Adapting Assateague

Design Strategies for Resilient Buildings and Landscapes at Assateague State Park

Prepared by

Architecture 601: Adapting Assateague Studio

Summer 2021

SCHOOL OF
ARCHITECTURE,
PLANNING & PRESERVATION

Contents

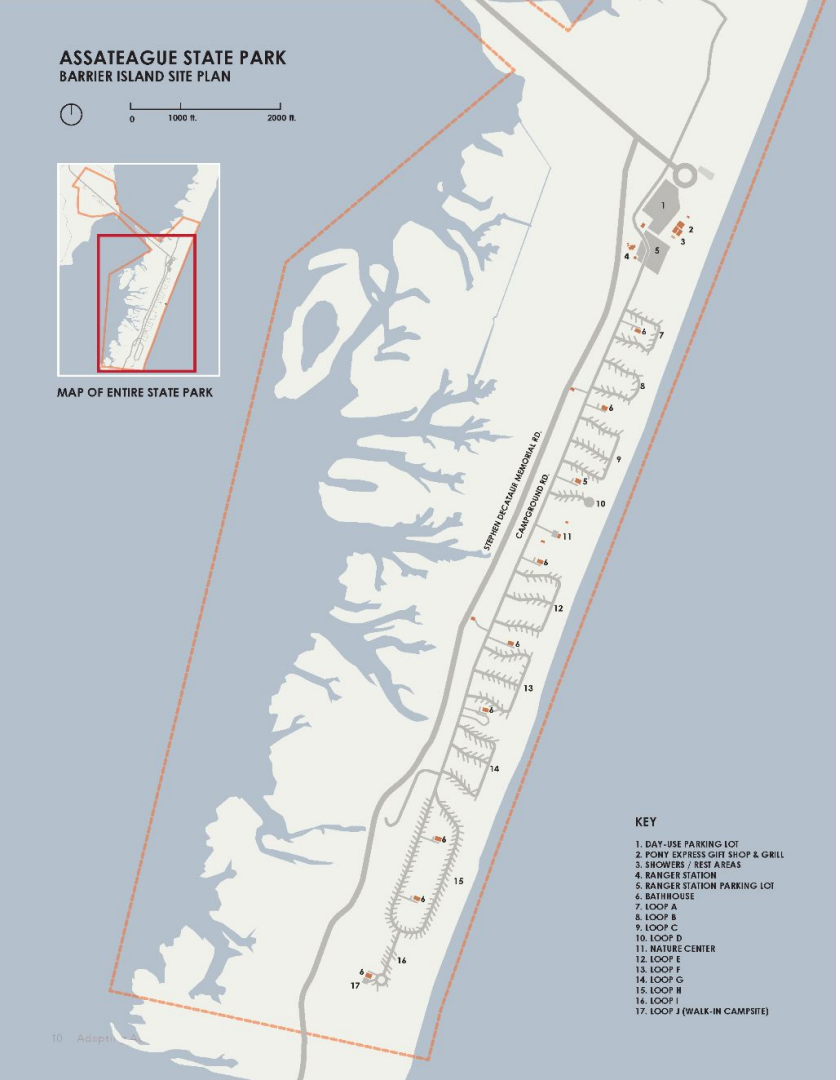
ARCH601:
topical inquiry
tasked to work directly with the Department of Natural Resources to design a new Ranger Station and create a Resiliency Masterplan for the island.

01
Assateague Island

Historical, Current, and Future Conditions

Assateague Island is a 37-mile long barrier island along the coasts of Maryland and Virginia, and is part of a chain of barrier islands stretching from Maine to Texas. The island is bordered by the Atlantic Ocean on the east and the Sinepuxent Bay on the west. The landscape is characterized by sandy beaches, salt marshes, maritime forests and coastal bays that are inhabited by waterfowl, deer, clams, and wild horses.

The island, once used by the Assateague tribe as fishing and hunting grounds, has a rich post-colonial history of changing land use and geomorphological flux. More change is coming, as sea level rises and storm surges intensify, which will have dramatic effects on the ecologies of the island and the infrastructure of Assateague State Park.



LEFT Contemporary site plan of barrier island portion of Assateague State Park. *(by S. Jamero)*

Land Use and Ownership, Past and Present

Assateague State Park is an 850-acre coastal park, located primarily along a two-mile stretch of Assateague Island, a 37-mile long barrier island off the eastern coast of the Delmarva Peninsula. Bordered by the Atlantic Ocean on the east and the Sinepuxent Bay on the west, the park's sandy dunes and coastal bays provide diverse habitats that support rich ecological communities. These habitats — bayside mudflats, beach and intertidal zones, dunes and grasslands, wetlands, marshes, and shrub and forest areas — are influenced by the dynamic coastal processes that shape the barrier island.

The many ecosystems and natural resources of Assateague Island have spurred and supported human activity there since the 1300s, when the Assateague tribe used the island for fishing and hunting. Today, people visiting the island have access to its rich wildlife and opportunities for nature-based recreation. The responsibility for the protection and management of the island's natural resources is divided amongst the U.S. National Park Service, the U.S. Fish and Wildlife Service, and the Maryland Department of Natural Resources (DNR). The Maryland DNR manages Assateague State Park, the most visited state park in Maryland.

Assateague State Park occupies area on both the mainland and Assateague Island, and the two areas of the park can be accessed through the Verrazano Bridge. The mainland portion of the park includes the park headquarters and visitor center, as well as the Rackliffe House, an 18th-century plantation house where visitors can learn about the history of the region and the Native, African, and European Americans who occupied the site. On Assateague Island there is a range of park infrastructure, including day use areas, campsites, a ranger station, visitor center, bathhouses, gift shop, concession stand, and marina. Visitors can access day-use areas including the beach, picnic areas, hiking trails, play spaces, and the nature center. Overnight visitors can stay on the campground, where 342 campsites as well as three youth group campsites are located around ten loops along the Atlantic coast (see Appendix for full park map and list of infrastructure).

The infrastructure in Assateague State Park is protected by a 2-mile long artificial dune; however, the dune has impeded naturally-occurring sand transport and overwash processes necessary for the continued health of the island and its habitats. While notches cut through the dune in 2008 and 2009 have permitted overwash and restored habitat, balancing the park's shifting geographies with visitor requirements will be necessary to meet the future needs of the island.

Day Users and Campers: Two Populations, Two Experiences

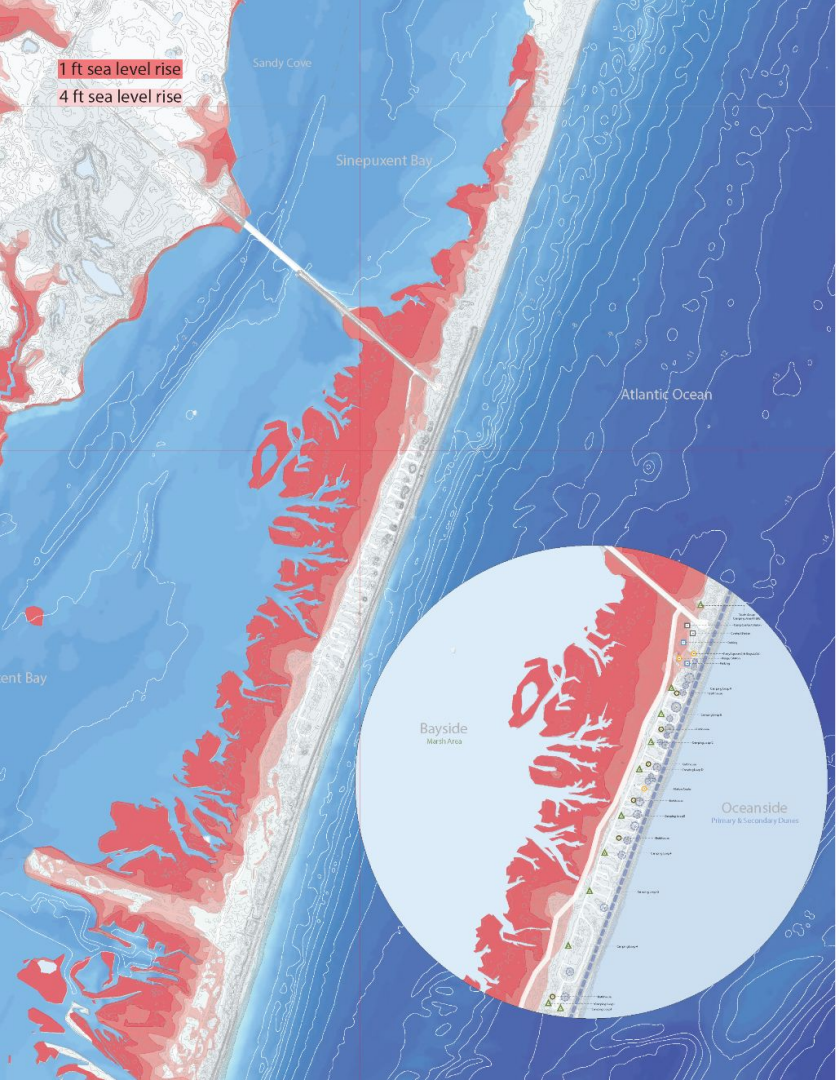
Today, people coming to Assateague State Park can experience it in two ways: as day-use visitors or as campers. As visitors enter the park from Verrazano Bridge, day-use visitors pass through a booth and into a designated parking lot. From there, visitors can pass through the Pony Express gift shop and grill, where concessions, grocery items, and souvenirs are available. The beach is accessible a short walk past the Pony Express and dunes separating the ocean from day-use facilities.

Campers staying on the island enter through the campsite booth and past the Ranger Station, a building constructed in 1981 and housing the campground office and park employees. The 342 campsites are located along quarter-mile loops southwest of the Ranger Station. Each loop contains a bathhouse, with one dump station shared amongst all campsites. In total there are nine newly remodeled bathhouses with warm / cold water, interior and exterior showers, and exterior dishwashing sinks. From the campgrounds, visitors have access to six miles of paved asphalt roads, a paved hiker/biker trail, the nature center, and the Atlantic coast. Trails within the campgrounds connect to other trails within the National Seashore, managed by the U.S. National Park Service.

Through these facilities, visitors of Assateague State Park can observe the island's unique ecosystems and partake in a range of water- and land-based activities such as swimming, fishing, kayaking, crabbing, hiking, bicycling, and wildlife viewing.

ABOVE View to Ranger Station and day-use parking lots. *(by Y. Konan)*

RIGHT Mapping the separate and different spatial sequences of day-users and campers. *(by S. Jamero)*



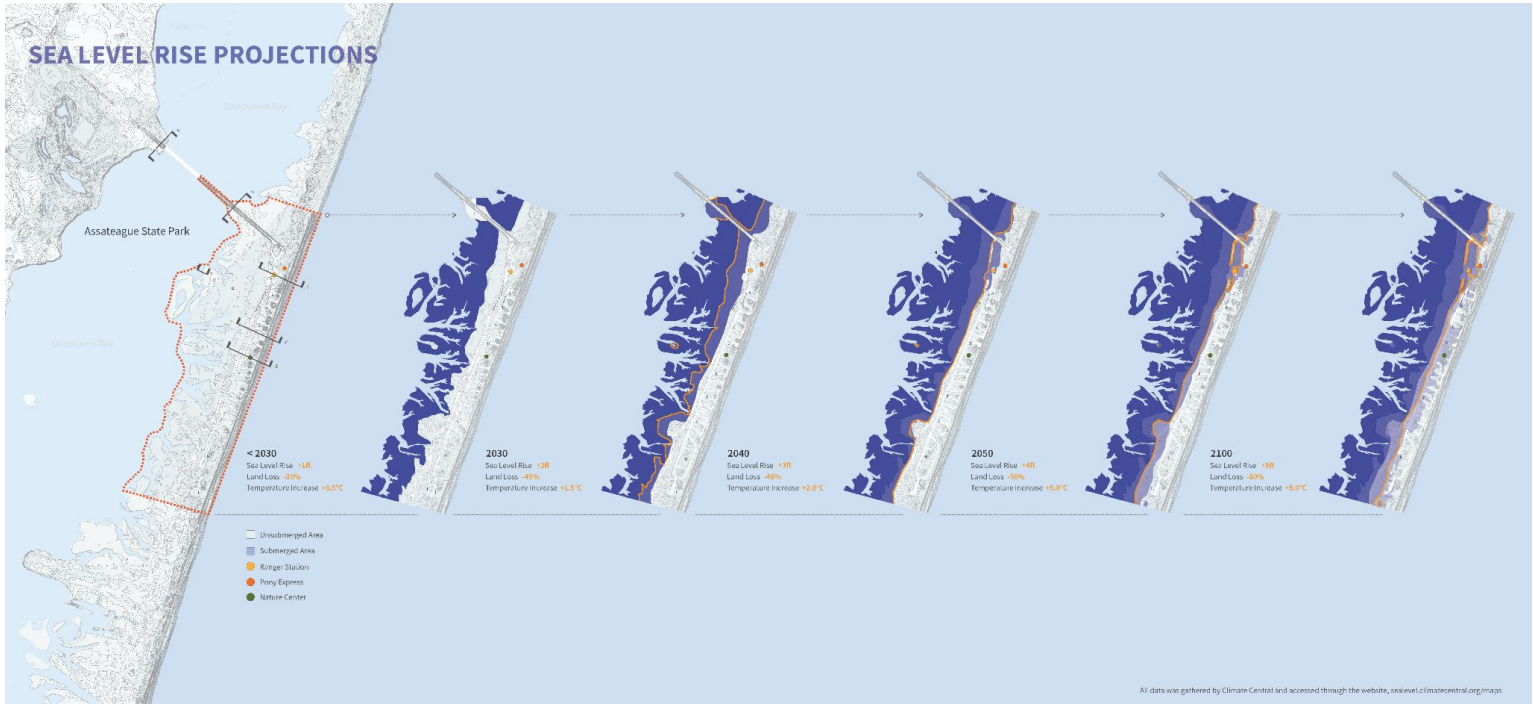
LEFT Sea level rise projections. *(by J. Lee)*

