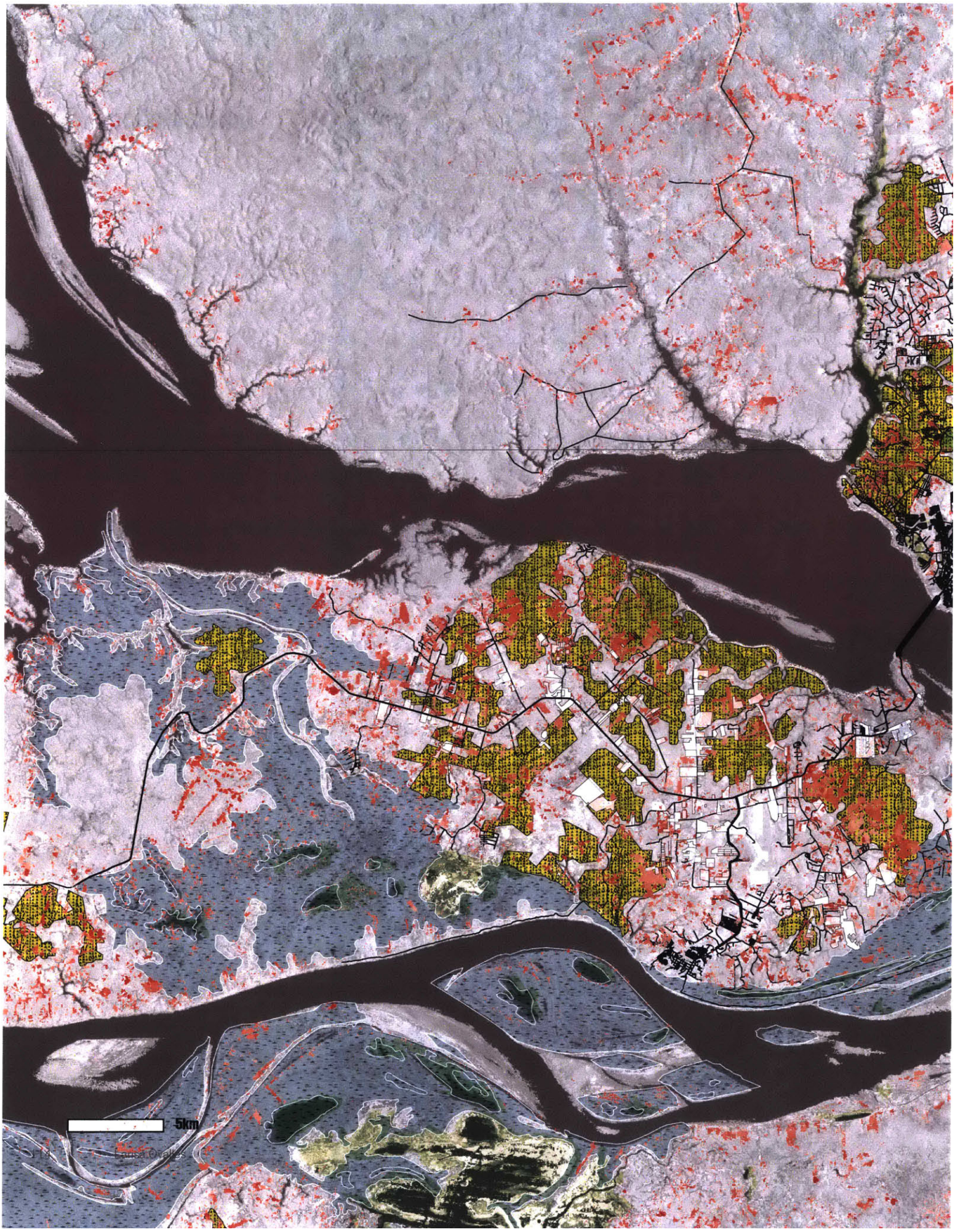
Area of Environmental Protection (APA)
National, 1995 - area: 4,617

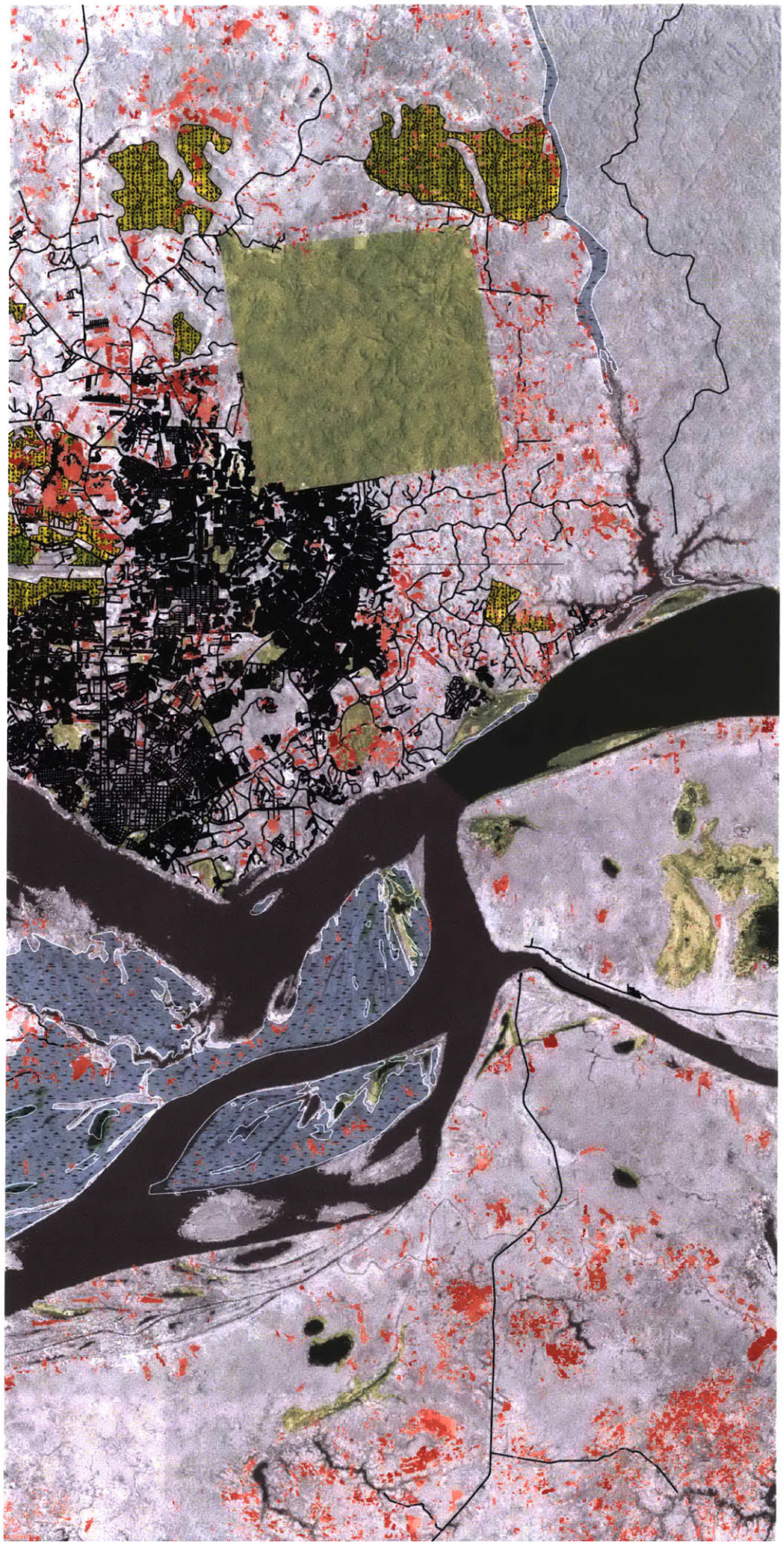

5km

Deforestation

The municipality of Iranduba lost about 49,000 hectares of primary forest land according to the latest data from the National Institute for Space Research (INPE).

Recent deforestation patterns since 2002, show that deforestation is occurring in a fragmented and uncontrolled random pattern.

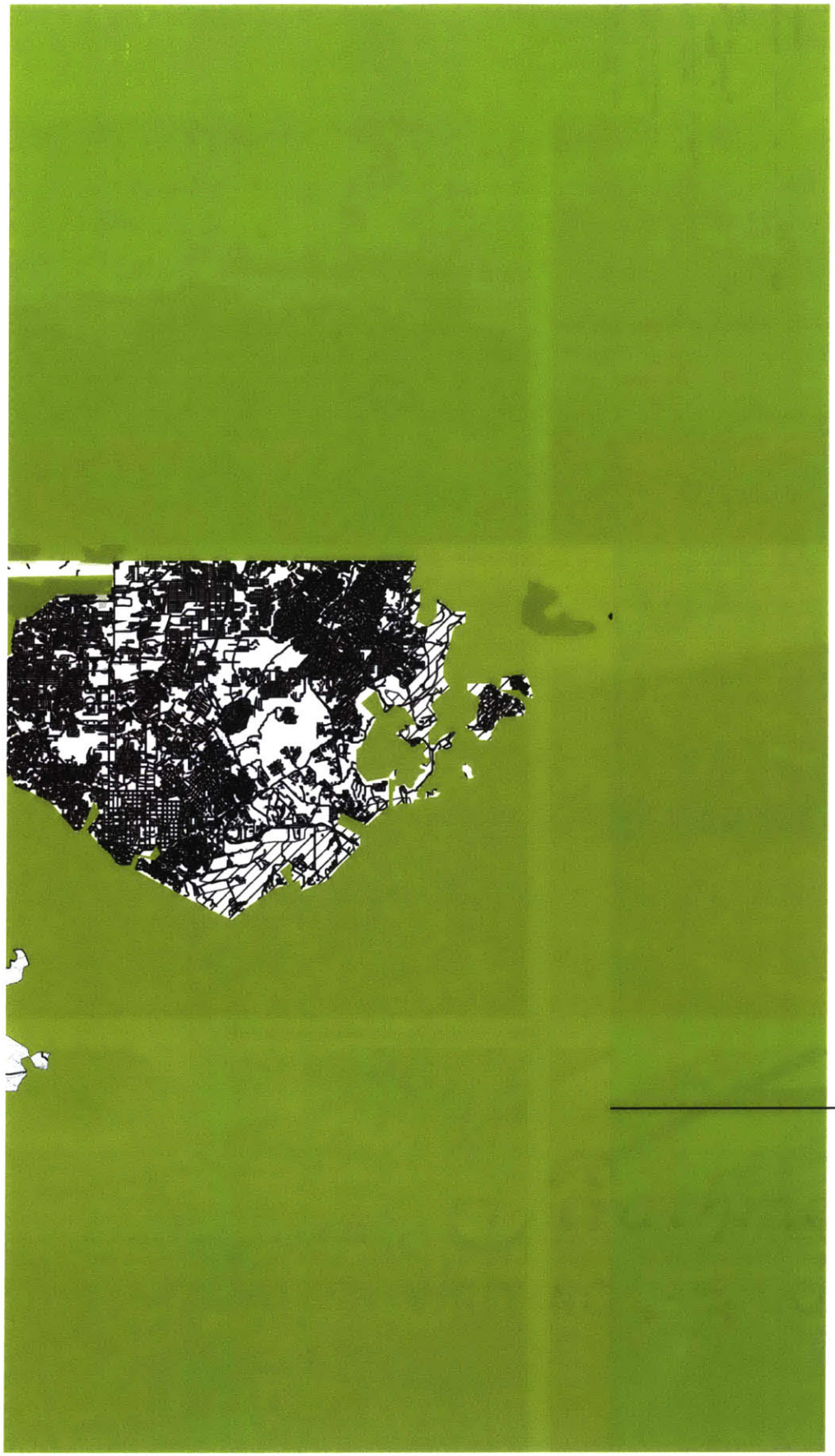

5km



FOREST FRAGMENTS

Remainign Forest Fragments

SEASONAL AGRICULTURE



Floresta Ombrófila Densa and Vegetação Secundária sem Palmeiras

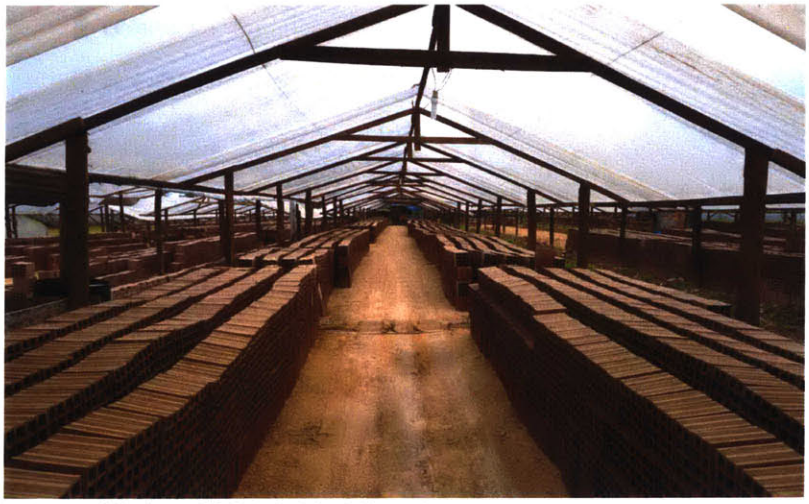
Culturas Cíclicas

Iranduba Port_ Rio Salimoes

Agriculture and Cattle

Multiple New Gas Stations

New Housing Development Advertisements



hosts one of the largest Brick industries in the region

New Plots through clearing

Clearing Land for New Housing Development

New Housing Development

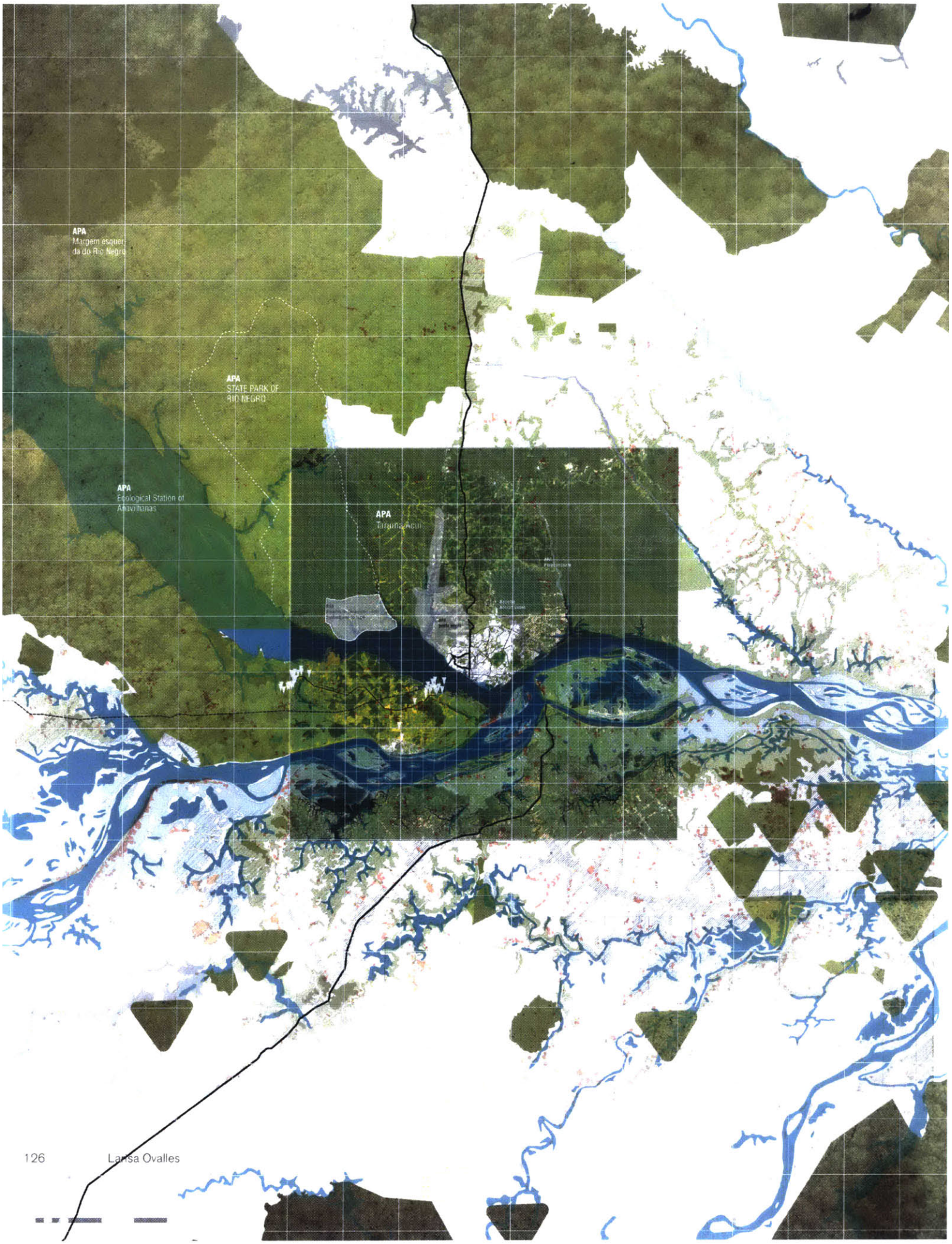
We already see some drastic changes to the landscape- with road expansions, gas stations, housing developments and ubiquitous forest clearing activity.

30
Iranduba, Igarapes - River Settlement
Larisa Ovalles

31
New housing development

32
Iranduba, Road expansion

33
Iranduba, Lot clearing for development


APA
Margem esquer
da do Rio Negro
APA
STATE PARK OF
RIO NEGRO
APA
Ecological Station of
Anavilhanas
APA
Tarumã-Açu

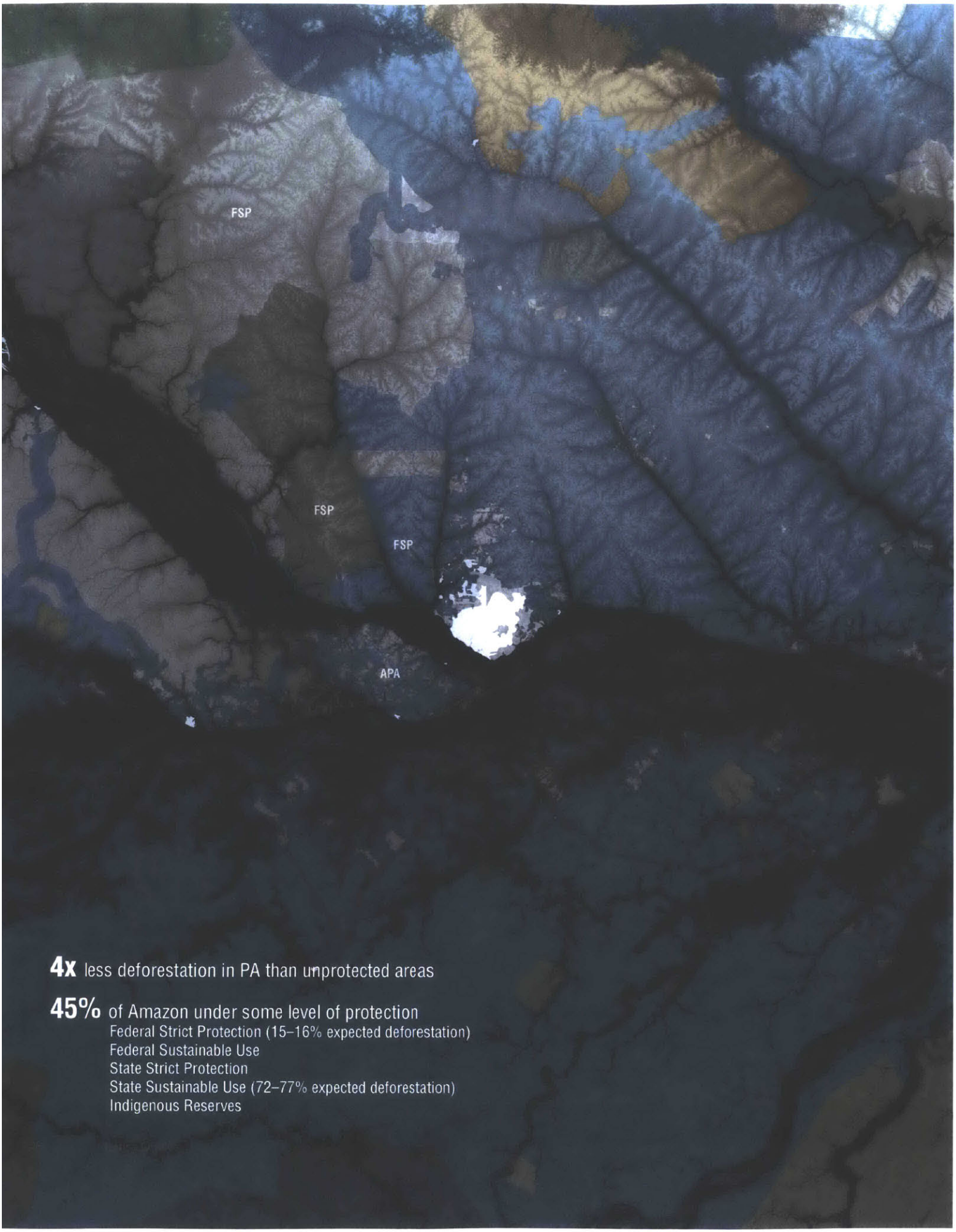
04

STAGING FRONTIER DYNAMICS

Urban Design Proposal

*"Imagine an entrepreneurial effort to create a property exchange focused on an interplay among properties... the exchange would rate not only properties themselves, but the benefits of changing use or swapping positions in their landscapes."**

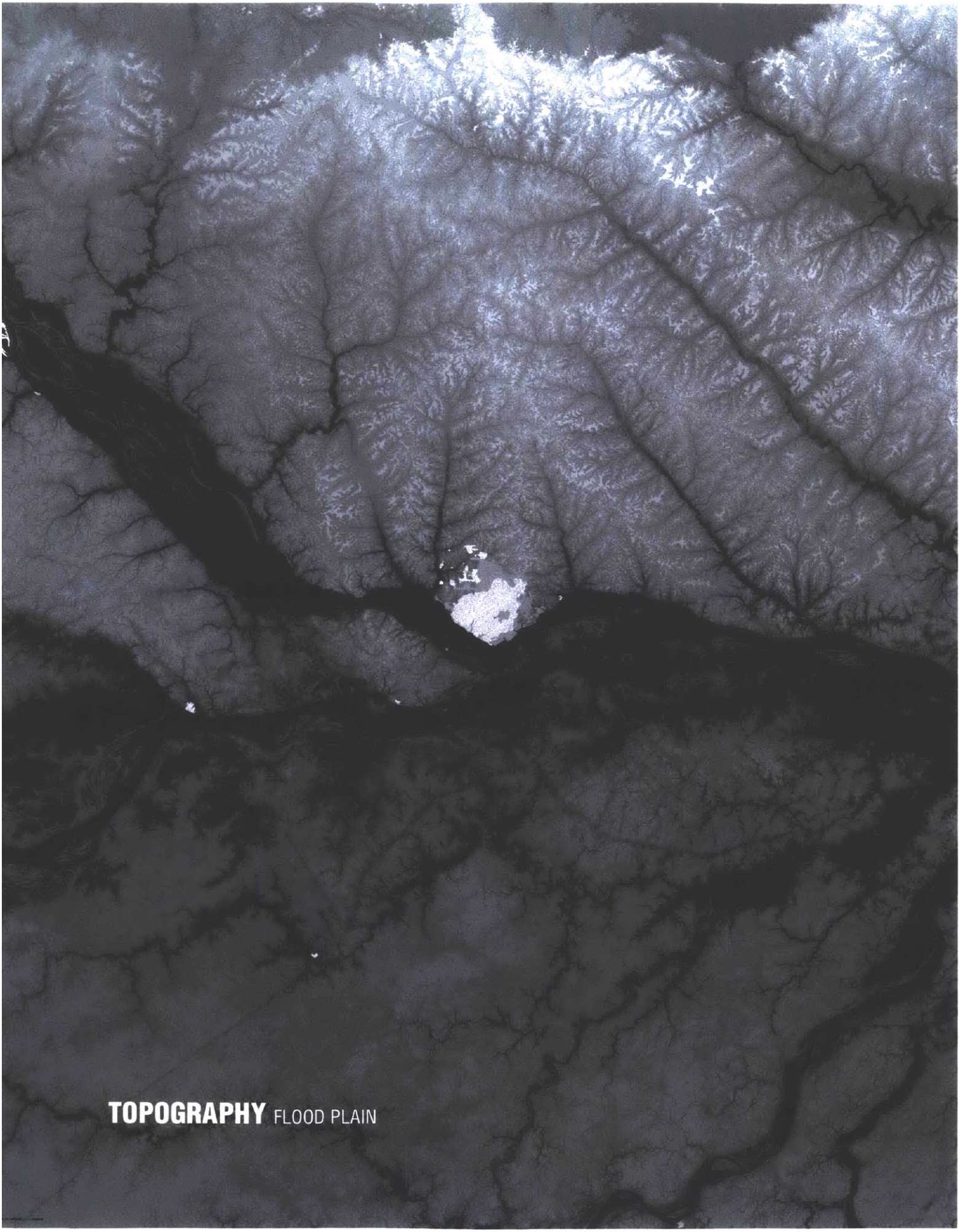
("Keller Easterling — Subtraction Protocol 2 Water" 2016)



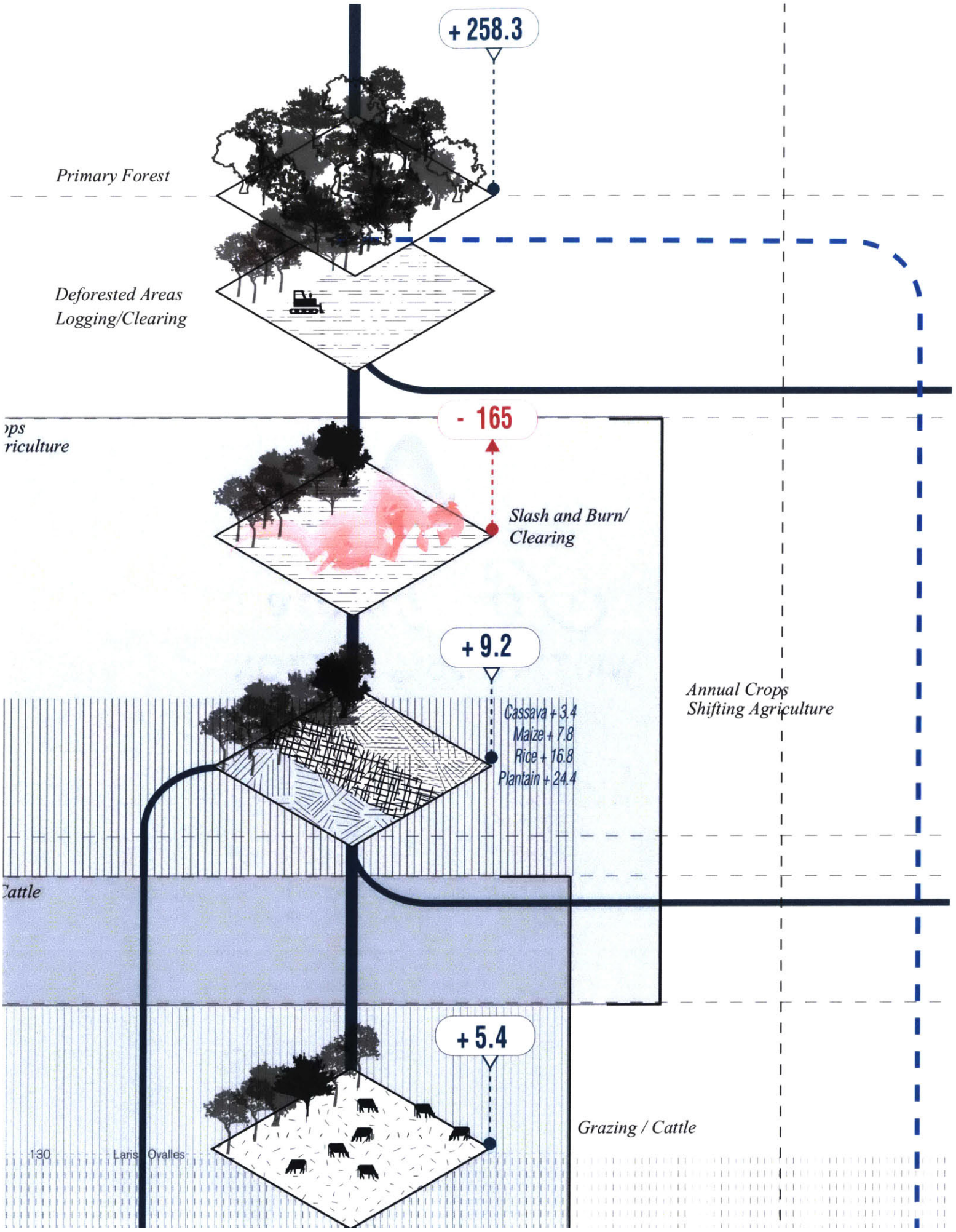
4x less deforestation in PA than unprotected areas

45% of Amazon under some level of protection

Federal Strict Protection (15–16% expected deforestation)
Federal Sustainable Use
State Strict Protection
State Sustainable Use (72–77% expected deforestation)
Indigenous Reserves



TOPOGRAPHY FLOOD PLAIN


+ 258.3
Primary Forest
Deforested Areas
Logging/Clearing
- 165
Slash and Burn/
Clearing
+ 9.2
Cassava + 3.4
Maize + 7.8
Rice + 16.8
Plantain + 24.4
Annual Crops
Shifting Agriculture
+ 5.4
Grazing / Cattle

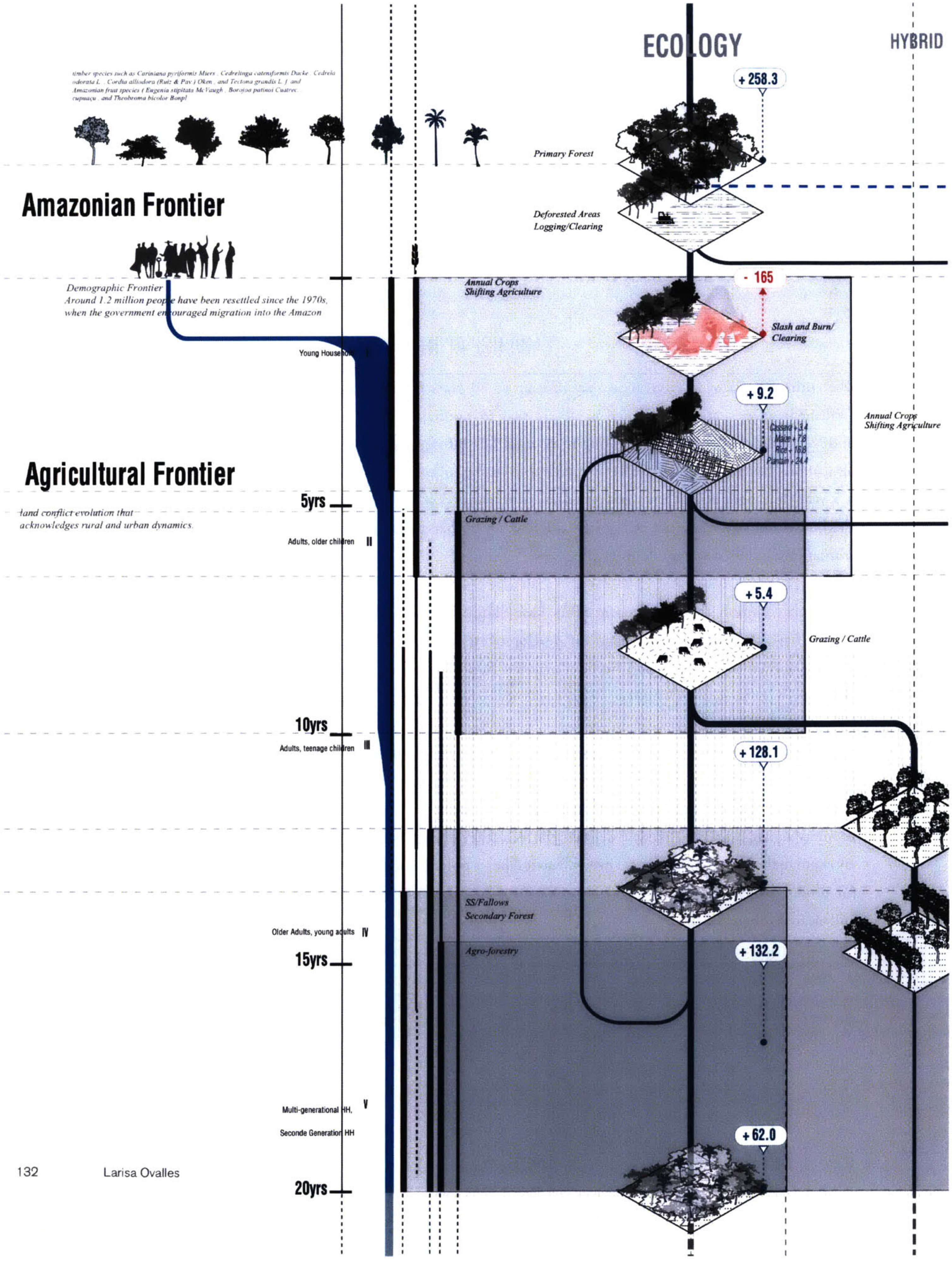
LAND USE AT THE FRONTIER

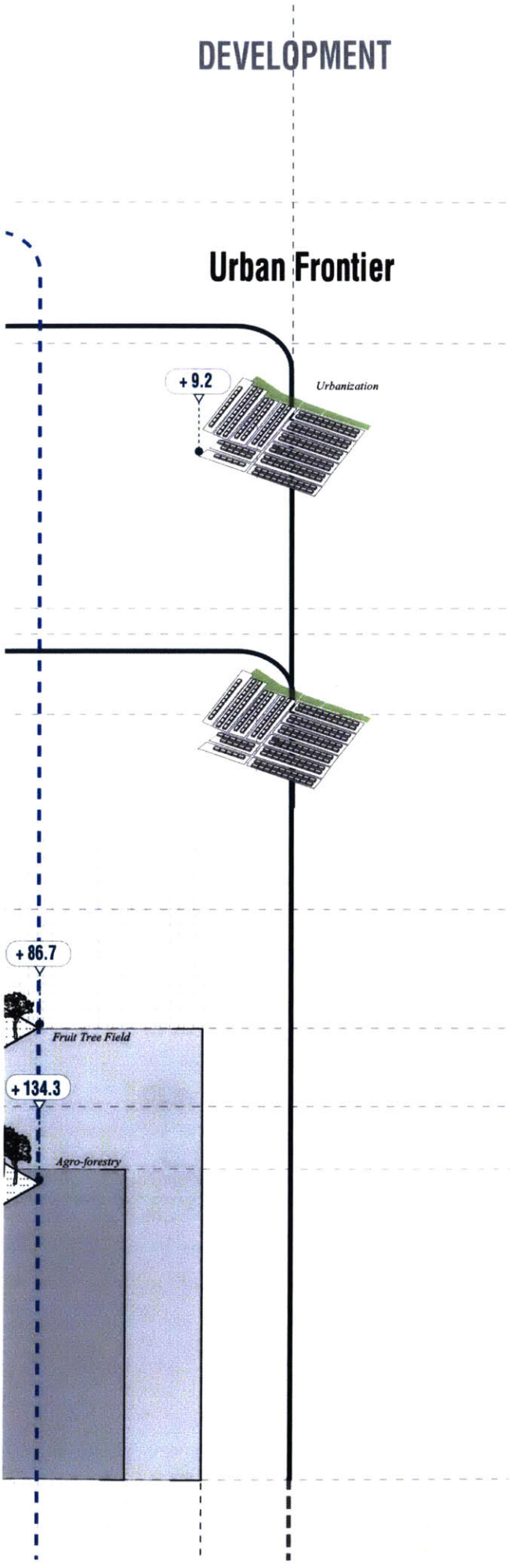
The entire process of farm creation may take up to 10 years in Amazonian settlement areas. Land use change is closely tied to household dynamics and have followed a process of clearing to be used for shifting and swidden agriculture. After nutrients have been depleted from the soil, usually within a 5 year time period, it is then converted to cattle pastures. Depending on the household size, these are either left to fallow or are harvested for fruit plantations and used for agroforestry processes. *

*Walker, Robert, and Alfredo Kingo Oyama Homma. 1996. "Land Use and Land Cover Dynamics in the Brazilian Amazon: An Overview." Ecological Economics, Land Use Dynamics in the Brazilian Amazon, 18 (1): 67–80. doi:10.1016/0921-8009(96)00033-X.

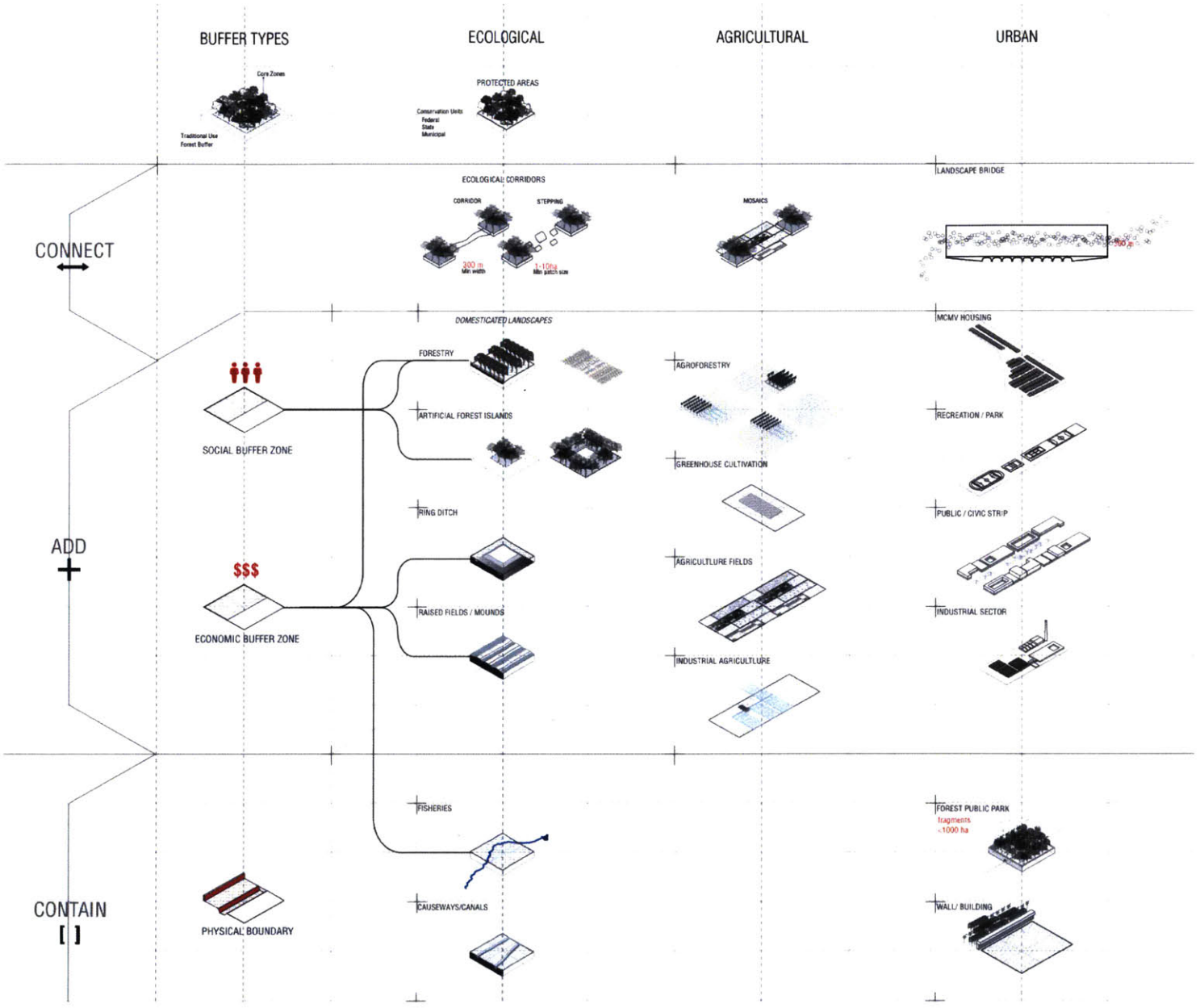
However, common trends in recent years have skipped these cycles and instead have cleared all forested land for development, further accelerating the transformation of the region from an agrarian frontier to an urbanized frontier.

Unfortunately, forest is not often recognized as productive use. Consequently, large landowners frequently convert forest to pasture in an attempt to reduce their vulnerability to land invasion by squatters and strengthen their property rights. Squatters likewise deforest the areas they occupy in order to lay claim to the land. This presents a problem as it ignores potential alternatives for productive landscapes to negotiate between forested or agricultural use and cleared urbanized land.


