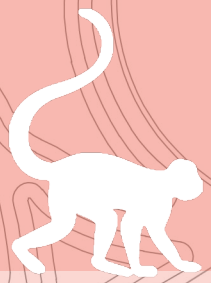
A Zoo for San Jose

CAMILLE GREMILLION
SENIOR CAPSTONE PROJECT 2018



Senior Capstone Project, 2018
A Zoo for San Jose
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Submitted in partial satisfaction of the requirements for the degree of BACHELOR OF SCIENCE IN LANDSCAPE ARCHITECTURE in the department of Human Ecology

University of California, Davis

Approved: _____
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Abstract

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Over the past decade, the image of zoos has been continuously evolving, slowly replacing recreational purposes with conservation practices. Fortunately, many are aware of the severe impacts of climate change and exploitation of natural habitat on endangered species, and are using these zoos, or more appropriately named, conservation centers, to study and to educate the public on how to help these endangered species. The following essay summarized the analysis, process and research steps taken in order to better understand and implement a zoo design which educates the public while reversing the observation roles of humans and animals.

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To Elizabeth Boults, who provided me with invaluable resources and for guiding me throughout the entire project.

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To Chloe Myaskovsky, who saved my shoe after I nearly lost it in the marshland of my site.

INTRODUCTION

The topic of my senior project involves taking a different approach to zoo design, particularly in dense urban areas, which focuses on an "animal first, people second" aspect. This idea comes from the evolving image of zoos around the turn of the century to the present, turning away from outdated zoo design processes which focus on recreational aspects rather than conservational. Ideally, a zoo meeting expectation for my project would consist of changing the roles of humans and animals; creating a confined observation area where visitors can look out to large, open and spacious areas designed to mimic the natural habitat of the housed animal.

CASE STUDIES

San Francisco Zoo

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San Diego Zoo

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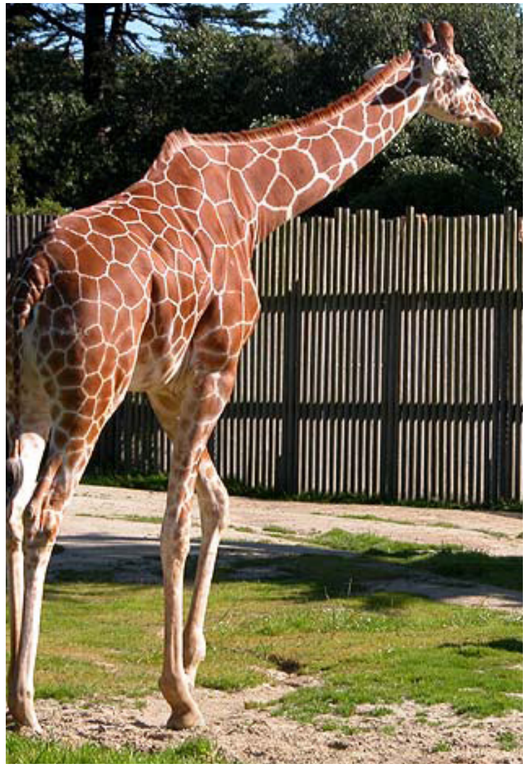
London Wetland Centre

SAN FRANCISCO ZOO

San Francisco Zoo, located west of San Francisco and adjacent to the shore, resides at approximately 100 acres in coverage. The zoo is famous for being one of the country's first to provide spacious, bar-less exhibits, and used moats as a means of exhibit division. Upon my visit I have noticed that in certain exhibits, such as the giraffe's, blend well with the surrounding environment with the use of rocks, and vegetation. Much of the vegetation included in the exhibit was composed of water tolerant plants, such as *Aloe arborescens, Kniphofia x 'Christmas Cheer,' Aloe saponaria, Protea eximia, and Leucospermum cordifolium 'Veldt Fire.'* This plant palette is not only successful in terms of drought tolerance, but also produces a blooming plant palette for all seasons throughout the year.
As for the barrier between visitors and animals, I found design of the giraffe exhibit in particular to be successful due to the layout of the space. In order to enter the exhibit, the visitor must find their way through a short tunnel of rocks underneath the exhibit, and eventually will be lead to a small viewing node protruding in one area. This is an effective method in avoiding intrusion of the visitor path into the animal's space, and in turn places the visitors in a more confined space rather than the giraffes.



SAN DIEGO ZOO

San Diego Zoo, regarded as one of the world's best and most progressive zoos, offers a diverse arrangement of animal exhibits and activities to help engage the public with understanding the importance of habitat conservation. Upon my visit, I personally feel that San Diego Zoo succeeds in some of these areas, but also lacks in certain aspects. One example of what I found to be successful is the aviary: A very large bird cage where one can enter and become immersed in the world of the birds. Using this method of design, visitors are in the "confined" space along with the birds, completely ridding the need of a barrier between people and animals. Bird's nests are located a safe distance from the visitor's path, and since birds can quickly evade any sort of attempt of human contact, their safety is not compromised. Bird feeders are also present just out of reach of visitors, allowing visitors to closely observe the feeding action. Barriers within the aviary are also disguised with vegetation and waterfalls, further adding to the immersive atmosphere.

Another design element San Diego Zoo uses which is particularly successful in hiding barriers is the use of ha-ha's; the depressions which separate the exhibit and visitor's space is lush with vegetation and waterfalls, transforming it into part of the space rather than a divider. One area which stood out to me as rather unsuccessful was the design of the North Sulawesi Babirusa exhibit, which was built below the visitor's line of sight. Designing an exhibit to be at the eye level or above establishes a secure feeling for the animals while also providing them a sense of privacy. Also, the portion of the zoo which houses reptiles does so in a taxonomic fashion, keeping them in a building called "The Reptile House," which displays a series of small enclosures containing the reptiles. This takes away from the overall experience and remains feeling stagnant in traditional means of display

LONDON WETLAND CENTRE

The London Wetland Centre was implemented by the Wildfowl and Wetlands Trust (WWT) in order to create a refuge for wetland species with several observable decks located a safe distance from the site. For educational and conservation purposes, a section of the zoo was cut off from the public completely. One of the significant design guidelines the authors mention is designing based on what is called "behavioral architecture." This method of architecture takes into consideration the psychological and behavioral well-being of the zoo animals, focusing on creating an atmosphere similar to the animals' natural habitat, and creating an environment which not only appeals to their needs, but challenges them. In order for the animal to have the best and most beneficial experience, "the enclosure should present its animal occupants with as complex and challenging an environment as possible requiring them to make decisions, rather than a predictable routine which produces stereotyped behavior" (Plowman, Stevens, 71). This design method will not only stimulate more active behavior among the animals, but also provide a more exciting experience for the zoo's visitors. In general, it is difficult to study or predict a captive animals behavior, since the behavior of captive animals varies far differently than from those in the wild considering the environmental circumstances. To create an enriched, dynamic environment for the animals, one must consider implementing new climates, new feeding techniques, and various other evolving methods in the exhibit rather than just focusing on creating an illusion of the exhibit being in the wild.

SAN JOSE, CALIFORNIA

San Jose, located in the south of the Bay Area, is widely kknown for being located around major tech companies, and is home to a variety of museums, airports, and schools of different age groups. The presence of multiple schools and universities provides an opportunity to bring students to the proposed conservation center if they would like to observe and be educated on particular animal species. Being a densely populated area with an international airport, this location would be a convenient destination for zoo enthusiasts, students, researchers or anyone looking for a wild experience in the Bay Area. The two museums are popular locatioins for school trips (growing up in the Bay Area, I have been on quite a few myself), and adding a zoo experience would greatly benefit the relationship between humans and animals, bringing us closer to learning and understanding the proper methods of conservation.