Sea Level Rise Projections and Park Topographies

Since 1990, global sea level has risen by between 0.02 and 0.04 inches annually, an issue particularly important for barrier islands due to the potential impacts of sea level rise on shorelines, marsh stability, and groundwater sources. On Assateague Island, the rate of sea level rise is significantly higher than the global average rate, with the sea level projected to increase by up to 7.5 inches by 2030. Currently, sea level rise affects two to five feet of the island's shoreline each year, and the ongoing changes in sea level will have greater impacts and consequences into the future. (2013 ASIS Geologic Resources Inventory Report 12-17)

Sea level rise is expected to impact many processes and systems on Assateague Island: shoreline erosion; saltwater intrusion into aquifers; wetland inundation; coastal flooding; the condition of infrastructure and cultural resources; storm surge intensities; and coastal geomorphological processes. While changes to barrier islands as a result of sea level rise cannot be precisely predicted, it is likely that as the sea level in the mid-Atlantic changes, Assateague Island will migrate landward, disintegrate in areas that are frequently inundated, and transform into a submerged marine sand body. Additionally, erosion and shoreline retreat, already prevalent along the northern tip of the island, may be exacerbated by higher sea levels, and sea level rise is very likely to result in significant morphological changes to Assateague Island.

Over the past several decades, the Maryland Department of Natural Resources and the National Park Service have attempted to better understand and mitigate issues related to sea level rise on the island through research and restoration projects. These projects have laid the groundwork for steps taken to stabilize the island and decrease shoreline erosion and disintegration. However, questions concerning habitat vulnerability, freshwater salinization and wildlife impacts, and opportunities for infrastructure replacement remain a priority for the effective planning and management of Assateague Island and its resources.



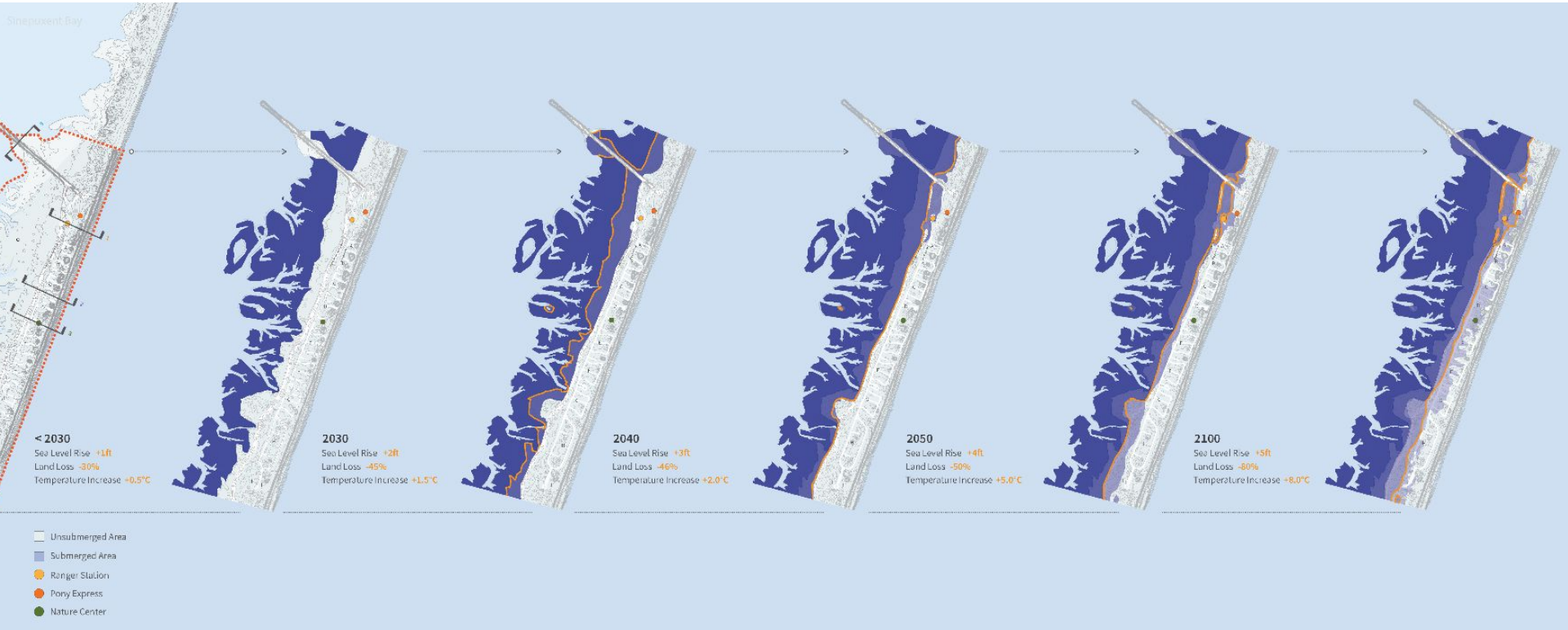
Impacts of Sea Level Rise on Park Habitats

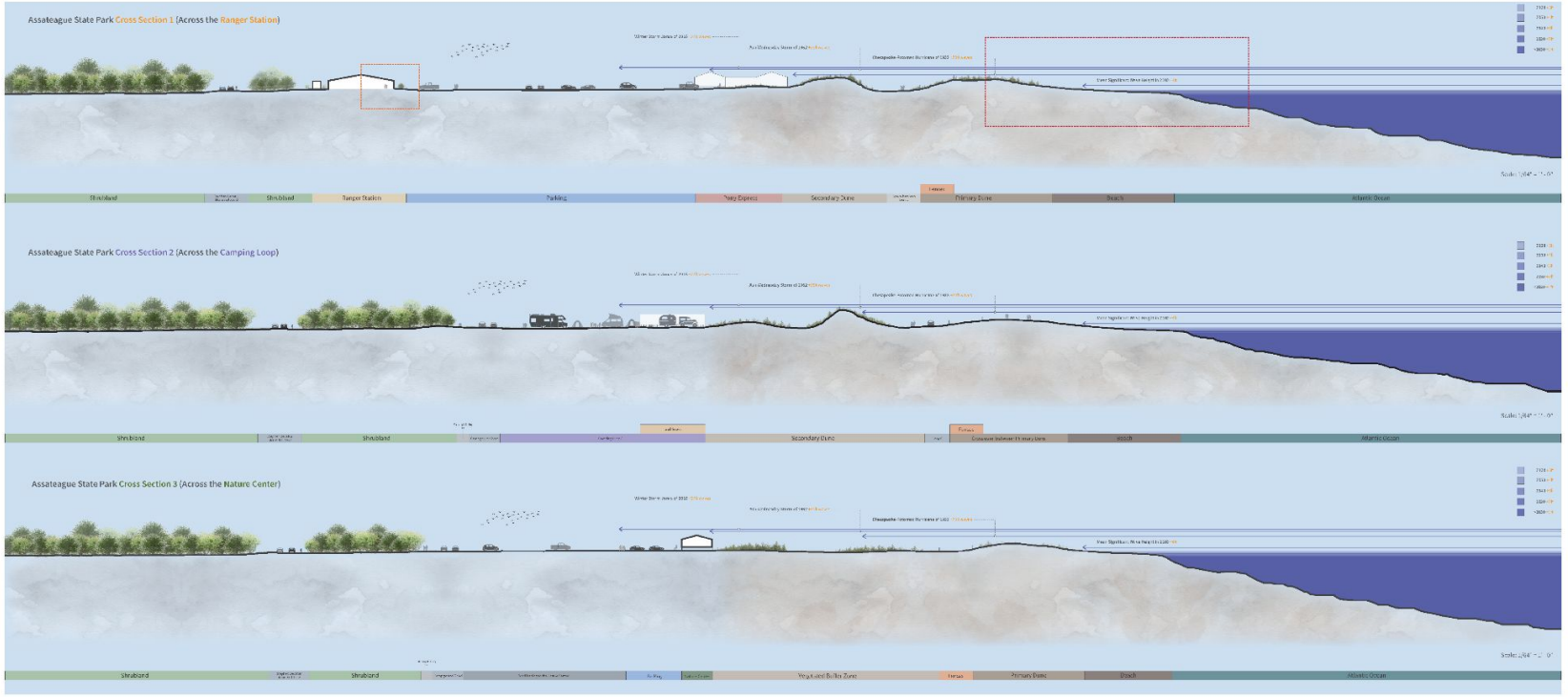
Changes in the rate and extent of erosion, overwash, and inlet formation as a result of sea level rise will cause shifts in habitat throughout the island. Overall, habitat and species diversity is expected to decline, with species tolerant of greater and more frequent disturbances surviving. Inland areas that require more stable conditions, such as forests and shrublands, are likely to decline as sediment movement, saltwater inundation, and other climate-driven changes increase.

Of the island's habitats, salt marshes are particularly vulnerable to sea level rise due to their low elevation. Increases in sea level have the potential to erode and overwhelm the marshes, ultimately converting them from wetlands to intertidal mudflats or open water. Although some marshes may migrate inland to areas of higher elevation, large areas of marshland will likely be lost, resulting in decreased primary productivity, reduced habitat availability for many diverse species, and a decline in the availability of aquatic species necessary to the region's fisheries.

ABOVE Sea level rise projections, 2021-2100. *(by J. Lee)*

RIGHT View of primary dune. *(by Y.Konan)*


Sinepuxent Bay
< 2030
Sea Level Rise +1ft
Land Loss -30%
Temperature Increase +0.5°C
2030
Sea Level Rise +2ft
Land Loss -45%
Temperature Increase +1.5°C
2040
Sea Level Rise +3ft
Land Loss -46%
Temperature Increase +2.0°C
2050
Sea Level Rise +4ft
Land Loss -50%
Temperature Increase +5.0°C
2100
Sea Level Rise +5ft
Land Loss -60%
Temperature Increase +8.0°C
Unsubmerged Area
Submerged Area
Ranger Station
Pony Express
Nature Center



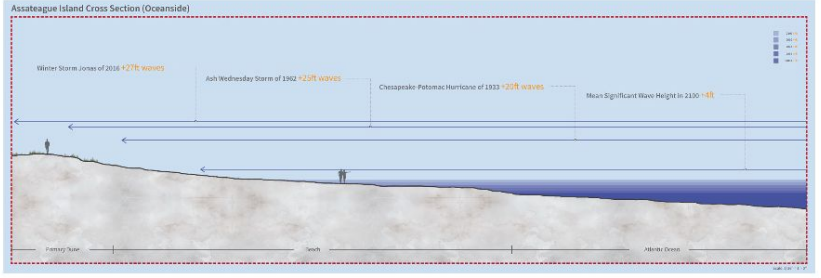
Infrastructure Response to Sea Level Rise

The loss of land expected to occur with sea level rise will impact the ability of the infrastructure in Assateague State Park to continue to provide facilities for visitors. Fixed infrastructure, including roads, parking lots, the visitor center, and ranger station, will be increasingly susceptible to the impacts of climate change — increased flooding, saltwater intrusion, higher tides — and as such will be more difficult and costly to maintain. The campgrounds, also vulnerable to flooding, may become difficult to access due to the movement of sand onto roads and campsites.

