Portfolio

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USC, School of Architecture . B.ARCH | 2022

Selected Works
2020 - 2022

Content

01 Haze Cartography

Studio Title: Good or Bad Natures
Project Type: Experimental Pavilion Design
Site: New York City Central Park, New York, U.S.A
Team: Mars Zhang, ChengXi Liu
Instructor: Nerea Calvillo, Rocio Crosetto

Haze Cartography is an experiment to explore the capacities of “invasive species” in benefiting their ecosystems through designed interventions. The two studied plant species are the Norway Maple and English Ivy show reactivity to chemical pollutants in the air. The English Ivy has air-purifying properties, absorbing VOCs, and greenhouse gases. On the other hand, anthocyanin, the red pigment found in the leaves of Norway Maple trees, is a pH indicator that reacts to changes in soil and atmospheric conditions. The proposal becomes an ambition to combine the properties of the English Ivy and Norway Maple Tree that focuses on intervening with the air in New York’s Central Park, the supposed lungs of the city. With a mesh dyed with anthocyanin placed over the maple trees, the mesh changes colors through acid-base reactions between the dye and the pollutants, signaling the presence of matter suspended in the air. The project constantly evolves, corresponding to the pollutant levels and types varied by climatic and environmental conditions.

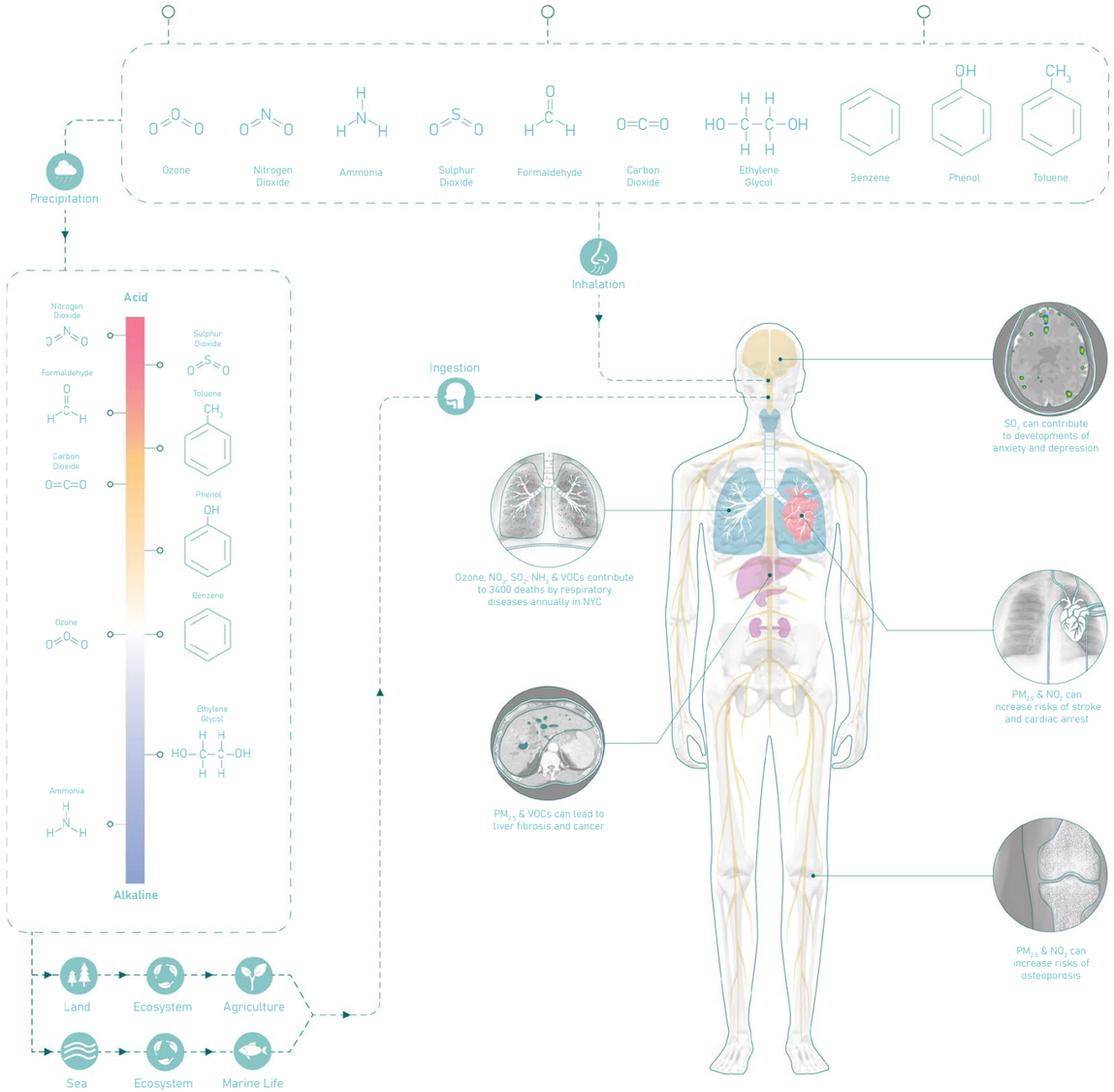
Urban Air Pollution and Health Effects

New York City is one of the most polluted cities in the United States. The high pollution levels are attributable to fossil fuel consumption in vehicles, powerplants, and buildings. The pollutants produced contribute to adverse health effects on its residents annually.

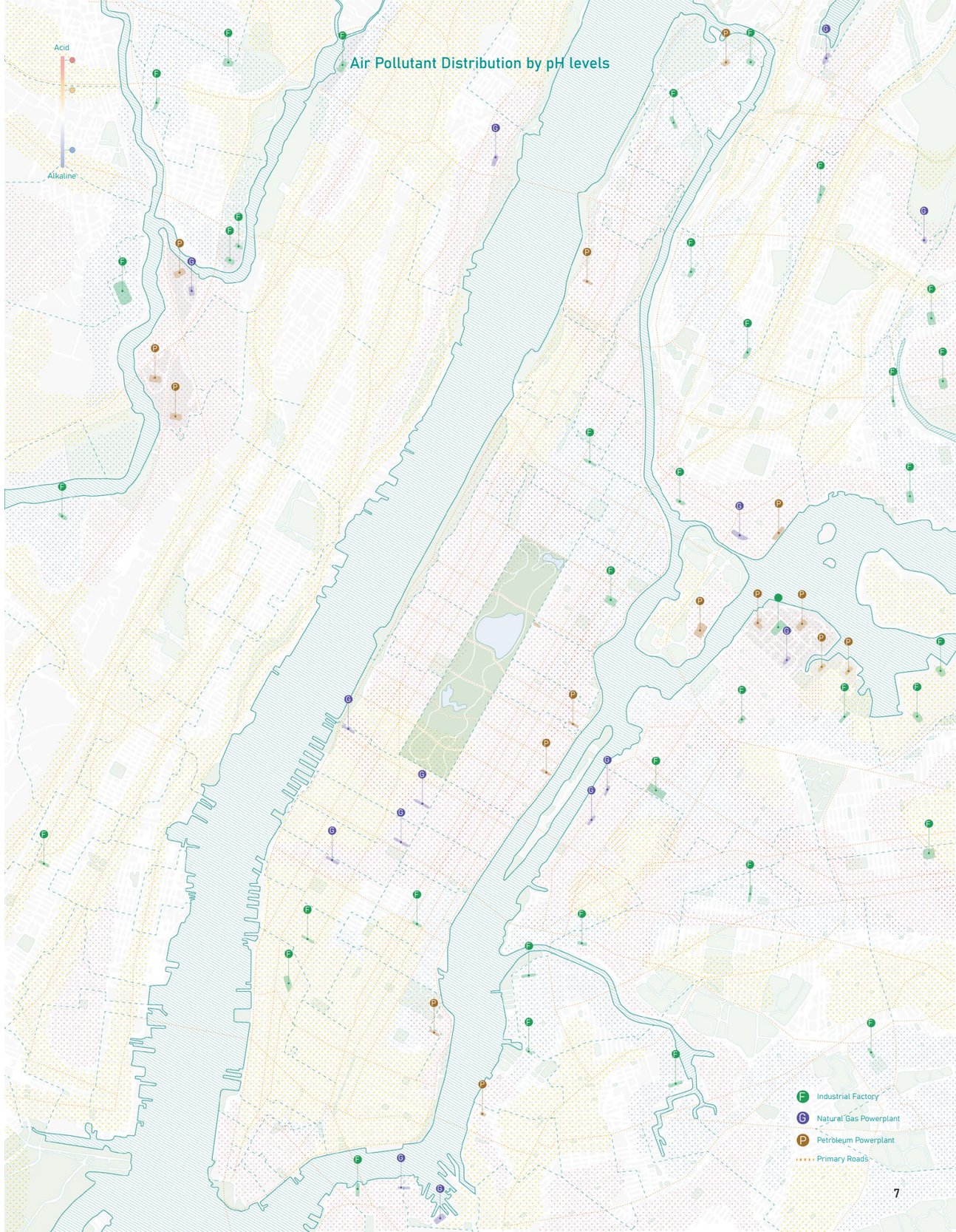
Buildings give off up to **55 tons** of pollutants in NYC daily