ECOLOGY
HYBRID
timber species such as Cariniana pyriformis Miers , Cedrelinga cateniformis Ducke , Cedrela odorata L. , Cordia alliodora (Ruiz & Pav.) Oken , and Tectona grandis L. f. and Amazonian fruit species (Eugenia stipitata McVaugh , Borojoa patinoi Cuatrec. , cupuaçu , and Theobroma bicolor Bonpl
+ 258.3
Primary Forest
Amazonian Frontier
Deforested Areas
Logging/Clearing
Demographic Frontier
Around 1.2 million people have been resettled since the 1970s, when the government encouraged migration into the Amazon
Annual Crops
Shifting Agriculture
- 165
Slash and Burn/
Clearing
Young Household I
+ 9.2
Annual Crops
Shifting Agriculture
Agricultural Frontier
5yrs
land conflict evolution that acknowledges rural and urban dynamics.
Grazing / Cattle
Adults, older children II
+ 5.4
Grazing / Cattle
10yrs
Adults, teenage children III
+ 128.1
SS/Fallows
Secondary Forest
Older Adults, young adults IV
Agro-forestry
15yrs
+ 132.2
Multi-generational HH, V
Seconde Generation HH
+ 62.0
20yrs



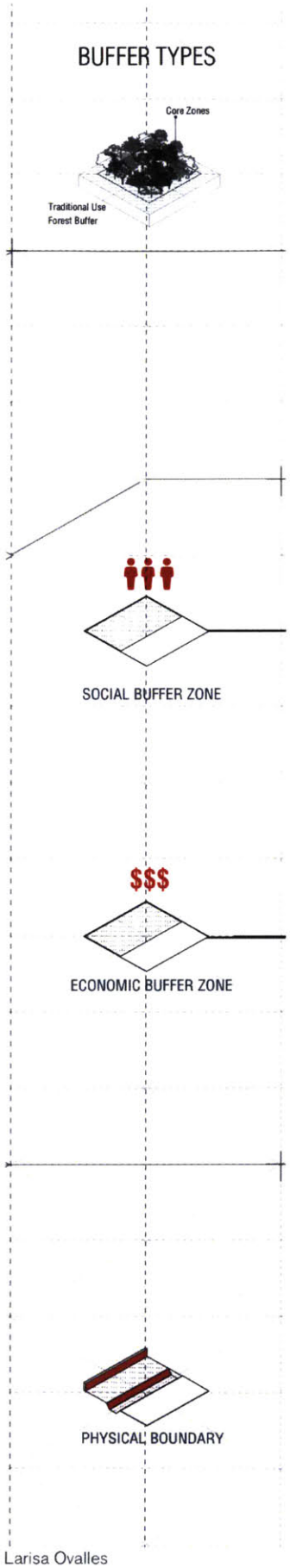
FINAL DIAGRAM LAND USE TURNOVER DYNAMICS
Historic process of domesticated landscpes in the Brazillian Amazon, and current shifts to urbanized lands and potential productive alternatives


BUFFER TYPES
ECOLOGICAL
AGRICULTURAL
URBAN
Core Zones
Traditional Use
Forest Buffer
PROTECTED AREAS
Conservation Units
Federal
State
Municipal
ECOLOGICAL CORRIDORS
CORRIDOR
STEPPING
300 m
Min width
1-10ha
Min patch size
MOSAICS
LANDSCAPE BRIDGE
CONNECT
DOMESTICATED LANDSCAPES
FORESTRY
ARTIFICIAL FOREST ISLANDS
RING DITCH
RAISED FIELDS / MOUNDS
FISHERIES
CAUSEWAYS/CANALS
SOCIAL BUFFER ZONE
$$$
ECONOMIC BUFFER ZONE
ADD
+
AGROFORESTRY
GREENHOUSE CULTIVATION
AGRICULTLURE FIELDS
INDUSTRIAL AGRICULTLURE
MCMV HOUSING
RECREATION / PARK
PUBLIC / CIVIC STRIP
INDUSTRIAL SECTOR
FOREST PUBLIC PARK
fragments
<1000 ha
WALL/ BUILDING
CONTAIN
[ ]
PHYSICAL BOUNDARY

MATRIX AND DESIGN TOOLS

In order to establish a new hybrid periphery growth model at the frontier which incorporates natural and built space, the project explores ecological, agrarian, and urban tools and proposes strategies of addition and subtraction, sharing and exchange in order to: connect and link disarticulated forest fragments; contain and guide development; and provide alternative hybrid and collective models for new Productive Landscapes.

In doing so, the project examines the dynamics and interplay between two entities, nature and development, in order to create strategies for a collective zone that capitalizes on the dynamic quality of the Amazonian frontier.



BUFFER TYPES

Buffer zoning is not a new concept, but until 10-20 years ago the buffer principle was only applied in order to protect conservation areas from human disturbances. Currently, buffer zones are also utilized as a tool to address the socioeconomic needs in addition to minimizing human impact on conservation areas.*

The Physical Buffer:

When necessary, physical boundaries and barriers are used to protect conservation areas. The best physical barriers are natural features such as rivers, topography. Artificial barriers include walls, canals, other infrastructure. They serve to prevent animals from either leaving the are, or people from entering the are. In the proposal, physical barriers are used to contain and guide development to certain areas.

The Economic Buffer Zone

This buffer zone has a production function, in this case economic development is the priority.

The Social Buffer Zone

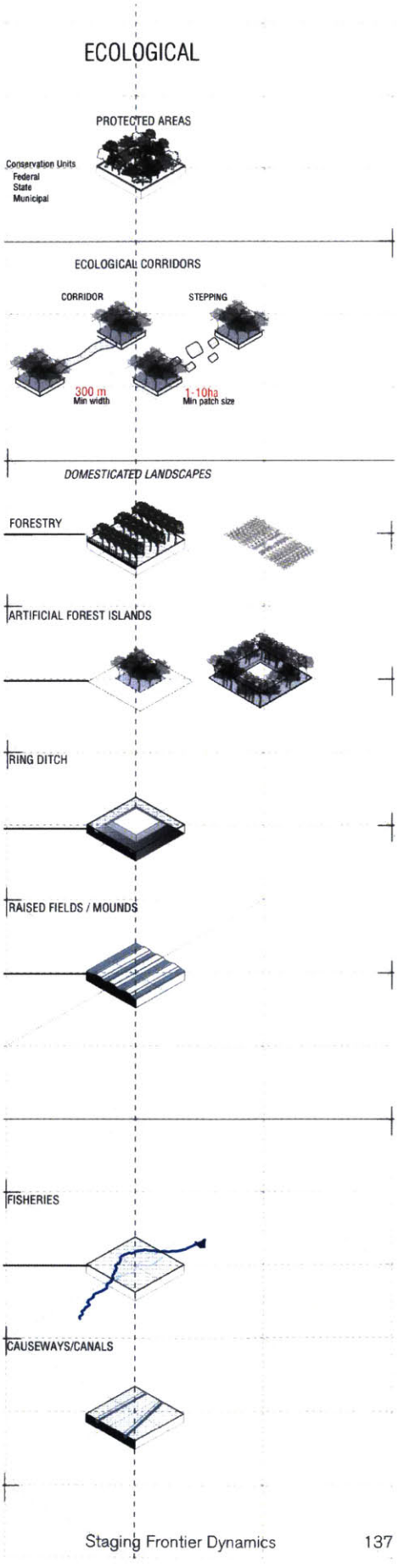
Social buffer zone approach uses the cultural and social uses of the population to form a barrier, control and monitoring system between a conservation area, and its surroundings. This buffer will be implemented as part of the contain strategy to created a mediating buffer framework which houses collective and shared social services.

* Ebregt, Arthur. 2000. Buffer Zones and Their Management: Policy and Best Practices for Terrestrial Ecosystems in Developing Countries. National Reference Centre for Nature Management.

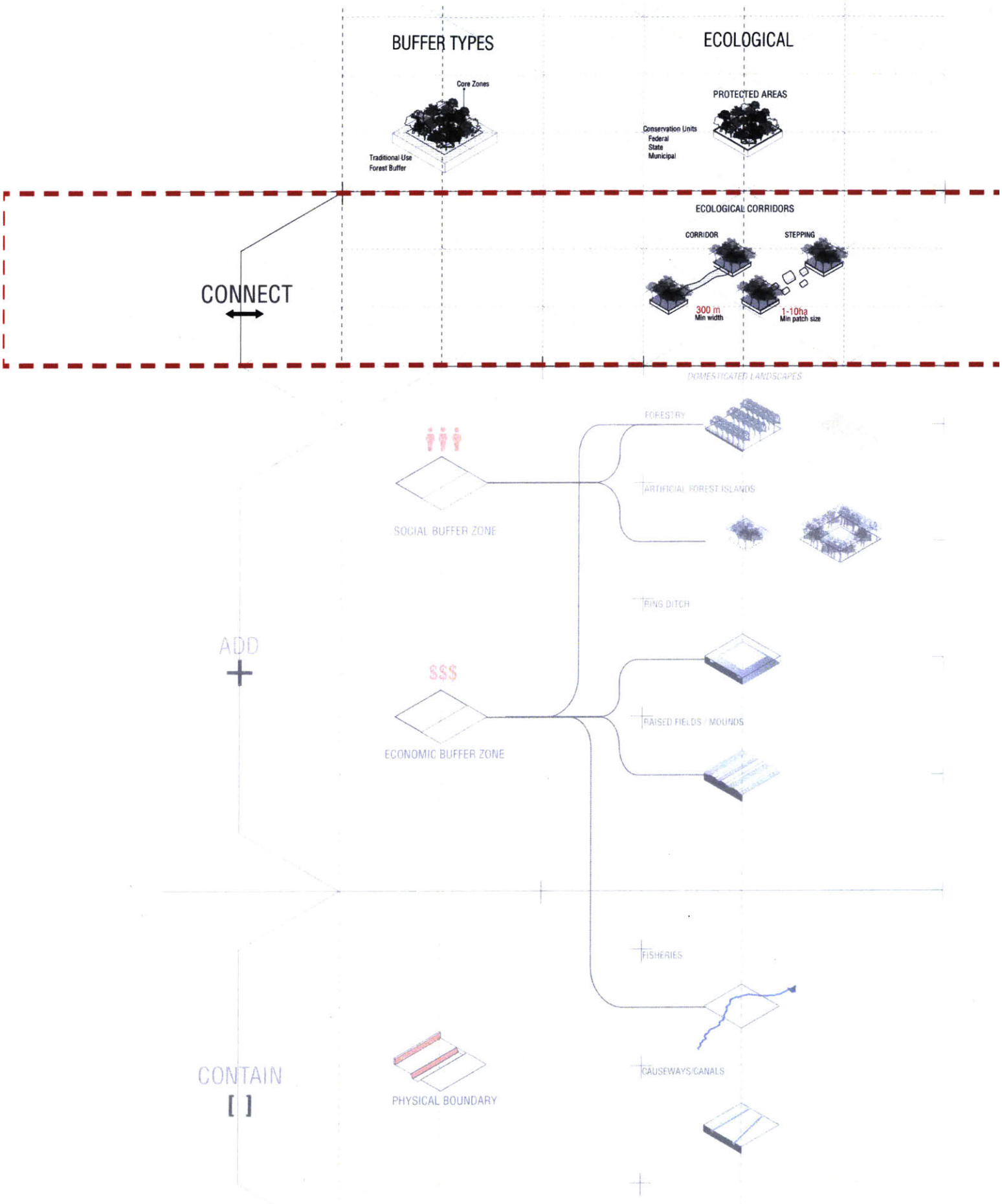
THE HISTORICAL ECOLOGIST PERSPECTIVE

Following historical ecologist perspective, who argue that disturbance caused by human activities is a key factor in shaping biodiversity and environmental health, the proposal takes tools and practices of domesticated landscapes that transform the environment into productive landscapes.

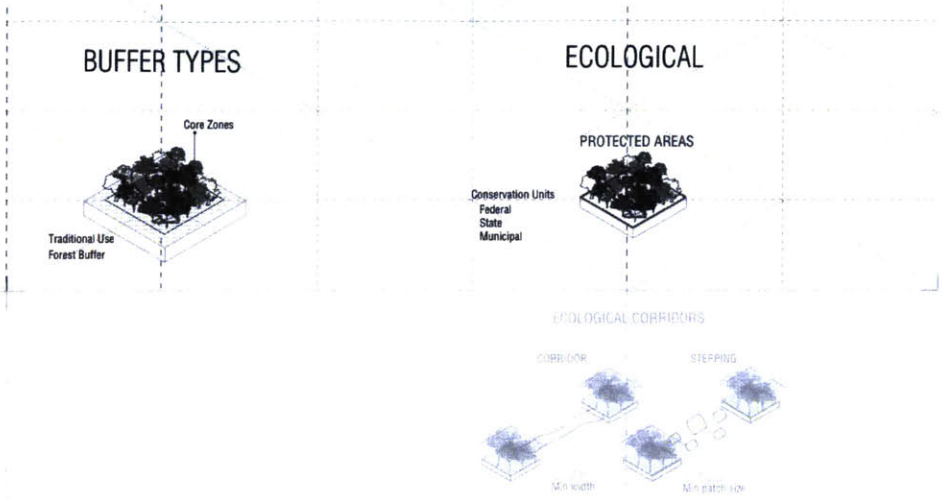
From burning, farming, mounds, raised fields, forest management, forest islands, agroforestry. Failure of fencing off and excluding people, the need for strategies that embrace the coexistence of nature and humans. *



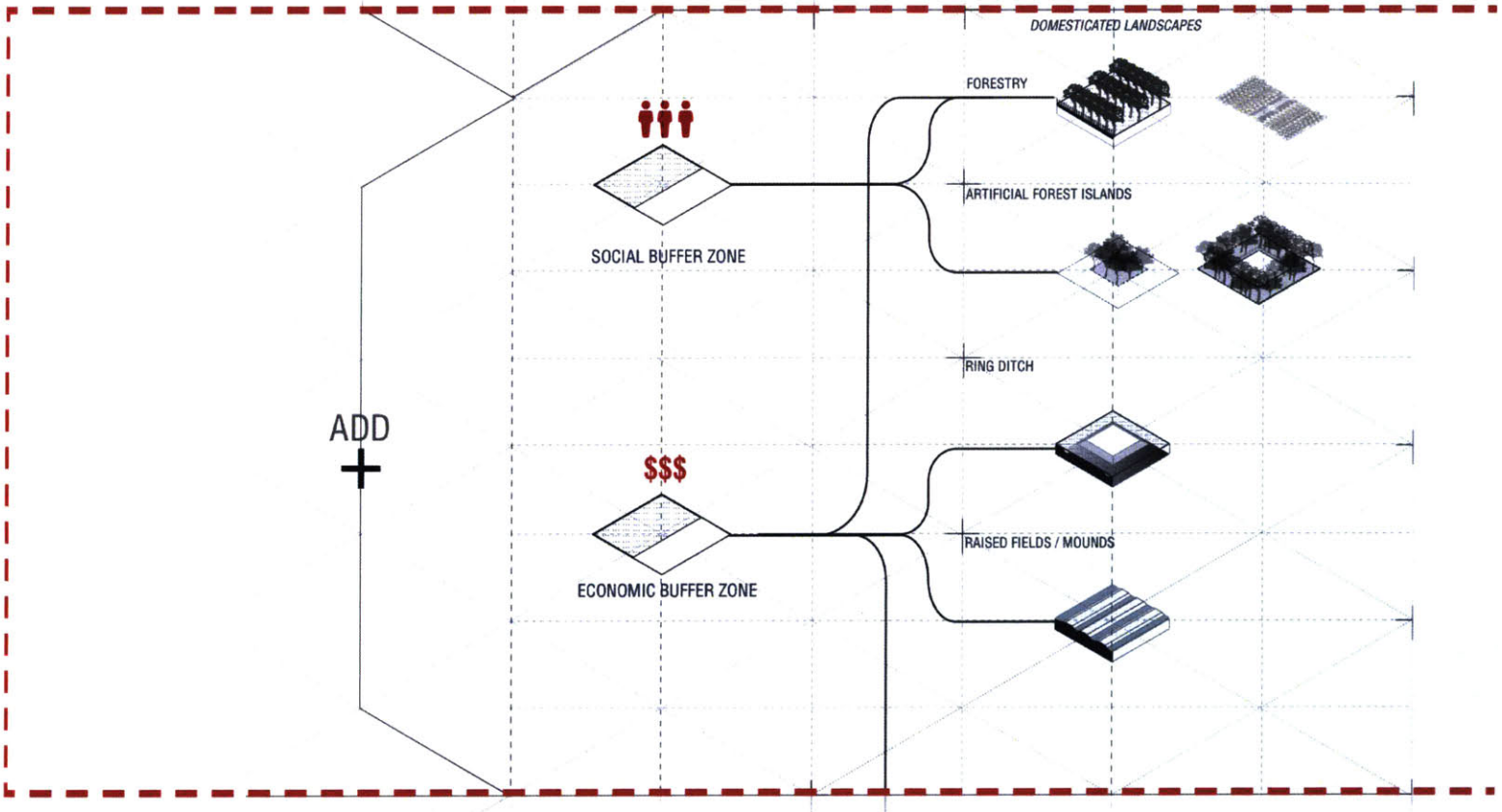
* Erickson, Clark L. 2008. "Amazonia: The Historical Ecology of a Domesticated Landscape." In The Handbook of South American Archaeology, edited by Helaine Silverman and William H. Isbell, 157–83. Springer New York. http://link.springer.com/

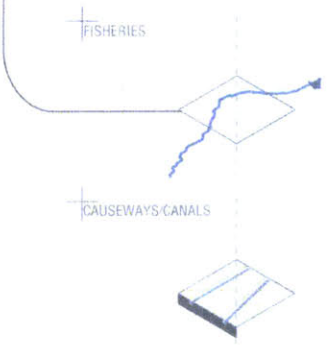

BUFFER TYPES
Core Zones
Traditional Use
Forest Buffer
ECOLOGICAL
PROTECTED AREAS
Conservation Units
Federal
State
Municipal
ECOLOGICAL CORRIDORS
CORRIDOR
STEPPING
300 m
Min width
1-10ha
Min patch size
CONNECT
DOMESTICATED LANDSCAPES
FORESTRY
ARTIFICIAL FOREST ISLANDS
SOCIAL BUFFER ZONE
RING DITCH
ADD
$$$
RAISED FIELDS / MOUNDS
ECONOMIC BUFFER ZONE
FISHERIES
CAUSEWAYS/CANALS
CONTAIN
[ ]
PHYSICAL BOUNDARY


AGRICULTURAL
URBAN
LANDSCAPE BRIDGE
MOSAICS
MDMV HOUSING
AGROFORESTRY
RECREATION / PARK
GREENHOUSE CULTIVATION
PUBLIC / CIVIC STRIP
AGRICULTURE FIELDS
INDUSTRIAL SECTOR
INDUSTRIAL AGRICULTURE
FOREST PUBLIC PARK
WALL/ BUILDING
ROAD

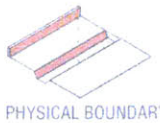


CONNECT





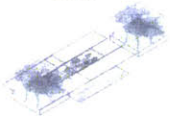
CONTAIN
[ ]



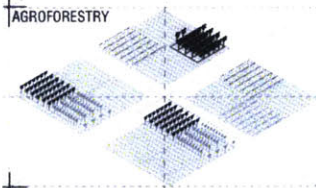
AGRICULTURAL

URBAN

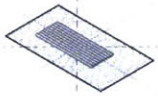
LANDSCAPE BRIDGE



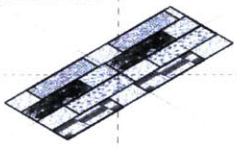
AGROFORESTRY



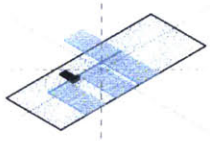
GREENHOUSE CULTIVATION



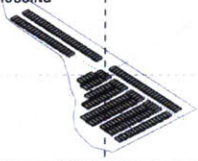
AGRICULTLURE FIELDS



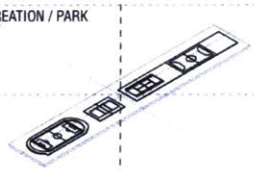
INDUSTRIAL AGRICULTLURE



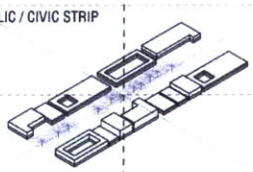
MCMV HOUSING



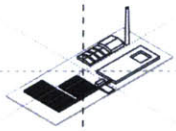
RECREATION / PARK



PUBLIC / CIVIC STRIP

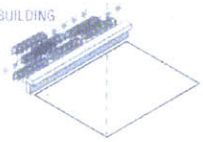


INDUSTRIAL SECTOR

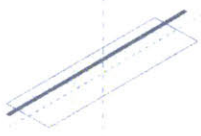


FOREST PUBLIC PARK

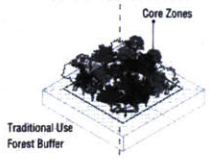
WALL BUILDING



ROAD

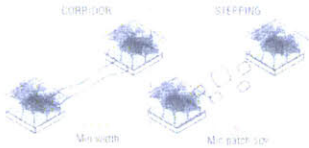


BUFFER TYPES



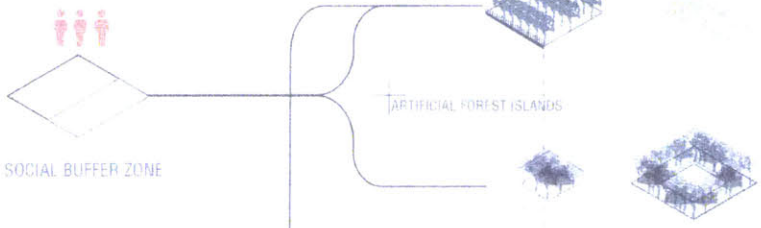
ECOLOGICAL

ECOLOGICAL CORRIDORS



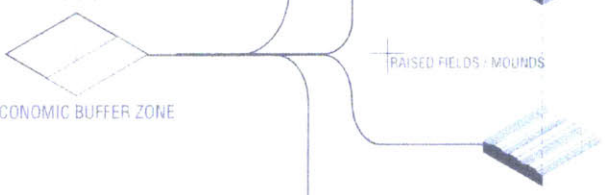
CONNECT

DOMESTICATED LANDSCAPES

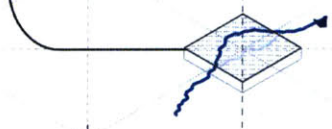


RING DITCH

ADD

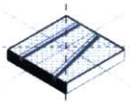


FISHERIES



CONTAIN
[ ]

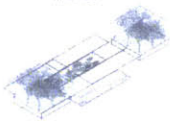
CAUSEWAYS/CANALS



AGRICULTURAL

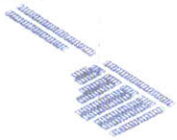
URBAN

MOSAICS



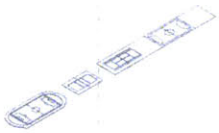
LANDSCAPE BRIDGE

MCMV HOUSING



AGROFORESTRY

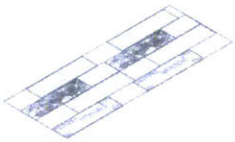
RECREATION - PARK



GREENHOUSE CULTIVATION

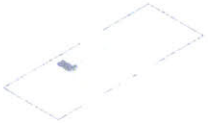
PUBLIC / CIVIC STRIP

AGRICULTURE FIELDS



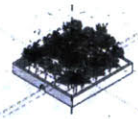
INDUSTRIAL SECTOR

INDUSTRIAL AGRICULTURE

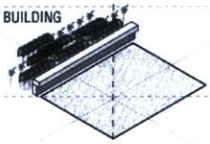


FOREST PUBLIC PARK

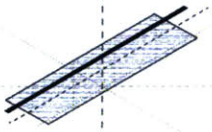
fragments
<1000 ha

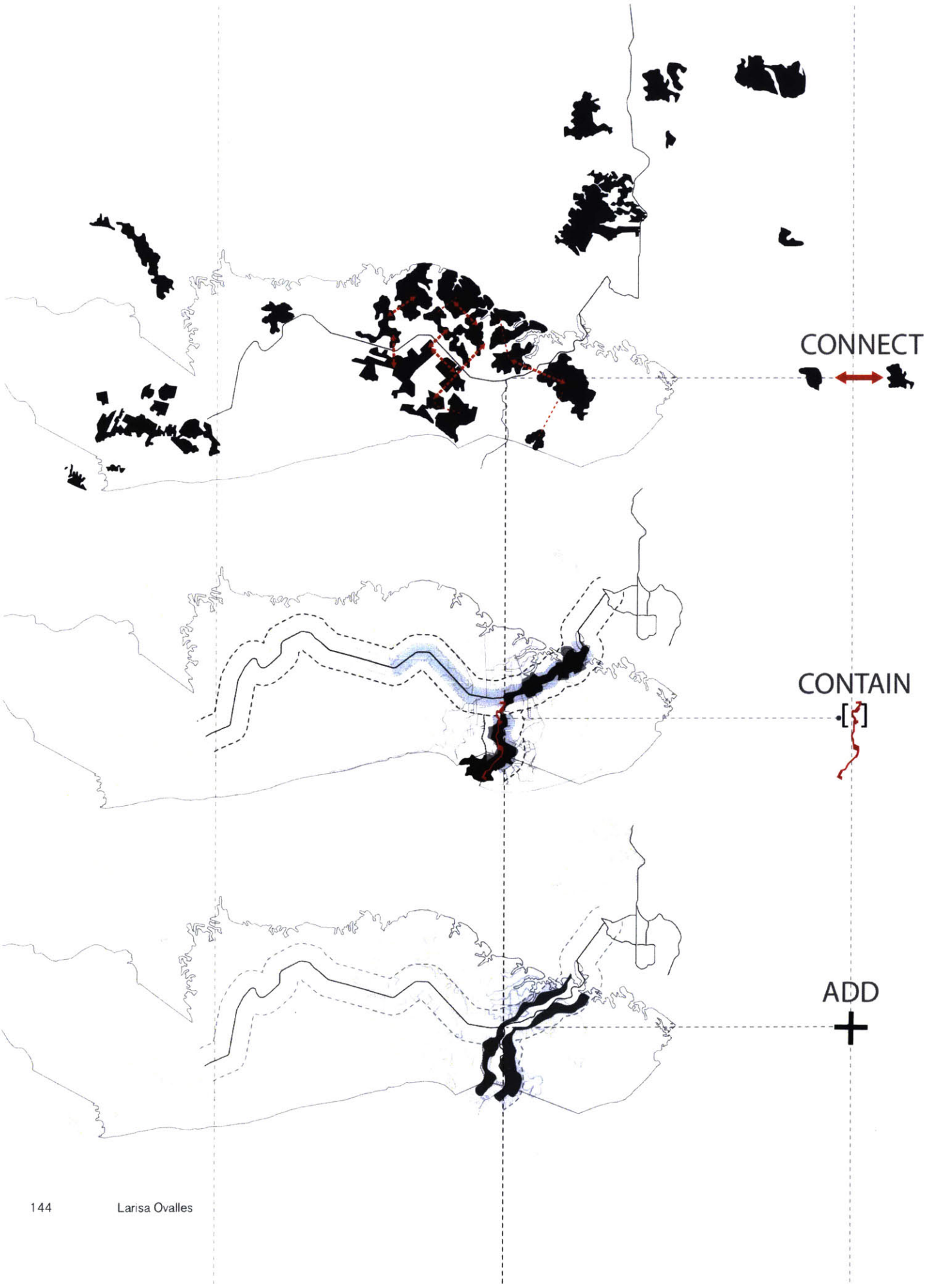


WALL/ BUILDING



ROAD




CONNECT
CONTAIN
ADD

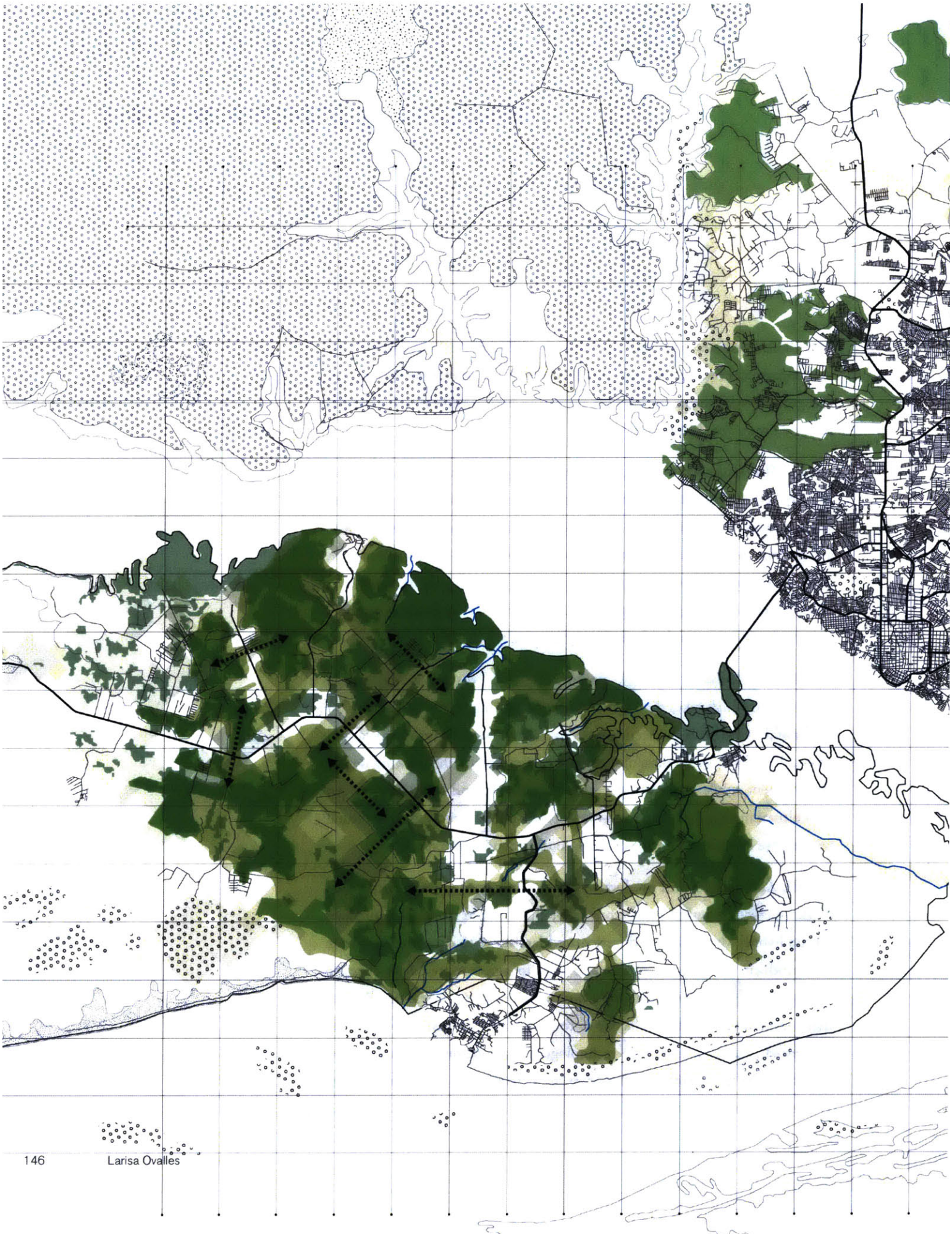
STRATEGIES FOR A NEW FRONTIER DEVELOPMENT MODEL

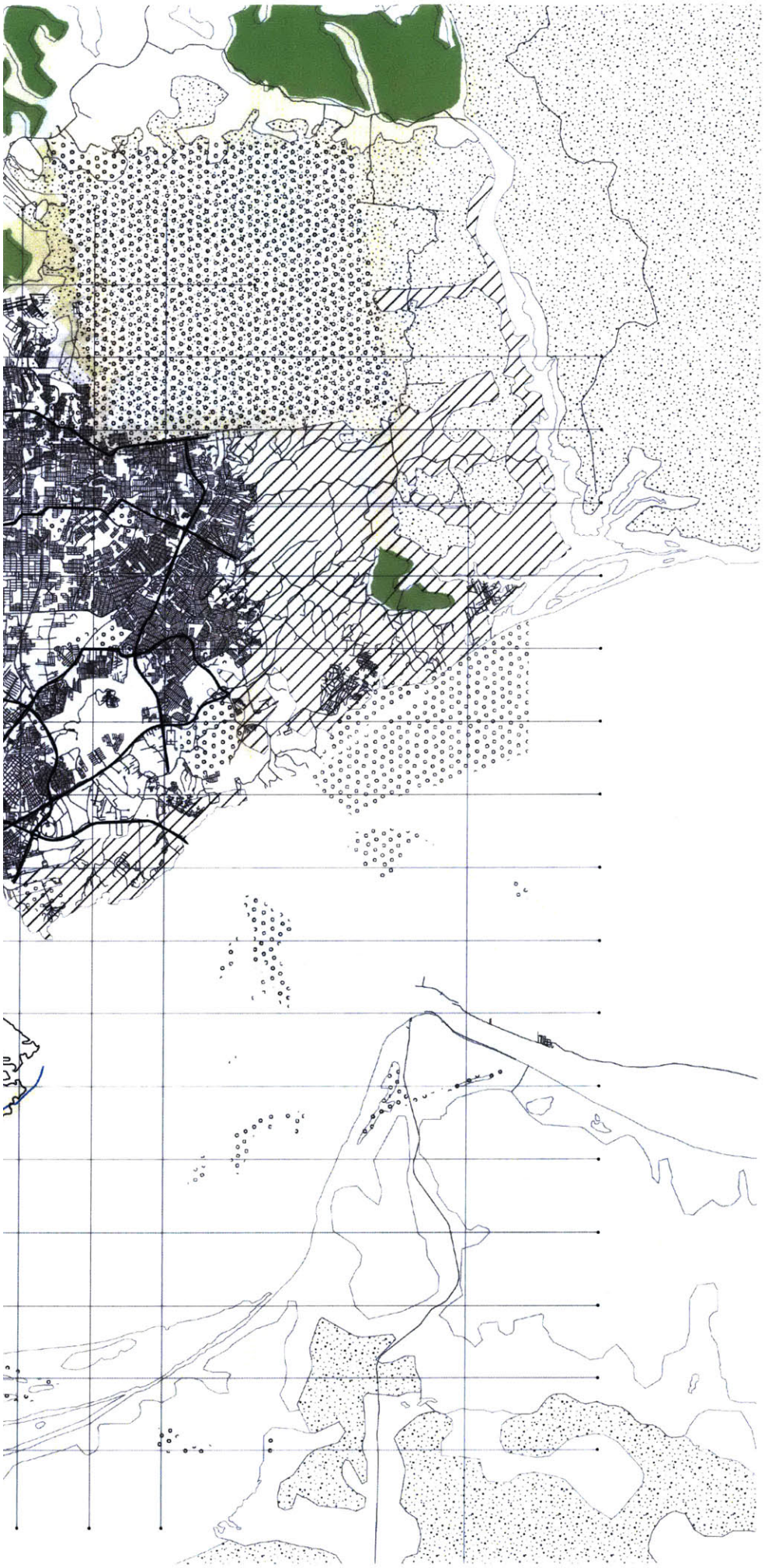
The thesis proposes strategies of addition and subtraction, sharing and ~~exchange in order to: connect and link disarticulated forest fragments; contain~~ and guide development; and provide alternative hybrid and collective models for new Productive Landscapes.

II. The Connect proposal gives remaining natural forest fragments priority in the effort to link them through two main strategies: a. An exchange/ swap strategy which aims is to concentrate deforestation and development along main roads, which will then allow for secondary growth succession in order to reconnect forest fragments. B. a Interplay strategy which targets new development in the region and proposes a interdependency model which will tie new development and reforestation processes.

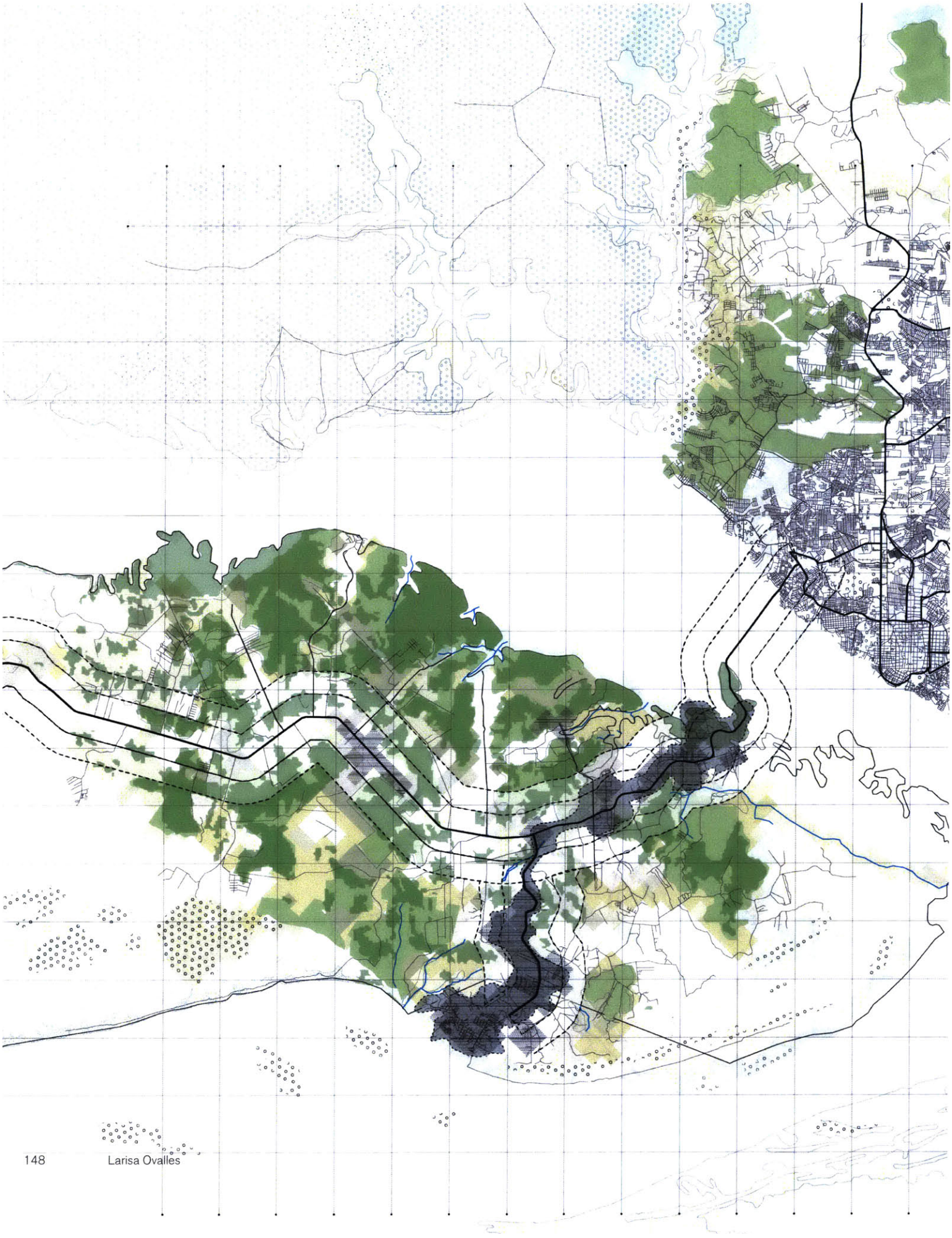
II. The Contain strategy, proposes The 'Mediator' is the design intervention which takes the form of a new organizing structure within 1km buffer of the road. This connecting open space framework serves as a social and physical buffer to guide development and accommodate the growing denser development, while also hosting a series of collective and social services. An agricultural market, recreation and open spaces, pubilc buildings, agricultural cooperative centers and an agricultural housing cooperative model.

