# PROCESS-BASED DESIGN

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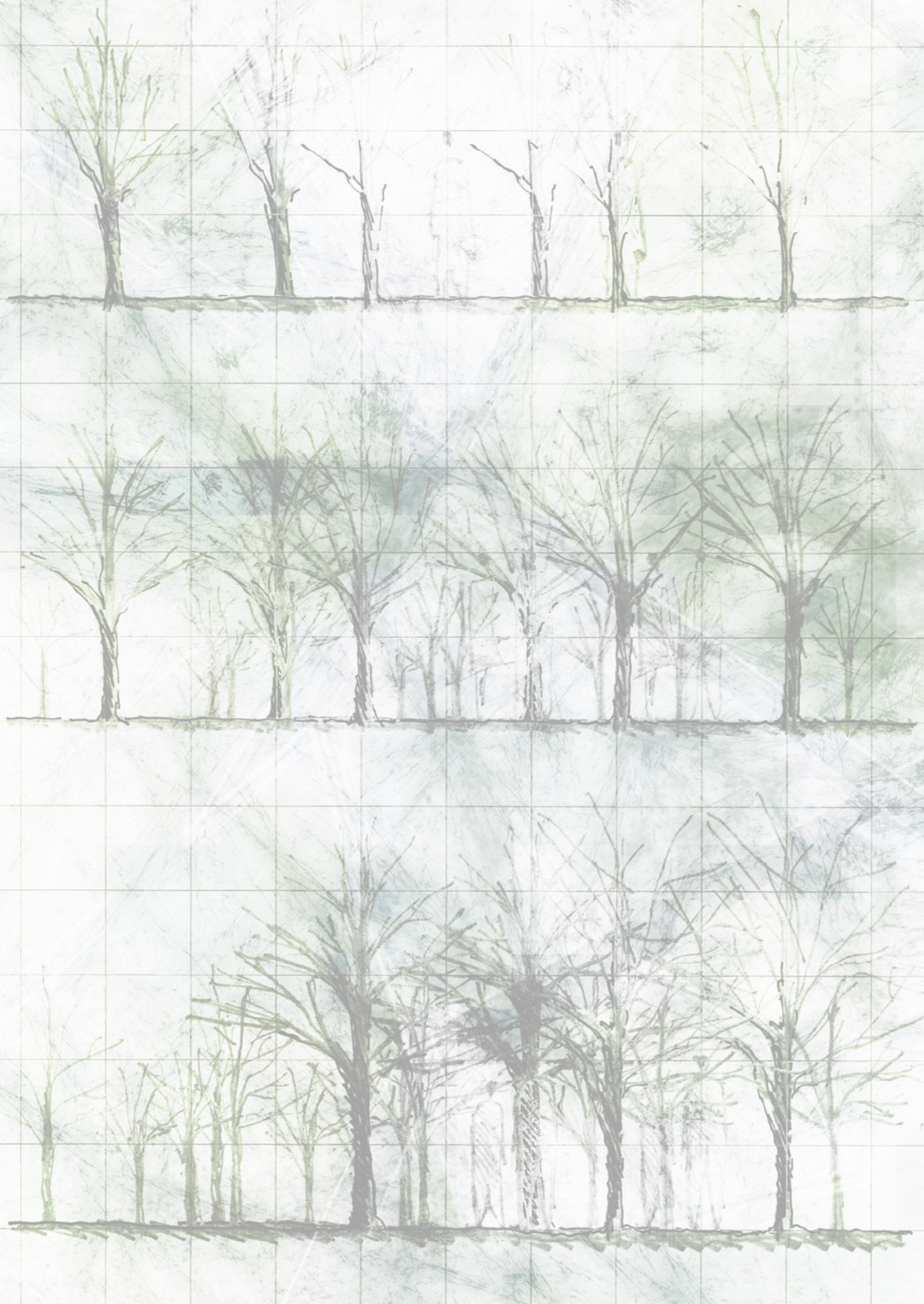
*This thesis work is dedicated to my parents*
*for their endless love, understanding and support.*




## ACKNOWLEDGEMENT

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I am grateful to advisors present at my thesis presentation, Professors Charlene LeBleu, Valerie Friedman and Michael Robinson, who were more than generous with their expertise and precious time.

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Most of all, I would like to thank my dear friend, Bo Wu. Thank you for your support, encouragement and companion during my graduate years. Your positive attitude and enthusiasm have motivated me to be a better person in life and future professional practice.

*“There is one mysterious feature about the new and potent environment we now live in. The really total and saturation environments are invisible. While they are quite invisible in themselves they do make visible the old environments.”*

*-- Marshall McLuhan, “The Invisible Environment”, 1966*



# ABSTRACT

Landscape designs, nowadays, are commonly presented as compelling visions, both in real projects and conceptual designs. By the end of the deadline, people will be able to experience the new environment as the visions promised. In this type of plan for the environment, the design approach is most likely to have static outcomes, and to miss dynamic, complex, and rich qualities of the environment -- as McLuhan said “invisible environment.”

Landscape’s dynamic qualities could be represented as the processes (visible and invisible) over time. In 1966, Marshall McLuhan wrote that “Environments are not just containers, but are processes that change the content totally.” Process-based design is the approach that explores and is inspired by these environmental processes.

Process-based design can offer a noticeable advantage in terms of time management. It thus can contribute to other related aspects, such as economy and social fabric enhancement. Further, process-based design as the product of revealing the time and culture of the environment is capable of highlighting the time sequence of the environment. It generates the wider dialogue for the public to engage with the timeline of the space. From the historical significance to the future revolutions, this design approach offers the public opportunities to witness and understand every transitional moments and process.

# LANDSCAPE'S STATIC MISCONCEPTION

Figure 1

Figure 2

A landscape photo preserves the objective scene happening in a particular moment, thus presenting the story or status of that specific moment to the observers. A rendering perspective of a landscape design can ideally and clearly illustrate the visualization of the design vision to the audiences. Similar to James Corner's idea that "Images are eidetic, they possess the power to condition designed results". It is obvious that images have visual enforcement which can active the scenic imagination and deliver the spatial production. The expressions of landscape mentioned above, however, are easily framed as the static and frozen scene which thus unconsciously misleads or even overlooks the essence of the landscape.

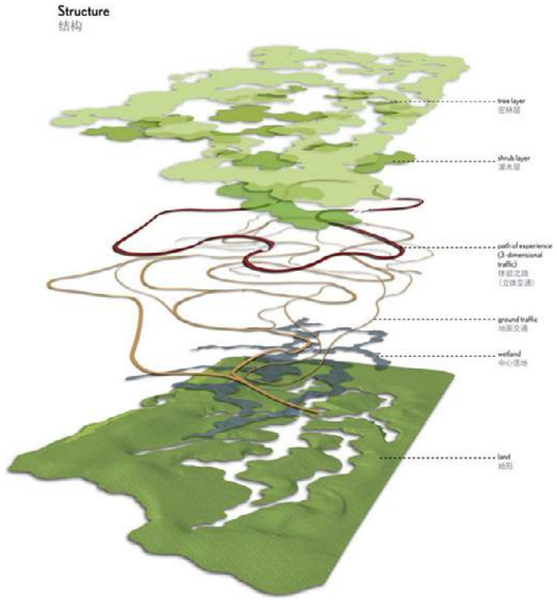



Figure 3

Figure 4

Generally the landscape can be misunderstood in the way of splitting its components into elements or objects and then ordering them by a certain hierarchy. This understanding grounds landscape in a static perspective, and simultaneously twists the design process and representing medium.

Landscape designs are always presented as compelling visions, both in real projects and conceptual designs. By the end of the construction and installation, people will be able to experience the designed environment as or similar to those visions promised. In this type of planning for the environment, the design approach is most likely to generate static and complete compositions, and to omit dynamic, complex, and potential interdisciplinary processes of the environment.

Therefore, the misunderstanding – landscape is static – omits the truth that the fluid, dynamic and hybrid tendencies of the whole living systems is the essence of the landscape.

# NON-STATIC INSPIRATION

## Fresh Kills Park

*Staten Island, New York, NY, USA (2001)*

Figure 5

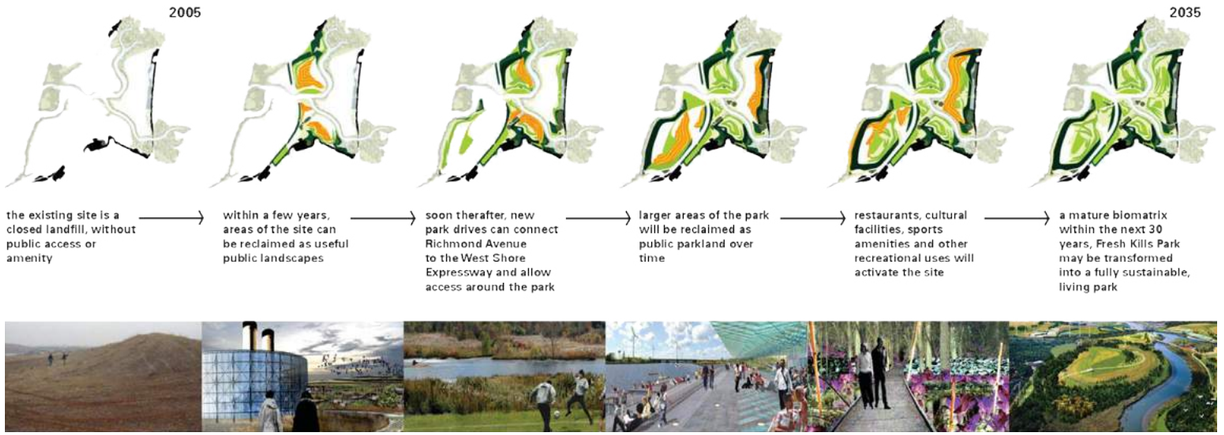
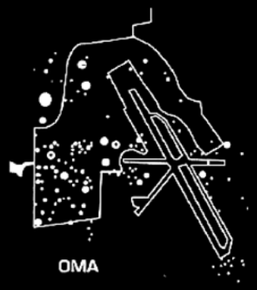



Figure 6

Unlike, Fresh Kills Park adopted a set of non-static principle within the design process. Field Operation defined Fresh Kills Park as “lifescape”, which means “a reconstituted matrix of diverse life-forms and evolving ecologies”. According to Field Operation, the former landfill site had over 40% industrial land use and vacancy. In the future scenario, the site will be transformed into an area where over 75% of land use is proposed to accommodate ecological, recreational and residential programs. The design aimed to cultivate an adaptive habitat over time, which is mimicking the natural ecology. Obviously, it is going to be relied on human manipulation to achieve the designated result which is a “man-made” nature. In the common perception, nature is considered as the separate part from the cultural aspect. However, the synthetic nature, this time, keep enough space for the site to grow and evolve over time unlike other general design projects with a designated and static result.



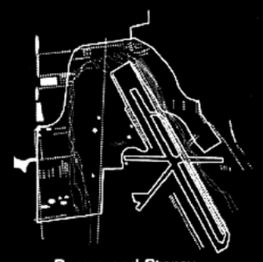




Figure 7



# NON-STATIC INSPIRATION

## Downsview Park Competition

*Toronto, Ontario, Canada (1999)*

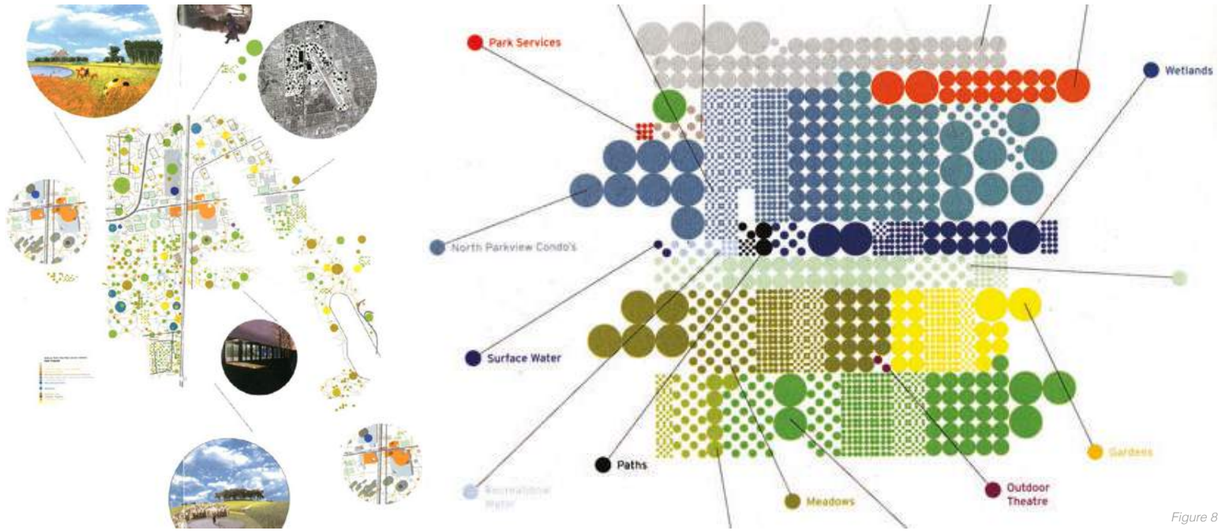



Figure 8

The competition of Downsview Park was held in 1999, which aimed to select a large-scale urban park design based on a former military site in Toronto. The top five design proposals have a shared theme – they were not conventional and fixed master plan for an urban park but more like frameworks which allow the park to grow over time during a 15-year operation process. The difference is that each of their frameworks has various degrees of manipulation and flexibility. Tree City, the winning design, reflected the most clearly and unique recognition of non-static landscape and the related design approach at that time. This recognition thus directly guided the proposed formula ("grow the park + manufacture nature + curate culture + 1,000 pathways + destination and dispersal + sacrifice and safe = low-density metropolitan life") instead of a static design proposal. However, more than ten years after Tree City won the competition, the actual implementation of the park still cannot come to a right way until the designer's team regenerated the project. In 2004, they translated the original design formula into a comprehensive park plan by employing the concept of Six Hundred Acres of Ecologic, Economic, and Social Sustainability. Tree City could have been more successful when it came to the phase of placing on the ground if it had a real and physical expression. Some may argue that the open-ending failed it as a public park. However, the surreal programmed strategy overrode the physical form and materiality which eventually failed the design formula during implementation.

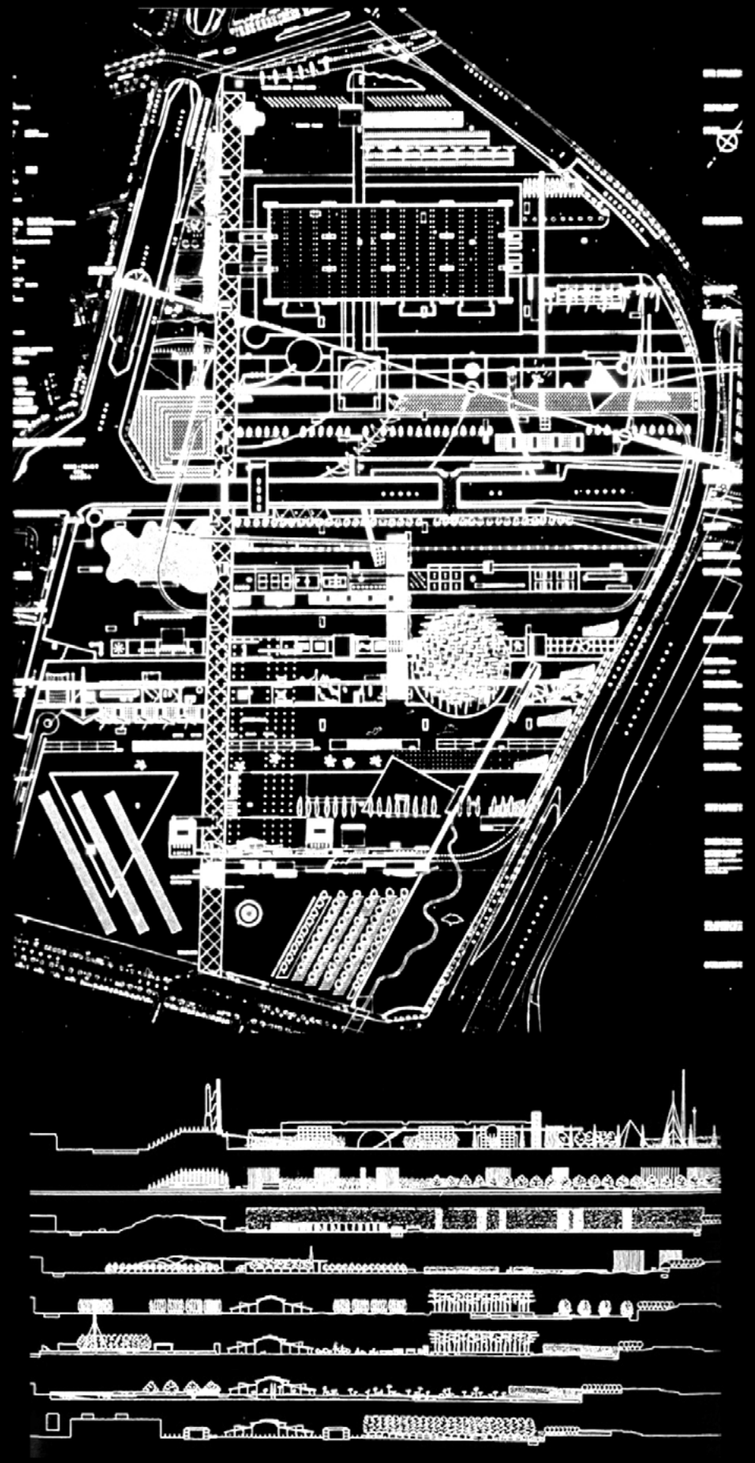


Figure 9



# NON-STATIC INSPIRATION

## Parc de la Villette, OMA's Proposal

*Paris, France, 1982*

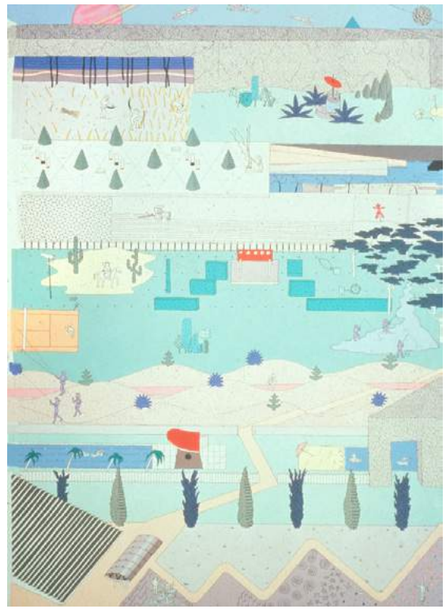


Figure 10

There are tremendous complexity and dynamics constantly floating around the urban fabric. Those fluxes and movements of the urban setting do not simply refer to the high-speed transitional tools, like vehicles and airplanes, also the visible and invisible fluxes of fluctuating hydrology, energy exchanges and consumptions, varied urban wastes, migratory fauna, and many other processes. In the design competition for the Parc de la Villette, the proposal of OMA Office demonstrates the conceptual strength and foundation regarding recognizing the transient and dynamic characteristic of the urban fabric. OMA's proposal respects and imitates the urban non-static nature and richness through the manipulation of programmatic developments rather than pure physical elements that each of them has extremely specific and static use. The non-static reflection of this OMA's proposal, both the programmatic design strategy and its related representing medium, have remained charming to landscape design for a noticeable period even today.