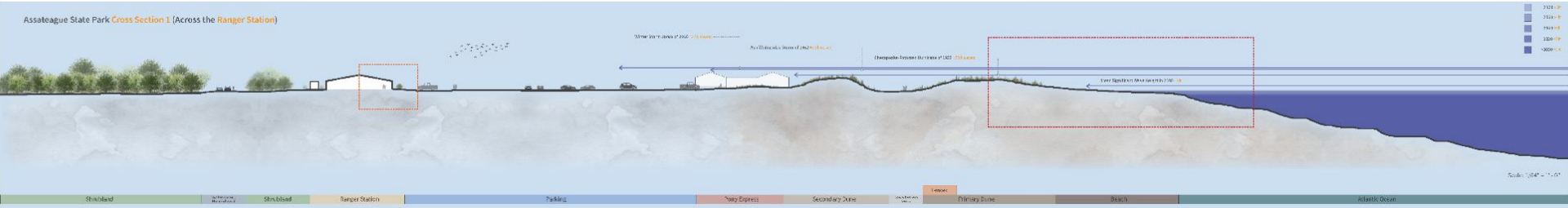
In response to sea level rise and related changes, several adaptive measures for infrastructure are being pursued and undertaken, including low impact road and parking lot construction; the design and construction of mobile facilities that can be moved off-site when necessary; and the construction of flood-proof buildings.

ABOVE Island cross sections with sea level rise elevations and major storm wave heights. *(by J. Lee)*

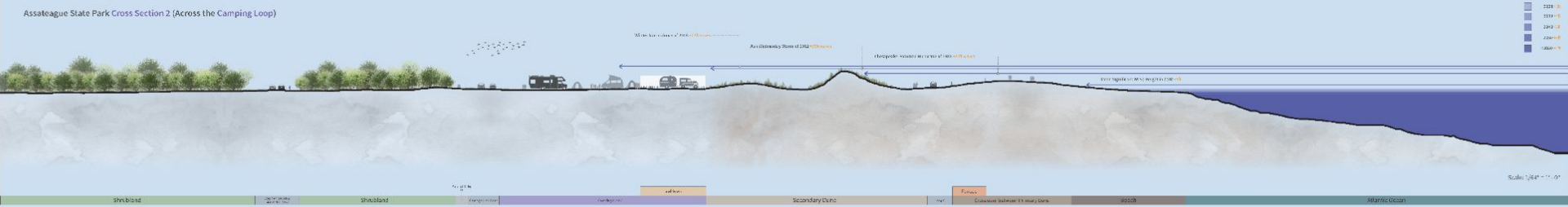
RIGHT Detail of major storm wave heights at primary dune. *(by J. Lee)*



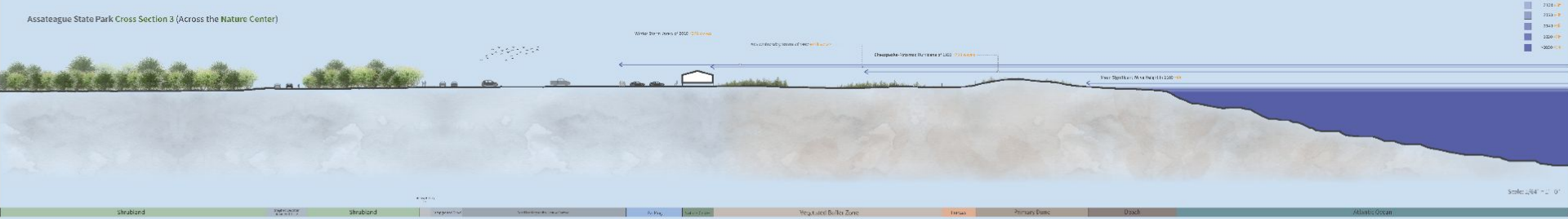
Assateague State Park Cross Section 1 (Across the Ranger Station)



Assateague State Park Cross Section 2 (Across the Camping Loop)

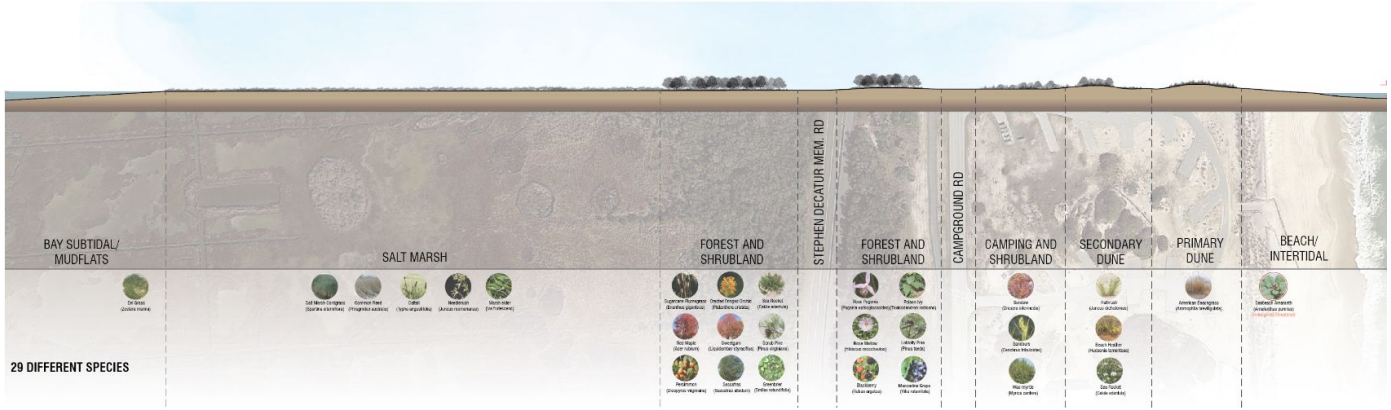


Assateague State Park Cross Section 3 (Across the Nature Center)



