



2023

LAUREN MORRIS

OSMOSIS

# ACKNOWLEDGEMENTS

To my design committee, professors, family, and friends,

I am writing this acknowledgement to express my deep gratitude for all the help and support you have provided me throughout this project. Your contributions have been invaluable and I could not have achieved what I did without your guidance, encouragement, and generosity.

Your expertise, insights, and feedback have been instrumental in shaping my ideas and refining my approach. Your unwavering support and willingness to lend a helping hand, even during the most challenging times, have meant the world to me.

I also want to thank you for your patience, understanding, and kindness. You have been a source of inspiration and motivation, and I feel fortunate to have had the opportunity to work with you.

With gratitude and warm regards,

Lauren Morris

# COMMITTEE

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**COMMITTEE MEMBER** JUAN CARLOS BALTAZAR

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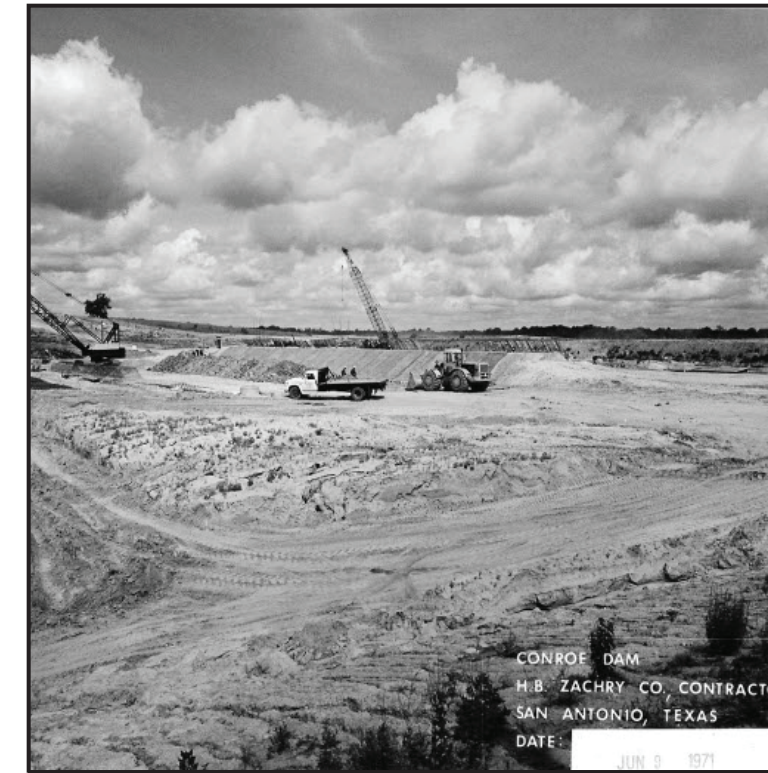
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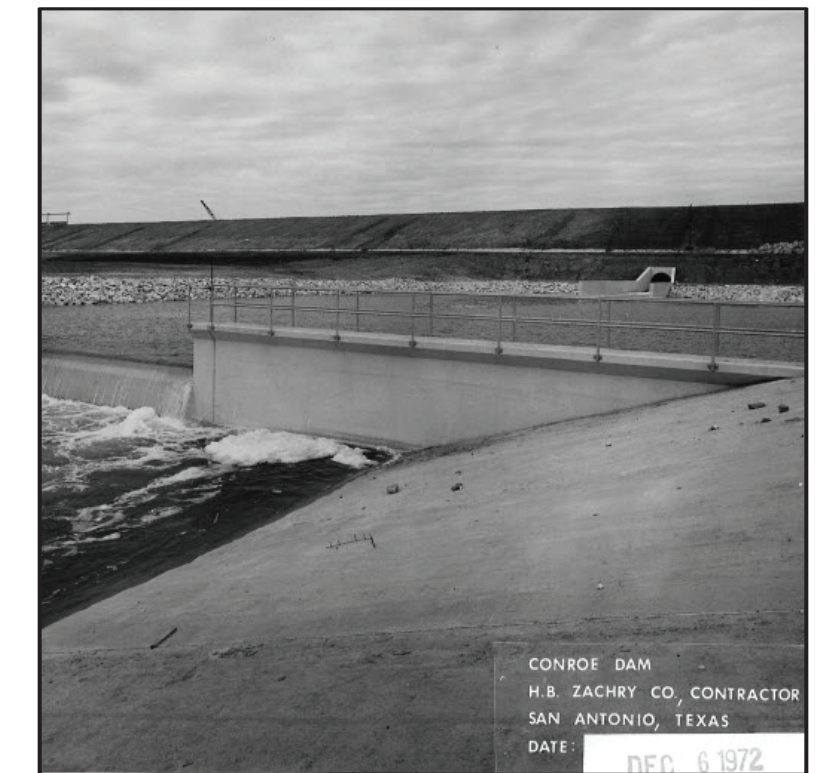
**BACKGROUND**

# LAKE CONROE

Lake Conroe was built after a record 7-year drought during the 1950s to avoid water shortages in the future. "The headwaters of Lake Conroe, formed by the West Fork of the San Jacinto River, are located 17 miles west of Huntsville in western Walker County. The river flows southeast for about 90 miles through Montgomery County to its confluence with the East Fork of the San Jacinto River on the northern rim of Lake Houston in northeastern Harris County." (SJRA, 2014) It was completed during 1973, and consists of 2 concrete outlets, 1 service spillway, and 1 service outlet. The lake has 19,640 surface acres, 450 square miles of watershed drainage area, 150 miles of shoreline, average depth of 20 feet, and an average water elevation of 201 feet above sea level. Lake Conroe holds 140 billion gallons of water, and the current lake level - as of 2023 - is 200.94 feet. The highest recorded level in history was 206.24 feet in 2017, and the lowest recorded elevation was 192.68 in 2011.



Lake Conroe construction



## THE ECOSYSTEM

About 2 years after Lake Conroe was filled, roughly 500 acres of the lake was infested by an exotic plant - *Hydrilla verticillata*. After an additional 4 years, it covered nearly 4,500 acres, becoming problematic to the lake's recreational users. A study was launched by the State of Texas Legislature, enlisting the Texas Parks and Wildlife Department (TPWD) and the Texas Agricultural Experiment Station to conduct a study to determine the viability of releasing *Ctenopharyngodon idella* - grass carp- to control and remove the hydrilla from the water. 270,000 diploid grass carp were released into Lake Conroe, resulting in hydrilla, along with all other aquatic vegetation, to disappear. For 13 years, the lake remained free of hydrilla, until the discovery of a few acres, which was then treated by the SJRA with herbicide treatments. TPWD and SJRA have been working together since the 1990s to develop a hydrilla management plan whose goal is to "use ecological, biological, chemical, and mechanical strategies for control of hydrilla while promoting diversity of the aquatic plant community." (Chilton, II et al., 2008)

hydrilla

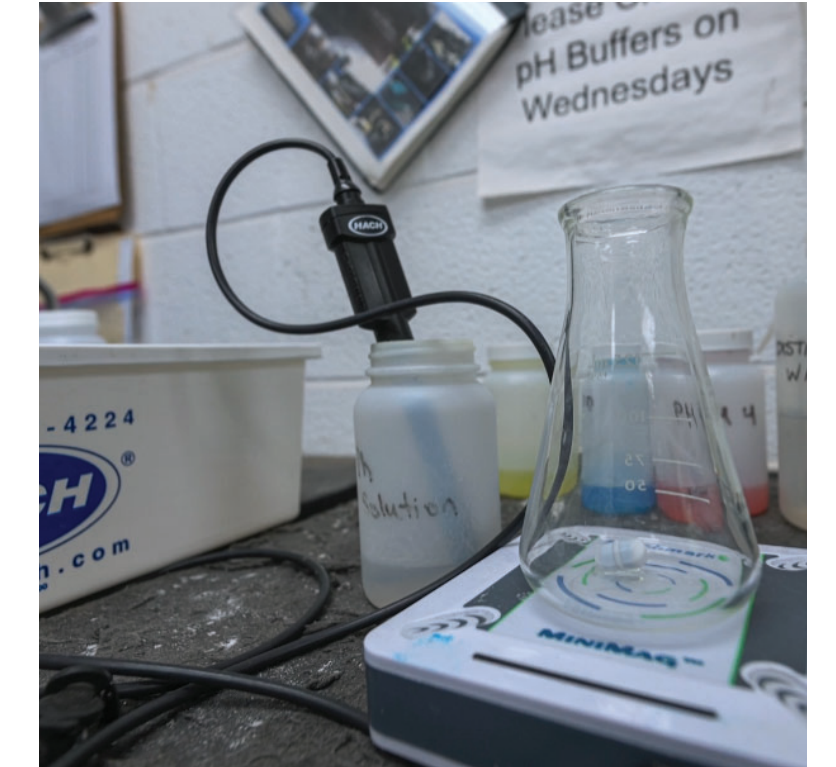


grass carp



# THE CLIENT

The San Jacinto River Authority (SJRA) was formed in 1937 by the State of Texas Legislature as the San Jacinto Conservation and Reclamation District in 1937. The name of the agency was changed in 1951, but the SJRA's purpose remained the same. Their primary objectives are to "develop, conserve, and protect the water resources of the San Jacinto River Basin." (SJRA, 2014) The Lake Conroe Division oversees operations and maintenance, licensing and permitting, water quality, and aquatic invasive species management. "Through partnering with local, state, and federal organizations, the Lake Conroe Division manages invasive aquatic plants, zebra mussels, and other invasive species on the reservoir. With various participating organizations, SJRA's Lake Conroe Division has developed a program to establish native vegetation across the reservoir and sustain a suitable fisheries habitat." (Simpson, 2021)



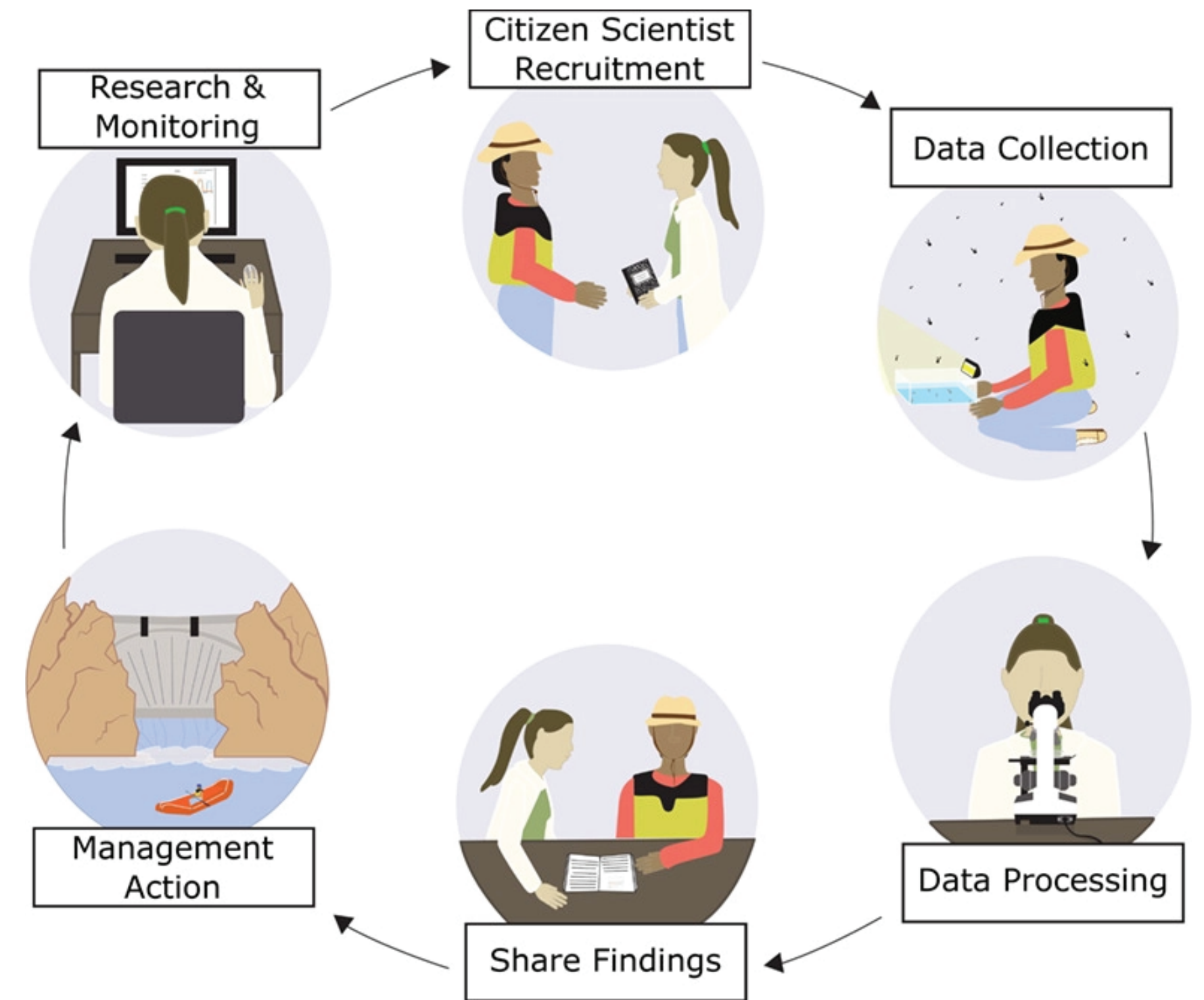
**water testing**





# CITIZEN SCIENCE

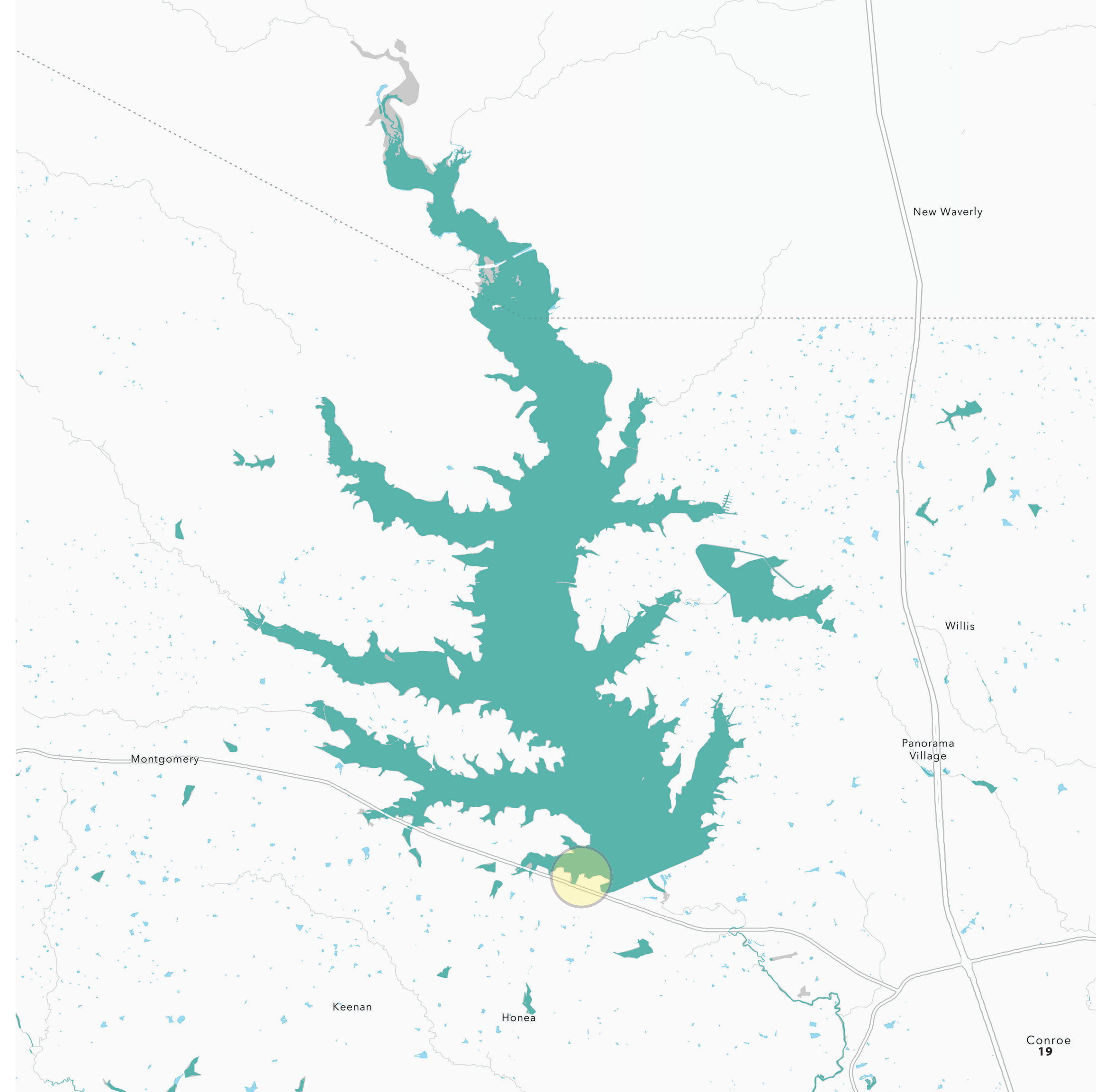
A concept known as Citizen Science, is where the general public voluntarily participates in the scientific process through the formulation of research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems. Through crowdsourcing, organizations that use these methods of the scientific process submit an open call for voluntary assistance from large groups of people to volunteer. Public and private schools, higher education institutions, and every day individuals from other professions are welcomed to participate in the aiding of the scientific process with organizations dedicated to scientific research. This program encourages the collaboration between scientists and the general public.