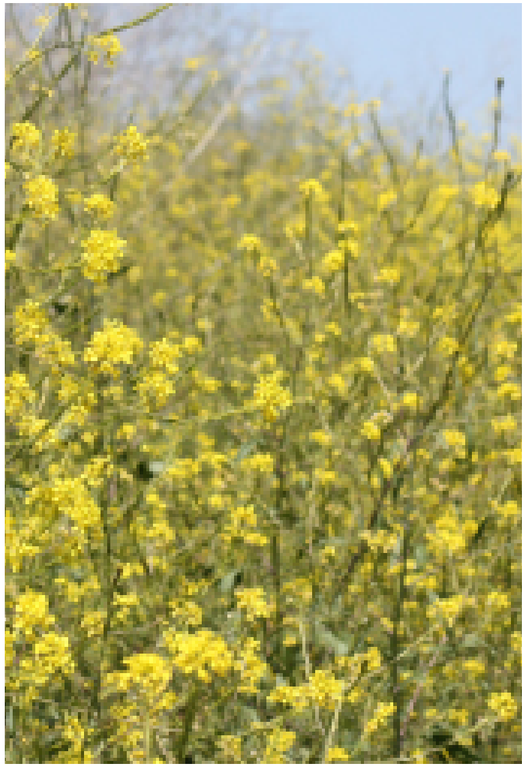
CHOOSING A SITE

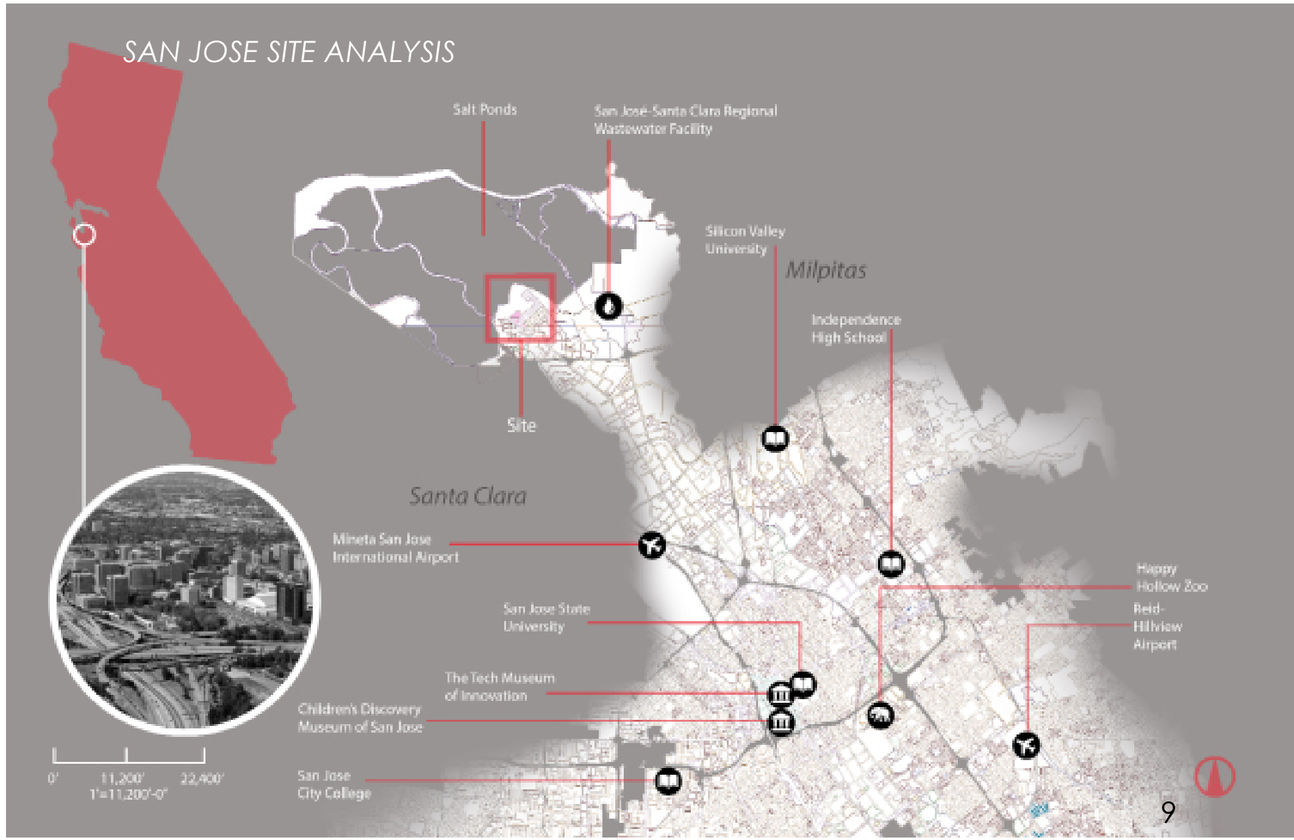
Looking into potential sites for designing a zoo, several factors were taken into consideration: Does this area contain the necessary habitats for the animals this zoo will house? Is this area susceptible to flooding, and if so, what precautions could be taken to reduce flooding hazards? Does this area present educational opportunities for animal and plant research? Does this area already contain zoos or conservational centers? After looking over these questions in detail, one area in particular seemed to be fit, although did present a few challenges: A site north of downtown San Jose, nestled on the southern edge of the bay. Above this area resides several salt ponds, currently undergoing development by sediment teams and scientists to help recover marshland habitat while designing for flood protection. After doing extensive research, the only zoo located in San Jose is a small children's zoo called Happy Hollow, mainly designated for recreational activities. Looking into sources of GIS, much data was acquired in order to locate nearby water treatment plants, schools, and the connection of sewer lines while also indicating zoning information. From this information, it was shown that this area contains a mixture of different types of land use: Heavy industrial (wastewater treatment plant), residential (a small section of mobile homes), and other types. This area also happens to have the most highly concentrated amount of wastewater lines, providing many connections to water around the site. Right at the edge of the salt ponds, an approximately 200 acre site categorized as "open space," surrounded by chunks of "planned development." What these areas are being planned to be developed for are unknown, and further information could not be acquired.

Another great opportunity this area held for designing a zoo was the presence of San Jose State University, residing south of the site. Currently, marshland habitat is considered one of the most endangered habitats in the world; therefore, a portion of the zoo will be off limits to researchers and students to study animal and plant conservation, particularly marshland habitat. In addition, students at the university will have a marshland research center in a convenient location, and

will be able to study the habitat while examining the effects of sea level rise on the plants and animals in the area. Since this area in particular is also susceptible to flooding, this also provides an opportunity for landscape architects and sustainable environmental designers to design and reshape landscapes for flood control. One example of this that has already been implemented and proven to be successful is the Wetland Centre in London mentioned previously in the essay. In further detail, the Wildfowl Trust in charge of organizing the zoo created a design so that "each exhibit would have a clear wetland conservation focus, ealing with particular environmental messages within as a 'near-to-real' habitat context as possible" (Plowman, Stevens, 16). This zoo also achieved an equitable balance between indoor and outdoor experiences, and expanded the variability of wetland species in order to encompass other wetland wildlife. Methods used to gather information which will influence the design of the zoo include indirect observation in order to observe people's responses to animals at existing zoos. The biggest challenge having to face in this project's site analysis is finding a large enough space to hold a zoo with multiple exhibits, multiple habitats and different ecosystems. Being located in a denser, urban location, there are not many options for acquiring the desired amount of space, so one solution became apparent: build upwards. The idea of the general zoo layout is to create different levels of ecosystems; working from underground to the top. The first step would be to work outside and slowly develop inwards, so the ponds north of the site which were originally salt ponds harvested for industrial uses will be converted to marshland habitat, and in addition the habitat would also be designed at a particular slope to combat potential flooding issues sparked from climate change.