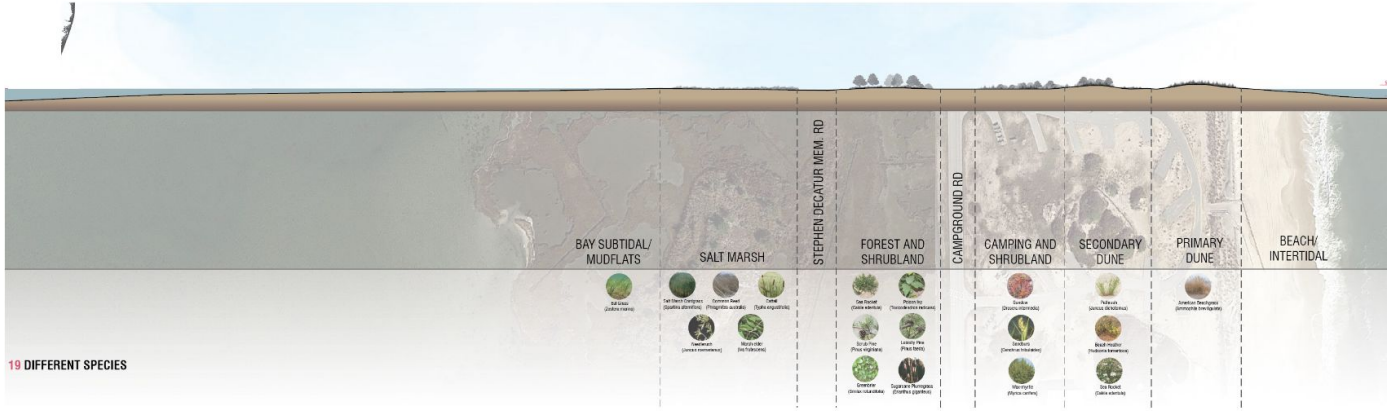
ASSATEAGUE ISLAND

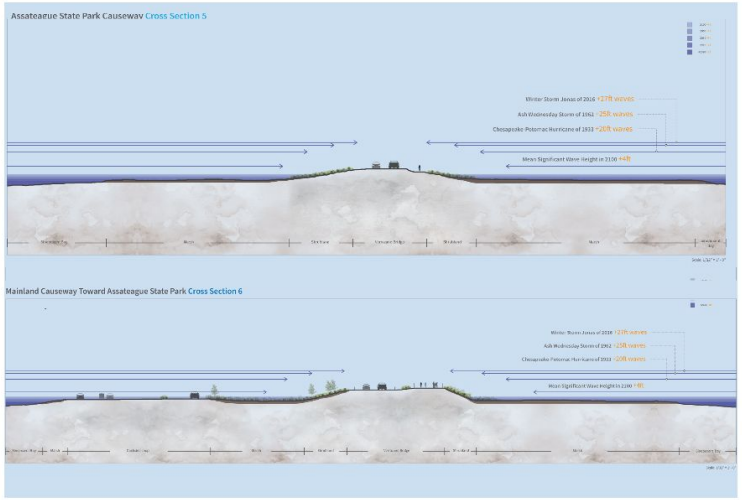
YEAR 2021

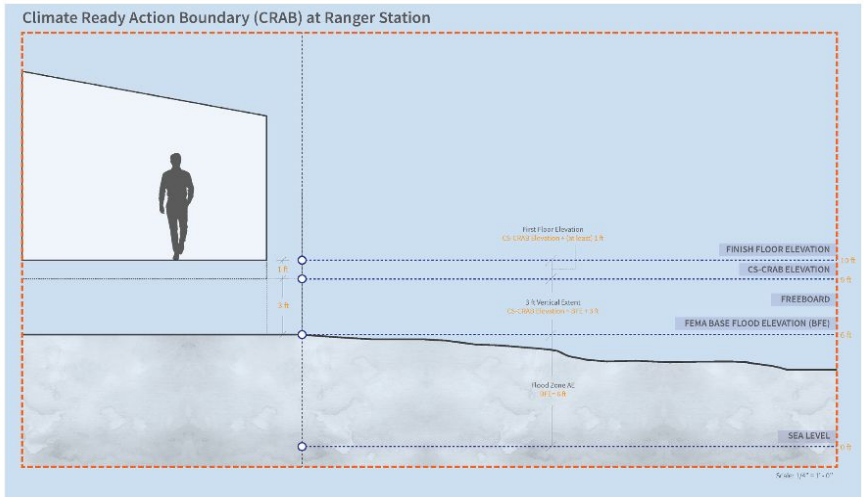


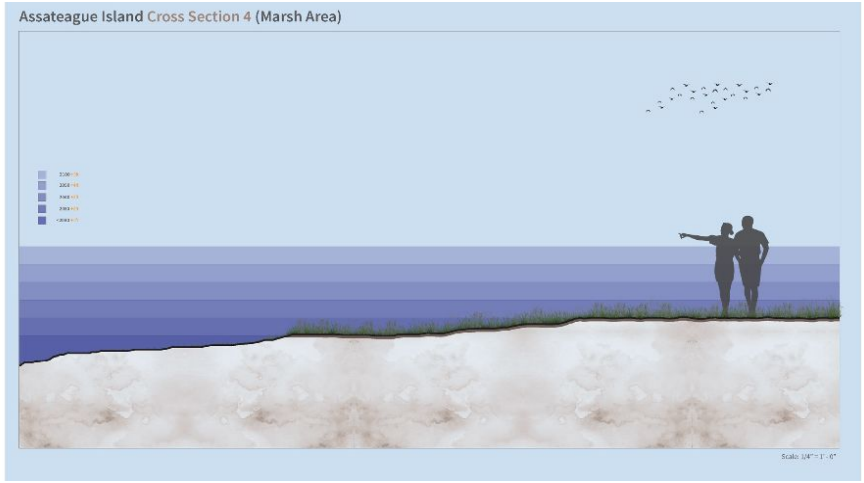
ASSATEAGUE ISLAND

YEAR 2100









CRAB (Climate Ready Action Boundary) Elevations

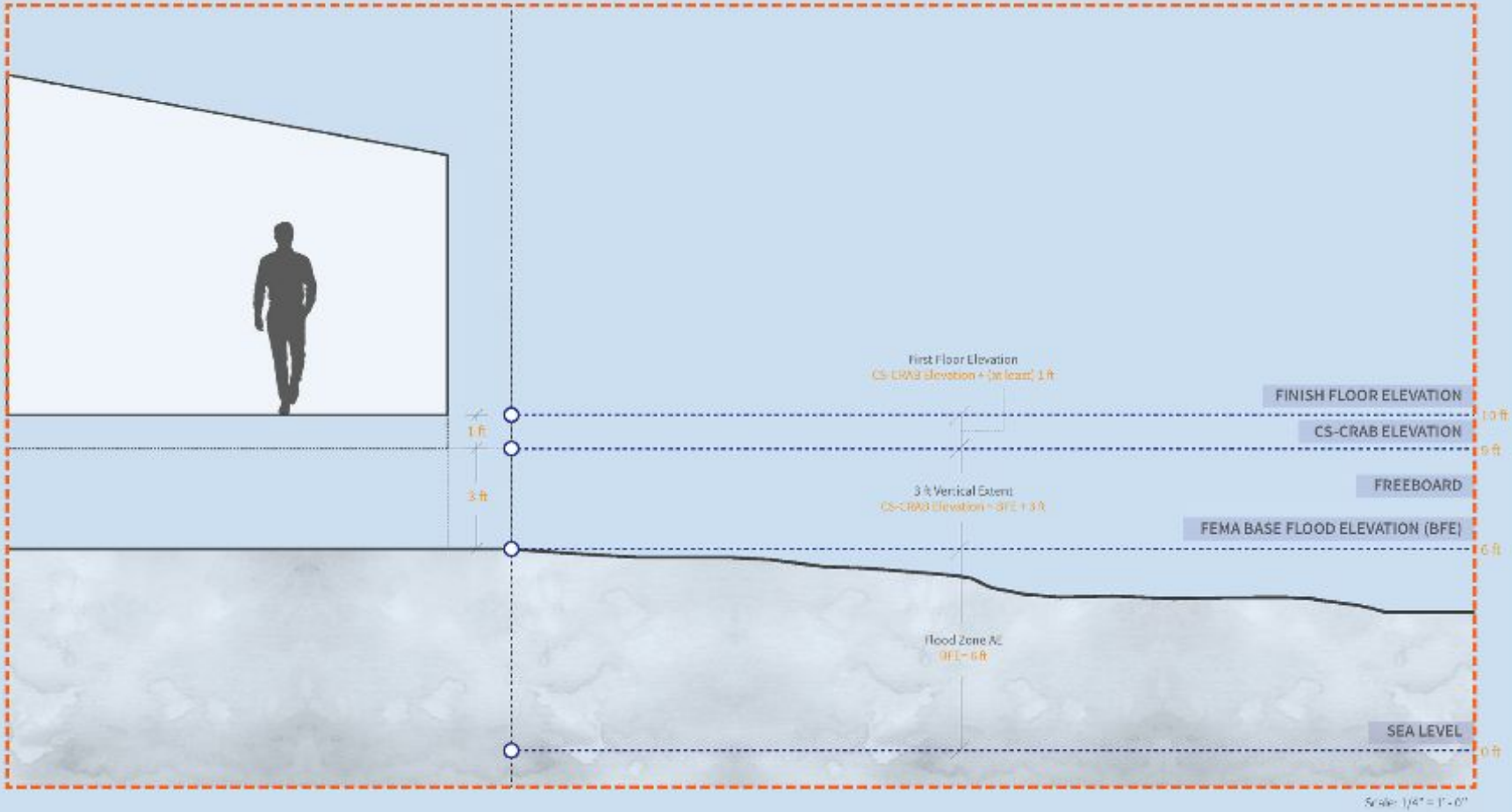
One metric used to inform flood-proof design is the Climate Ready Action Boundary (CRAB) elevation, defined by the Maryland Department of the Environment as the elevation of the 100-year FEMA floodplain plus an additional three feet. The Maryland Department of Natural Resources requires that all damaged, essential state and local structures located waterward of the CRAB be constructed with a first-floor elevation at least one foot above the CRAB elevation. Following these guidelines, the ranger station and other visitor facilities in Assateague State Park must be elevated ten feet above sea level, or four feet above their present ground-level elevation, to ensure that the structures are resilient to sea level rise and flooding events.

ABOVE Assateague State Park causeway cross sections with major storm wave heights. *(by J. Lee)*

BOTTOM View of causeway at Assateague island. *(by Y. Konan)*

RIGHT Climate Ready Action Boundary (CRAB) stnadards; and marsh detail with sea level rise elevations. *(by J. Lee)*

Climate Ready Action Boundary (CRAB) at Ranger Station



Human and Non-human Habitat

The diverse habitats of Assateague Island support an abundance of mammal, amphibian, bird, insect, crustacean, and fish species. In the ocean surrounding the island, there are whales, seals, and dolphins, as well as flounder, sea trout, and striped bass, with the latter three drawing people to the island for inlet and surf fishing. While the sandy, constantly-changing beach environments support minimal plant life, Loggerhead sea turtles *(Caretta caretta)* and nesting shorebirds such as piping plover *(Charadrius melodus)* and black skimmer *(Rynchops niger)* can be found along the beach.

Moving landward, the harsh and salty dunes provide habitat for red foxes *(Vulpes vulpes)* and several snake species. In the sheltered zones beyond the dunes, forest-dwelling species including five-lined skinks *(Eumeces fasciatus)*, northern fence lizards *(Sceloporus undulatus hyacinthinus)*, native white-tailed deer *(Odocoileus virginianus)*, and non-native sika deer *(Cervus nippon)* are present. The island's sika deer, introduced from Asia in the 1920s, competes with some native species for resources; as such their population throughout the island is managed through hunting on Assateague Island National Seashore. Near the center of the island, freshwater ponds provide breeding habitat for several frog and toad species.

Closer to the bay, rich and productive marshlands provide habitat for a wide range of species including blue crab *(Callinectes sapidus)*, horseshoe crab *(Limulus polyphemus)*, American wigeon *(Mareca americana)*, and migratory birds that stop at Assateague Island on their route along the Atlantic migratory flyway. Of the more than 345 bird species that have been sighted on the island, the most prevalent include osprey, herons, egrets, and sandpipers. The marshes and forests on Assateague Island support a diverse range of avian species, including clapper rails *(Rallus longirostris)*, red-winged blackbirds *(Agelaius phoeniceus)*, downy woodpeckers *(Picoides pubescens)*, and great horned owls *(Bubo virginianus)*, while the more temperate, coastal waters attract temporary migratory birds such as brent geese *(Branta bernicla)* and brown pelicans *(Pelecanus occidentalis)*.

The sheltered, nutrient-rich waters along the bay side of the island provide habitat for many aquatic species, particularly blue crabs *(C. sapidus)*, a species culturally and commercially important to the region, and fish, who migrate to the estuary in the spring to breed.

LEFT Human and non-human island inhabiants. *(by Y. Konan)*

Wild Horses of Assateague

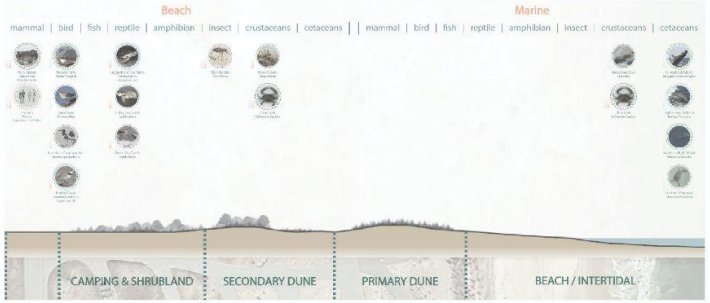
Of the many species inhabiting Assateague Island, the most well-known are the wild Assateague horses, who roam freely throughout the island. Over time, these short, stocky horses have adapted to the island's habitat and climate, feeding on grasses and other plants in the salt marshes. Because the best food sources are found in the marshlands, the horses tend to live there for most of the year. In summer, the horses migrate to the beach where there are fewer insects; that is where they can be viewed by summer visitors.

Today, there are approximately 230 horses on the island, with around 80 in the Maryland herd and 150 in the Virgina herd; the herds are separated from one another by a fence at the Maryland-Virginia state line. While the horses are a cultural resource and a feature important to many island visitors, their grazing and trampling decreases the presence and height of grasses, which in turn can reduce habitat for birds and destabilize the dunes. To minimize negative impacts that the horses can have on the island's communities, the horse population is controlled through contraceptive vaccines in Maryland, while in Virginia, foals are sold at an annual auction. These programs have ensured a sustainable herd population and the continued health of Assateague Island and all of its inhabitants.

ABOVE Distribution of non-human inhabitants of the park (whole island). *(by Y. Konan)*

CENTER View of Assateague wild horses grazing on dune grass at the primary dune. *(by Y. Konan)*

RIGHT Distribution of non-human inhabitants of the park (partial island sections). *(by Y. Konan)*



Dune Formation and Maintenance

The ongoing stability of the dunes along Assateague State Park is of great importance to the protection of infrastructure and habitat. First constructed in the 1970s, the park's 18ft-tall primary dune was designed to protect visitor facilities from overwash and other natural barrier island processes. However, the dune has been continually destroyed by storm events and then later rebuilt, a process that has accelerated erosion and narrowed the beach. To stabilize the dune, two fences have been added, providing places for sand to collect, building up the dune edge and broadening the dune. Other measures to stabilize and reinforce the dune include adding sand to the western side of the dune and planting American beach grass (*Ammophila breviligulata*).

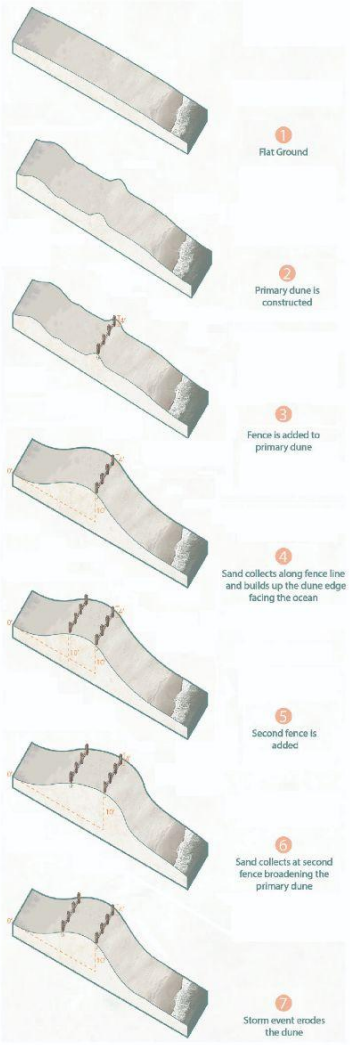
While dune restoration strategies can provide protection from erosion, high tides, intense storms, and storm surges, other measures focused on adaptive infrastructure may also increase the resiliency of the park's facilities to storms and sea level rise. For example, by constructing moveable facilities and replacing asphalt with clay and clamshell construction, it may be possible to protect necessary infrastructure while restoring natural barrier island function and minimizing dune maintenance.

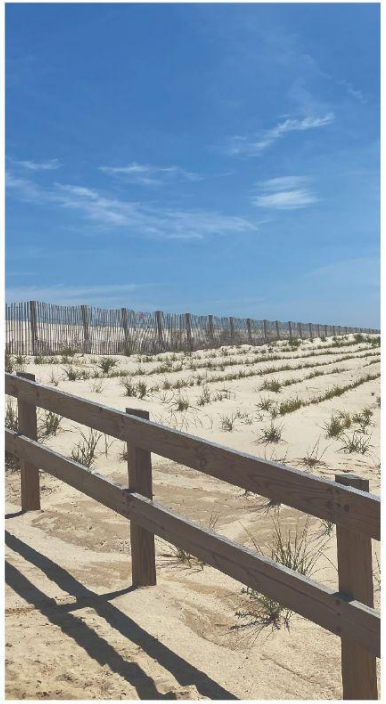
ABOVE Vegetation of secondary dunes. *(by Y. Konan)*

RIGHT Construction process of primary dune. *(by Y. Konan)*

ABOVE RIGHT View of fence line at primary dune (detail). *(by Y. Konan)*

BOTTOM RIGHT View of fence lines at primary dune (aerial). *(by Y. Konan)*



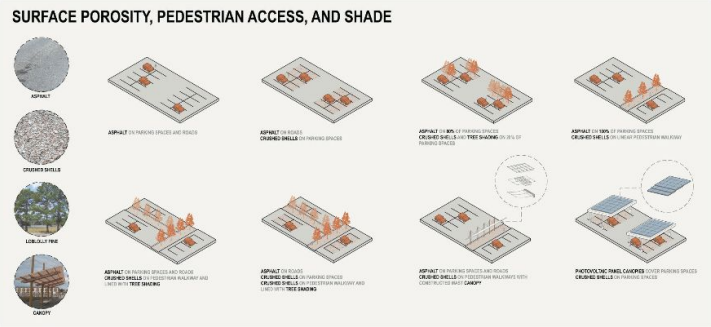


02
Resiliency Planning

Strategies for a Resilient State Park

Assateague Island is not just a landscape in flux—it is a place of intensifying change as natural coastal processes, storms, and sea-level rise shape and shift the island. Climate change models predict that by 2040 the island will experience increases in temperature and extreme weather, a sea level rise of 3.5–9 inches, and altered precipitation patterns.