# PROCESS-BASED DESIGN

“Environments are not just containers, but are processes that change the content totally.” (Marshall McLuhan, “The Invisible Environment”, 1966). Dr. Barnett’s overarching idea about the “open system” and “system thinking” addresses the similar logical observation and recognition of processual landscape systems. Landscape unfolds itself as the system assembles by revealing those internal and in-between systems (external) fluxes on the time sequence. Further, it can be articulated by both visible and invisible processes over time though the angle of human observation. Process-based design is the approach that explores and is inspired by these landscape processes. It is the approach based on the recognition that landscape is constantly changing and growing over time. To express this recognition, process-based design approach thus immerses itself in revealing and selectively working with the hidden and omitted interactive connections of the setting landscape rather than planning for a total, complete vision which frequently overrides stationary data analysis to objectify the decision making, thus guiding towards a final static composition.

1. CONTEXTUAL LEARNING AND PREDICATIONS MATTER

The contents of landscape form its essence which thus reflect certain characteristics of being dynamic, fluxional, transient, and continuingly interactive. Based on these design reorientations, interventions, and outcomes, process-based design shall become more diverse and processual instead of remaining objectified, static, and motionless. Regarding landscape as a massive “open system,” implies that landscape is always in the status of “transforming”; however, contextual learning and even predicting the inherent continuing tendencies based on the given landscape are still inevitable and necessary. Those predictions of processes and relationships are helpful to rationally imagine how the landscape will “become,” which will enforce the design process to explore and even interact with (acceleration or disturbance of) the unseen connections and relationships of the internal and in-between system. It offers the foundation to investigate and reveal the hidden relationships and processes.

2. TIME MATTERS

J.B. Jackson wrote that “landscape architecture theorists and practitioners typically frame their understanding and response to landscape change as a dialogue with an evolving and emergent landscape.” This realization was reconfigured through the perspective of how time can render the processes and fluxes of the landscape when it embraces the constant and novel fluctuations of the landscape. “There is one mysterious feature about the new and potent environment we now live in. The really total and saturation environments are invisible. While they are quite invisible in themselves they do make visible the old environments. We can always see the emperor’s old clothes, but not his new ones.” (Marshall McLuhan, “The Invisible Environment”, 1966). The lens of time, therefore, as a profound piece of evidence, can provide insight into the invisible, fluxional and relentless landscape processes.

3. SPECIFIC EMPHASES

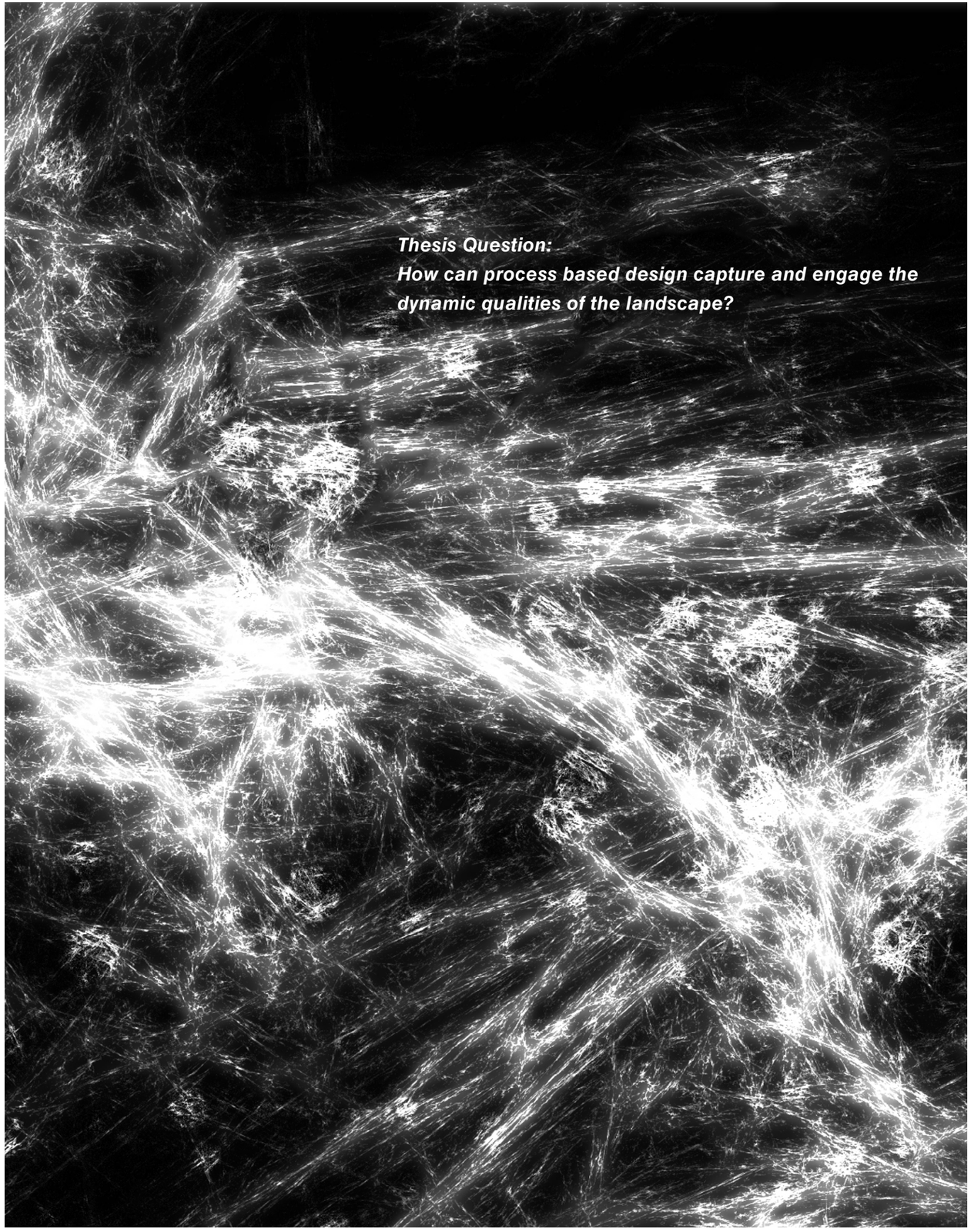
The application of process-based design can be specified in three points of emphasis:

The designer investigates the processual fluxes and richness of the given landscape through the lens of time thus selectively working with them. Therefore, the design will be most likely to imply or be supported by the setting landscape processes. The overarching design outcome may even yield to the given processual setting.

Process-based design tangibly and legibly mirrors the in-between design process and the design intent, simultaneously reflecting how time can render the design by employing the agency of flora succession. In other words, making every effort visible even in a massive time scale.

Process-based design provides opportunities for the public realm to be involved in the in-between processes and evolve over time along with the field. The public realm here is considered as the most important medium group to pass on the nature of the non-static landscape. It has great potential to fundamentally adjust the misunderstanding of static landscape when the public witness and appreciate the ongoing processes towards relentless “transforming.”

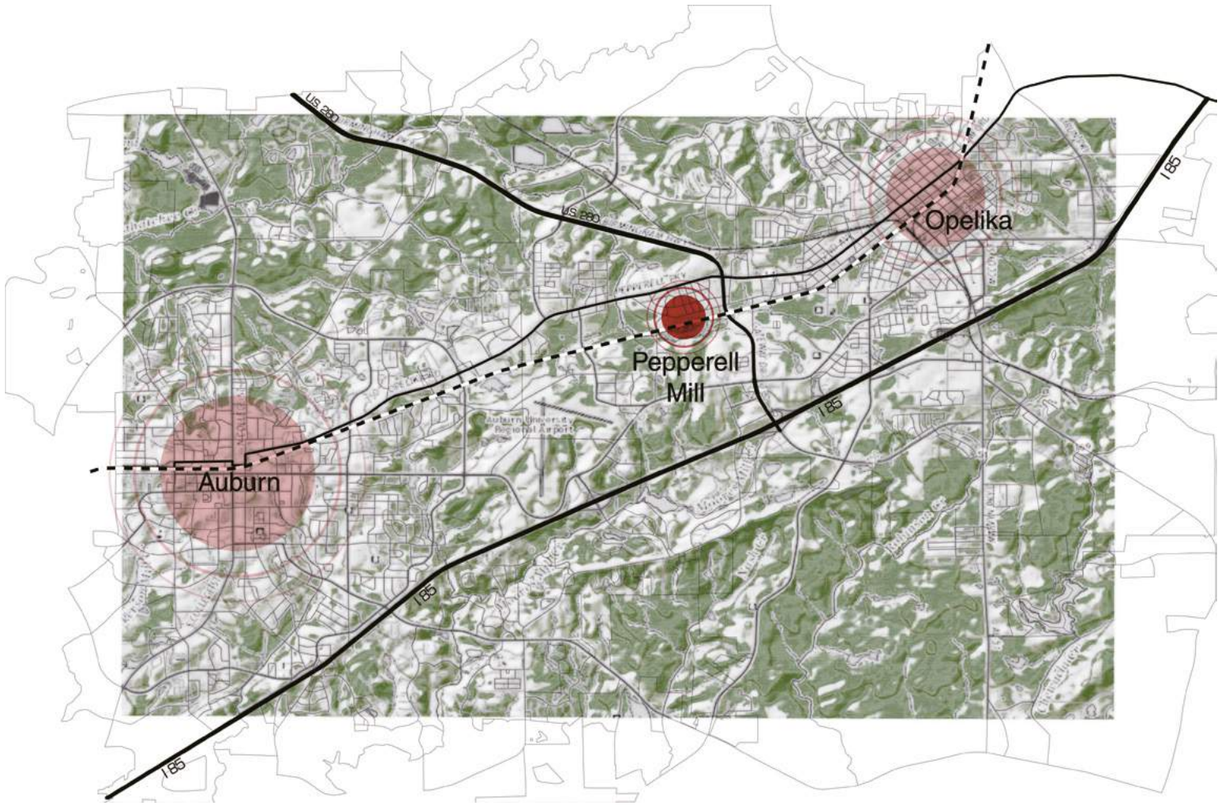




# THESIS
# INVESTIGATION FIELD

## Pepperell Mill

*Opelika, AL 1925-2006*




Pepperell Mill, a typical Southern cotton mill with historical significance located in Opelika, AL, is selected as the exploring field of the thesis project. Pepperell Mill shows rich and hybrid processes and changes through the lens of time, thus becoming a suitable site to explore the dynamics of process-based design. Within the New South Era, steel and cotton manufacture, grist mills, flour mills, and wool mills were all main parts for industrialization support of the state of Alabama. Because of abundant agricultural resources and competitive labor forces, Alabama was relatively attractive for textile industrial investment. The cotton textile industry developed in the 1880s. Also, the railroads built during Reconstruction were a major impetus to the industrialization of Alabama's economy. Industrialization was greatly increased during World War II with the appearance of factories producing machines, munitions, powder, and other war supplies. Industrialization and commerce increased throughout the state. As one of many manufacturing industries, the textile mill could represent part of the expanding process of Alabama's economy.

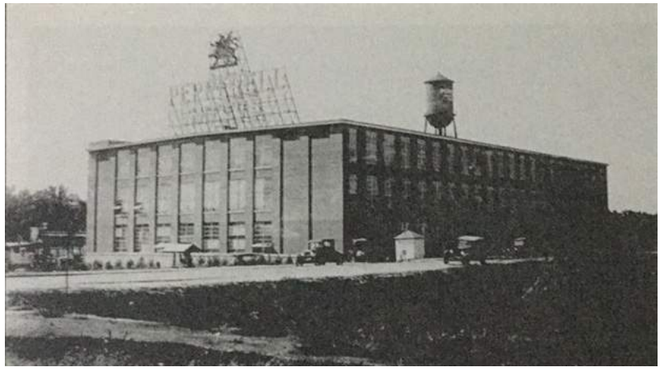


Figure 11
*The First Mill Built In 1926*

Figure 12
*Early Aerial View of the Mill Village*

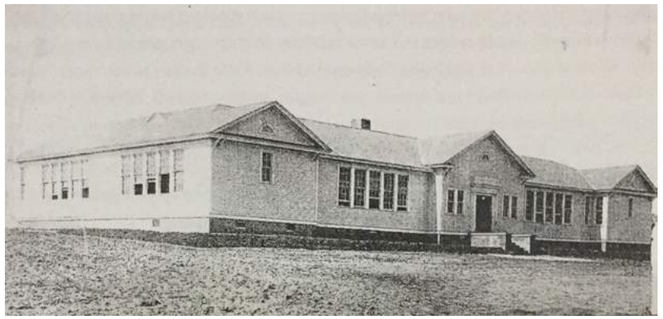


Figure 13
*The First School As It Was Completed In 1926*


Figure 14
*The Barber Shop*

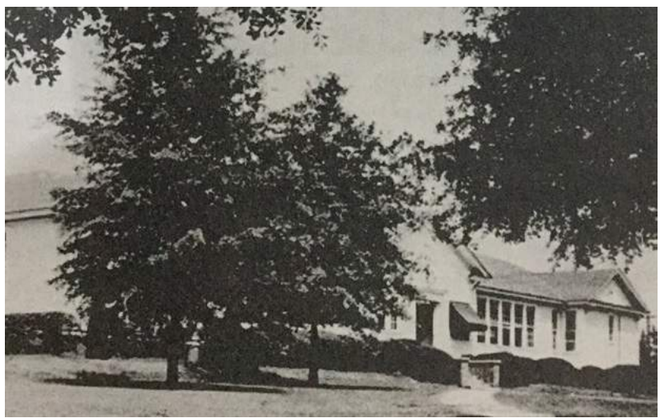


Figure 15
*The school during 1940's*

Figure 16
*Pepperell United Methodist Church*

According to The Heritage of Lee County, the original textile mill consisted of a brick mill, an opener room, and a warehouse. In the further expansion between 1929 and 1930, the company added an office building and another mill building. The company built a mill village to house its employees. Between the late 19th century and the early 20th century, this was a common trend in most of the textile manufacturing companies in the southern region of the United States. The mill village, owned by the company until 1958, contained both residential housing and community buildings which included a church, a school, and a community park. The mill and its village had a strong sense of vibrant community all through its history. According to the historical documentation in The Museum of East Alabama, it used to have its own column in the local newspaper to announce social events, clubs, and baseball and basketball teams that competed with teams from Opelika and other towns.

Figure 17
*The Mill Village In The First Construction Phase*

# FORMER PROCESSES

## Pepperell Mill

*Opelika, AL 1925-2006*

Pepperell Manufacturing Company is a textile company based in Biddeford, Maine. When Pepperell Manufacturing Company considered building its first textile mill in south, Opelika, as one of the railroad towns in Alabama, which believed industry was the key point to a local economy, offered a lot of promotions. Opelika, with developed railroad lines and surrounding dominant cotton fields, convinced the company. The mill was built in 1925, located in western Opelika. It was right outside of the city limit at that time.