# SYNTHESIS

Through the usage of Citizen Science, the San Jacinto River Authority can conduct research to improve Lake Conroe's aquatic vegetation and aquatic wildlife while also educating the general public about the lake's delicate ecosystem. "Humans need water and the management of freshwaters is a direct reflection of cultural values" (Metcalf et al., 2022). "Freshwater research is well suited for citizen science applications as people are intrinsically motivated to care about aquatic resources." (Metcalf et al., 2022) This provides a great opportunity for adults and students alike to be involved in the scientific process and provide the scientists with real, usable data. While the SJRA has an office building located near the dam on Lake Conroe, there is not a location dedicated to the research and experimentation that can hold this amount of activity.

In what environment can this connection be fostered? How do we create a space that encourages the collaboration, learning, and observation between student and teacher? "Human beings' exposure to nature is considered to have positive effects on their psychological health, and therefore, it is feasible to create an environment that stimulates well-being by using restorative methods that improve mood and increase mental vitality, thus reducing fatigue." (NEVZATIF et al., 2021) This question led to the specifically chosen site and strategic placement of the building's program.

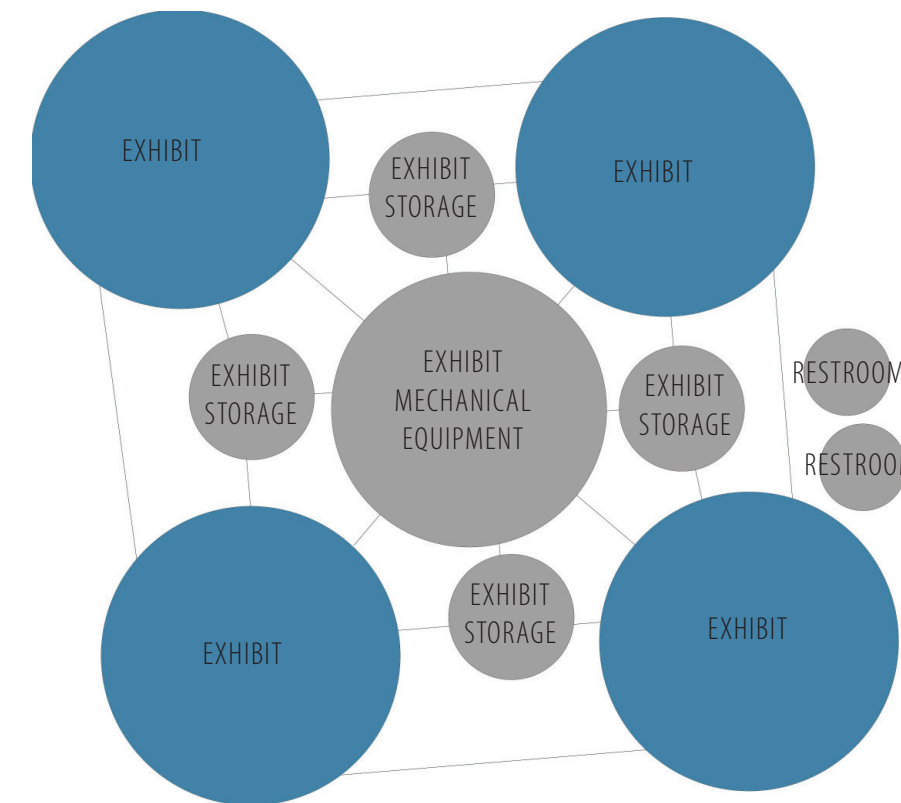




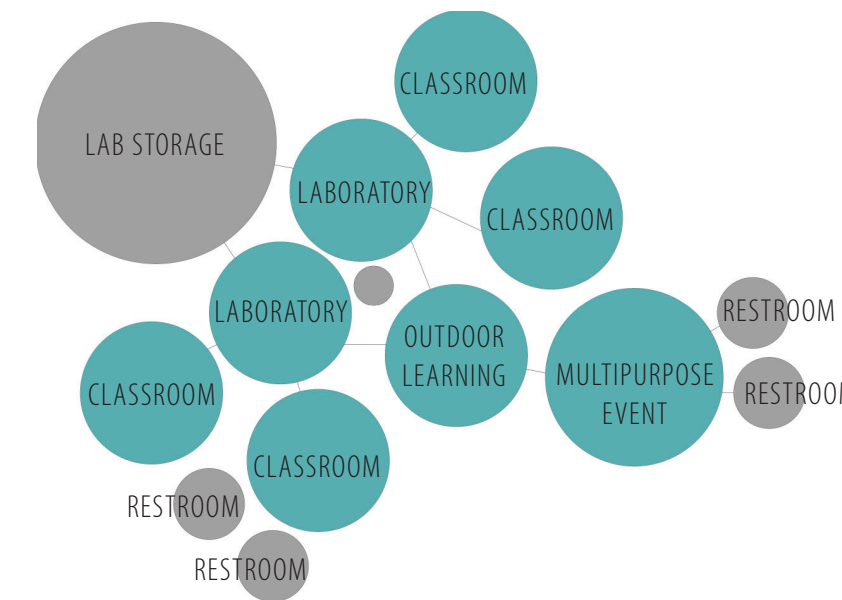
**PROGRAM**

# AQUARIUMS + EDUCATION + ADMINISTRATION + EVENT SPACE

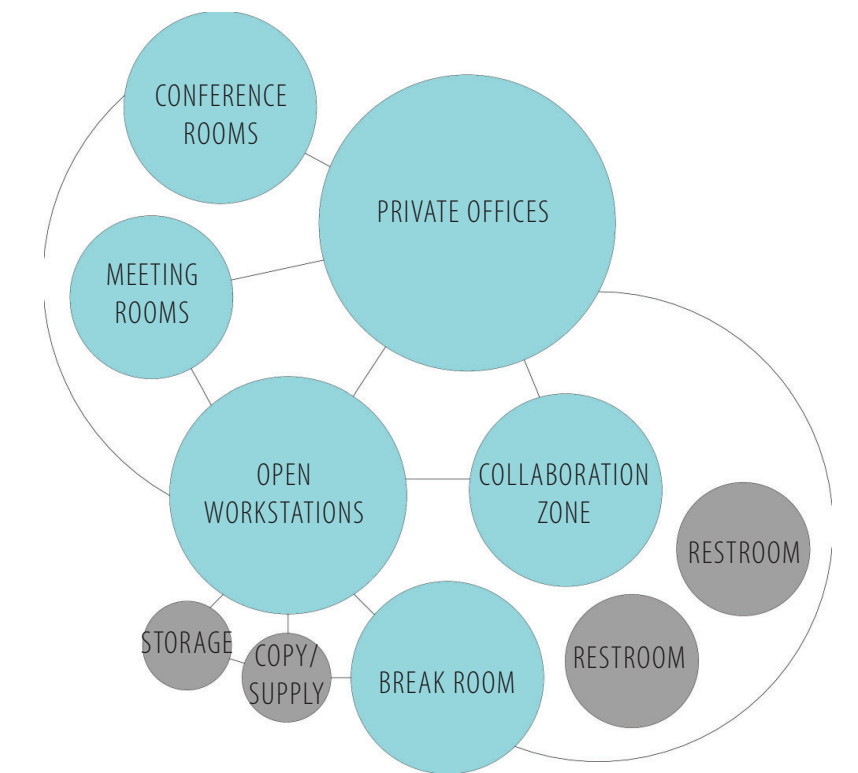
The Texas Freshwater and Fisheries Center, along with information from San Jacinto River Authority gave way to the formation and development of the program. A marine biological research and education center project by Lake Flato was precedent for materials, spatial layouts, and square footages of certain spaces. Similar case studies further validated the chosen program. Other precedents were explored for the design of the aquariums, the multipurpose event space, and the structural system. The final program includes a multipurpose event space, aquariums, laboratories, classrooms, and a fully functional office. The laboratories and classrooms are for the specific users of the citizen science program, along with the scientists and researchers who work for the San Jacinto River Authority. The aquarium with several aquatic exhibits is intended for the general public, along with aiding in the learning and observation program of the citizen science sector. The multipurpose event space is designed to hold several configurations of tables and chairs to accommodate the needs of whatever functions may be occurring.



**AQUARIUMS**



**ADMINISTRATION**



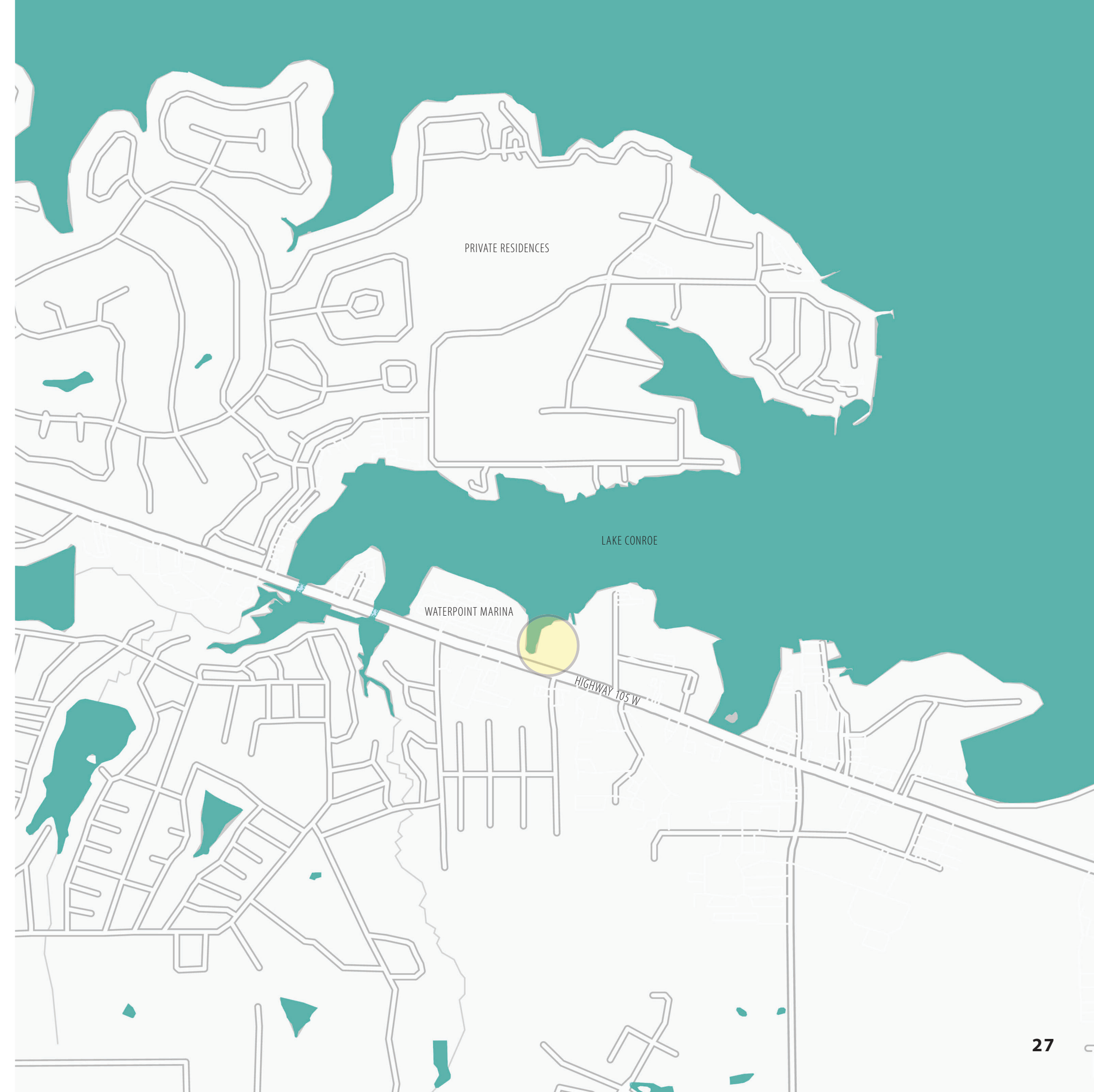
**SCIENCE + RESEARCH**



SITE

## ANALYSIS

The site is located along Highway 105 West in Conroe, Texas. The site is directly adjacent to an inlet and Waterpoint Marina. The marina has a variety of restaurants, shopping, and docks for boats. Currently, the property is zoned by the City of Conroe as Single Family Residential, but due to the nature of the site and proximity to the adjacent marina, efforts will be set in place to rezone to Commercial. Overhead powerlines, post and wire fencing, and a drainage pathway run along the southern edge of the property that borders the highway. The existing landscape consists of grass and sand, along with a few existing trees near the highway that will remain. The sun is higher in the sky during the summer months and lower in the winter months. The wind comes predominantly from the south, but is also received from both the east and the west. Conroe experiences an above average humidity throughout the year, and the most wind is experienced in the spring months.