In the face of these changing conditions, a Resiliency Plan is being formed by the Maryland DNR, with a mission to "conserve and foster an appreciation of the natural resources of Assateague State Park and to continue to provide substantial recreational opportunities for as long as possible in a sustainable manner." This ethos guides the range of ongoing and new resiliency strategies on the following pages that address dune maintenance, sand fencing, camp loops, parking lots, and educational spaces.



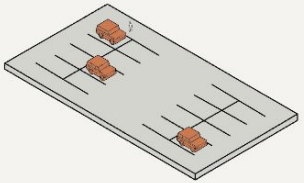
Strategies to Increase Surface Porosity and Shading

Presently, the parking lot is paved entirely with asphalt. This design proposes that some impervious asphalt cover be reduced and replaced by native materials such as clay and crushed shells, particularly on parking spaces and paths. Unlike asphalt, when these materials erode or are damaged, they blend more easily with the environment and cause less harm to the habitats and species across Assateague Island. The crushed shells used on pedestrian walkways also serve as a transitional material between the built-up areas and the permeable dunes and beaches.

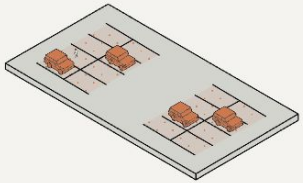
The design proposal also introduces several shading systems throughout the parking lot. Trees, specifically loblolly pines (*P. taeda*), can be planted along walkways to provide shade and comfort for pedestrians as they move across the parking lot and between the Ranger Station and the Pony Express. The trees may be designed as windbreaks as well, serving to block storm winds coming from the northeast and warm, western winds from the Sinepuxent Bay.

ABOVE Surface porosity, pedestrian access, and shade. *(by S. Jamero)*

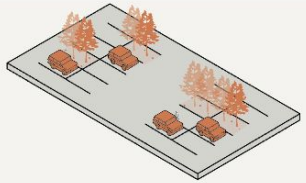
RIGHT Detail of Surface porosity, pedestrian access, and shade. *(by S. Jamero)*



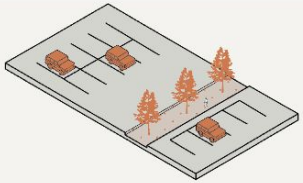
ASPHALT ON PARKING SPACES AND ROADS



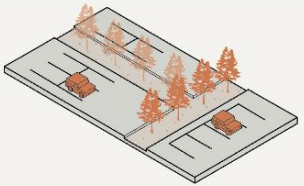
ASPHALT ON ROADS
CRUSHED SHELLS ON PARKING SPACES



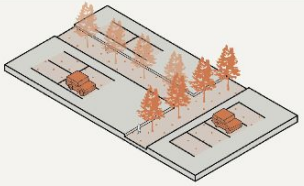
ASPHALT ON **80%** OF PARKING SPACES
CRUSHED SHELLS AND **TREE SHADING** ON 20% OF PARKING SPACES



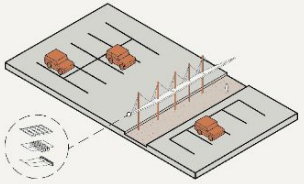
ASPHALT ON **100%** OF PARKING SPACES
CRUSHED SHELLS ON LINEAR PEDESTRIAN WALKWAY



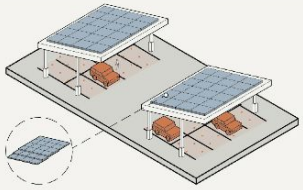
ASPHALT ON PARKING SPACES AND ROADS
CRUSHED SHELLS ON PEDESTRIAN WALKWAY AND LINED WITH **TREE SHADING**



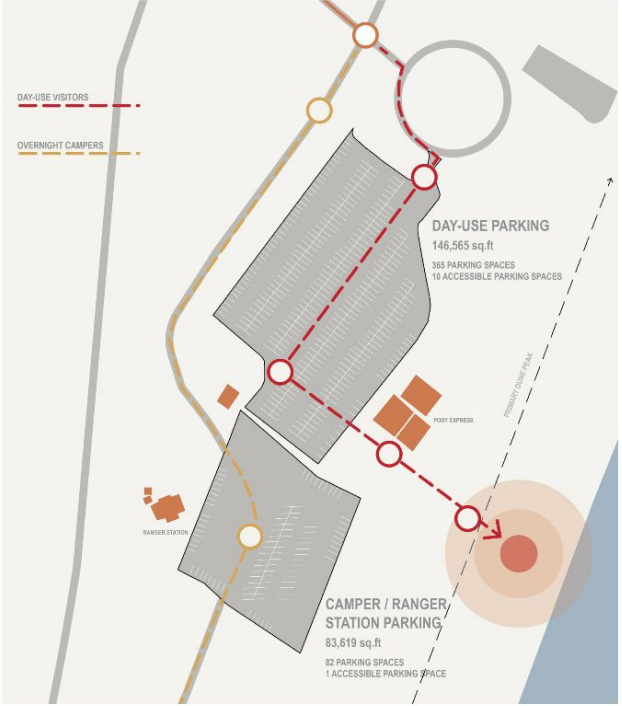
ASPHALT ON ROADS
CRUSHED SHELLS ON PARKING SPACES
CRUSHED SHELLS ON PEDESTRIAN WALKWAY AND LINED WITH **TREE SHADING**

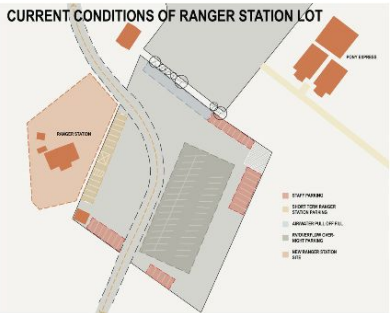


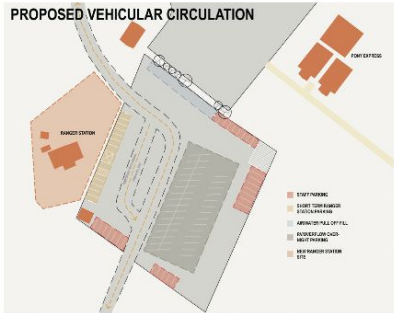
ASPHALT ON PARKING SPACES AND ROADS
CRUSHED SHELLS ON PEDESTRIAN WALKWAYS WITH CONSTRUCTED MAST **CANOPY**



PHOTOVOLTAIC PANEL CANOPIES COVER PARKING SPACES
CRUSHED SHELLS ON PARKING SPACES







Proposed Vehicular Circulation

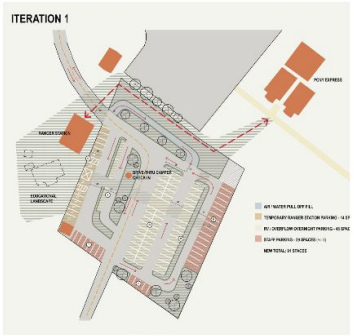
To improve the experience of overnight visitors checking in at the Ranger Station, a drive-thru camper check-in lane is added closer to the Ranger Station, with space adjacent to the lane available for a staffed booth, allowing for increased ease and efficiency of check-in before visitors proceed to their campsites. The lanes are widened, enabling the circulation of both RVs and cars while also providing temporary parking for RVs.

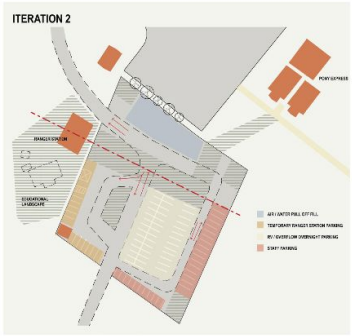
The added median strip where the check-in booth could be located also creates opportunity for additional landscaping and the introduction of green space. Trees, shrubs, and grassy areas would reduce surface heat gain, provide shade, and break up the large asphalt parking lot.

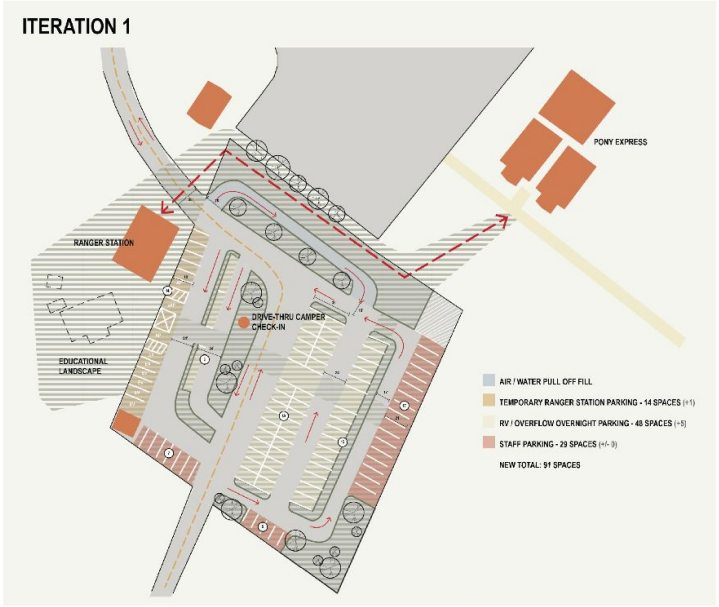
ABOVE View of Ranger Station lot and day-use lot. *(by Y. Konan)*

RIGHT ABOVE Current parking conditions. *(by S. Jamero)*

RIGHT BOTTOM Current conditions of ranger station lot; and proposed vehicular circulation with camper check-in lane. *(by S. Jamero)*







Ranger Station Landscape

This design proposal suggests expanding the program of the Ranger Station so as to increase public facilities and establish an educational landscape around the building. This landscape creates a welcoming environment and provides an alternative destination for beach-goers. Signage throughout the education landscape will educate visitors about the habitats and animals on Assateague Island and explain rules for visitor interactions with the island's ecosystems.

The educational landscape connects to other landscaped areas, including the pedestrian pathway, which links the Ranger Station to the Pony Express and provides a green corridor for park users to enjoy.

ABOVE Proposed Ranger Station lot landscape iterations. *(by S. Jamero)*

CENTER View of Rnager Stertion lot. *(by Y. Konan)*

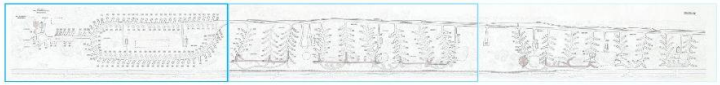
RIGHT Detail of Proposed Ranger Stetion lot, Iteration 1.*(by S. Jamero)*

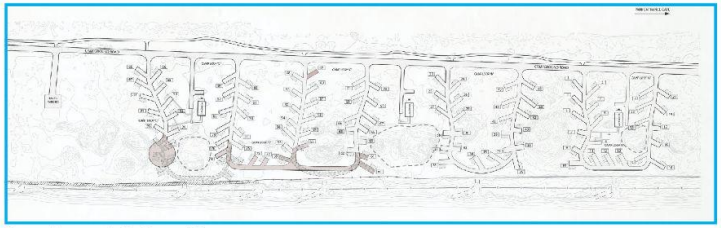
Campsite Distribution

The campsites are divided amongst the various loops, with 21 sites in Loop "A", 23 in Loop "B", 38 in Loop "C", 10 in Loop "D", 35 in Loop "E", 45 in Loop "F", 35 in Loop "G", 114 in Loop "H", 11 in Loop "I", and 5 in Loop "J". In recent years, the paved areas closest to the dunes at several loops have been demolished, removed, and replaced by a loop road that runs inland of the current road and dune fencing. This strategy has removed the most vulnerable campsites from beng covered by sand from the primary dune during storm events.