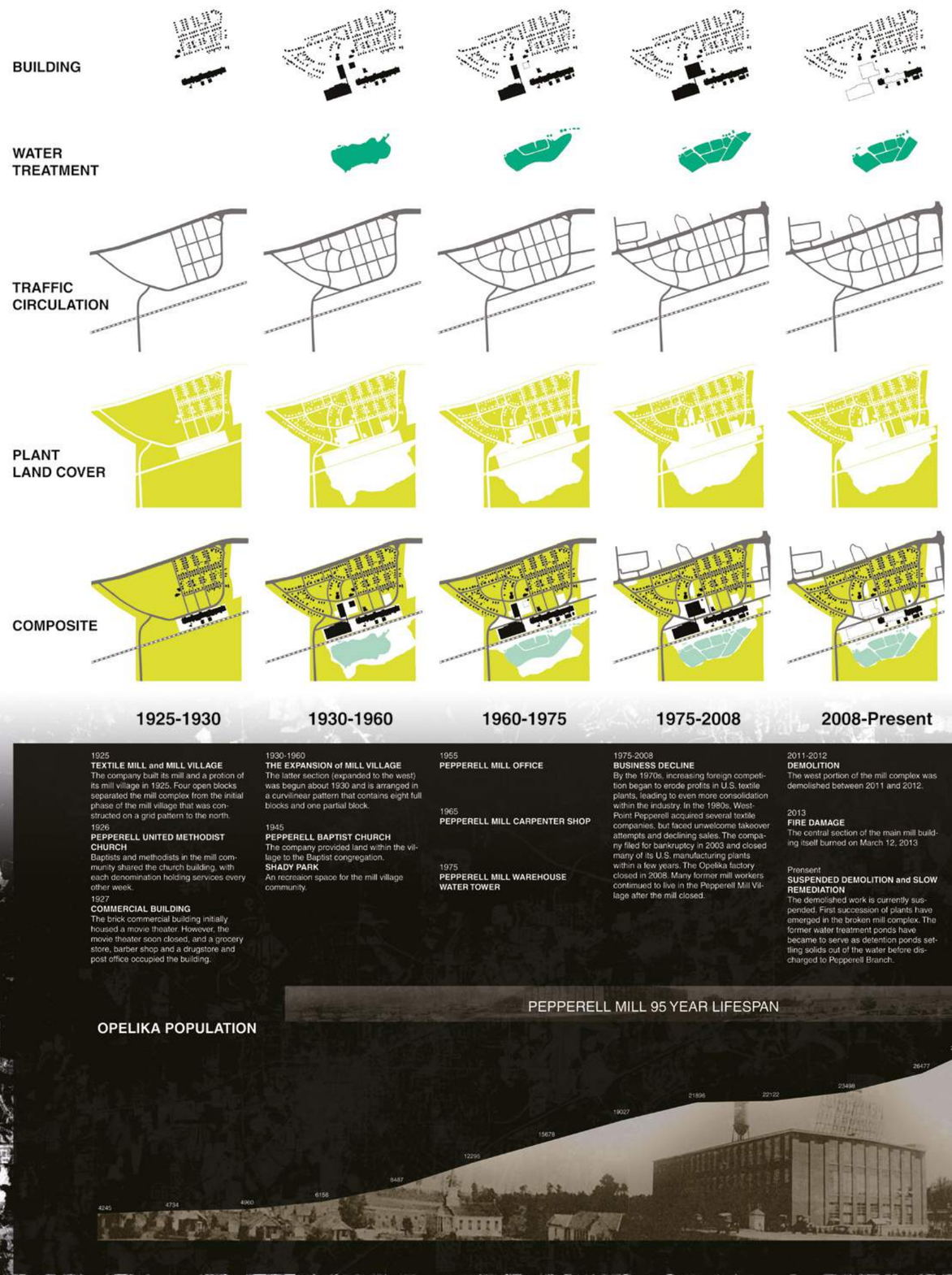
The Pepperell Mill was the largest manufacturing industry in Opelika since its establishment in 1925. Its business foundation significantly contributed to the local industry and enhanced the industrial development even in the county level. Between 1890 and 1929, the number of cotton mills in the state increased from thirty-one to eighty-three.[1] the South was competitively attractive to the Northern textile stakeholders because it had lower labor costs, weak unions, and the abundant raw material nearby. Considering the industrial development was the most effective contribution to the local economy, the government, and citizens of Opelika city made great efforts, such as land and tax incentives, and the advantage of developed railroads, to convince the Pepperell Manufacturing Company to build its first Southern textile factory here.

In regional scale, the lifespan of the Pepperell Mill reflected the trend of cotton manufacturing campaign of Alabama. For instance, the resistance to unionization in the 1930s and increased production for war supply during World War II. Pepperell was one of the last textile companies in the state to own the houses in its mill village, which it sold to private owners in 1958.[2] Most of the textile manufacturing companies had closed in the late 20th and early 21st centuries. The Pepperell Mill closed in 2006, which demonstrates the decrease of the cotton manufacturing industry.

In local scale, the Pepperell Mill contributed to Opelika in many aspects, such as sparking population increases, commercial growth, and additional industrial establishment. According to Census report, between 1900 and 1920, before the mill establishment, Opelika population grew by only 17%. By 1925, the arrival of the mill contributed to the city population increase of 24%. By 1950, Opelika had more than 12,000 population, nearly double the population in 1930. The success of the Pepperell Mill also encouraged more industrial investments within the city. The high demand for raw cotton and mature business development of the Pepperell Mill largely associated the local economy and cotton cultivation. The achievement of the Pepperell Mill also inspired additional industrial developments. A smaller cotton factory in Opelika closed in the late 1920s but reopened in 1935. In the years after the end of World War II, several factories were established in Opelika, including Ampex (magnetic tape), Diversified Products Corporation (recreational equipment), and Uniroyal (automobile tires).[3]

*1, 2 & 3 United States. National Park Service. National Register of Historic Places Registration Form. OMS No. 1024-0018, 2014. Online at http://www.nps.gov/nr/feature/places/pdfs/14000090.pdf*





As part of the daily mill operation, the raw material was stored at the back of the manufacturing building after unloading from the trains.

Figure 18

The card room in the main manufacturing building. The tubes with different colors indicated different blends of cotton.

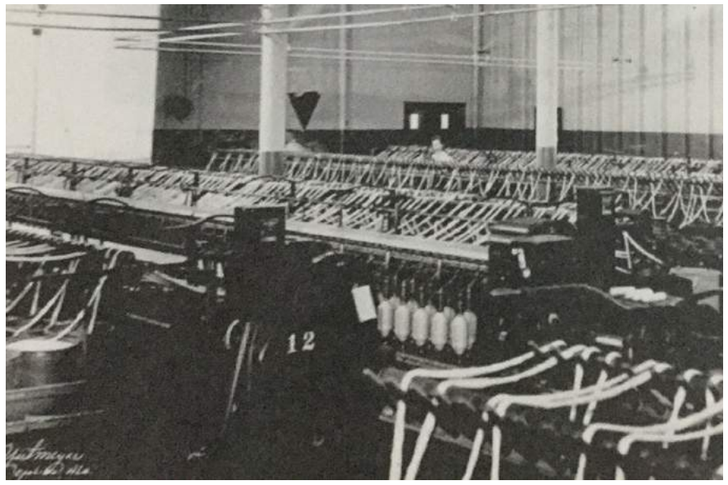



Figure 19

The boiler room was built in the early construction phase. It was responsible for continuously supplying energy to both manufacturing process and mill administration department.

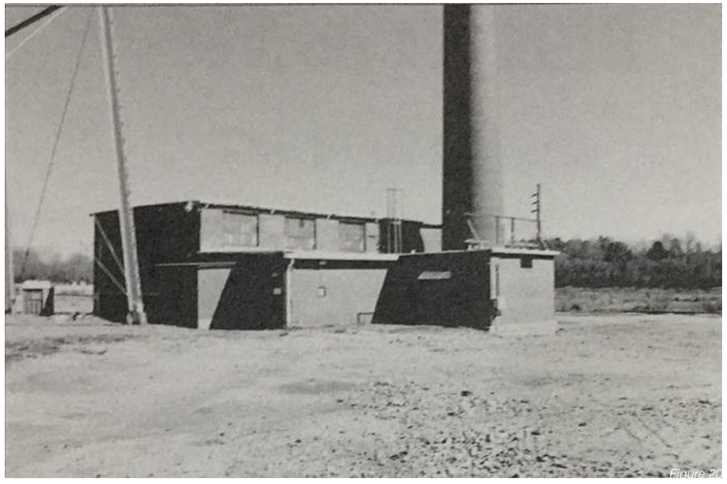
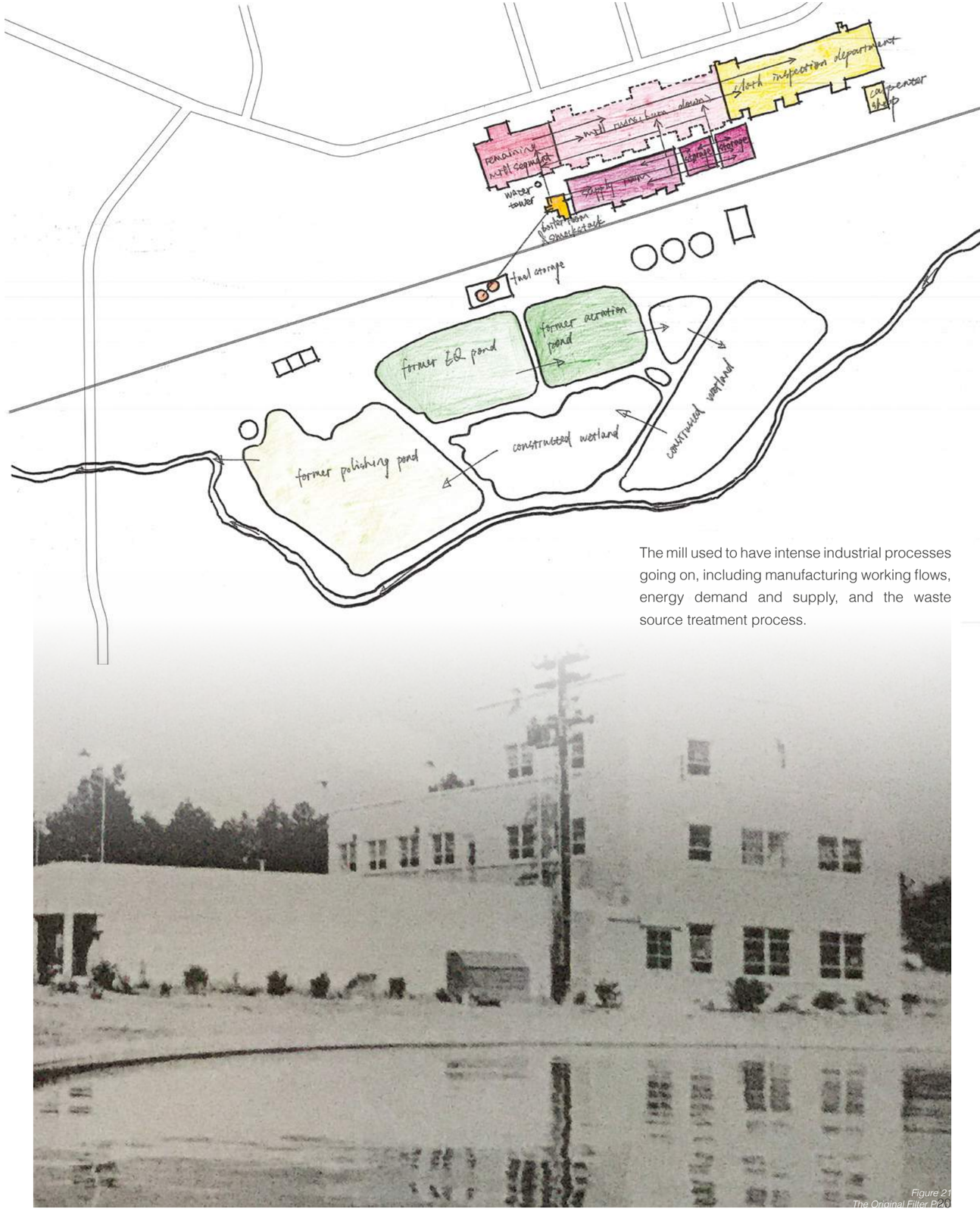


Figure 20




The mill used to have intense industrial processes going on, including manufacturing working flows, energy demand and supply, and the waste source treatment process.