III. Add: The Hybrid productive zone, mainly located on the other side of the mediating buffer framework from the 'contain' strategy, capitalizes on the hybrid, dynamic and disarticulated landscape to drive the economic and productive zone, and proposes a shift to agroforestry as an effective strategy linking environmental opportunities with economic realities. Within this negotiation area, the objective is to encourage the best use of already deforested areas, considering technological innovation and alternative hybrid production systems, such as pasture management, agroforestry, crop-livestock-forest integration





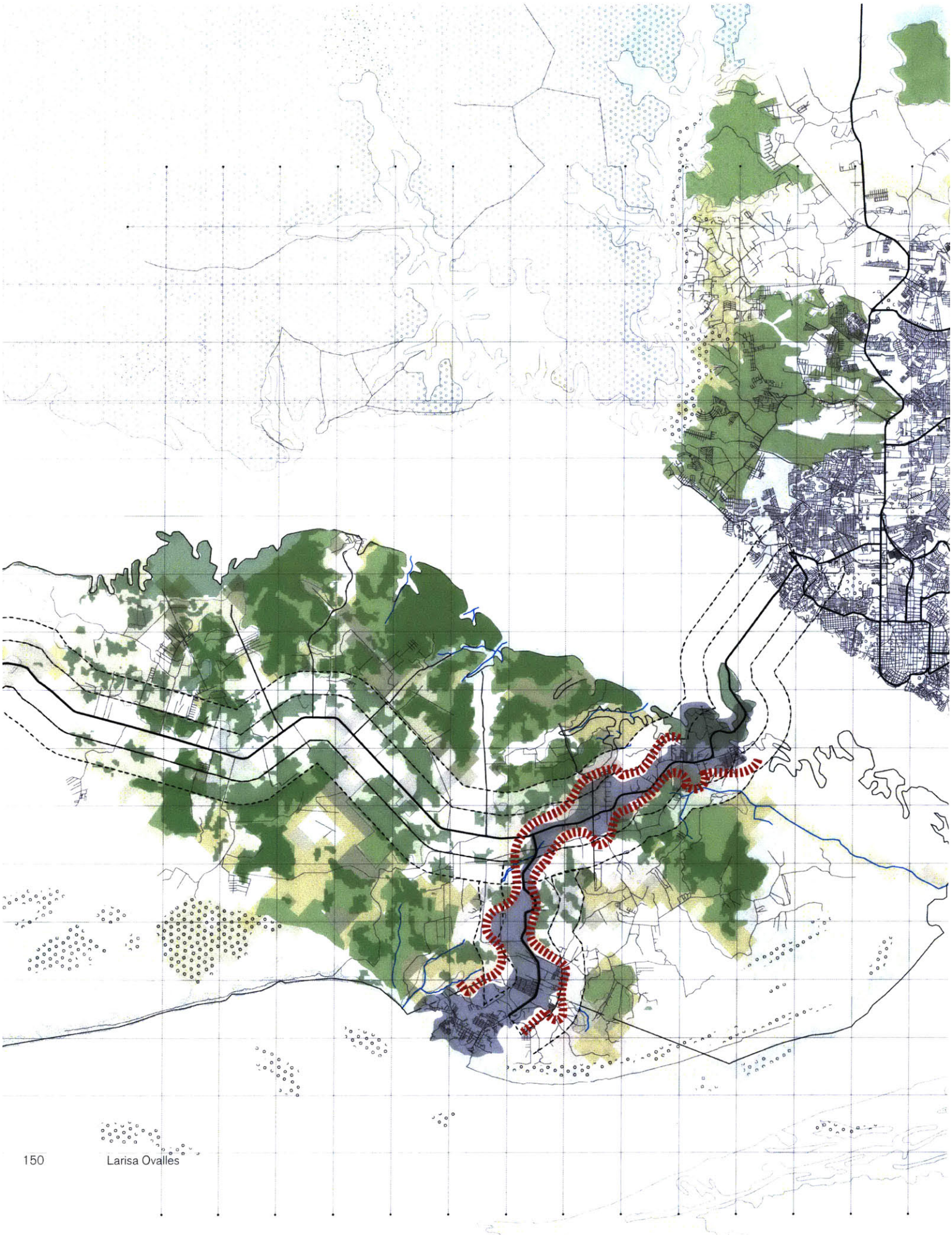
CONNECT

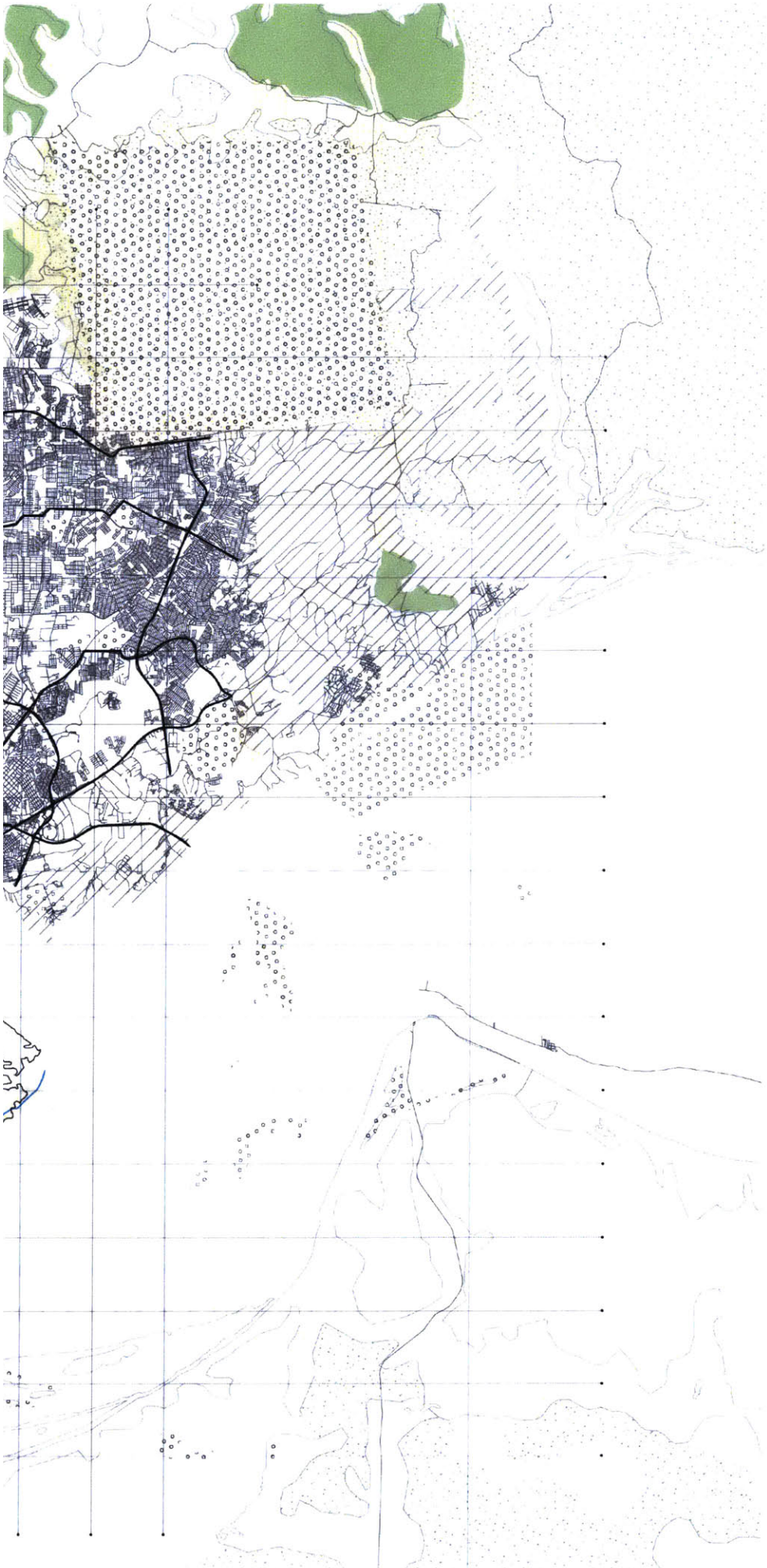


CONNECT

CONTAIN

[ ]





CONNECT

CONTAIN

[ ]

NEGOTIATE

+


CONNECT

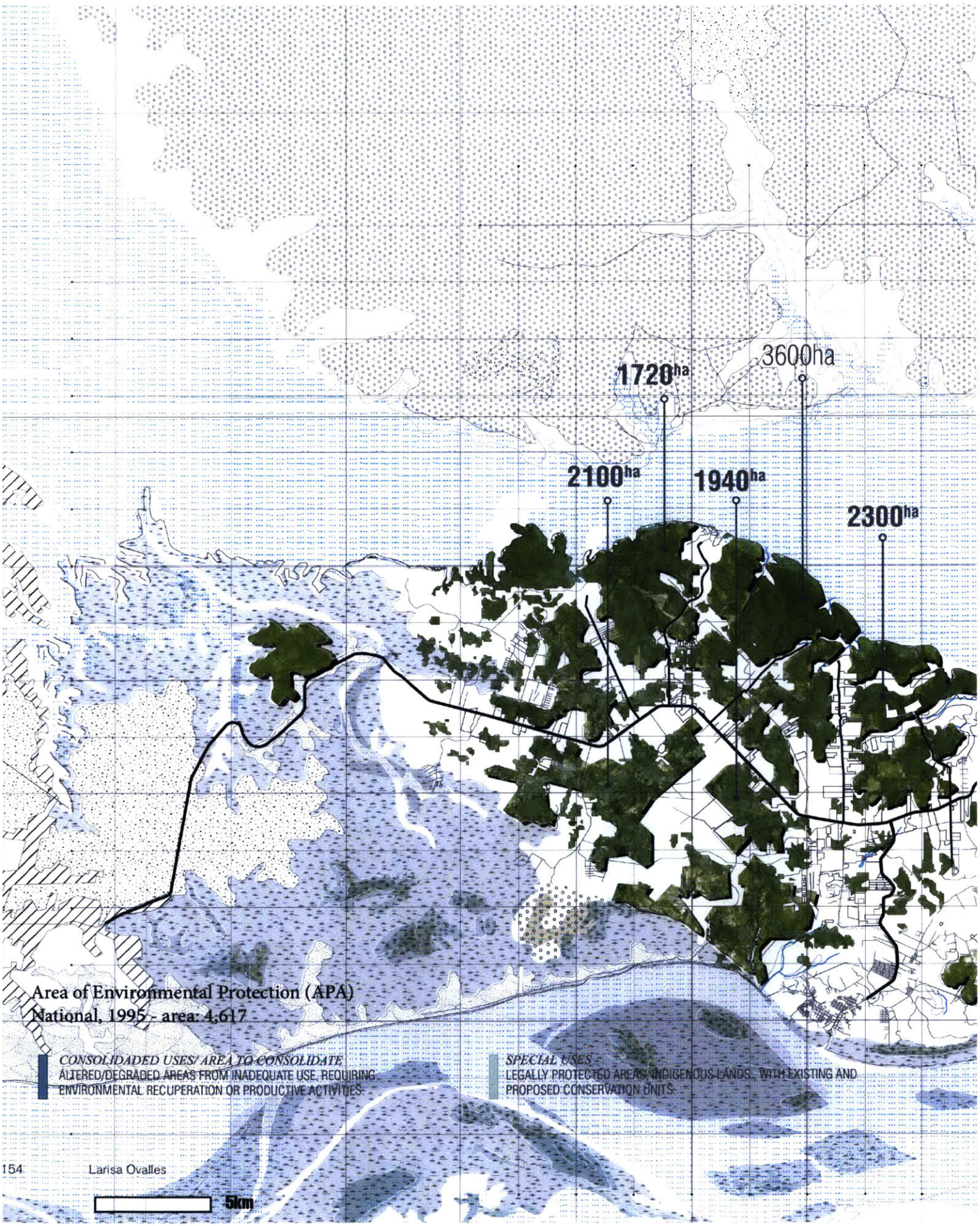
CONNECT

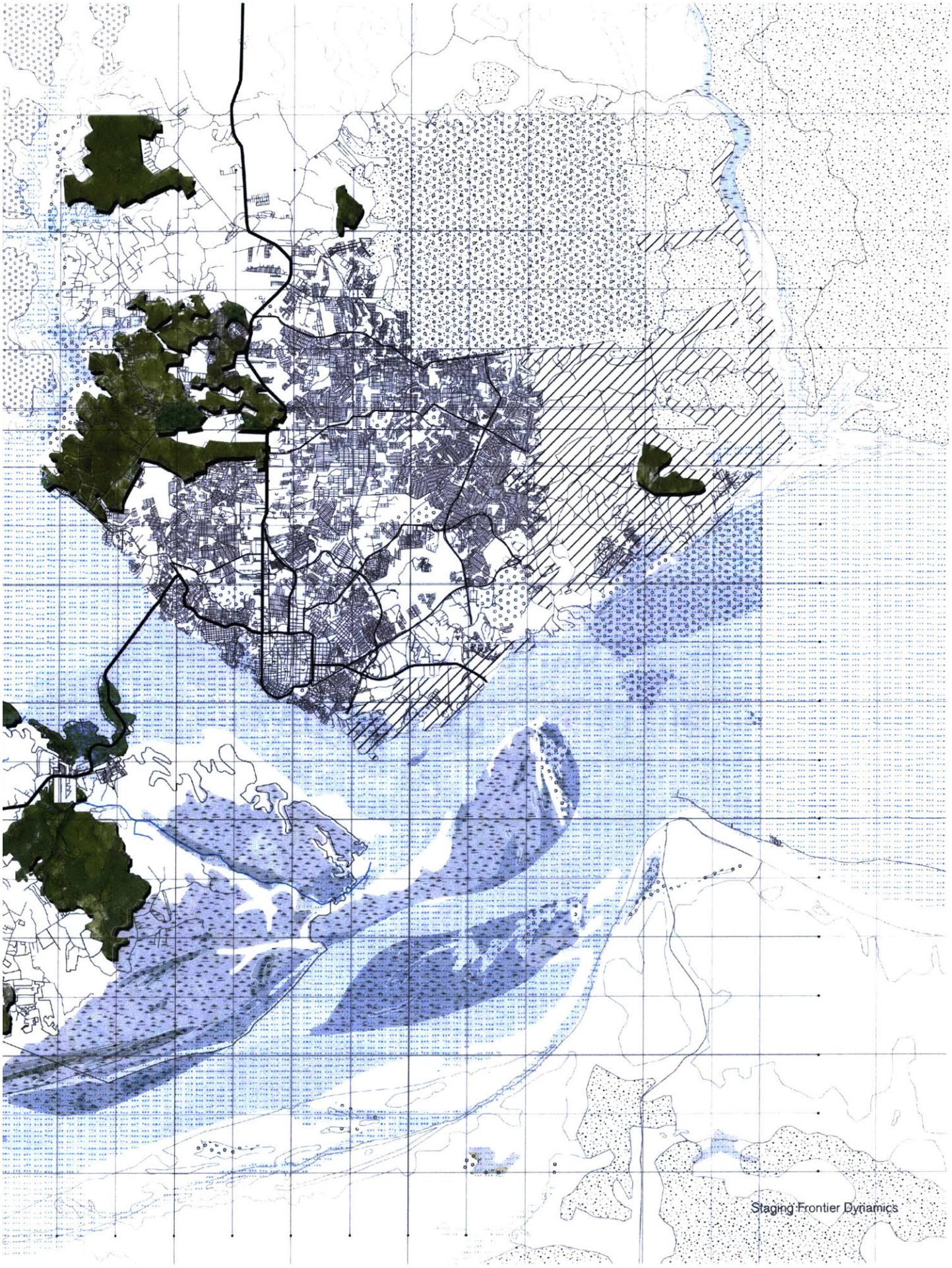
The only remaining forest fragments larger than 1000 hectares are mainly located near the Black River. These fragments still have a value for conservation and should be turned into officially protected areas by the government. The proposal gives these fragments priority in the effort to link them through two main strategies:

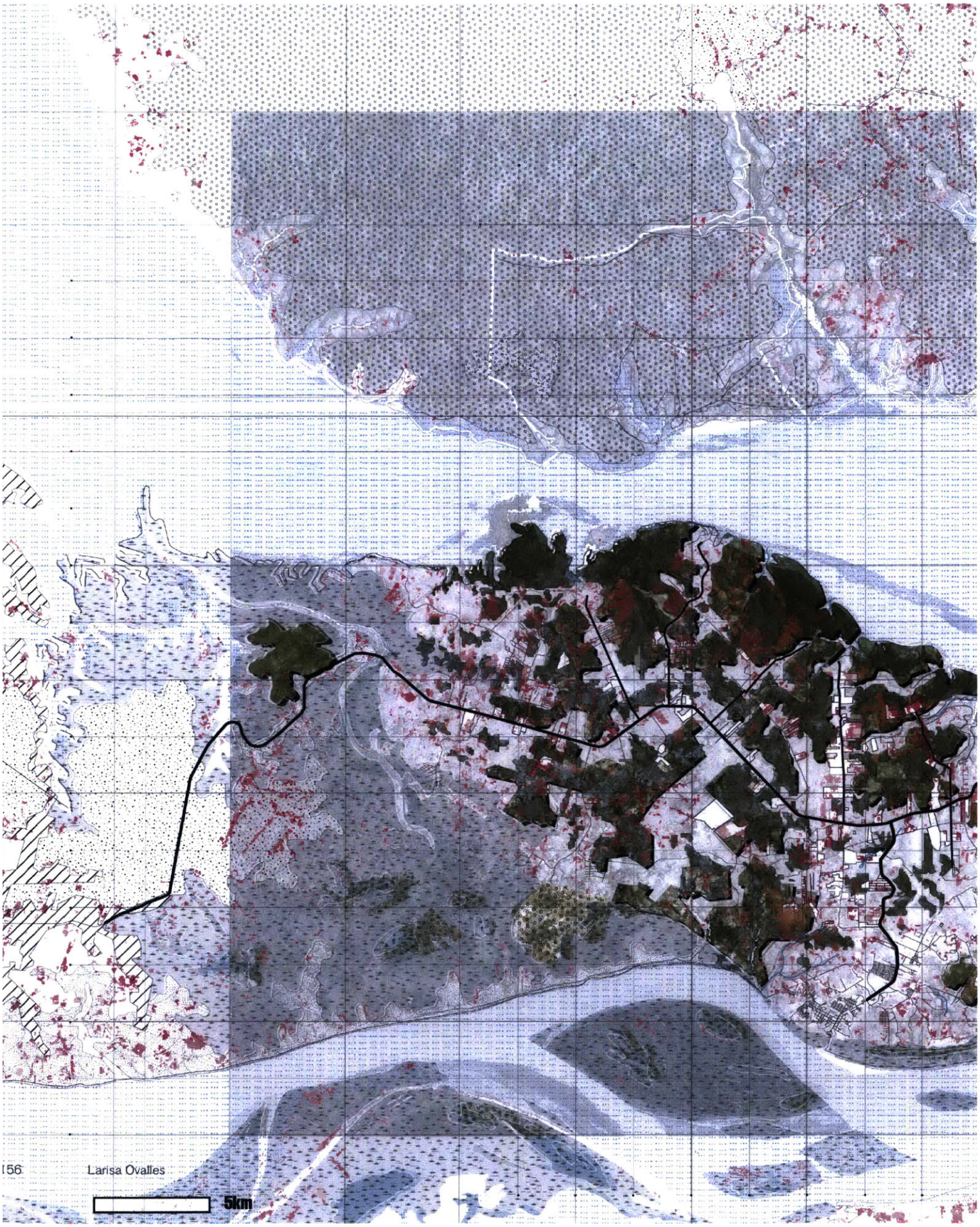
1. The Exchange/swap strategy, which aims to concentrate deforestation and development along main roads, which will then allow for secondary growth succession to reconnect forest fragments.
2. The second strategy targets new development in the region and proposes a interdependency model which will tie new development and reforestation processes through an interplay strategy

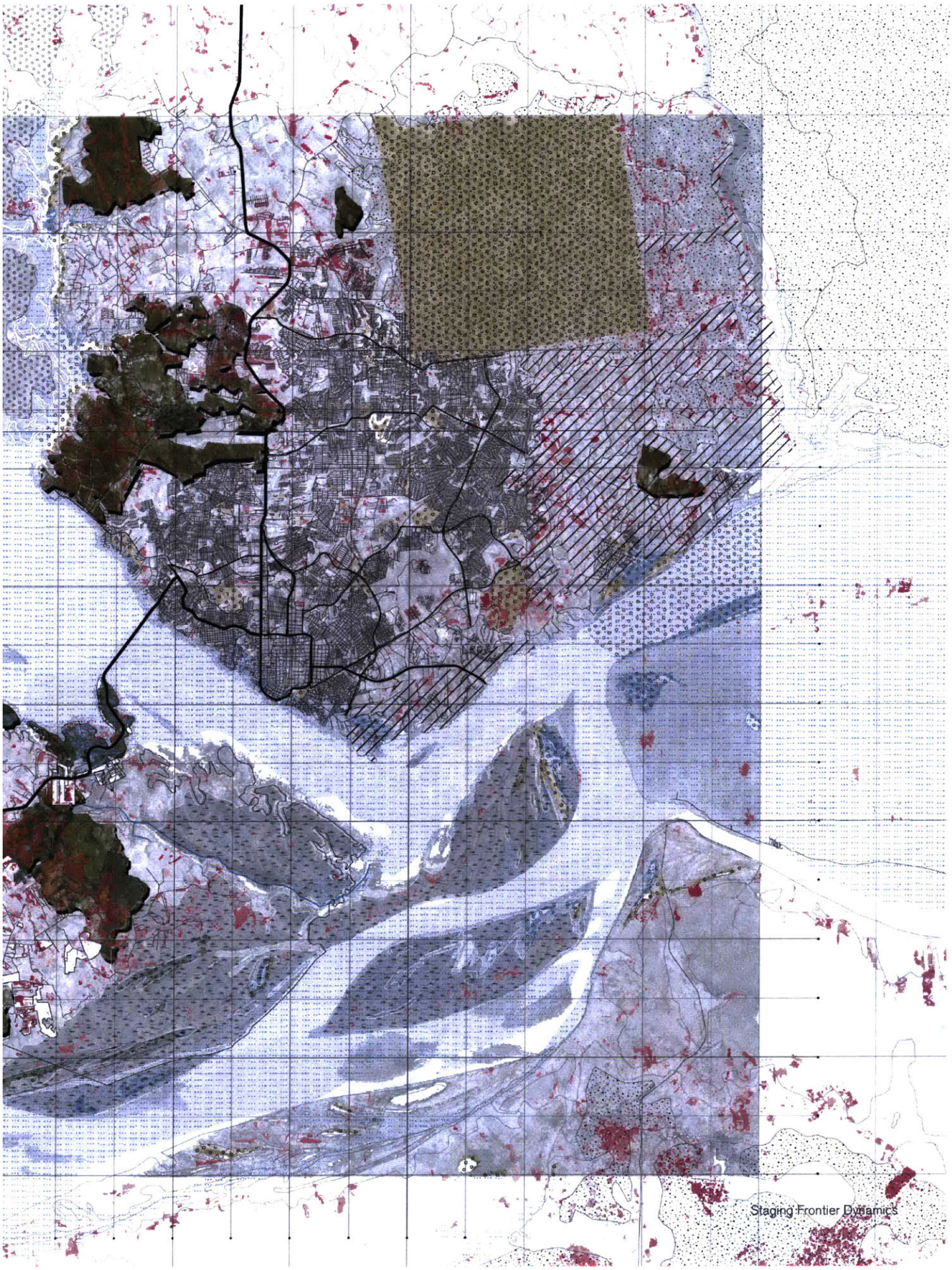
Patterns of forest cover loss and gain hint at potential areas for linking and application of exchange and swap strategies of land for relocation or consolidation to reduce collective risk.
These strategies are executed by some of the previous matrix tools accordingly, in order to create ecological corridor which follow the minimum width of 300m for species to cross.

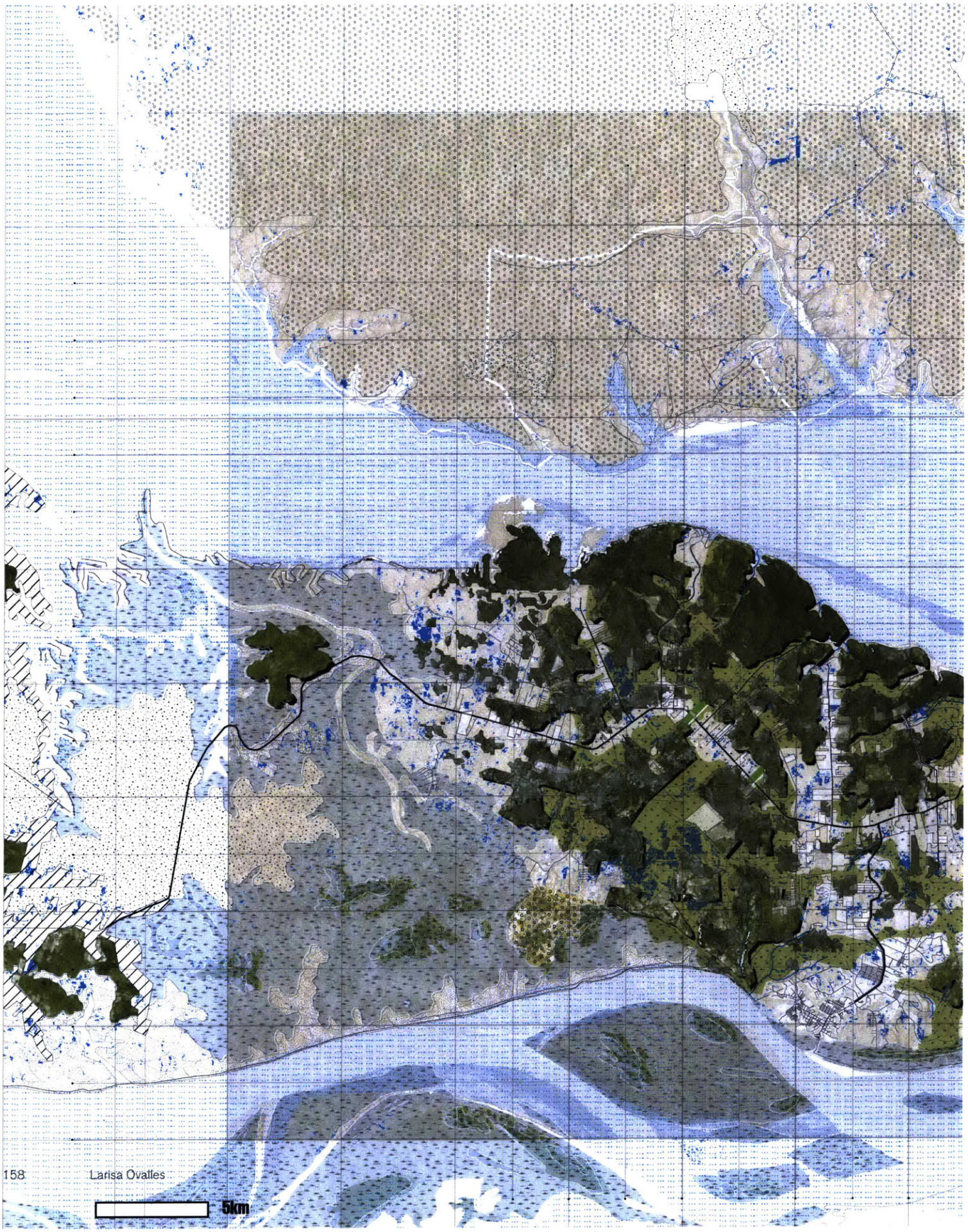
01
Interplay Strategy - New development is tied to reforestation process

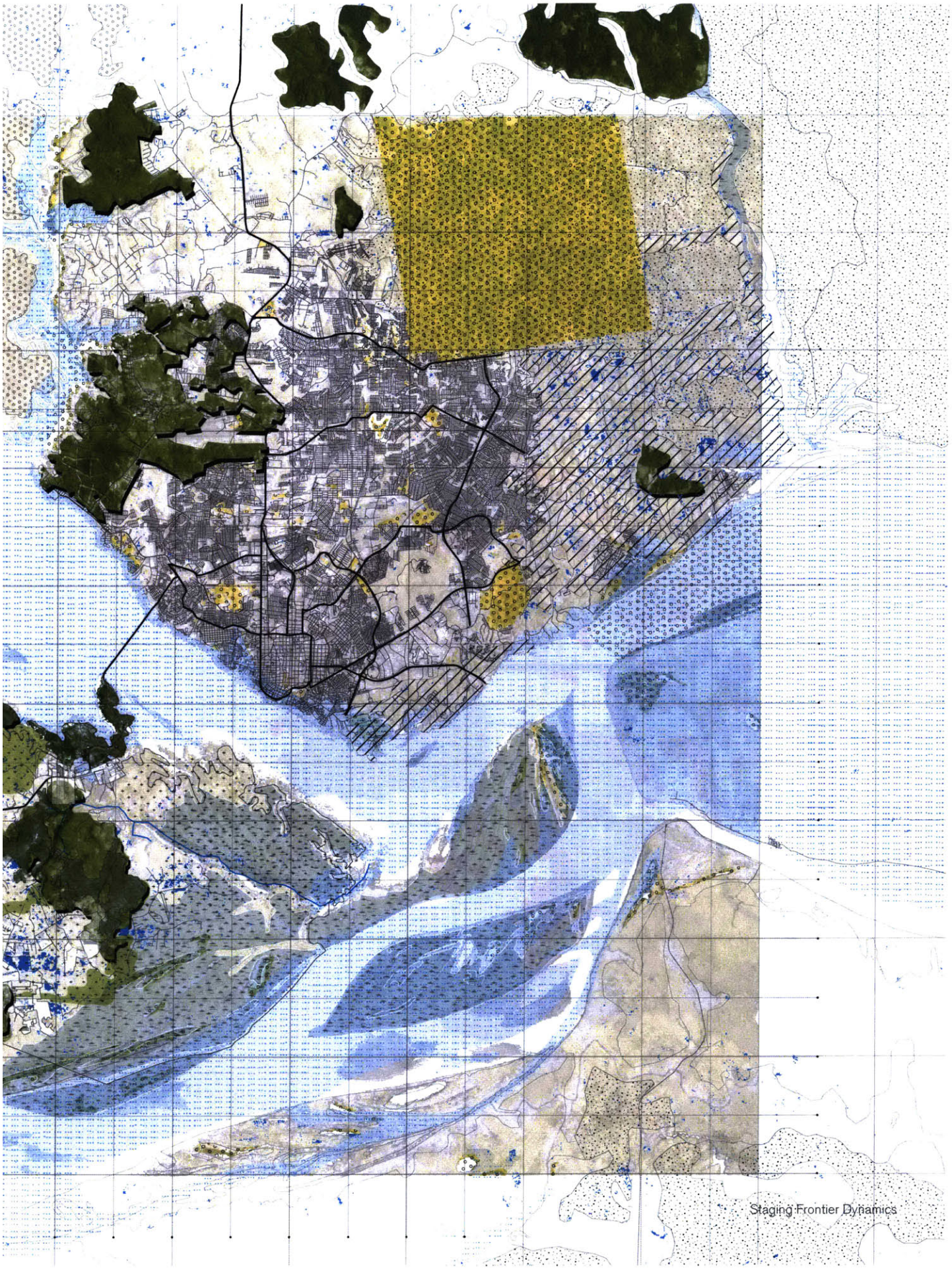

1720ha
3600ha
2100ha
1940ha
2300ha
Area of Environmental Protection (APA)
National, 1995 - area: 4,617
CONSOLIDADED USES/ AREA TO CONSOLIDATE
ALTERED/DEGRADED AREAS FROM INADEQUATE USE, REQUIRING ENVIRONMENTAL RECUPERATION OR PRODUCTIVE ACTIVITIES.
SPECIAL USES
LEGALLY PROTECTED AREAS, INDIGENOUS LANDS, WITH EXISTING AND PROPOSED CONSERVATION UNITS.
Larisa Ovalles
5km



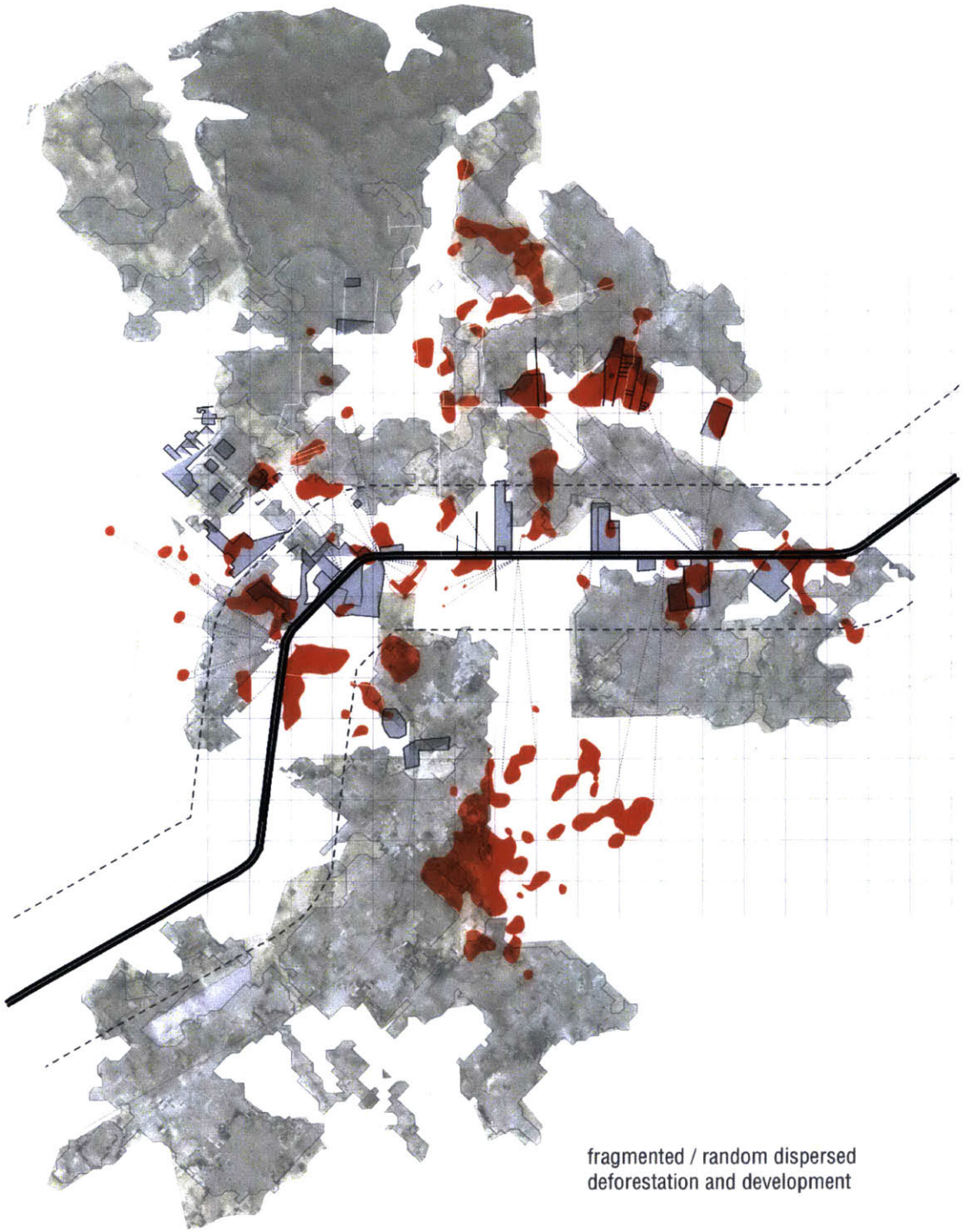

5km



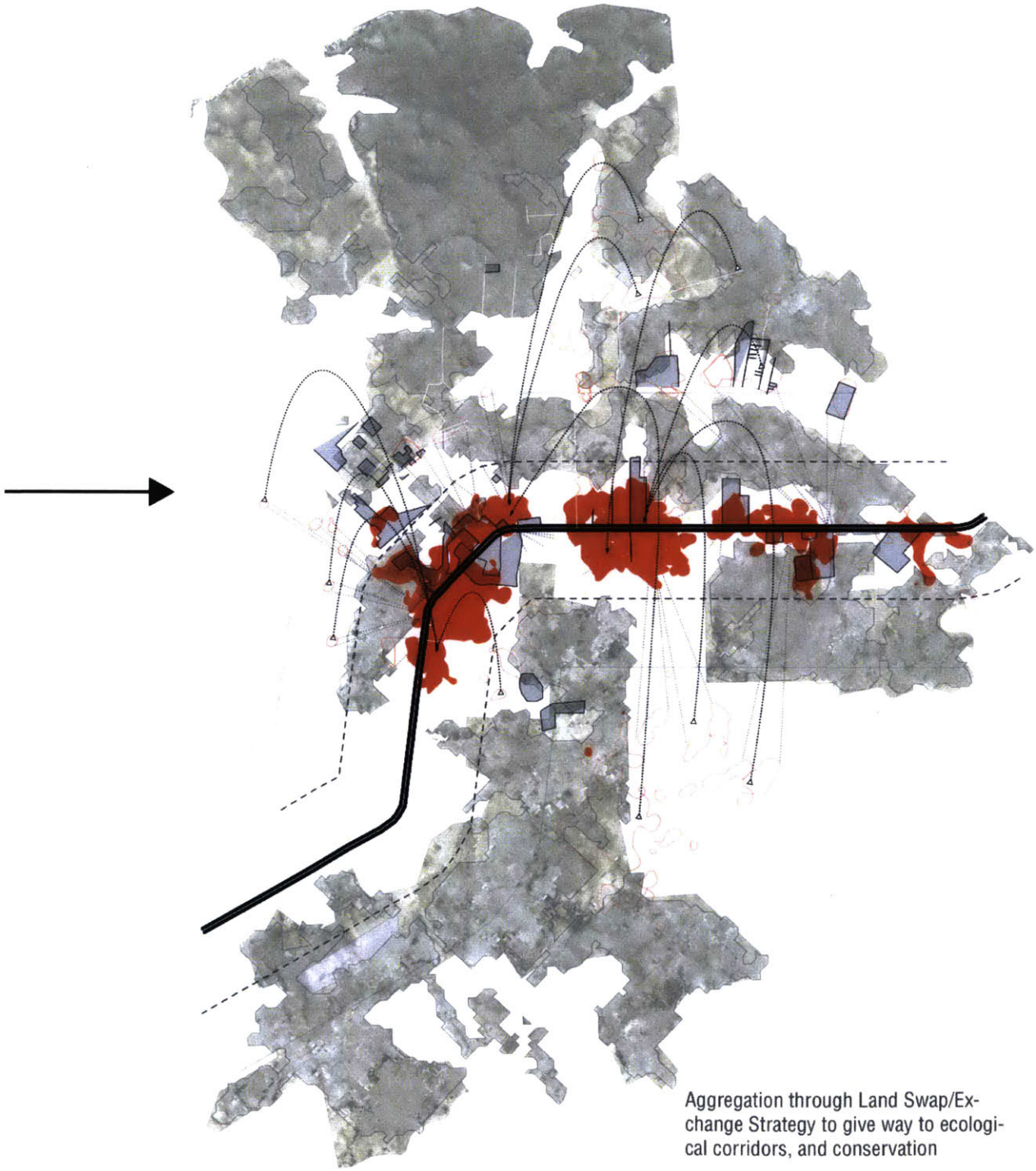

5km



EXCHANGE / SWAP STRATEGY
Aims to concentrate deforestation and development along main roads, which will then allow for secondary growth succession to reconnect forest fragments.