# CONTEXT



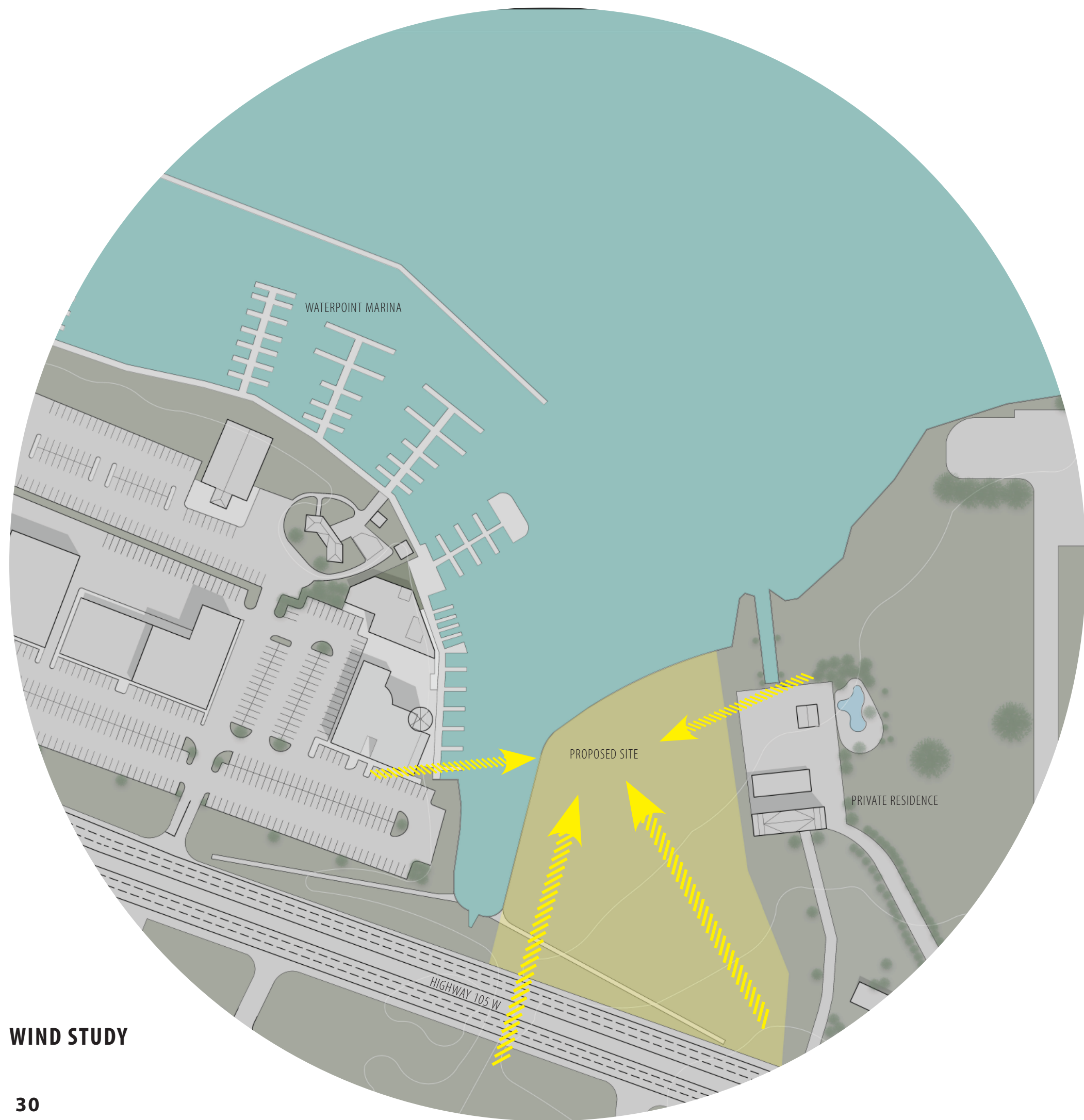
**SHOPPING + RESTAURANTS**



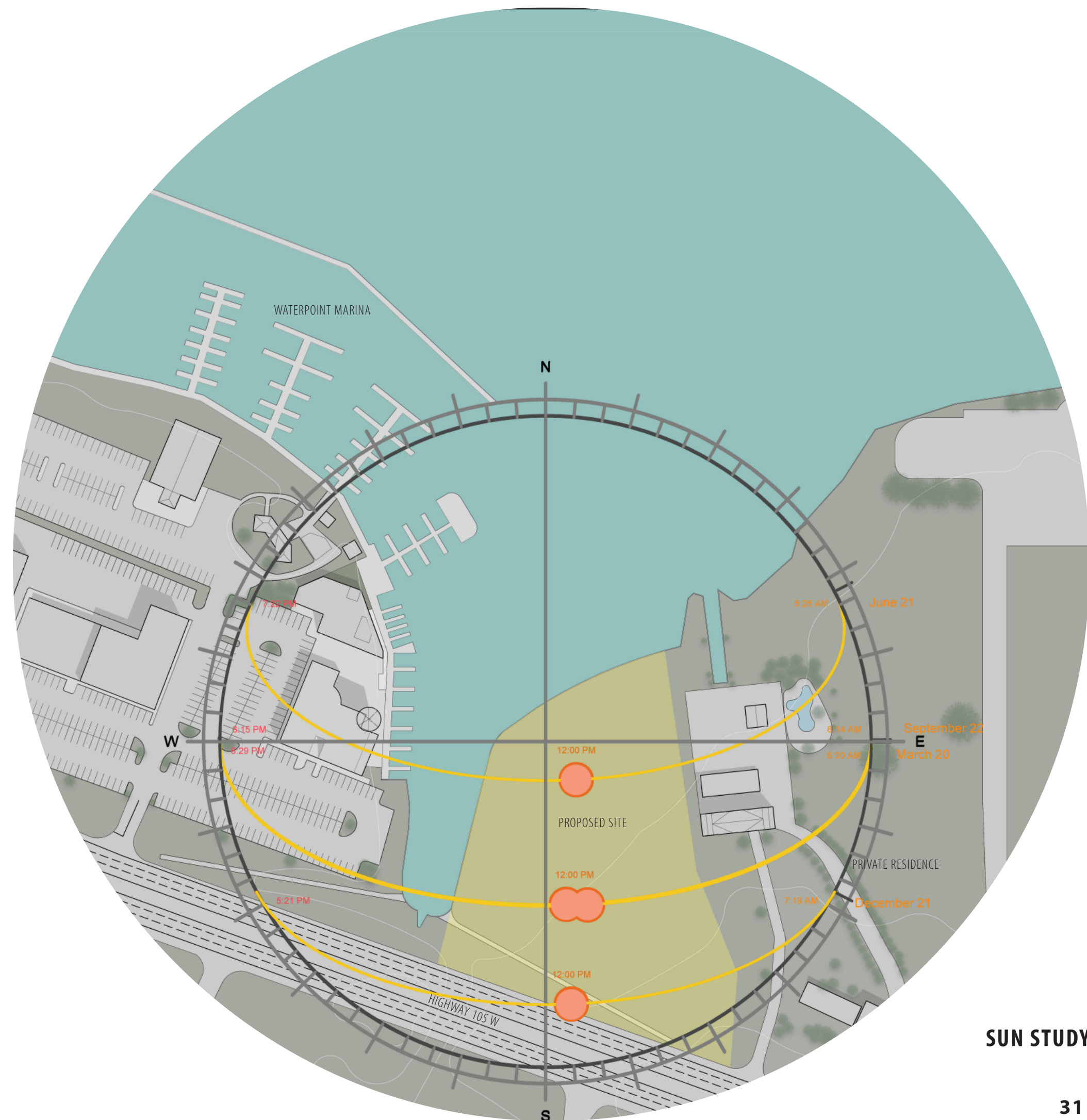
**BOAT DOCK**



**PRIVATE RESIDENCE**



WIND STUDY



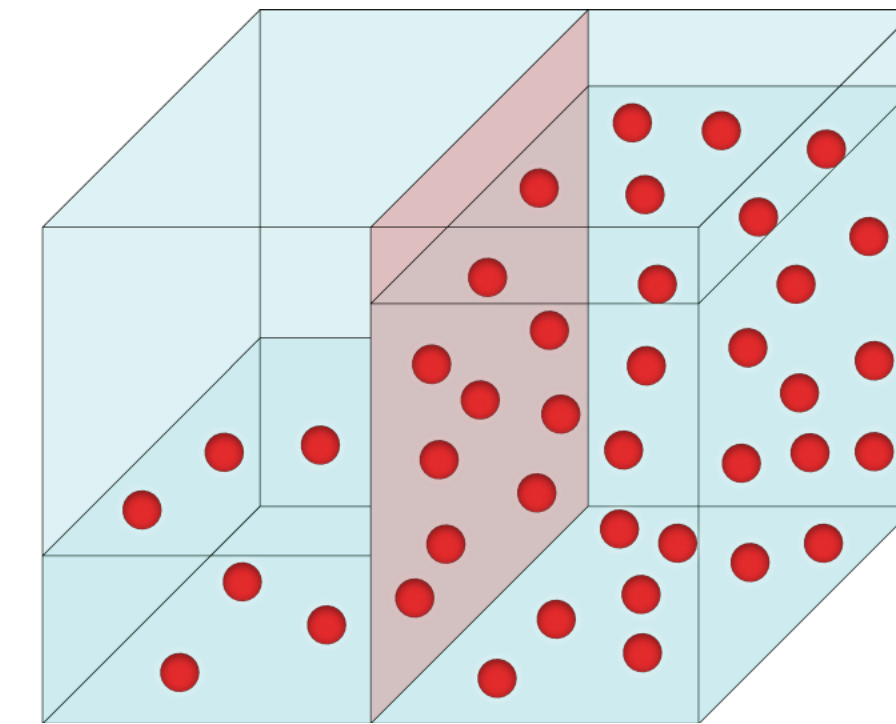
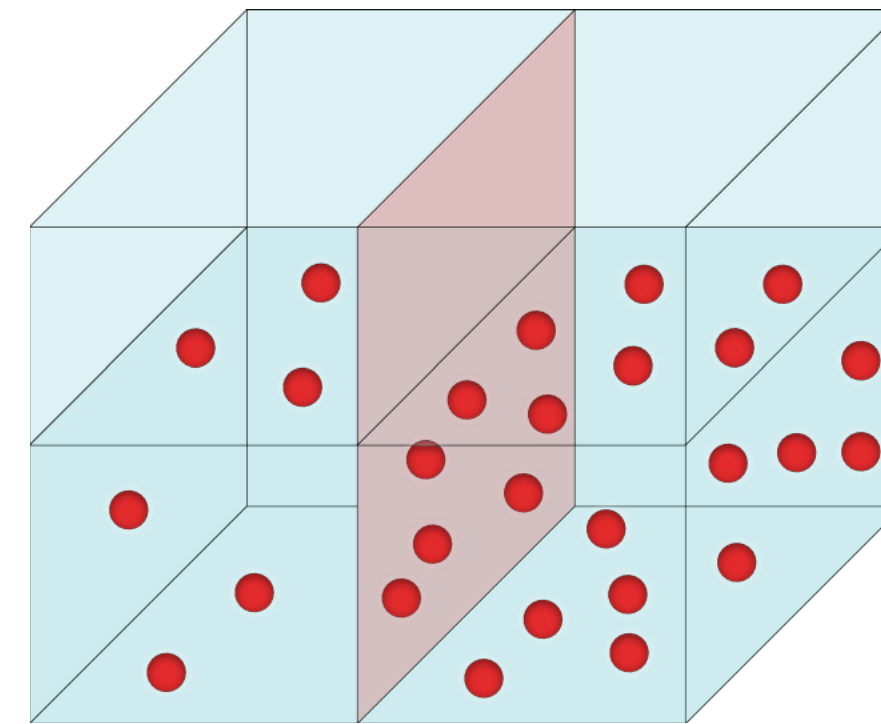
SUN STUDY



**CONCEPT**

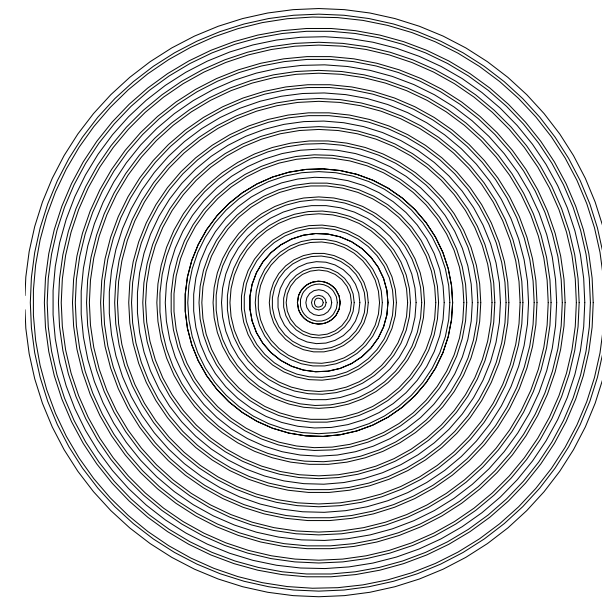
# OSMOSIS

The biological term "osmosis" is the movement of water molecules from a highly concentrated solution to a lower concentrated solution. The design process originated through the action of this definition. The people represent the water molecules, observing and designing with their movement through the project at the forefront. The buildings represent the solution that the molecules move through. "We have managed to transform the natural environment to fit our needs." (Gruber, 2011) Life happens within architecture, and biology is the study of life itself.

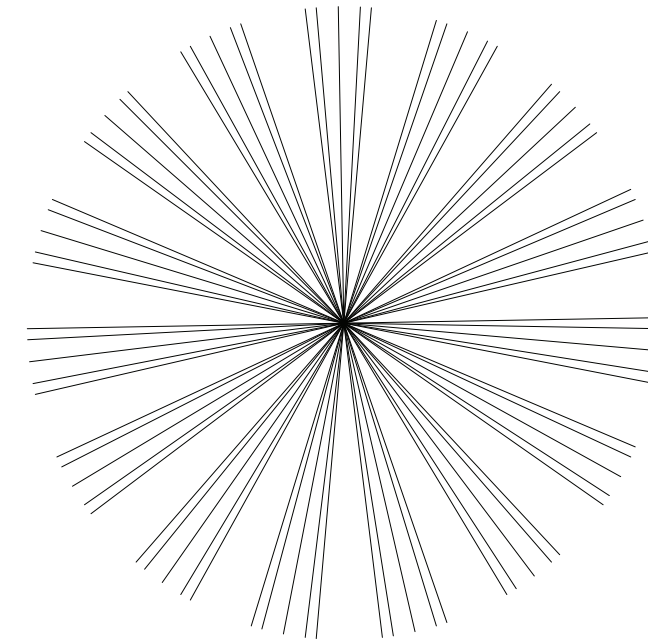


## THE GRID

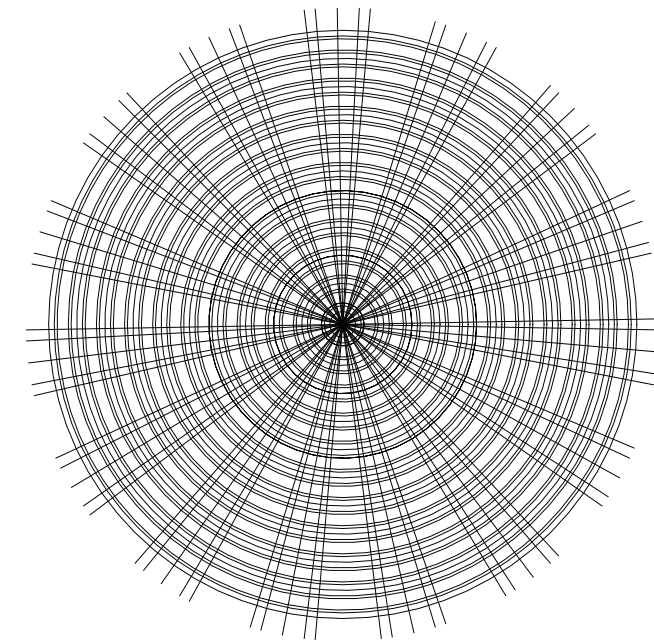
The project starts with and follows a grid, which is a combination of a radial grid and tartan grid. The radial grid was chosen based on the line of separation between the land and water, and the Tartan grid was chosen to introduce a method of alternative spacing. The grid helps organize the spaces and provides structure to the overall design. The radial grid fits best within the site, and, combined with the Tartan, it brings proper proportions and consistency.