A large portion would be off limits to visitors and designated for research and conservation. The next step would to use the adjacent land mass declared as "open space" to begin building the "zoo tower." The idea is to begin underground; to create a cavern system for reptilian and amphibian creatures; traditionally these types of species are imported into zoos first, being far easier and less expensive to handle. The next level would be designated for aquatic species; the layout of circulation for this exhibit would be to design a series of pathways and nodes for visitors, maximizing exhibit space for the animals. Hallways and nodes will be composed of durable see-through material, allowing visitors to have a nearly 360 ocean experience, completely immersed in the world of the sea. Finally, the top level will be designated for mammals. Stairs and elevators will lead from the aquatic level to the mammal level, leading the visitors to several smaller "nodes" which extrude from the ground, again maximizing the area for mammal species. Ideally, all species housed in this portion of the zoo will be under the endangered or threatened status, making the zoo more of a conservation center, and giving the animals significantly more freedom in the facility. The adjacent water treatment plant provides a great opportunity for a water source for plant nourishment, and plants displayed in the zoo can act as thickets for further water filtration from the water treatment plant.





SAN JOSE SITE ANALYSIS

Don Edwards San Francisco Bay National Wildlife Refuge

SITE

- Sanitary Network Structure
- Sanitary Pressurized Main
- Sanitary Pump Station
- Planned Development
- Agriculture
- Heavy Industrial
- Industrial Park
- Open Space
- Residential
- Light Industrial

0' 2,000' 4,000'
1"=2,000'-0"

SAN JOSE SITE ANALY

The proposed site, about 200 acres, is nestled by the south edge of the bay. The zoo would ideally house 4 types of habitat: (1) Marshland, (2) Troglobite, (3) Aquatic, and (4) Grasslands. Marshland would be the first habitat to be implemented for a few reasons: Development by sediment teams is already progressing in order to restore marshland habitat in this area, and the surrounding water sources provide ample opportunity for sediment accumulation , which will further create a more habitable environmentfor marshland species. Placing the zoo in this location presents some constraints, however, because this area is susceptible to flooding as sea level rises. Moving inwards towards the center of the plot will be the other three habitats, built vertically on top of each other. Northeast of this site is the Don Edwards San Francisco Bay National Wildlife Refuge which presents an opportunity for reserachers and scientists to collaborate with the zoo's conservation efforts.

Sanitary Pump Station:
This pump station, connected to several scattered throughout the area, presents an opportunity to be a water source for the proposed zoo. However, the industrialized area may be a constraint aesthetically, being a prominent man made structure distracting from the wildlife aesthetic.

Residential:
Residential space provides an opport
to attract more local visitors, but can
issue due to some may not wanting
their property.

SITE

Parking:
This plot of land, currently designated for planned development, would be an ideal location for parking, since it is located between two medium traffic flow areas coming from the highway. This may be a problem for adjacent neighborhoods, and may cause congestion for residents of the area.

Light Traffic Flow
The streets in this area are located in a planned development area, and are going to be removed for open space, which will add space for the zoo.

Mobile Home Park:
Mobile homes are usually located in places considered "destinations" for traveling families. Placing a zoo here would further influence the location as a destination space. The constraints this area would include traffic congestion, making it difficult for visitors to drive their mobile homes into the location.

Medium Traffic Flow

Heavy Traffic Flow

237

0' 1,006' 2012'
1"=1,006'-0"

THE HISTORY OF ALVISO, SAN JOSE

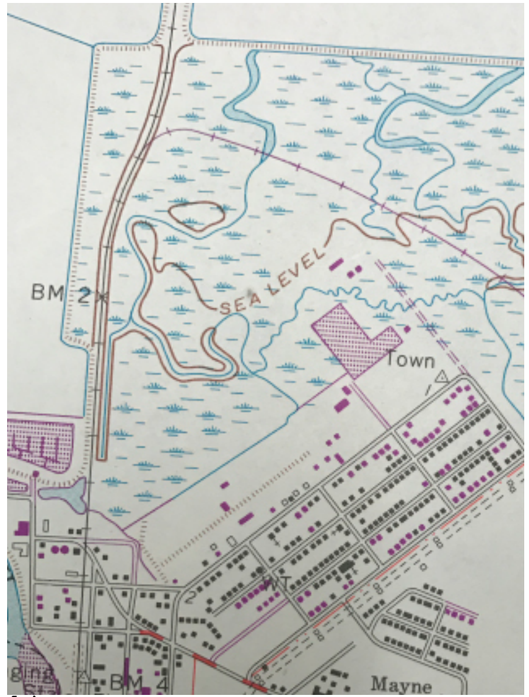
The port and town of Alviso, San Jose, was once home to the Ohlone Indians. In the year 1813, Ygnacio Alviso was granted the land by the Rancho Rincon de los Esteros under Mexican rule. Alviso opened the docks and dedicated their purpose for trade of various items such as grain, produce, lumber and hides. Later in the year 1849 the port was opened for travelers who were visiting San Francisco and San Jose. With the opening of the railroad surrounding the area in 1864, the productivity of the port trading system declined due to hydraulic mining in the Sierra foothills, which in turn had silted the lower San Francisco Bay. Flooding in 1890 significantly damaged the town and decreased the amount of potential residential space. As time progressed, the identity of Alviso has shifted from a major trade hub to protected wetlands, and is home to a variety of shore birds and waterfowl. This presents an opportunity to bring the public up close in order to learn more about the benefits of wetlands on the environment while also educating them about the animals that live there.

SITE VISIT

When visiting the site, I noticed a few elements which immediately stood out. Looking upon the railroad, the water in the proposed site was a light pink hue, indicating the presence of salt-loving bacteria (the area was originally mined for salt). This could possibly contribute to processes such as eutrophication (starving the water of oxygen). Providing a marshland zoo would filter out the excess nutrients from various sources such as runoff from adjacent light industrial areas. In addition, while crossing from levee to levee I was faced with a few obstacles; the ground seemed dry but once I stepped foot onto the "dry" dirt surface, my

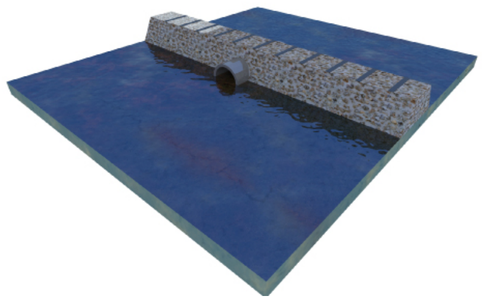
foot sank right through the ground and I nearly lost my shoe (thankfully my classmate Chloe was able to pull it back out). It was troubling to find that directly beneath the dry surface was a thick layer of tar-like clay, which was nearly impossible to remove from my hand and permenantly stained by shoe black.
The adjacent ponds seemed to recieve little tidal action, but the water in the site itself remained still. Since the area is susceptible to flooding, water control structures will have to be installed to control the inlet and outlet of water, especially with the influence of sea level rise. Alviso in particular has suffered a history of negative effects from regional development, such as hard paving which prevented water absorption into the ground. This, in turn, led to the eventual sinking of Alviso, making it more vulnerable to flooding. Along the levee, which was also considered part of the Bay Trail, resided a water level measuring device that read to be at approximately half a foot in elevation.