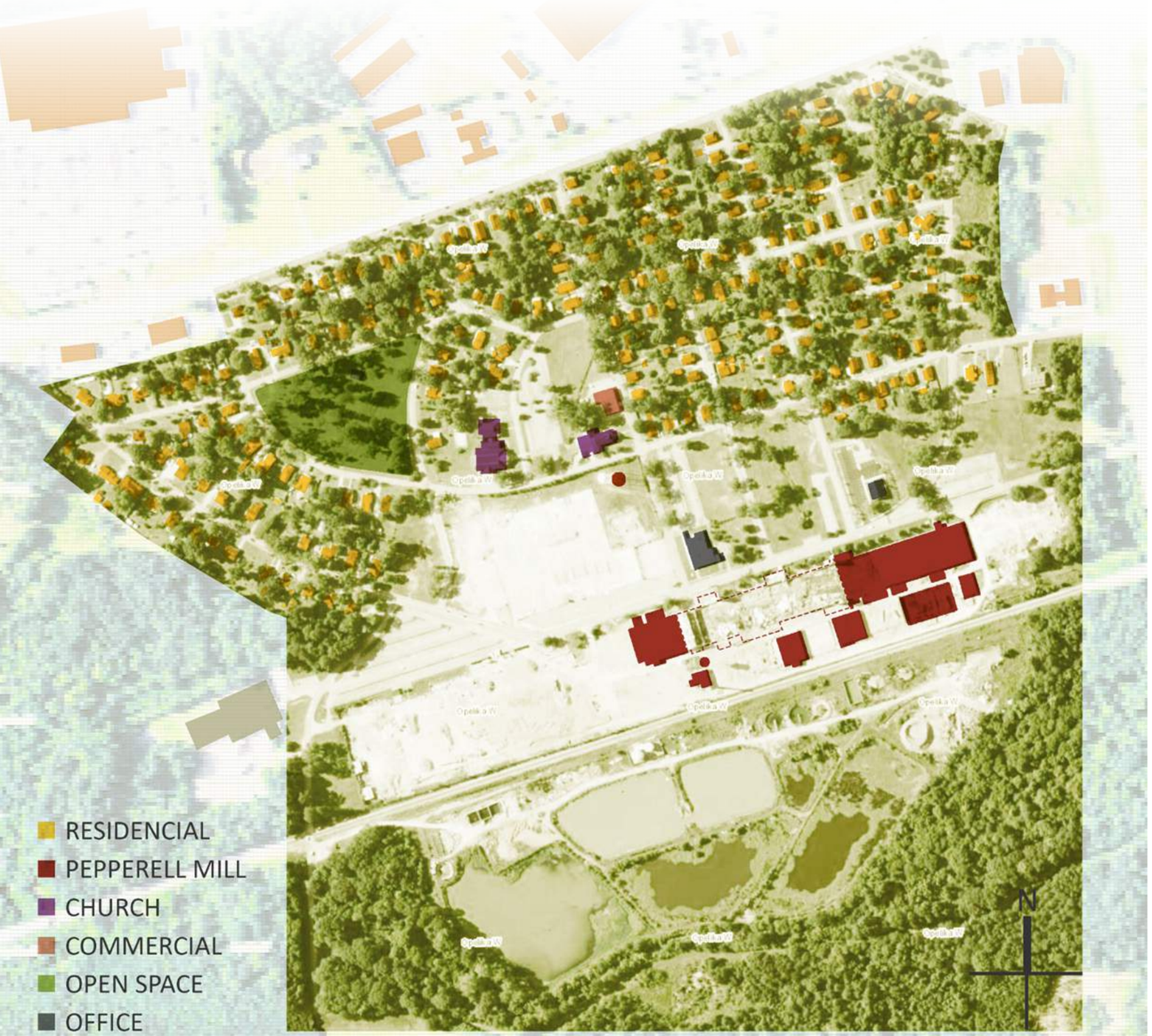


Figure 21
The Original Filter Plant

# EXISTING PROCESSES

## Existing Condition

*2006-2016*



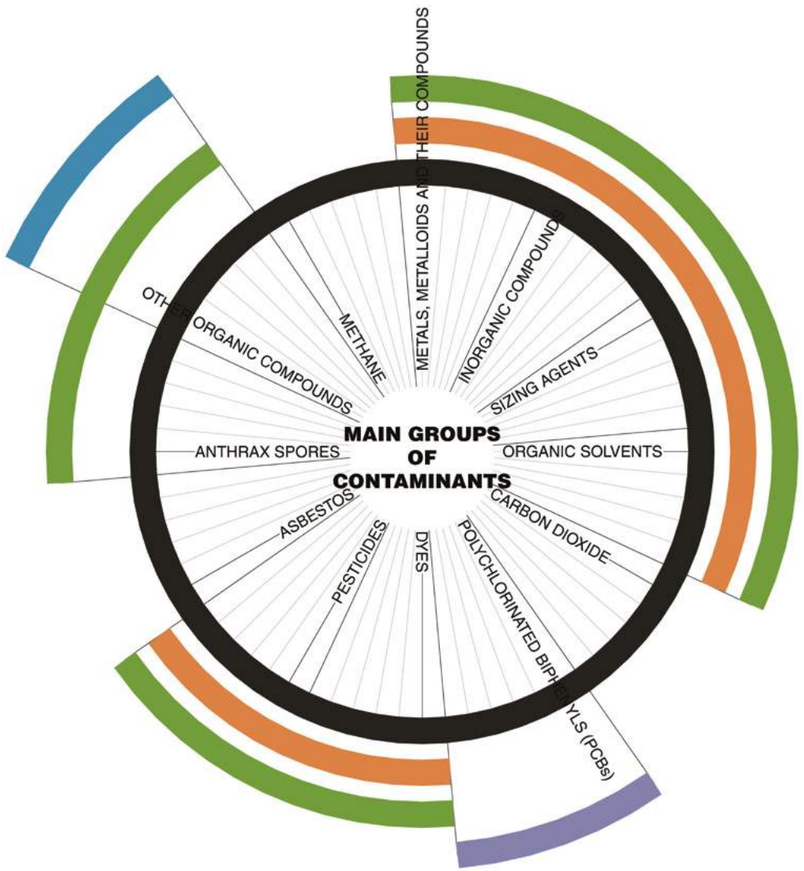


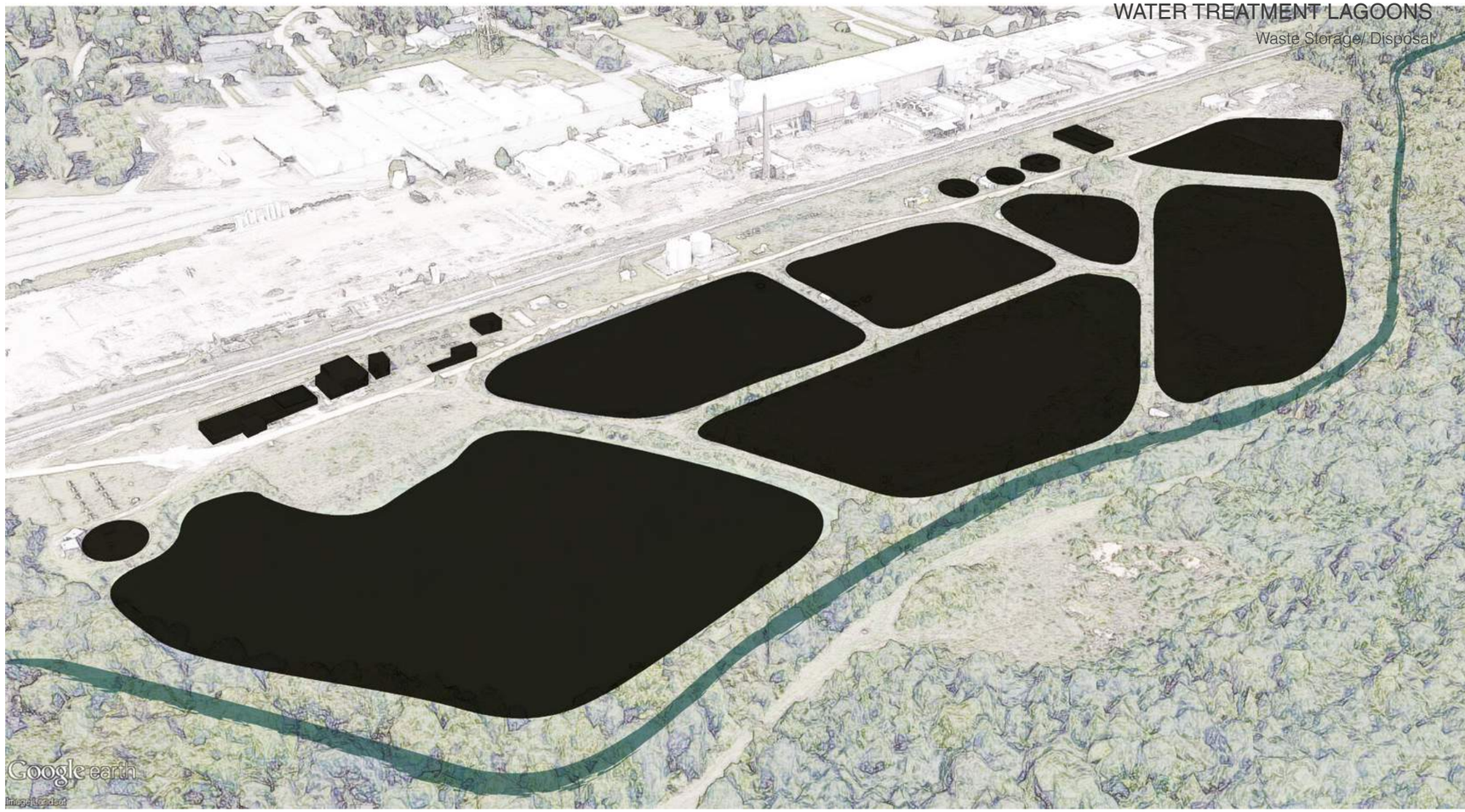

Pepperell Mill was closed in 2006. Most of the former mill workers are still live in the mill village and have a strong bond with the mill. The historic church, water towers, and the smoke stack, just like the landmark of the field. The railroad in the south is still active for industrial transportation.

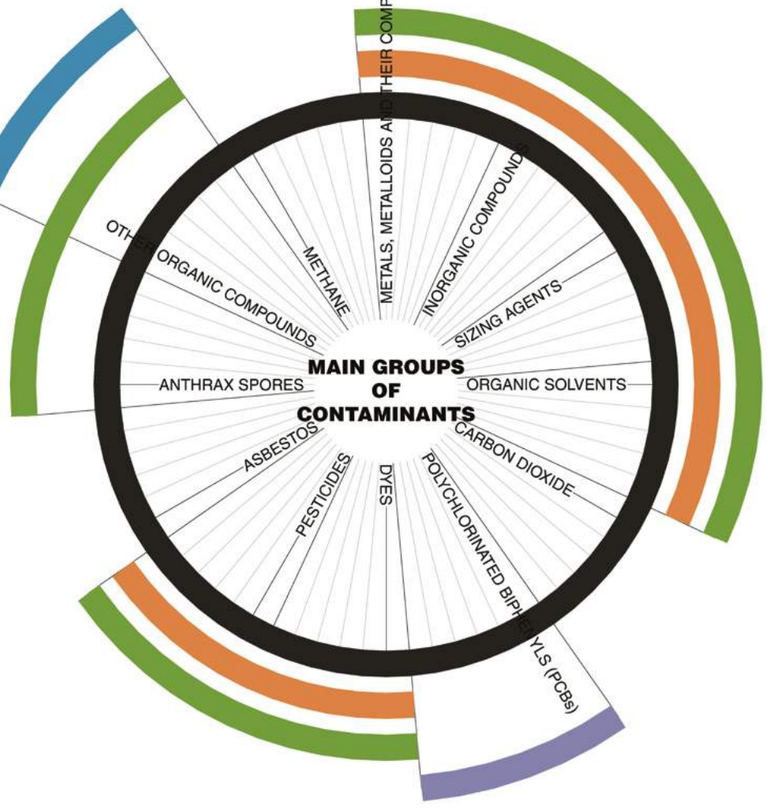
# EXISTING PROCESSES

## Contamination Concerns

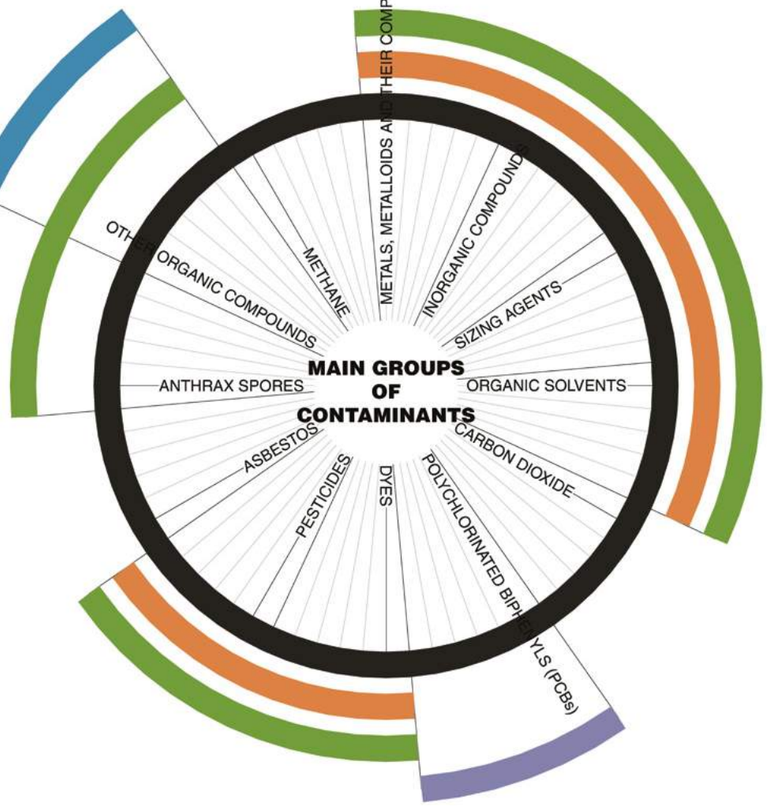
The industrial feature still resulted in tremendous ecological concerns and impacts. The general textile working flow included bleaching, dyeing, printing, and finishing which could have had potential waste stream source in each working flow. One of the main on-site waste treatment concerns is water treatment ponds. In general, the ponds produce residual sludge which remains on the site even after removing solid waste and sludge. Further, this may have affected surrounding areas by stormwater runoff.




MAIN GROUPS
OF
CONTAMINANTS
METALS, METALLOIDS AND THEIR COMPOUNDS
INORGANIC COMPOUNDS
METHANE
SIZING AGENTS
ORGANIC SOLVENTS
CARBON DIOXIDE
POLYCHLORINATED BIPHENYLS (PCBs)
DYES
PESTICIDES
ASBESTOS
ANTHRAX SPORES
ORGANIC COMPOUNDS


TEXTILE MILL
Main Manufacturing Process
Google earth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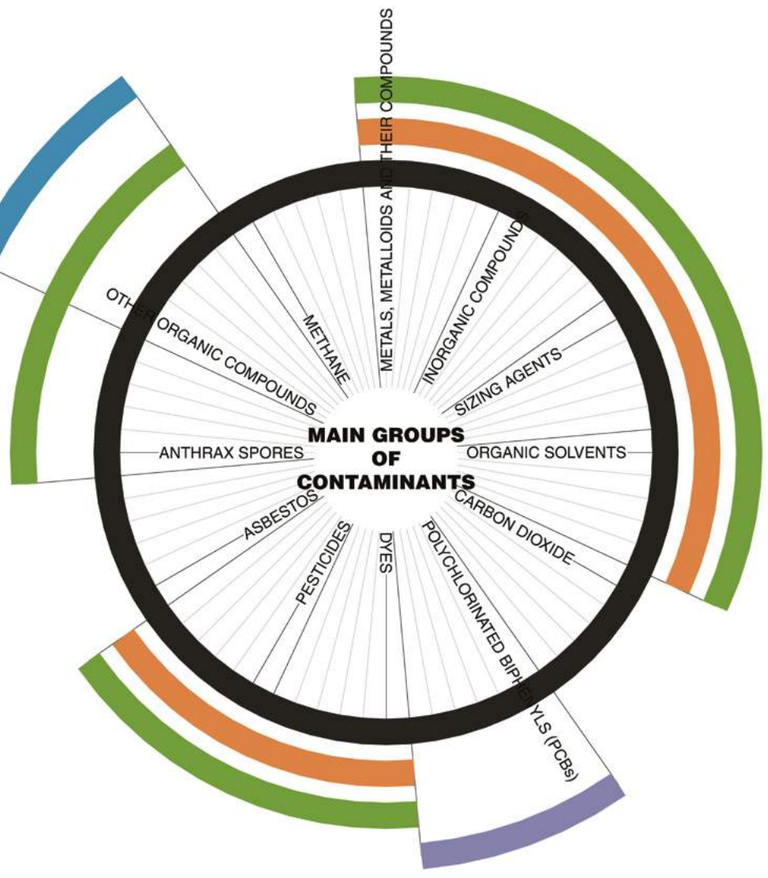
PESTICIDES
ASBESTOS
ANTHRAX SPORES
ORGANIC COMPOUNDS
METHANE
MAIN GROUPS
OF
CONTAMINANTS


WAREHOUSE
Raw Material Delivery and Storage
Google earth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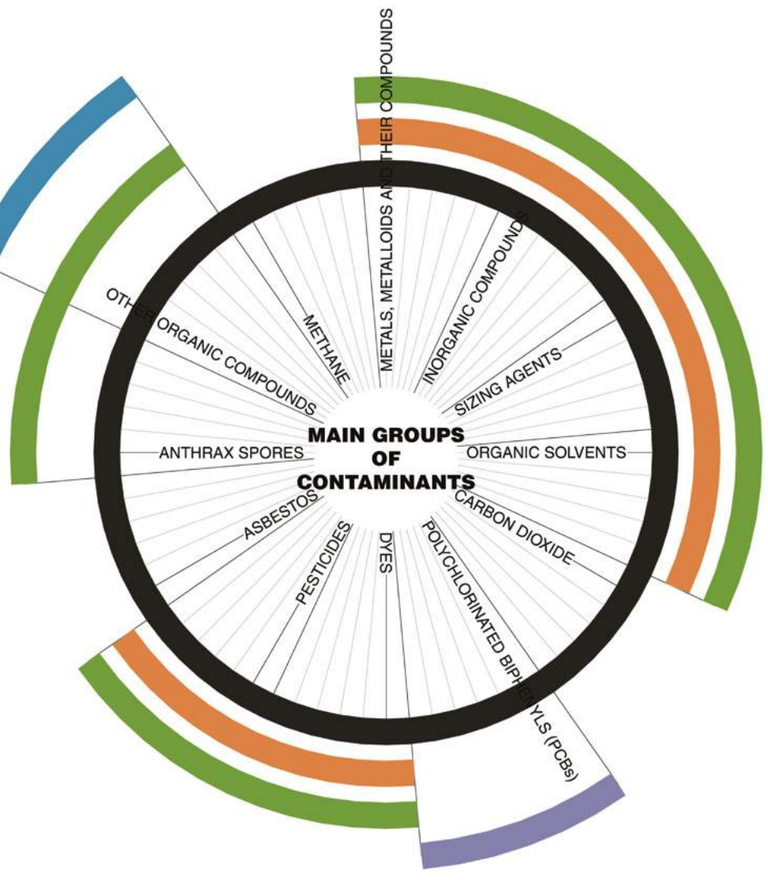
OF
CONTAMINANTS


FUEL STORAGE TANKS
Fuel Storage
Google earth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PESTICIDES
ASBESTOS
ANTHRAX SPORES
ORGANIC COMPOUNDS
METHANE
MAIN GROUPS
OF
CONTAMINANTS


BOILER ROOM
Electrical Substation and Transformers
Google earth

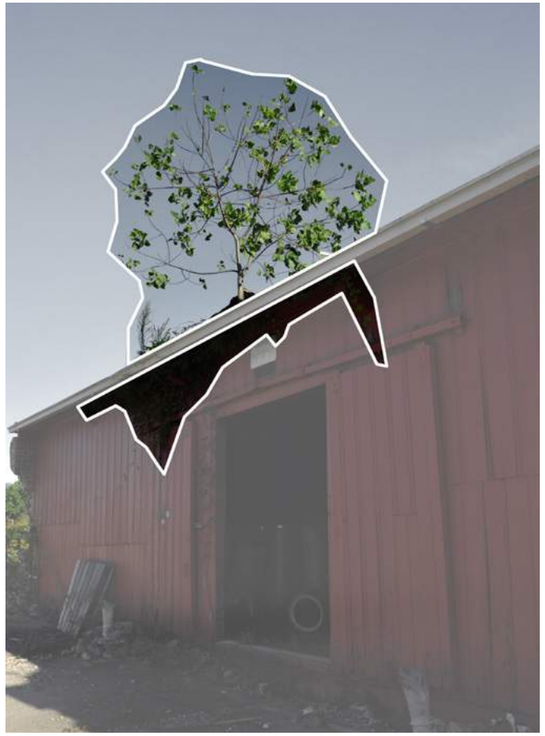
# EXISTING PROCESSES

Emerging Ecological Process



Due to the change of abandoned former industrial areas, the site's ecology has changed as well -- transformed from intense industry ecology and social ecology to natural ecology. Emerging early successional plant communities began to occupy those areas, for instance, red bud and goldenrod.





In general, early successional habitats are highly dynamic, highly productive seral stages with uniquely adapted animal communities. High productivity characterizes early successional communities and provides habitat for many disturbance-adapted wildlife species. Early successional habitats are highly ephemeral. In their absence of further disturbance, the attractiveness and productivity of many wildlife habitats decline. Early successional plants are herbaceous annuals and perennials that quickly occupy disturbed sites. They reproduce seeds that are disturbance adapted or can be widely dispersed by wind, water, or animals.[1] Because of this point, these post-industrial areas are closely related to pollinator habitat. With these regards, these areas have great potential to contribute to the pollinator habitats and the related ecology significance.

*1. United States. Natural Resources Conservation Service. Early Successional Habitat. 2007. Online at http://www.americaslongleaf.org/media/11802/early-successional-habitat.pdf*

# SEQUENTIAL STRATEGIES WITH SHIFTING PROCESS EMPHASIS

## Design Investigation

There were tremendous processes happening in the thesis investigation field. They were related and contributed to each other. They were shaped or affected by each other and formed as the assemblage of the space which also contribute to the sense of space. As these regards, selectively working along with those processes became the essential step of process-based design.

Inspired by the former and existing processes of the site, the sequential design strategies chose three processes from the complex processual assemblage – textile manufacturing process, public realm, and plant successional process. They are correlated to public engagement and phytoremediation process assisted by the planting resource. Those three processes are not separate as dependent components but keep interacting with each other. Even though they are just part of the processual assemblage, they still have the complex features and relationships.

Therefore, the after-mill landscape became a processual assemblage seeking the leverage point to unfold the discourse of remediation, industrial legacy, and community emotional connection, instead of being a conventional site grounded by its property boundaries and objectifying goggle.


Stage I aimed to engage with remediation process due to the remaining residual sludge and relieve the secondary contamination caused by on-site stormwater runoff. Simultaneous, preparing for the public space development was another emphasis in this stage. It was the necessary and strategic attraction for public involvement.