Powerplants give off up to **8 tons** of pollutants in NYC daily

Vehicles give off up to **21 tons** of pollutants in NYC daily



Air Pollutant Distribution by pH levels

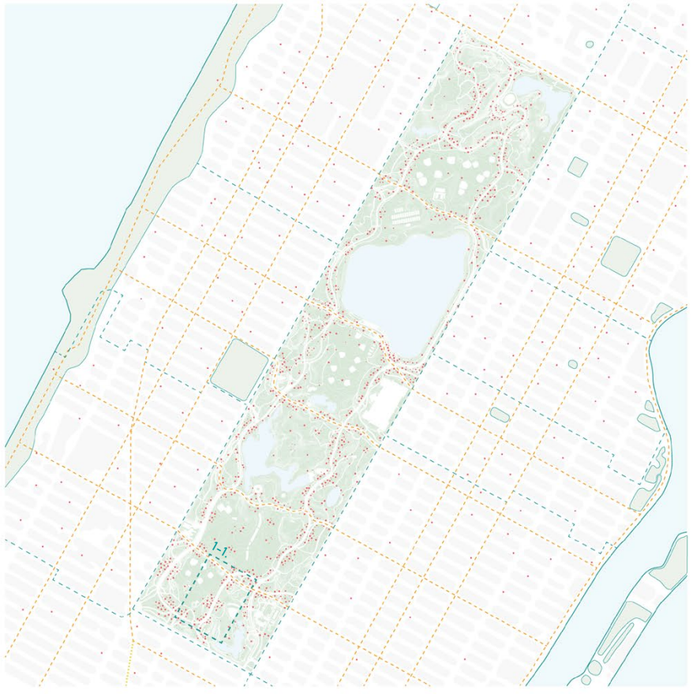


Site Context and Urban Environment

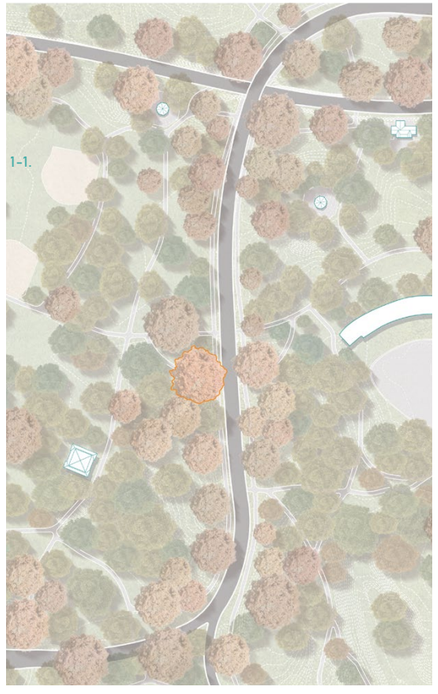
The project begins at the Driprock Arch of Central Park, where two invasive plant species, Norway Maple & English Ivy, were found. The two species are considered invasive due to their nature to deprive other species of access to essential nutrients. As a result, the New York Park Conservancy implements strict regulations on where these plants are allowed to grow within the park.

The Norway Maple tree is located next to the Driprock Arch, with an ivy plant clung to its bark. The arch is a stone bridge designed to divert vehicular and pedestrian traffic and connect other park features with the landscapes. The vehicular activity above produces numerous pollutants harmful to the human body and natural environment.

The two plant species are naturally resistant to urban air pollution, especially the Norway Maple. They are found along the main roads inside Central Park.



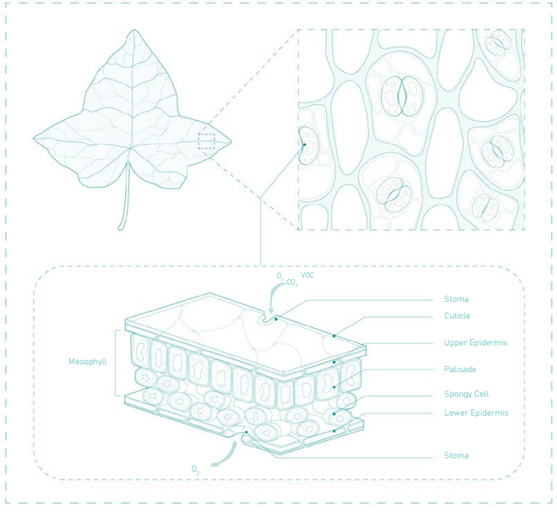
Since the Norway Maple is known for its hardiness and resistance to urban polution, they are primarily found in clusters distributed along the main roads going through the park. While the Norway Maple trees are also found in the city, they are mostly concentrated within Central Park to offset the air pollution vehicular traffic brings to the green space.



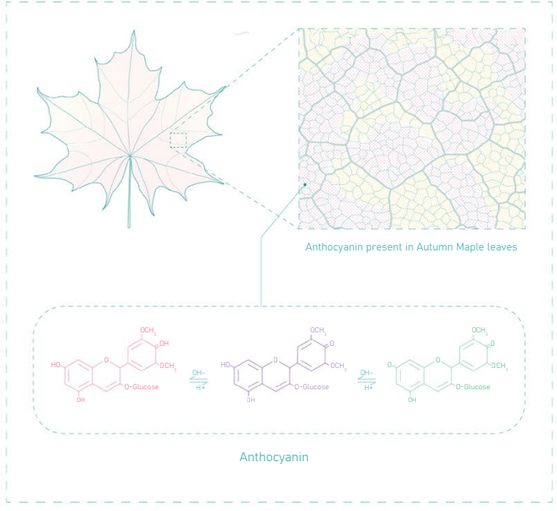
The studied Norway Maple tree is located near the southern entry of the park where traffic is the heaviest within Central Park.

Reducing & Revealing the haze

The Norway Maple and the English Ivy possess properties that allow the plants to survive in air-polluted environments and remove harmful particulate matter from the air. The design intervention intends to utilize these unique traits of the invasive species to reduce and visibilize these otherwise unseeable harmful clouds in the air New Yorkers breathe every day.