GRADING AND WATER CONTROL (EXISTING)

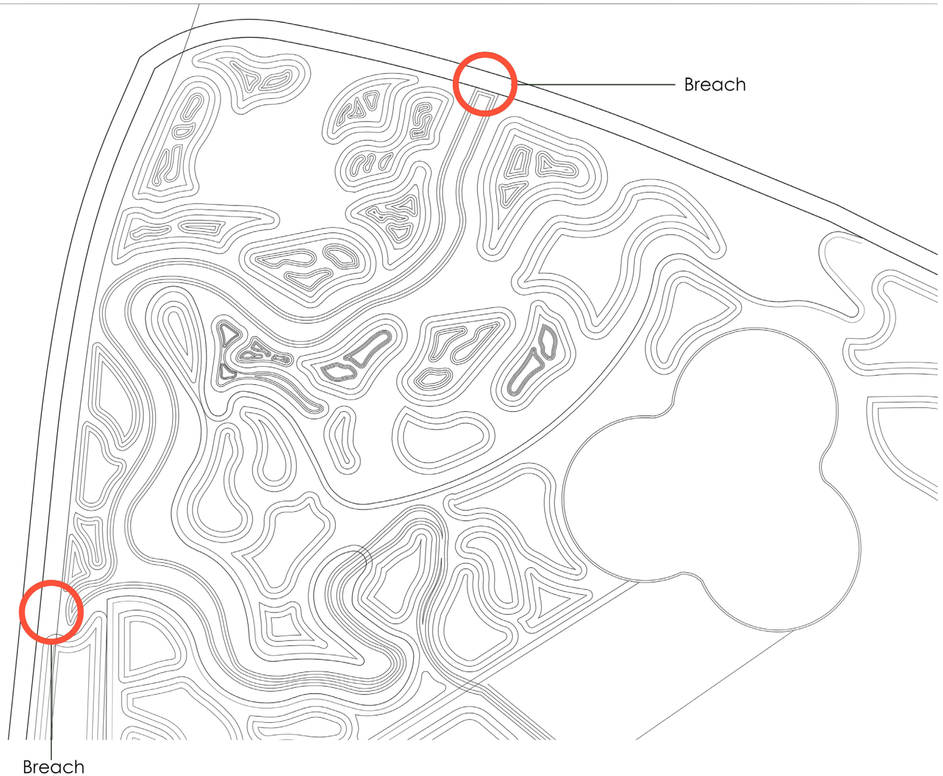


WATER CONTROL CULVERT DESIGN

To regulate the water level within the zoo taking into consideration the effects of sea level rise, two small breaches will be made underneath the levee and railroad, with a concrete water culvert installed. This should allow water to pass through without damaging the railroad and will be designed to filter out harmful products in the water. Since the adjacent salt marshes have a higher water level than that of the zoo, the culvert will operate under outlet control. (Water flows into the culvert faster than it flows through and out



PROPOSED GRADING PLAN



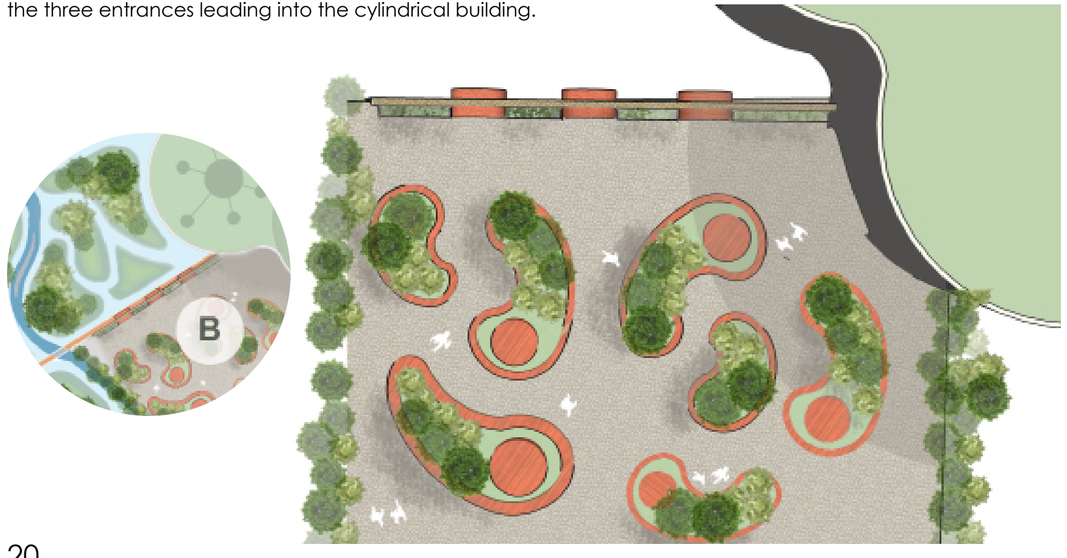
INTRODUCTION

The primary research question I have considered looking into the process of zoo design is "How can we create a zoo which achieves a more equitable, democratic balance between the space of animals and humans?" This question proposes a number of considerable thoughts: Due to the recognition of zoos needing to shift towards conservation rather than recreation, we must focus on putting animals first by creating a greater space for them, forming a more realistic, dynamic environment for them, and studying them to help preserve their species. However, one subquestion stems from this main question: About how much of the needs of the visitor should we satisfy? The needs of the visitors must also be considered, because in order for us to better help conserve endangered animals, we must establish a strong connection between the visitors and the animals. Without making the exhibit interesting to visitors, we cannot gain much help from the public, nor will the public understand the negative impacts of events such as climate change and habitat exploitation on the environment. Therefore, the needs of the visitors must also be considered, however the ratio of space should shift more towards animals. To appeal to visitors, however, "means that we must not only provide interesting signage and interpretives, but we have the daunting task of ensuring that every aspect of the exhibit follows the educational message we are intending to send" (Ludlum, 10). Another sub question which was brought to my attention was how would the exhibits in the zoo be organized? Historically, zoos have arranged their animals in a non-cohesive, housing system, such as the "reptile house," or the "monkey house." These outdated zoo practices would include small exhibits with bars, taking into little consideration the needs of the animal. One thing to think about in arrangement of zoo animals is deriving a theme, and create a continuous gradient of one exhibit into another, creating an illusion of one large ecosystem. This theme, through vegetation and natural decoration, should be continued into visitor areas, hiding any barriers or separations. The third sub question that surfaces is "How can we display animals without making them seem inferior to observing visitors?" Even though bars are slowly being replaced by clear barriers, seeing animals in confined spaces rarely facilitates respect for the animals.

The following chapter walks through each section of the zoo, beginning with the entrance plaza, and ending with the vertical zoo. Design concepts depicted throughout the following exhibits attempt to address these research questions, and will hopefully bring light to how we can truly prioritize the needs of the zoo's animals.

ENTRANCE PLAZA

Once the visitors find parking, they will make their way into the entrance plaza. This is the transitional stage from the human to the animal world, and marks the beginning of the journey. The plaza contains a series of planters which are designed to mimic the organic shapes of the islands scattered throughout the zoo. Here, they are smaller and more identifiable, giving visitors an idea of the islands' raw form. The planters all have seating benches, composed of redwood, and display a small sample of the vegetation that will be found within the site. The organic forms of the planter curve and bend into a dendritic form, creating multiple capillaries of pathways which lead to the main entrances (this mimics the similar dendritic form of tree branches, or streams). From this plaza, the visitor can either choose to enter the zoo into the beaver and otter habitat, or into one of the three entrances leading into the cylindrical building.



