

# Street Trees and Their City: Rethinking Tree Practices for the Fluctuating City of New Orleans, Louisiana, USA

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## ABSTRACT

Street trees are a crucial part of urban landscapes. Yet as we expect street trees to perform both as living natural systems and urban infrastructure, treatments of street trees are often contradicting as the roles of tree care transfer across commercial nursery practices and local tree care practices by governments, private organizations or local communities. With current discussions and practices for street trees scattered or segmented, this project calls for a data-driven approach that will allow us to view street trees as one systematic and vivid entity.

The project is situated in the city of New Orleans, Louisiana in the USA, a city that is facing issues of subsidence, hurricanes, and rising sea levels. With an urgent need to consider the future of both the urban trees and the city, as well as measured and recorded incidents of change and shock in the landscape, New Orleans provides a rich platform for observation, analysis, and speculation. Geo-spatial data mapping is utilized in parallel with human scaled studies with the aim of developing a discussion towards understanding and designing of street trees in a manner that stretches across individual instances and city-scale tree networks. Similarly, it is important for the work to address projected changes in time. From this approach, systematic and geo-spatial-data-based approach to urban tree planning is developed. The work results in a conceptual design solution that proposes a transition of tree care practices to become localized in the streets of the city, most critically a solution that allows us to shift street tree discussions and decision-making processes from individual trees to urban forests to better anticipate for urban street tree resilience.

## HIGHLIGHTS

- Redefines tree care systems as hybridized natural and engineered systems
- Visualizes and examines street trees as mapped data and scaled observational analysis
- Expands decision-making processes to the city-wide network of street trees, instead of individuals
- Proposes hyper-localized tree nurseries and promotes community ownership for street trees
- Explores speculative design approach as demonstration of tree system resilience

## KEYWORDS

Street Trees;  
Sustainability Management;  
Infrastructure;  
Geo-Spatial Data;  
Climate Resilience

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## 1 Problems With Street Trees: Natural or Engineered?

Street trees are a common and crucial part of our urban environment. However, there exist many misalignments between what we expect from trees as a living system and how that system is being constructed as an urban infrastructure. The general assumption that street trees are environmentally sustainable runs counter to the actual lifespan and mortality rate of actual street trees. According to a recent analysis that looked at 11 studies of urban trees in the USA, the average lifespan of urban street trees is 19 ~ 28 years, with mortality rates of 3.5% ~ 5.1%; and calculations based on these numbers indicate that only half of the street trees planted will reach the age of 13 ~ 20.<sup>[1]</sup> Criticism goes to how our practice works, how the tree nursery practices might be impacting root health, how the root structure might be limited by the urban ground, or how governmental guidelines might be insufficient. Yet trees are not so simple, even those that have been tamed and molded into the fabricated landscape of cities, and are perhaps arguably more complex with added layers of culture, economy, and politics to the original biology and ecology of trees. These aspects become juxtaposed and create diverging roles for street trees. Street trees are artifacts of culture and history, yet are also products of industrial manufacturing. Street trees are goods that are economically valued, yet are also objects that become easily disposed. Street trees are symbols of life and strength, yet are also images of risk and vulnerability. What seems to be lacking in discussion is how street trees and related practices (which are currently scattered) can become a more cohesive system of care, allowing street trees to be designed as a system that can thrive in each city instead of trees that are nurtured to survive as individuals.

This article argues that we need to shift assessment and decision-making process from the scale of one tree or even one neighborhood to the network across multiple trees and areas, and cross the different phases of a tree, including tree nursery practices, transportation methods, planting, maintenance, and removal. As we begin to understand street trees as systems that consist of multiple layers of information at different spatio-temporal scales, the question for an appropriate approach needs to be addressed: how can we create conversation and solutions for street trees that are informative and socially intentional? As a case study to address this question, the project is situated in New Orleans in the USA, a city susceptible to subsidence, hurricanes, and sea level rise. By seeing the trees of New Orleans as a system, we are then able to understand how that system responds to shocks and how we can design better street tree systems.

## 2 Street Trees in the City of New Orleans

### 2.1 Methodologies: Representing Ecological and Social Intricacies in Geo-Spatial Data

To understand street trees as large scaled systems, this project explores methodologies of using geo-spatial data to analyze and drive decisions. As a design tool, data-driven methods provide ways for our understanding and design to be “responsive.” Such strategies challenge static design and require making negotiations with the environment as a response rather than to gain control.<sup>[2]</sup> This becomes crucial in understanding natural systems—in this case, street tree systems—where data-driven strategies allow design to engage with the existing ecological and cultural systems as a dialogue. This project utilizes publicly available data-sources as a basis of analysis through GIS, while also referencing published map information for layered studies of the city and its street trees. The representation of data becomes a crucial basis and platform for the conceptual design ideas to be built upon.