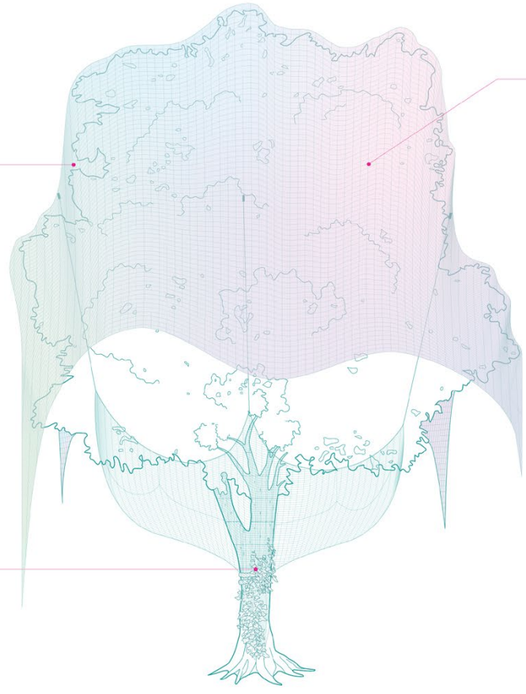
The English Ivy absorbs harmful pollutants such as greenhouse gases, VOCs, and ozone. The stomata on its leaves open to absorb moisture and particulate matter to photosynthesize. In indoor environments, its leaves can remove up to 89.8% of Benzene and other VOCs.

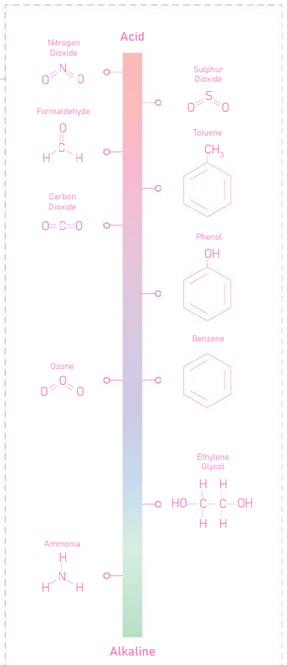


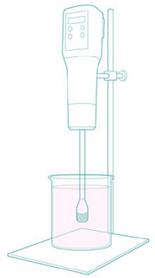
The Norway Maple leaves contain Anthocyanin, a chemical component that gives the leaves its signature red color during Autumn. It is a pH-sensitive chemical that changes colors on a red to purple to green spectrum going from acid to base.

From experiments, silk fabric dyed with the anthocyanin extract demonstrates an ability to change colors with the presence of various airborne chemical substances

The net forms a surface for the ivy to climb on, reducing the damages on the tree by the ivy vines

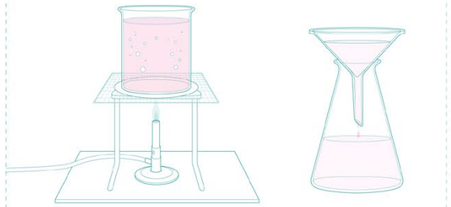






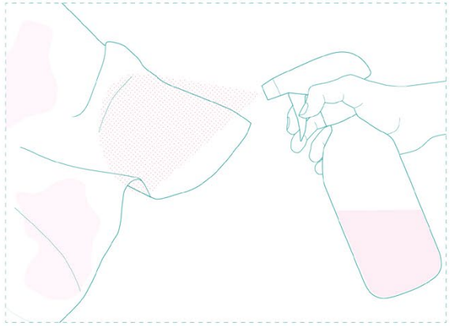
Homogenization

Maple leaves collected are
homogenized in distilled water



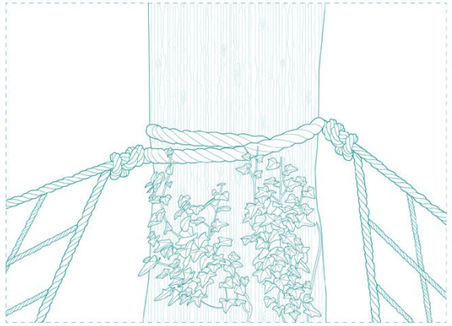
Extraction

Homogenized mixture is boiled and
filtered to yield an anthocyanin solution



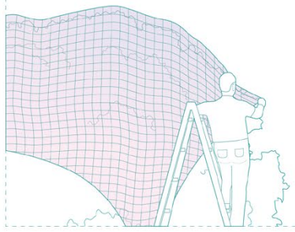
Dyeing

Squares of natural silk are sewn
and dyed with the anthocyanin extract



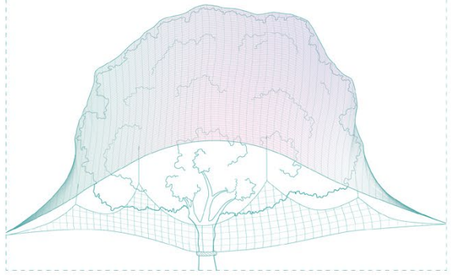
Preparation

Nets are tied to the trunk to give ivy a surface
to climb on and minimize damage on tree



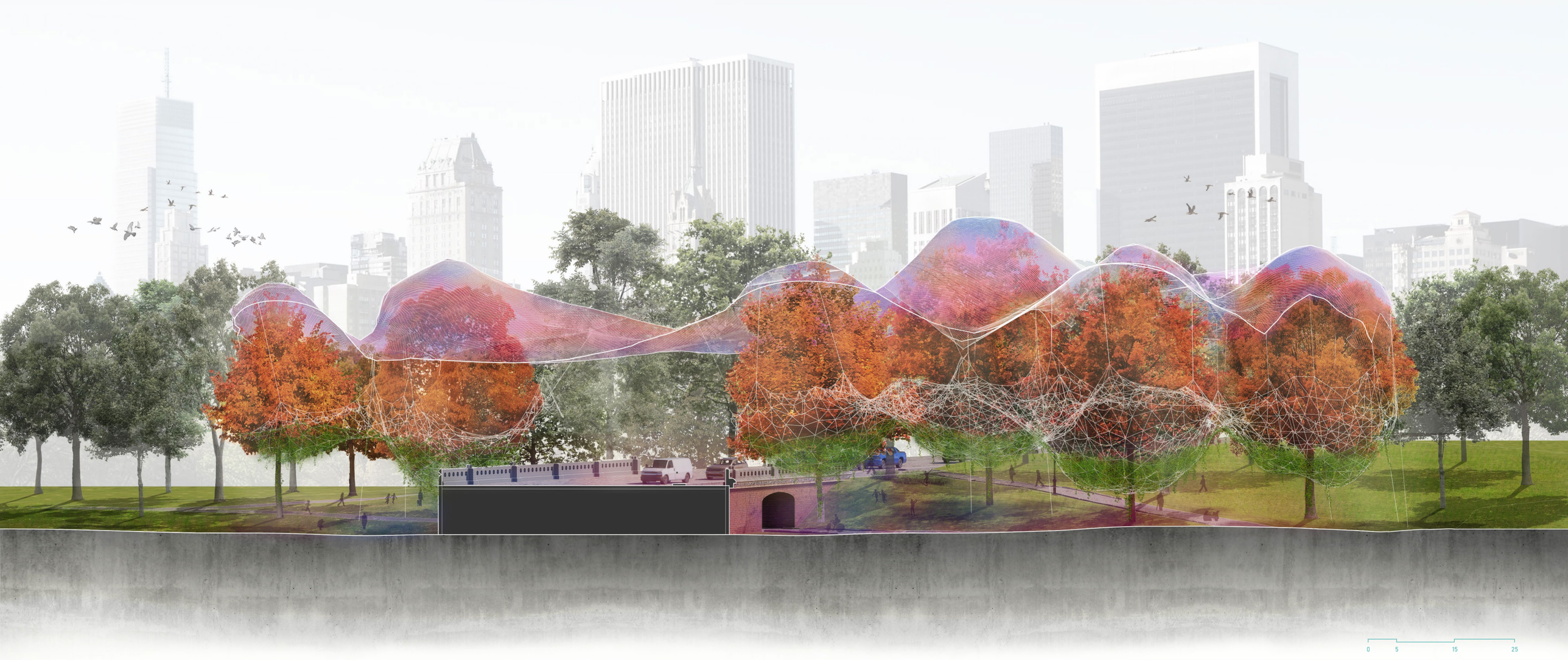
Installation

The dyed mesh is laid over tree canopies



Assembly

The net is fastened to the overhead mesh
and the system is completed



Year 1

Project begins with attaching the ivy net to the pigmented mesh. Pollutant levels are lowest in the Summer, and are mostly alkaline from farming.