ENTRANCE PLAZA PERSPECTIVE

RIPARIAN HABITAT

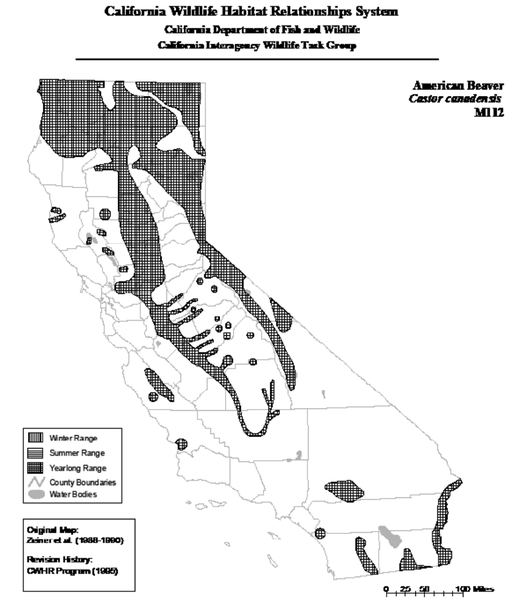
The South-east corner of the zoo will be designed into a riparian habitat, or in other words, the transitional zone between land and a river or stream. Here, there is ample opportunity for a diverse selection of wildlife to thrive. Riparian zones serve several important roles in the ecosystem, such as a natural filter preventing over sedimentation into the river and adjacent bodies of water. This will be a significant addition to the zoo, as it was once primarily used for salt farming. Salt loving bacteria can be detrimental to aquatic life, so additional filtration will be beneficial to water quality, and in turn, better for the furry hosts of the zoo. In addition to sediment filtration, the dense canopy inhabiting the riparian zone will also serve as a food source for the American Beaver, and will provide them with ample wood for lodge and dam building. The dense canopy will also serve as a natural sound barrier between the zoo and the Caltrain tracks, as well as the adjacent residential neighborhood.

Beavers are nature's engineers, and are known as a focal species within the animal network. They semi-aquatic rodents, and have long, sharp incisors which cut through trees and other plants. Many other species rely on the beavers' actions, such as dam building. This provides a means for which the other animals can have easier access to the river in order to catch fish. A beaver's home is comprised of twigs, branches and other tree materials. Partially submerged underwater, beaver homes can only be accessed via underwater to better avoid predators, and the inner portion is elevated above water which provides a place for mothers to give birth. There is a small opening in the top of the lodge which allows air to flow through. Beavers like to eat alders, willows and birches, which they often store in a food pile if food becomes scarce.

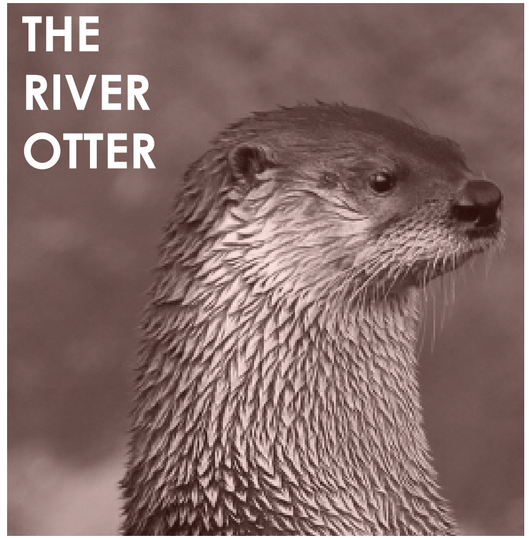
The American beaver feeds in "valley foothill hardwood, montane hardwood-conifer, mixed conifer, red fir, Douglas-fir, montane chaparral, annual and perennial grasslands, and wet meadow" (Grinnell et al. 1937, Tappe 1942, Hall 1960, Jenkins and Busher 1979). A beaver colony of a smaller size typically lives in a home range of about 36 acres. The American beaver enjoys eating aquatic vegetation, lilies, and cattails; the exhibit along the south west stream will provide plenty of this vegetation, as there will also be a mix of conifers, willow, and aspen. The abundance of trees will provide the beaver with wood for the winter, and at an area of approximately 43 acres, the exhibit is large enough to accommodate the spatial requirements of beaver housing which is up to 650 ft from any

body of water (CWHR, 1990). In addition, the American beavers held in the zoo will be provided other external sources of wood in order to preserve the trees within the exhibit.

Located in muddy banks, a beaver lodge is typically 6 feet high and 40 feet wide. This is where the American beaver gives birth, and is highly protected by predators with all entrances being underwater. Since they require moderately deep rivers to feed and find cover, the location of the exhibit adjacent to the stream is ideal for the American beavers to thrive. The human path running through the exhibit is surrounded by tall grasses and cattails in order to hide the legs of visitors, which in turn will prevent frightening off any animals. The visitor path, designed to follow the natural contours of the existing site, has limited access to the beavers' habitat to provide privacy and establish a feeling of safety for them. Rather than branching off of the path directly into their habitat, the exhibit is designed with a series of disguised tunnels which branch off, leading to various nodes disguised as beaver dams. These fake beaver dams are only accessible to visitors, and will allow them to observe the American beavers without directly intruding.



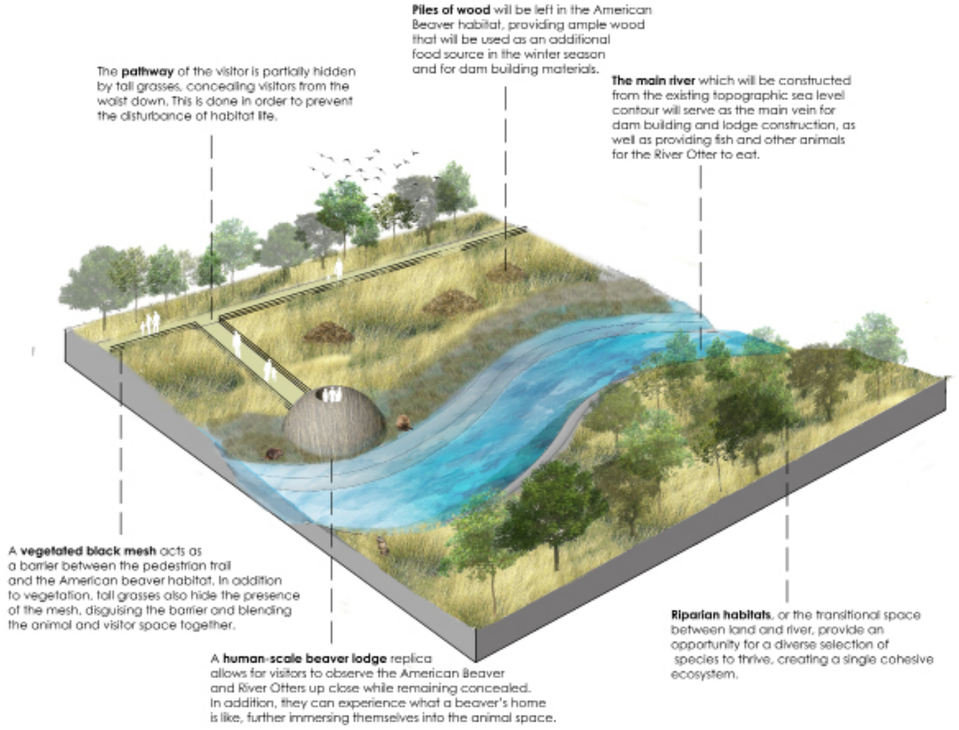
Source: CWHR (1995)