**RADIAL**



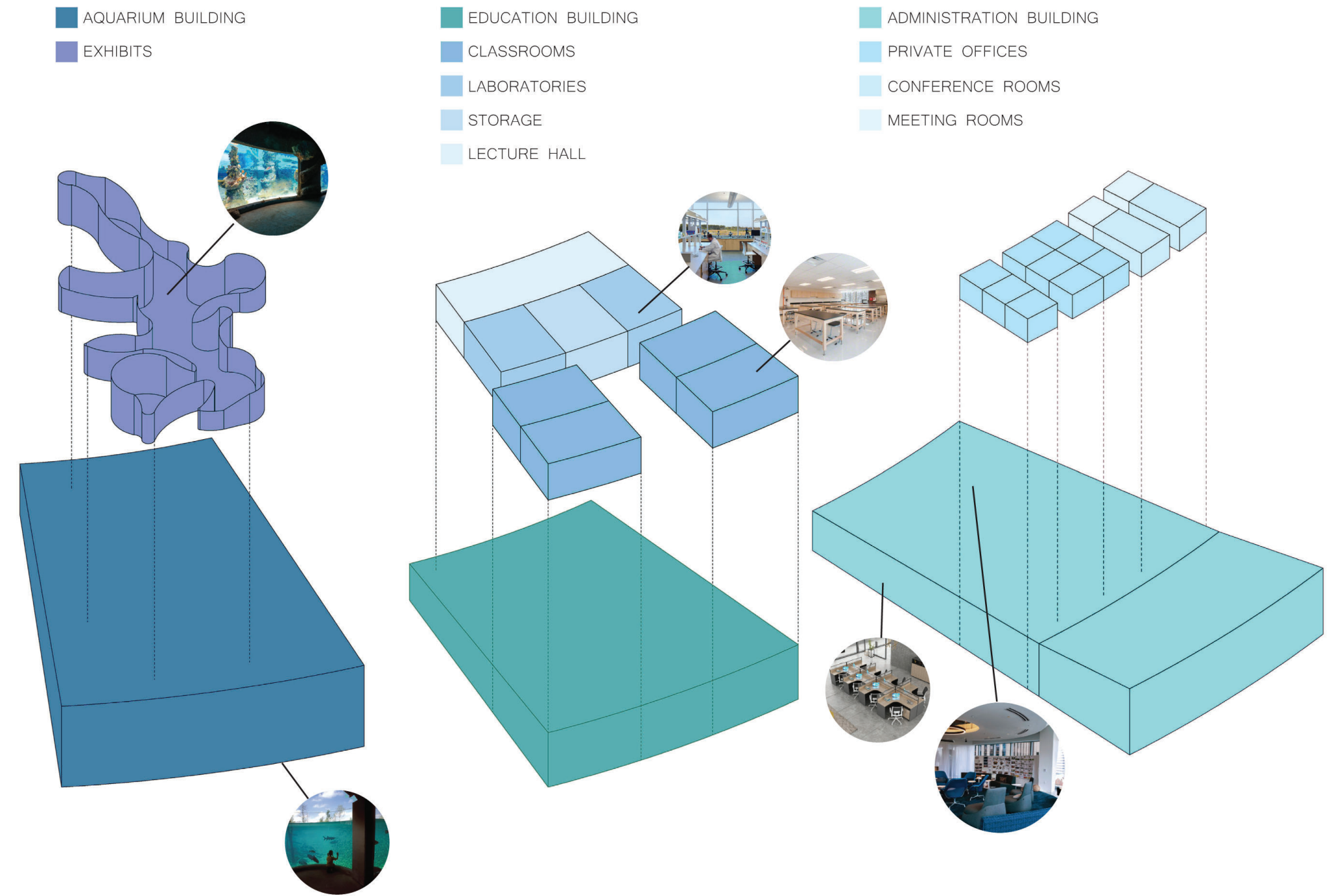
**TARTAN**



**COMBINED**

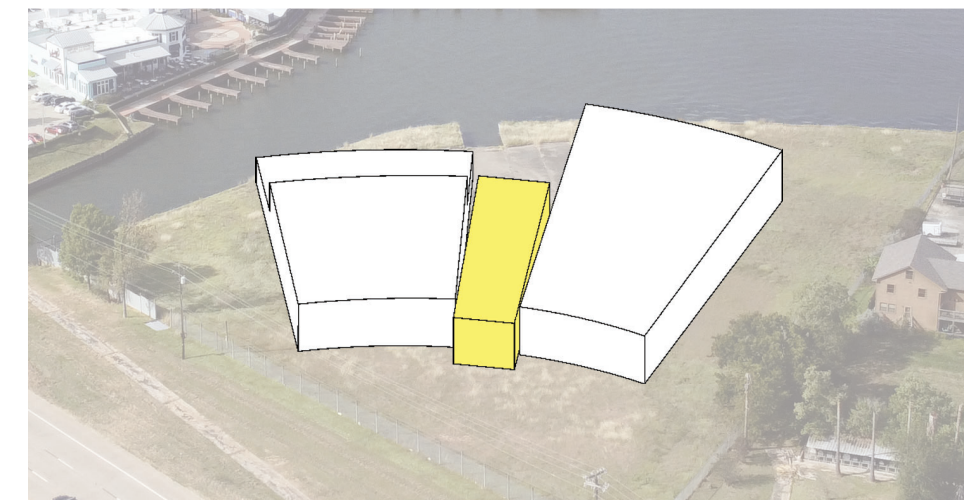
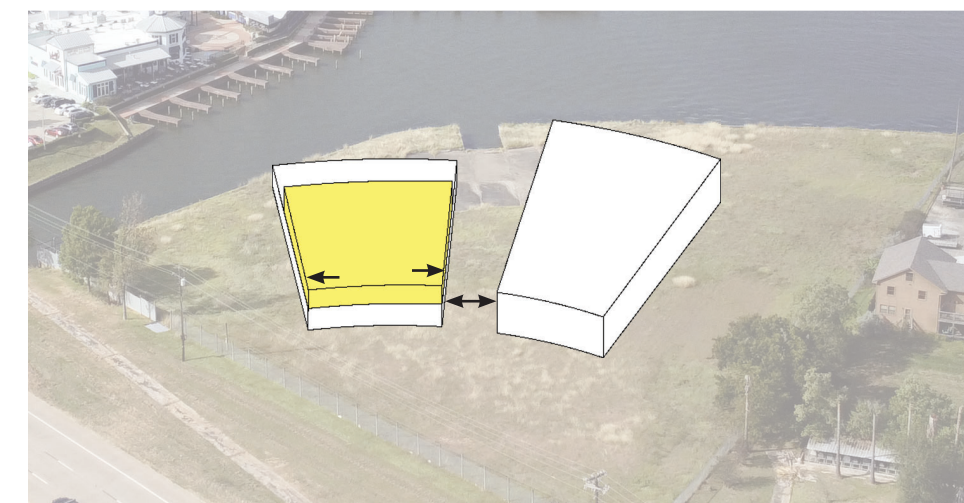
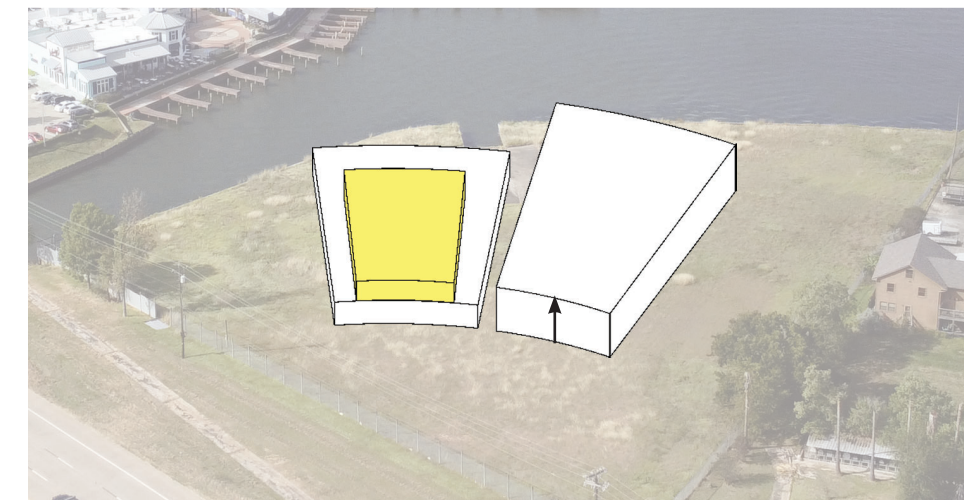
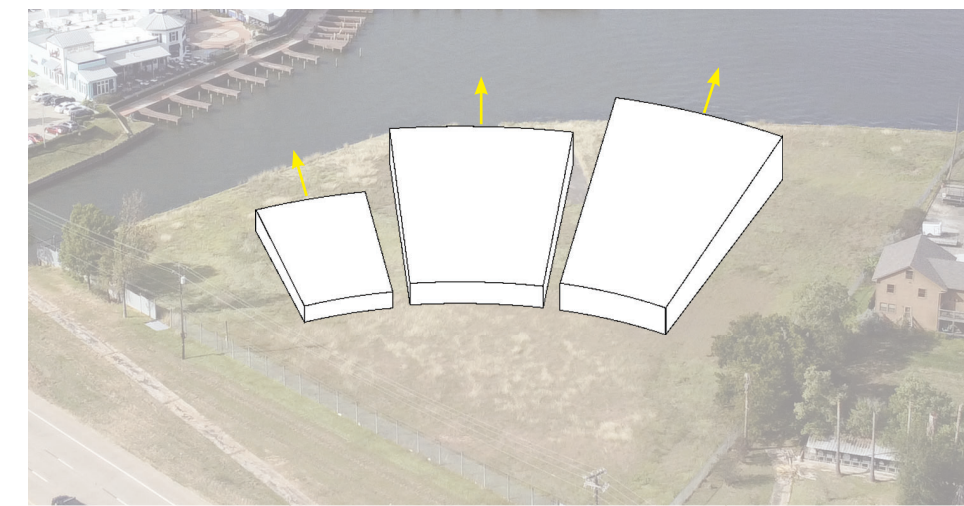
# PROGRAMMATIC MASSING

Each major program is separated into three masses. The original shape of the aquatic exhibits was derived from the shape of Lake Conroe. In the final design, all curves of the exhibits are pieces from this form. The educational building is laid out to emphasize the prominence of the event space (lecture hall), in relation to the laboratories, classrooms, and storage. The administration building should be located with direct access to the education building, as this is the program for the permanent building users. Offices are located in clusters, next to open workstations that promote collaboration amongst employees. Meeting rooms and conference rooms are grouped for proximity to both the open workstations and offices.



# CONCEPT

The design process began with programmatic blocking and stacking with to-scale masses. After positioning the masses on the site, curves were shaped to follow the natural curvature of the edge of the land and water. The top edges of the masses were adjusted in height to accommodate daylighting. After the programmatic blocking and stacking, 3 masses were positioned and connected via indoor walkway, symbolizing the process of osmosis. The layout and positioning of the program follows a combination of a radial grid with a tartan grid. The radial grid was chosen based on the shape of the site, and the tartan grid provides another layer of organization.



## 3 PROGRAMMATIC MASSES

Three separate masses representing each major program - administration, education, and aquarium. Each form follows the radial + tartan grid that aligns with the edge of the land and water. The radial facades allow for clear views to the lake.

## ELEVATE + STACK

The mass on the right represents the aquarium, and was raised to allow for double height ceilings to accommodate aquatic exhibits. The administration mass was stacked on top of the education mass to open up more land on the site and maximize higher viewpoints.

## ALIGN + SEPARATE

The administration mass is now aligned with the mass below, and both volumes are separated further apart to emphasize a central axis on the site. This also places emphasis on the separation of the two major programs of the project.

## ADDITION + CONNECTION

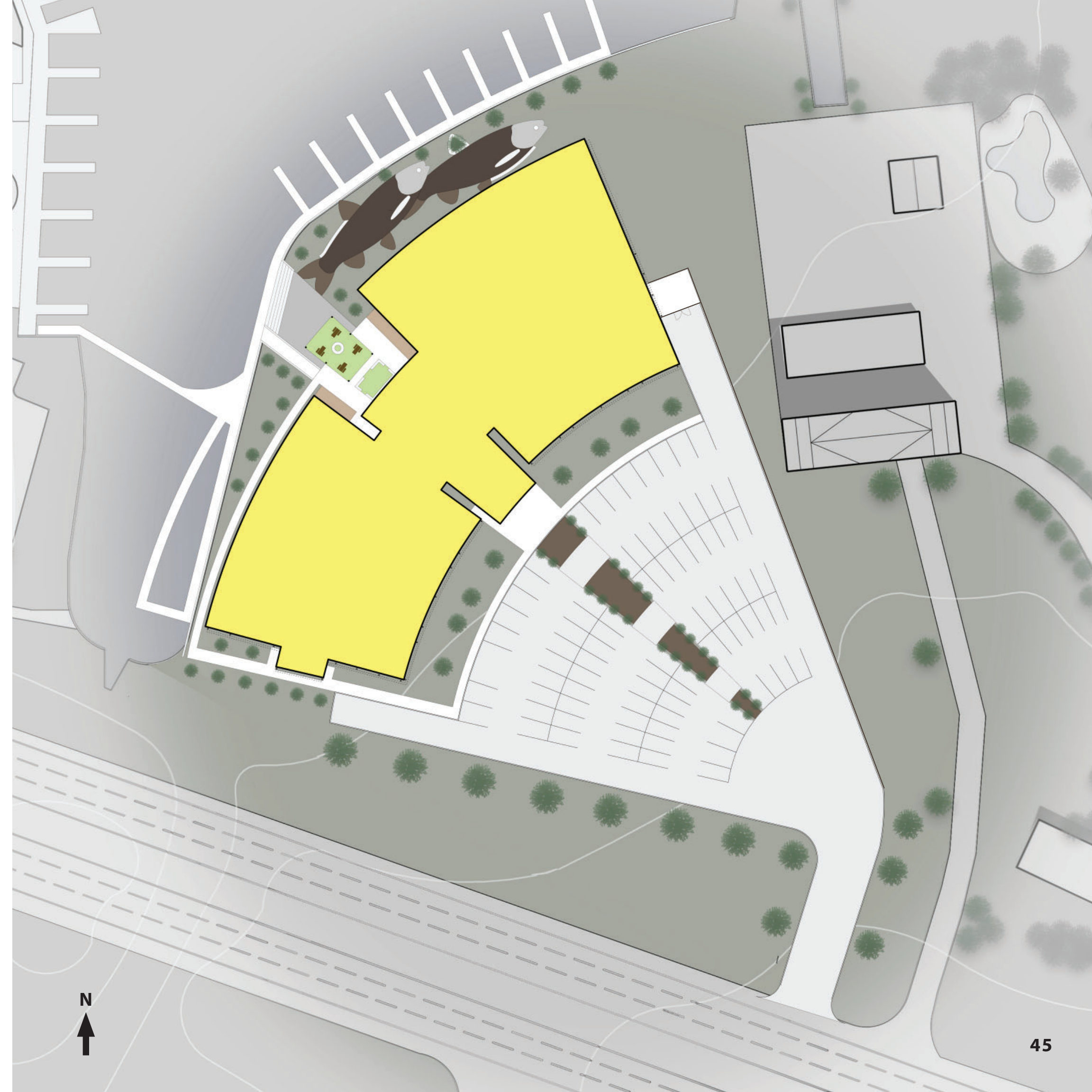
A central volume is added in the center to physically connect the two masses. The facade protrudes out further to be a focal point that will indicate a main entrance.



**DESIGN**

## SITE

The site can be accessed from the southeast, directly off of Highway 105, and is adjacent to an inlet with a marina and shopping center. Travel by boat is also encouraged, and a dock with parking for boats lines the perimeter of the inlet. This dock also provides access to the marina and shopping center, adding a layer of walkability that this portion of Lake Conroe lacks. The dock is a concrete structure wrapped in an aluminum wood-look material. Concrete steps and ramp lead up to an outdoor plaza with turf, overhead string lights, and concrete benches. Three different types of pavers make the shape of grass carp on the ground, with concrete benches and planters extruded along the edges. Visitors from this side of the project either enter through the central building that holds the event space and welcome center, or an entrance that leads to the labs and classrooms. The view entering the site from the southeast is greeted by three separate but connected buildings. This configuration was fueled by the process of osmosis. Users of the building circulate similarly to the water molecules moving. The facades are wrapped in three layers of vertical fins that are fixed at specific angles to control the amount of sunlight that enters into the building. The central building consists of the welcome center and event space. A suppressed aquarium that divides the event space and aquatic exhibits is visible upon entry.



# PLAZA

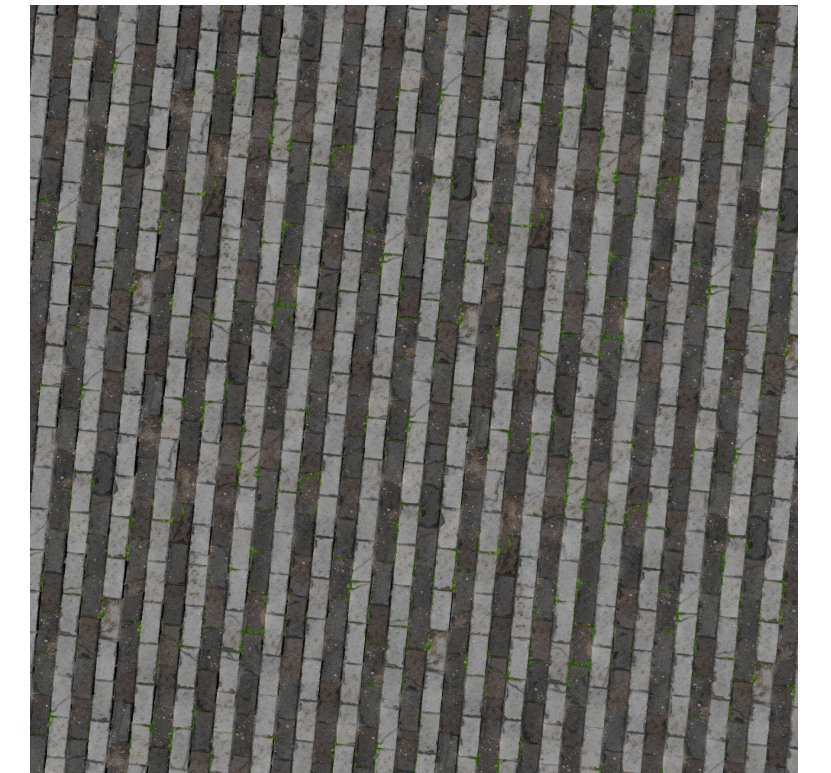
The plaza is a design of pavers, concrete benches, and concrete planters that make up the shape of grass carp. Each part of the grass carp has a specific shape and color designated paver to represent the part of their body. The concrete benches and planters are integrated along the fish's shape.