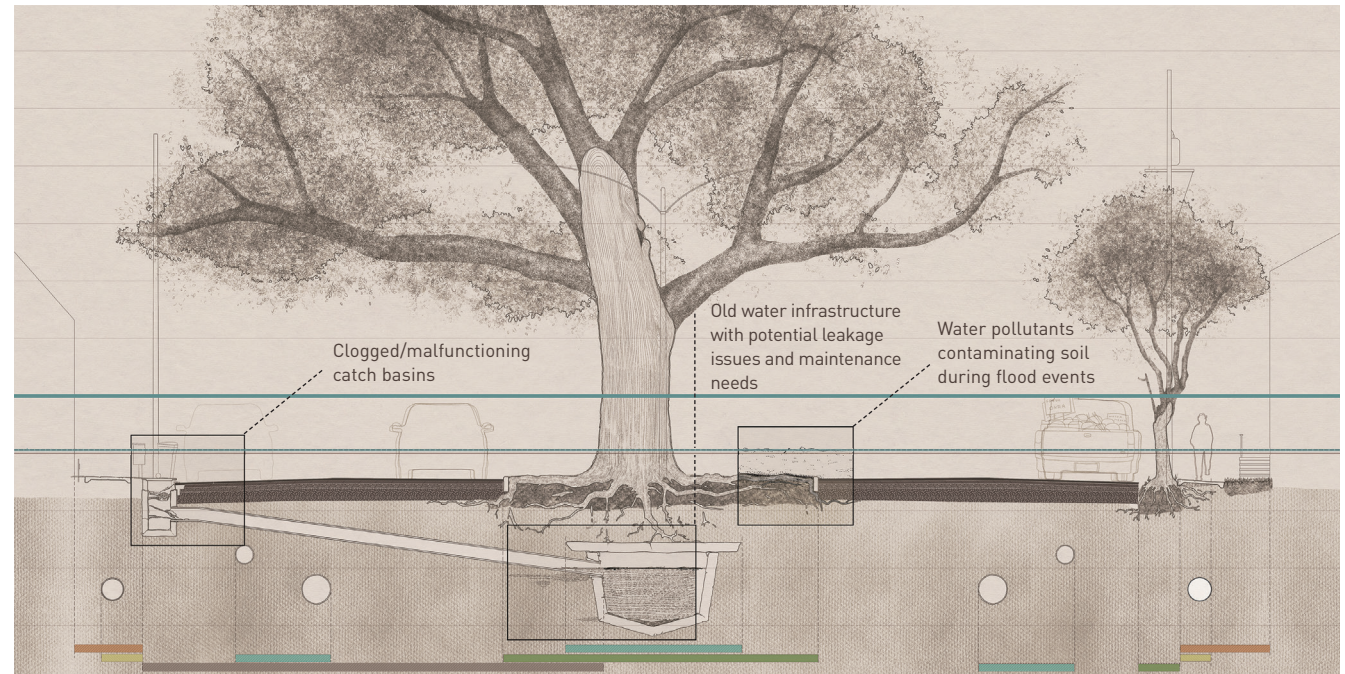
It is also important to acknowledge the limitations of mapping trees as data to assure that the trees are not to be seen as mere points of data. In discussing topics of sustainability and environmental equity, data-driven technology has the tendency to potentially downscale overly abstract complex problems.<sup>[3]</sup> Thus, while geo-spatial data drawn from scientific information are illustrated as precise mapping, it is important that the work also represents the nuanced and complex layers existing in the “points” that are being mapped.

### 2.2 Introducing Street Trees of New Orleans Through Sections

New Orleans is known to have a historically rich relationship with street trees in the recent decades. However, with increasingly extreme changes in climate, its street trees also become vulnerable and threatened by events of shock, most dominantly stormwater flooding. In 2005, when Hurricane Katrina hit New Orleans, a part of the loss was seen in urban tree cover, where the worst neighborhoods had up to 15% reduction.<sup>[4]</sup> And while many of the native trees showed to be resilient in such drastic events, more discussions were made to plant more trees to improve resilience of the city. Street trees have provoked an interesting dialogue in New Orleans not only as culturally complex symbols and artifacts, but also being ecologically critical to the city’s future resilience.

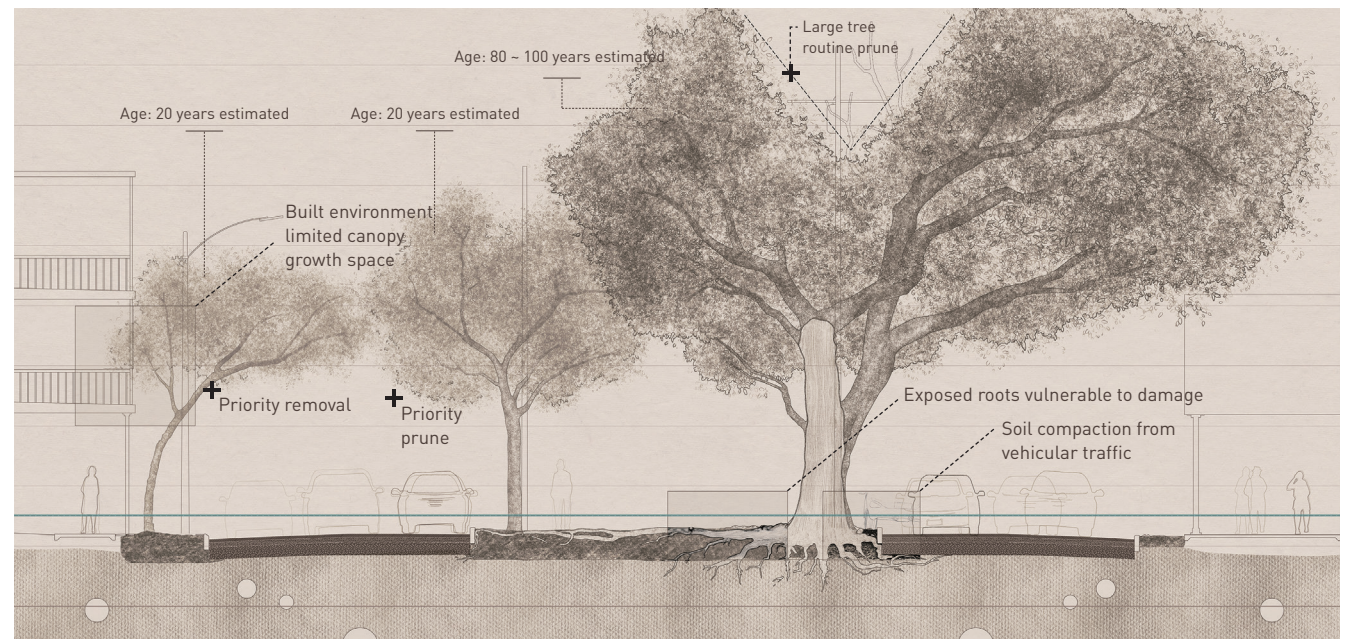
In this project, street trees of New Orleans, in conditions of stress and conflict while also being of great magnificence, are presented as intricate sections to reveal their social and spatial complexities.