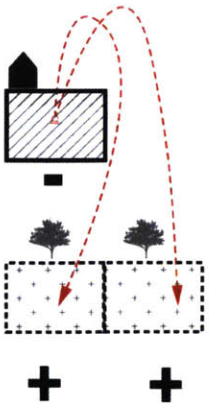
fragmented / random dispersed deforestation and development

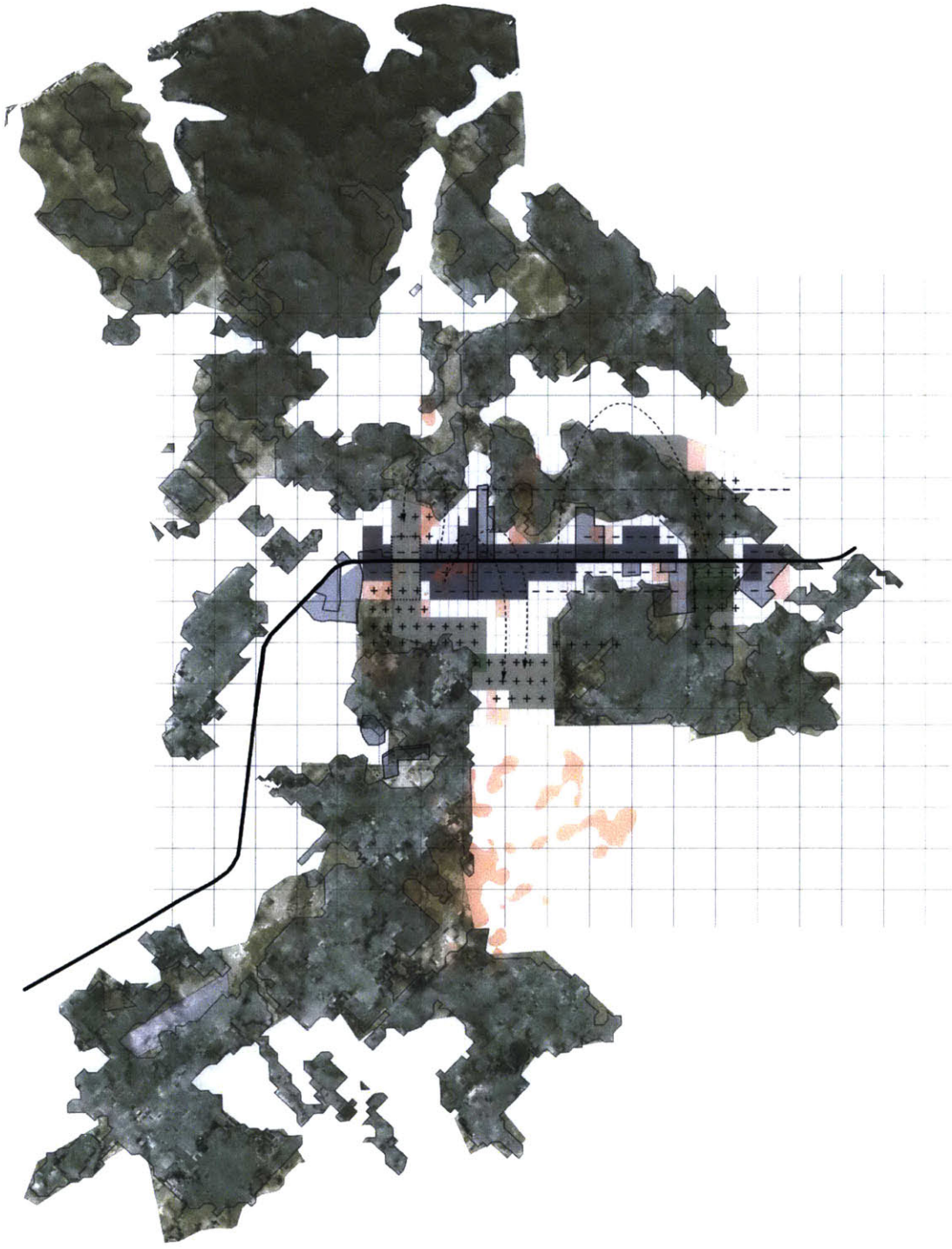


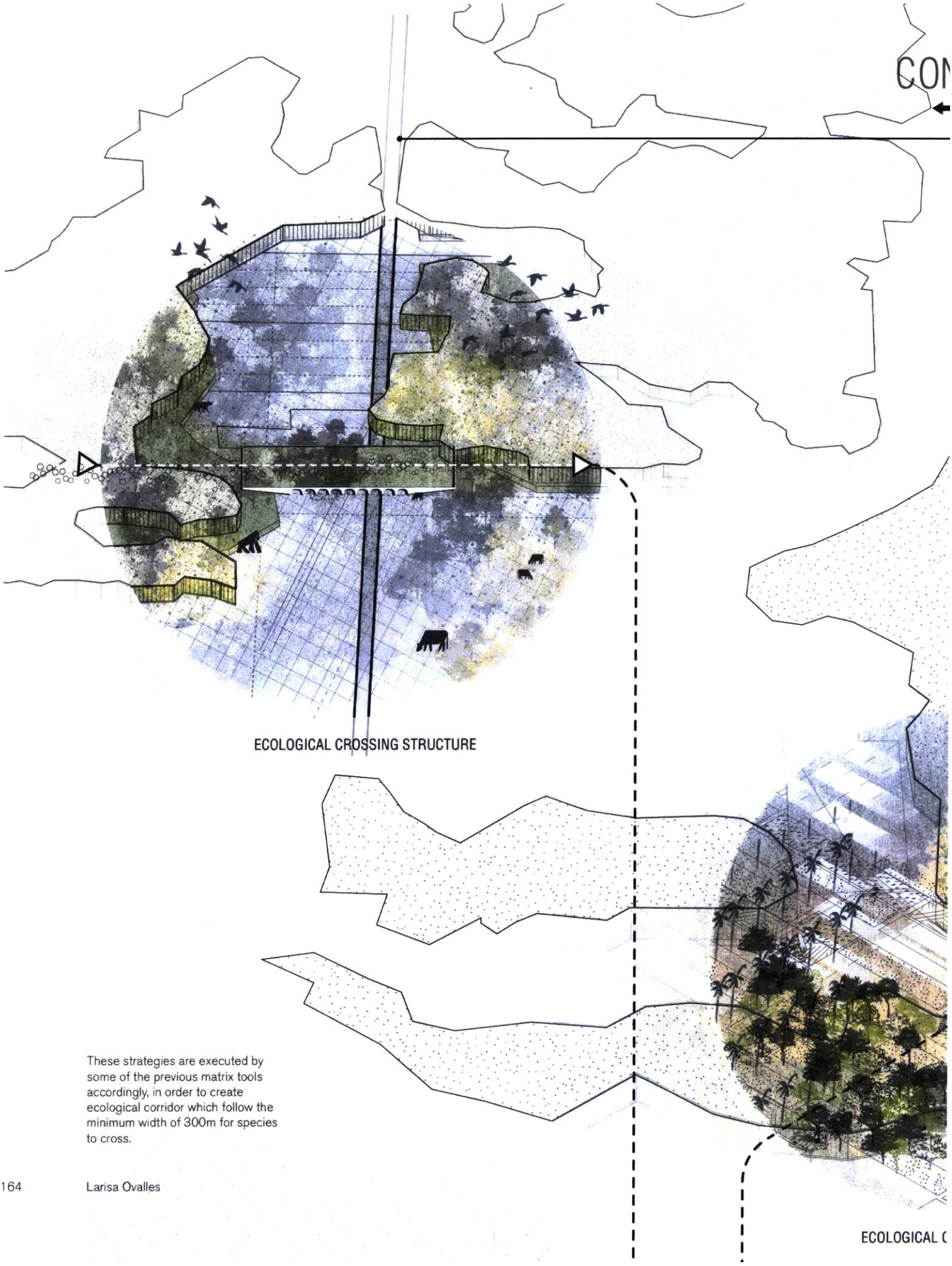
Aggregation through Land Swap/Exchange Strategy to give way to ecological corridors, and conservation

DEVELOPMENT =
REFORESTATION STRATEGY

This second strategy targets new development in the region and proposes a interdependency model which will tie new development and reforestation processes through an interplay strategy

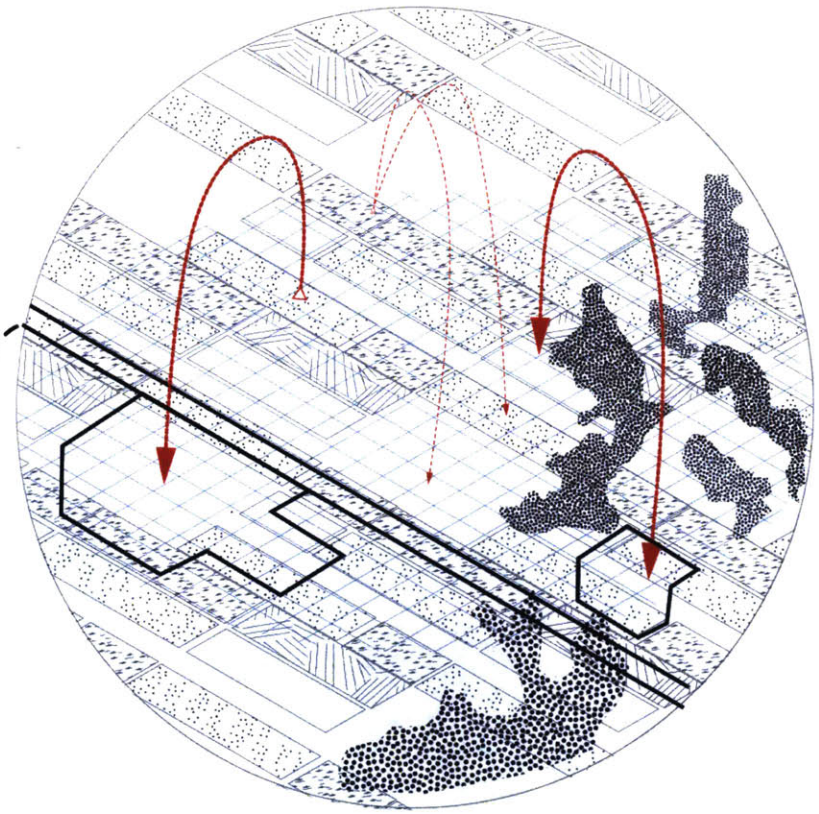




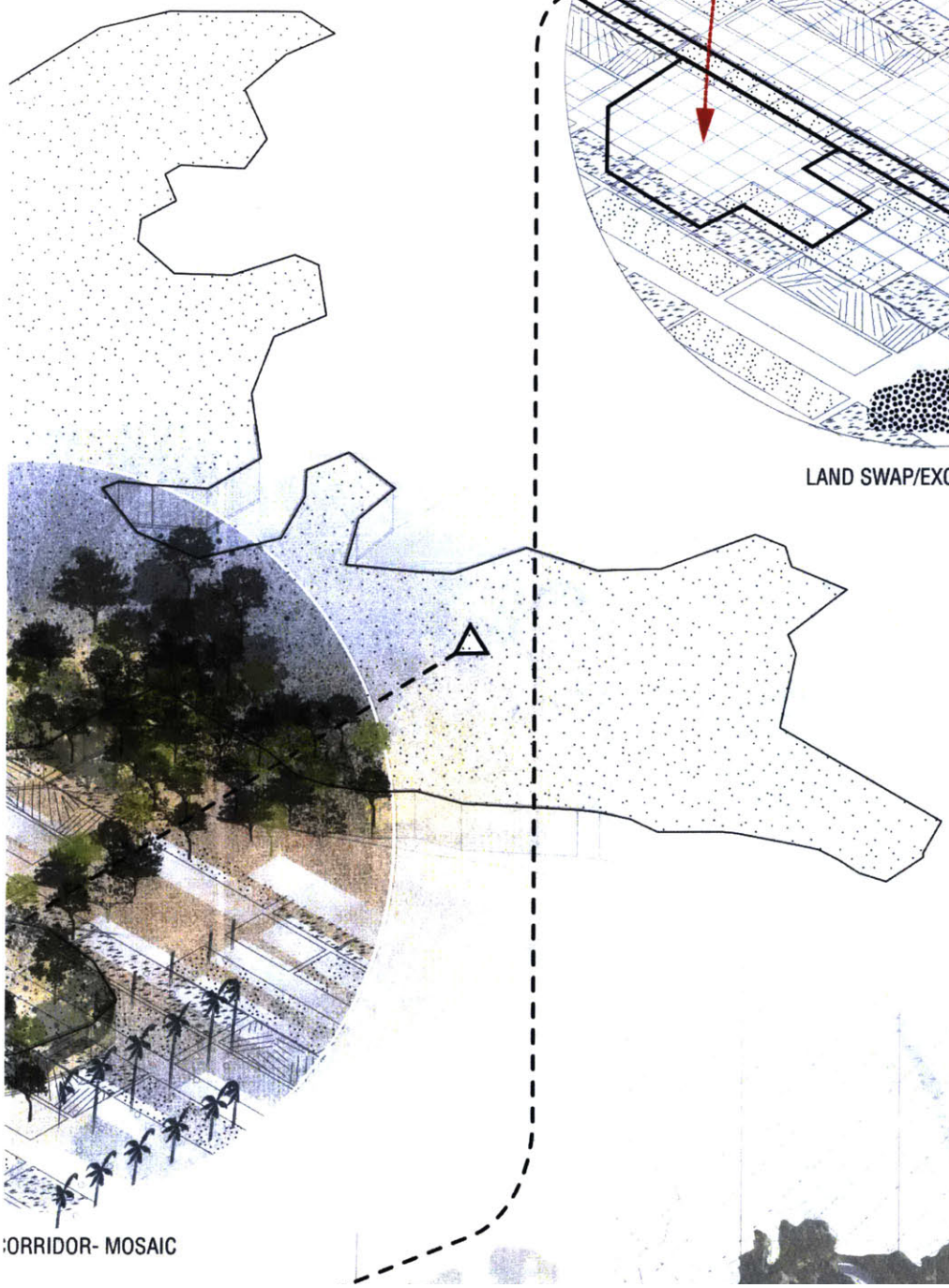


These strategies are executed by some of the previous matrix tools accordingly, in order to create ecological corridor which follow the minimum width of 300m for species to cross.

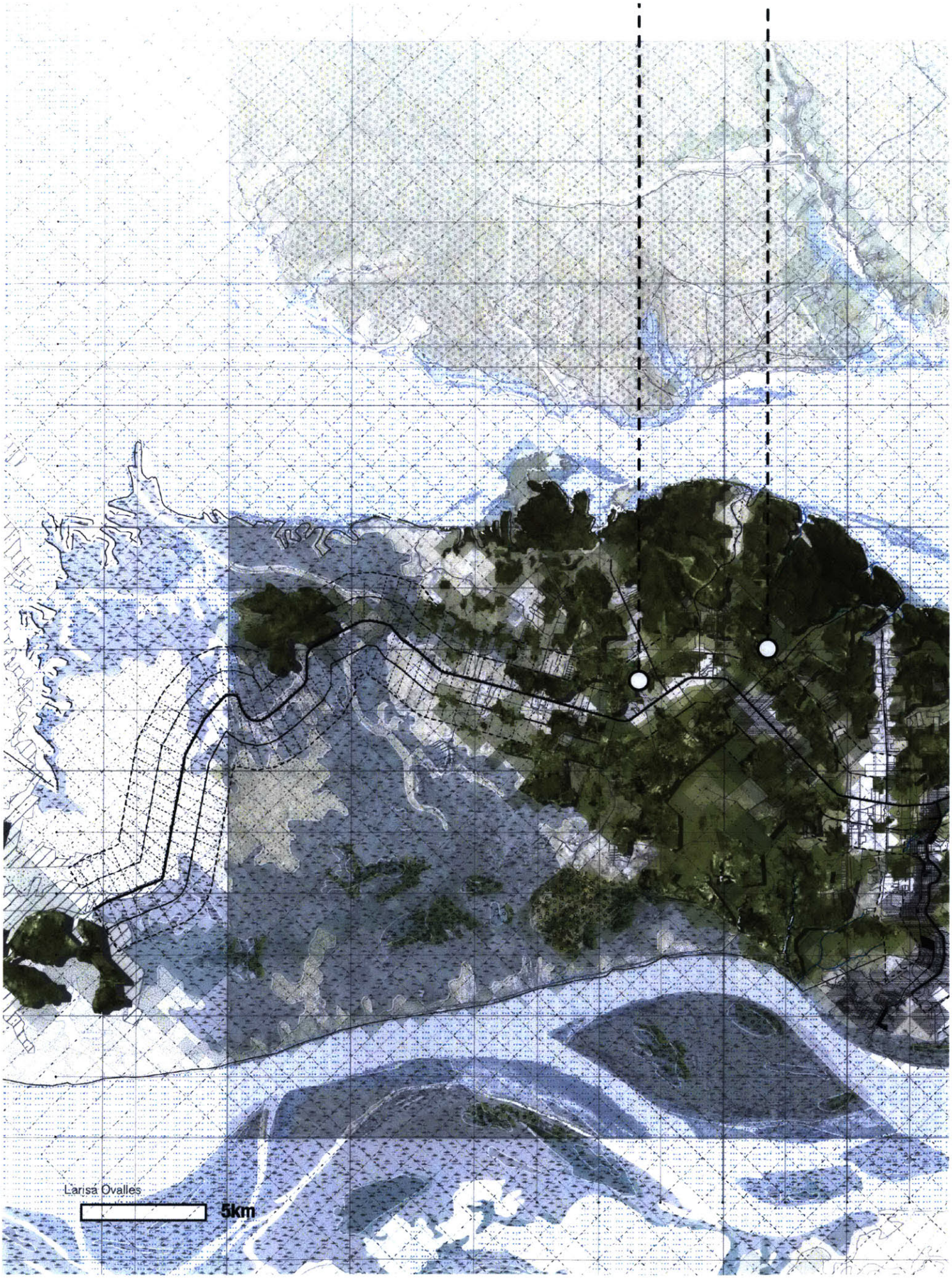
JNECT

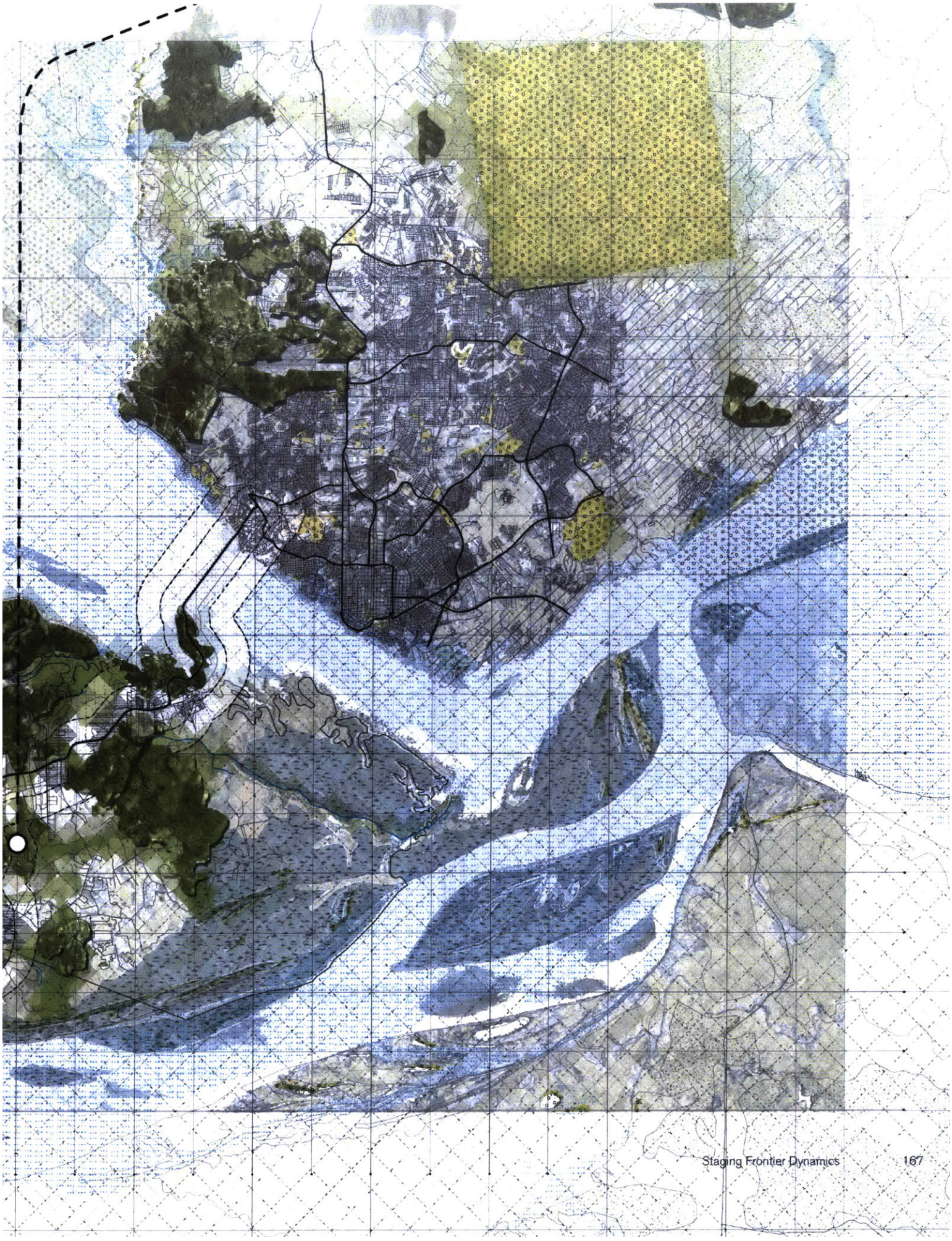


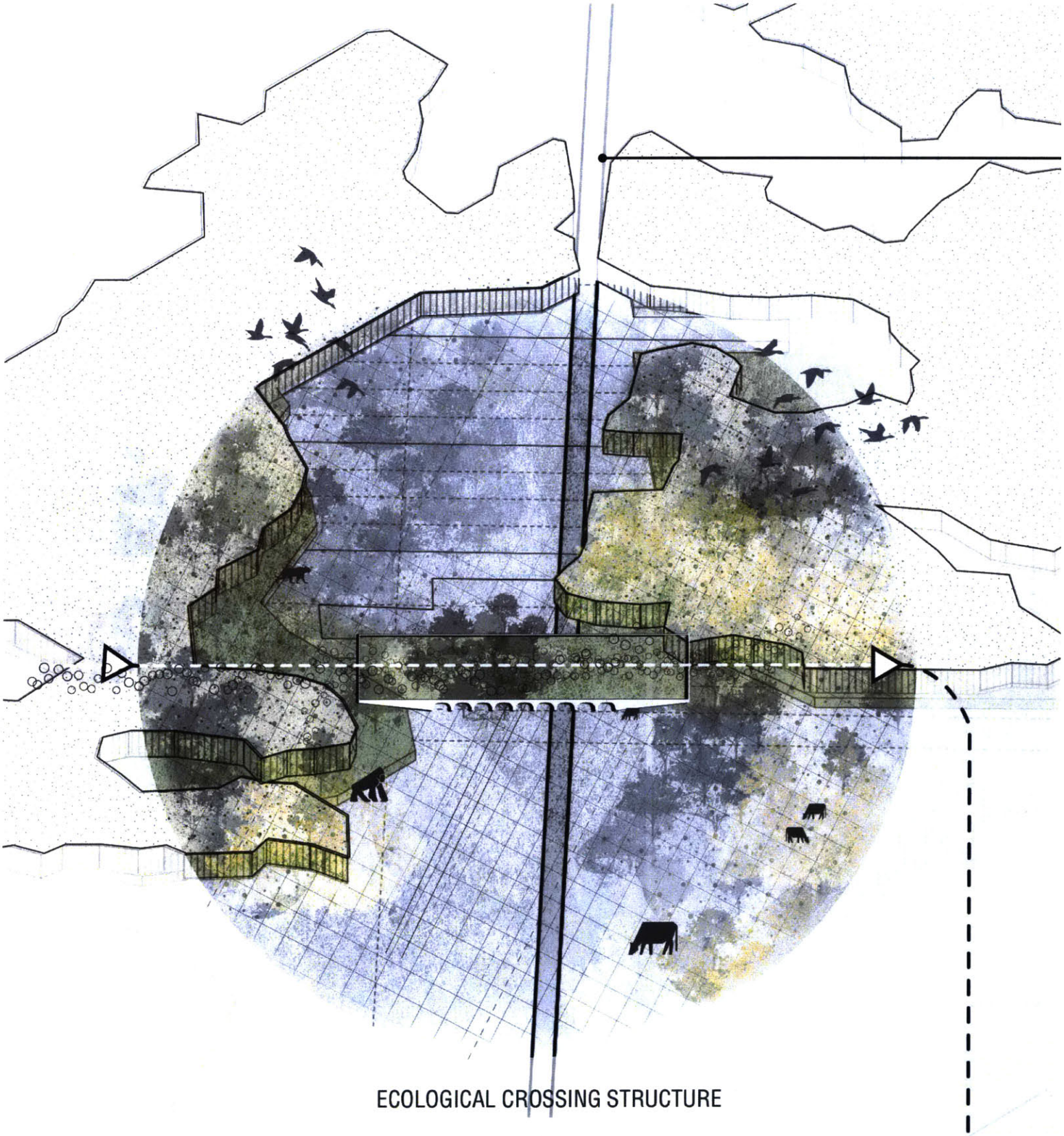
LAND SWAP/EXCHANGE STRATEGY



:ORRIDOR- MOSAIC

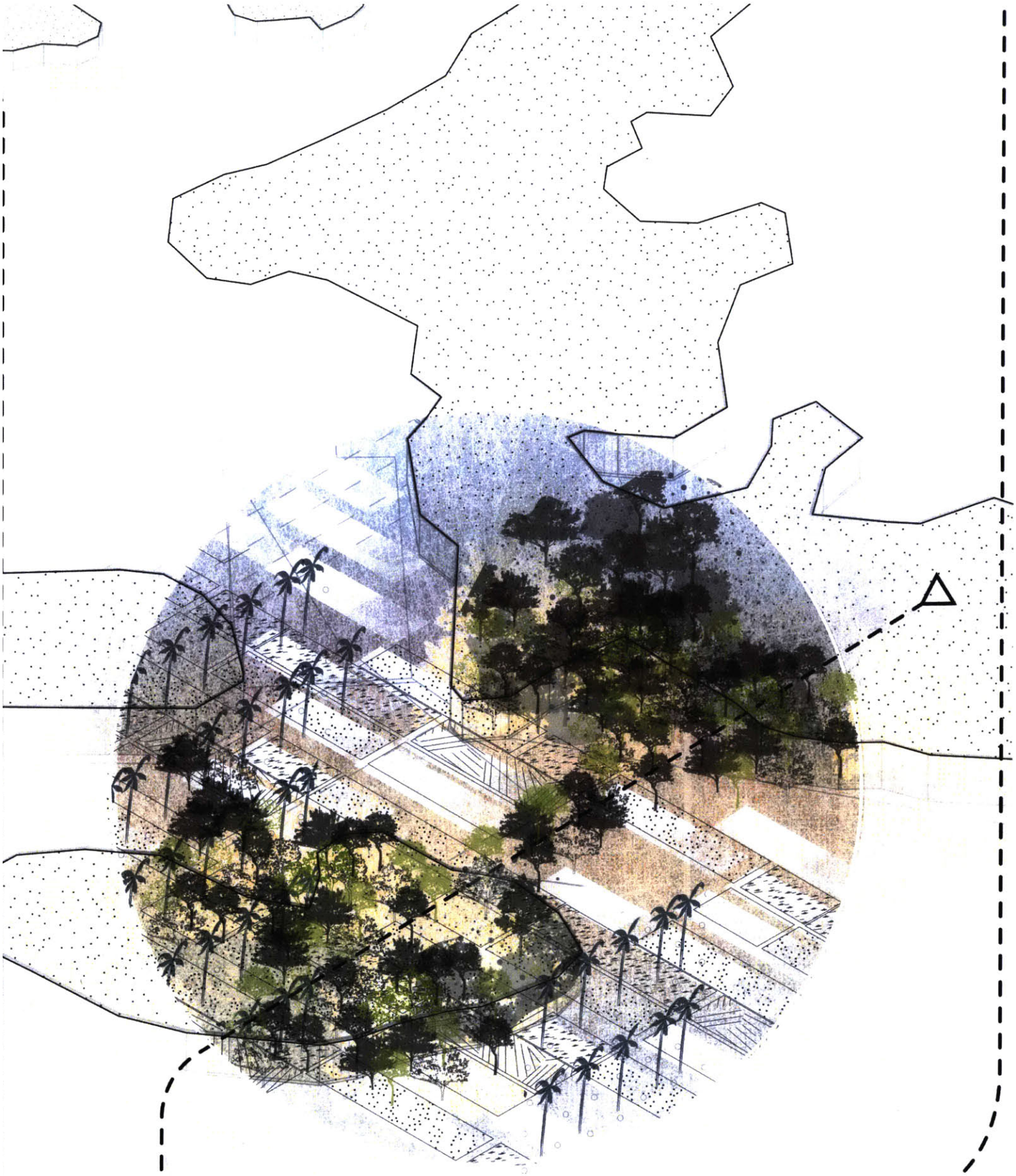

Larisa Ovalles
5km





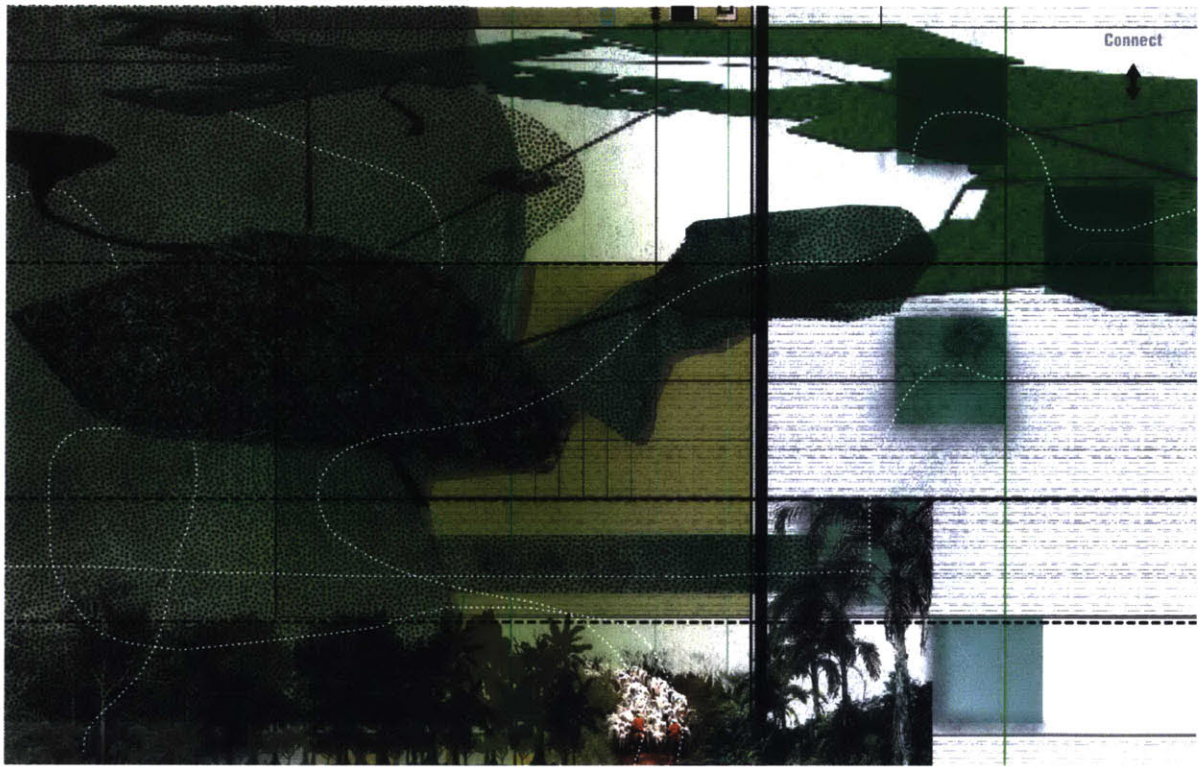
ECOLOGICAL CROSSING STRUCTURE

Connect
An ecological crossing structure will beused to connect forest fragments across road networks.
300m min width

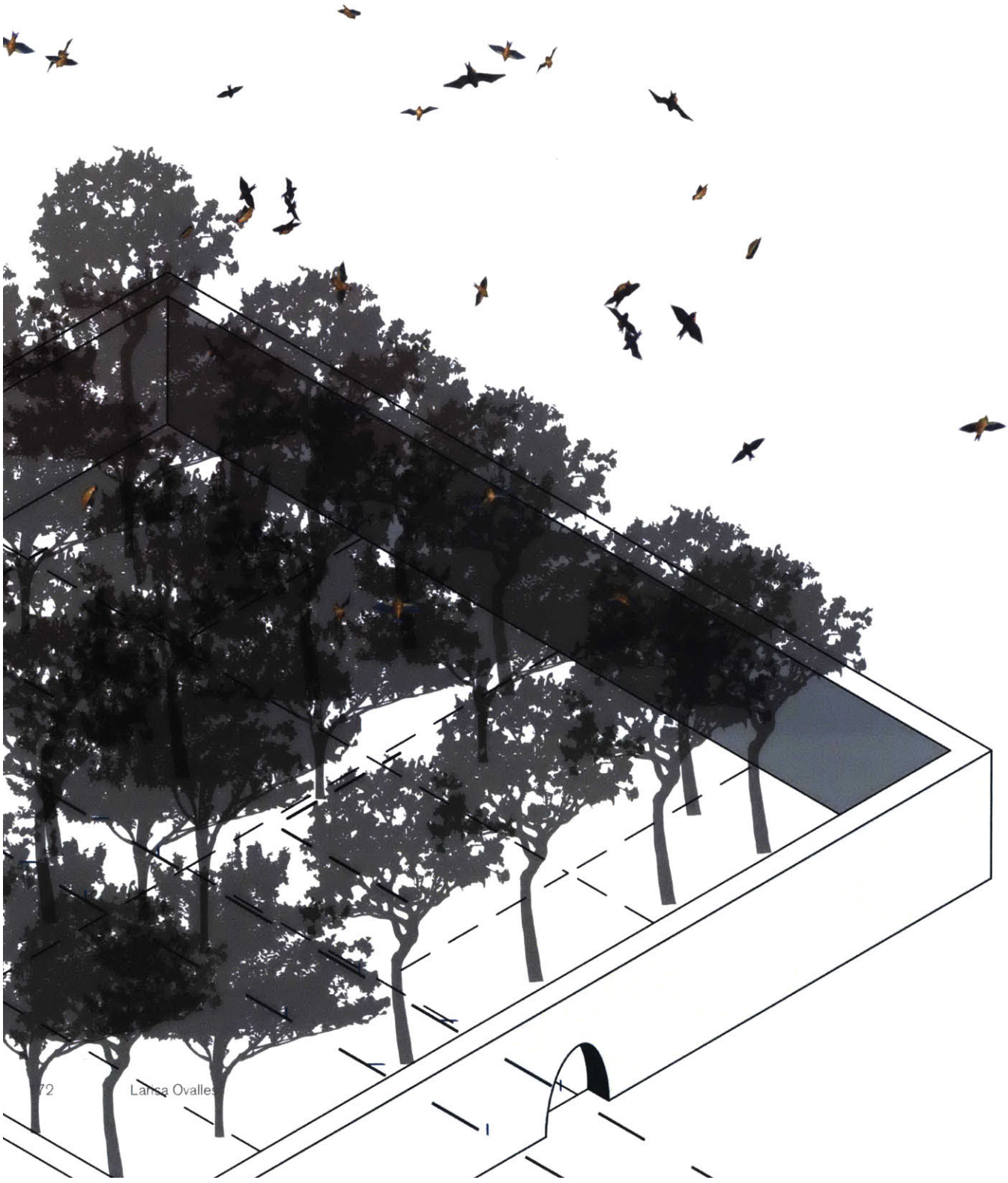


ECOLOGICAL CORRIDOR- MOSAIC

Connect Strategy
Linking Forest Fragments through
exchange and swap



Connect Strategy
Ecological corridors through
agricultural landscapes



CONTAIN

Given the region's unavoidable economic and population growth, this strategy aims to negotiate and guide development to prevent uncontrolled growth and prevent further disarticulated landscape through deforestation.
Studies have concluded that about 95% of deforestation happens within a 1km-2km zone of intervention adjacent to roads.*

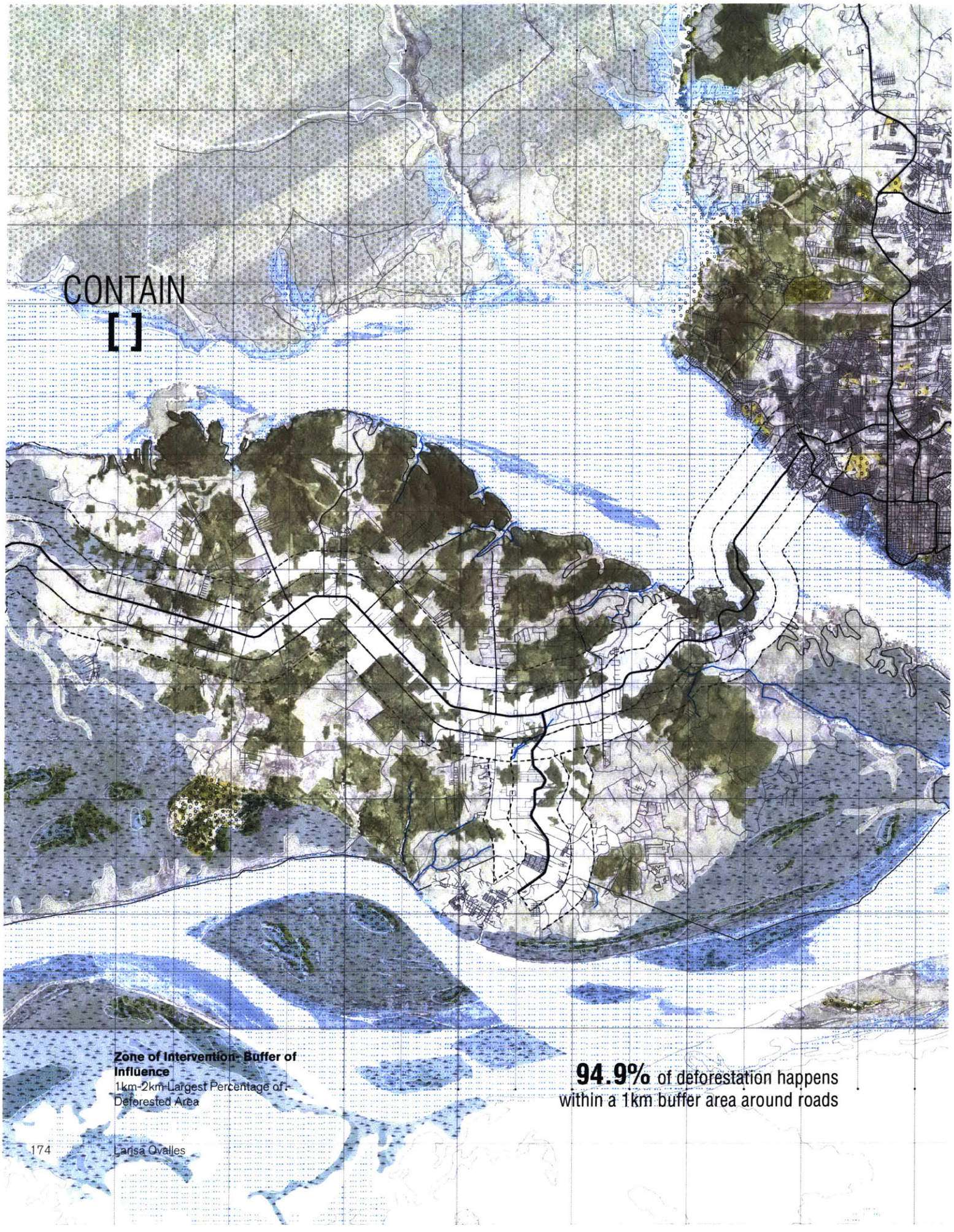
On site observations showed that most of these changes are manifested along the main corridor connecting the Ponte Rio Negro bridge entrance and the city center of Iranduba.

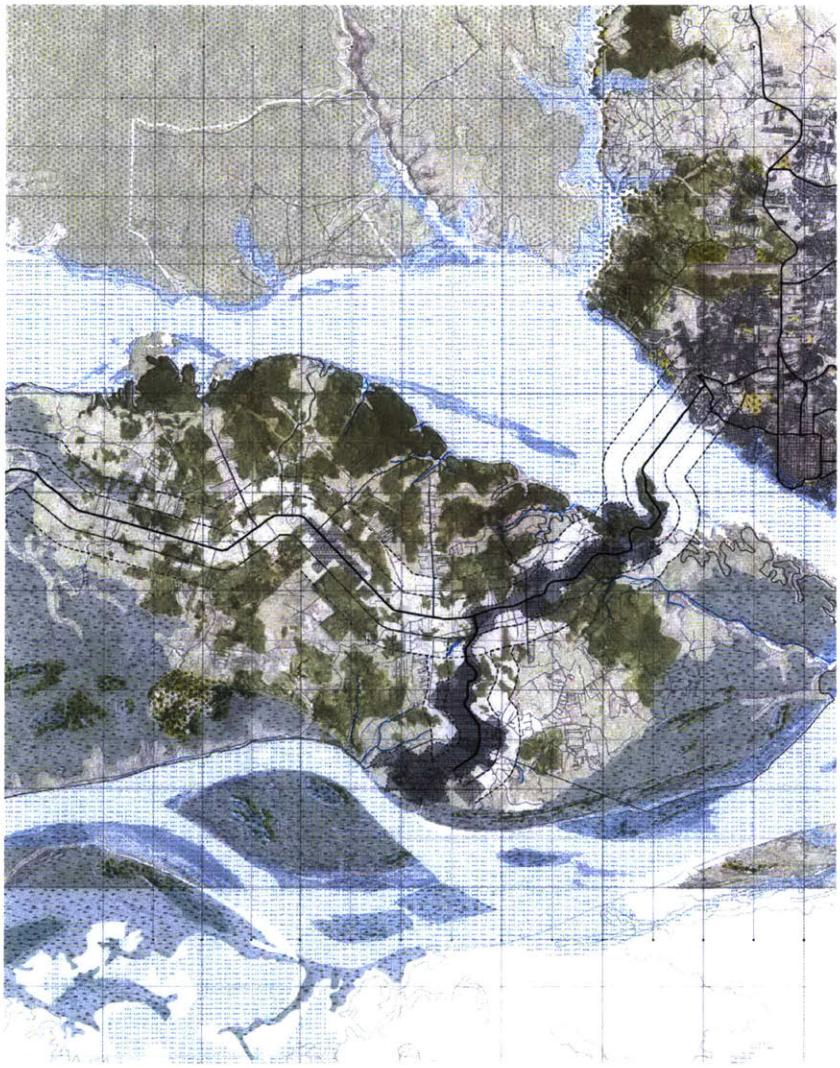
The mediator' is the proposed design intervention which takes the form of a new organizing structure following geographic conditions. This social and physical buffer will accommodate the growing denser development towards the road, while also hosting a series of collective and social services. An agricultural market, recreation and open spaces, public buildings, agricultural cooperative centers and an agricultural housing cooperative model.

This urban buffer creates a series of hard and softer edges, physical natural boundaries according to its context.

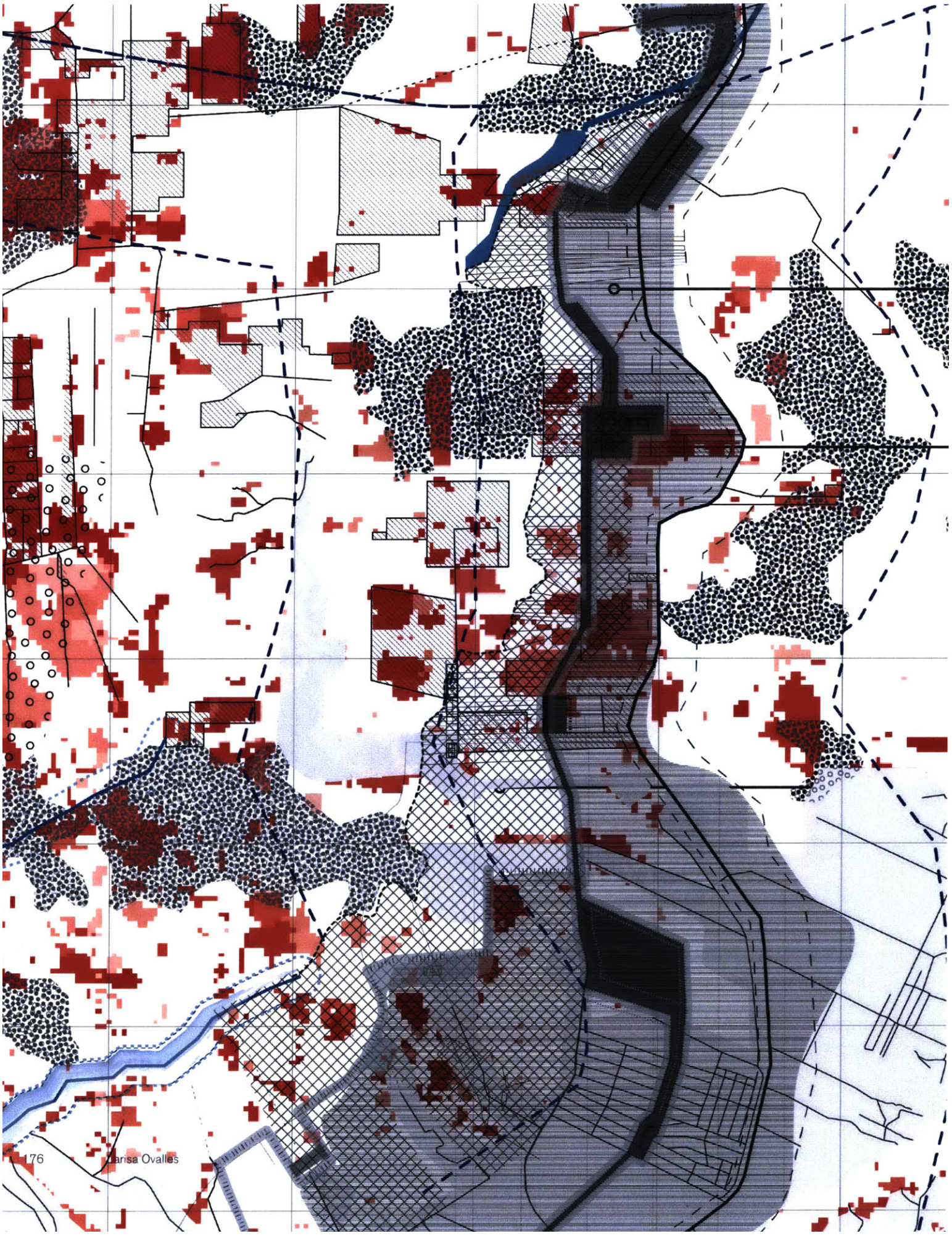
The new urban buffer framework follows the structure, not of a road infrastructure, but of a forested, green public space serving mainly as a social buffer to prevent continuous deforestation in certain areas and allow forest succession in others. These processes grow and change through time simultaneously, benefitting from the dynamic qualities of the context.