Year 5

The English Ivy begins populating the net. Pollutant levels begin to rise in Autumn, and air acidity increases, giving a slightly red hue.

Year 10

The English Ivy continues to grow, putting stress on both the net and mesh. Pollutant levels are highest in the Winter, giving a strong red color.

Year 15

The weight of the ivy pulls down on the net and mesh. The densely ivy grown environment purifies the air, giving the mesh a purple hue (pH neutral)

Year 20

The mesh sustains damages from the overgrown net. The sagged net forms new habitats for small mammals and birds to inhabit.

02 House of Falling Waters

Studio Title: Enacting Entanglements-Climate Adaptation of Venice's Green Theater
Project Type: Experimental Performance and Theatrical House
Site: San Giorgio Maggiore, Venice, Italy
Instructor: Jorge Otero-Pailos, Mark Rakatansky

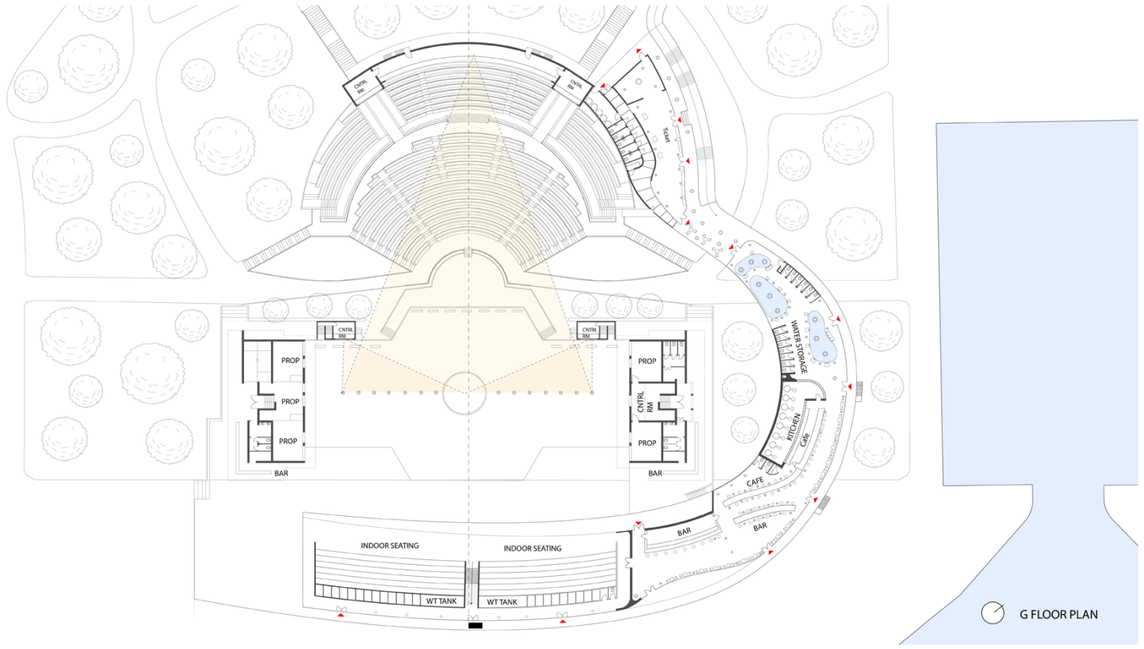
The House of Falling Waters centers around redefining the performative experiences under the existential threat of the acqua alta and a shortage of potable water on the site of San Giorgio Maggiore. The House of Falling Waters becomes a way to focus on the circulation, distribution, and manipulation of water on the site to improve the functionality as well as the theatrical experience of the existing theater. The project takes into account the local climate, environment as well as site context to allow theatrical performances to take place in both wet and dry conditions. The programs are designed in a sequence that communicates the different processes water is handled and used on the site, and the project focuses on two primary functions: as a water collection facility and, as an experimental theater that produces holograms by projecting digital media onto mist.

Site Context & Environmental Conditions

The site is located in the island of San Giorgio Maggiore in Venice. The existing green theater, or Teatro Verde, is under the threat of annual aqua alta. The theater gets flooded every year during the rain season and is only in use very occasionally.