## SCALES



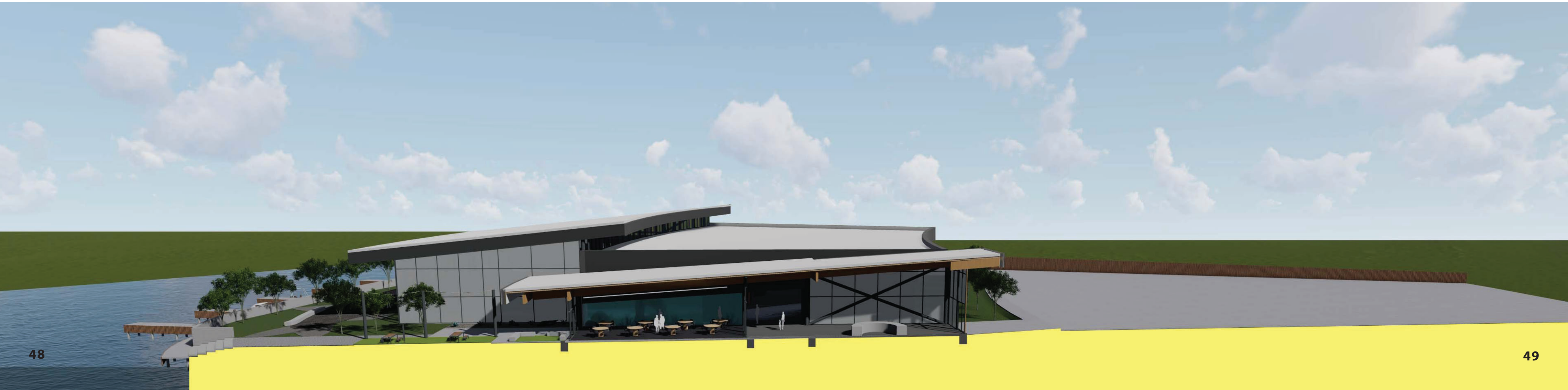
## BODY



## HEAD

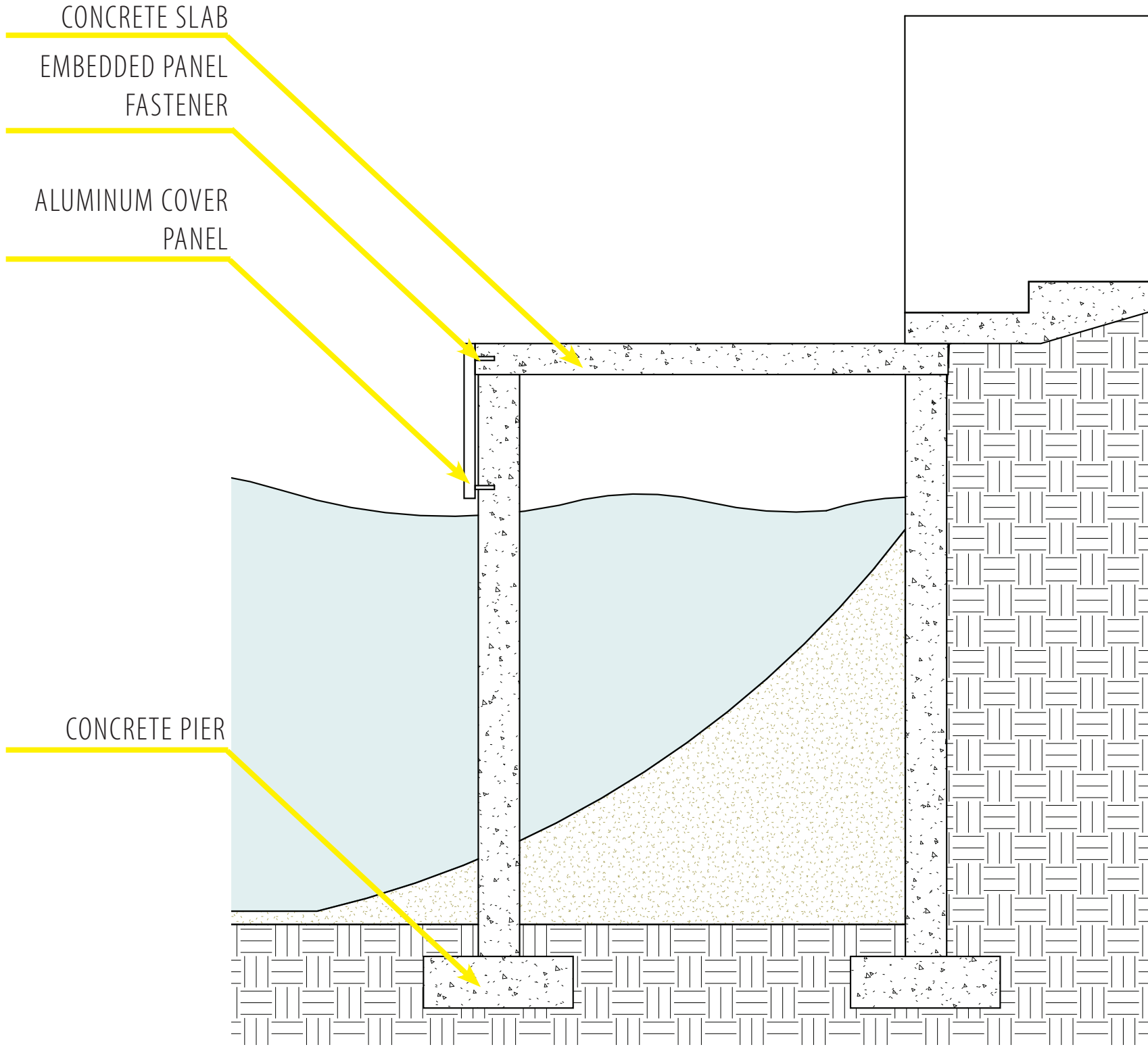






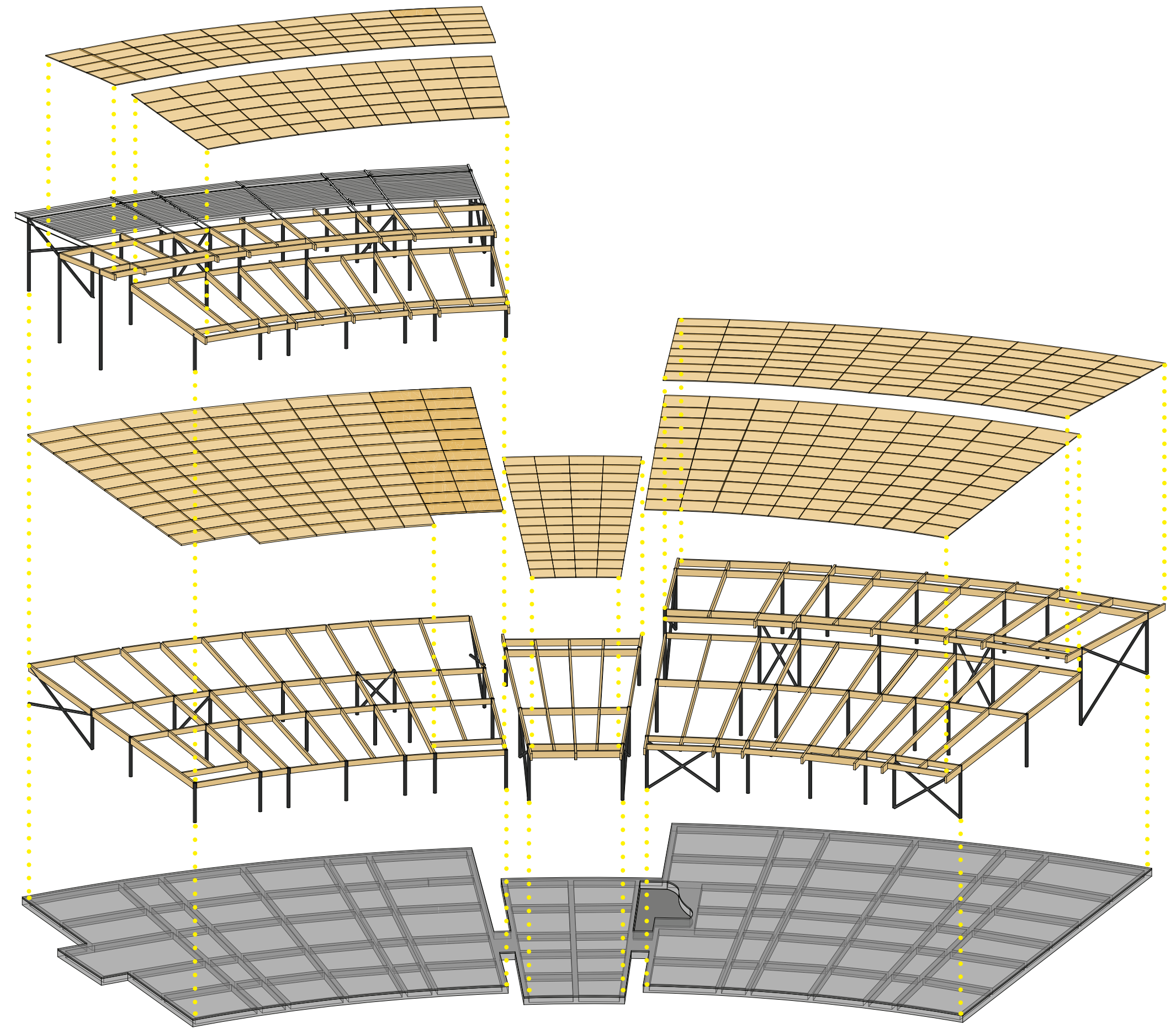
# BOAT DOCK

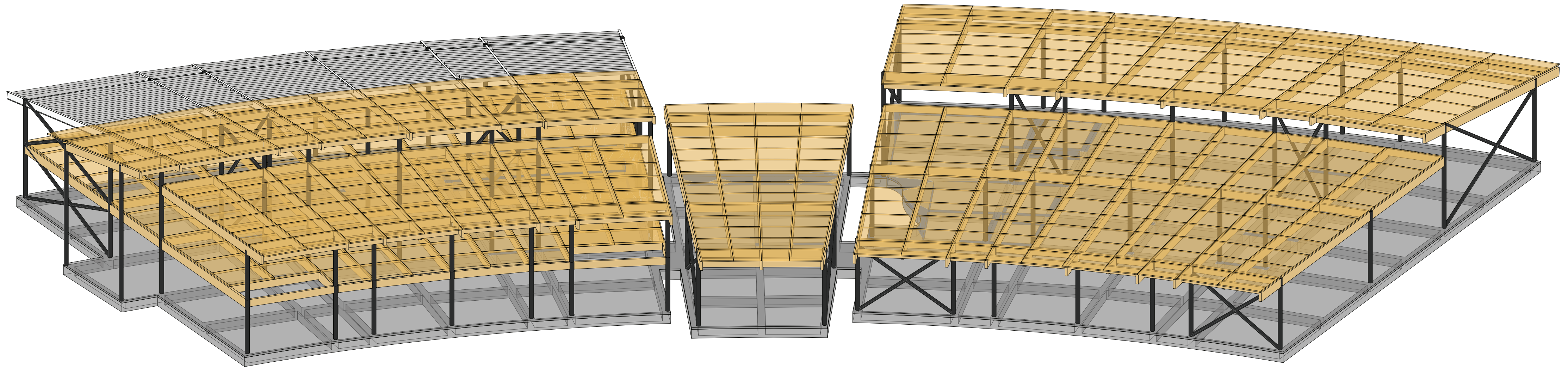
The boat dock provides eighteen spots for standard sized boats that reach up to 30 feet. Lake Conroe remains at a fairly consistent water level, so concrete was chosen for durability. A aluminum cover panel is fastened to the concrete structure to provide protection as well as a material consistent with the building. The aluminum panel is a marine-grade material that will not warp over time. The material is also certified for durability, colored with an advanced paint technology that provides a powder coat finish that resists peeling, chipping, and cracking. It is also stain and scratch resistant, perfect for the location of the aluminum panels produced by Knotwood Architectural Systems.



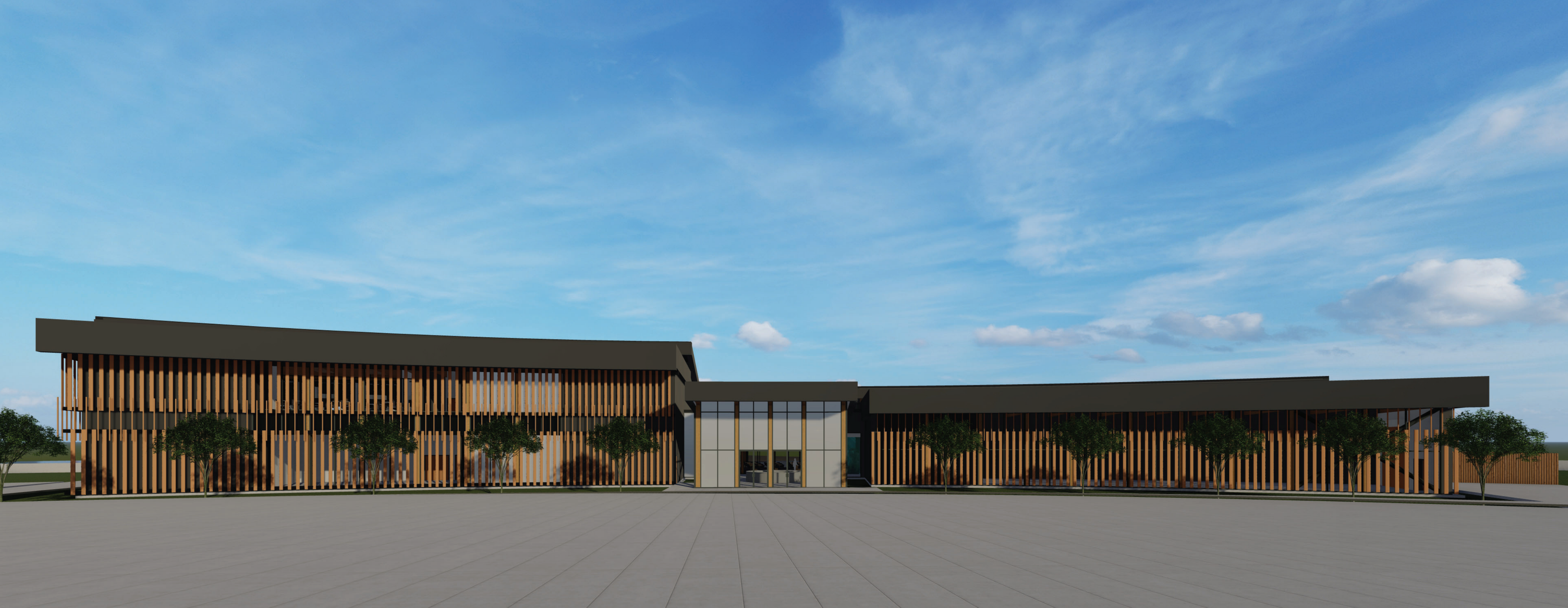
# STRUCTURE

The structure of the building is a hybrid system, using both mass timber framing and steel columns. The first iteration of the structure was rigid with simple column to beam connections. After several iterations, altering the bay dimensions, heights, and angles, a final form was selected. The structural grid follows a combination of the tartan grid and a radial grid. The central structure is a shed roof system, with the lowest point being closest to the lake. This positioning allows for the welcome center and event space to be naturally lit. The aquarium building's structure is at the same elevation as the research and office building, which are both at a higher elevation than the central building. The high roofs of both buildings slope down towards the lake, while the low roofs are flat and allow drainage towards the center. At a specific interval of the radial grid, the structure height increases, allowing opportunity for clerestory glazing to let in daylight from the south. The clerestory glazing is the only glazing on the south facades that are uncovered by the shading system.