- Private property owner
- Energy corporation (electric power provider)
- Department of Parks and Parkways, City of New Orleans
- Department of Public Works, City of New Orleans
- Sewerage and Water Board of New Orleans
- Flood level (Hurricane Katrina, 2005)
- Projected flood level (U.S. Army Corps of Engineers, 2019)
- Sea level



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- Projected flood level (U.S. Army Corps of Engineers, 2019)
- Sea level

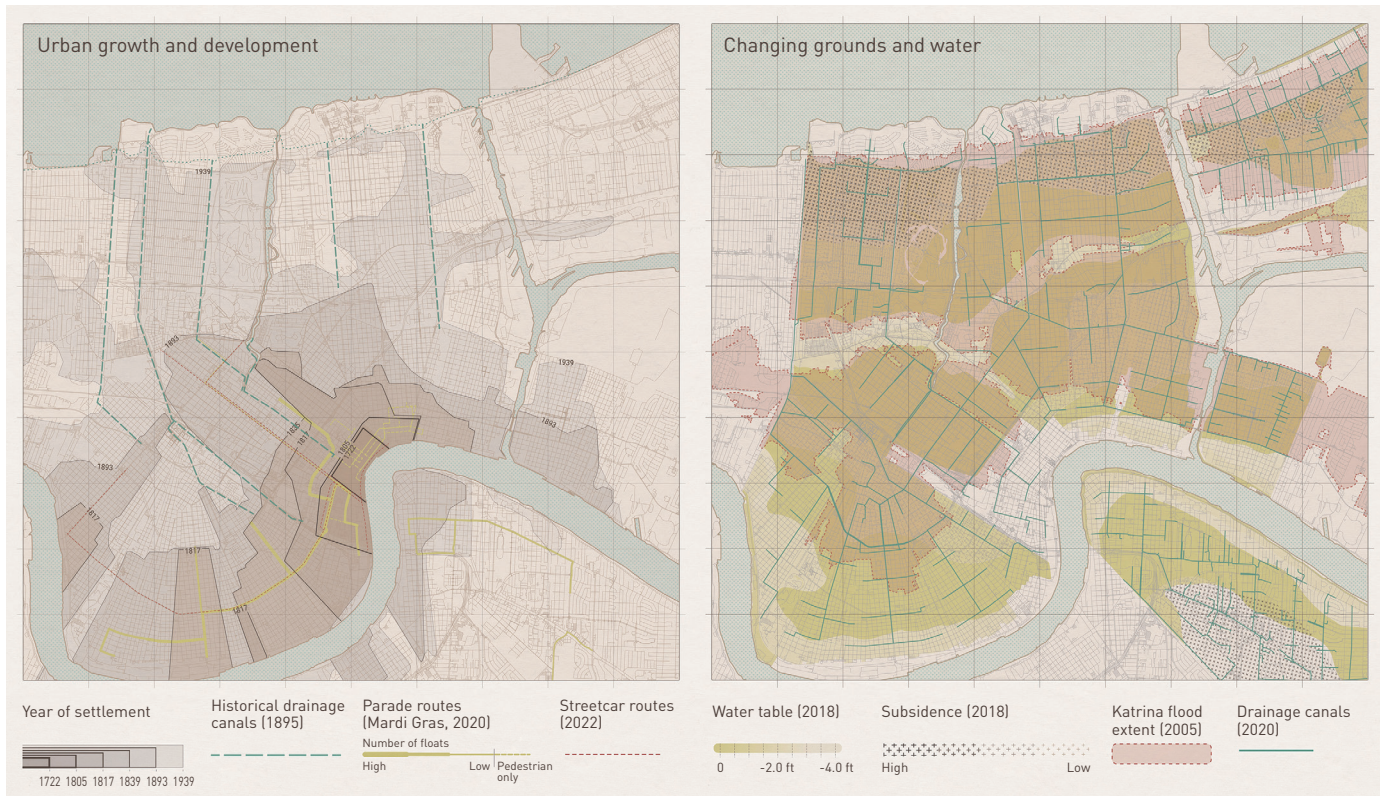


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1. Layered infrastructure and management: section of Orleans Avenue, New Orleans.
2. Care and communities: section of Esplanade Avenue, New Orleans.

In a section of Orleans Avenue, located halfway between the Mississippi River and Lake Pontchartrain and 2 ft below sea level, the street in a high-density residential neighborhood is home to mature southern live oaks (*Quercus virginiana*). These trees are confined not only in sideways by the width of the street median, but also vertically by underground canals. The underground canals of Orleans Avenue are some of the older drainage canals still in use, alluding to potential issues of leakage and trapped debris. Being 2 ft below sea level, flood levels were recorded to be up to 7 ft above ground during Hurricane Katrina according

to mapped flood levels.<sup>[5]</sup> In addition to being submerged in water, urban contaminants in flood water could become an issue as well (Fig. 1). In another section of Esplanade Avenue near the French Quarter and notably above sea level, a closer look is taken at urban activity and maintenance practices for street trees in the high-traffic area that is both residential and commercial. There is often a limitation in canopy growth especially for trees on streets, as well as limitations underground. The street medians here are used often for parking or large parade events, potentially causing higher levels of soil compaction and root damage. Transmission wires



3. Continuously changing and drastically varying growth conditions of street trees in New Orleans
- 4-1. High flooding risk: prolonged flood damage and stress on tree roots.
- 4-2. High urban usage: increased compaction and stress on exposed tree roots.

also intersect with this tree, where routinely pruning is done by an energy company, in a specific manner to protect the transmission wires (Fig. 2).