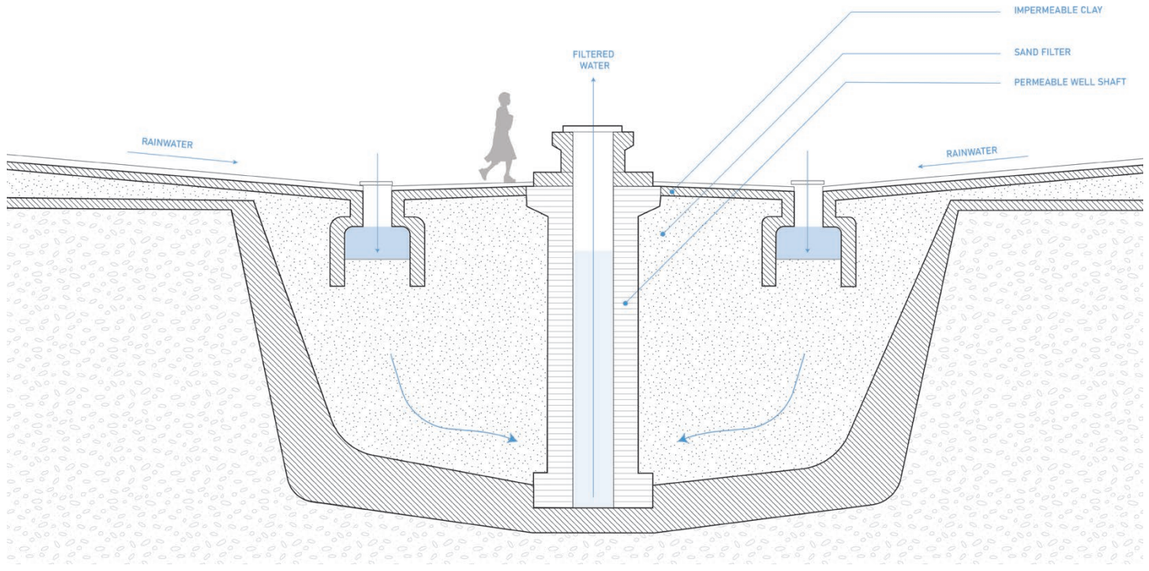
Site & Design Proposal Plan

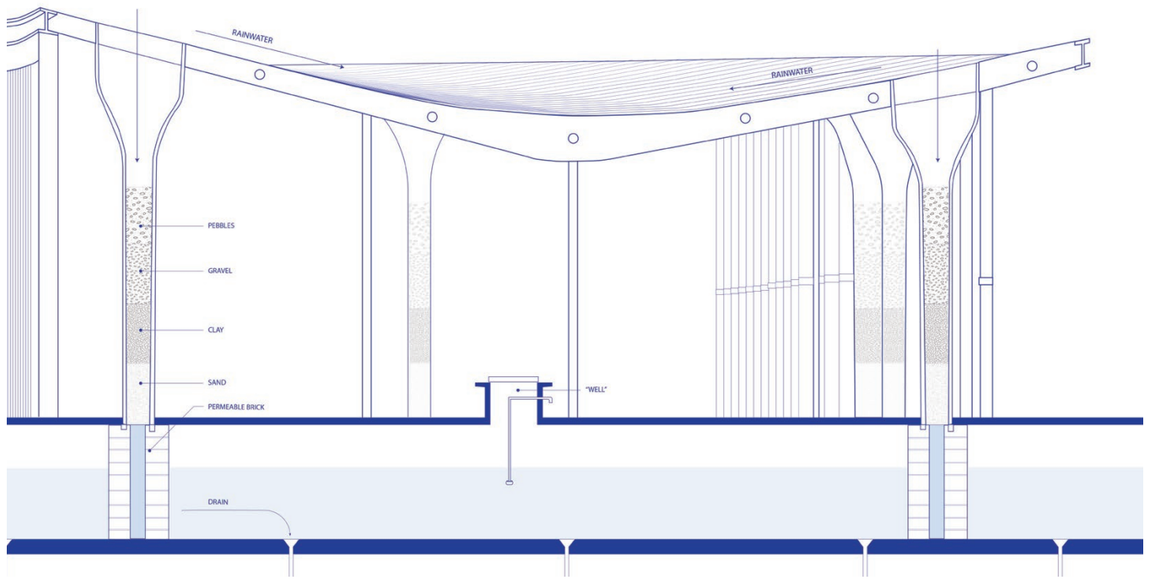
The design takes into account the rising sea levels as a result of the acqua alta. The design considers "water" as a main theme in the project in the way that water is circulated, redistributed, and processed.



Venetian Wells & Design Inspiration

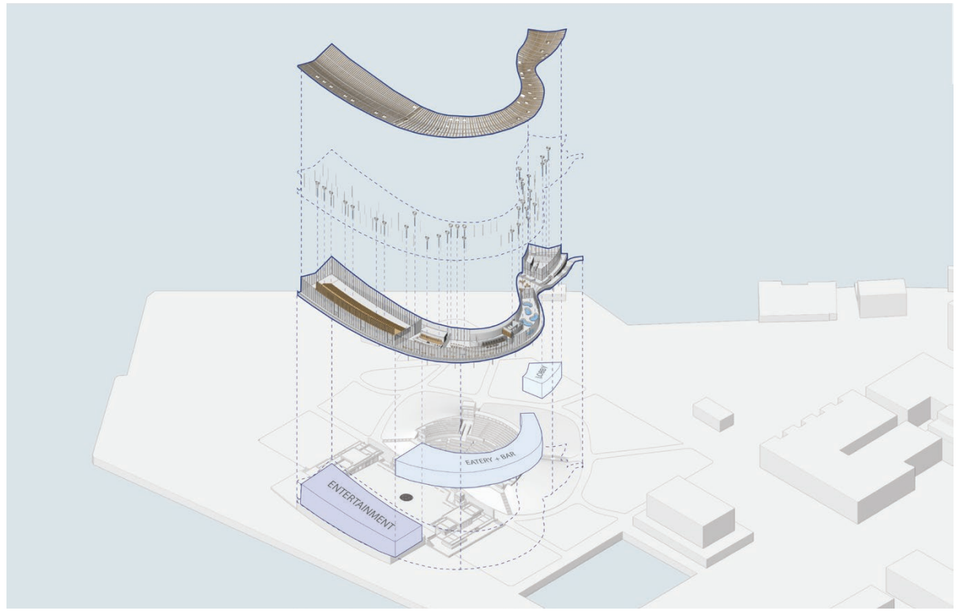
The famous invention of the Venetian Well was designed to provide the city with a safe source of drinking water through rainwater collection and provide the Venetians with drinking water for centuries. The main mechanism of the design is inspired by the Venetian well's ability to collect, filter, and distribute water.

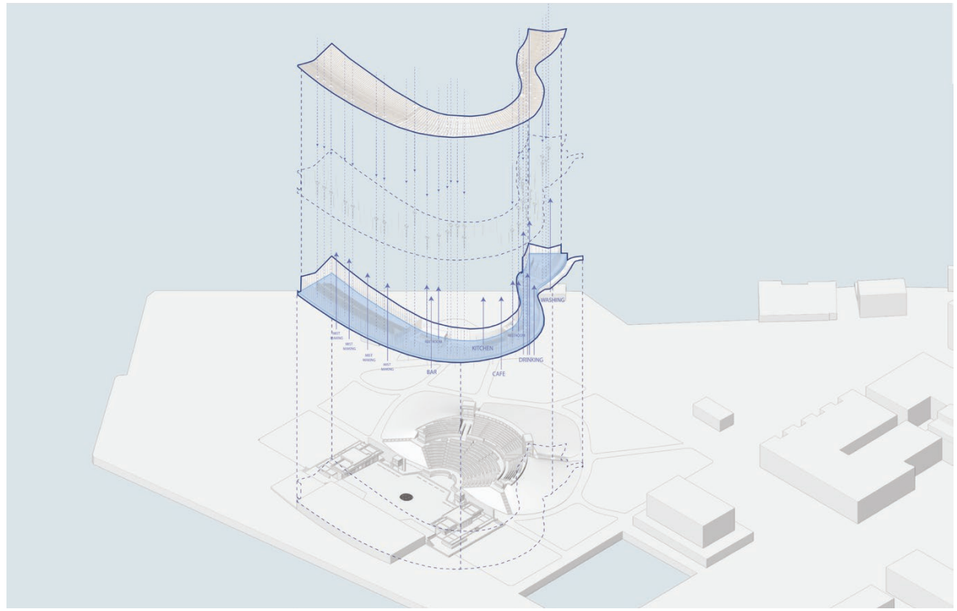


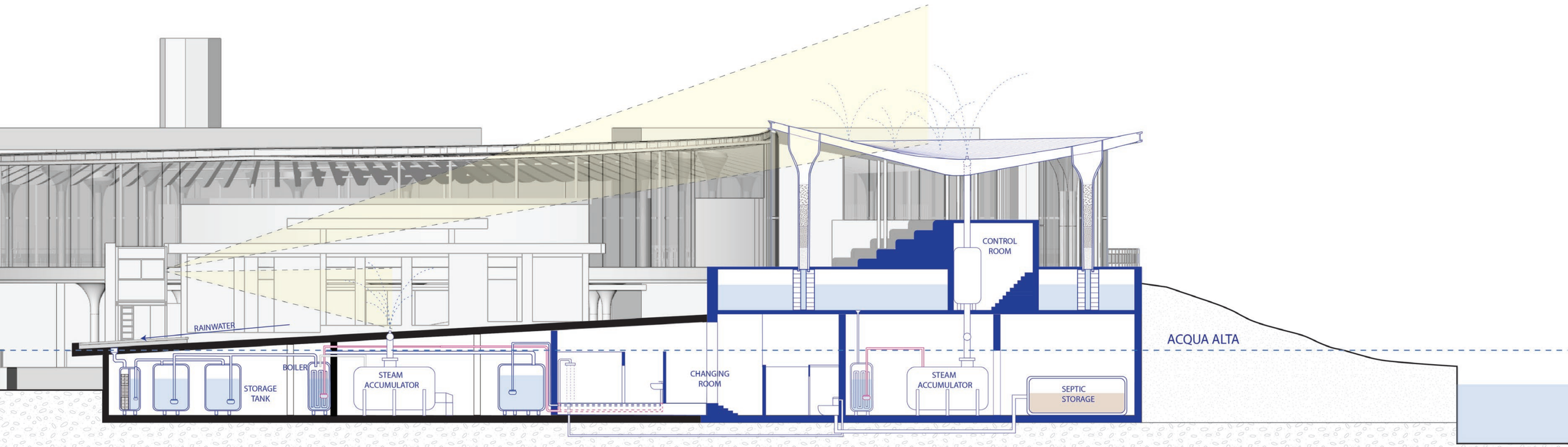


Programs & Water Network

The new addition is designed to integrate with the current programs of the Green theater and stage whilst extending its functions and improving the experience to accommodate the current conditions of the Acqua Alta - moving its visitors from the entry to spaces of gathering, pleasure, and finally entertainment.