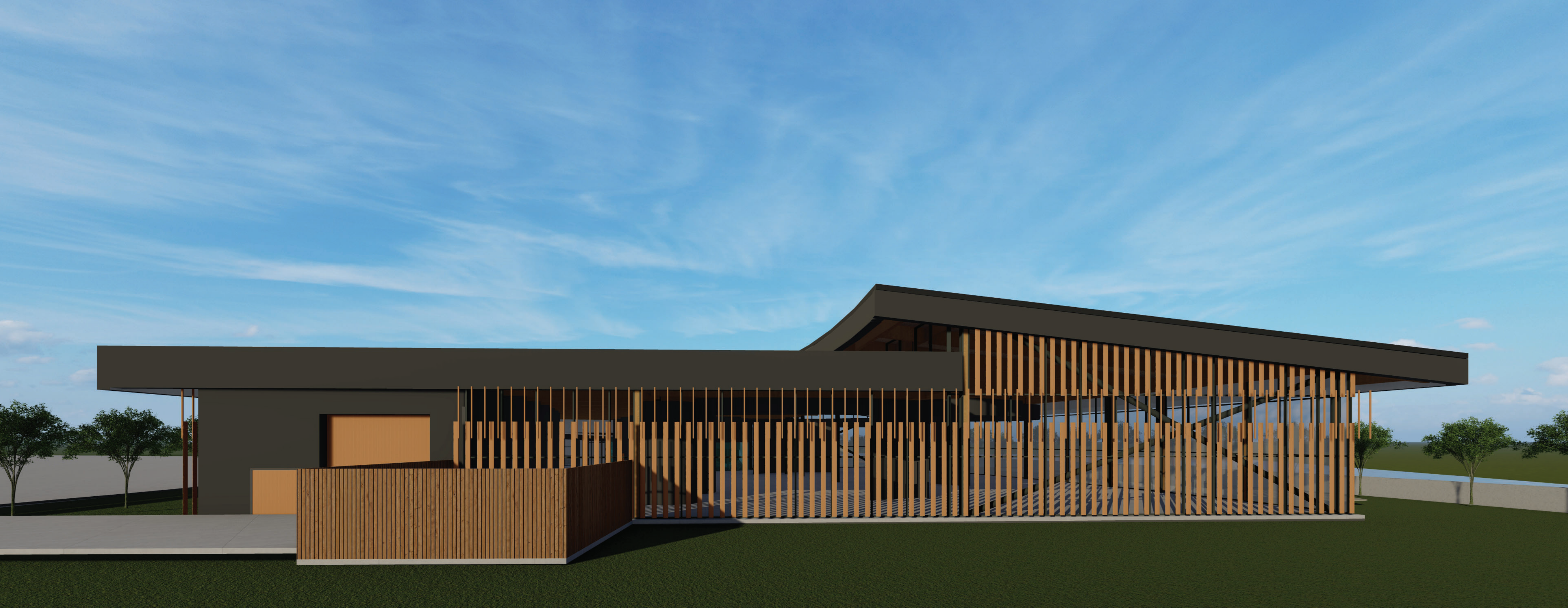




## STRUCTURAL AXON



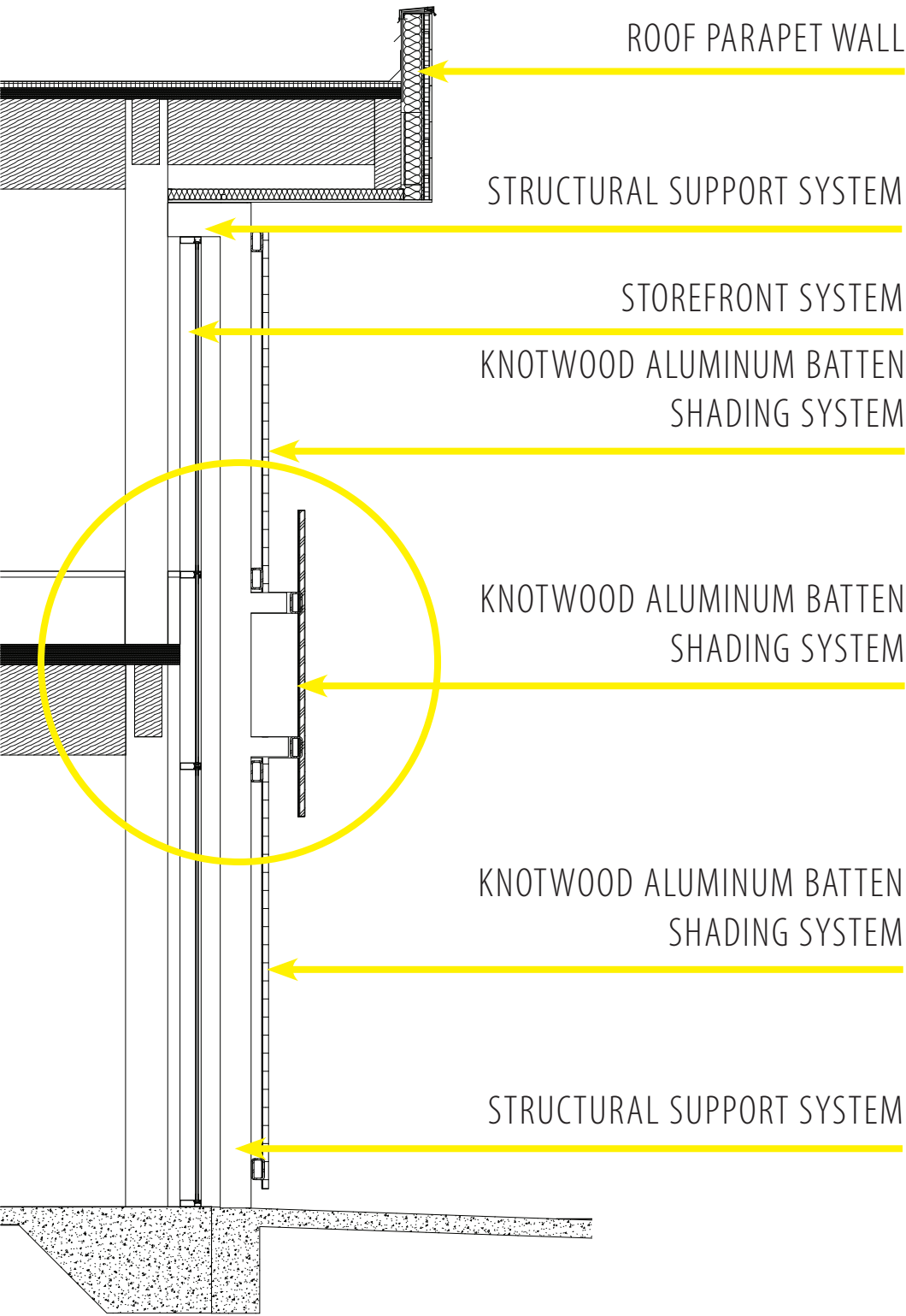
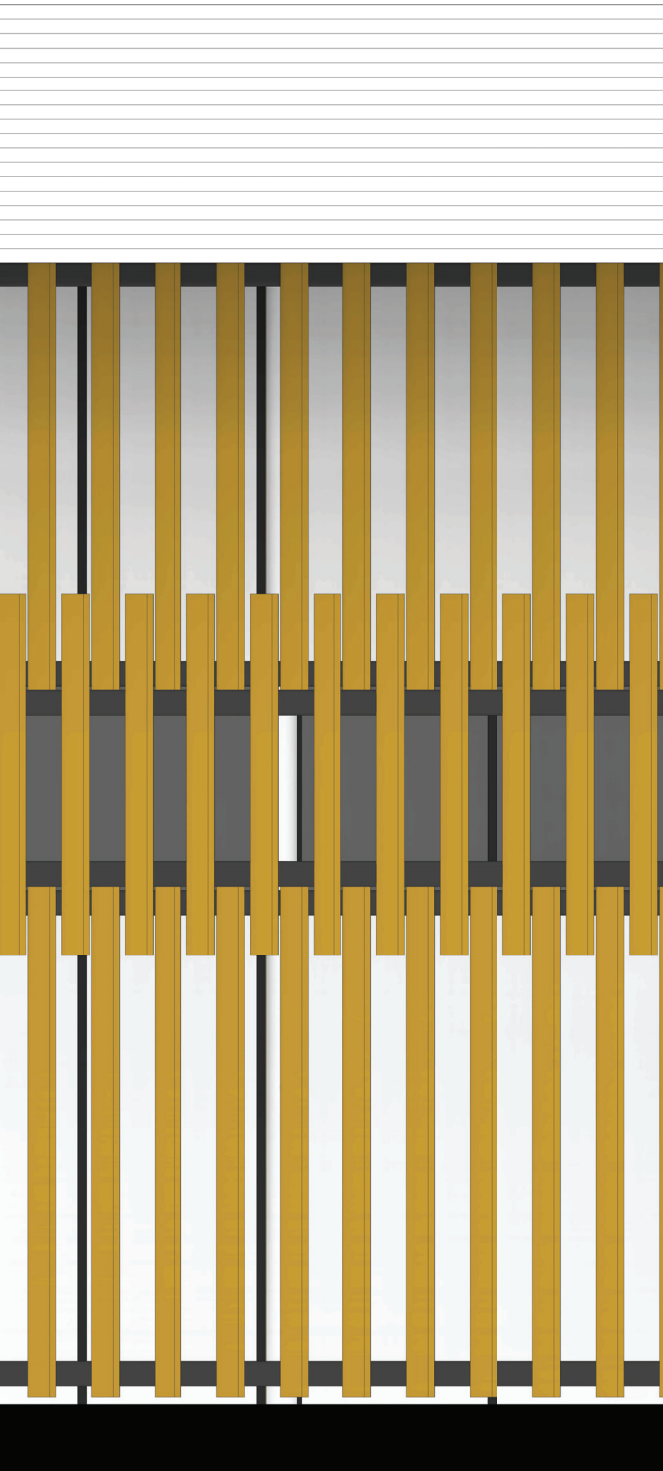
## SOUTHEAST ELEVATION

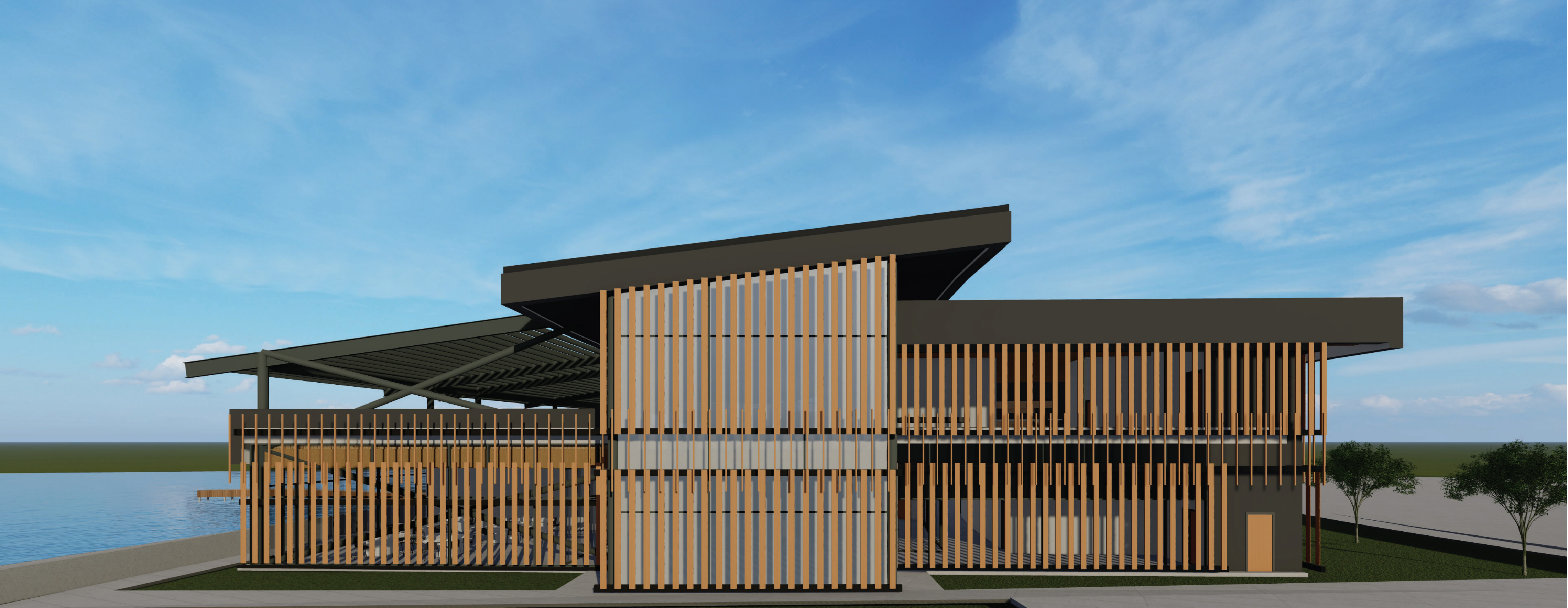


## NORTHEAST ELEVATION

# SHADING SYSTEM

Woven into the structural system is the substructure that supports the vertical shading system. This system includes 3 horizontal layers of aluminum vertical fins with a wood like material. With Lake Conroe being located within the Sam Houston National Forest, and the programmatic focal point of the project being nature and the environment, the vertical wood like fins mimic the trees through both orientation and material. Knotwood Architectural Systems manufactures these woodlike aluminum fins that provides several benefits. Aluminum is lighter, stronger, and straighter than natural wood, and is a marine-grade material perfect for the project's location. The fins are lightweight, corrosion resistant, non-combustible, non-porous, and dissipates heat by absorbing the heat slowly and releasing it quickly.