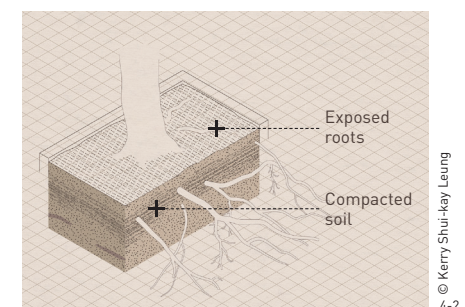
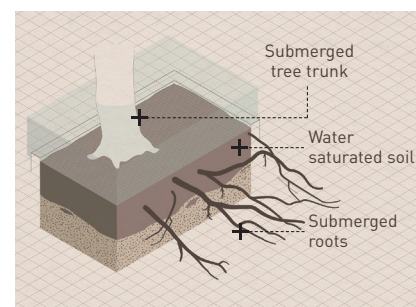
### 2.3 Mapping Trees and Their City

With an understanding of sectional relationships between trees and the urban environment, the city's vulnerabilities were mapped with an attempt to further examine the range of issues of street trees across the city. The maps are meant to make sure that each represented tree and condition can be illustrated into a nuanced and layered section.

The city of New Orleans is located along the Mississippi River and expanded gradually from the edge of Mississippi to Lake Pontchartrain since the early 1700s. The land was originally a cypress swamp before occupation by French Colonial Empire, and water was drained from the ground to allow for urban settlements. For over 200 years, water has been continuously drained from the original swamp, and the city of New Orleans was made possible due to the intense system of drainage canals and pipes. This also caused the topography to sink, with the city now being mostly below sea level, protected from water by the great levee system.<sup>[6]</sup> To this day, the city relies on drainage canals to keep itself from flooding caused by rain and stormwater (Fig. 3).

Within continuous drainage during colonial occupation, the land faces varied and intersecting conditions, so do the street trees across the city. The mapped conditions show a range of water table heights, subsidence, and flood risk (Fig. 3). The different stressors for trees including limited root depths, submerged roots (Fig. 4-1), decreased water retentions, and exposed roots (Fig. 4-2).

With trees being sourced as manufactured goods, a sustained tree resilience in the city becomes further compromised by limitations of trees as a commodity—nursery trees are meant to be standardized as products.<sup>[7]</sup> Not only are trees propagated from the same genetic base in homogenous environments before being placed in varied conditions of the city, but in the case of New Orleans, street trees are likely to be sourced from nurseries across states like Mississippi and



Georgia, due to lack of large suppliers in the local area. Transplanted nursery trees may not be adaptive to the new environmental and urban stressors (Fig. 5).

### 3 Seeking Opportunities for New Practices

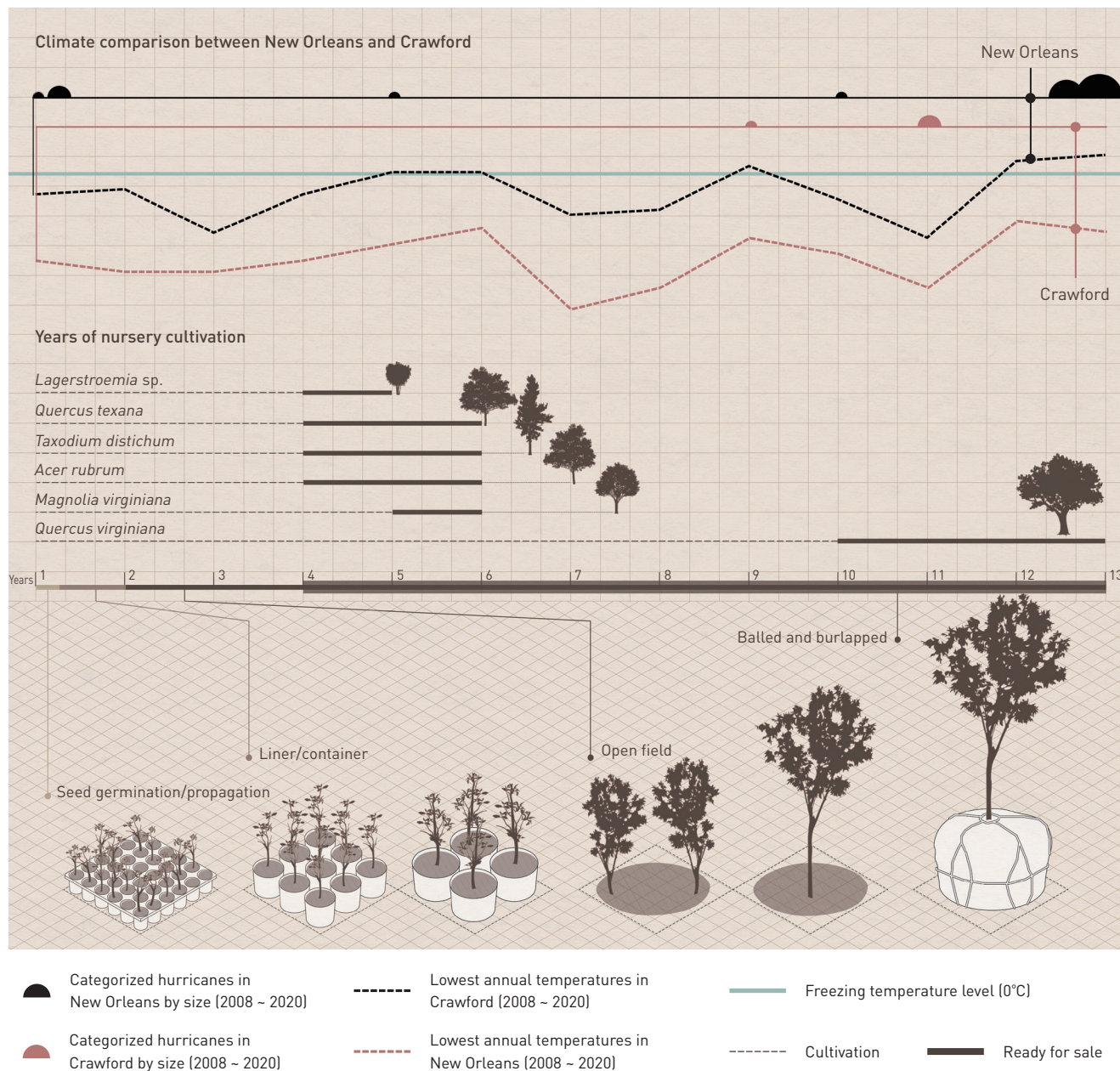
#### 3.1 Rethinking “Resilience” of Street Trees as Systems

Currently, the identity of trees as environmental resilience in New Orleans relies on the remaining historical *Quercus virginiana* trees that have survived many decades of social and environmental changes. And while preserving historical oak trees in the city is important, ultimately, there needs to be a succession for a system

to become sustainable and resilient, as would any natural living ecosystem.