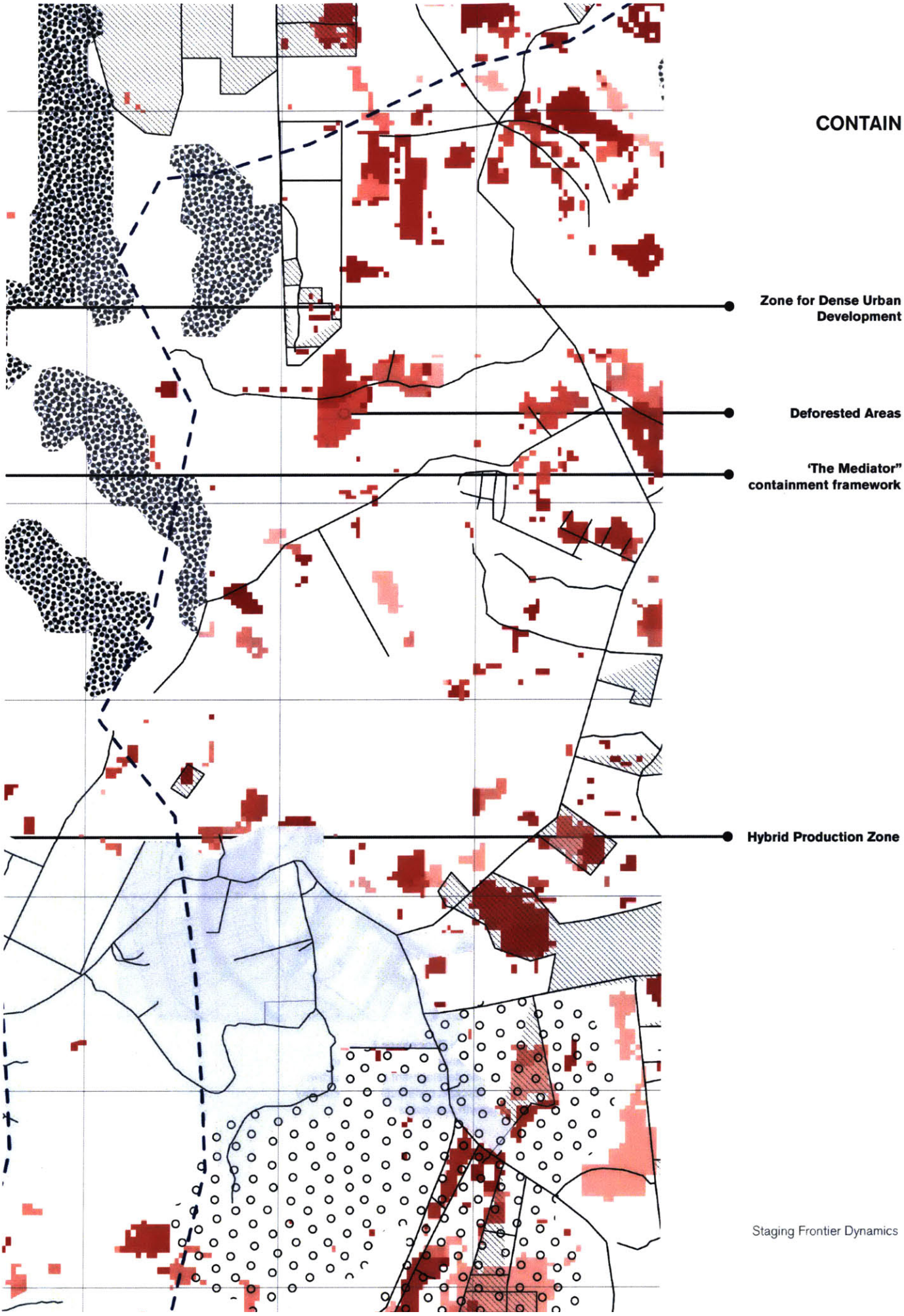
*Barber, Christopher P., Mark A. Cochrane, Carlos M. Souza Jr., and William F. Laurance. 2014. "Roads, Deforestation, and the Mitigating Effect of Protected Areas in the Amazon." Biological Conservation 177 (September): 203–9. doi:10.1016/j.biocon.2014.07.004.

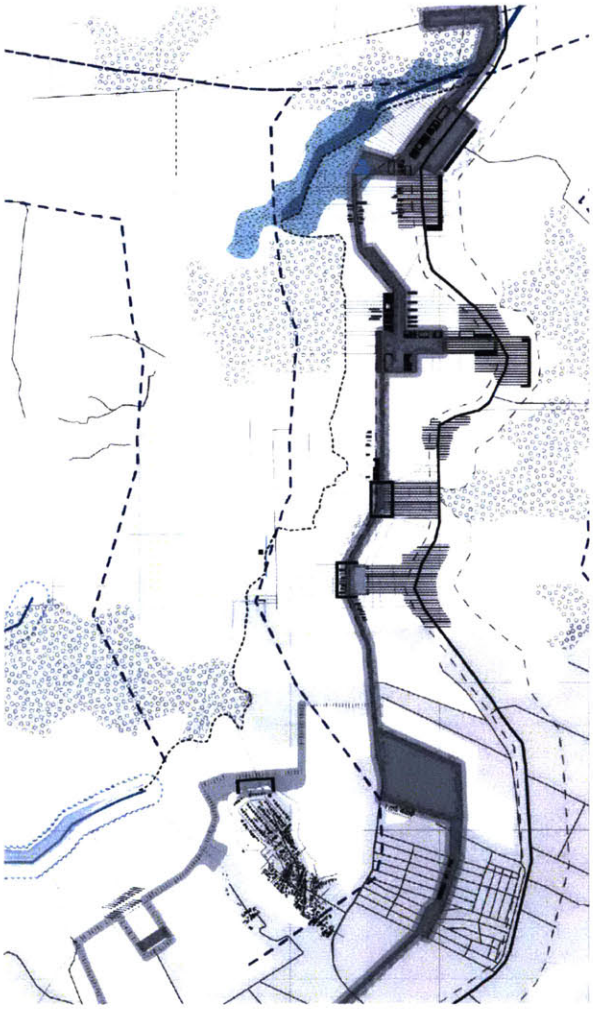

CONTAIN
[ ]
Zone of Intervention- Buffer of Influence
1km-2km Largest Percentage of Deforested Area
94.9% of deforestation happens within a 1km buffer area around roads



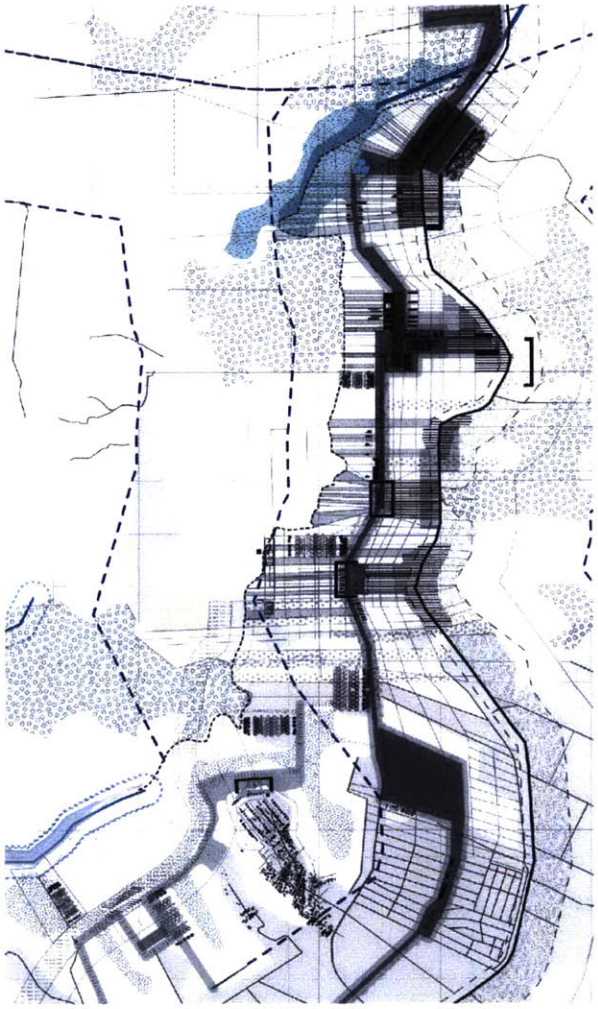
Concentration of Urban Development
Along existing road infrastructure connecting city center



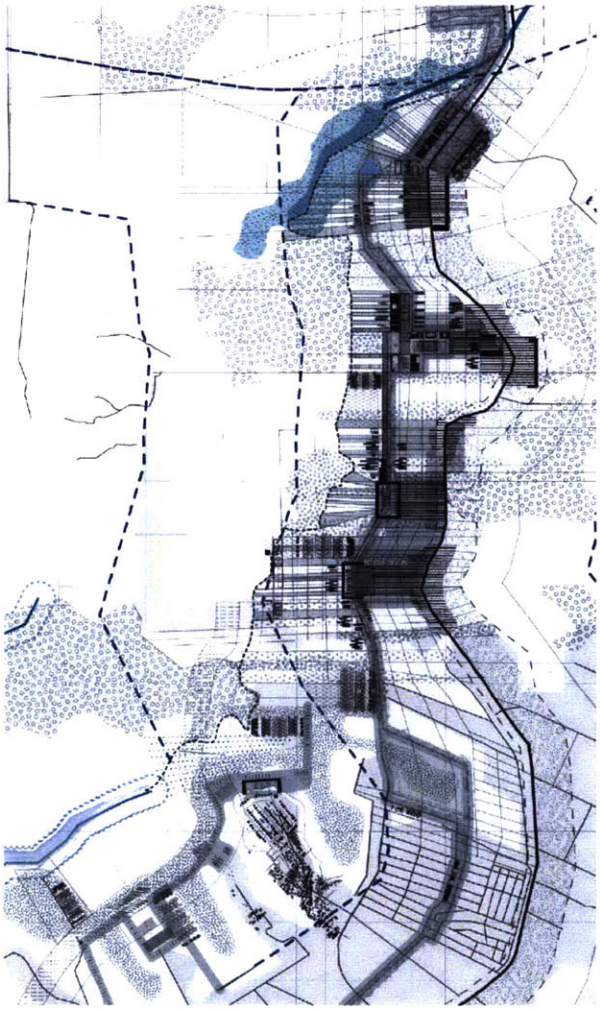

CONTAIN
Zone for Dense Urban Development
Deforested Areas
'The Mediator" containment framework
Hybrid Production Zone



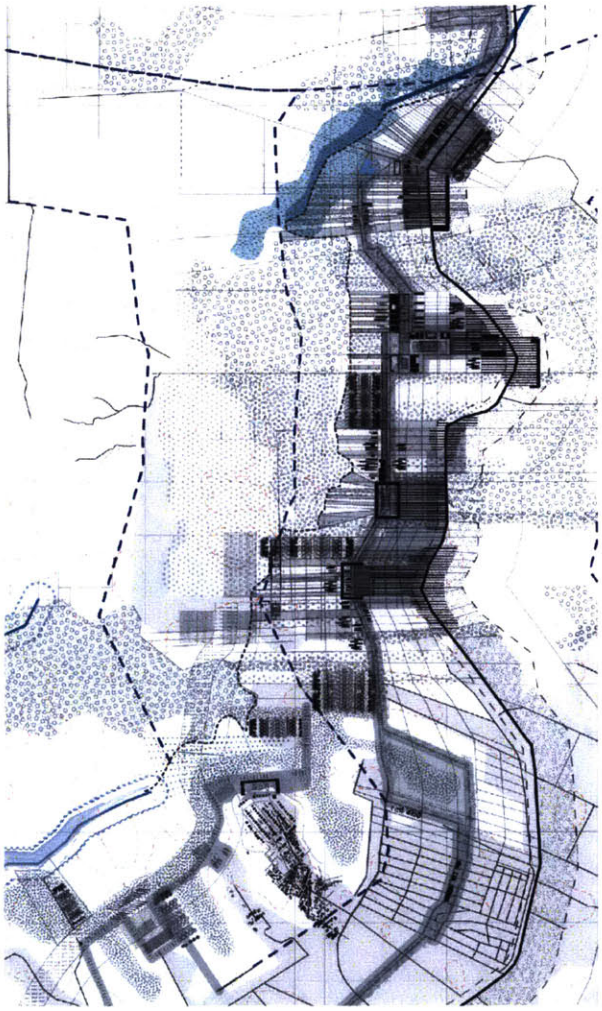
Contain Framework and Collective Zone
The Mediator, acts to both guide development and create programmatic spaces for shared and collective uses, providing necessary social services.



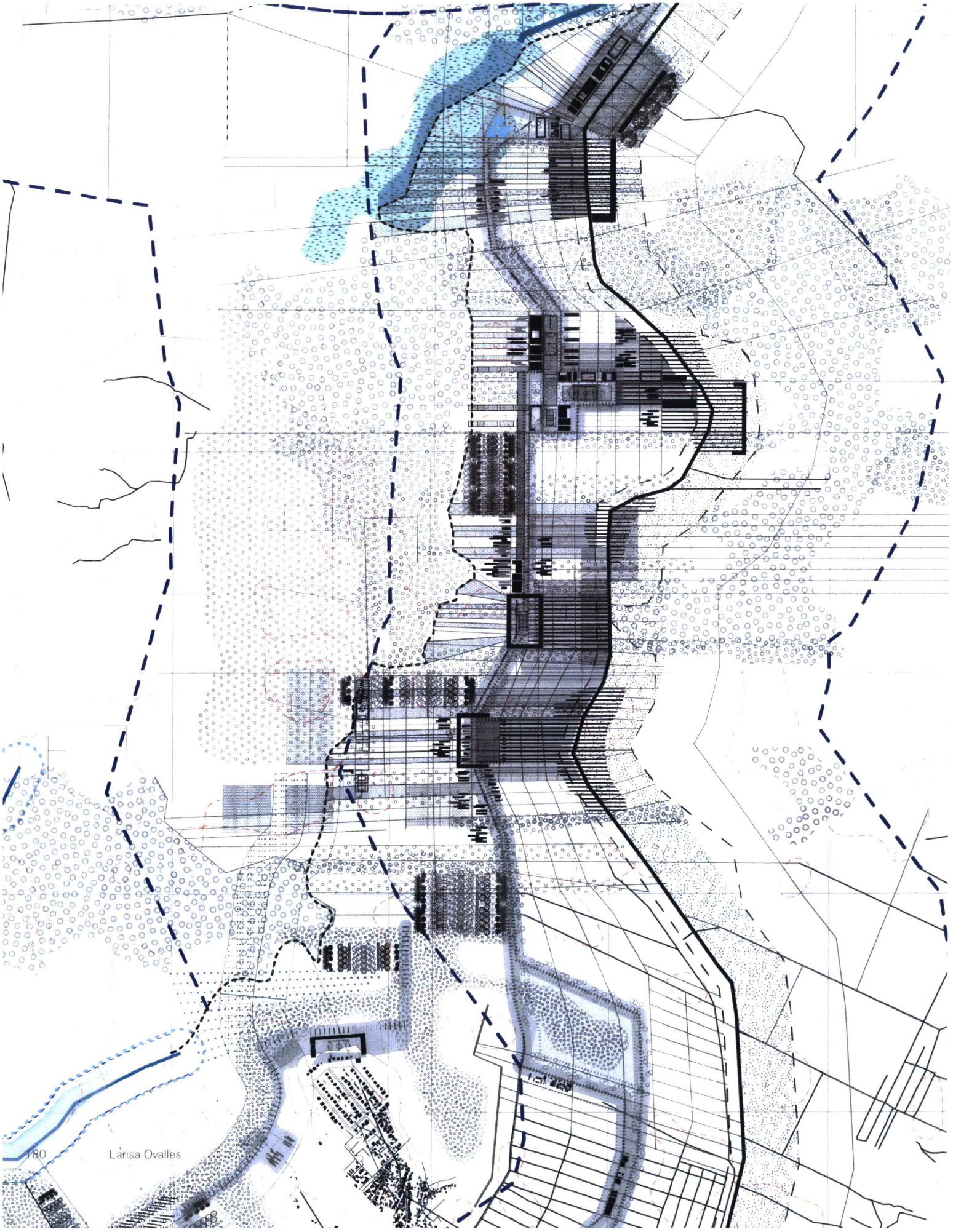
Growth Processes I
Simultaneous growth between urban development and productive landscape, contributing to secondary growth succession



Growth Processes II

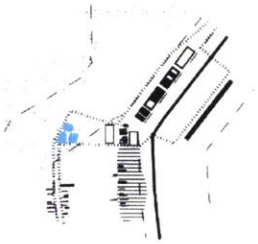


Growth Processes III

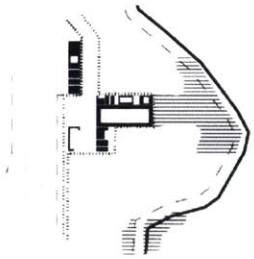


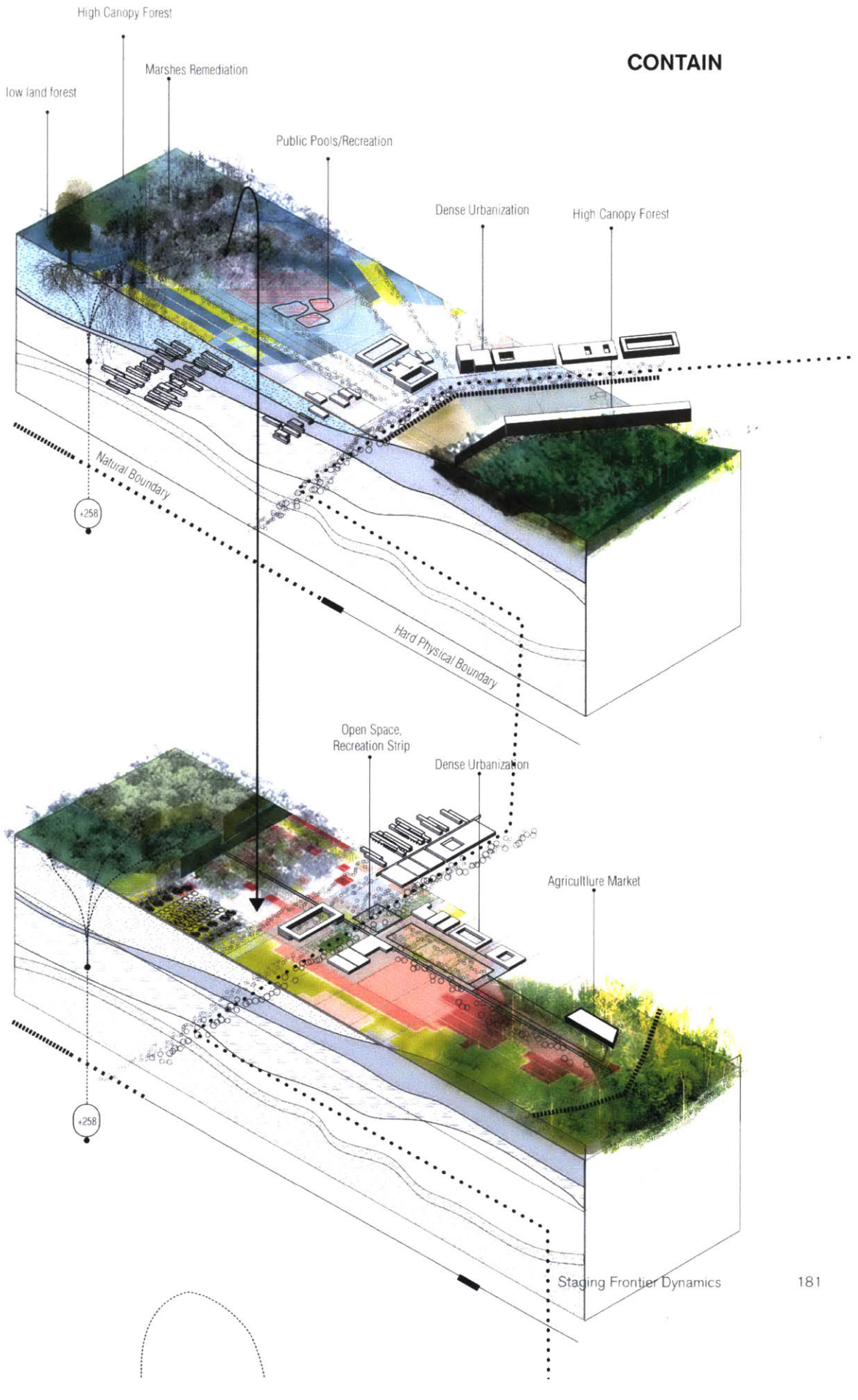
CONTAIN

Water Reclamation



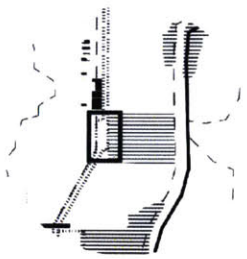
Market + Training Center

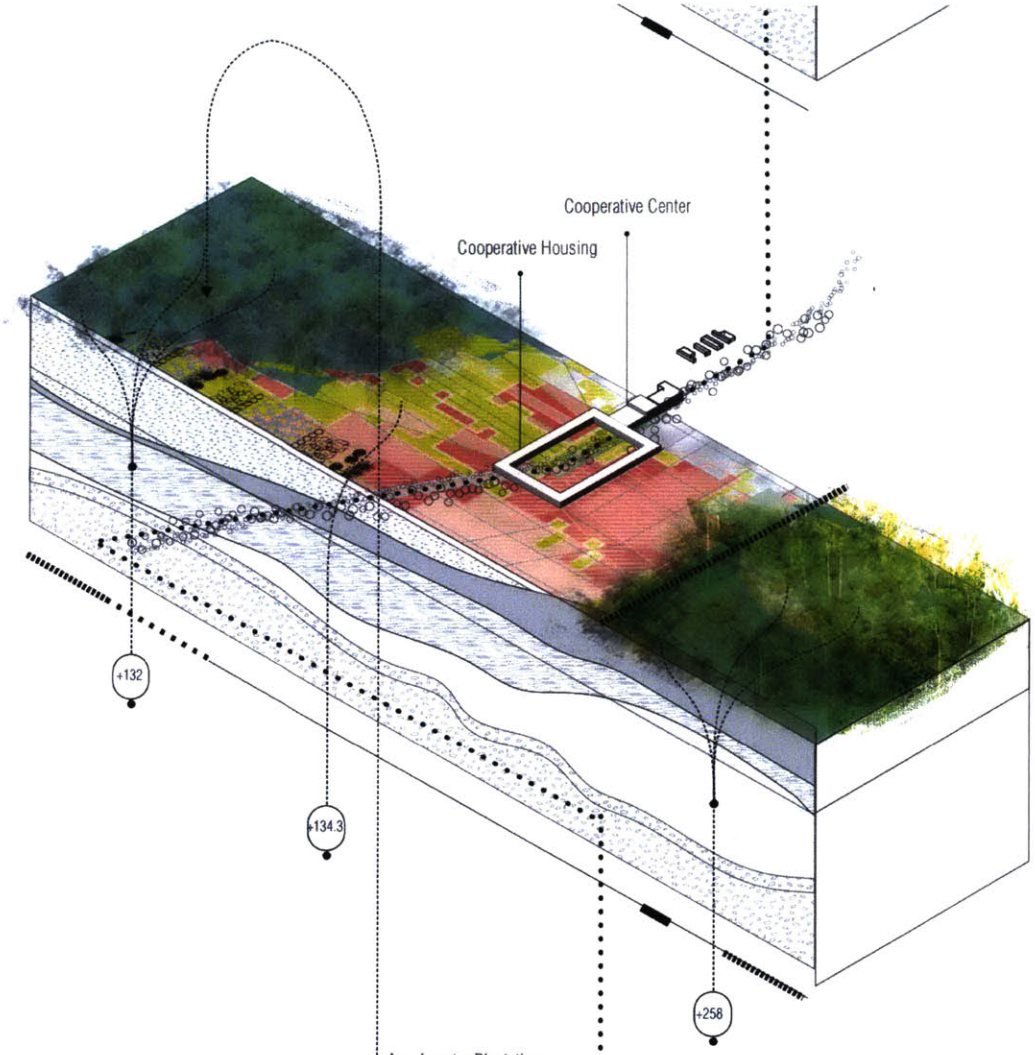




These two transects show the implementation of the economic buffer as a shared collective agricultural cooperative and the adjacent multipurpose agricultural plots. These productive landscapes themselves serve as a another buffer zone. The main shared, collective, social services fall within the proposed 'mediator' framework.

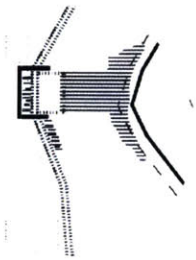
Agricultural Hub Center

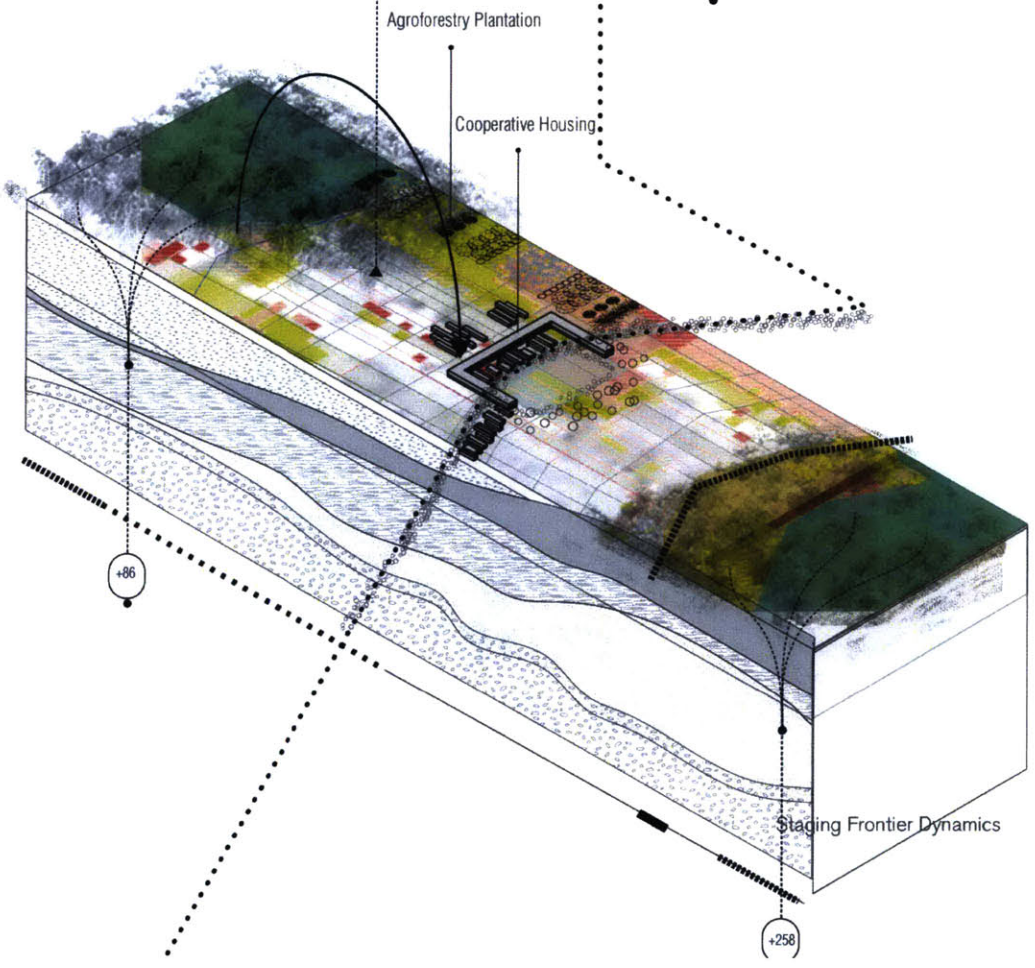


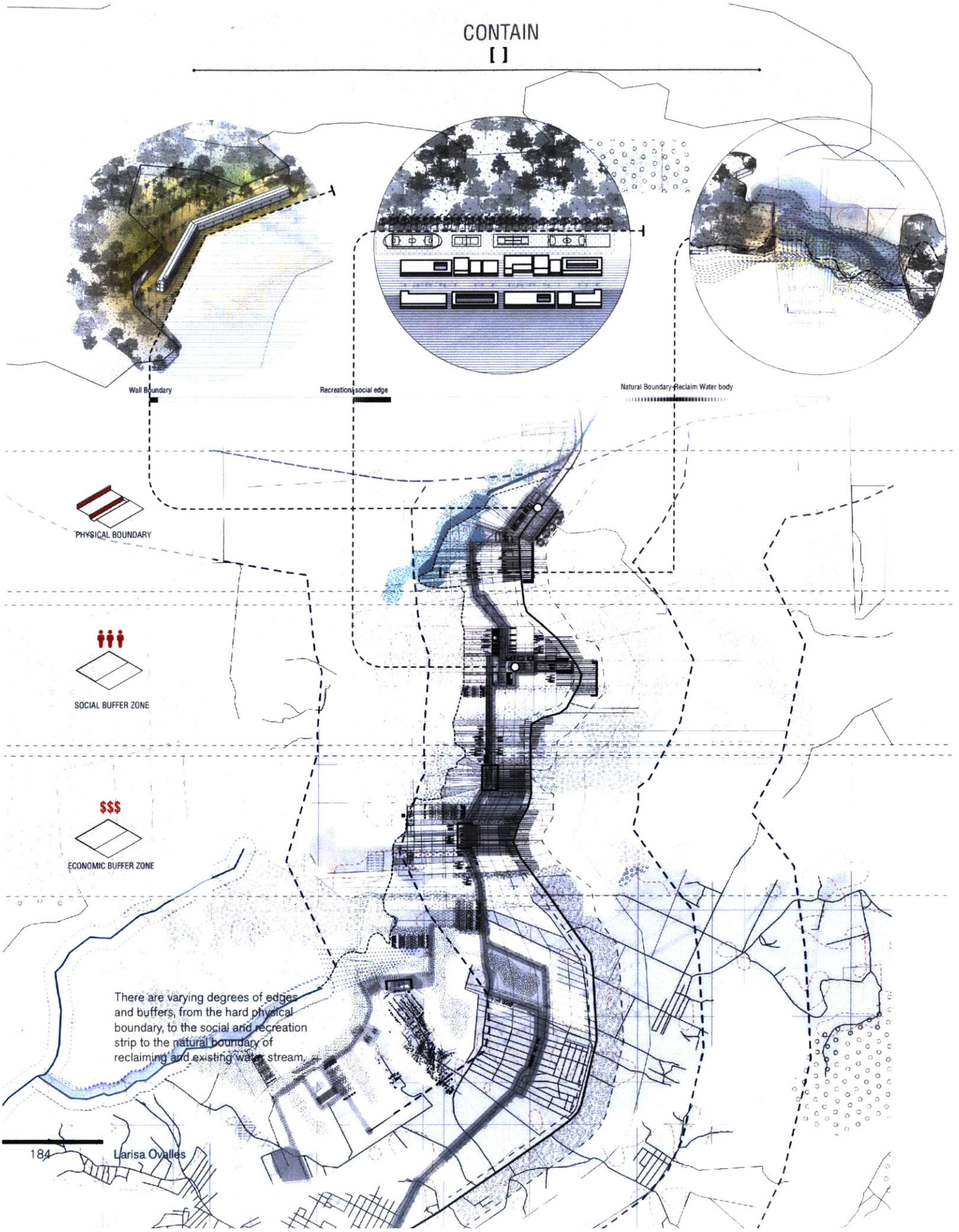


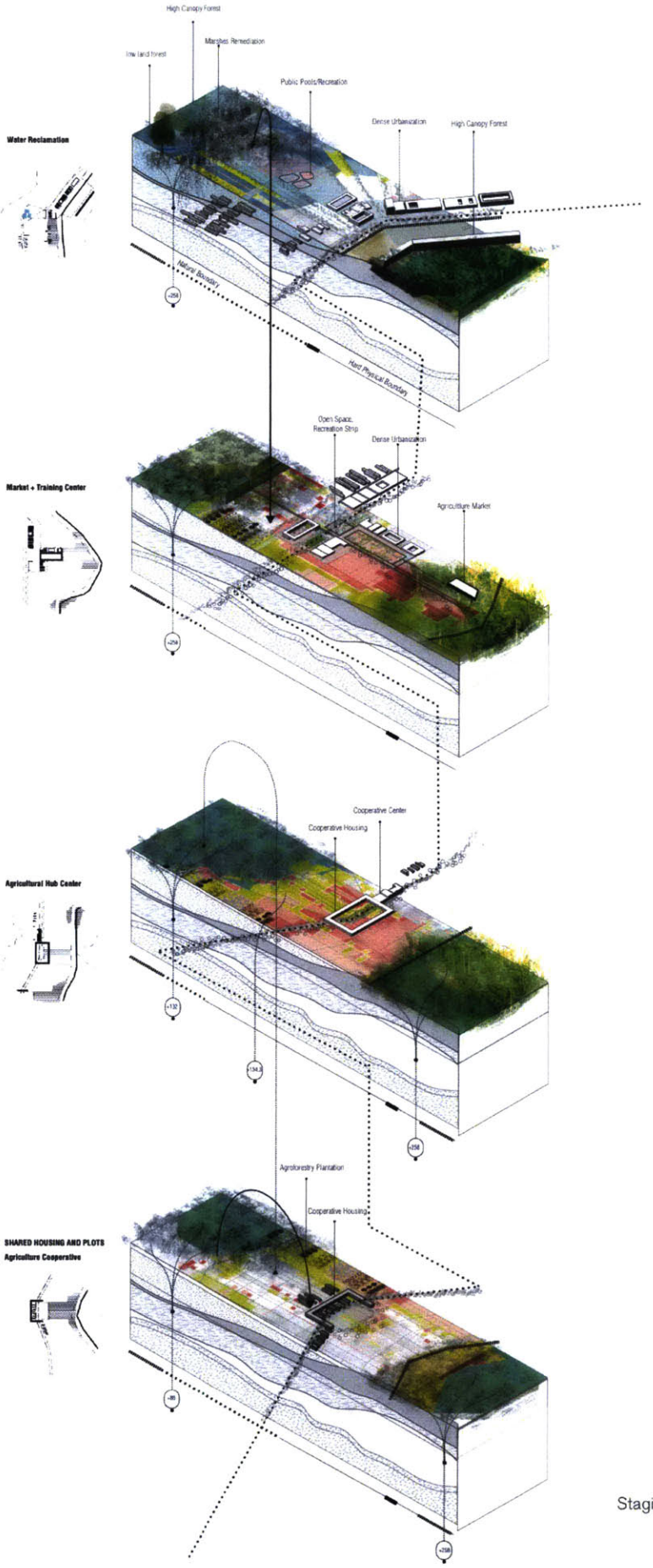
SHARED HOUSING AND PLOTS

Agriculture Cooperative

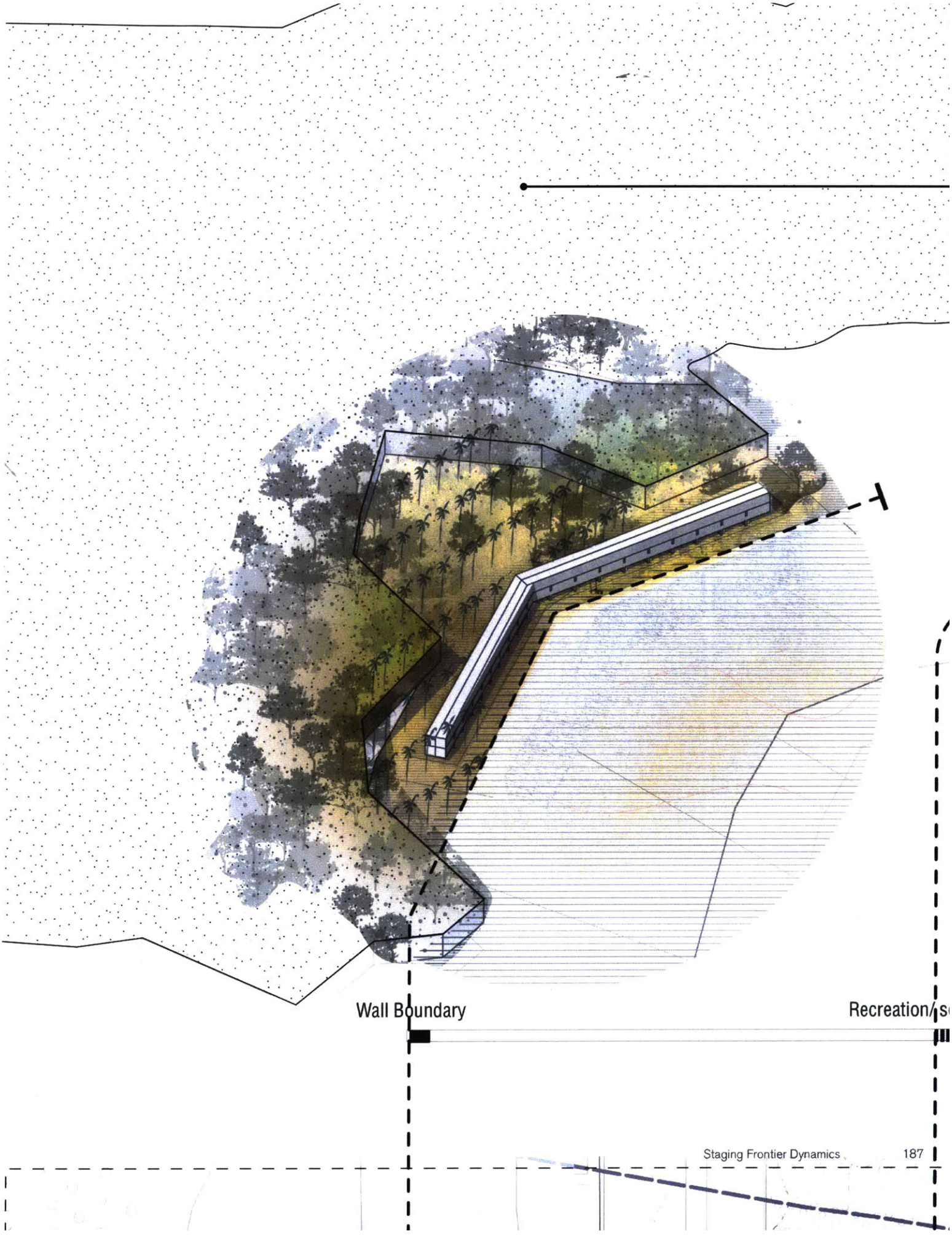





CONTAIN
[ ]
Wall Boundary
Recreation social edge
Natural Boundary Reclaim Water body
PHYSICAL BOUNDARY
SOCIAL BUFFER ZONE
$$$
ECONOMIC BUFFER ZONE
There are varying degrees of edges and buffers, from the hard physical boundary, to the social and recreation strip to the natural boundary of reclaiming and existing water stream.