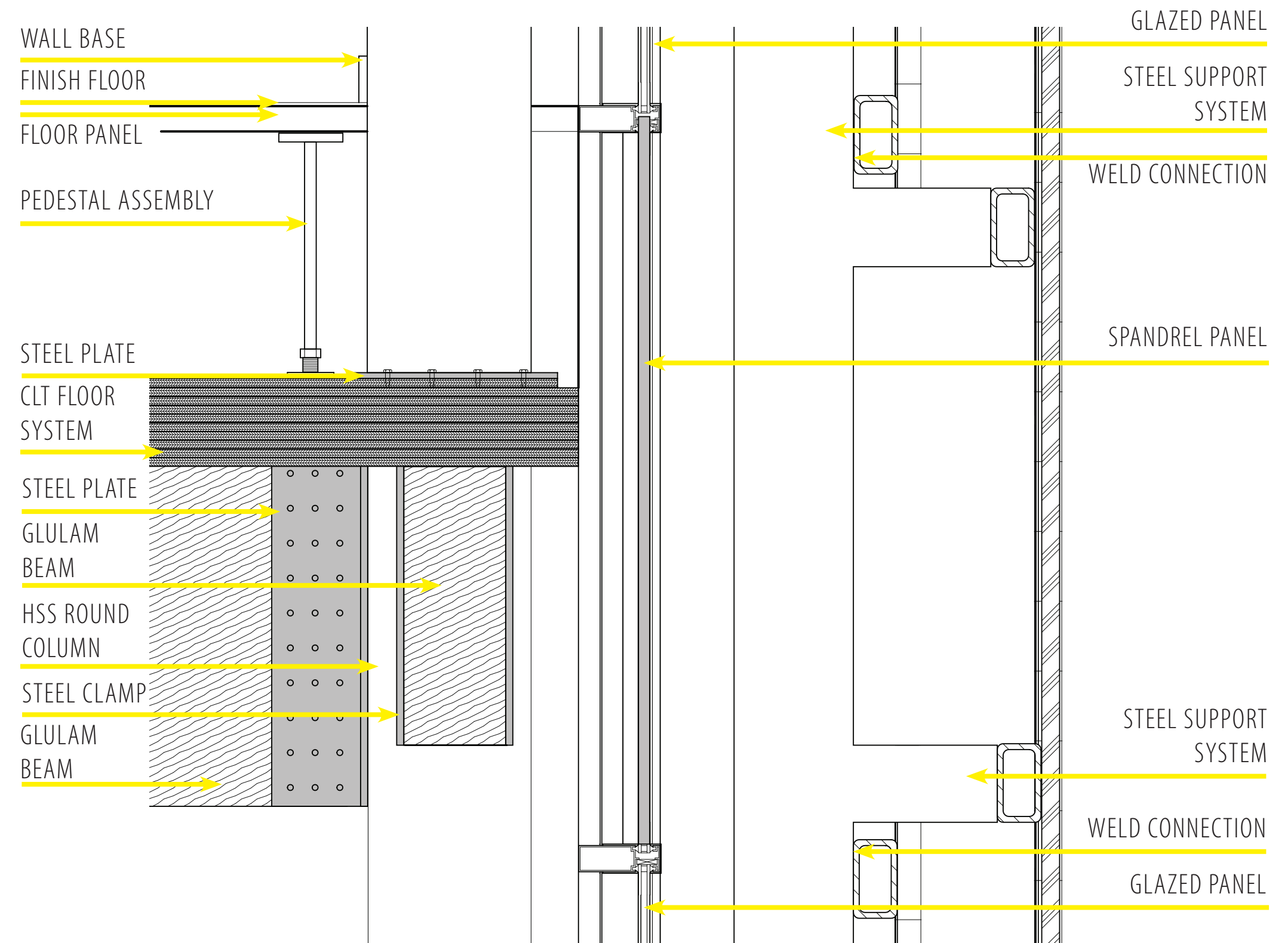




**SOUTHWEST ELEVATION**



# SHADING DETAIL





# FIRST FLOOR PLAN

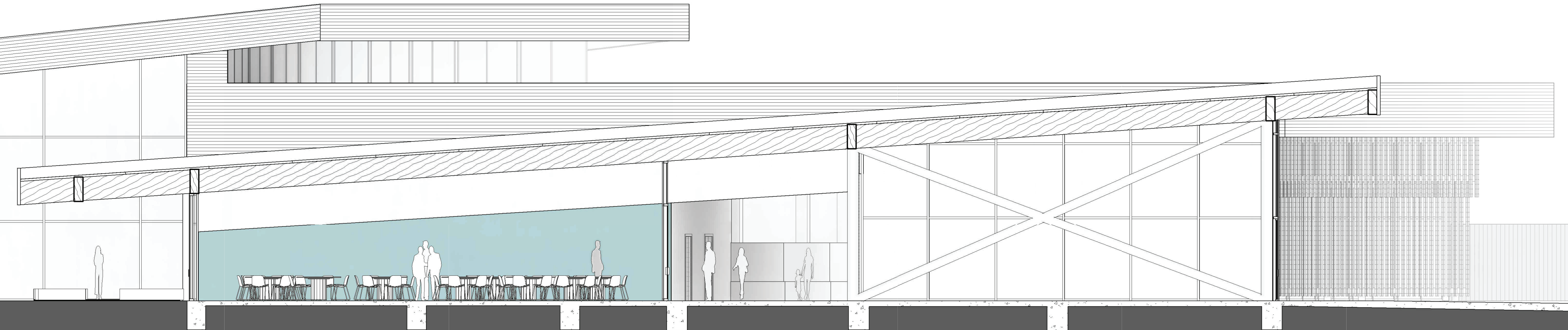


## PLAN LEGEND

- 1 LOBBY
- 2 MULTIPURPOSE ROOM
- 3 RESTROOM
- 4 AQUARIUM LIFE SUPPORT SYSTEMS
- 5 AQUATIC EXHIBIT
- 6 FISH OBSERVATION TANK
- 7 CHILDREN'S PLAY AREA
- 8 TANK ACCESS ROOM
- 9 LABORATORY
- 10 CLASSROOM
- 11 STORAGE
- 12 STAIRS
- 13 WORKSTATIONS & COLLABORATION
- 14 MEETING SPACE
- 15 CONFERENCE ROOM
- 16 PRIVATE OFFICE
- 17 BREAK ROOM
- 18 COPY/SUPPLY
- 19 OUTDOOR PATIO
- 20 MECHANICAL YARD
- 21 MECHANICAL ROOM
- 22 ELECTRICAL ROOM

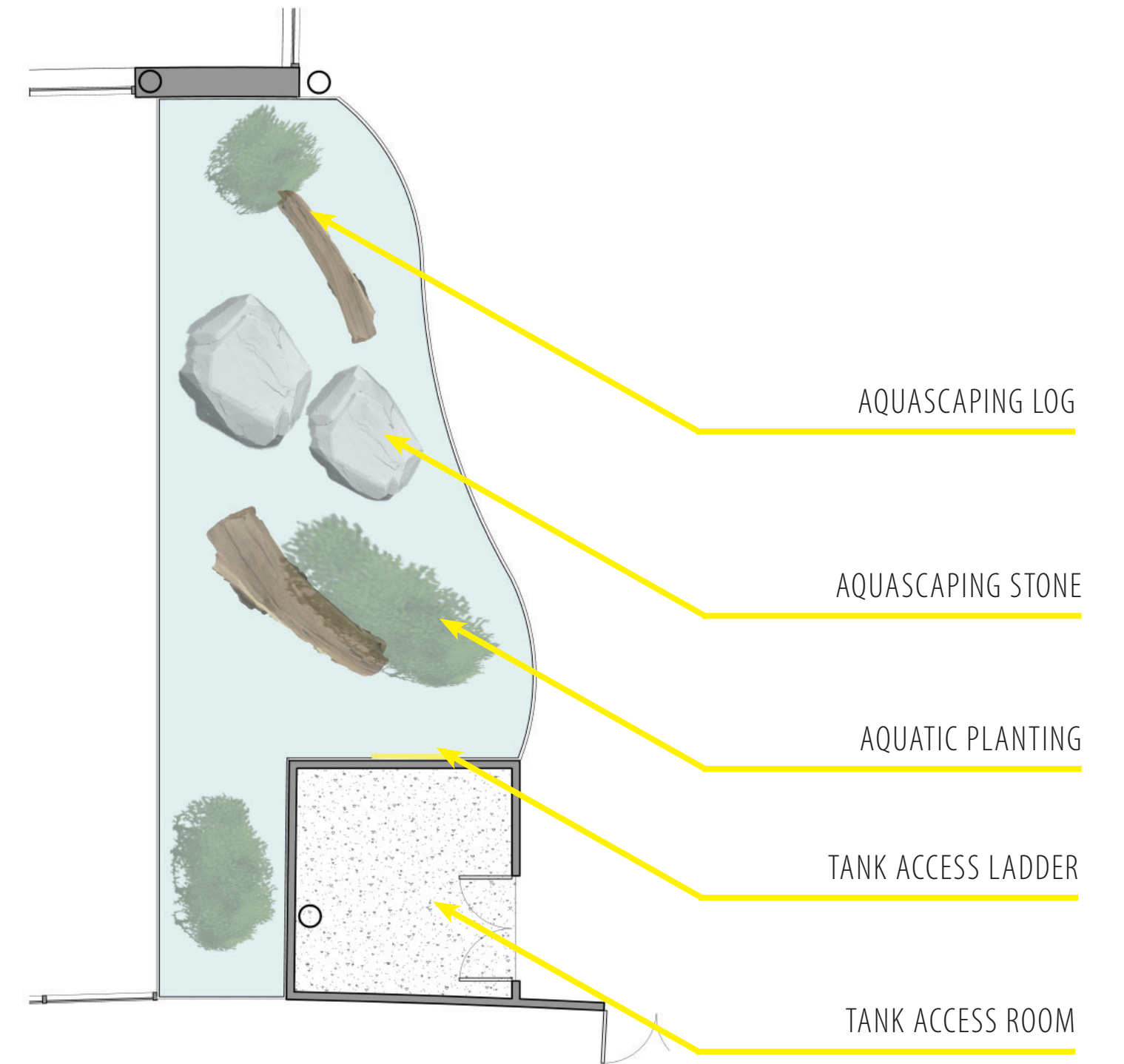


# BUILDING SECTION



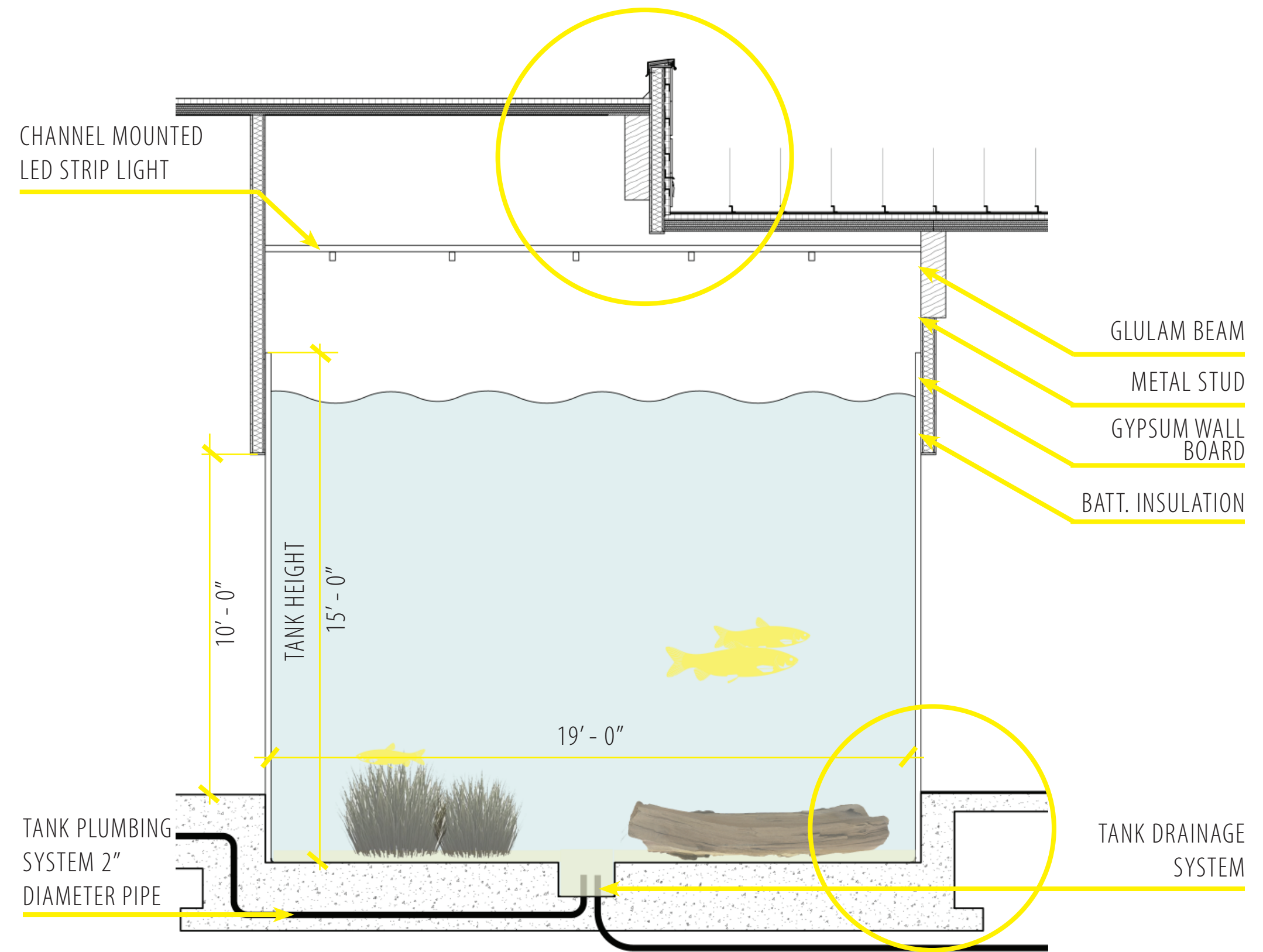
# AQUARIUM PLAN

The aquarium that separates the aquatic exhibits and the event space is a custom fabricated acrylic tank, decorated with aquascape driftwood, rocks, and planting. Due to the centralized location of the aquarium, a tank access room is adjacent to the tank for upkeep and maintenance purposes.

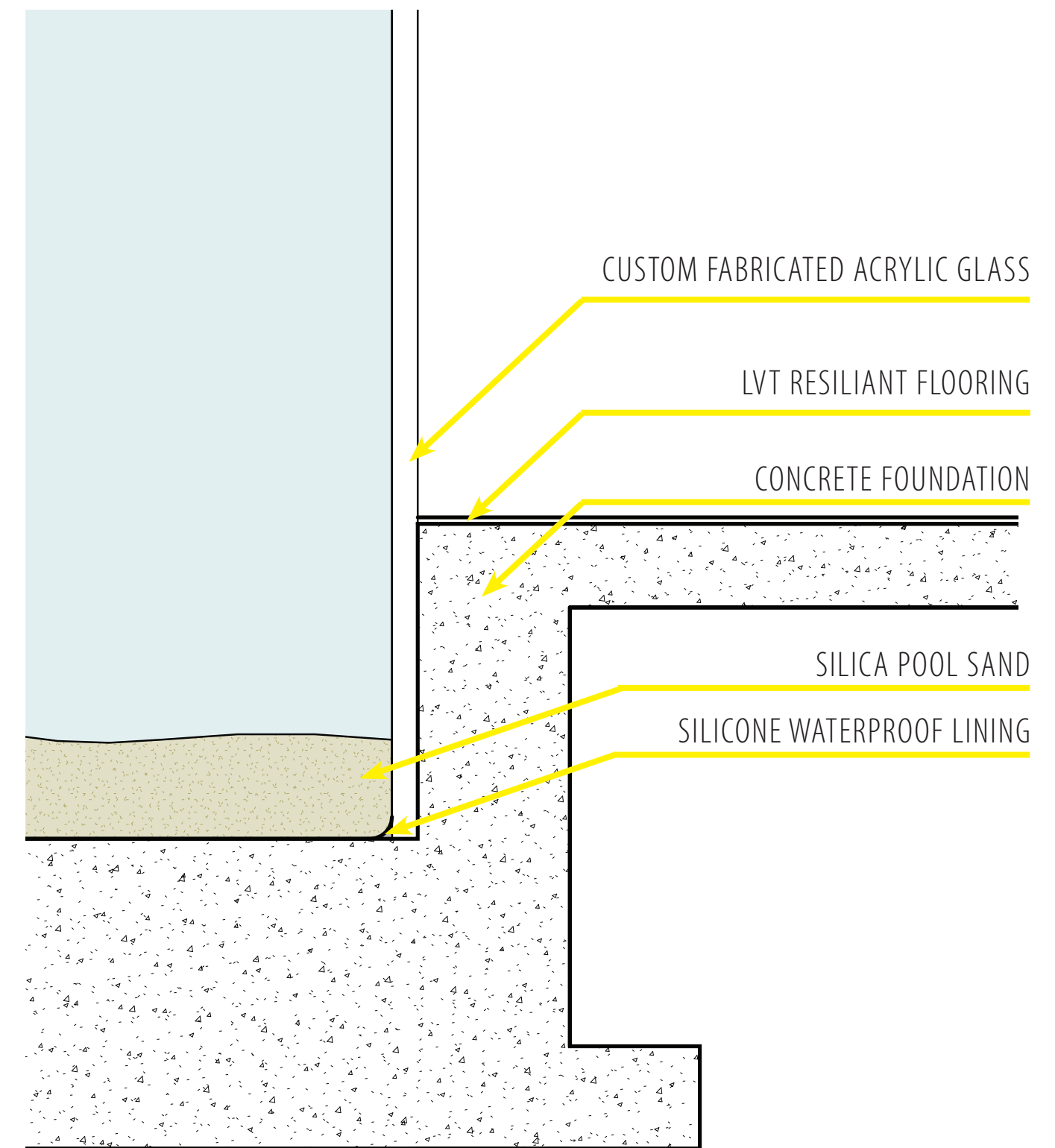


# AQUARIUM SECTION

The tank is suppressed and also extends higher than the gypsum furdowns on either side, giving visitors a floor to ceiling look and feel. The plumbing system is positioned underneath, and connects to a system of pipes under the slab that support the aquariums in the remainder of the project. There is also a required tank drainage system that leads out and away from the building.