RAINWATER
BOILER
STORAGE TANK
STEAM ACCUMULATOR
CHANGING ROOM
CONTROL ROOM
STEAM ACCUMULATOR
SEPTIC STORAGE
ACQUA ALTA

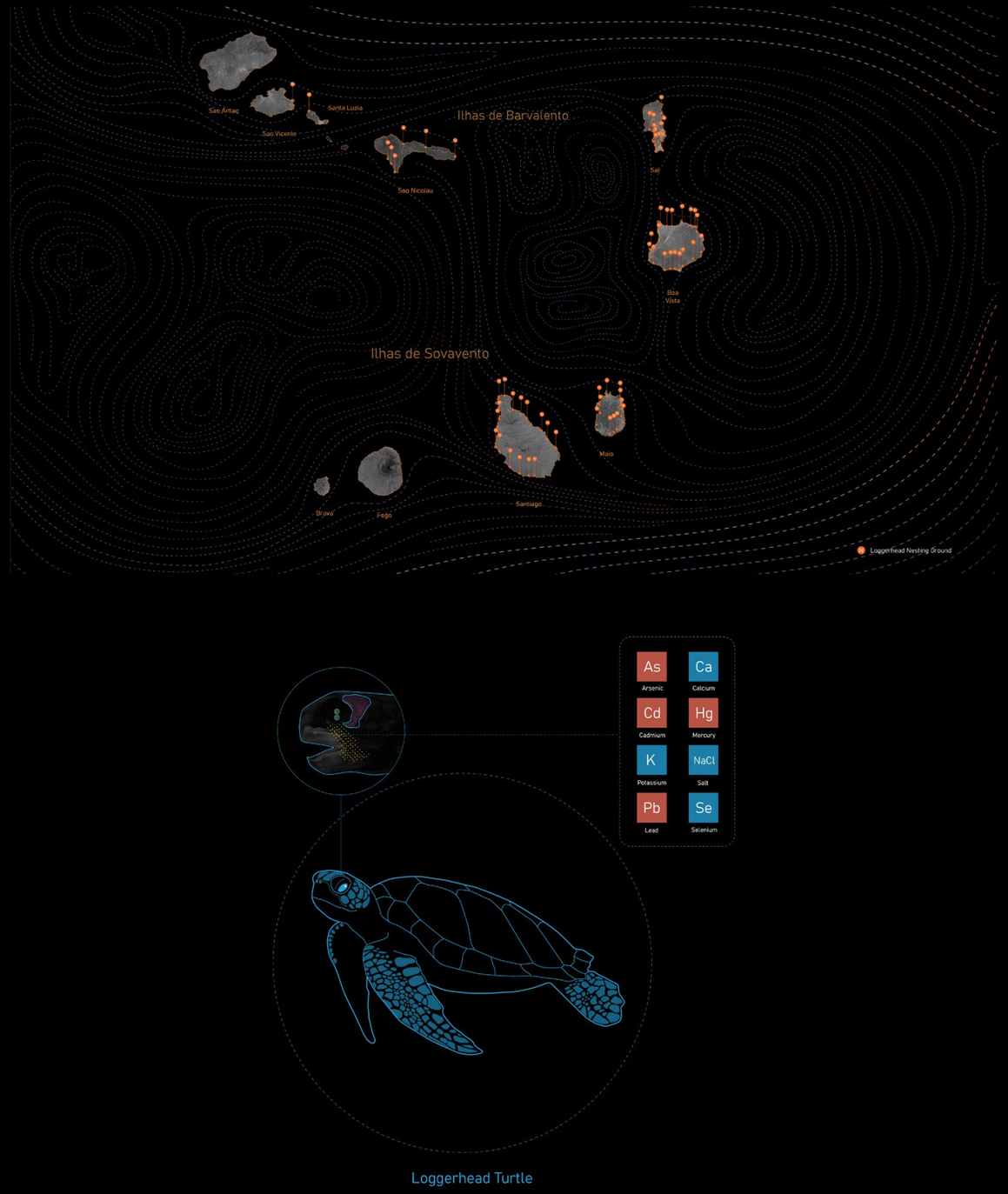
03 Haline Vessels

Studio Title: Scripting Islands–Storying the Ocean
Project Type: Experimental Performance and Theatrical House
Site: Cabo Verde
Instructor: Patricia Anahory

Haline Vessels explores the possibility to render visible, and help ease, the effects of anthropogenic activities on the marine environment of Cabo Verdean oceans. The work investigates the increasing concentration of haline elements and foreignly introduced metals in seawater attributable to unsustainable practices related to construction and water desalination industries within the archipelago. Loggerhead sea turtles (caretta caretta), an annual visitor of the Cabo Verde islands, consume its seawater to stay hydrated, but rid themselves of the excess salt & minerals from the seawater through their tears. Scientific analyses of the tears discovered that there are heavy metals and harmful chemical substances in the seawater where the turtles roam. The content of the tears become artifacts that tell a story about the ocean and establish an implied correlation between land activities and marine pollution. The design intervention becomes an investigation that explores the possibilities of architecture behaving as an artificial bioindicator while pushing the boundaries of building technology using haline materials

Loggerhead Biology & Habitats

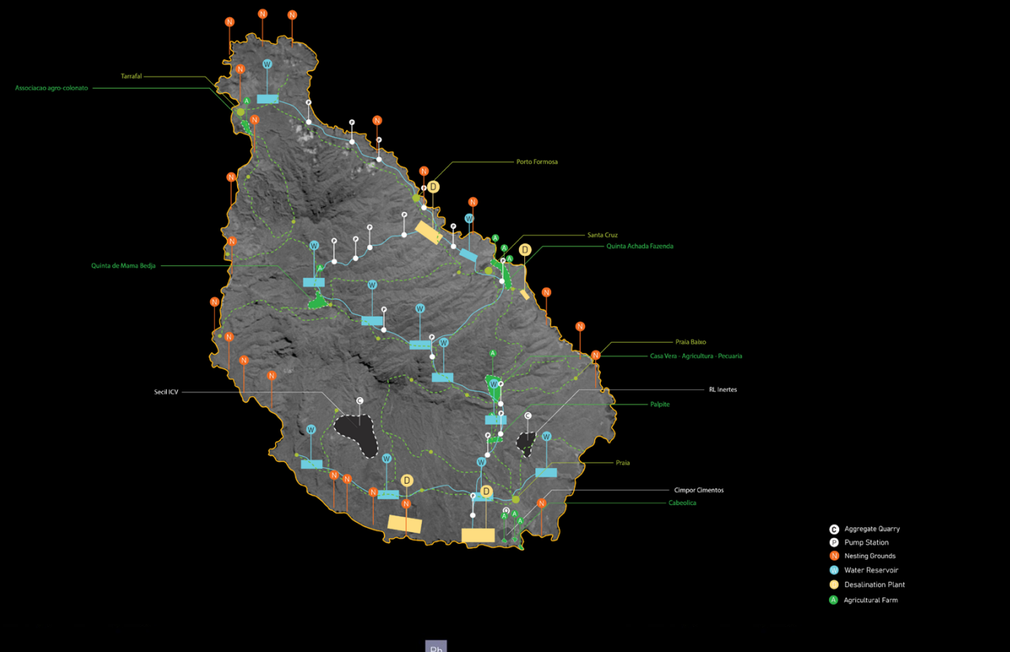
The loggerhead sea turtles are found most abundant on the eastern coasts of the islands. Through scientific analysis, heavy metals have been discovered in the tears secreted from the turtle's salt glands.