#### 3.2 “Neutral Grounds”: A Webbed System for the Start of a New Tree Practice

To better situate street tree systems as engineered infrastructural systems, this project builds on a well-established system of the city, the street medians, or “neutral grounds” (Fig. 6), as they are referred to locally in New Orleans. Neutral grounds are important public spaces of the city; the name originated from disputed territories between the Anglo-American and French municipalities in Louisiana, but became the term to describe street medians that



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5. The tree market: trees as commodity
6. A “neutral ground” in New Orleans

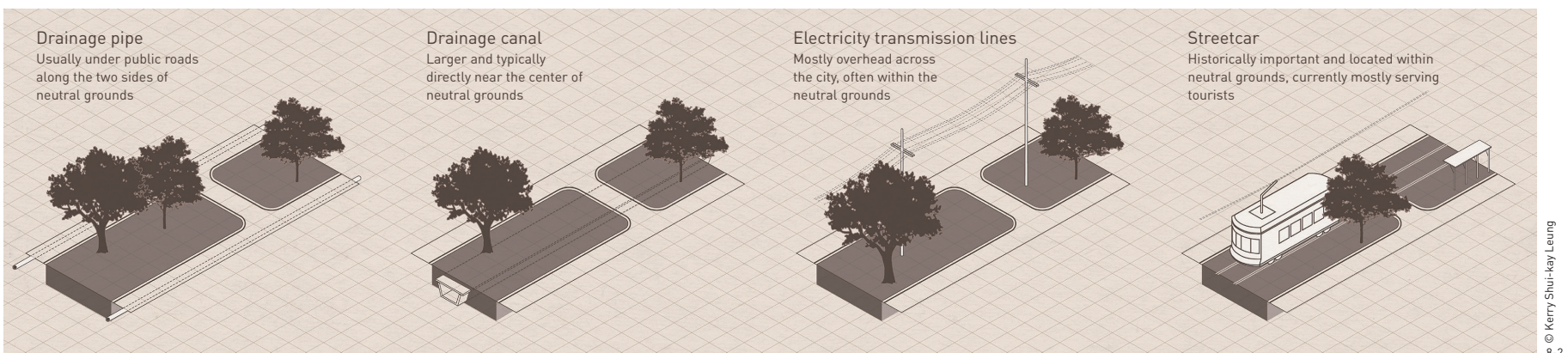
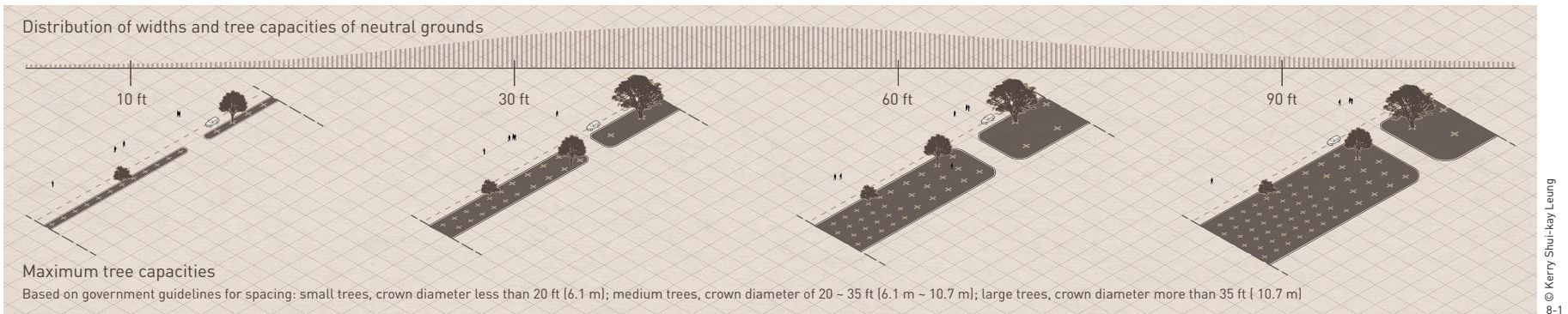


7. Distribution of public trees and conditions of trees in "neutral grounds"  
 8. Tree capacity and infrastructure arrangement of "neutral grounds"

were between the different municipalities in New Orleans in the 1830s, which were not distinctly governed by any municipality.<sup>[8]</sup> In the context of this project, this term is maintained not to emphasize local linguistic difference, but to highlight the public belonging and cultural identity that neutral grounds have in the city, a crucial element that helps drive the development of the project.

In the public right of way of New Orleans, there are a total of 105,813 trees<sup>[9]</sup>, of which 14% are in neutral grounds, based on the overlapped GIS information. Among trees in neutral grounds, *Quercus virginiana* is one of the more dominant species due to the historical practice of planting Oak Tree corridors (Fig. 7).<sup>[9]</sup>

As a public space, neutral grounds are commonly used for walking, parking, and gathering for daily purposes, festivals, and parades, especially in the historical neighborhoods. Spatially, the range of widths in neutral grounds provide not only a functional space, but also a set of parameters that can be further developed as a designed system. As infrastructure, neutral grounds are multi-layered complex, including street trees, transmission lines, street cars, underground canals, and pipes (Fig. 8). The spatially similar yet contextually varied neutral grounds offer potentials for building a system of street trees that will also be able to identify and tackle a range of concerns for street trees in the city. This allows us to see street trees not just as individual entities, but as a collective



network that contains both mature and young tree communities, as well as city infrastructure that connects to other important infrastructural systems.