PLAN OF STAGE I

Tree Nursery
selective remove & harvesting

Public Space
activities & gathering ground

Tree Nursery
phytoremediation assistance

Annuals & Perennials
phytoremediation assistance

Rain Garden
stormwater management

Former Waste Water Treatment Pond

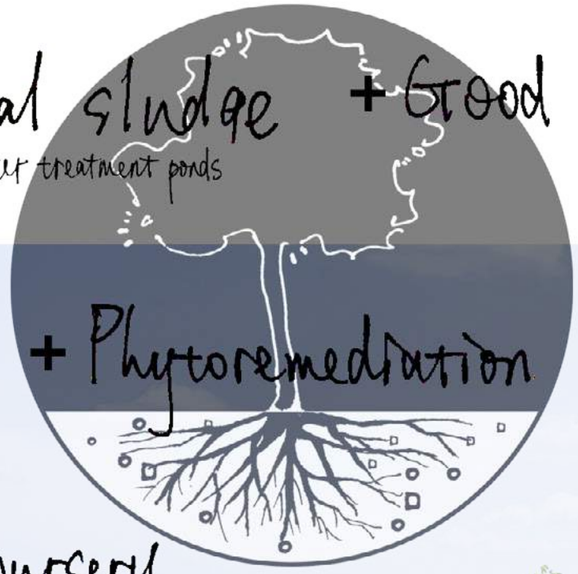
Existing Constructed Wetland

Constructing Wetland
phytoremediation processing

N

0 100 200 300 700 ft

+ Residual sludge + Good soil
in the former water treatment ponds



+ Phytoremediation

= Tree nursery
Commercial use
On-site transplanting
Timber harvest rotation every 6-8 yrs

= Public attention
learning & engagement

+ Temporary activities
& celebrations

= Demonstration facility

+ Residual sludge
in the former water treatment ponds

+ Phytoremediation

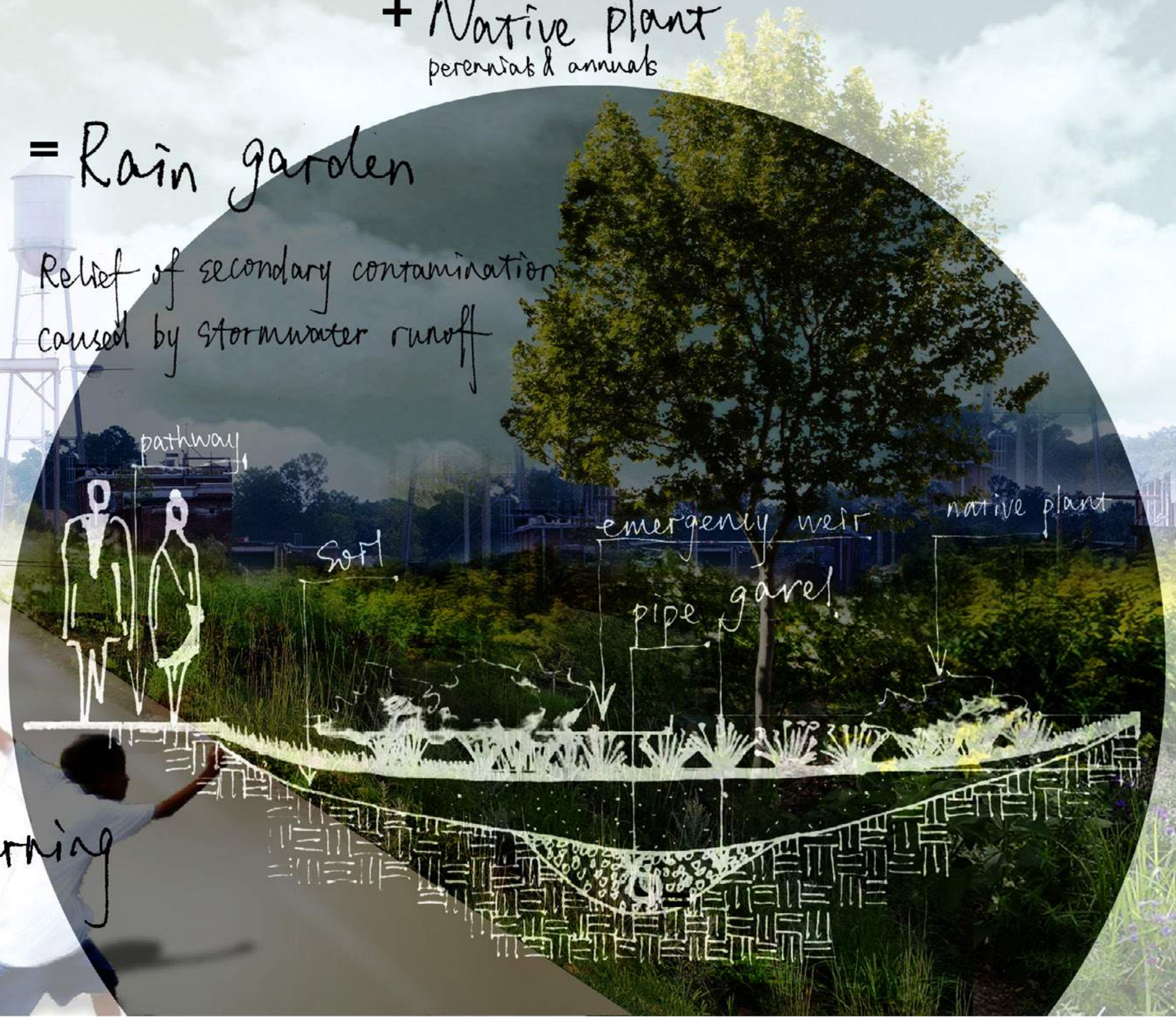
+ Good soil

+ Native plant
perennials & annuals

= Tree nursery

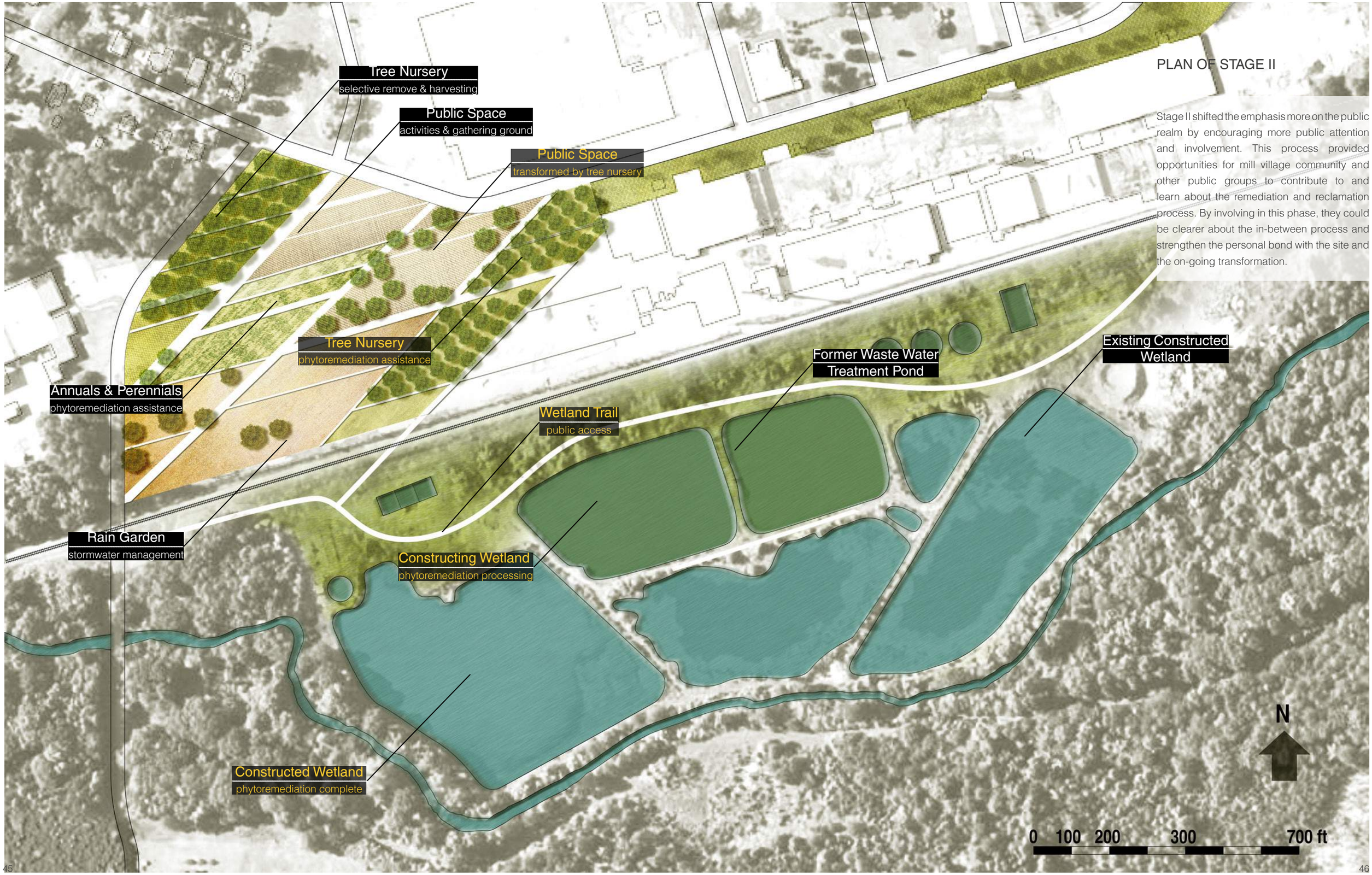
= Rain garden

Relief of secondary contamination
caused by stormwater runoff




= Demonstration facility

= Public attention & learning



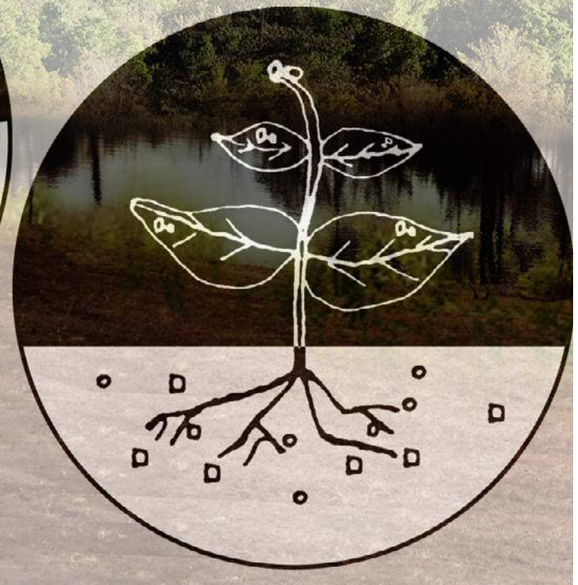

## PLAN OF STAGE II

Stage II shifted the emphasis more on the public realm by encouraging more public attention and involvement. This process provided opportunities for mill village community and other public groups to contribute to and learn about the remediation and reclamation process. By involving in this phase, they could be clearer about the in-between process and strengthen the personal bond with the site and the on-going transformation.

+ Residual sludge cleaning

+ Constructed wetland

= Remediation demonstration
phyto & bioremediation



= Public attention
learning & engagement

# PLAN OF STAGE III

Stage III indicating the role altering the process of the plant realm, from phytoremediation assistance to educational attraction, such as succession plant demonstration, commercial harvesting, and other uses.

Tree Nursery
selective remove & harvesting

Public Space
activities & gathering ground

Public Space
activities & gathering ground

Annuals & Perennials
transformed by tree nursery

Annuals & Perennials
phytoremediation assistance

Public Space
transformed by tree nursery

Tree Nursery
phytoremediation assistance

Rain Garden
stormwater management

Wetland Trail
public access

Constructed Wetland
phytoremediation complete

Constructed Wetland
phytoremediation complete

Wetland Trail
full public access

Constructed Wetland
phytoremediation complete

N

0 100 200 300 700 ft

= Evoking further reclamation

+ Pollinator habitat

+ Native plant perennials & annuals

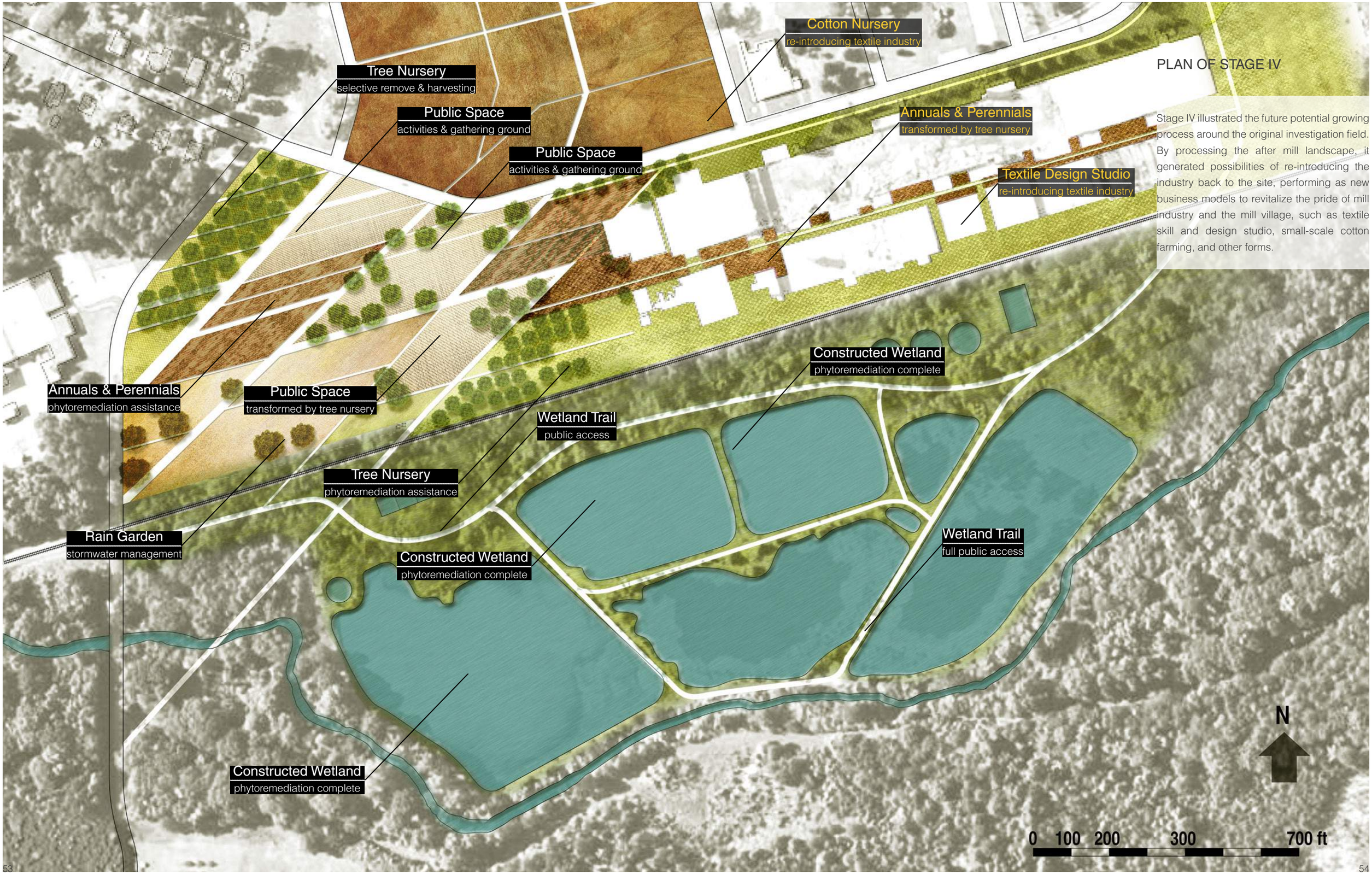
= Successional demonstration

On-site transplanting

Seeds harvest & cultivation

= Public attention

learning & engagement




## PLAN OF STAGE IV

Stage IV illustrated the future potential growing process around the original investigation field. By processing the after mill landscape, it generated possibilities of re-introducing the industry back to the site, performing as new business models to revitalize the pride of mill industry and the mill village, such as textile skill and design studio, small-scale cotton farming, and other forms.

+ Potential to reintroduce the industry

= improving the attachment & processing flow between the mill & its village

+ Productive field

= community engagement

= educational studio

= community workshop

# SEQUENTIAL STRATEGIES WITH SHIFTING PROCESS EMPHASIS

## Reflection

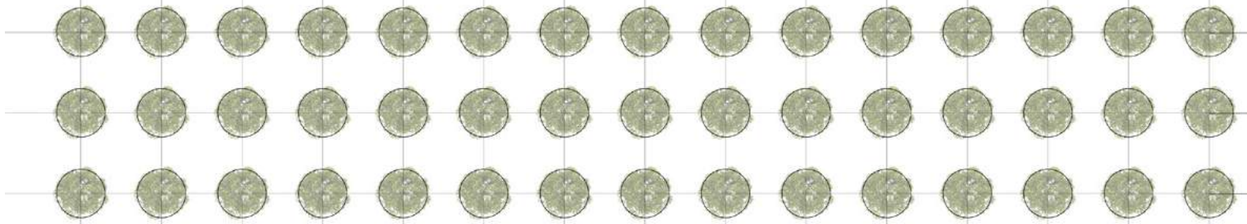
Although process-based design intends to focus on the dynamic, complex and indeterminate tendency, the physical expression regarding form and material performance is still extremely relative. As the designer, the physical form and configuration is the most directive and fundamental medium to translate the design intent or strategy to the world. It is the practice of physical expression that reveals or delivers the processual tendency in the tangible medium. There is almost no legibility to address any fluid, uncertain and process-driven tendencies without referencing the materiality. However, the physical expression here is not valuable for the aesthetic presence or static composition but how they provide the field for the process and relationship to interact without complete manipulating.