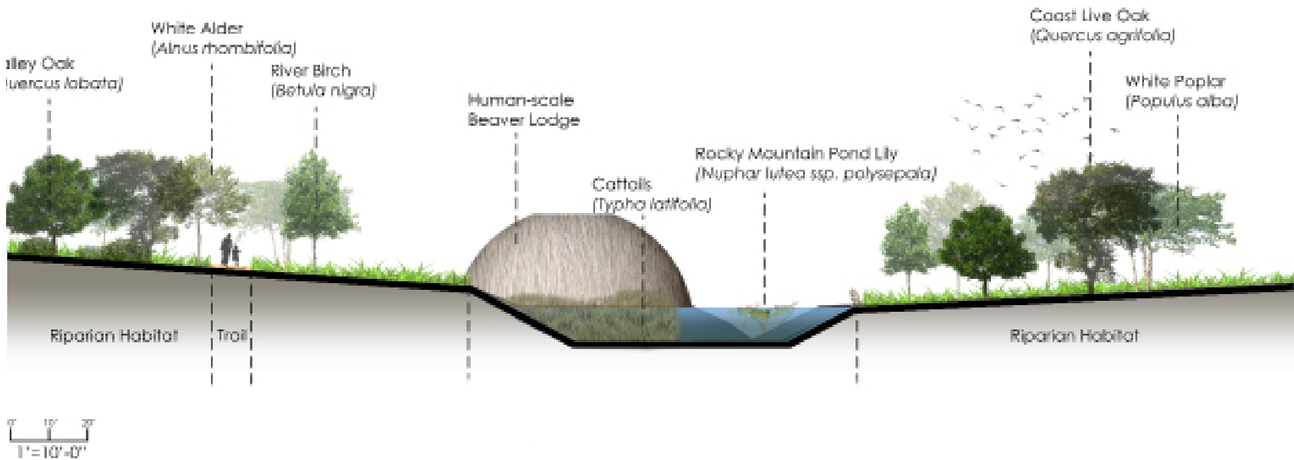
The number of river otters has greatly reduced under habitat exploitation and trapping for fur, but have started to slowly increase due to awareness and protection laws. Providing a space for them along with their dietary, reproductive and living necessities, the river otter exhibit will educate visitors how they survive, behave and thrive. The presence of tall wetland plants and thickets will provide plenty of cover for the otters, as well as hollow logs, stumps, snags, and burrows. At about 25 acres, the exhibit will feature areas of dense thicket as well as open spaces for people to observe from a distance (with legs concealed by tall grasses). The diet of the river otter consists of amphibians, mollusks, fish, and other aquatic vertebrates. They will obtain these food sources by foraging on land or digging through the bottom of watercourses. They typically nest within half a mile from any water source. To prevent visitors invading the exhibit, a moat barrier derived from the main water channel running through the park will be implemented which will rise about 2.5 feet above sea level. In addition, wire mesh concealed by hanging vegetation will also be used.

River otters tend to make their home in any habitat which provides plenty of coverage, has a good source of water and ample supply of food. Incredible playful creatures, they are often seen playing games with each other, and are more active during the night hours. River otters are typically active all year round. They have a lifespan of up to 21 years in captivity, but can survive up to 25 years. They are generally not known to be territorial animals, and are intelligent and social. In terms of home and cover, otters usually do not build their own home, but rather take advantage of the homes of neighboring animals, such as beavers. Because of this, the river otter and beaver will share an exhibit. Unfortunately, the increase of urbanization and habitat exploitation has led to a decrease in river otter numbers. Providing a space for them to reproduce and thrive as well as educating the public will hopefully increase awareness of their situation.

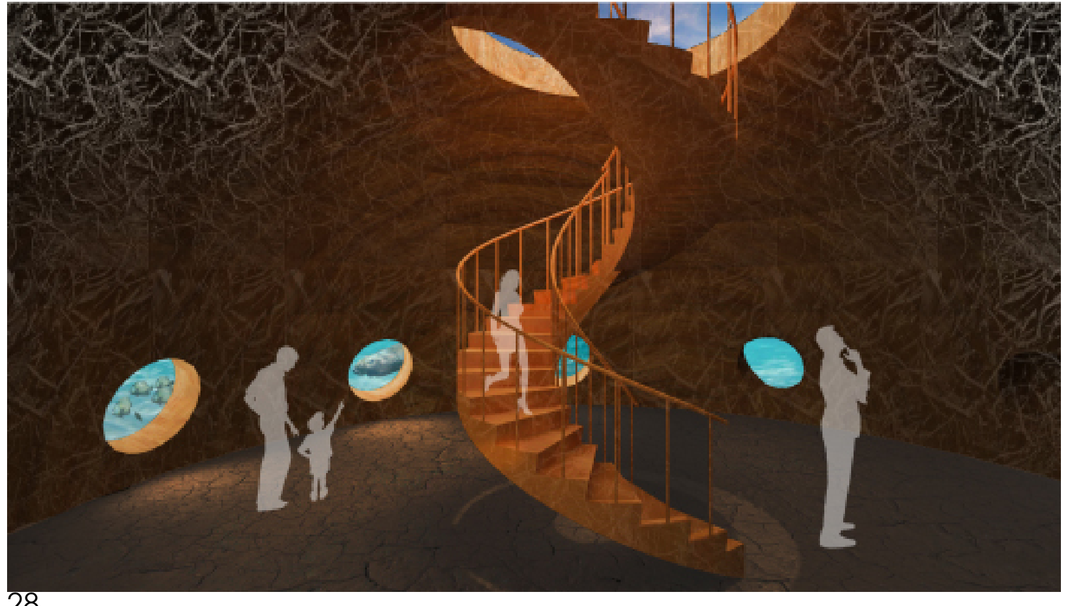
RIPARIAN EXHIBIT AXONOMETRIC



RIPARIAN EXHIBIT SECTION



A human-scale beaver dam is one approach to keep zoo visitors in a confined space while educating them on what a beaver's home may be like. Rather than using signage, people get to fully immerse themselves within a beaver's home, which is composed of gnawed twigs and is partially submerged underwater. Openings on the lower portion expose underwater life, and an opening on the top allows for visitors to observe life above the water while being partially hidden to prevent frightening away wildlife.

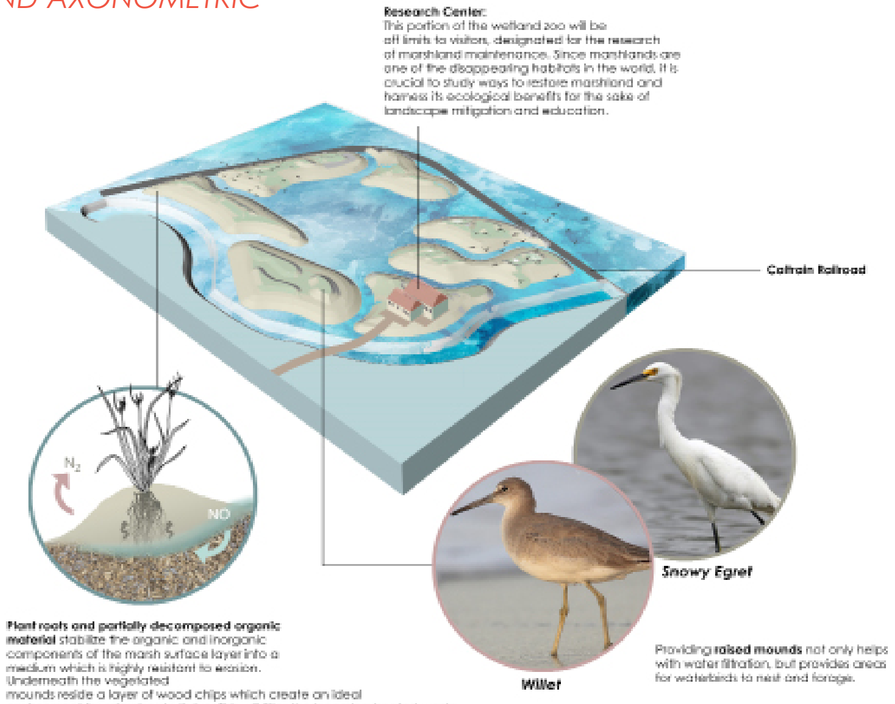


MARSHLAND HABITAT

The majority of the proposed site will be designated for wetland species, since the existing site is already ideal to accomodate wetland species. This will include the American Beaver, River Otter, Killdeer, Northern Harrier, Western Gull, Great Egret and Song Sparrow.