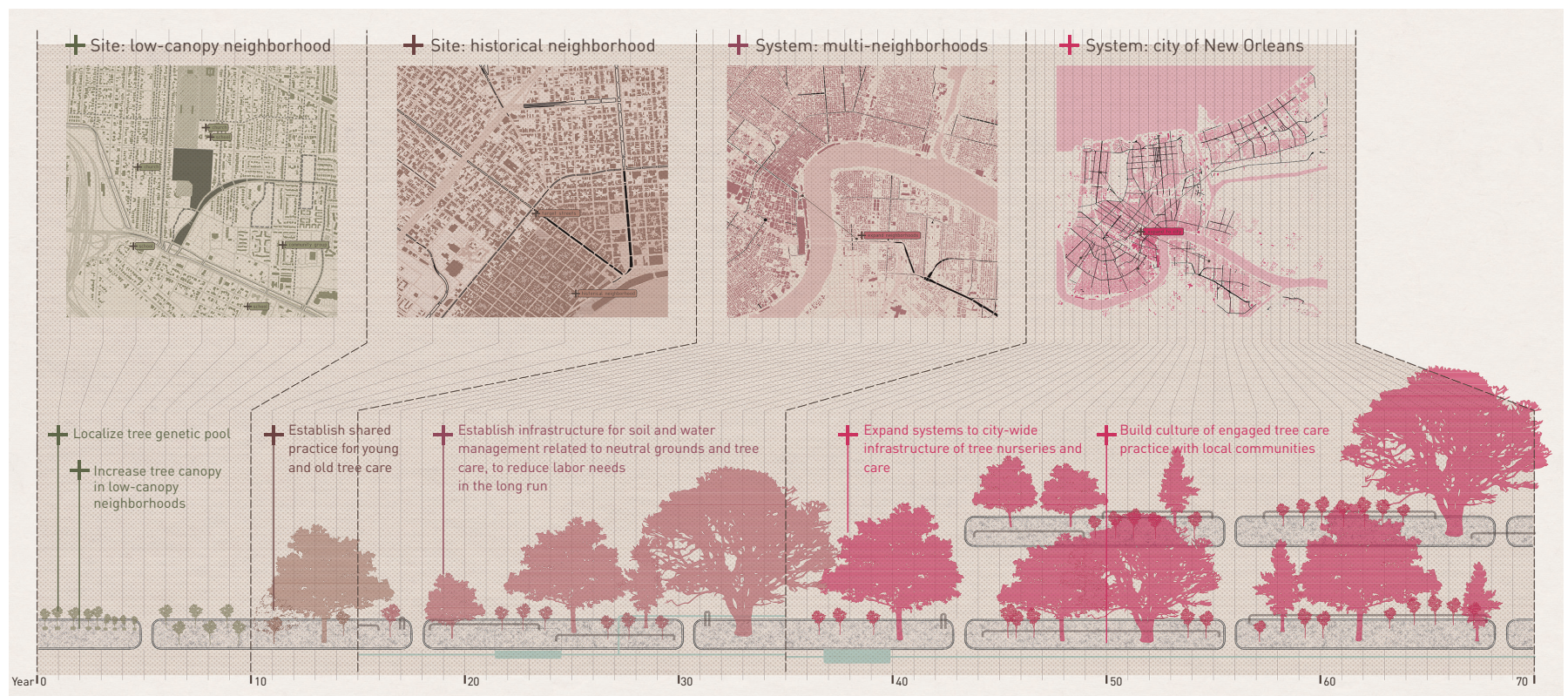
### 3.3 Mapping an Anticipatory Tree Care Practice

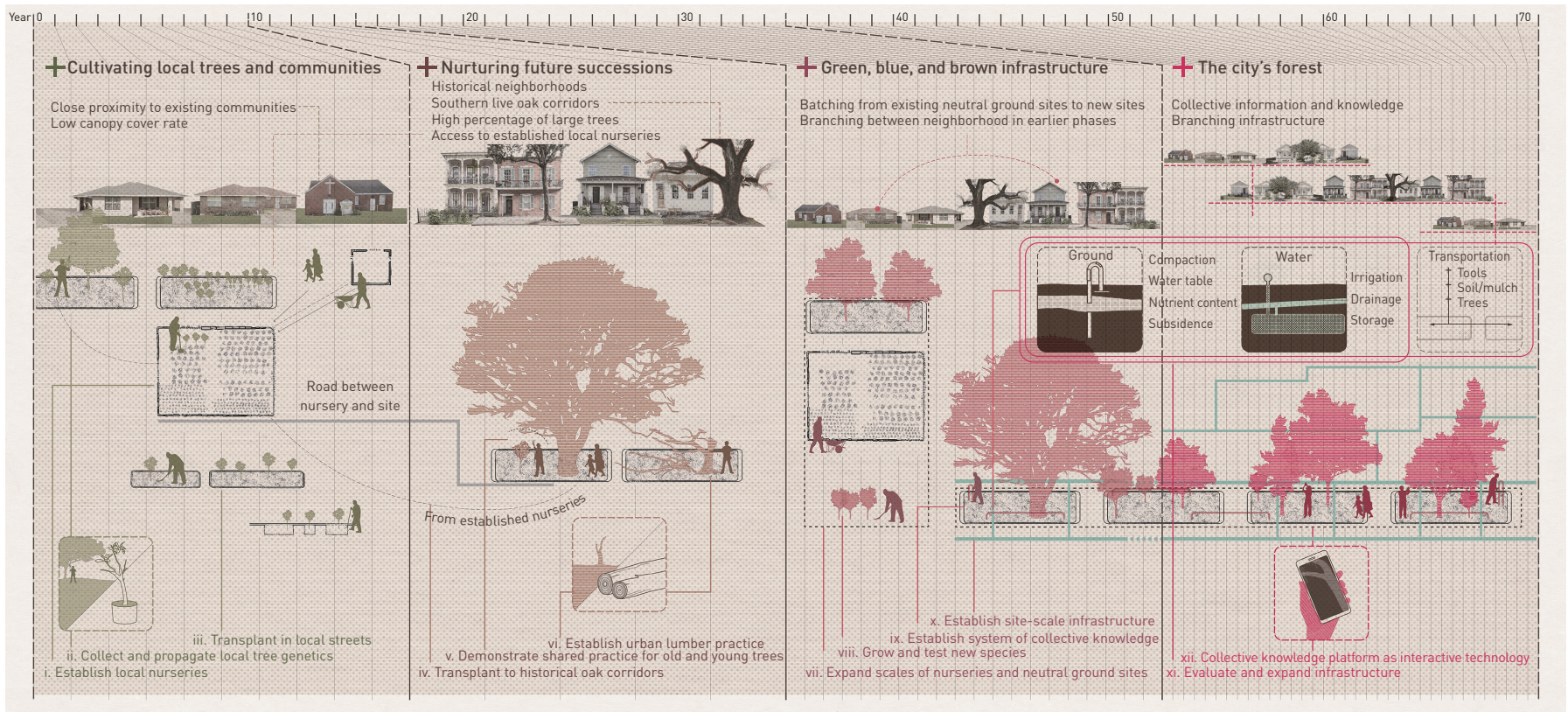
Given the significance of public services in tree-planting and maintenance in the post-disaster context, it becomes important to review the types of organizations in service and how they currently plant, maintain, and evaluate street trees, as well as what is outlined in future plans for the city. The government's future plans set goals to increase the tree canopy cover to 50%<sup>[10]</sup> and work toward a "no net loss" policy where trees removed for any reason shall be replaced to ensure that the tree "loss" can be compensated<sup>[11]</sup>. While these policies are positive, there still needs a broader discussion to anticipate drastic needs in the future. Knowing that urban trees will be facing more and more extreme temperatures and hurricanes, it becomes unsustainable to only account for tree replacement. Instead, this project proposes to establish an anticipatory system of care that responds to geo-spatial data and local needs, utilizing a collective knowledge base that drives resource allocation as a distributive and targeted