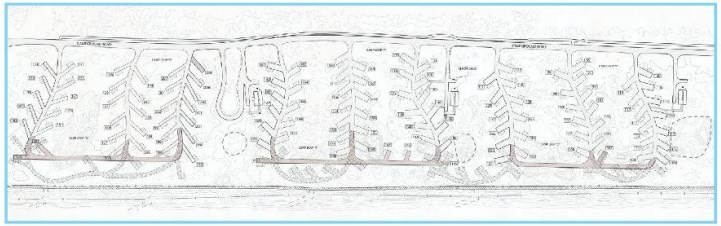
ABOVE Campsite catalog. *(by Y. Konan)*

RIGHT Campsite loops. *(by Y. Konan)*

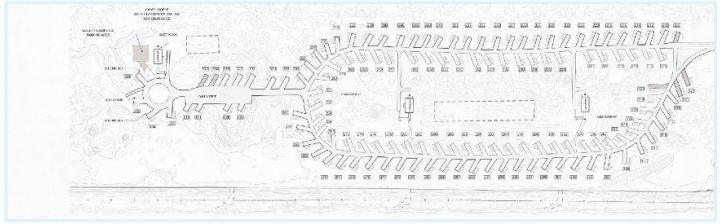




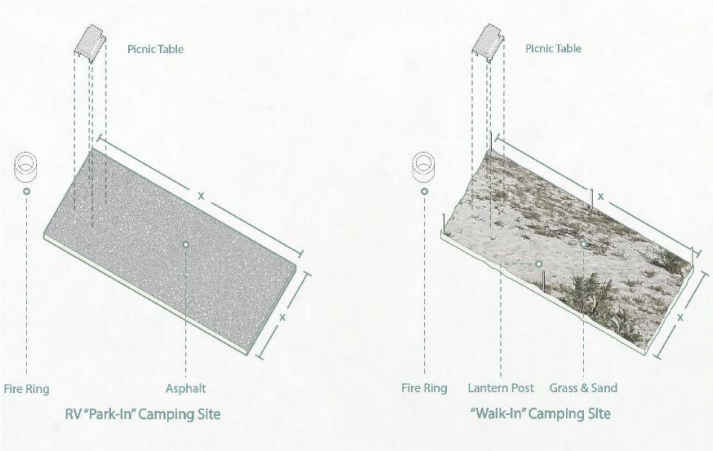
Camp Loops A, B, C, and D

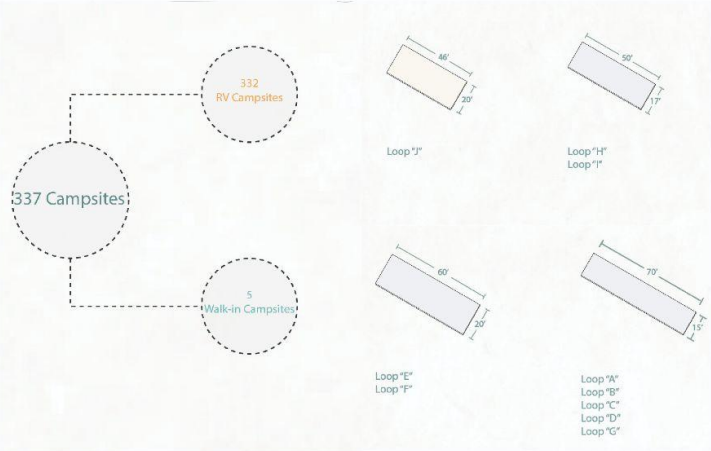


Camp Loops E, F, and G



Camp Loops H, I, J, and K





Campsite Characteristics

The park-in campsites, accessible by RV and car, are paved with asphalt and each contains a picnic table and fire ring. The sites range in size from 850 square feet (50' x 17') to 1,200 square feet (60' x 20').

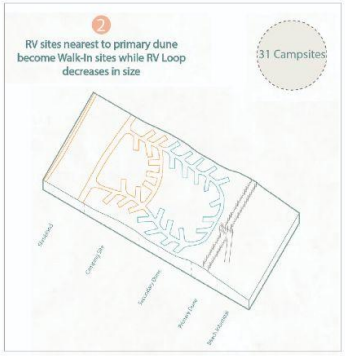
The walk-in campsites are slightly smaller than most of the park-in sites, each with an area of 920 square feet (46' x 20'). The walk-in sites also house a fire ring and exterior seating; however, they are not paved. Rather, the sites follow the natural topography, with the existing grass and sand preserved. The campsites are levelled, with clay added to the paths and the sites delineated by posts along the perimeter.

ABOVE Camp site types: RV "Park-in" camping site, and "Walk-in" camping site. *(by Y. Konan)*

CENTER View of typcial campsite bathhouse. *(by Y. Konan)*

ABOVE RIGHT Campsite count and dimensions. *(by Y. Konan)*

BOTTOM RIGHT *View of typical RV "Park-in" camping site.. (by Y. Konan)*

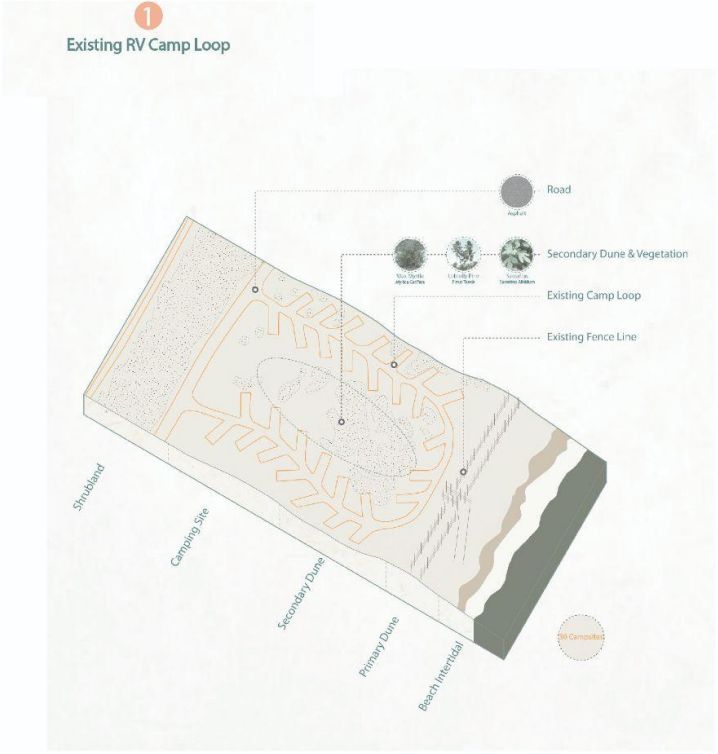


Adaptive Campsites: From RV sites to Walk-in sites

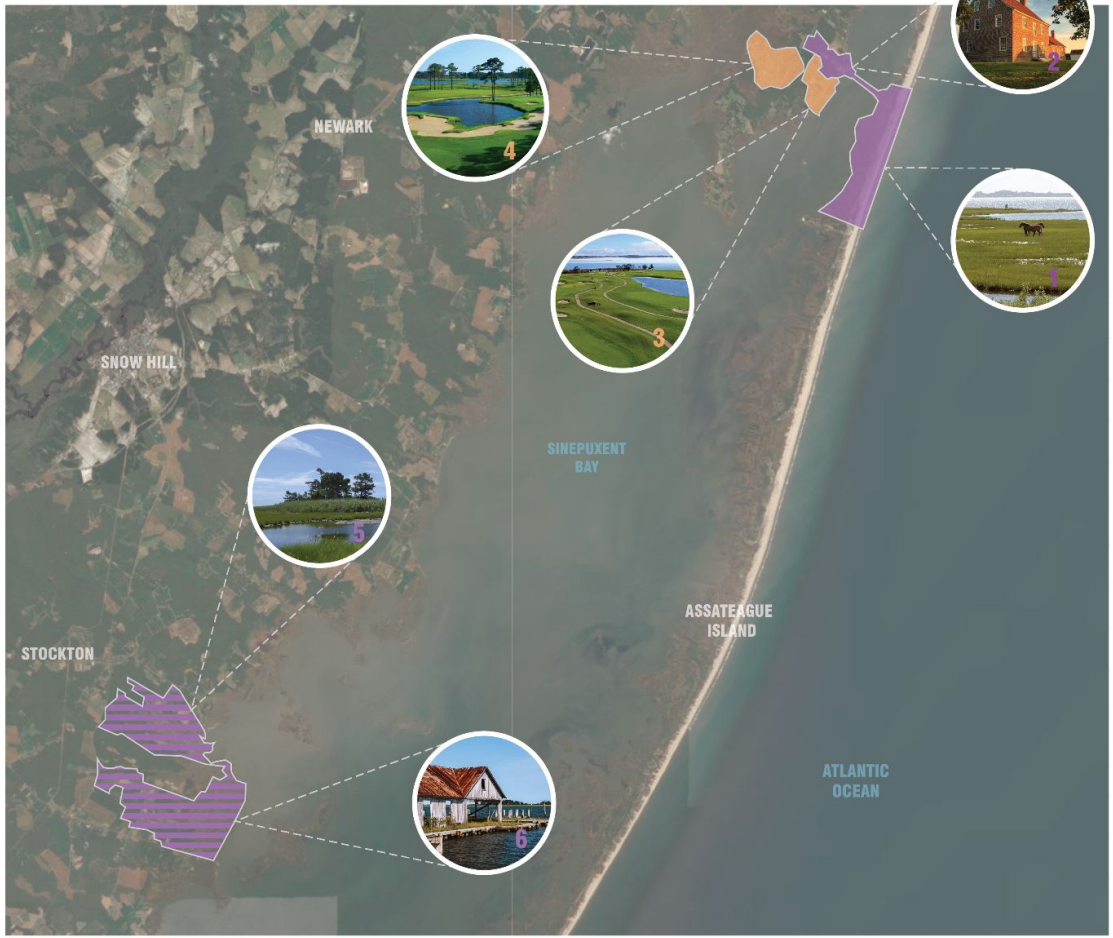
To adapt the campsites to a changing climate, this proposal calls for transforming the existing park-in loops to hybrid loops that accommodate both park-in and walk-in visitors. This change is imagined as happening in phases over time. RV sites closest to the dune can be converted into walk-in campsites, with additional vehicular parking located adjacent to the loop along Campground Road. A smaller RV loop would be established closer to the road so as to continue to provide ample space for park-in campers while protecting the paved sites from dune migration and severe weather events. If a third sand fence were added to widen and reshape the dune, the RV loop could be further reduced in size while the area used for walk-in campsites could increase. Although this configuration would require a more compact arrangement of sites, the campsite layout could more nimbly respond to the topography of the secondary dunes, and will be more resilient to changes along Assateague's coast.

ABOVE RV camp loop F transformation sequence over time. *(by Y. Konan)*

RIGHT Existing RV camp loop F. *(by Y. Konan)*



DNR OWNED LAND AND ACQUISITION OPPORTUNITIES



1 ASSATEAGUE STATE PARK (MAINLAND)
256 ACRES
.4 SQ. MILES
0.00 MILES FROM RANGER STATION

2 ASSATEAGUE STATE PARK (ISLAND)
692 ACRES
1.08 SQ. MILES
1.20 MILES FROM RANGER STATION

3 RUM POINTE GOLF COURSE
212 ACRE
.33 SQ. MILES
1.57 MILES FROM RANGER STATION

4 OCEAN CITY COUNTRY CLUB
455 ACRE
.71 SQ. MILES
2.42 MILES FROM RANGER STATION

5 EA VAUGHN WILDLIFE MGT AREA
1,346 ACRES
2.10 SQ. MILES
16.96 MILES FROM RANGER STATION

6 GEORGE ISLAND LANDING
1,681 ACRES
2.63 SQ. MILES
18.07 MILES FROM RANGER STATION

STATE PARK LAND
DNR OWNED LAND
POSSIBLE LAND ACQUISITIONS

RUM POINTE LAND ACQUISITION AND REWILDING OF COURSE

PRECEDENTS

ORCHARD HILLS PARK, CHESTERLAND, OHIO
237-ACRE
Formerly managed as a golf course, is in the process of reclaiming a natural landscape. Six trails total 3.6 miles. Children can have fun here on an orchard-themed playground. Restoration has been funded in part through a grant from the Ohio Environmental Protection Agency and U.S. Environmental Protection Agency under provisions of Section 319(h) of the Clean Water Act.
Amenities
- Athletic Fields
-Cross Country Skiing

FORESRT BEACH MIGRATORY PRESERVE, BELGIUM, WISCONSIN
116-ACRE
Located along Lake Michigan in the town of Belgium, Forest Beach Migratory Preserve was established in 2017. This preserve contains a 5-acre hardwood forest with seasonal ponds, open grassland and prairie, a partially wooded ravine and 5 constructed wetland ponds. Today the preserve hosts a "patchwork quilt" of habitats that support all kinds of migratory birds, reptiles and mammals.
Amenities
- Hunting
-Water Features
- Bird Watching