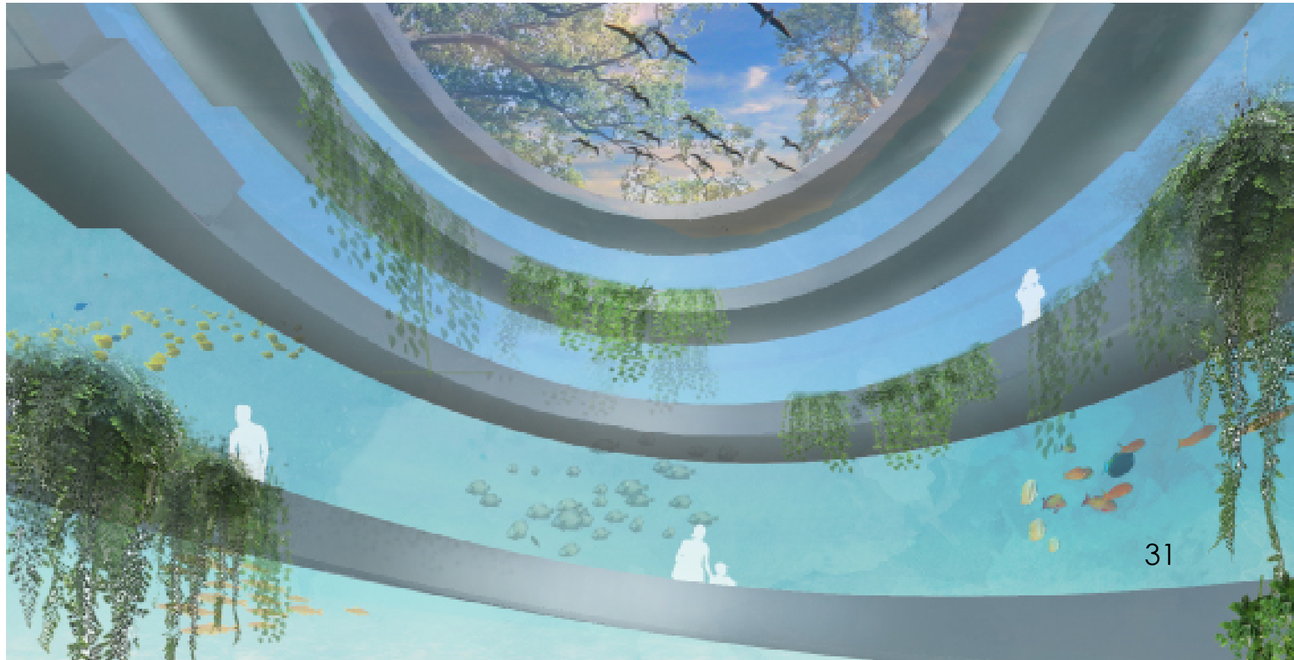
Progressing along the trail, visitors will find themselves transitioning from the riparian habitat to the more open marshland habitat. This is located at the far north end of the site, where visitors can experience first hand the effects of marshland habitat on the landscape. In addition to water filtration, the various islands vary in topographic value, providing multiple levels of mounds, and in turn more opportunities for the development of different, diverse slopes and habitats. The mounds also provide the waterbirds, shorebirds and other marshland animals with high water refuge as sea level rises.
A diverse group of shore birds and waterfowl already visit the existing site frequently, such as Killdeer, Northern Harrier, Western Gull, Great Egret, and Song Sparrow. Birds which follow the Pacific Highway migratory path use Alviso as a resting spot for the winter, and scientists often examine their behavioral patterns throughout the year. Birds like the Song Sparrow nest in the low dense scrub. Killdeer feed on insects and seeds, and distract prey from eating their young by faking injury. Egrets and the Northern Harrier vary in feeding habits, as Egrets eat fish, and Harriers small birds. Other birds serve as filter feeders as their diet consists of grasses, seeds and aquatic algae.

WETLAND AXONOMETRIC

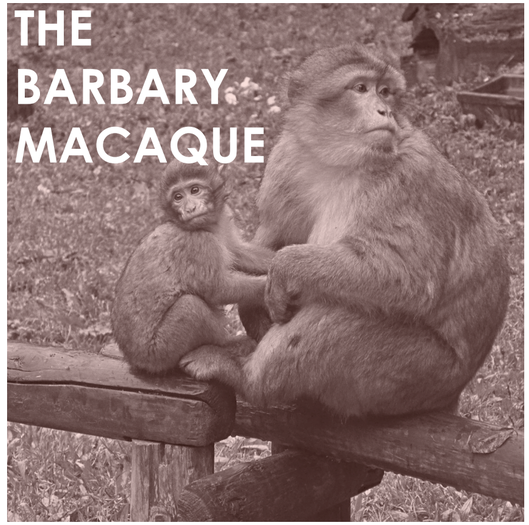


AQUATIC SPECIES

The zoo's aquarium will be located in the building adjacent to the entrance; two large, cylindrical buildings which will house a series of spiraling ramps. These ramps will guide visitors through the world of the sea; they are completely encapsulated in a 360 degree fish tank. This will keep visitors in a confined area, reversing the role of the fish and the visitor. The ramp, rising four stories, will eventually lead to the rooftop portion of the zoo (this area is left exposed to encourage visitors to explore the rooftops). At the end of the ramp, visitors will find themselves peering out of a node at the top of the zoo into a completely different terrestrial habitat. This will mimic the natural organization of progression from sea to land, tying together and creating a single theme.