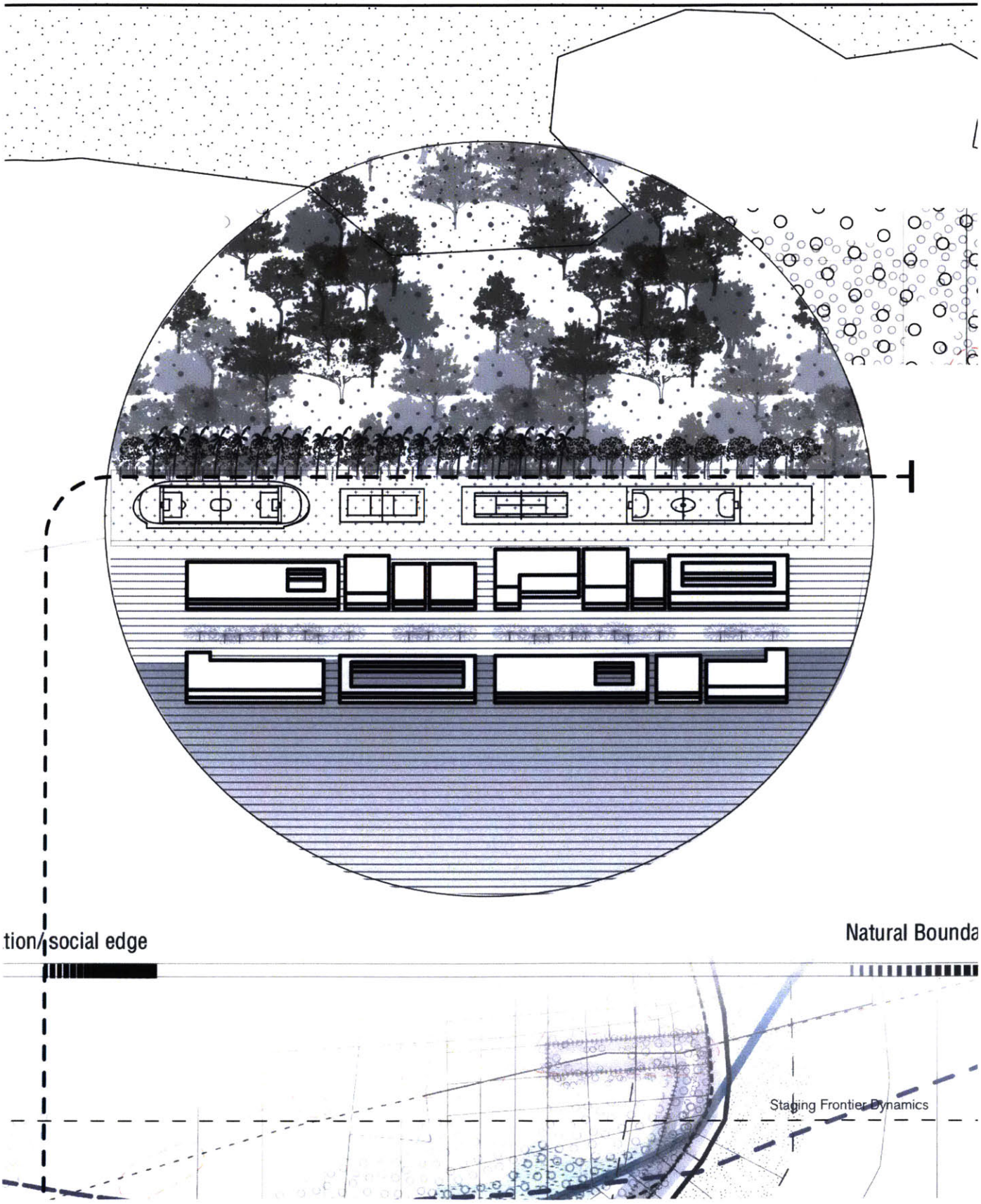

High Canopy Forest
Marshes Remediation
low land forest
Public Pools/Recreation
Dense Urbanization
High Canopy Forest
Water Reclamation
Nature Boundary
Hard Physical Boundary
Open Space, Recreation Strip
Dense Urbanization
Market + Training Center
Agriculture Market
Cooperative Center
Cooperative Housing
Agricultural Hub Center
Agroforestry Plantation
Cooperative Housing
SHARED HOUSING AND PLOTS
Agriculture Cooperative

Hard Physical Boundary
Building wall typology

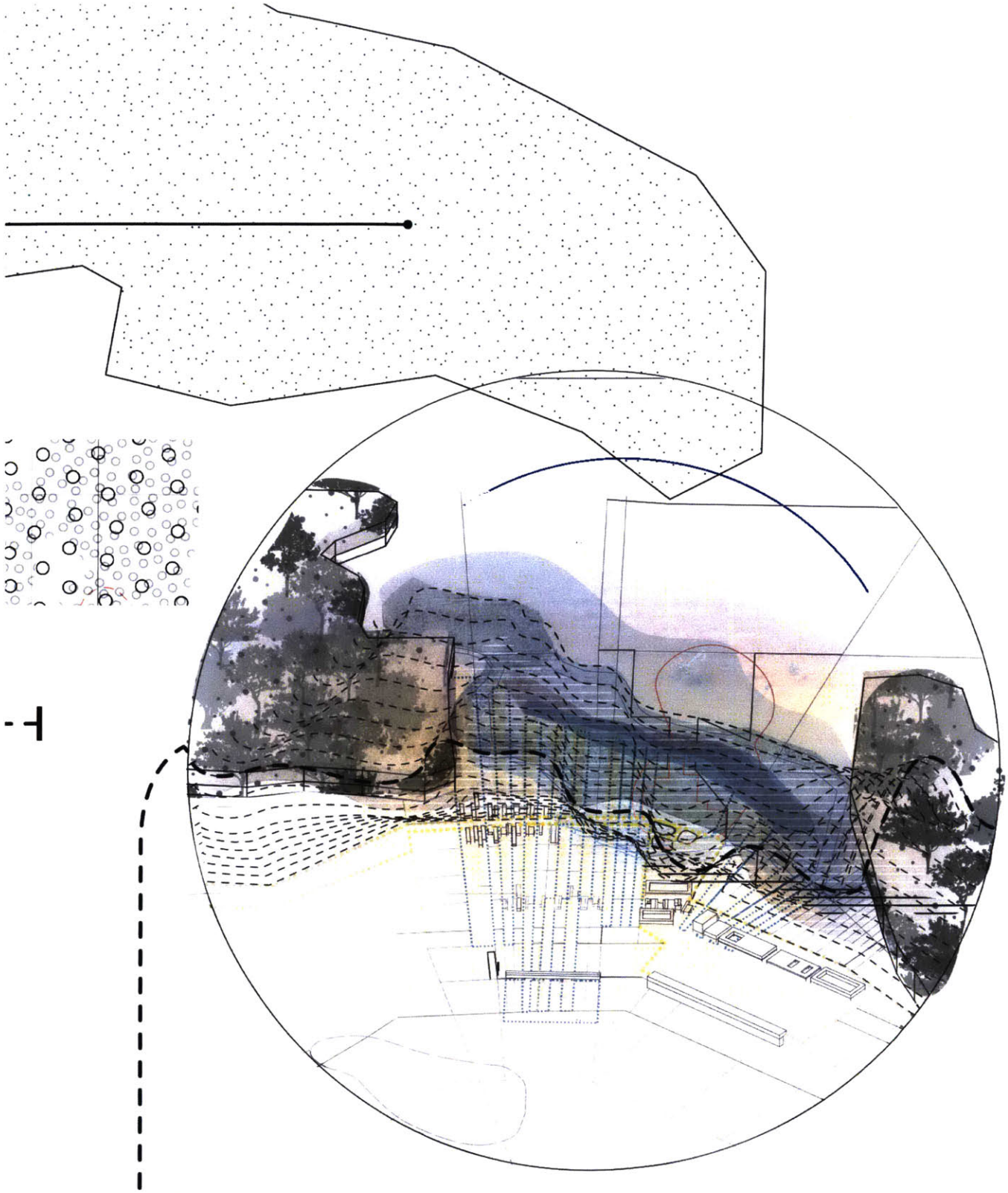

Wall Boundary
Recreation/s

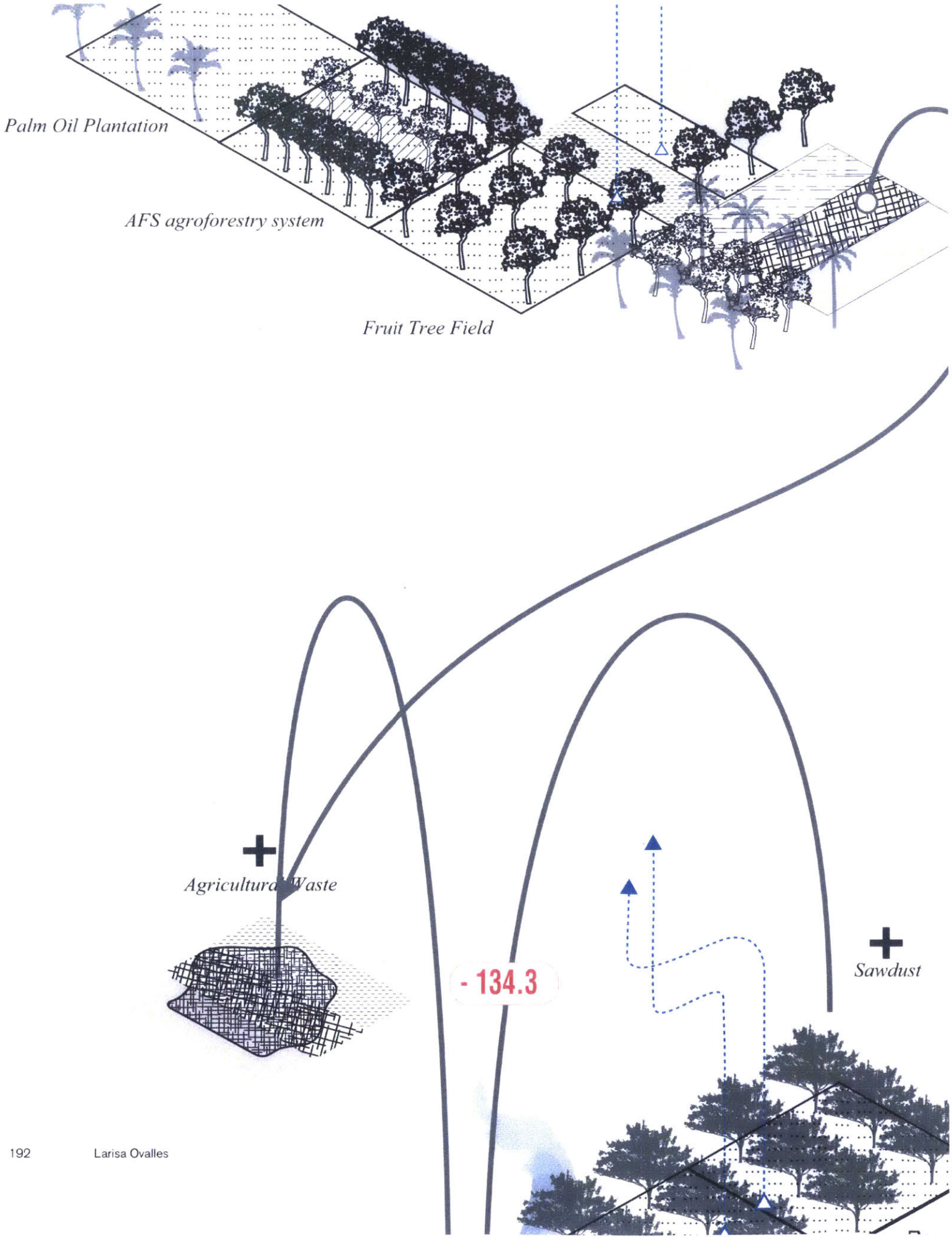
Social Buffer Boundary
Public Market and Recreation strip
typology

CONTAIN
[ ]



Natural Feature Buffer Boundary
Reclaiming and existing water stream strategy


ural Boundary-Reclaim Water body


Palm Oil Plantation
AFS agroforestry system
Fruit Tree Field
Agricultural Waste
- 134.3
Sawdust

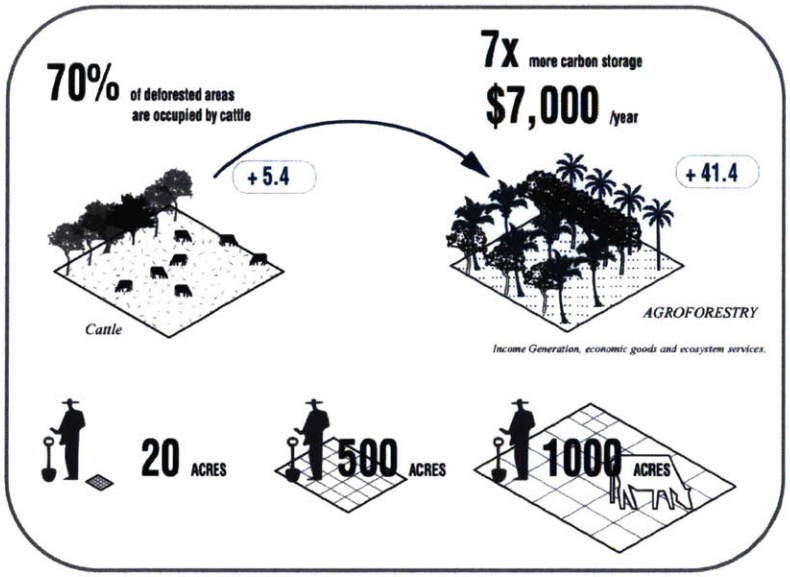
ADD: Productive Landscapes

The hybrid productive zone, mainly located on the other side of the mediating buffer framework from the 'contain' strategy capitalizes on the hybrid, dynamic and disarticulated landscape to drive the economic and productive zone.

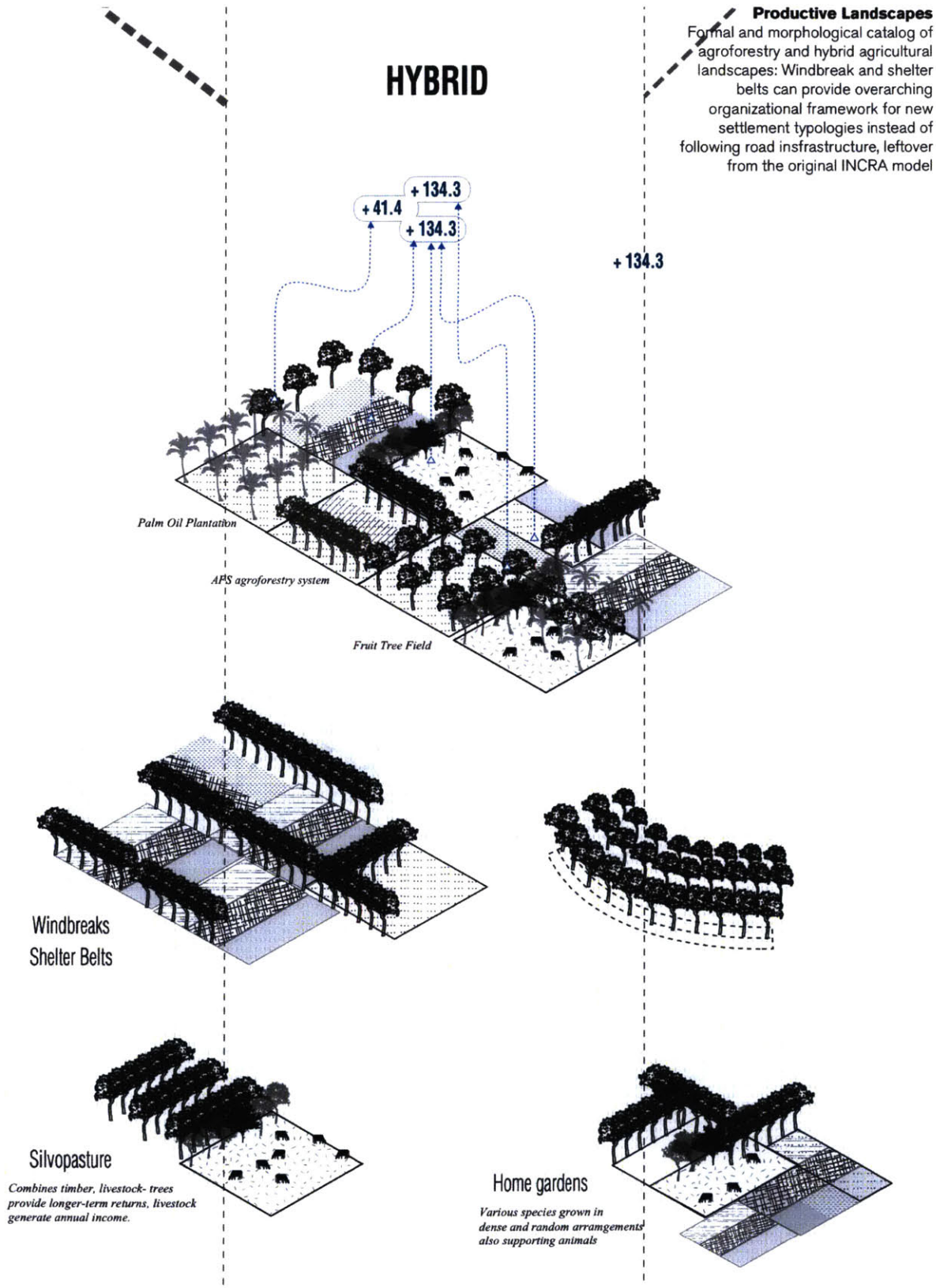
Within this negotiation area, the objective is to encourage the best use of already deforested areas, considering technological innovation and alternative hybrid production systems, such as pasture management, agroforestry, crop-livestock-forest integration,

My main focus being on the shift to agroforestry an effective strategy linking environmental opportunities with economic realities, while enhancing the livelihoods of those in the region. An increase in units dedicated to complex agroforestry and managed secondary forest systems.

Productive Landscapes

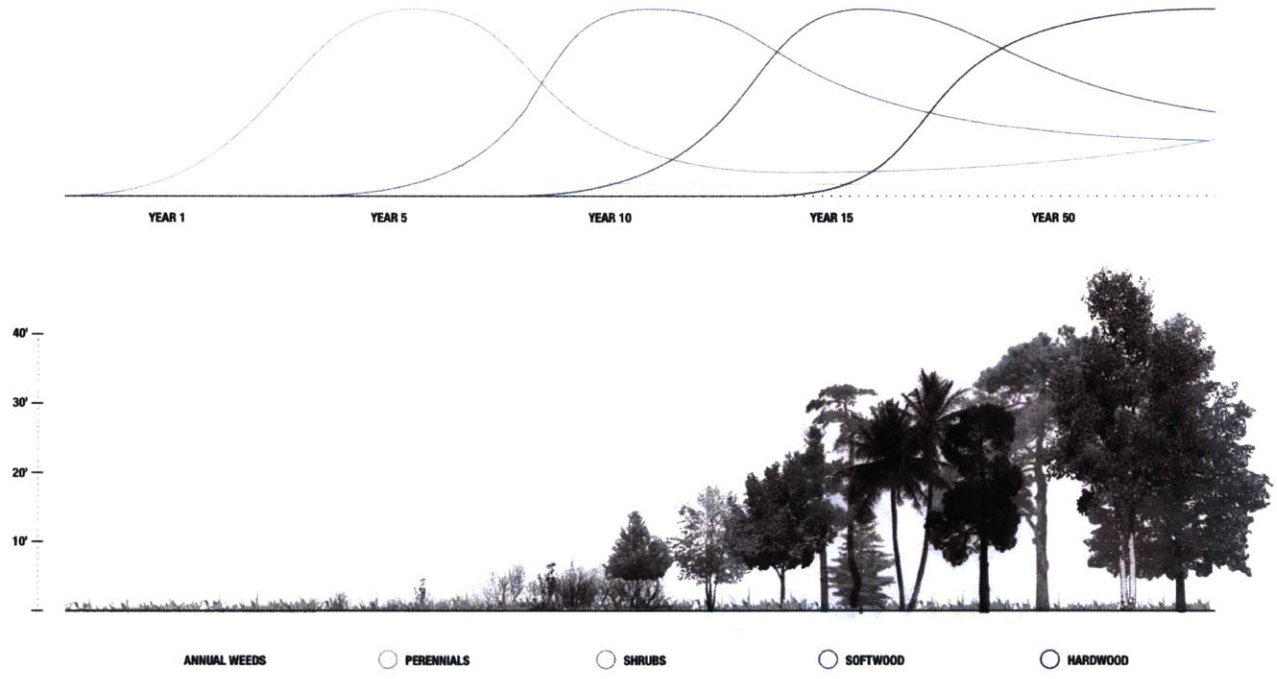


Productive Landscapes
Agroforestry systems compared to land use for cattle grazing pastures. Proposed agroforestry hybrid zone will have overall economic and environmental benefits

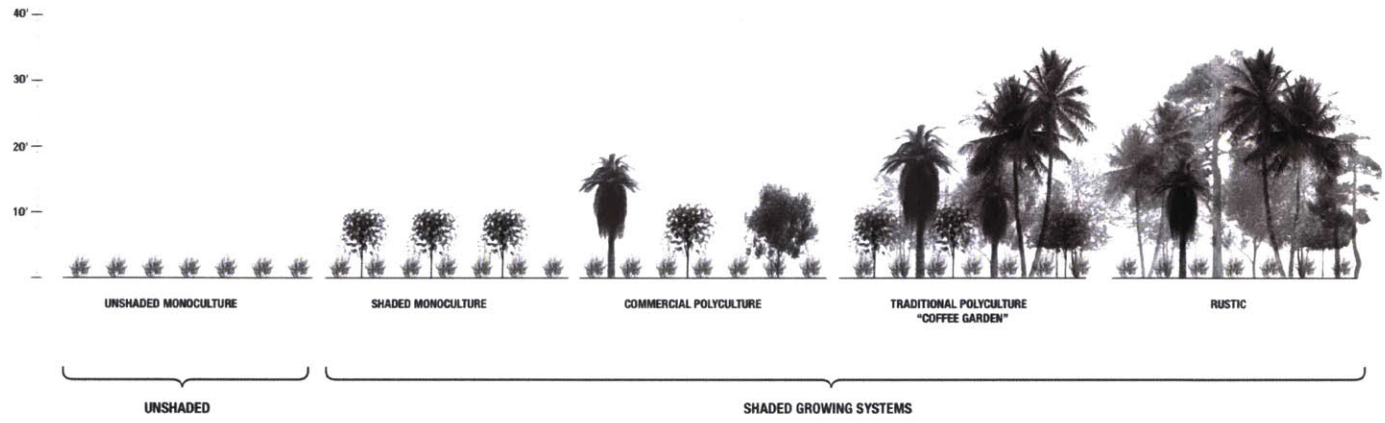


Productive Landscapes
Formal and morphological catalog of agroforestry and hybrid agricultural landscapes: Windbreak and shelter belts can provide overarching organizational framework for new settlement typologies instead of following road insfrastructure, leftover from the original INCRA model

Natural Forest Succession/
Ecological Regrowth Timeline



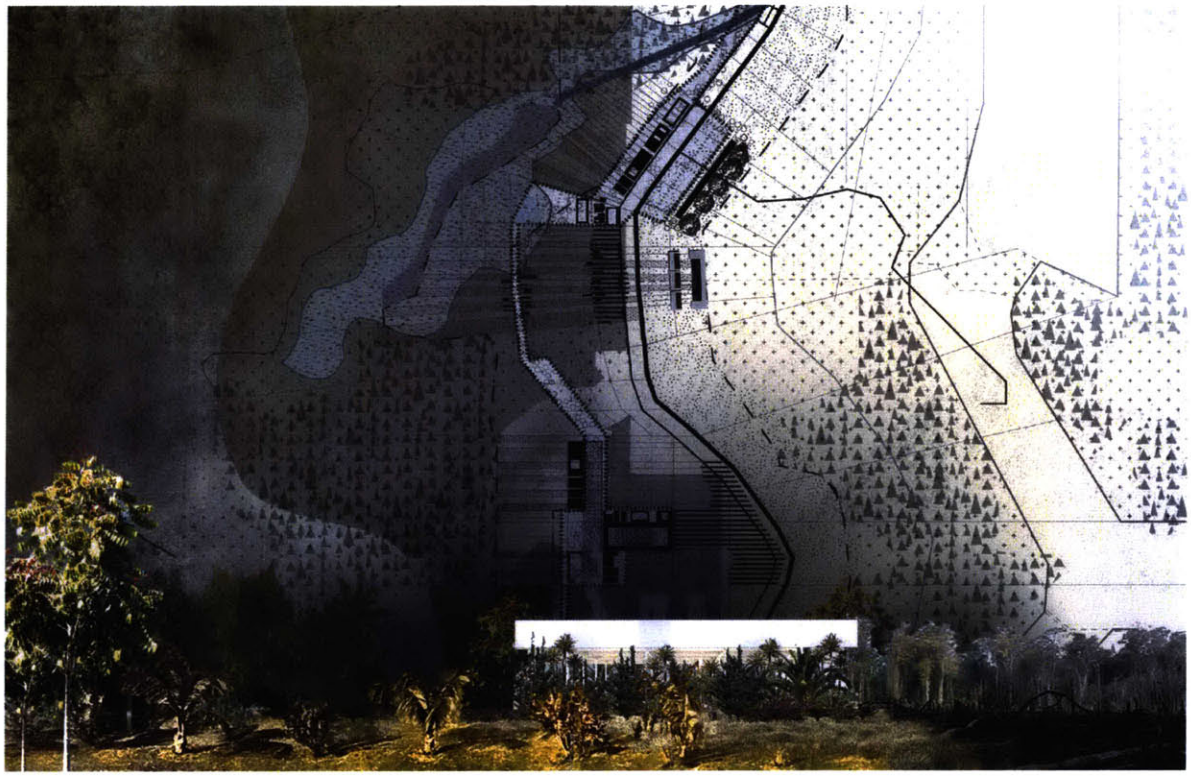
Agroforestry System Timeline

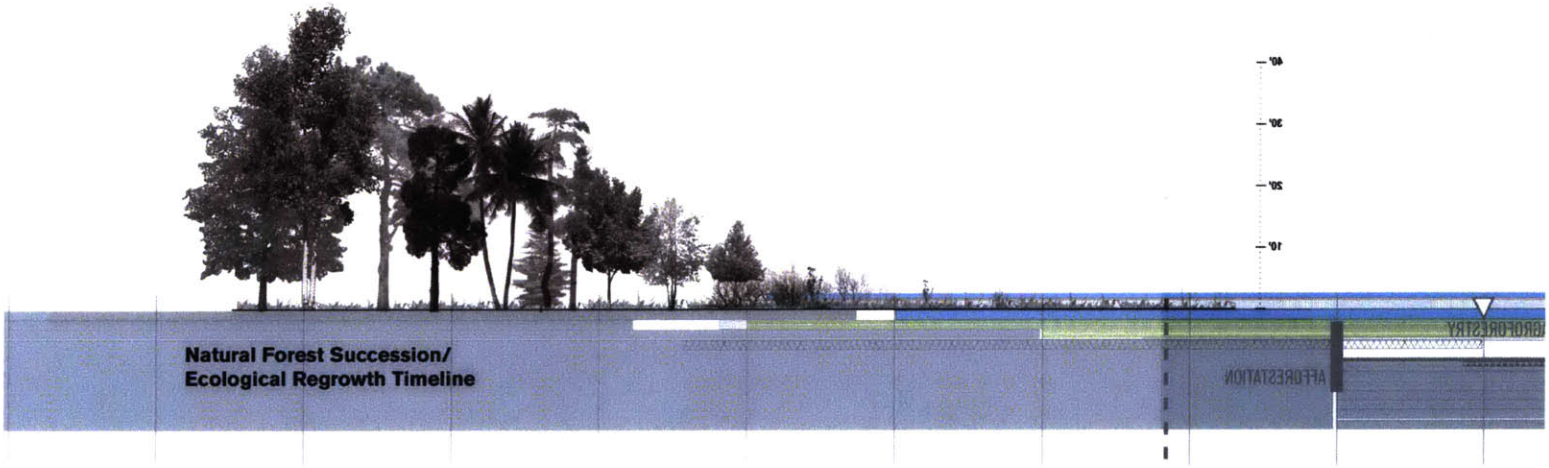


Contain

[ ]

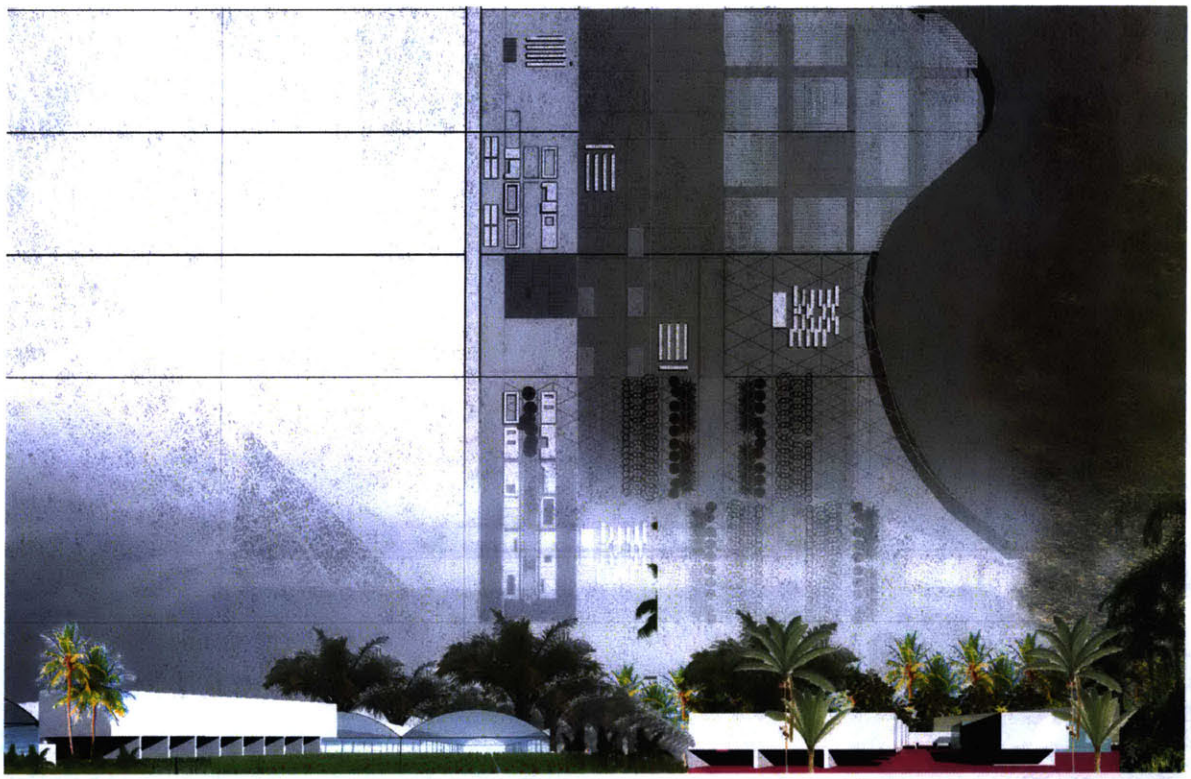
CONTAIN STRATEGY
By guiding development in a certain direction, secondary growth and reforestation processes can begin to link ecological corridors

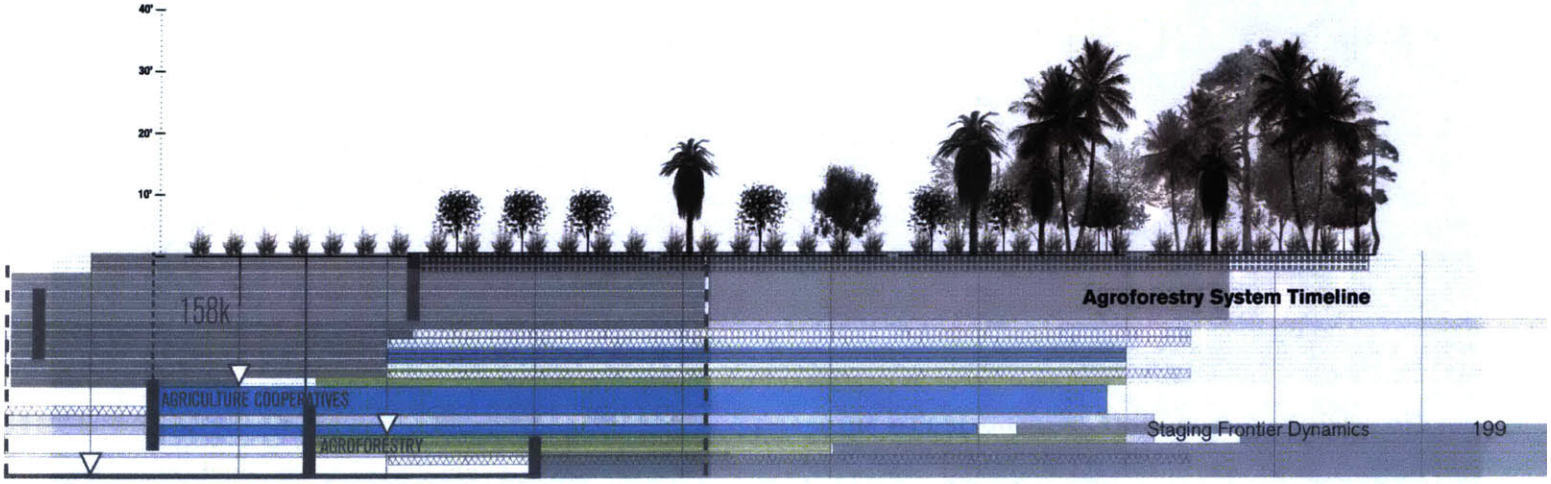


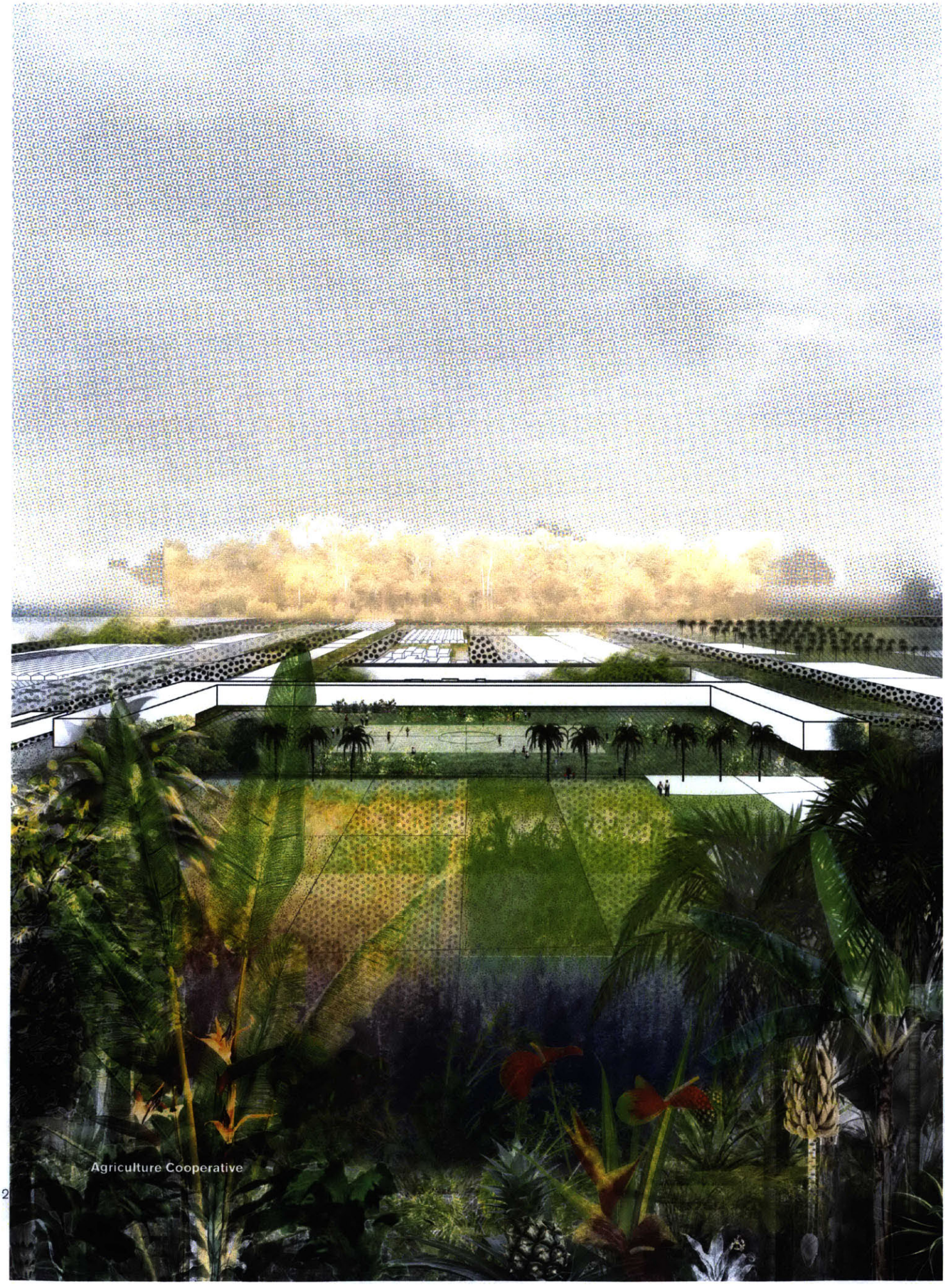


Natural Forest Succession/ Ecological Regrowth Timeline

Productive
+

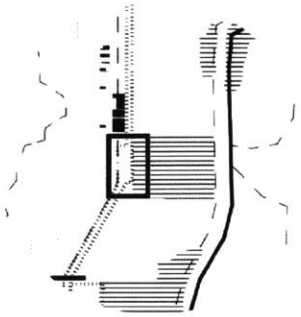



40'
30'
20'
10'
158k
AGRICULTURE COOPERATIVES
AGROFORESTRY
Agroforestry System Timeline



Agriculture Cooperative

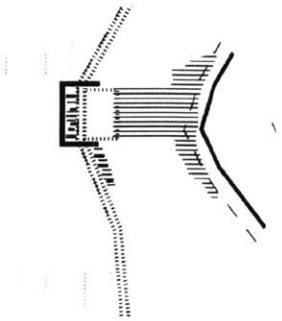
Agricultural Hub Center



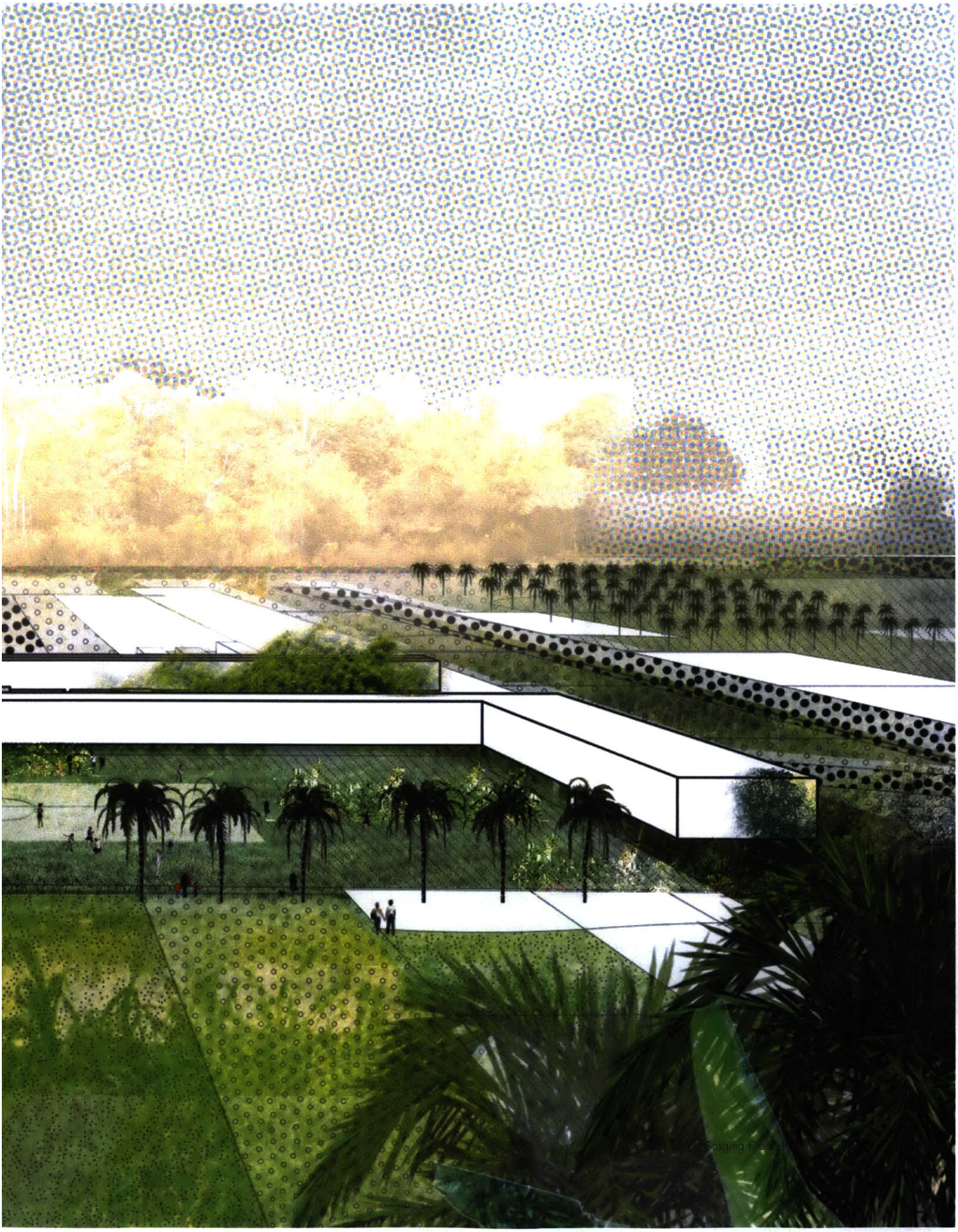
Agriculture Cooperative
Collective shared settlement pattern, consolidation of land and promotes social interaction, and productive alternatives to land use transformations