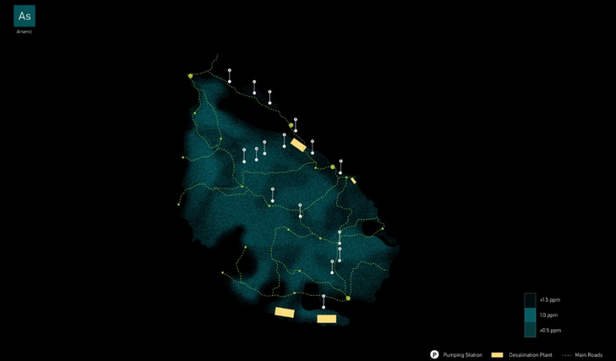


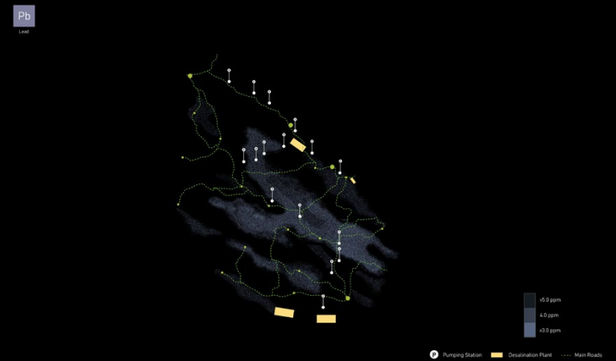
Loggerhead Turtle

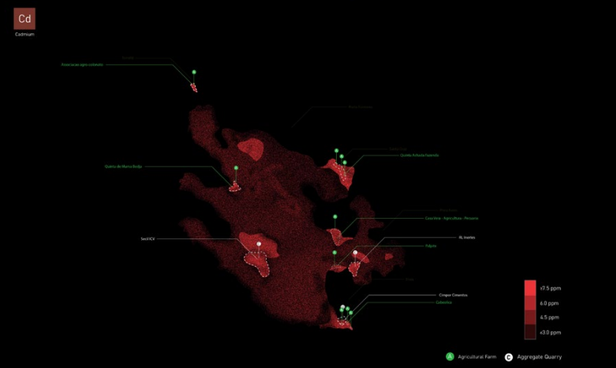
Santiago Island Context & Heavy Metal Distribution

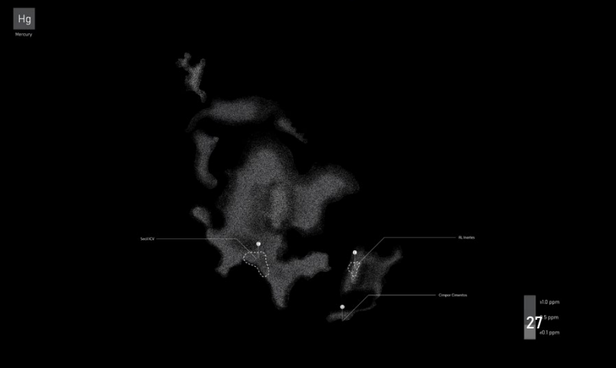
Unsustainable practies on the island of Santiago contribute to distribution of heavy metals on its top soils.The same heavy metals are present in the habitats of the turtle's nesting grounds.





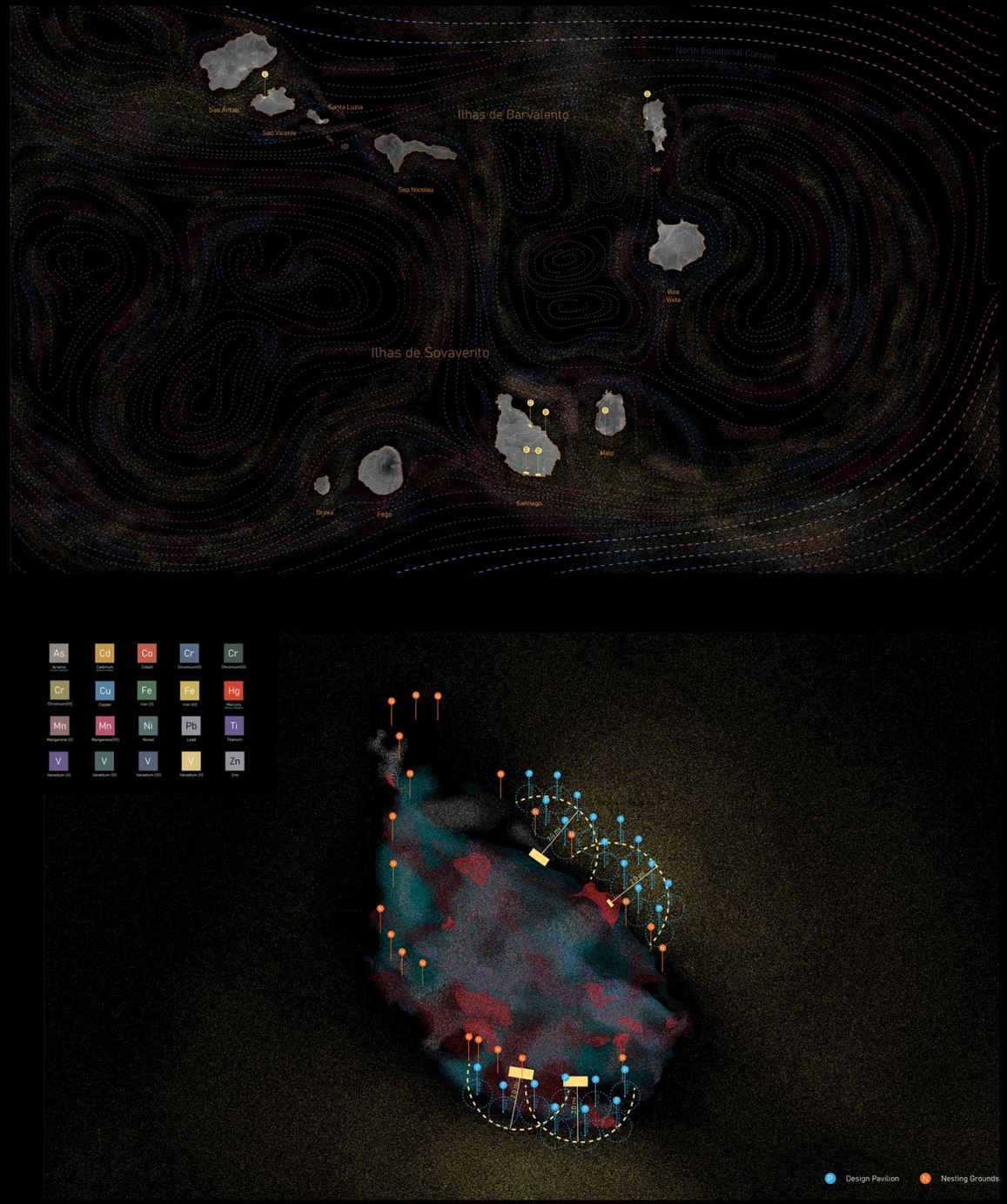






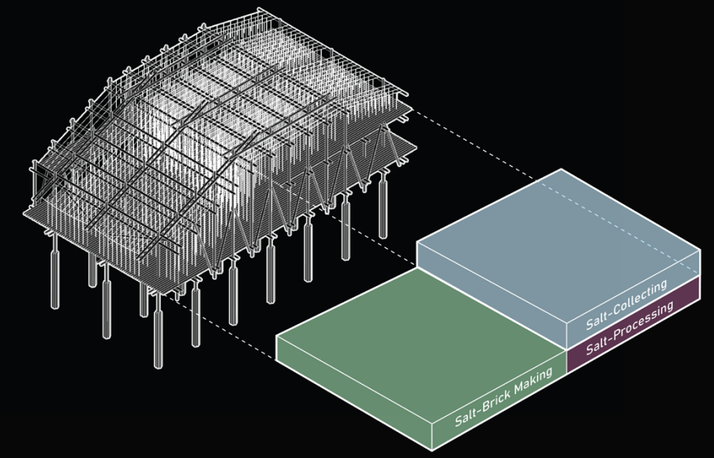
Heavy Metals Distribution by Ocean Currents