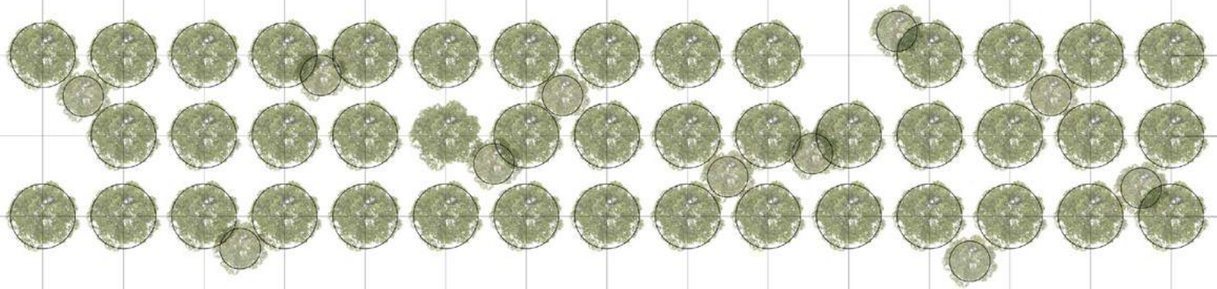
The physical expression in the sequential strategies was performed through the surface operation. In this thesis investigation circumstance, surface operation means preparing a set of surface to accommodate processes to happen (then repeating this set of surface by a certain rule. In the design case, the set of surface related to the surface with open park atmosphere, tree nursery surface for phytoremediation process, annual and perennial flora planting surface for both phytoremediation and succession demonstration purpose. In the future stages, this set of surface has been operated until fully transformed the site.

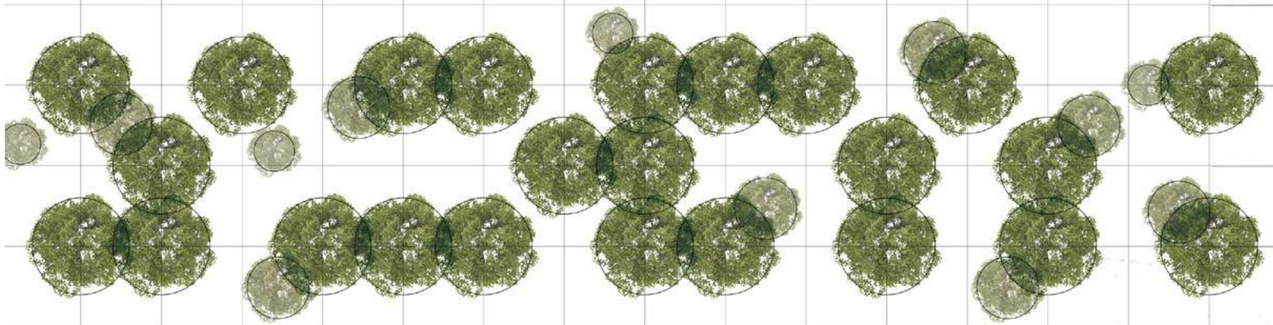
However, this physical expression, for now, cannot fully address and engage with the dynamic qualities of landscape due to the iteration of surface operation which is likely to omit other possibilities of the site. Therefore, this recognition let the thesis research and design move forward. The further investigation aimed strongly to capture the interactive and processual tendencies of the site.

# PROJECTED PROCESS TYPOLOGIES

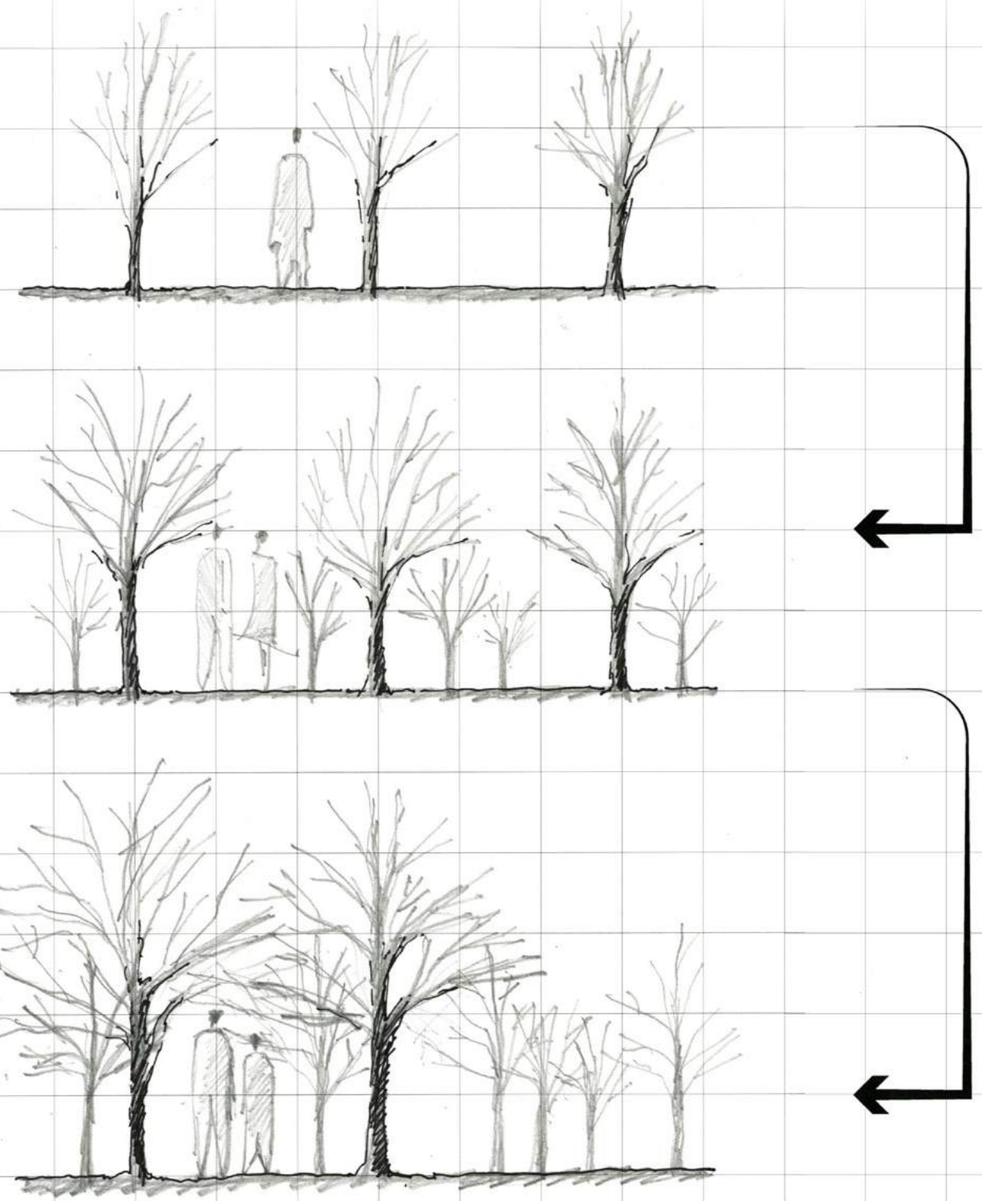
## Succession

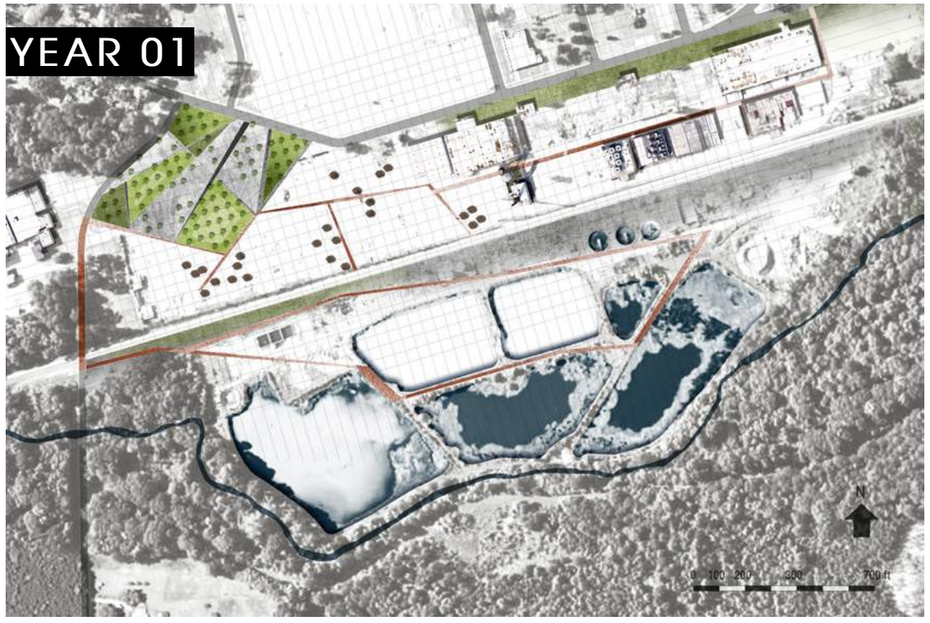




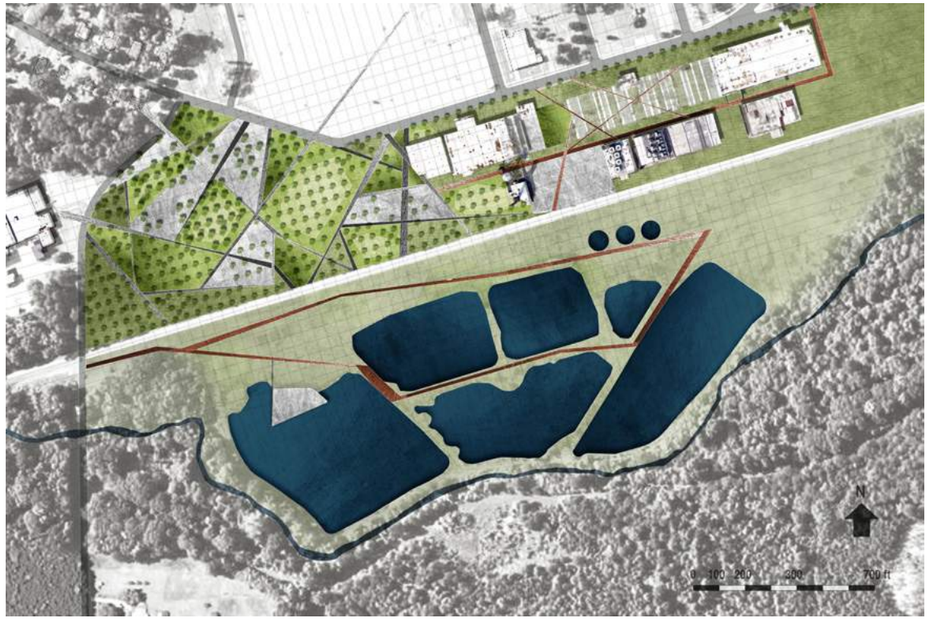


Plant succession performs tremendous quality over time. The projected process thus employing succession intended to engage with the dynamic richness and tendencies of the landscape. Therefore, the planting strategy, in this case, was not under the regular and common maintenance regime or selective remove management which is fully controlled by human (the designer). It intended to set proposed landscape in motion then let the successional process continuously involve in and transform the site.






The planting strategy performed under a clear and linear setting. The atmosphere here was similar with the tree grove. Because of the successional process of flora, the trees grew bigger and bigger. The related seeding process then was impacted by various factors, such as the wind, birds or other wildlife. Species which are suitable for this growing habitat started to emerge and evolve, other than the proposed planting palette.





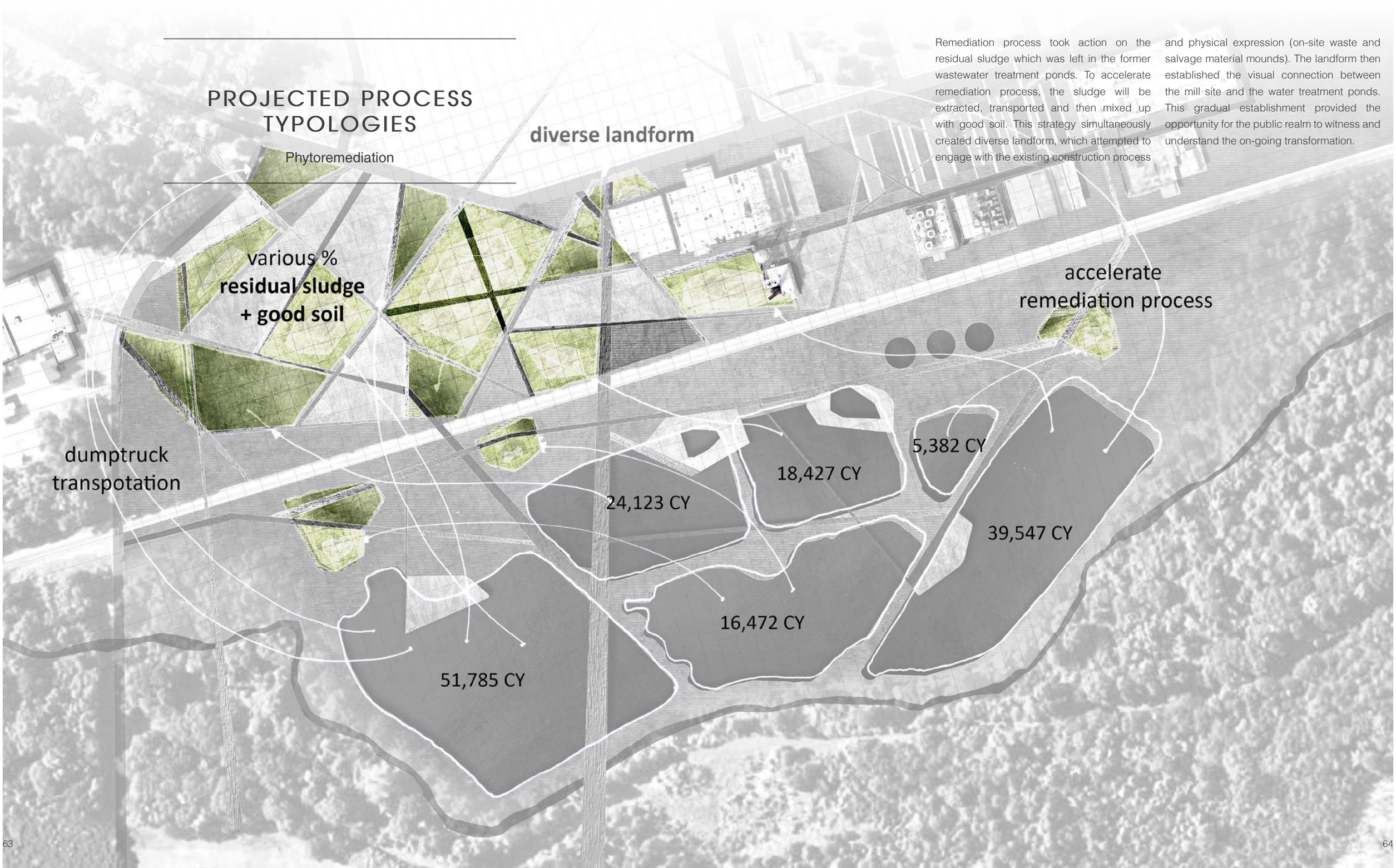


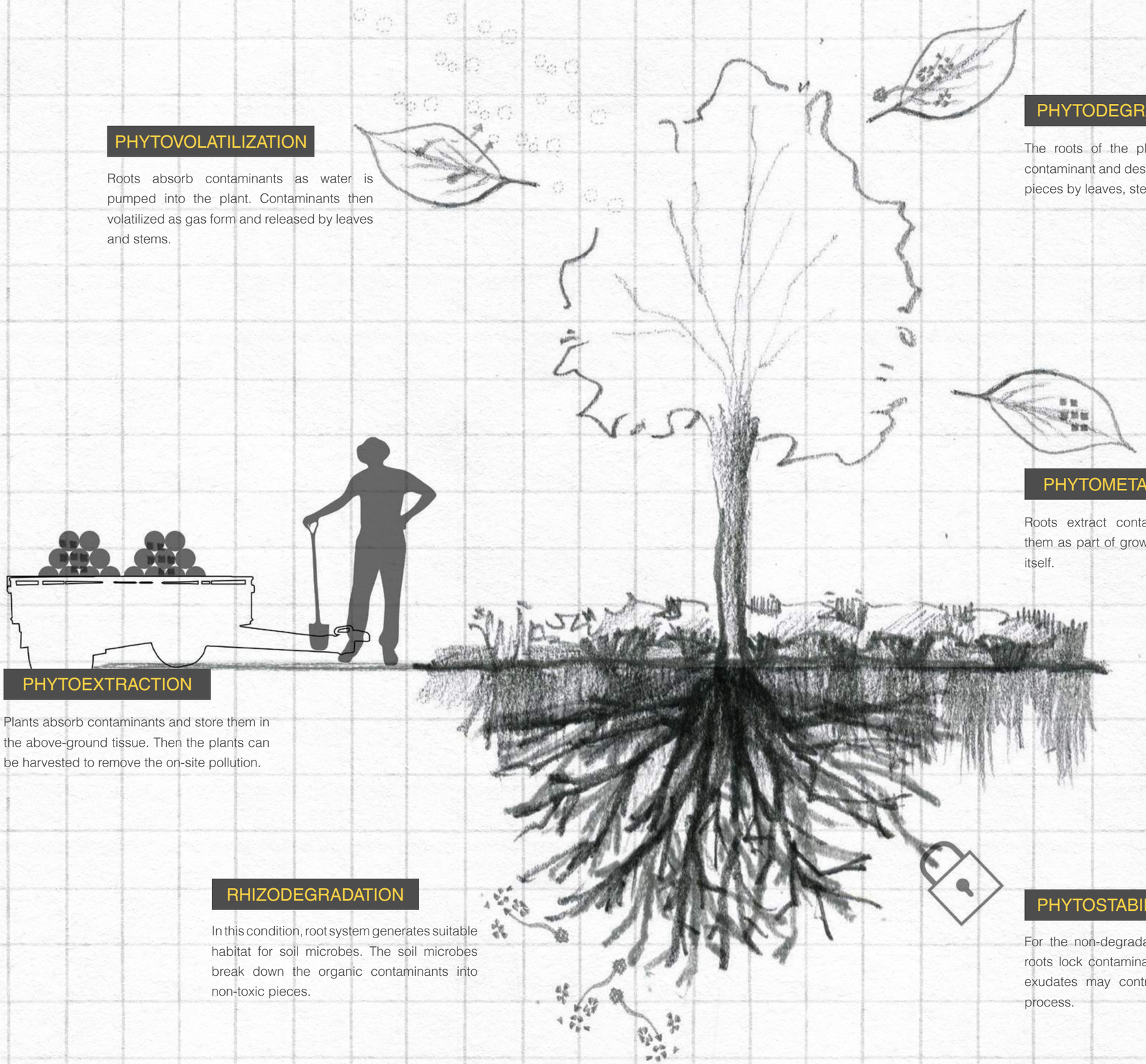
Over time, the physical planting expression began to lose the original strict framework. Meanwhile, the succession process could spontaneously transform the planting performance to various scales of “rooms” and even “cloud” form.