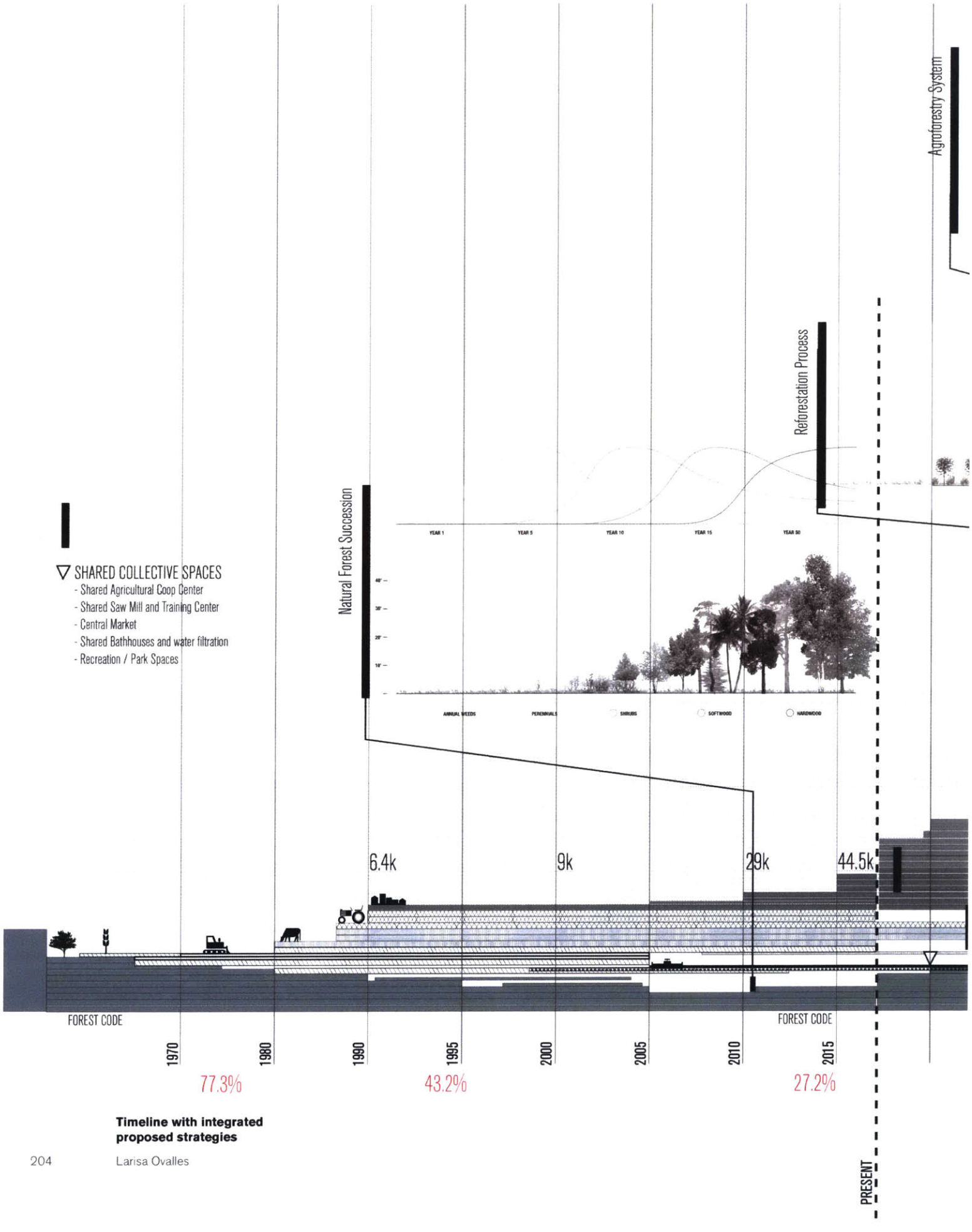
SHARED HOUSING AND PLOTS

Agriculture Cooperative

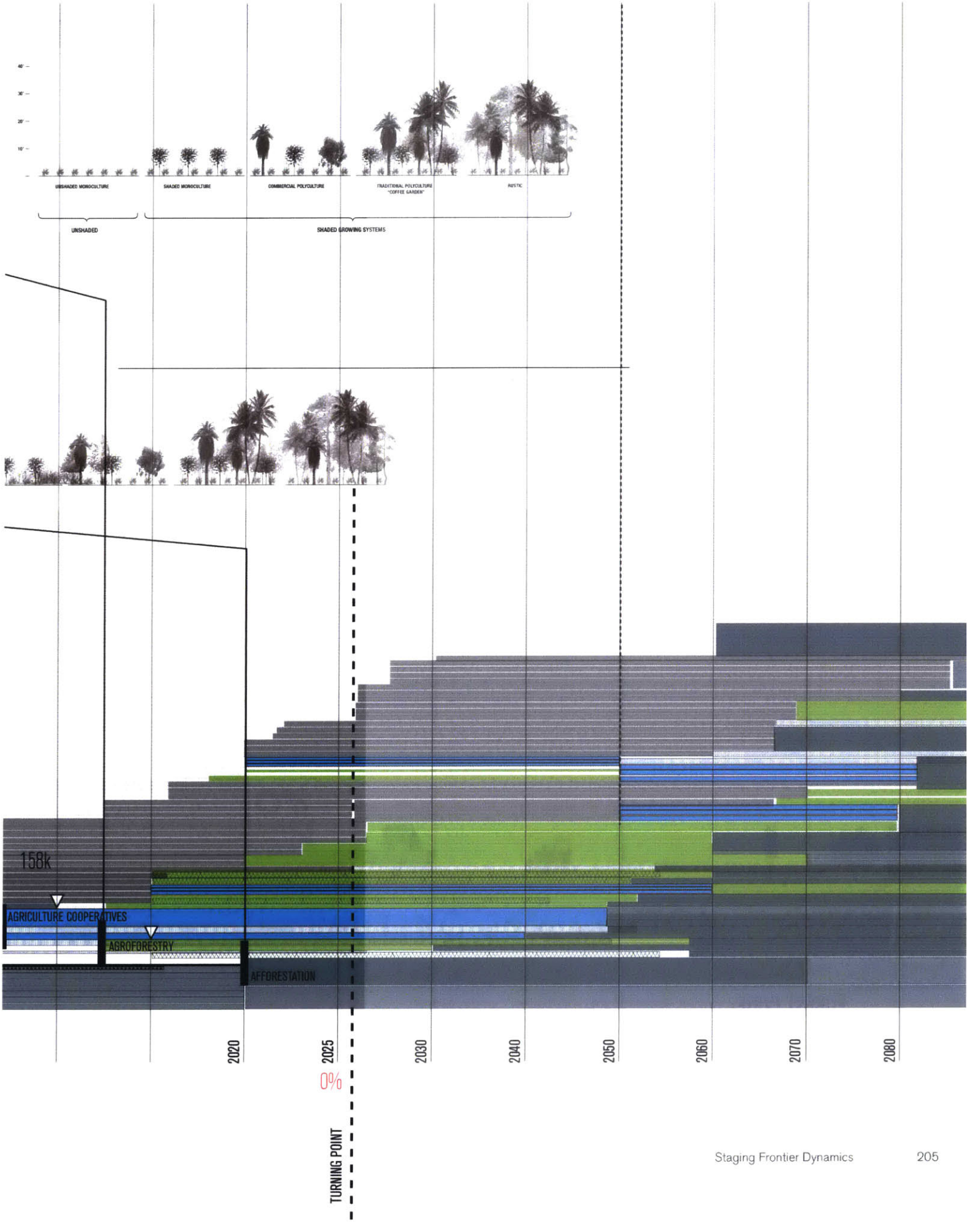



Agriculture Cooperative



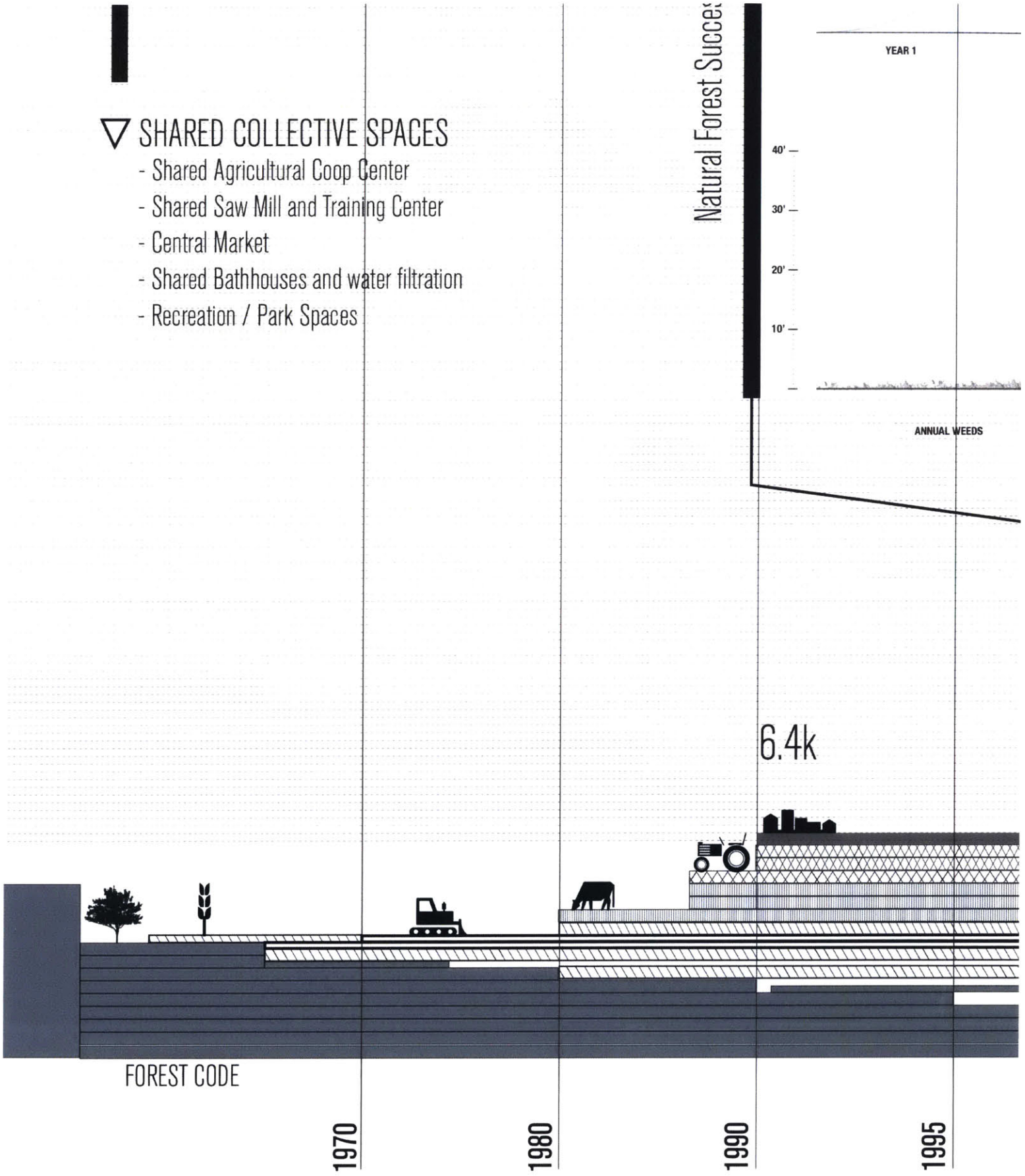


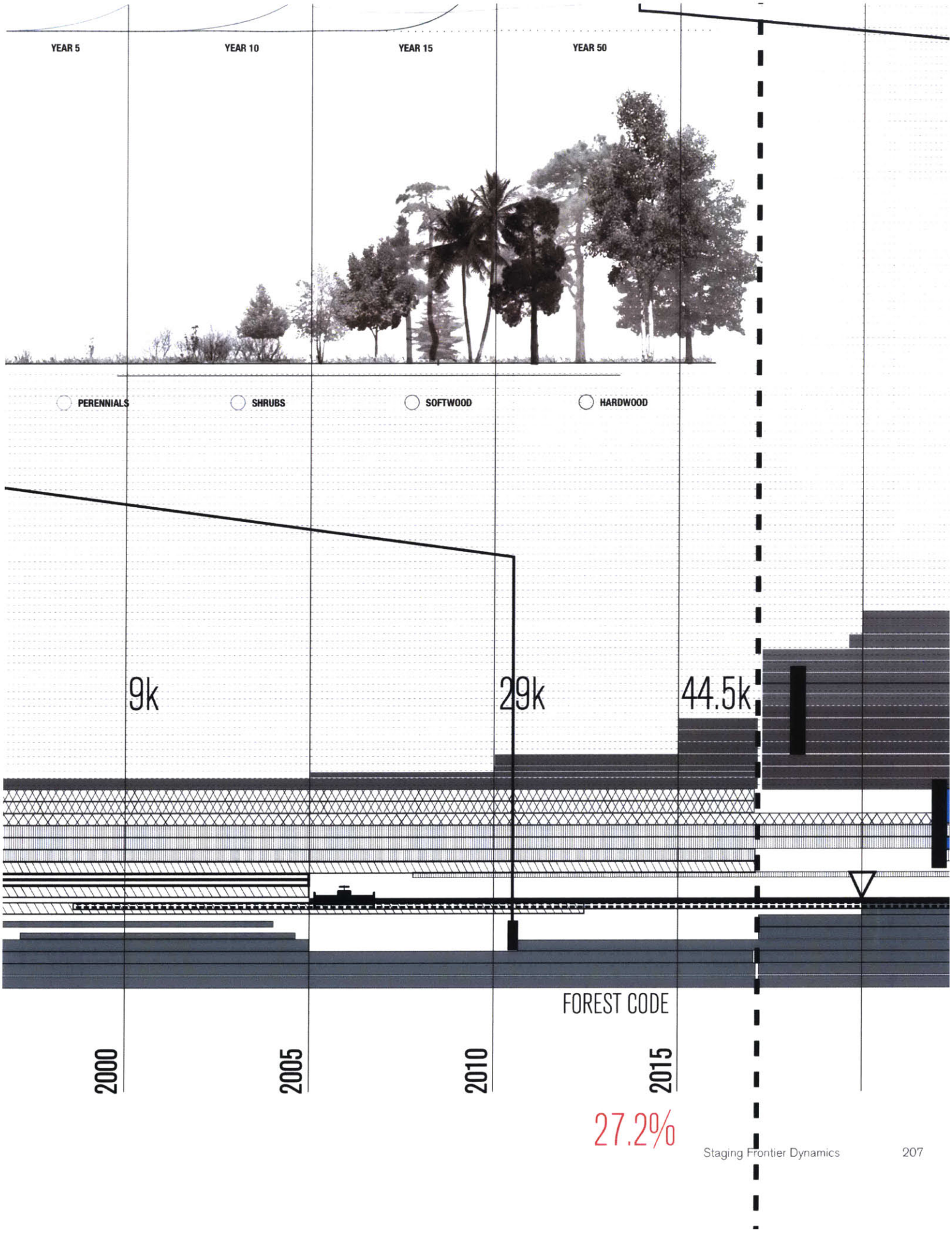
Timeline with integrated proposed strategies


40'
30'
20'
10'
UNSHADED MONOCULTURE
SHADED MONOCULTURE
COMMERCIAL POLYCULTURE
TRADITIONAL POLYCULTURE "COFFEE GARDEN"
RUSTIC
UNSHADED
SHADED GROWING SYSTEMS
158k
AGRICULTURE COOPERATIVES
AGROFORESTRY
AFFORESTATION
2020
2025
2030
2040
2050
2060
2070
2080
0%
TURNING POINT

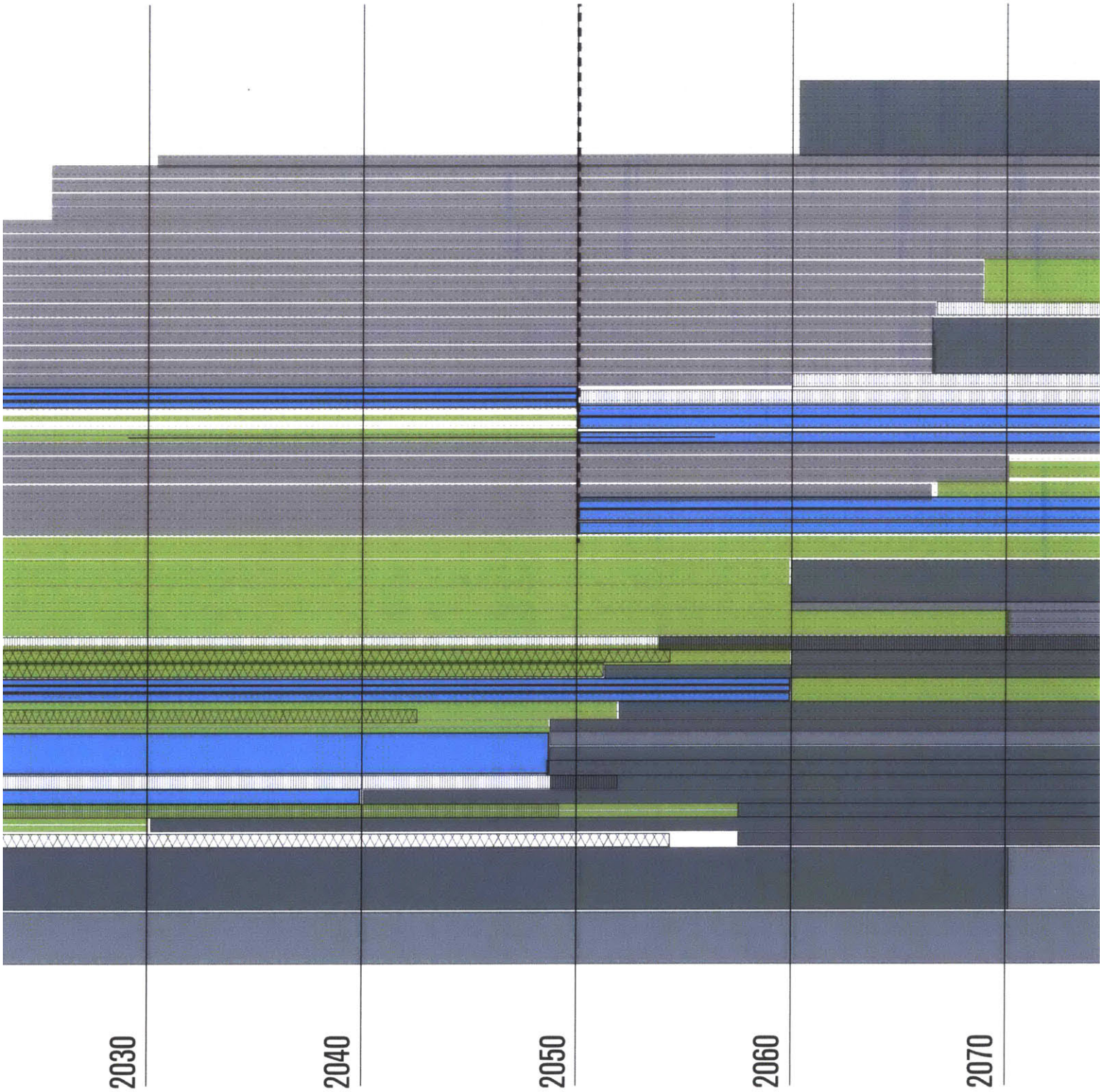
▽ SHARED COLLECTIVE SPACES

- Shared Agricultural Coop Center
- Shared Saw Mill and Training Center
- Central Market
- Shared Bathhouses and water filtration
- Recreation / Park Spaces




YEAR 5
YEAR 10
YEAR 15
YEAR 50
PERENNIALS
SHRUBS
SOFTWOOD
HARDWOOD
9k
29k
44.5k
FOREST CODE
2000
2005
2010
2015
27.2%

1.5k
158k
AGRICULTURE COOPERATIVES
AGROFORESTRY
AFFORESTATION
2020
2025
0%
PRESENT
TURNING POINT


2030
2040
2050
2060
2070

05

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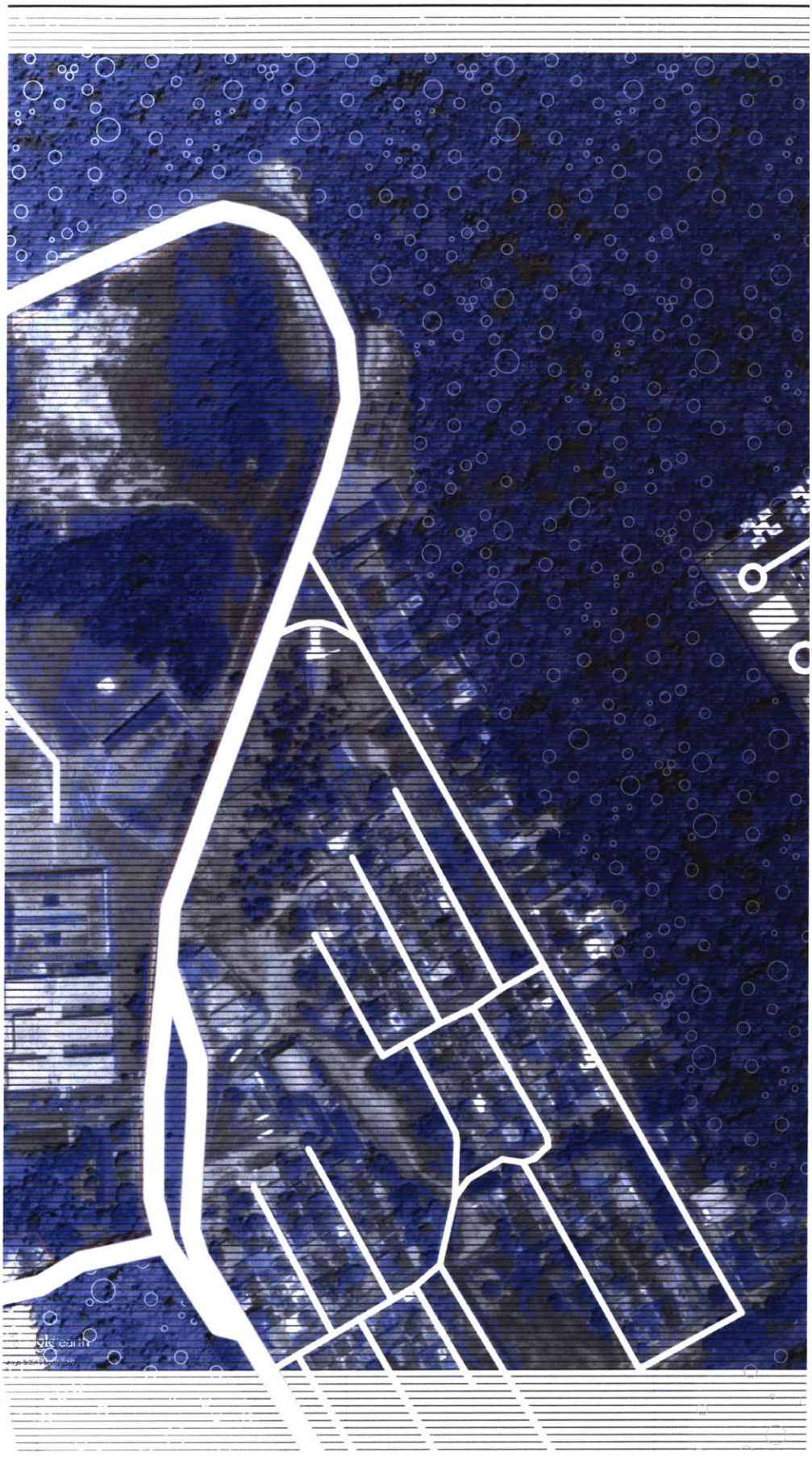
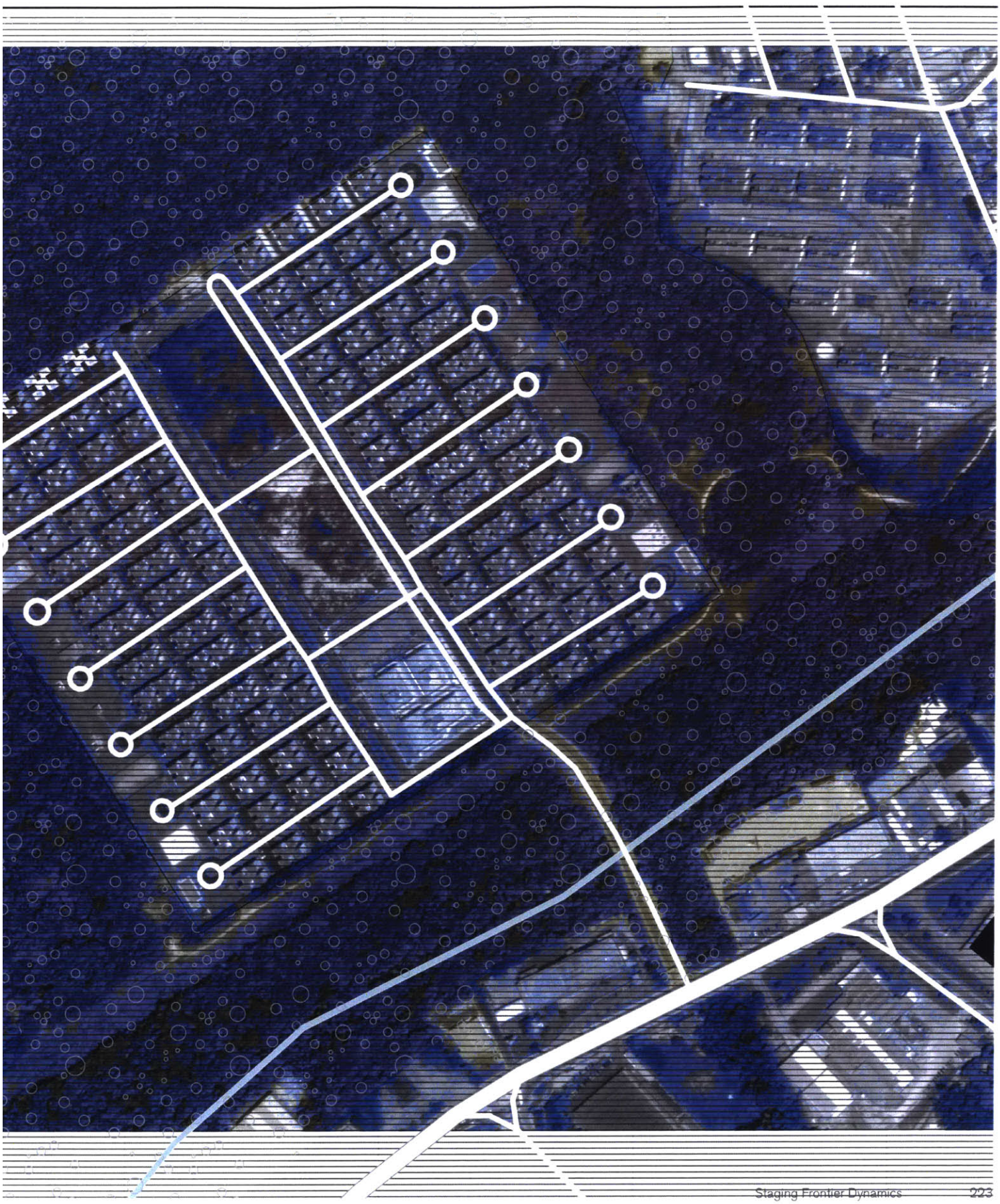
06

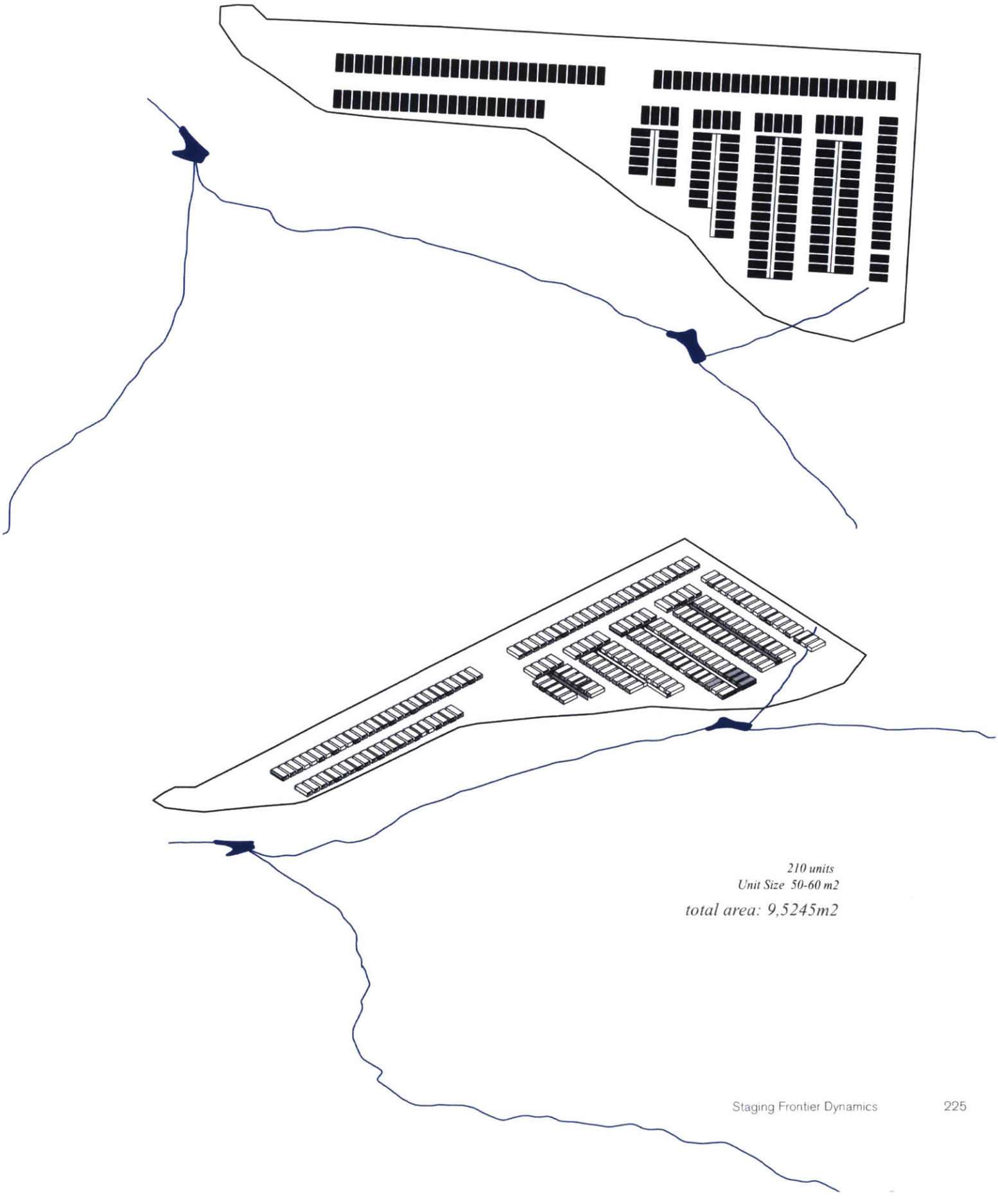
APPENDIX



MCMV Housing Estate



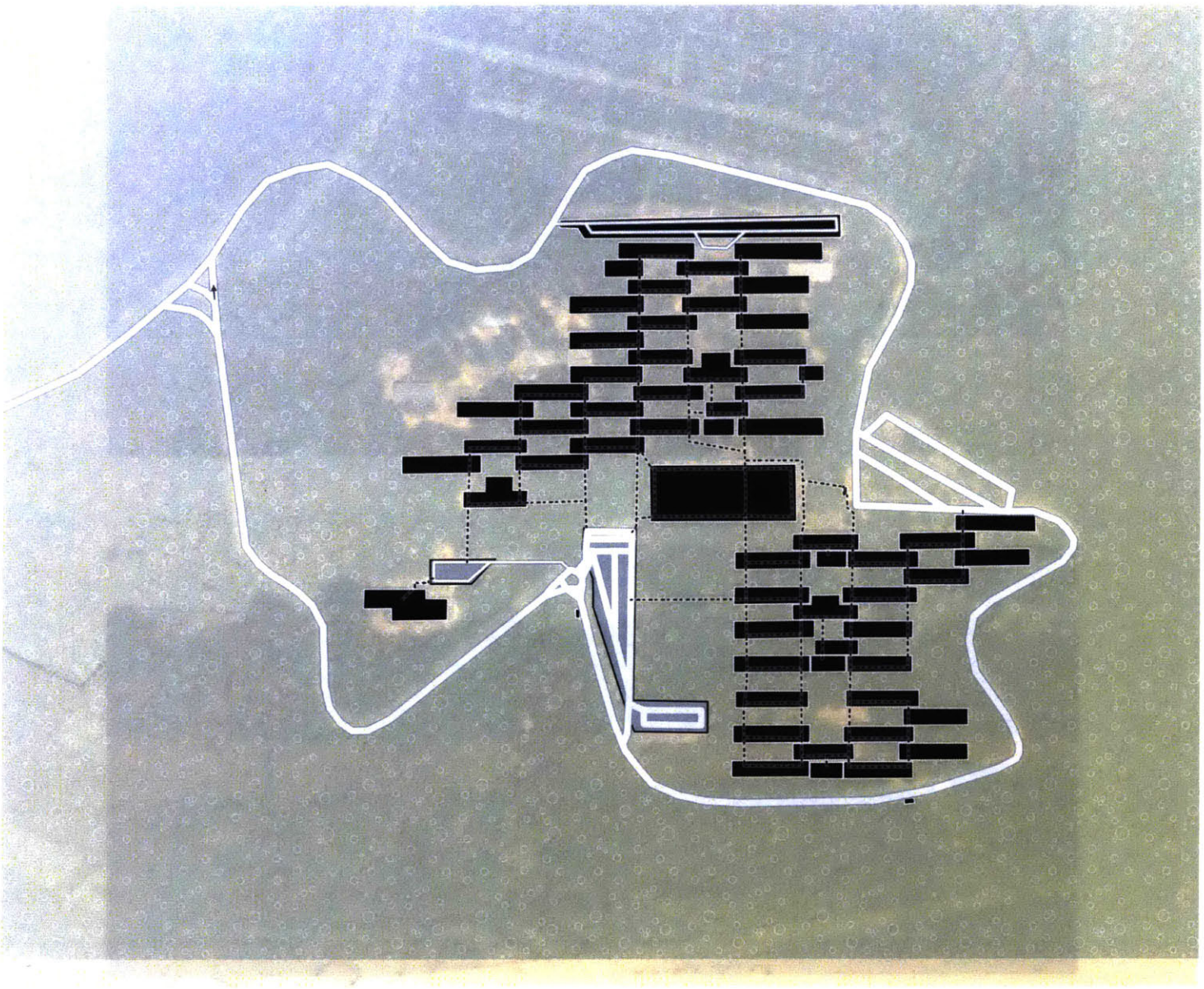
MCMV Housing Estate



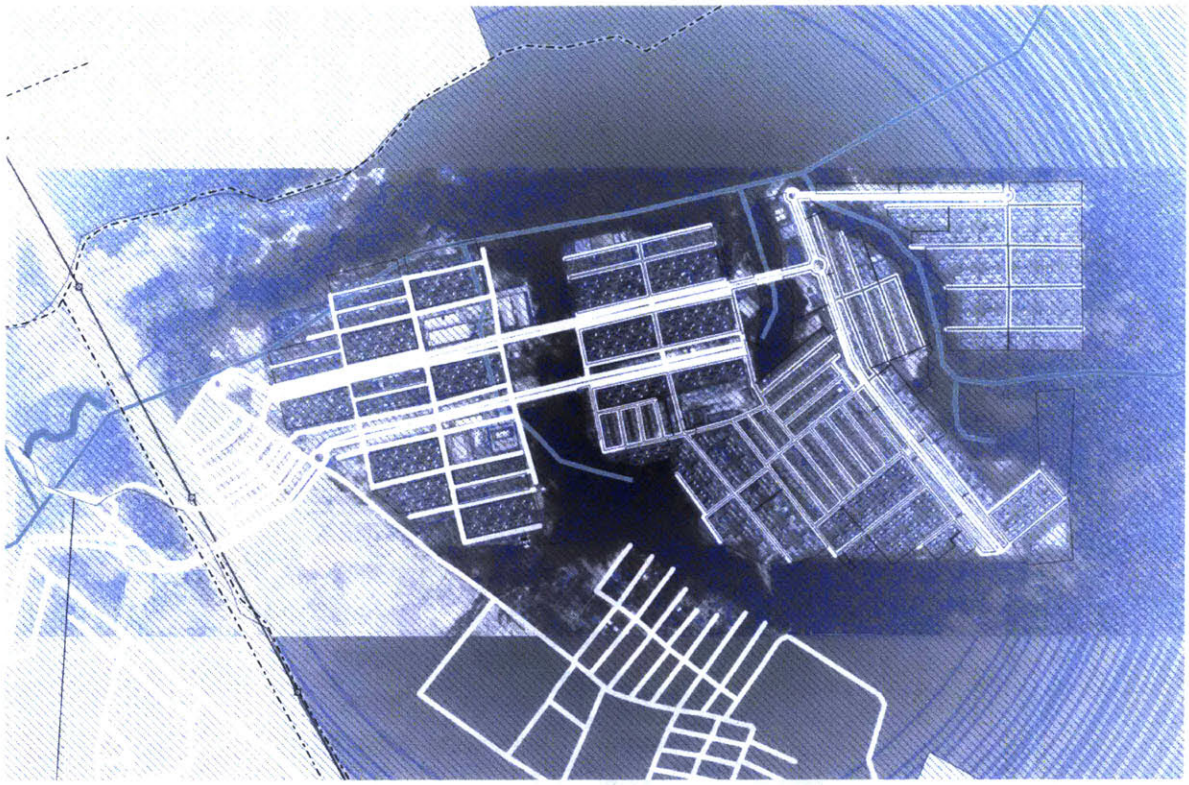
210 units
Unit Size 50-60 m2

total area: 9,5245m2

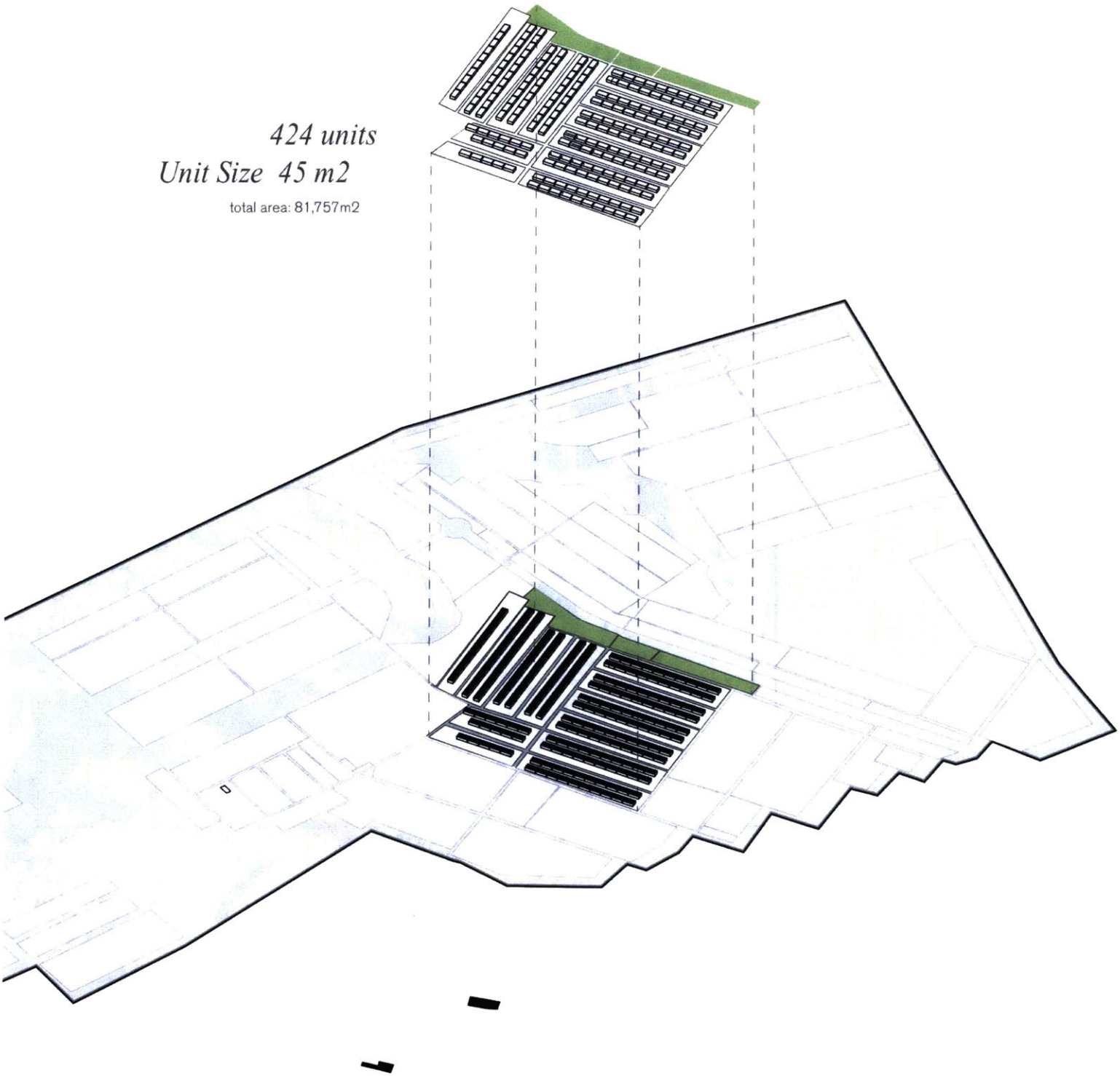
UFAM, Manus University
Designed by modernist architect Severiano Mario Porto, provides a good alternative example of an urban-forest integrated design