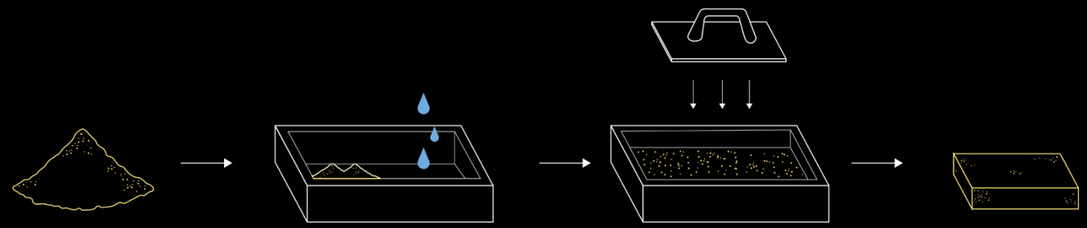
Heavy metals are distributed into the water through the ocean currents in the archipelago. The proposals are seen as nodes placed in the ocean to allow qualitative assessments of the water through the color of salts crystallized on the design.

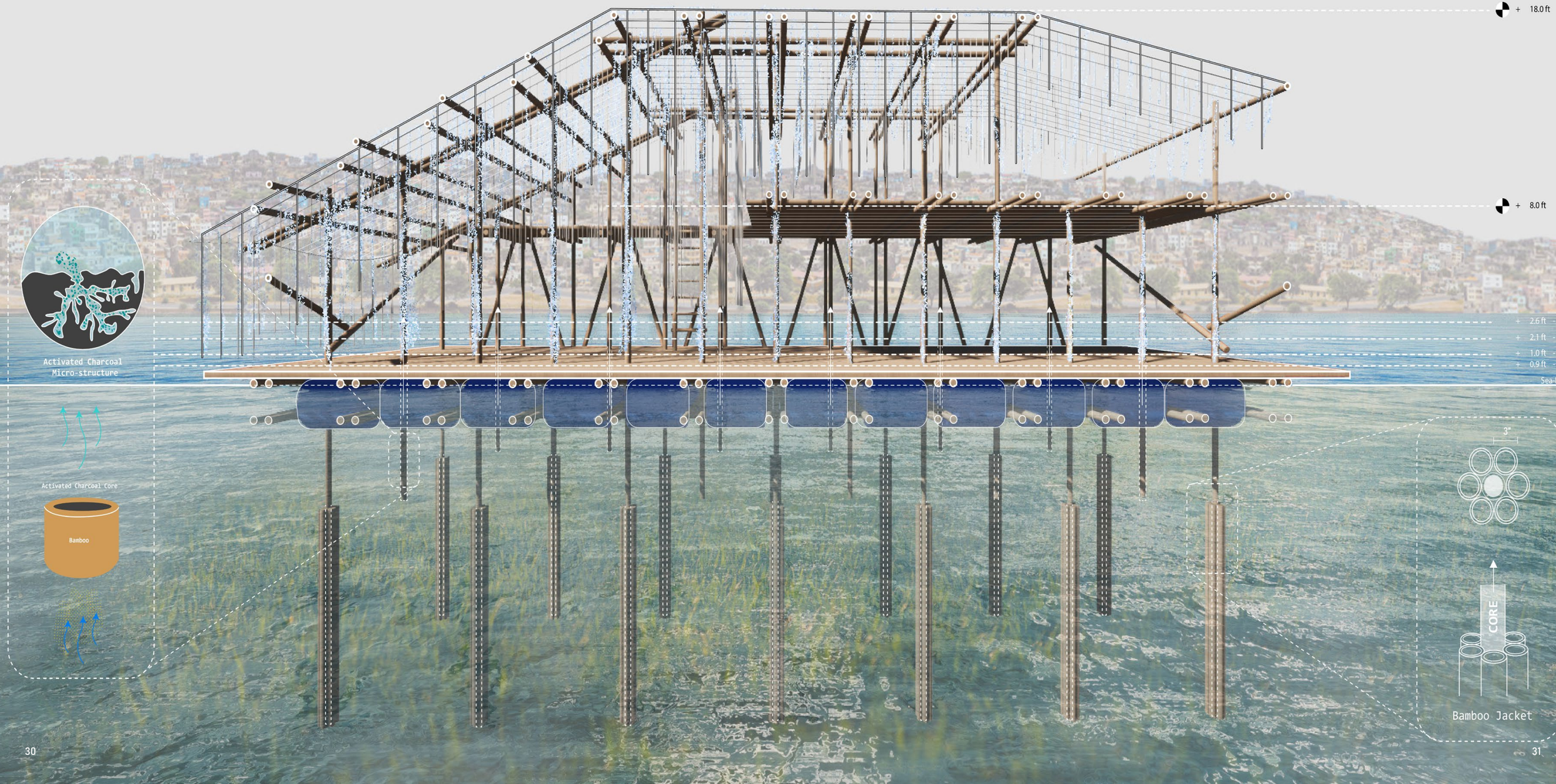


Program & Post-Collection Processes

The pavilion is made out of bamboo structures with hemp strings hung from the roof into the ocean water to allow crystallization to take place. The salt collected is processed to be made into pressed salt bricks.






+ 18.0 ft
+ 8.0 ft
+ 2.6 ft 18:45
+ 2.1 ft 12:45
+ 1.0 ft 06:45
+ 0.9 ft 00:45
Sea-Level
Activated Charcoal
Micro-structure
Activated Charcoal Core
Bamboo
3"
CORE
Bamboo Jacket

04 Loofah Squattah

Experimental furniture design made with natural materials

Studio Title: Making with Earth
Project Type: Natural material research & design ; Exhibition Curation
Site: 1014 - Space for Ideas, New York, U.S.A
Team Members: Tim Ting-Hao Chen, Paul Edward Liu
Instructor: Lola Ben-Alon, Khadijia Ann Tarver

The **Loofah Squattah** explores the potential application of plant based by-products, or their subsequent food wastes, as alternative materials for design and construction. The investigation primarily focuses on creating an improved understanding of both the physical properties of the loofah fruit in enhancing the structural strength and durability of earthen designs. The **Loofah Squattah** challenges the possibilities of applying the fruit to load-bearing purposes operating at the human scale, specifically as furniture, to test its strength and constructibility. In conceiving the concept for the furniture piece, the design considers all components of the fruit, using it as formwork, fibers for construction, and cushioning for comfort and support.

Research & Fabrication

The loofah fruit has complex networks of interconnected fibers that, once dried, lignify to form a rigid and sturdy structure. The design considers the physical structure and fibrous nature of the fruit for the investigation. The stool piece is made from 3 main materials namely, loofah fruit, clay-rich soil, and spent coffee grounds.