# PROJECTED PROCESS TYPOLOGIES

Phytoremediation

Remediation process took action on the residual sludge which was left in the former wastewater treatment ponds. To accelerate remediation process, the sludge will be extracted, transported and then mixed up with good soil. This strategy simultaneously created diverse landform, which attempted to engage with the existing construction process and physical expression (on-site waste and salvage material mounds). The landform then established the visual connection between the mill site and the water treatment ponds. This gradual establishment provided the opportunity for the public realm to witness and understand the on-going transformation.





## PHYTOVOLATILIZATION

Roots absorb contaminants as water is pumped into the plant. Contaminants then volatilized as gas form and released by leaves and stems.

## PHYTOEXTRACTION

Plants absorb contaminants and store them in the above-ground tissue. Then the plants can be harvested to remove the on-site pollution.

## RHIZODEGRADATION

In this condition, root system generates suitable habitat for soil microbes. The soil microbes break down the organic contaminants into non-toxic pieces.

## PHYTODEGRADATION

The roots of the plant get touch with the contaminant and destroy it into non-toxic small pieces by leaves, stems, and root systems.

## PHYTOMETABOLISM

Roots extract contaminants and transform them as part of growing nutrient for the plant itself.

## PHYTOSTABILIZATION

For the non-degradable contaminants, thick roots lock contaminants within the soil. Root exudates may contribute to the stabilizing process.

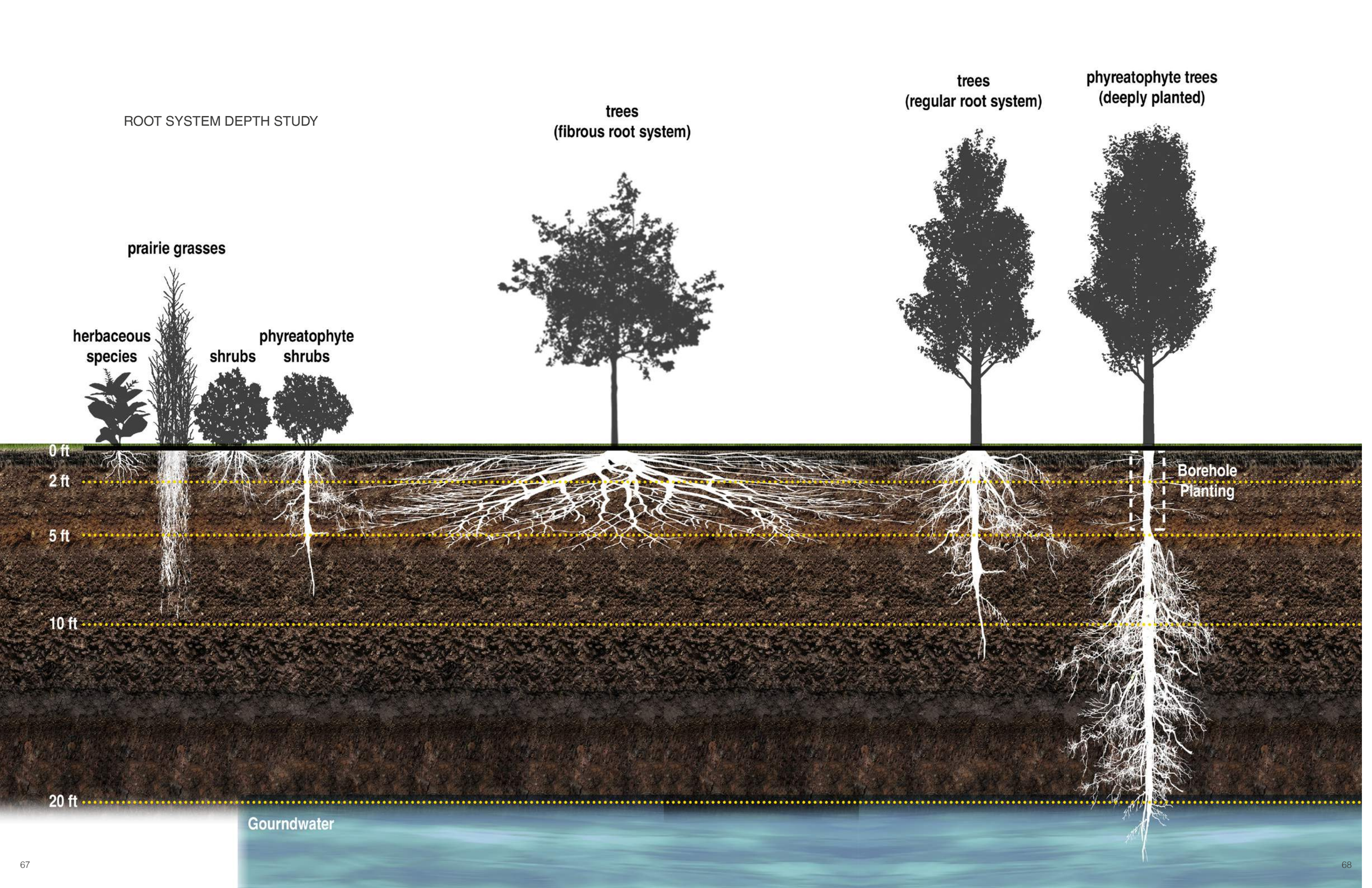


## PHYTOREMEDIATION TECHNIQUES

*Phytotechnology is the use of vegetation to remediate, contain or prevent contaminants in soils, sediments and groundwater, and/ or add nutrients, porosity and organic matter. It is also a set of planning, engineering and design tools and cultural practices that can assist landscape architects, site designers, engineers and environmental planners in working on current and future individual sites, the urban fabric and regional landscapes.* – Kirkwood and Kennen as an expansion of previous definitions (Rock, 2000; ITRC, 2009)

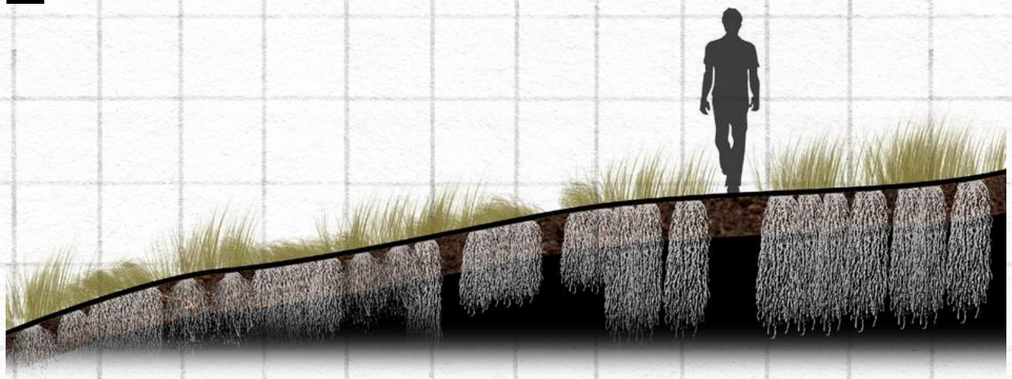
In this thesis project, phytoremediation, flora-based remediation process was employed as the main solution to remediate the on-site contamination.

ROOT SYSTEM DEPTH STUDY



SUCCESSION PROCESS OF PHYTOREMEDIATION PLANTS

1



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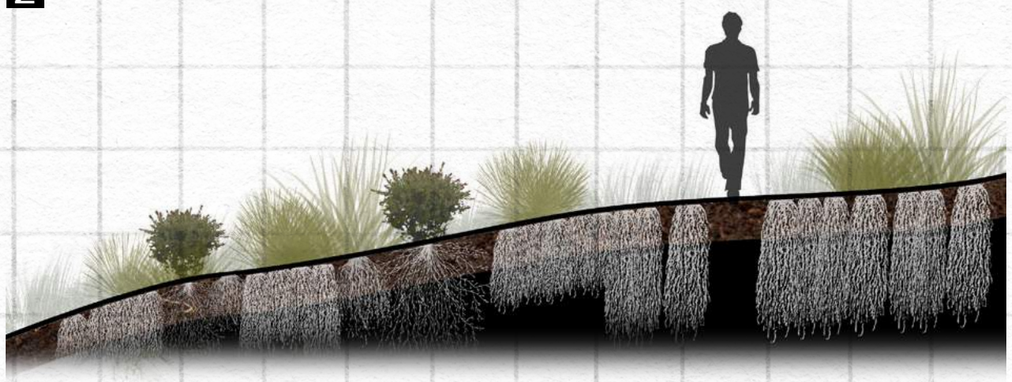



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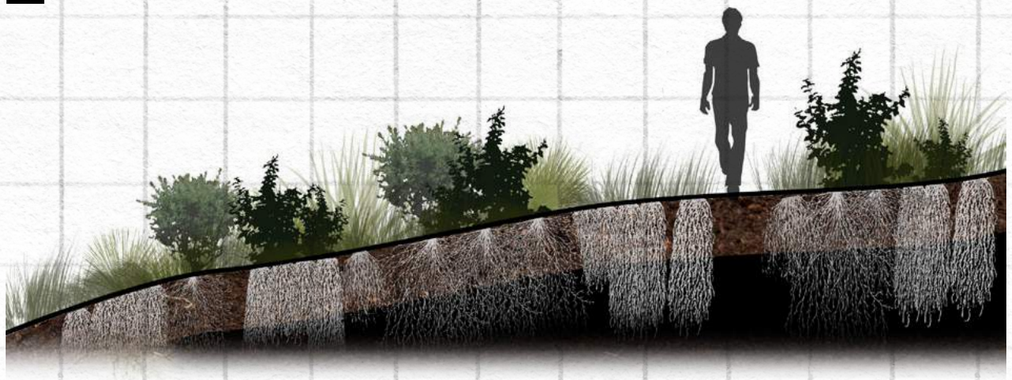

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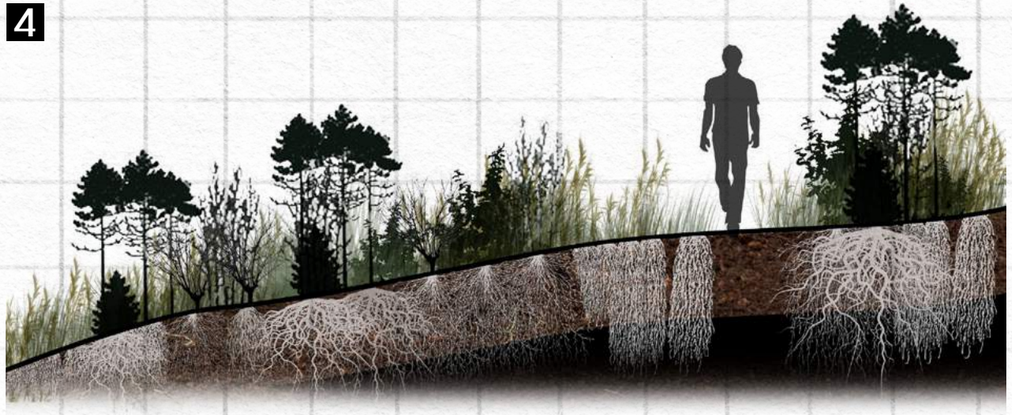


# PROJECTED PROCESS TYPOLOGIES

## Construction and Public Access & Witness

The construction process and public access are not always contradictory factors. In this process-based design case, the investigation intended to engage with public access and construction process simultaneously.

Former Waste Water Treatment Pond

Construction Circulation Mark (dump truck)

Sludge Pile and Construction Waste

Construction Circulation Mark
(dump truck)

Former Waste Water
Treatment Pond

Flora Buffer

Existing Concrete Surface
(former mill operation place)

Former Mill Building Material

Construction Circulation Mark

Construction Material Mound

# YEAR 01

## OPEN PARK
accommodating the public realm

slope landform

mound landform

construction circulation

As the plan of year 1 illustrated, the abandon parking lot in the northwest of the site was installed in the earlier time, performing as a small scale open park to accommodate the public activities. Dump trucks transported the residual sludge left in the former water treatment ponds through the existing construction circulation, which is preparing for the following landform construction.

N

0 100 200 300 700 ft


The mounds and slope landform has been fully implemented, the former mill building in the good condition was reused as a research lab and exhibition center to monitor the phytoremediation process and achieve public education value. At this moment, the construction process was pushing towards the southeast side to prepare the trail garden, public activity ground, wetland platform and the further planting.


The construction will be push back by the public access over time and eventually phase out. The construction processing circulation is gradually transformed into public path and trail.

# YEAR 35

TRAIL GARDEN
on-site planting exhibition

ADAPTIVE REUSE
commercial & textile studio

ADAPTIVE REUSE
research lad & exhibition center

slope landform

mound landform

public path & trail
*transformed by construction path*

public path & trail
*transformed by construction path*

WETLAND PLATFORM

public path & trail
*transformed by construction path*

WETLAND PLATFORM

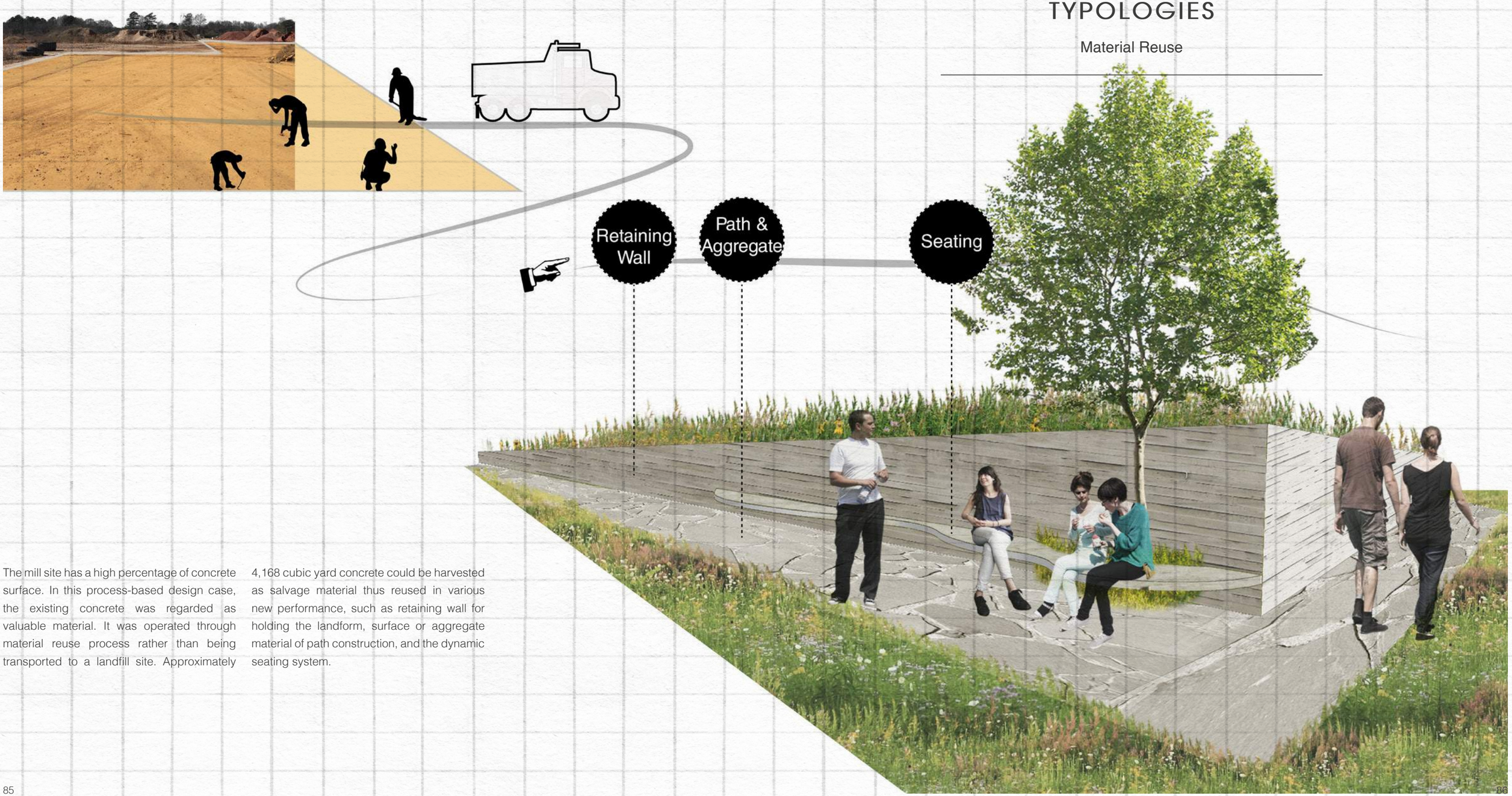
This design case engaged with both construction process and public access. It provided opportunities for the public realm, one of the most important medium group to accept and appreciate the dynamic qualities of landscape, to continuously interactive with the in-between processes towards relentless transformation.