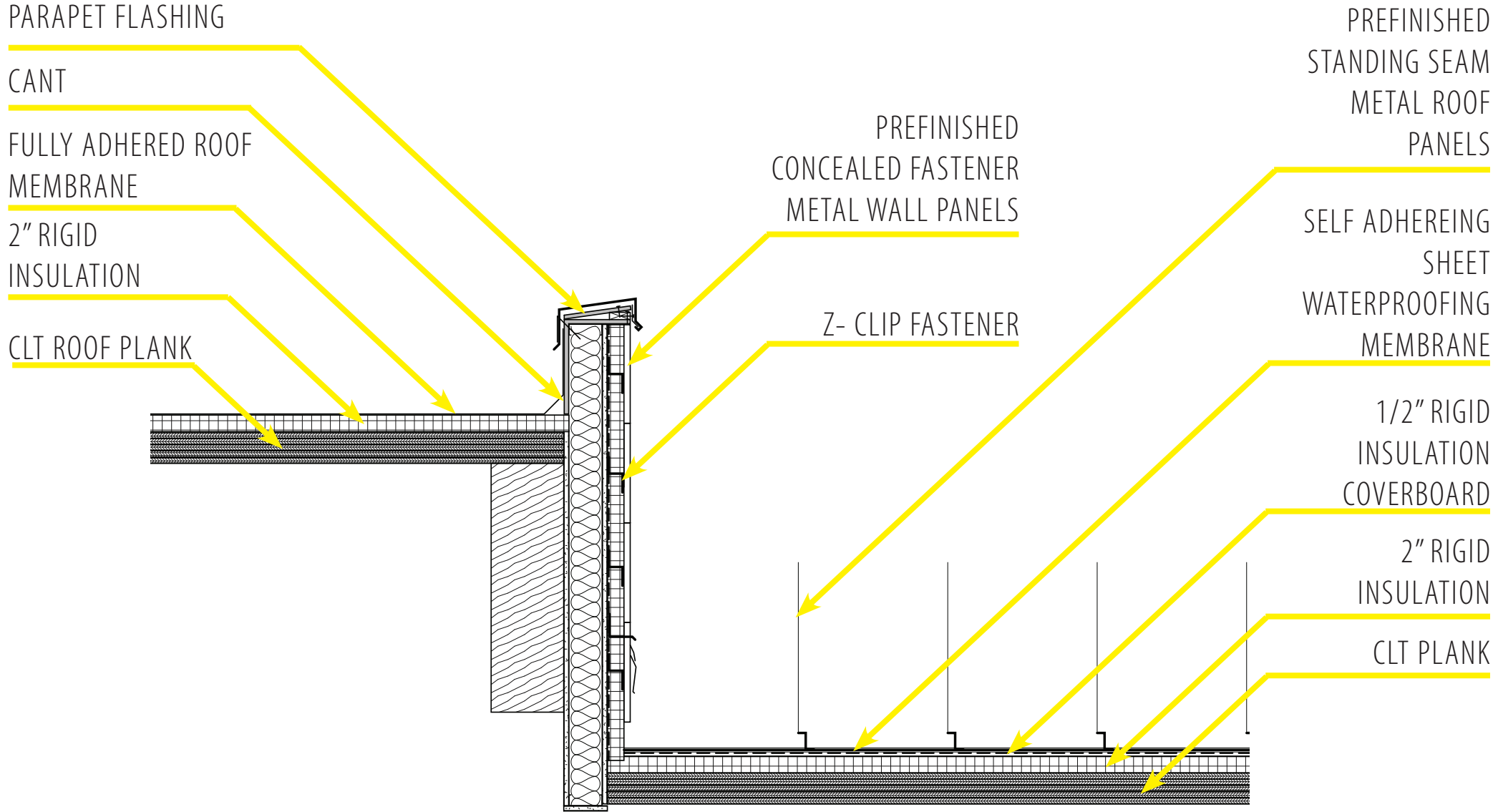
# AQUARIUM DETAIL

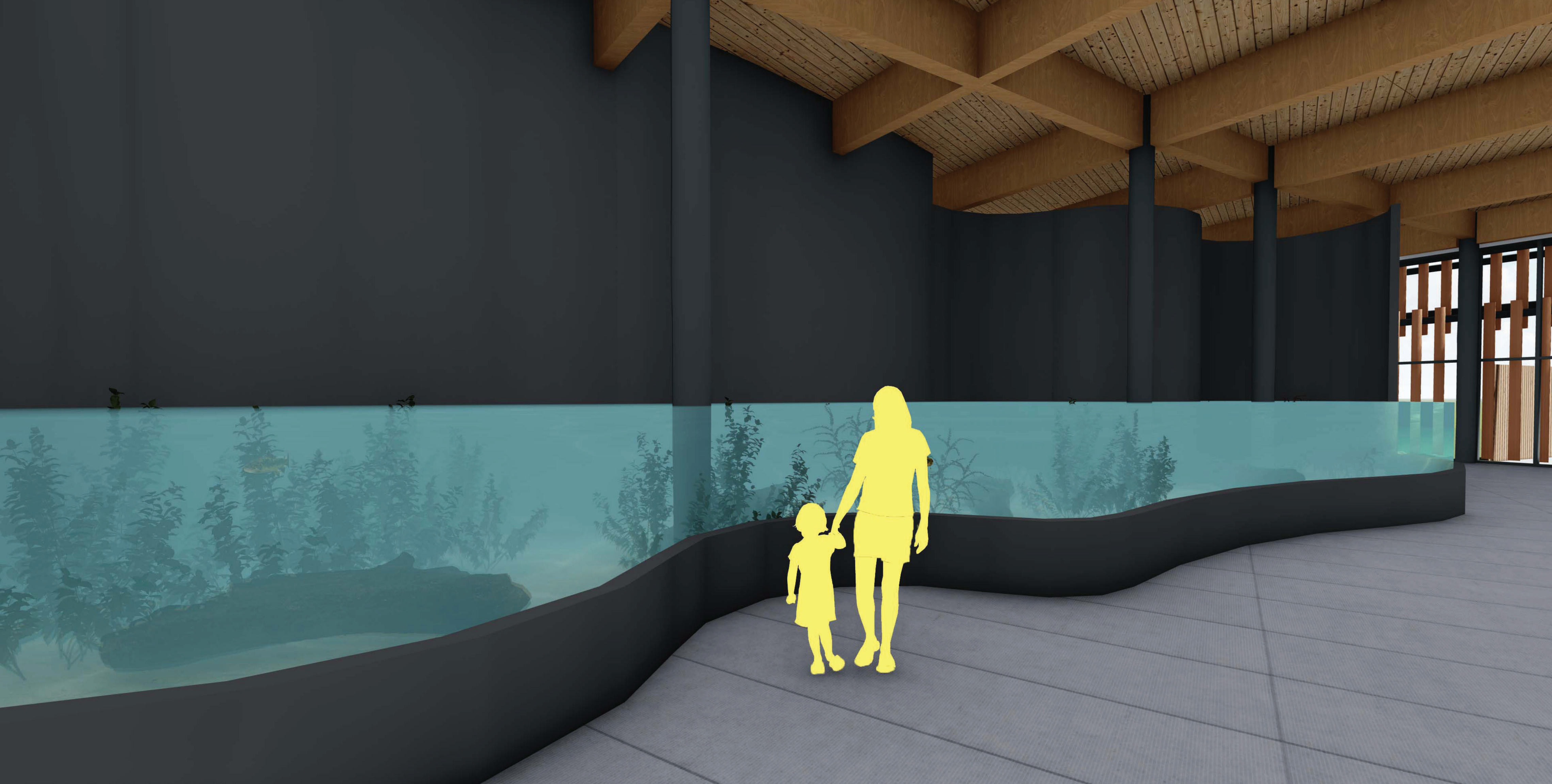






# ROOF DETAIL





# BUILDING SECTION



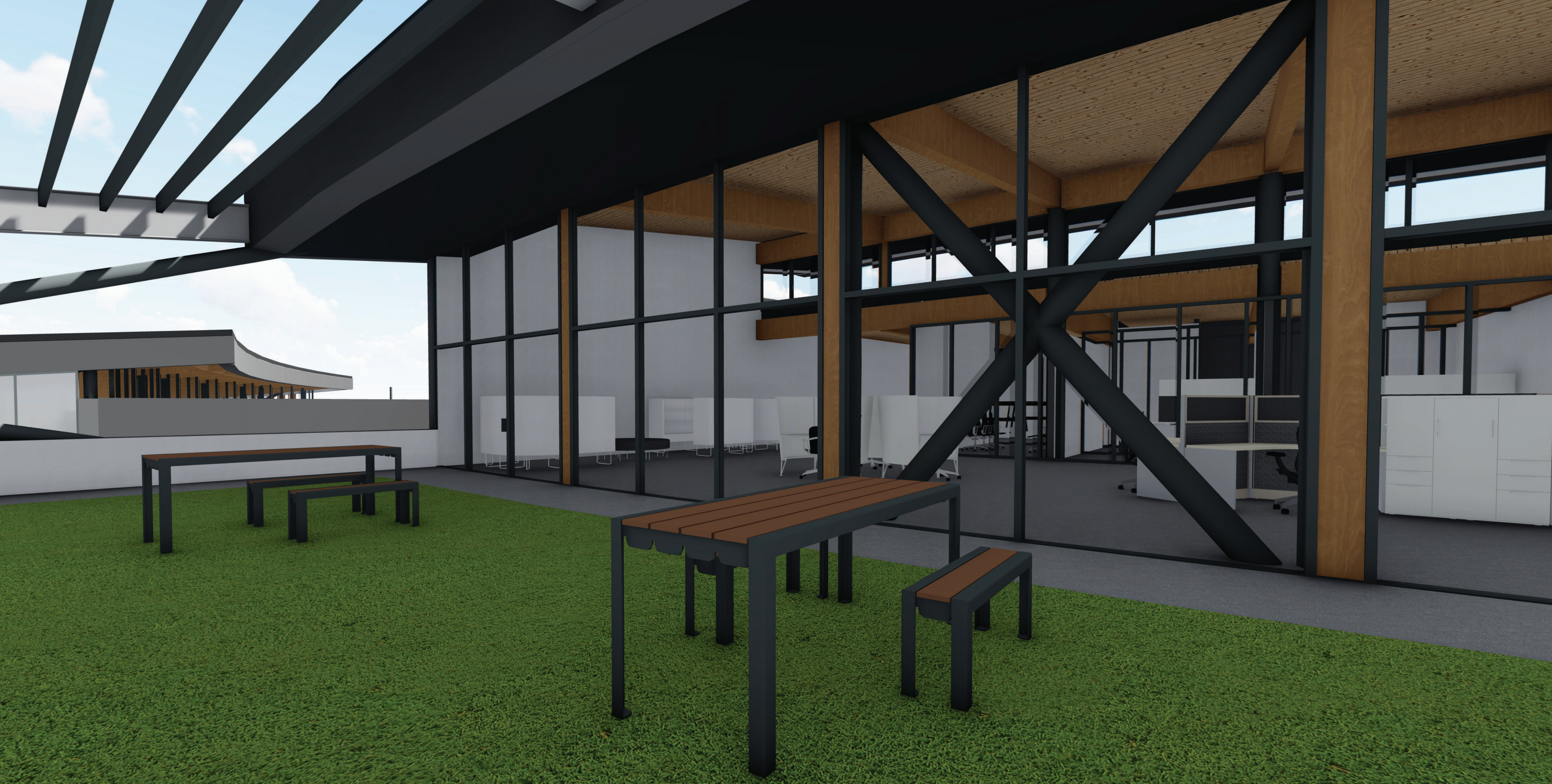
# SECOND FLOOR PLAN



## PLAN LEGEND

- 1 LOBBY
- 2 MULTIPURPOSE ROOM
- 3 RESTROOM
- 4 AQUARIUM LIFE SUPPORT SYSTEMS
- 5 AQUATIC EXHIBIT
- 6 FISH OBSERVATION TANK
- 7 CHILDREN'S PLAY AREA
- 8 TANK ACCESS ROOM
- 9 LABRATORY
- 10 CLASSROOM
- 11 STORAGE
- 12 STAIRS
- 13 WORKSTATIONS & COLLABORATION
- 14 MEETING SPACE
- 15 CONFERENCE ROOM
- 16 PRIVATE OFFICE
- 17 BREAK ROOM
- 18 COPY/SUPPLY
- 19 OUTDOOR PATIO
- 20 MECHANICAL YARD
- 21 MECHANICAL ROOM
- 22 ELECTRICAL ROOM









# SOURCES

All images produced by Lauren Morris excluding the following.

pages 8-9  
| Center for Aquatic and Invasive Plants | University of Florida, IFAS. (n.d.). Plants.ifas.ufl.edu. <https://plants.ifas.ufl.edu/plant-directory/hydrilla-verticillata/>  
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SJRA. (2014, December 28). History of Lake Conroe - San Jacinto River Authority. <https://www.sjra.net/lakeconroe/history/>  
page 13  
| Center for Aquatic and Invasive Plants | University of Florida, IFAS. (n.d.). Plants.ifas.ufl.edu. <https://plants.ifas.ufl.edu/plant-directory/hydrilla-verticillata/>  
Grass carp eggs discovered in Lake Erie tributary. (2017, September 12). WOSU News. <https://news.wosu.org/great-lakes-today/2017-09-12/grass-carp-eggs-discovered-in-lake-erie-tributary>  
page 15  
SJRA. (2015, January 3). Lake Conroe Division - San Jacinto River Authority. <https://www.sjra.net/lakeconroe/>  
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Metcalfe, A. N., Kennedy, T. A., Mendez, G. A., & Muehlbauer, J. D. (2022). Applied citizen science in freshwater research. *WIREs Water*, 9(2). <https://doi.org/10.1002/wat2.1578>  
pages 20-21  
Phil's 1stPix. (2010, September 24). Grass Carp: Gainer Springs. Flickr. <https://www.flickr.com/photos/1stpix/diacast/dioramas/5045375611>  
pages 24-25  
Drone image of site by Koichiri Aitani  
page 29  
Drone images of site context by Koichiri Aitani  
pages 32-33  
Background with air bubbles in the sea. (n.d.). IStock. Retrieved April 21, 2023, from <https://www.istockphoto.com/photo/underwater-bubbles-gm518174538-89867875>  
pages 42-43  
Empty%20Fish%20Tank Images - Browse 4,960 Stock Photos, Vectors, and Video. (n.d.). Adobe Stock. Retrieved April 21, 2023, from <https://stock.adobe.com/bexen/search?k=empty%20fish%20tank>

## Text Sources

(SJRA, 2014): SJRA. (2014, December 28). History of Lake Conroe - San Jacinto River Authority. <https://www.sjra.net/lakeconroe/history/>  
(Chilton, II et al., 2008): Chilton, II, E., Webb, M., & Ott, Jr., R. (2008). Hydrilla Management in Lake Conroe, Texas: A Case History [Review of Hydrilla Management in Lake Conroe, Texas: A Case History]. 247-257.  
(Simpson, 2021): Simpson, M. (2021, September 8). SJRA Fighting Invasive Plants on Lake Conroe - San Jacinto River Authority. <https://www.sjra.net/2021/09/sjra-fighting-invasive-plants-on-lake-conroe/>  
(NEVZATIF et al., 2021): NEVZATIF, DEMIRBASÖ, O., & HASIRCI, D. (2021). BIOPHILIC INTERIOR DESIGN: A CASE STUDY ON THE RELATION BETWEEN WATER ELEMENTS AND WELL-BEING OF THE USERS IN AN EDUCATIONAL BUILDING. *Anadolu Üniversitesi Sanat & Tasarım Dergisi*, 450-467. <https://doi.org/10.20488/sanattasarim.1049023>  
(Metcalfe et al., 2022): Metcalfe, A. N., Kennedy, T. A., Mendez, G. A., & Muehlbauer, J. D. (2022). Applied citizen science in freshwater research. *WIREs Water*, 9(2). <https://doi.org/10.1002/wat2.1578>  
(Gruber, 2011): Gruber, P. (). *Biomimetics in architecture : architecture of life and buildings*. Springer.