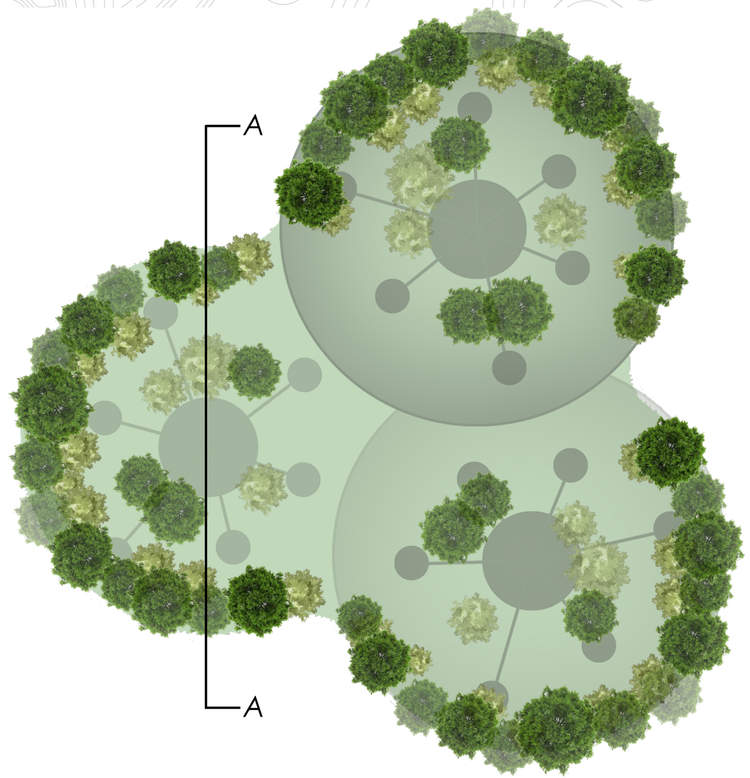


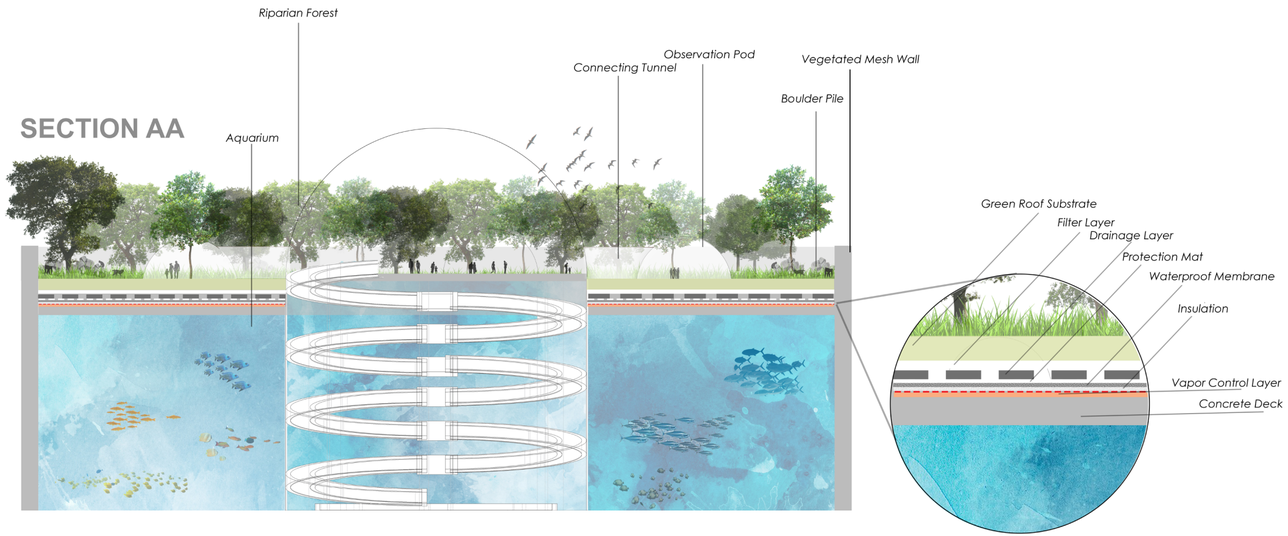
THE BARBARY MACAQUE



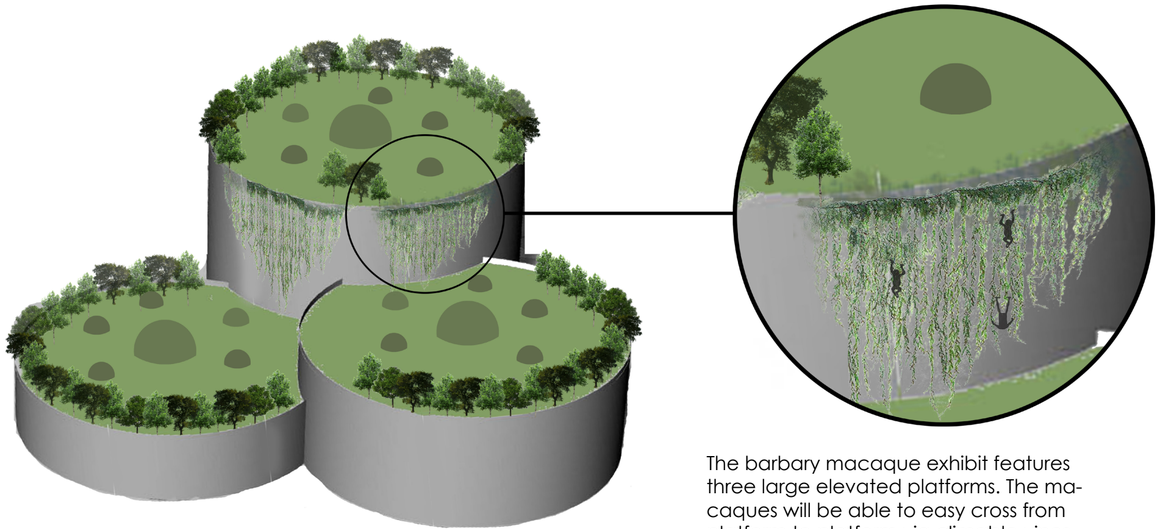
The Barbary Macaque, or the Macaca sylvanus, is the only known wild monkey population to have a known distribution outside of Asia. Categorized as an endangered species, their homeland in the upland riparian forests is becoming increasingly fragmented and shrinking in size due to habitat exploitation. They have also been poached and used as pets or illegal trade.They are native to the mediterranean climate, and are ground dwelling animals that feed on insects and vegetation. Most commonly, they feed on a variety of gymnosperms and angiosperms, consuming the entirety of the plant. The Barbary macaque can withstand a large range of temperatures, from dry arid weather to freezing cold conditions. Therefore, as weather fluctuates throughout the year, the macaques will be able to thrive in any condition, allowing them to roam freely without thermal stress. Since the tail of the Barbary Macaque is barely visible, it commonly incorrectly referred to as an ape. The social behavior of the barbary macaque involves living in groups which can range from 10 to 30, and are led by a single matriarch. This particular species of macaques is unique in how males will fully participate in the raising of the young, complete with grooming and playing. Social bonds formed by the act of grooming have been said to lead to lower stress levels (Heistermann, Michael, Semple, Stuart, 2007). The average age of a Barbary Macaque is 20 years.

The Barbary Macaque exhibit is composed of three large circular platforms, each at a different elevation. Combined, the entire area of this rooftop exhibit is approximately 20 acres, which is large enough to provide ample living space for 10-12 barbary macaques. Each cylindrical building, standing at an elevation of 20 feet, 40 feet, and 60 feet, respectively, are joined at the center. Visitors will not be able to cross from one circular platform to the next via the rooftop, but the barbary macaques will have easy access via vines and platforms. This will give the macaques freedom to move from building top to building top whenever they please. In addition, a dense canopy of riparian trees will be present as a vegetated barrier as well as a vegetated mesh to prevent monkeys from escaping the exhibit. Various piles of boulders will be scattered throughout the exhibit at different elevations to provide more areas to climb and explore. For feeding, a variety of insects, fruits, roots and leaves will be scattered in different locations to encourage natural foraging behavior.





BARBARY MACAQUE EXHIBIT PERSPECTIVE



The barbary macaque exhibit features three large elevated platforms. The macaques will be able to easy cross from platform to platform via climable vines and platforms.

CONCLUSION

In conclusion, zoos have undergone a long process of evolution throughout the past couple of centuries. Shifting from recreation to conservation, the negative effects of habitat exploitation and climate change on animals is becoming more apparent to the public eye, and much action is being taken in conservation centers, placing a great responsibility on modern day zoos.In creating a place for endangered animals, we must recognize that implementation of proper exhibit size, dynamic temperature and climate conditions, and placing the observation role on animals rather than humans, is extremely vital. In addition, we as humans have a great opportunity to maximize the protection of declining endangered and threatened species through our design of zoos, and we must follow specific conservational guidelines to ensure a positive future for all animals.

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