THE HIGHLANDS, GRAND RAPIDS, MICHIGAN
121-ACRE
Blandford Nature Center and the Land Conservancy of West Michigan collaborated on the purchase of the Highlands Golf Club in Grand Rapids in the winter of 2017 with a vision to transform the property into a natural area for community recreation and education. The vision to transform this former golf course into a premier space for learning, recreation and conservation is now a reality. The Highlands is a place where people of all ages can discover nature.
Amenities
-Hiking Trails
- Bird Watching
-Leashed Pets Allowed

*Additional Possible Amenities
- Art Installations - Solar Farm
- Dog Park - Frisbee Golf
- Archery Range - Drone Racing Course

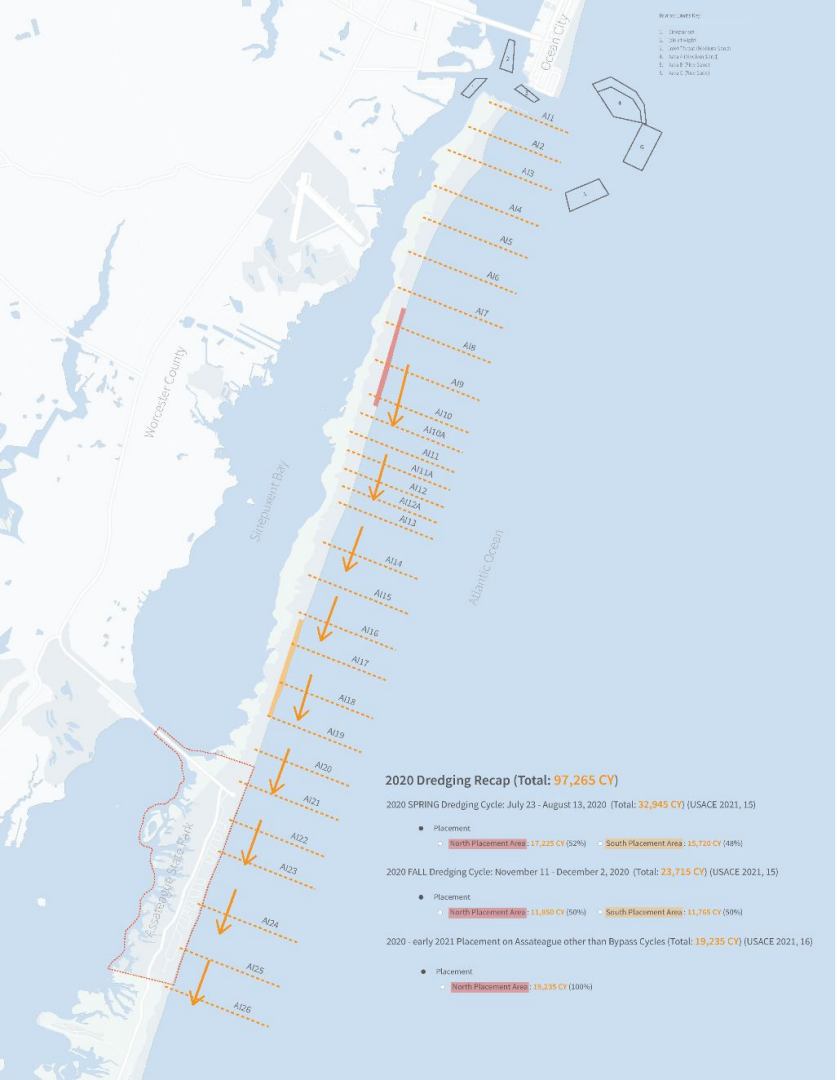
REWILDING OF GOLF COURSE

PHASE 1: DECONSTRUCTION

PHASE 2: RE-NATURALIZING

PHASE 3: ADDING AMENITIES

PHASE 4: BEACH FRONT



Shifting Sand: Dune Expansion + Shoreline Nourishment

The sands, dunes, and shoreline of Assateague Island are constantly shifting, moved by winds, waves, and rainfall. Because these forces have caused the sandy areas of the island to shrink and move westward, several restoration projects have been pursued to mitigate the sand starvation and shoreline retreat occurring in Assateague State Park.

Today the shoreline is maintained through a long-term habitat restoration project in a partnership between the National Park Service and the United States Army Corps of Engineers. Twice a year dredged sand is placed on the northern end of the island to mitigate some erosional effects of the inlet on Assateague's beaches and dunes. The sand is pushed southward towards Assateague State Park by longshore currents and winds, allowing for the park's shoreline to be passively restored. The sand used for shoreline replenishment is dredged from places in the region where it has accumulated, including at the Ocean City inlet. The dredging and relocation of sand from the inlet both supports beach maintenance and clears the inlet for recreational purposes and utilization by commercial fisheries.

New sand fence strategies can be implemented in Assateague State Park to better maintain the primary dune and prevent sand on the landward side of the dune from covering camp sites following storms, which is a costly and labor-intensive maintenance issue. Currently, the fence line between the dune and the camp loops is a straight line. But new configurations could help to alleviate erosion issues that routinely compromise the camp sites. Placing new fencing near the campsites and in areas between the camping loops and secondary dunes, as well as using fencing to connect the primary dunes with the secondary dunes, could widen the primary dune and thus decrease the occurrence of overwash fans during storm events. Another opportunity could be to place a back fence along the camping loops so as to both widen the existing dune and create a tighter alignment between the dunes and the campsites. As RV camping is phased out in coming years and camp loop configurations shift westward, the fence line can follow and the primary dune can be widened. The broadened primary dune would permit the ongoing use of the park's campsites, even as the island continues to shift.

LEFT Diagram of passive sand nourishment along Assateague Island. *(by J. Lee)*

Active Beach Nourishment

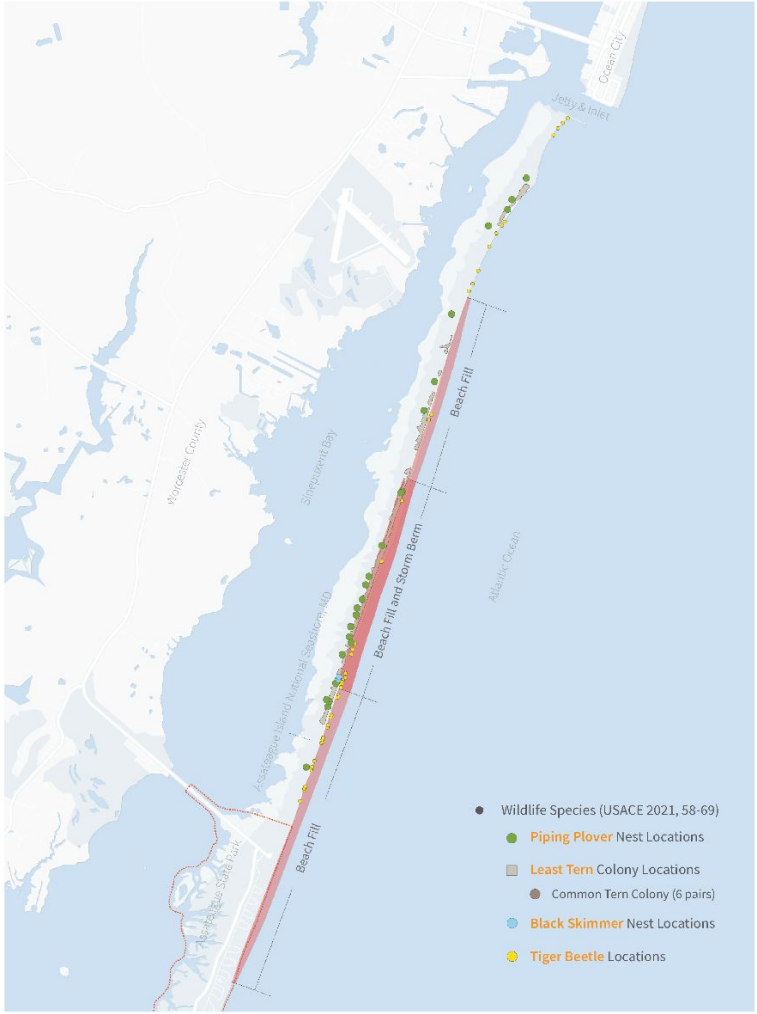
During the early 2000s, an active beach nourishment project was undertaken, replenishing the shoreline by expanding it 50-100 feet seaward through the addition of 1.8 million cubic feet of sand directly onto the beach.

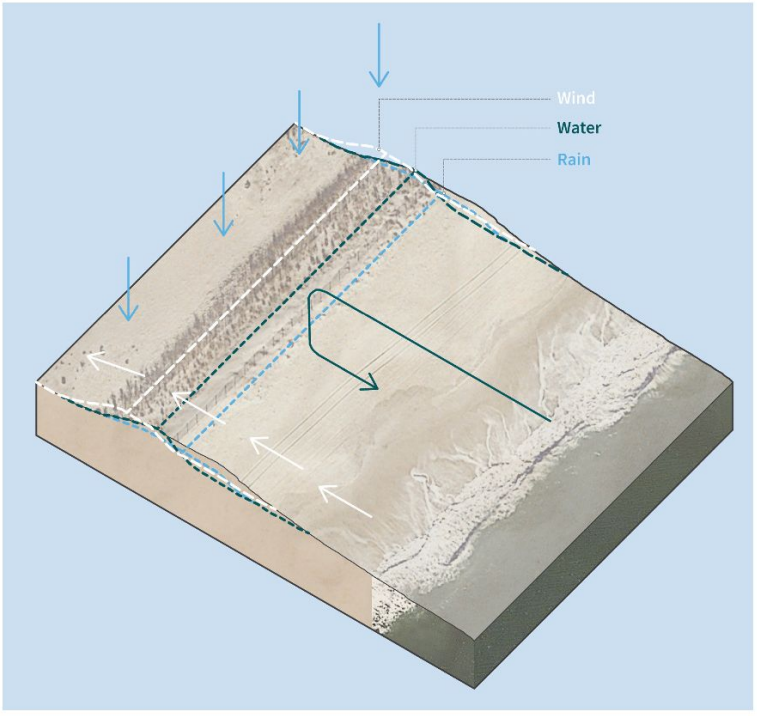
While the addition of sand is necessary for the replenishment of Assateague Island's shoreline, nourishment of this kind can cause damage to existing habitats. For example, several bird and insect species present on the island, including piping plovers (*C. melodus*), least terns (*S. antillarum*), black skimmers (*R. niger*), and tiger beetles, nest along the beach. The large-scale addition of sand to the shoreline can cause nests located near the shore to be covered by sand and can therefore pose a threat to the continued health of beach-dwelling species.

ABOVE Processes of passive sand nourishment (left); and active beach nourishment (right). *(by J. Lee)*

CENTER View of erosion at dune. *(photographer unknown)*

RIGHT Diagram of sand placement during one-time active beach nourishment project in early 2000s. *(by J. Lee)*





Dune Shaping Processes

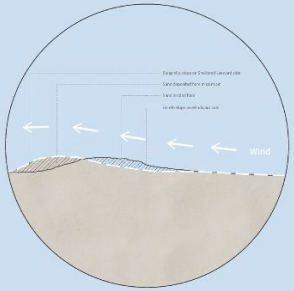
The island's dunes are shaped primarily by three forces: wind, waves, and rainfall. Most of the sand composing the dunes is moved by wind, with the overall volume of the dune being pushed landward as wind causes smaller grains of sand to pile up behind the dune's original location. The dunes are eroded during storm events, when waves hit the dune and remove large volumes of sediment. The vertical force of rainfall can also shape the dunes, flattening them during heavy rain events.

To minimize the impact of these forces, the Maryland Department of Natural Resources has implemented several strategies to maintain the dunes and protect the infrastructure in Assateague State Park. Ongoing dune maintenance practices include: planting shrubs and grasses to stabilize dune sand; adding fencing to trap sand and build up the dunes; and widening the dunes through the addition of sand.