practice. This work focuses on responsive strategies for the current and future needs of the city-wide tree system rather than individual and immediate tree care needs.

As a design strategy, the street tree practices should be treated as city scale system for these urban trees to function better as an urban forest, while also being localized in terms of sourcing, tree suitability, and location specific planting. Locality is a relative concept, and this project argues that the typical "local" that refers to the greater region is not local enough. Instead, this strategy proposes a distributed network of the city's hyper-local nurseries by utilizing the webbed system of the neutral grounds where soil health, elevation, infrastructural loading are the foundations where future trees can be cultivated and acclimatized. The phased strategy begins with site-scaled implementations targeting neighborhoods with low-canopy rates areas that need more immediate tree planting actions. This then expands to historical neighborhoods with mature tree canopies and high public interest that allows for the site to become the pilot that could begin to test and demonstrate the system. This strategy continually grows into other neighborhoods through the webbed connection of the neutral grounds, allowing for establishment of infrastructure designed for tree nurseries and tree

9. Shifting scale: practices for the city's street tree system





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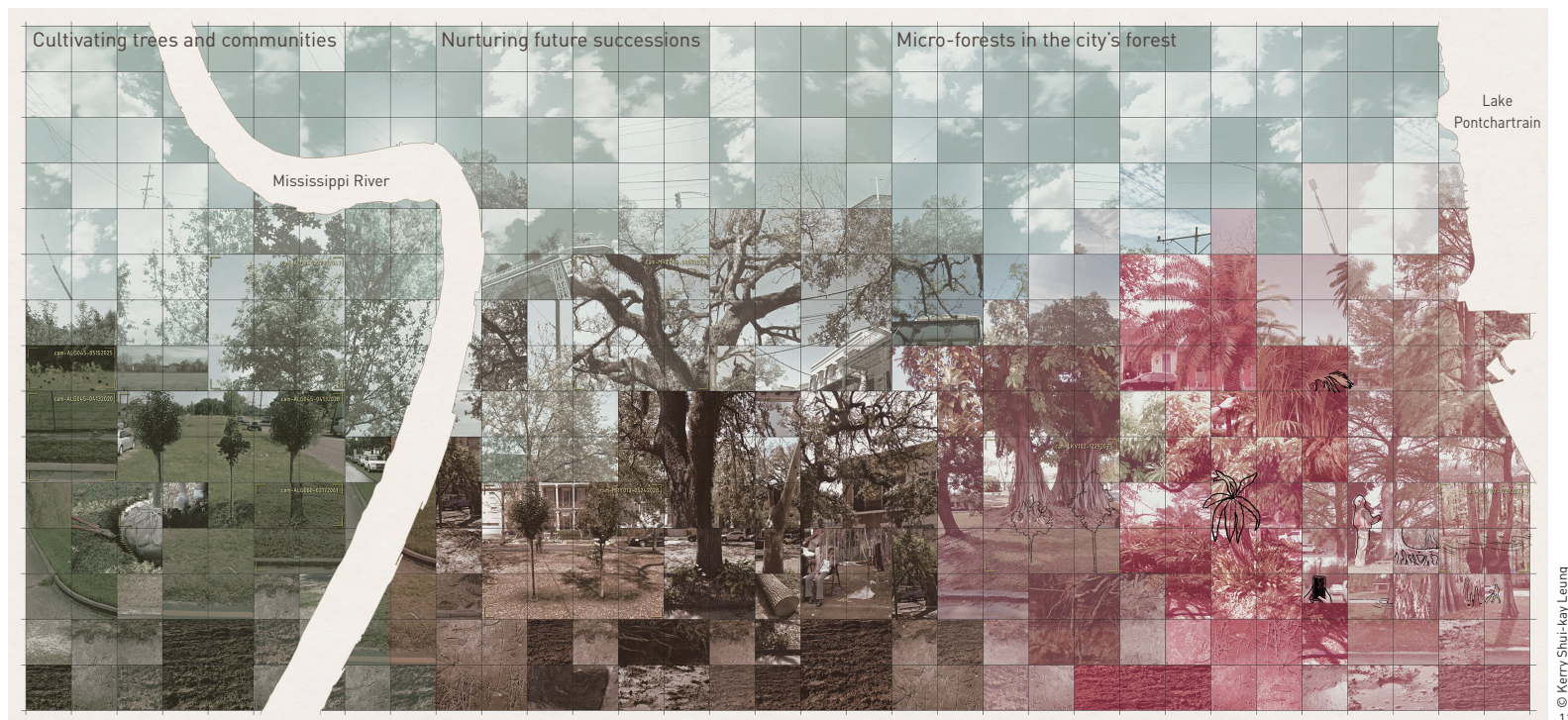
10. Shifting focus: practices for the city's street tree system.