N

0 100 200 300 700 ft

# PROJECTED PROCESS TYPOLOGIES

Material Reuse

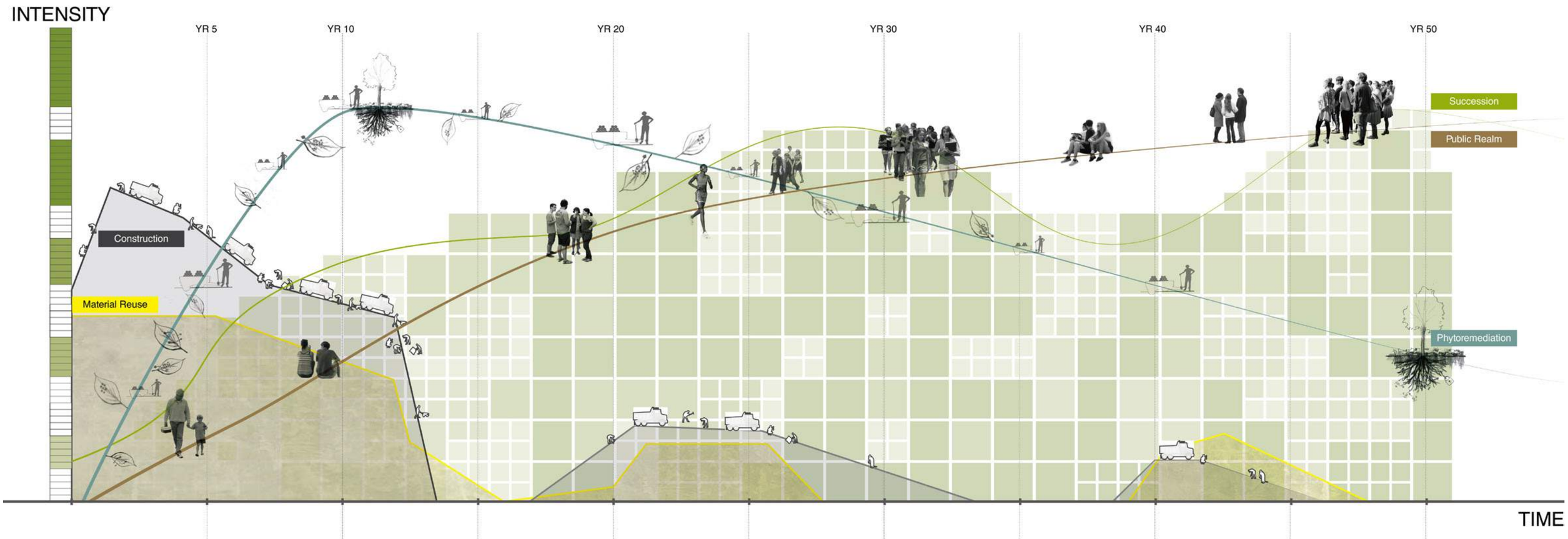


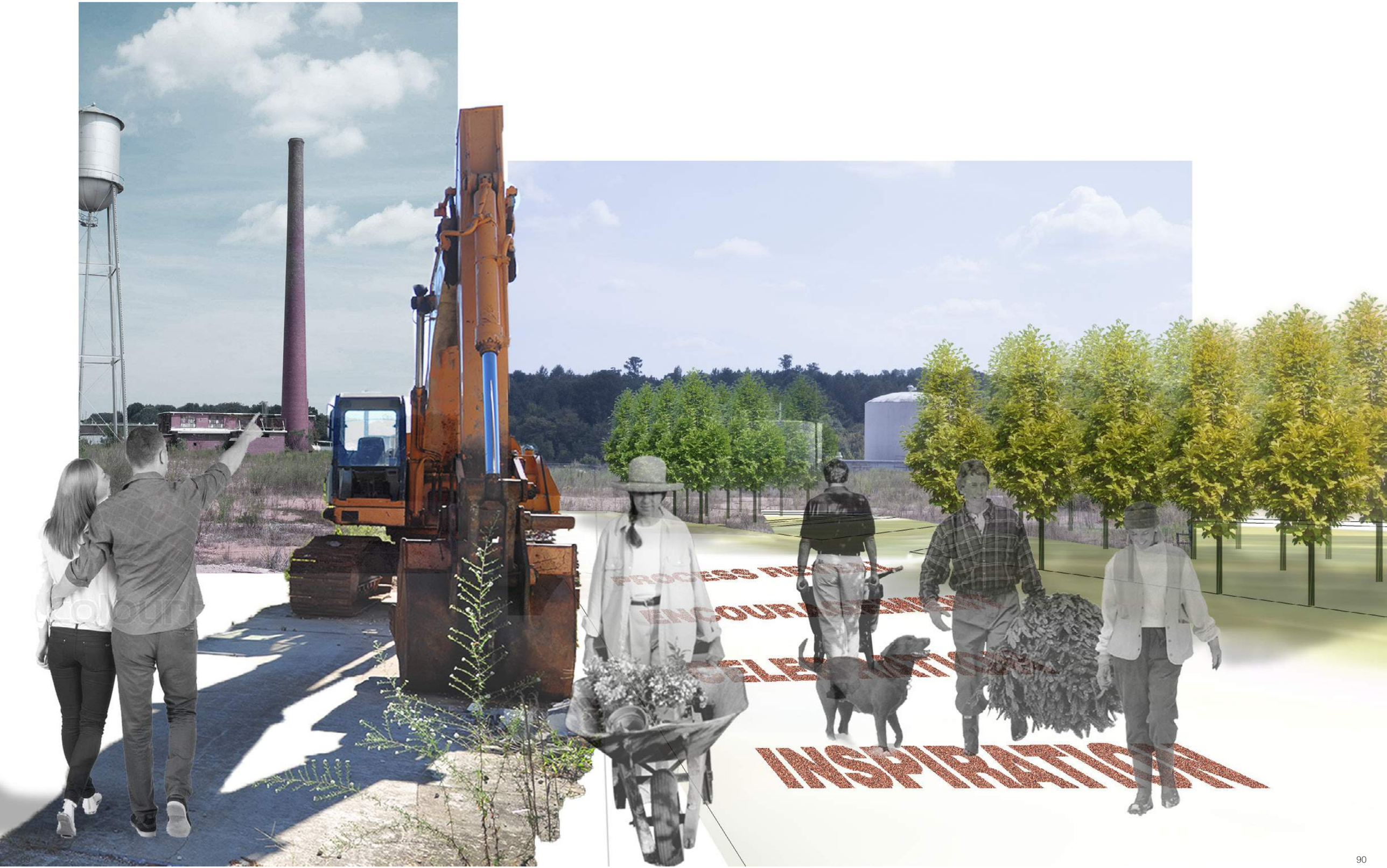

The mill site has a high percentage of concrete surface. In this process-based design case, the existing concrete was regarded as valuable material. It was operated through material reuse process rather than being transported to a landfill site. Approximately 4,168 cubic yard concrete could be harvested as salvage material thus reused in various new performance, such as retaining wall for holding the landform, surface or aggregate material of path construction, and the dynamic seating system.

# PROCESS OVER TIME

## Interactive Timeline

The four types of projected process demonstrated before were part of the whole processual assemblage existed in the investigation field. However, those four types of process cannot be regarded as independent or separate parts. They were constantly interactive with each other. As the timeline indicated below, the process of on-site flora succession revealed high intensity at first and then maintained as a certain range of fluctuation. Phytoremediation process was active within approximately ten years according to the crossover comparison of general contaminants and remediation time. After that, the flora resource continuously performed to take care of the remaining contaminants. Construction process and public access indicated shifting intensity over time. Compared to the natural process, such as succession, human manipulation process (construction and material reuse) were more compact and intended to decrease intensity over time.




INSPIRATION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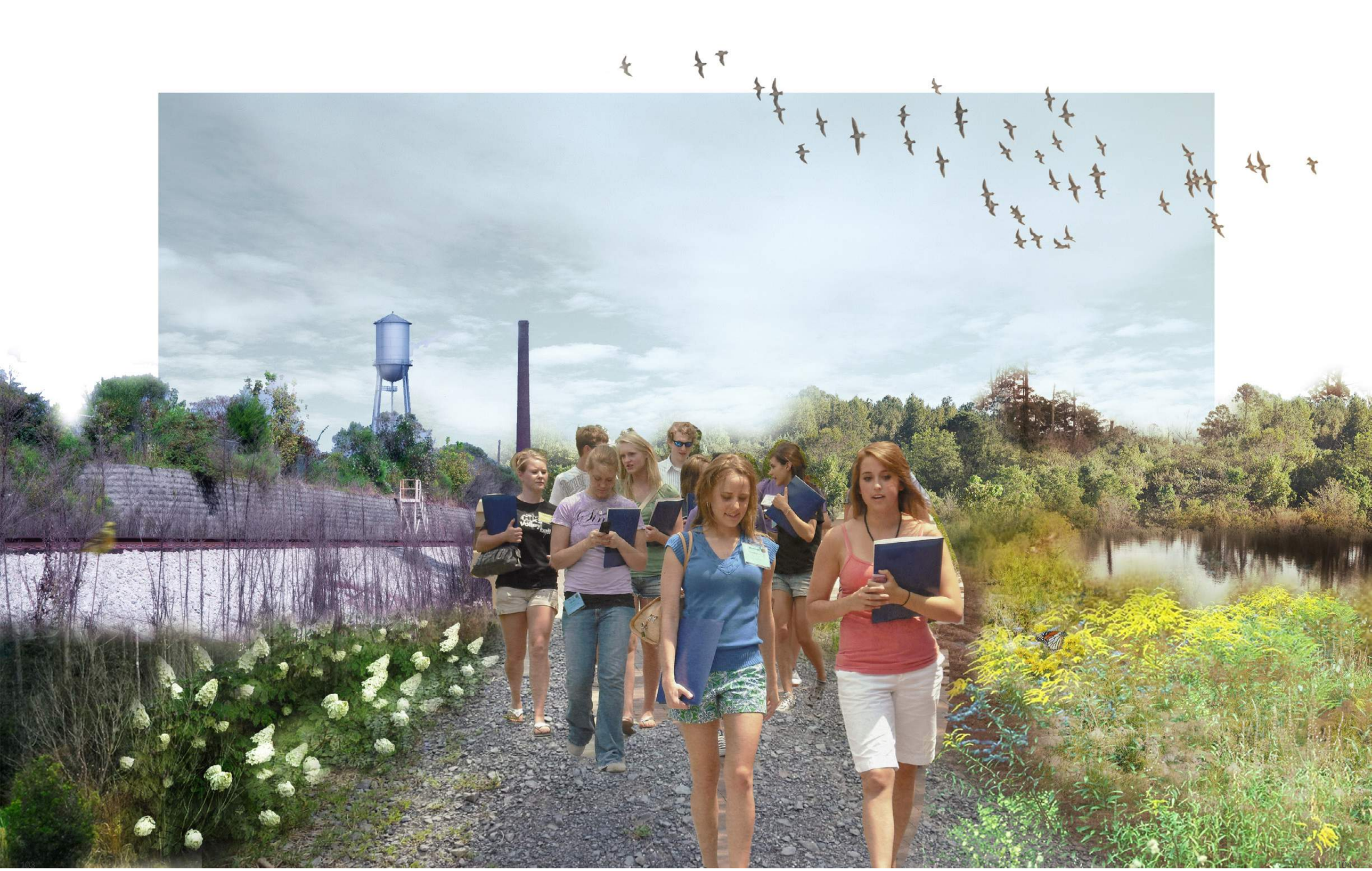


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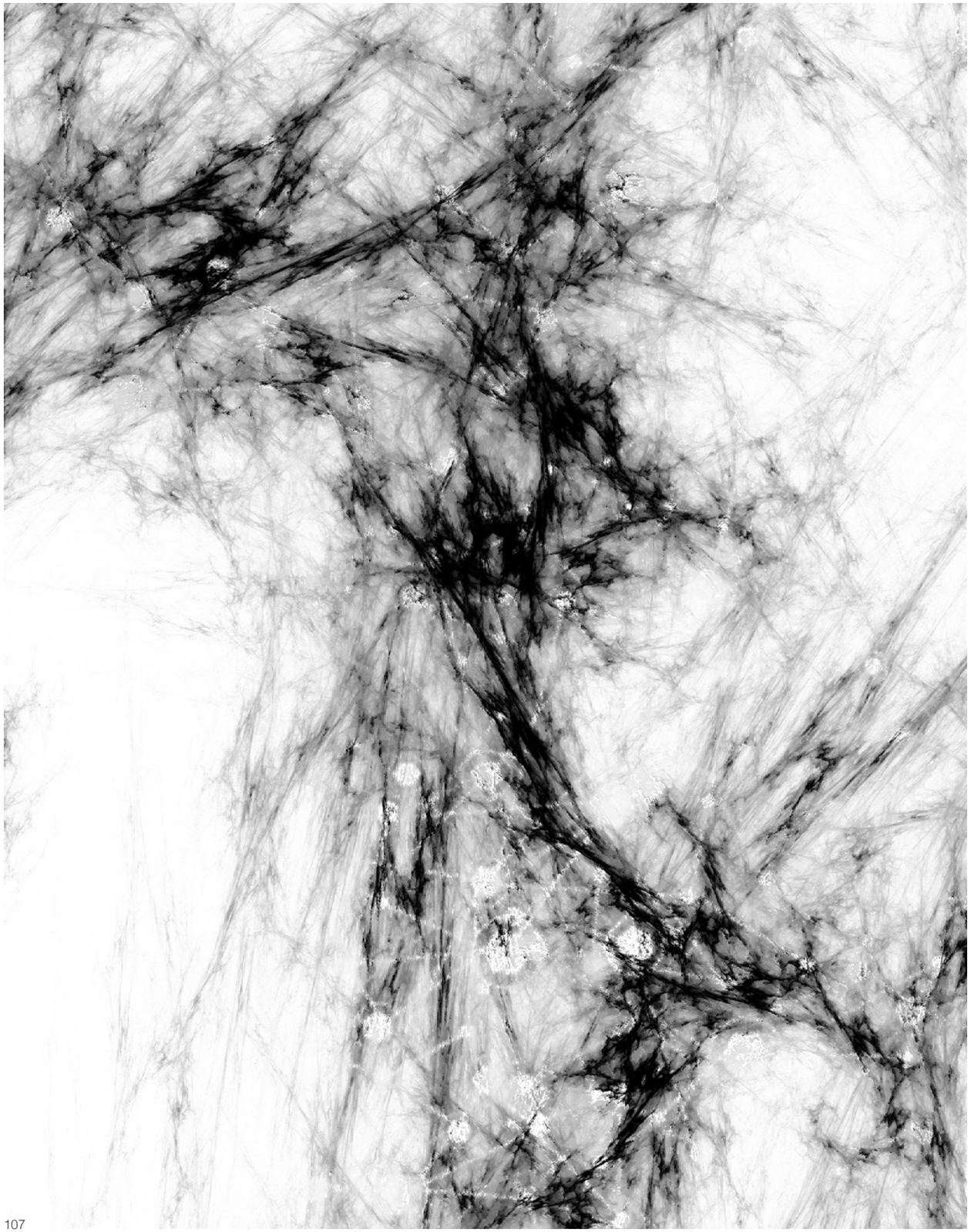

# REFLECTION

## Process-Based Design

The thesis investigation began with studying the on-site objects, related figures, and documents. They originated from the given landscape itself except being objectified as the static results. “How does process-based design capture and engage with the dynamic qualities of the landscape?” (the thesis question mentioned before). Capturing the dynamic qualities of the landscape here was interpreted by the design investigation as unfolding the discourse of remediation, historic industrial legacy, and community emotional connection. Therefore, the design investigation engaging with four projected processes (succession, phytoremediation, construction and public access, and material reuse) through the lens of time and the remaining historic on-site segments operated as the objectify-converse process, which was capable of revealing and engaging with dynamic qualities and relentless processes of the given landscape.

The thesis project employed succession as the agent to reveal the rich processes and tendencies of the landscape. In the design case, the intent was to set the proposal in motion but kept a loose framework to engage with the infinite possibilities contributed by the successional process over time. Currently, there are not many projects engaging with the full body of succession knowledge. However, succession, the obvious process-driven reflection, is capable of performing tremendous possibilities and dynamic qualities. The succession process, therefore, is undoubted a valuable field waiting to be engaged with in the future.

The continuous process of research and exploration enable this thesis project diving into a deeper level. Practical technique engagement was a missed opportunity of this thesis research. If the time allowed, the thesis investigation could seek more chances to practice with professional teams about on-site contamination testing and evaluation.

Pepperell Mill is the reflection of the textile trend in the southeast region. It thus indicated a vast opportunity within other abandon regional manufacturing mills for process-based design to investigate and explore. Further, process-based design may apply to other landscape typologies.

# ILLUSTRATIONS

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