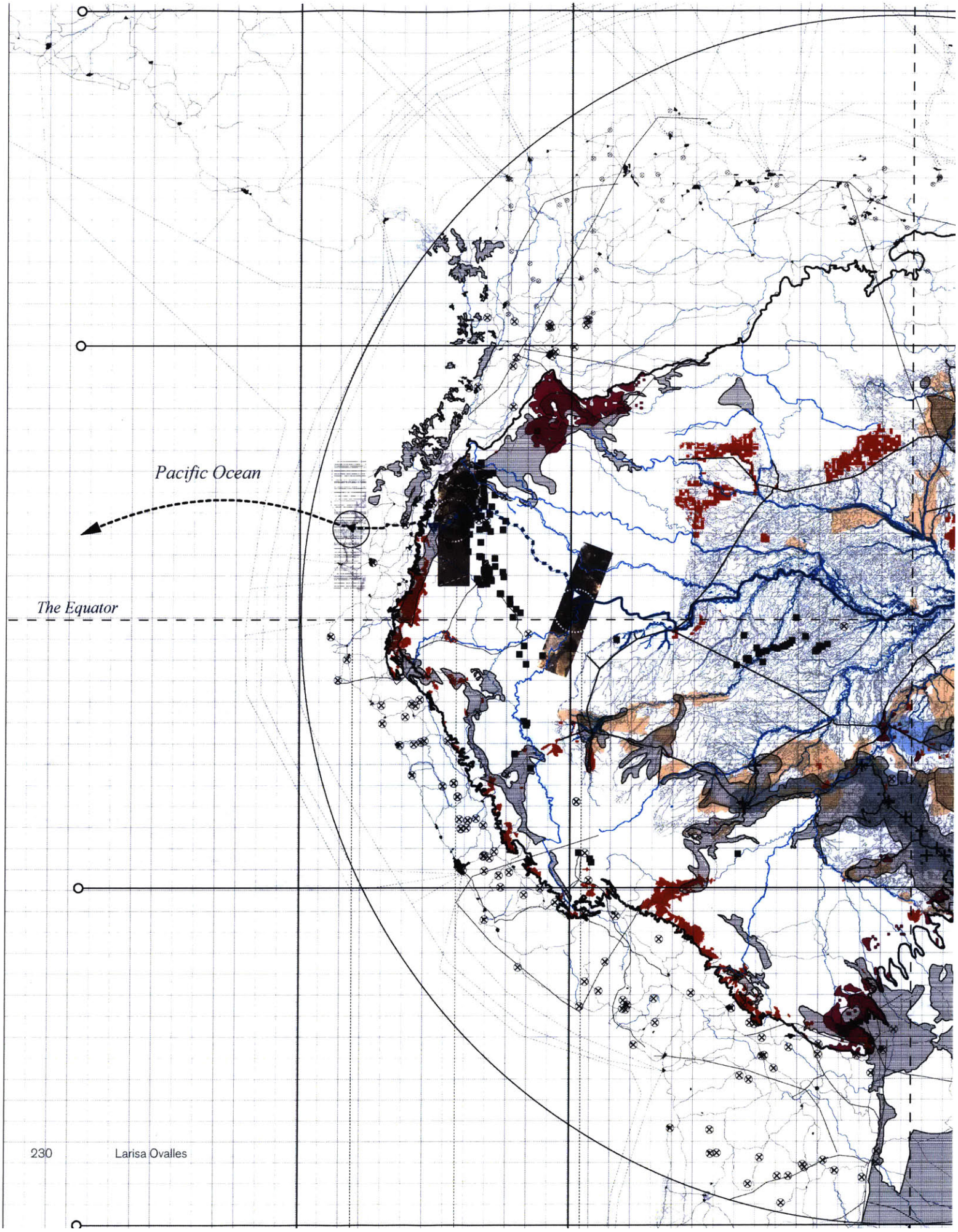


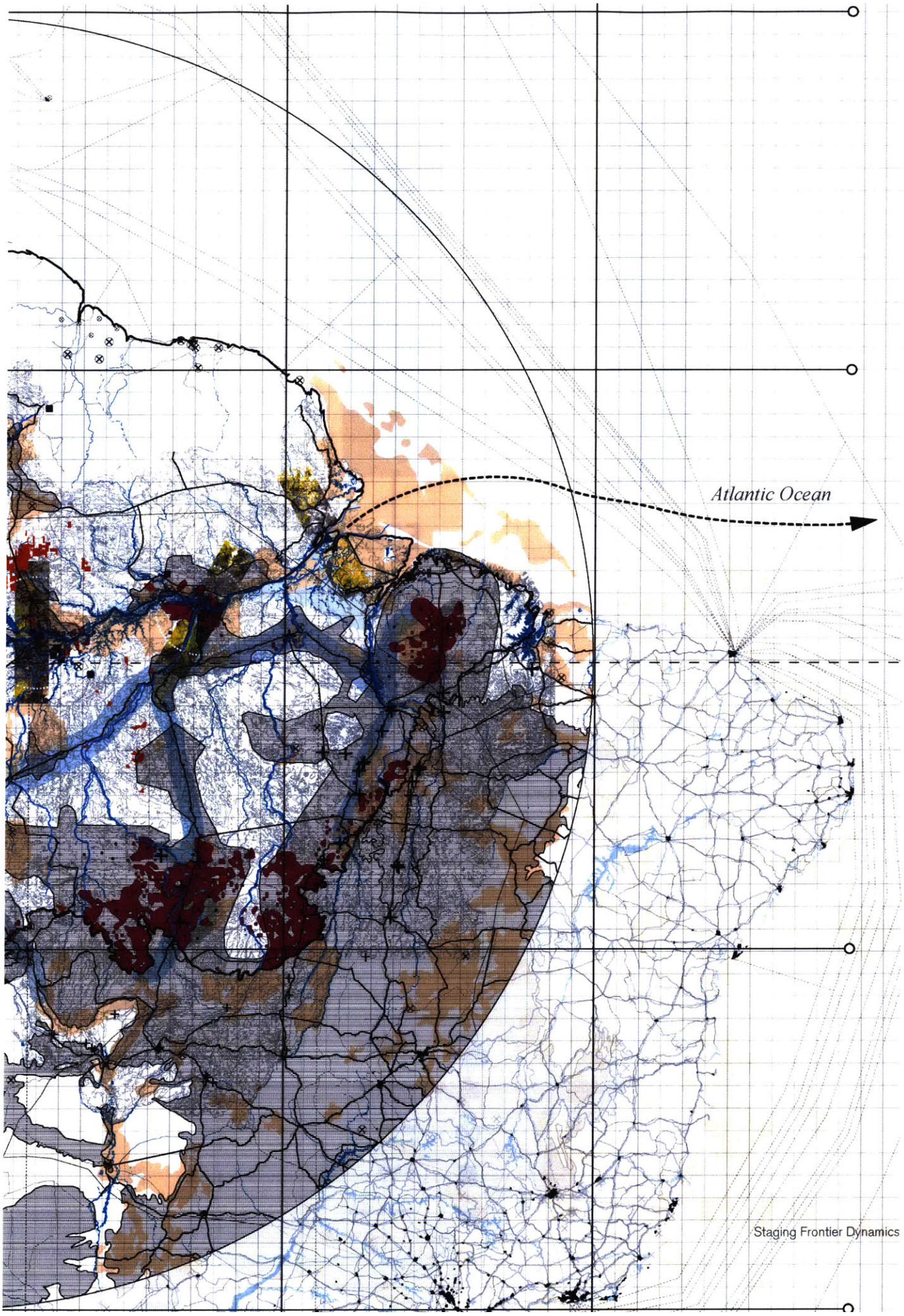
UFAM, Manus University
The overall layout and structure follows a more urban concept scheme

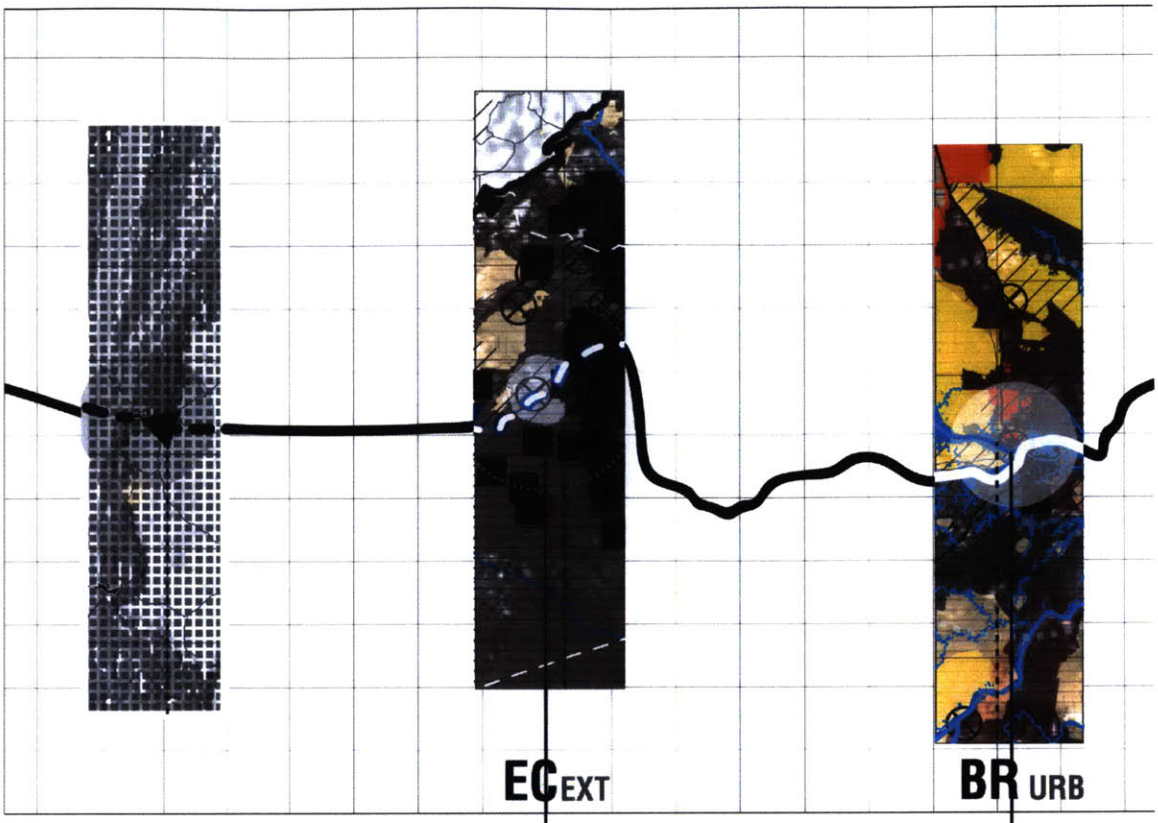


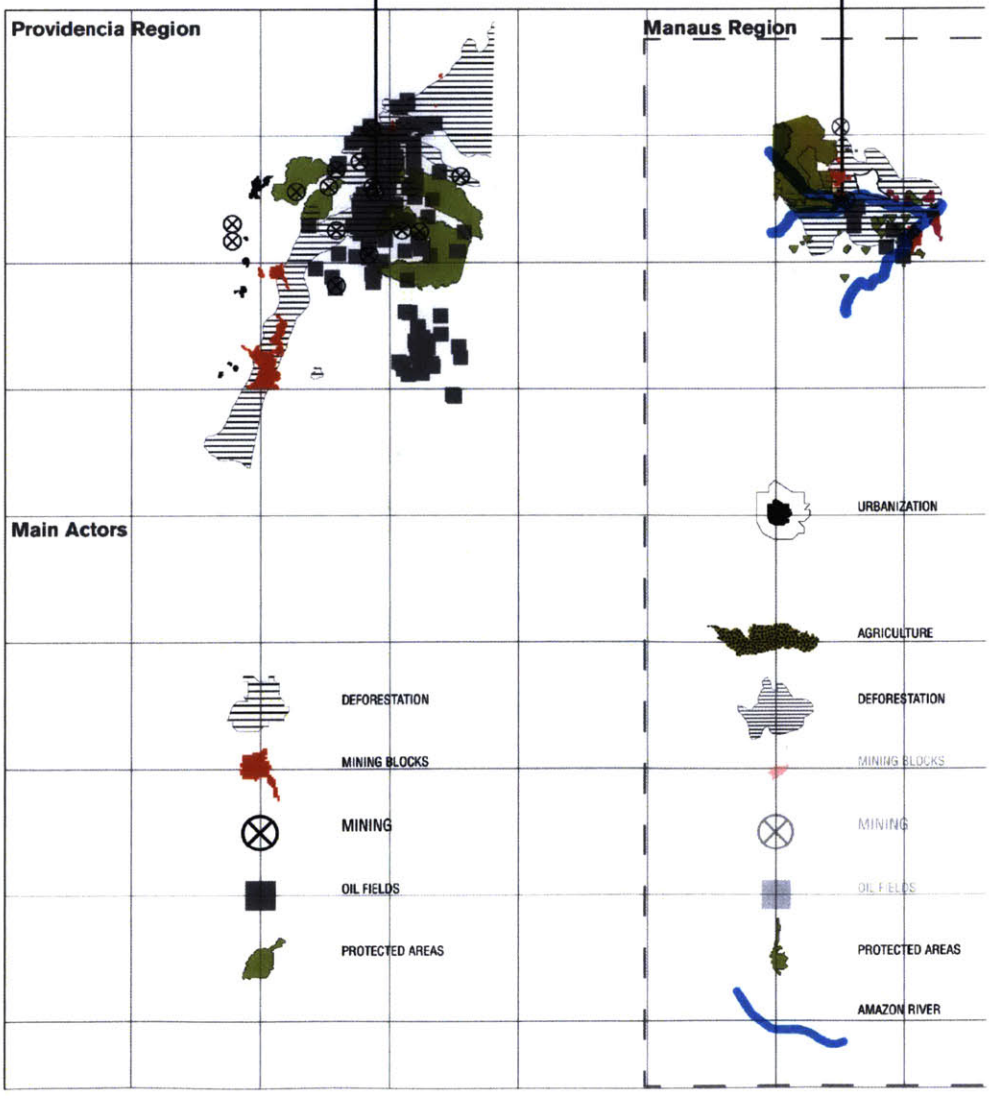
MCMV, Residencial Vivir Melhor
Number of Units: 1984
100blocks, 4 floors, 24ha
Open Space: 86%
Green Space: 25%

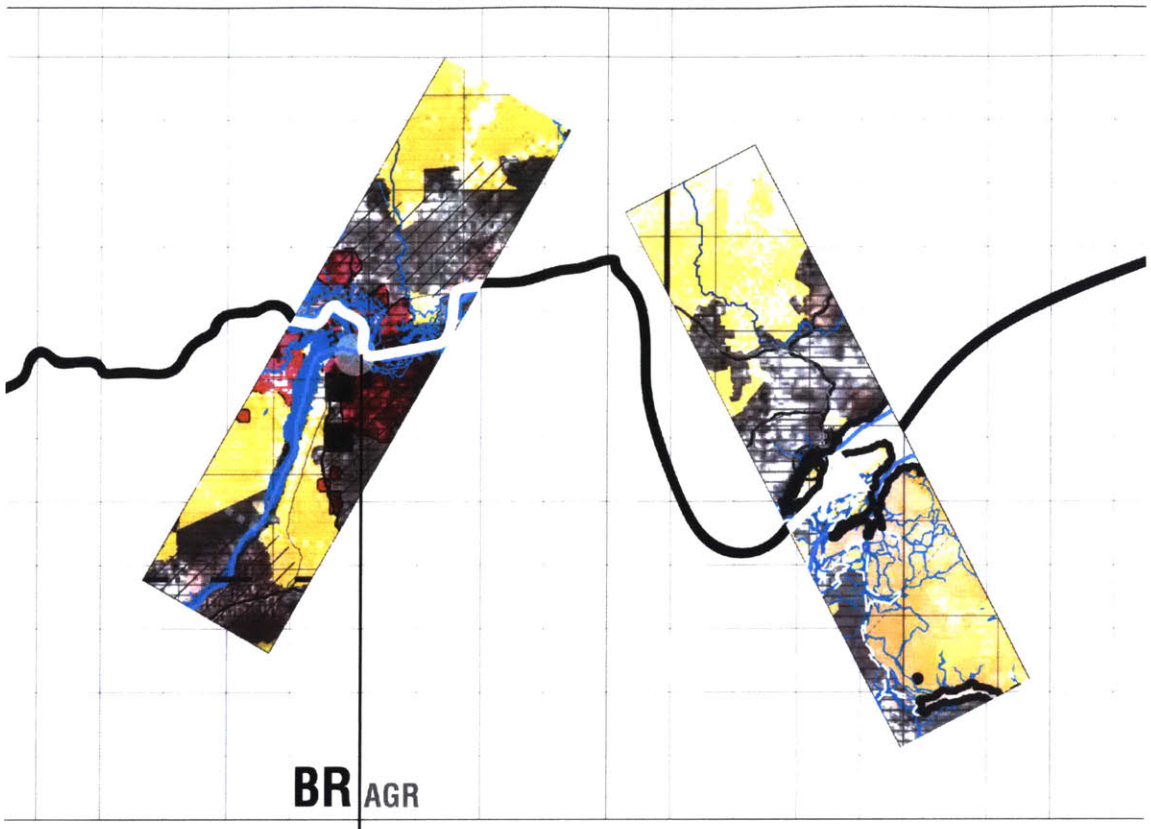

424 units
Unit Size 45 m2
total area: 81,757m2


Pacific Ocean
The Equator


Atlantic Ocean

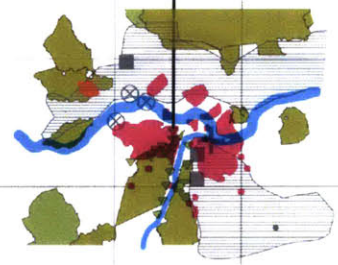

EC EXT
BR URB


Providencia Region
Manaus Region
Main Actors
DEFORESTATION
MINING BLOCKS
MINING
OIL FIELDS
PROTECTED AREAS
URBANIZATION
AGRICULTURE
DEFORESTATION
MINING BLOCKS
MINING
OIL FIELDS
PROTECTED AREAS
AMAZON RIVER



BR AGR

Santarem Region



URBANIZATION

SOY PLANTATIONS

AGRICULTURE

DEFORESTATION

SLAUGHTERHOUSES/CATTLE

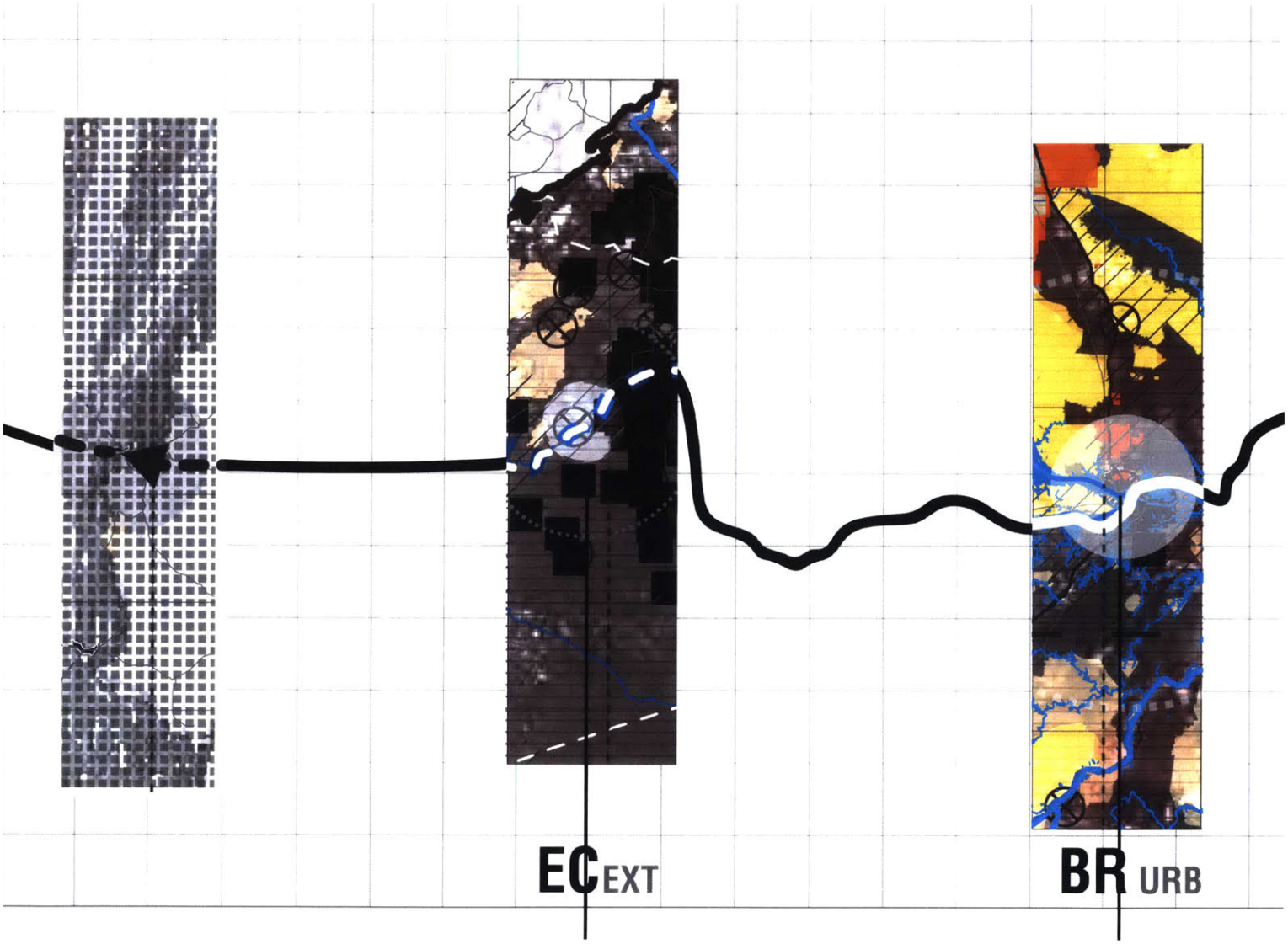
LOGGING FACILITIES

PROTECTED AREAS

AMAZON RIVER

Nodes along the Manta-Manaus Corridor

The Mining/Extaction Frontier
The Urban Frontier
Soy/Agricultural Production Frontier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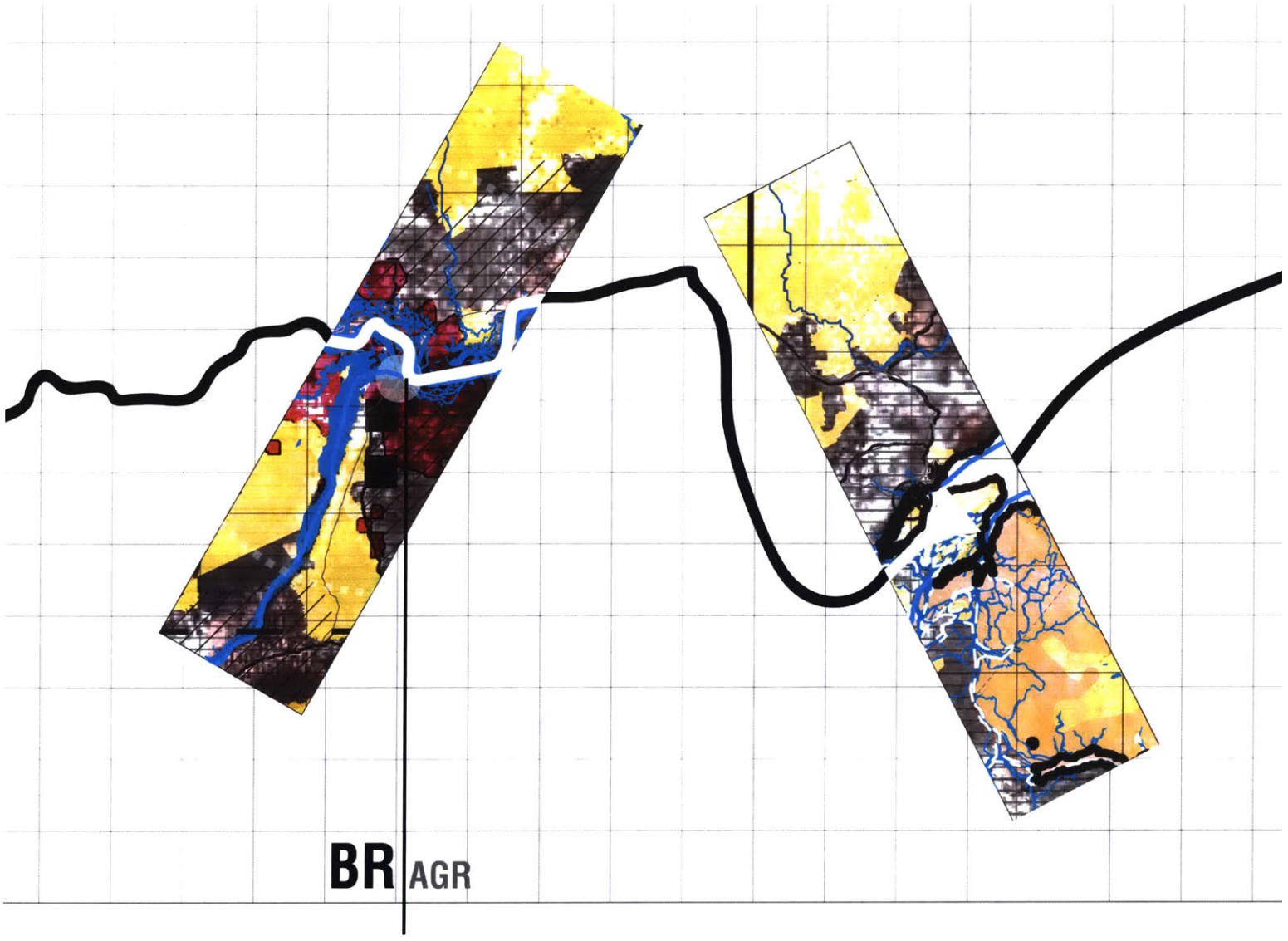
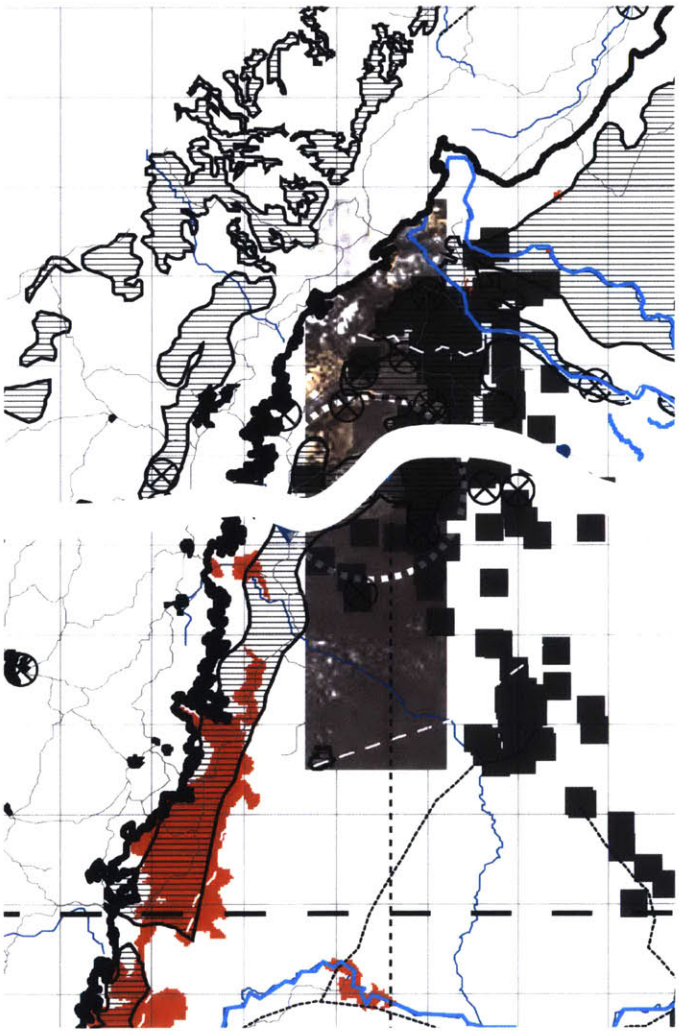
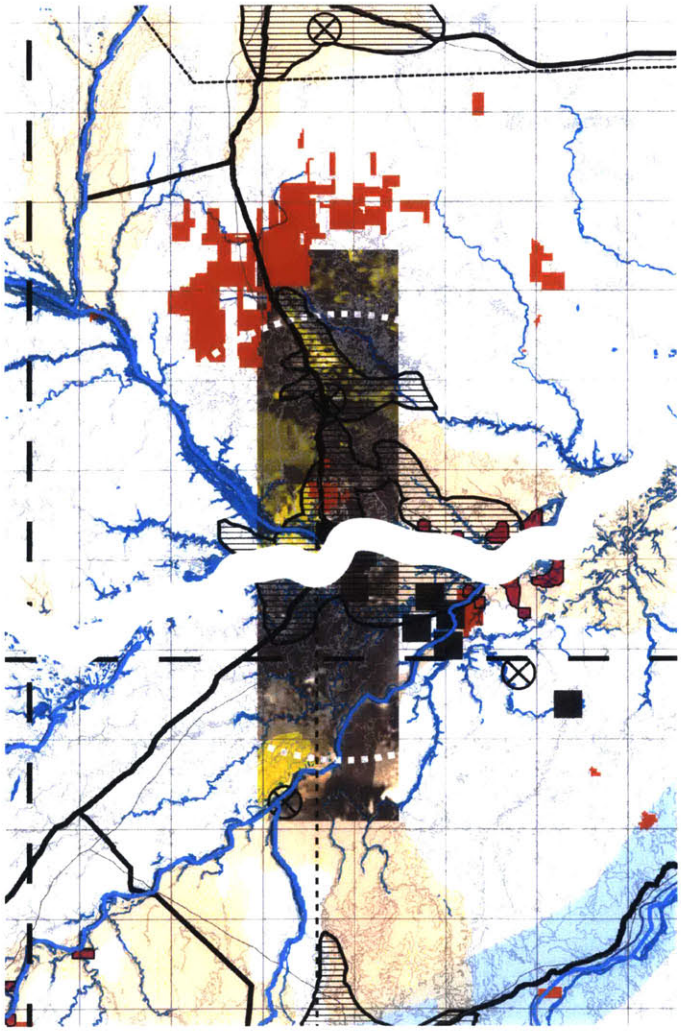


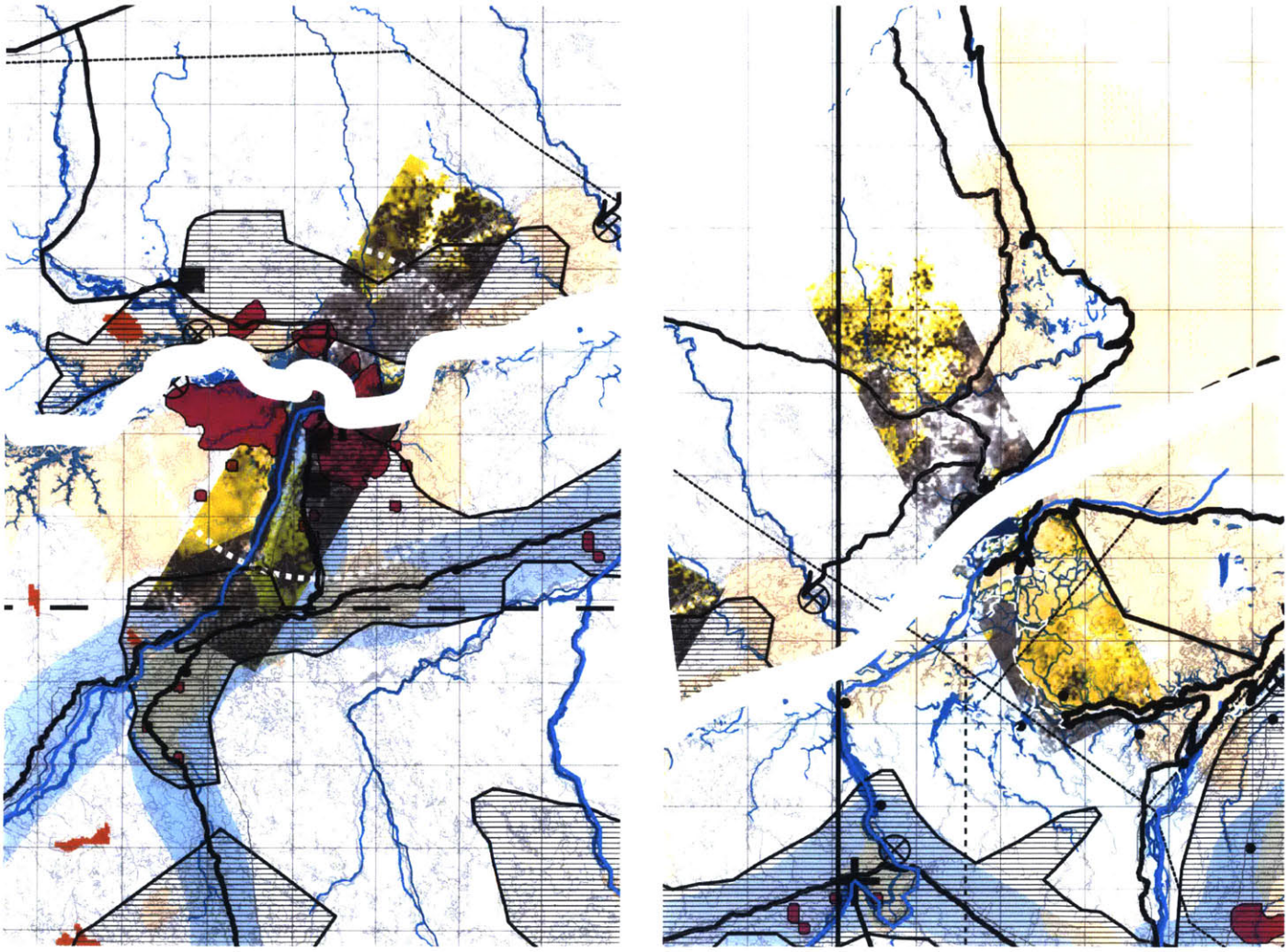
Nodes along the Manta-Manaus Corridor
The Mining/Extaction Frontier
The Urban Frontier
Soy/Agricultural Production Frontier



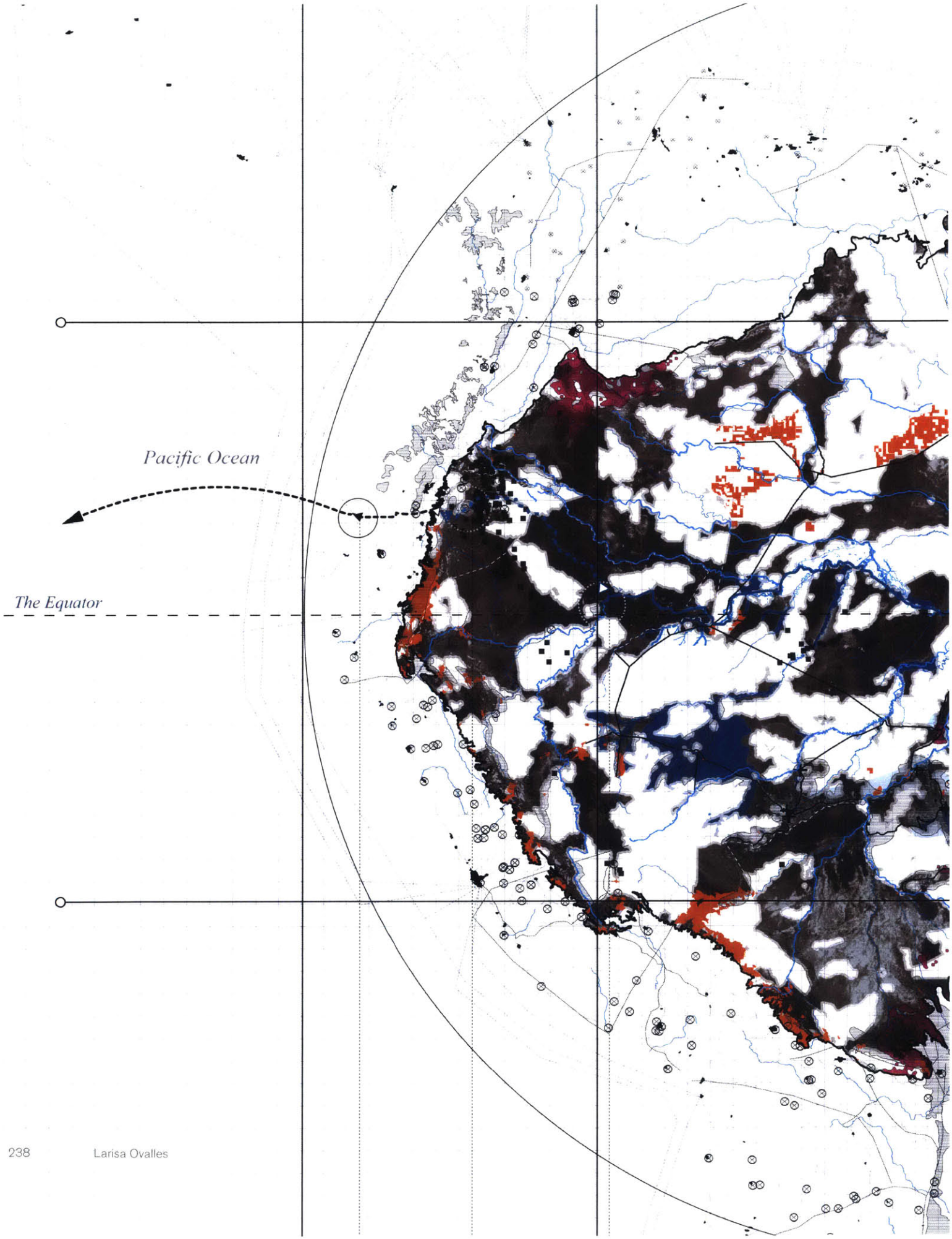
Providencia Region
Oil and Minning Concessions
Conflicts

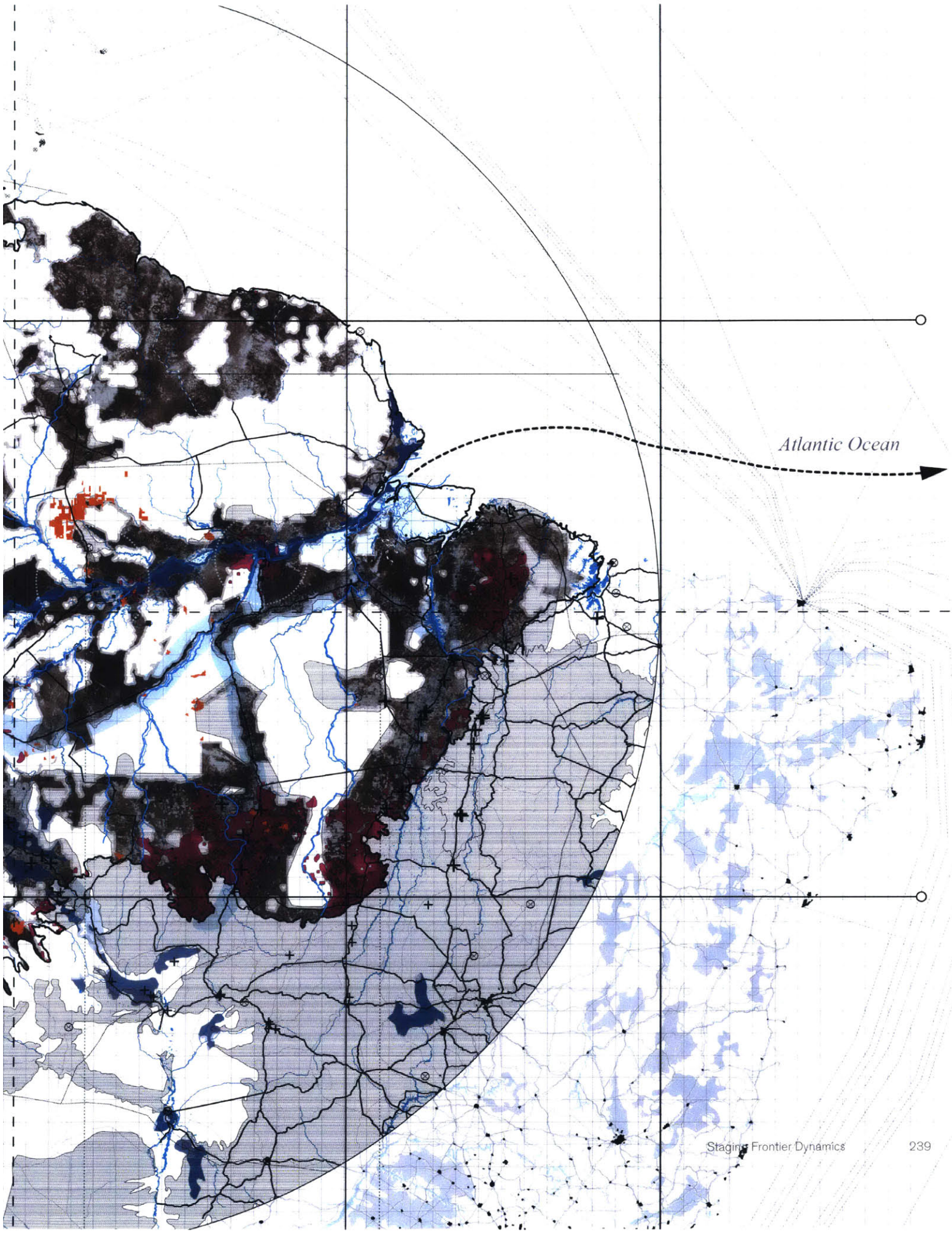


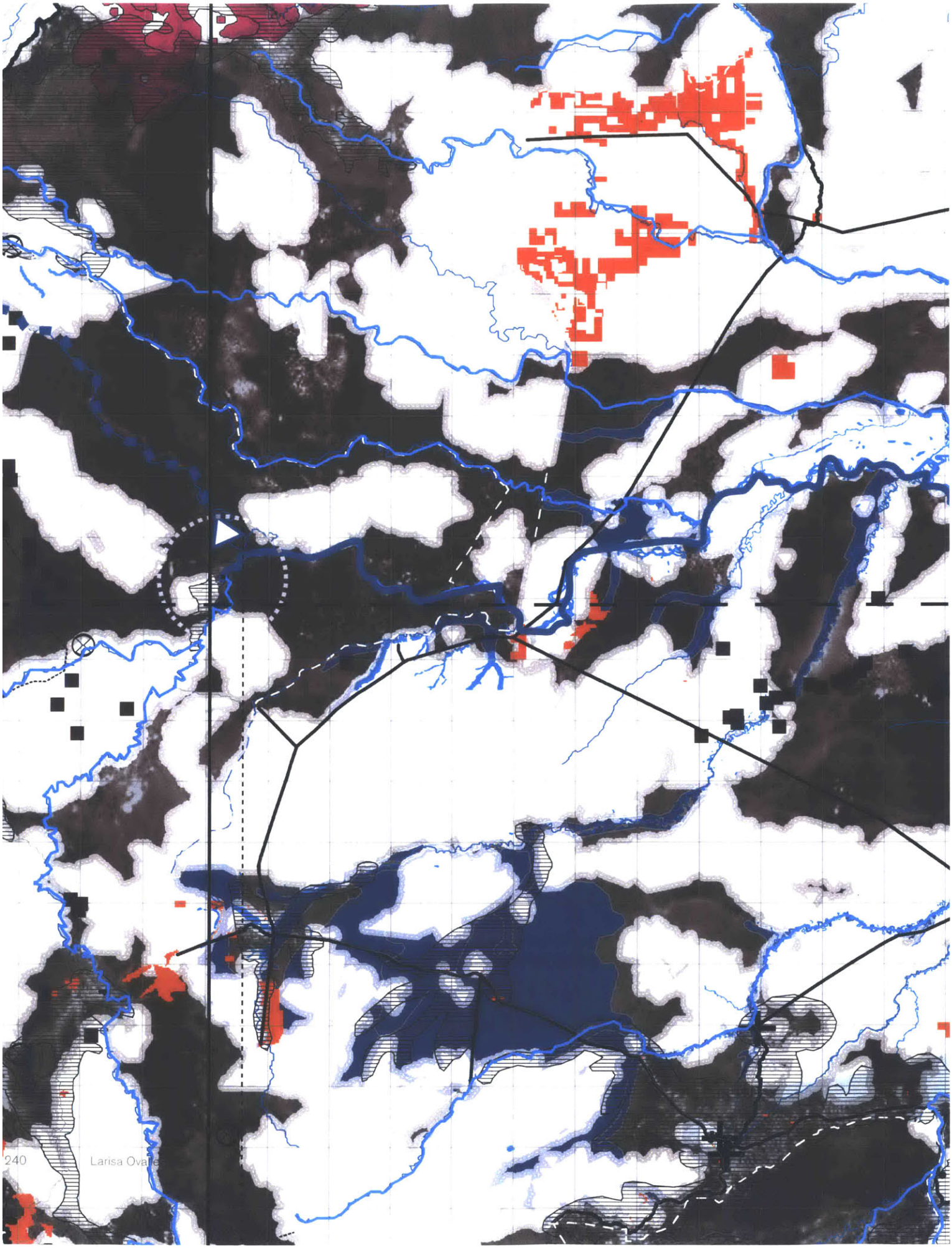
Manaus Region
Urban growth and economic
production Conflicts



Santarem Region
Soy Industry and Export


Pacific Ocean
The Equator


Atlantic Ocean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Larisa Ovalle