care (Fig. 9). While the system is one holistic mechanism in terms of resource, information, and knowledge sharing, utilization of hyper-localized data and responses encourages targeted cultivation of trees for each section of the city, allowing for greater potential for trees and communities involved in tree care to become resilient as a collective successive system.

As the site expands into system throughout the phases, the focus also shift to adjust the goals for both the proposed street tree system as well as the city. The beginning phases focus on targeting low-canopy cover neighborhoods where there are higher incentives and urgencies in providing equitable urban living environments. Projecting 10 years ahead, this goal shifts to mature tree care, where an increasing number of *Quercus virginiana* will require high attention, also urging the city to establish and nurture future urban tree successions. These activated historical streets become a resource of the city, creating a place with high public engagement, and allowing communities to begin to form and engage with local tree care practices. Further projecting ahead, while new sites can begin to grow and test new tree species to cultivate more resilient trees for the city, the goals also shift towards reducing labor needs for a sustainable urban system. This includes allowing tree

care to become part of the city infrastructure by building on the city's water infrastructure, establishing data-collection ground infrastructure, and developing a community platform for collective knowledge and practices (Fig. 10). The city's forest becomes both a natural and urban system where infrastructure becomes responsive to the environmental needs of street trees as a forest rather than as individuals, providing tree care that encourages tree resilience in health and succession.

Currently, trees represent history and resilience as artifacts that rely solely on the survival of old *Quercus virginiana* in the city. This project proposes a conceptual strategy that restructures tree care practices to become cohesive and city-specific, defining the tree as a system of the city rather than as individual objects. With a system of care that is implemented and engaged at the city scale, trees represent resilience as a form of care and knowledge, where the community can gain ownership of both the land and trees of the neutral grounds of New Orleans. While a city-scale identity towards the system of care is generated, smaller micro-forests also emerge from the data-based strategy, allowing communities and spaces of the city to gain new identities that responds to specific needs or roles of each space.



11. Capturing the perspective of the proposed tree care system

## 4 Discussing and Anticipating Futures

In the case of New Orleans, shock and changes in landscapes are anticipated in the future, where there is an urgent call for discussion for more sustainable street tree practices. The proposed methods and strategies for street tree resilience aim to illustrate possibilities by shifting our perspectives from individual entities to region-wide systems, providing a platform for discussion on what street trees can become in the future. While it is difficult in this project scope to formulate detailed site implementations, it has aimed to suggest design perspectives that capture the wide range of existing data-points, while also acknowledging that each data-point is nuanced. These “points” are equally significant in the information and insight that they provide, and the collective “points” become one cohesive picture (Fig. 11).

Beyond the case of New Orleans, the conundrums of street trees as being both natural and urban is apparent. A fundamental struggle exists between trying to have full control over the tree as a living system and trying to manifest all the environmental, cultural, and social benefits of trees. To be able to shift our understanding of street trees from being individual entities to being biologically complex systems situated in cultures of humanity, we can begin to respond to issues with street trees not just as individual instances, but instead formulate responses that are equally dynamic.

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# 行道树与韧性城市： 美国路易斯安那州新奥尔良市行道树种植再思考

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## 摘要

行道树是构建城市景观及城市韧性不可或缺的一部分，但由于其栽植养护通常涉及苗圃、政府、私营组织和当地社区等广泛主体，因而很难将其同时作为自然系统和城市基础设施来管理。考虑到目前针对行道树的研究与实践较为分散，本文基于地理空间数据驱动的方法，将美国路易斯安那州新奥尔良市的行道树视为一个完整的系统展开研究。近几十年来，新奥尔良的城市发展与行道树密不可分；而受气候变化影响，新奥尔良也面临着地面沉降、飓风、海平面上升等严峻问题。为了更好地实现行道树系统的工程基础设施功能，本项目在城市现有完善的道路中央分隔带（即新奥尔良当地所称的“中立地带”）上展开。

研究通过一系列剖面分析展示了新奥尔良行道树在城市中所具有的社会和空间特征及其面临的各类环境压力和冲突。同时，研究利用公共数据资源作为地理信息系统分析的基础，并结合各类历史、交通、气候等信息，对城市行道树现状进行分层研究。在本研究中，数据可视化为概念设计提供了重要基础和平台。研究提出利用新奥尔良的“中立地带”建立完善的行道树栽植与养护系统的阶段性设计策略，同时建立地理空间数据响应机制，利用群体知识库驱动资源分配，以满足行道树系统当下和未来的需求。由此将行道树相关的决策和实践由单棵树木扩展到城市森林，进而增强城市韧性。

## 文章亮点

- 将行道树栽植养护系统重新定义为兼具自然和人工性质的系统
- 通过地图数据和不同尺度的观察分析可视化呈现和剖析新奥尔良现有行道树
- 构建面向全市行道树系统而非单棵树木的决策过程
- 利用“中立地带”建立本地苗圃系统并推动实现社区对行道树的所有权
- 提供了一种可提升树木系统韧性的设计范例

## 关键词

行道树；  
可持续性管理；  
基础设施；  
地理空间数据；  
气候韧性

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