ABOVE Forces acting on dunes (axon). *(by J. Lee)*

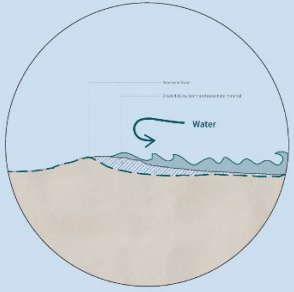
RIGHT Forces acting on dunes (section). *(by J. Lee)*

NEXT PAGE Proposed practices of dune maintenance through novel fence placement strategies (axons and plan). *(by J. Lee)*



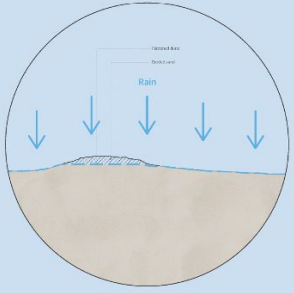
Wind Force

- The greatest volume of sand can be moved by strong wind because the amount of sand moved by wind is a power function of the wind speed. A wind of a particular velocity usually moves smaller grains and those smaller grains pile up behind the original dune. Eventually, the volume of dune will be pushed back through the wind force.



Water(Wave) Force

- During a storm, water levels are elevated because of storm surge and large waves are being produced. Those large waves constantly hit the dune, and can cause erosion and the removal of significant volume of sediment from the dune.



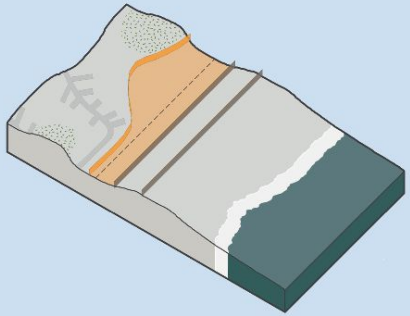
Rainfall Force

- Heavy rainfall can erode steep dune faces. Vertical forces by rainfall make the dune flatten and the condition of the surface changes after rain due to moisture absorption.

Proposed Practices of Dune Maintenance

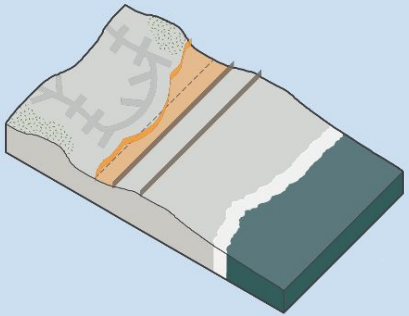
Various Shapes of New Fence Placements

1. Between Loops and Dunes



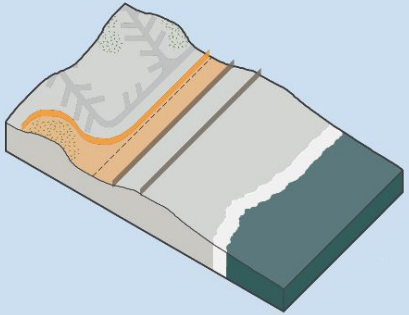
- Back fences near campsite can be shaped so that the primary dune could be extended into areas between camping loop and between secondary dunes. It allows the primary dune to form broaden crest.

2. Parallel to the Camping Loop



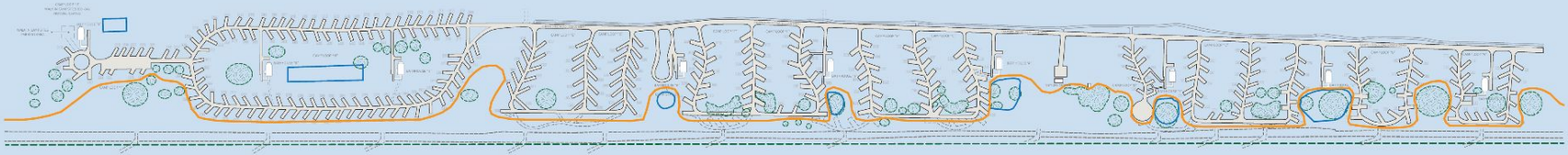
- Another possible shape of back fences is to place them along with the camping loop. It not only creates wider dune but also provides connection with the existing camping loop.

3. Connected to Secondary Dunes



- Through this shape of fence, the primary dune can connect with the secondary dunes. In that way, there could be a chance to reduce overwash fans during the storm events.

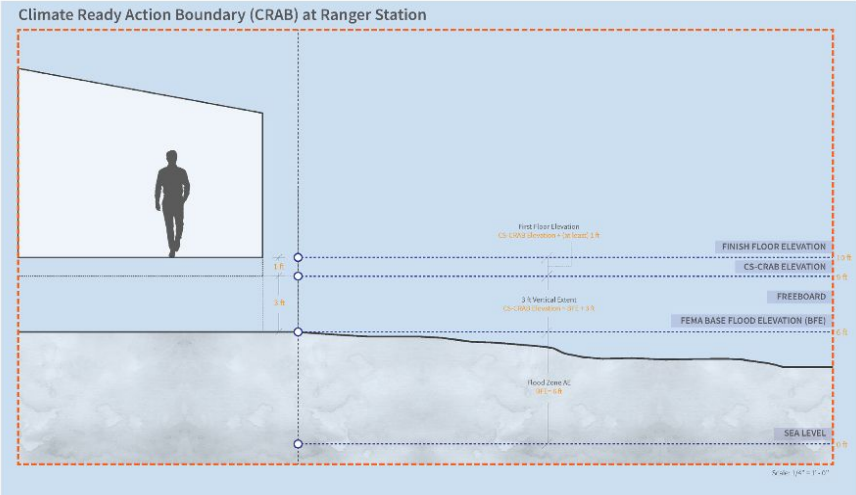
Proposed Fence Placement



03
Park Architecture

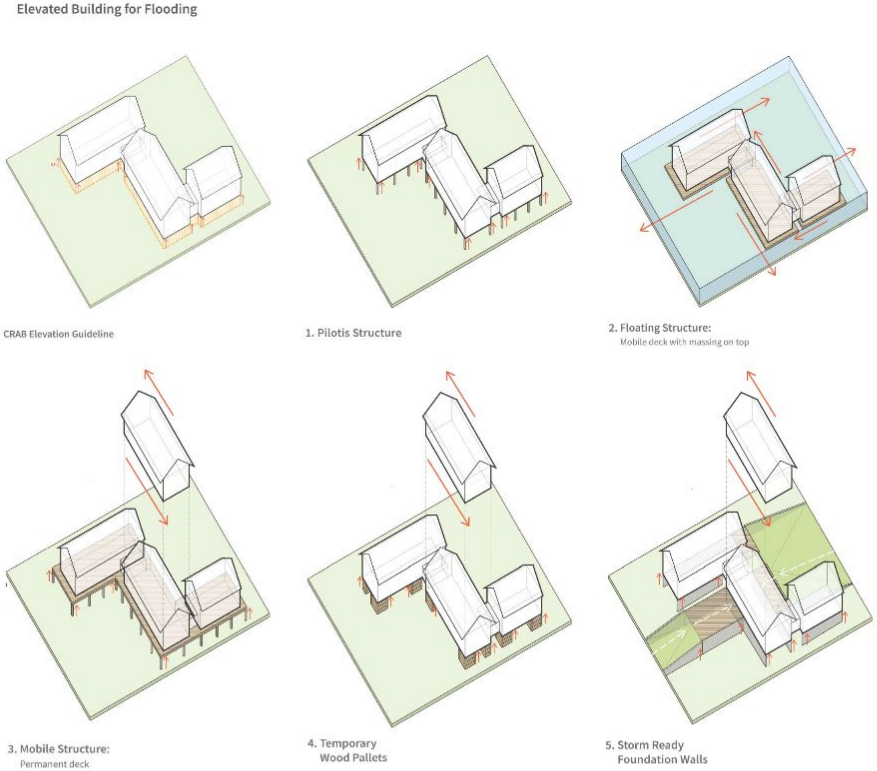
Ranger Station Building and Landscape Design

The redesign of the Ranger Station at Assateague State Park is an opportunity to create a new and welcoming point of arrival to the park. The design proposals on the following pages illustrate how passive solar and ventilation strategies can be creatively employed in the building. Case study projects, along with local indigenous and vernacular building practices were studied to derive design principles. The original program requirements have been expanded to include the design of a public, educational landscape, a space where visitors can gather to learn about the ecologies of the island and dynamic processes that shape it. The proposals also reimagine the Ranger Station parking lot as a landscape shared by people and cars, which offers a new, shaded pedestrian path between the Ranger Station and the Pony Express.



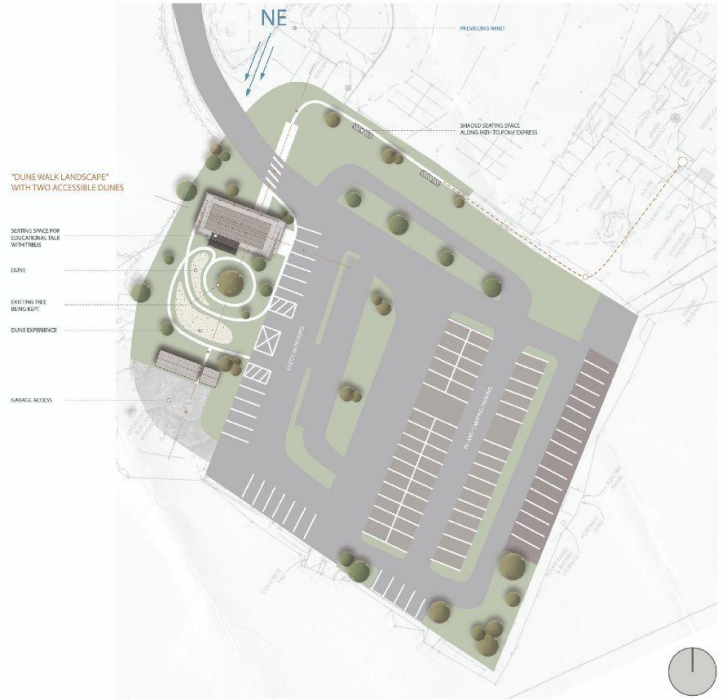
CRAB (Climate Ready Action Boundary) Elevations

One metric used to inform flood-proof design is the Climate Ready Action Boundary (CRAB) elevation, defined by the Maryland Department of the Environment as the elevation of the 100-year FEMA floodplain plus an additional three feet. The Maryland Department of Natural Resources requires that all damaged, essential state and local structures located waterward of the CRAB be constructed with a first-floor elevation at least one foot above the CRAB elevation. Following these guidelines, the ranger station and other visitor facilities in Assateague State Park must be elevated ten feet above sea level, or four feet above their present ground-level elevation, to ensure that the structures are resilient to sea level rise and flooding events.



THE GREETING

ABOVE The Greeting. Perspective view to main entry of Ranger Station. *(by Y. Konan)*



Site and Building Organization

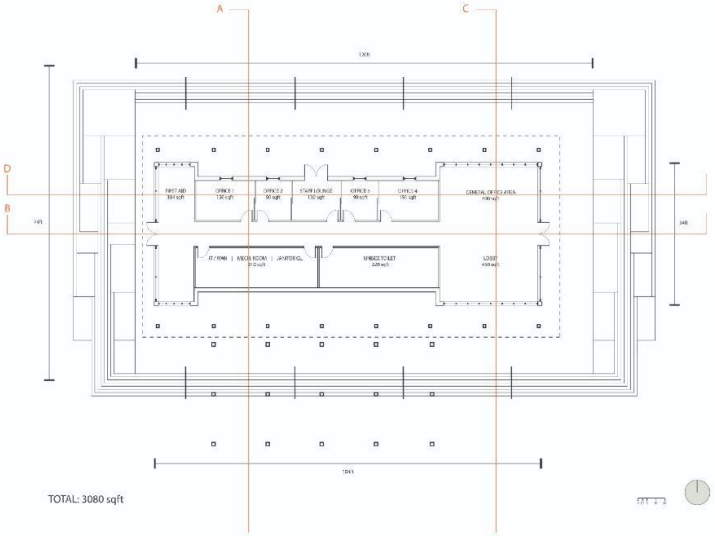
The site strategy for the project includes positioning the Ranger Station to the northern end of the site, in order to preserve an existing tree at the center of the site. The tree becomes a focal point in the Dunescape educational landscape, which features tear-drop shaped dunes and winding paths that encircle the tree. A large trellis projects from the southern facade of the building and provides shade for seating, creating a gathering place in-between architecture and landscape.

The Ranger Station is a rectangular volume, with public program positioned at the ends of the volume, and private program in the space in-between. The main entry to the building is located at the east facade, and is accessible to visitors approaching from the parking lot as well as walking from the Pony Express. The building is elevated on piers for flood protection, and the entire building is encircled with a broad porch and colonnade, which is shaded by generous roof overhangs.

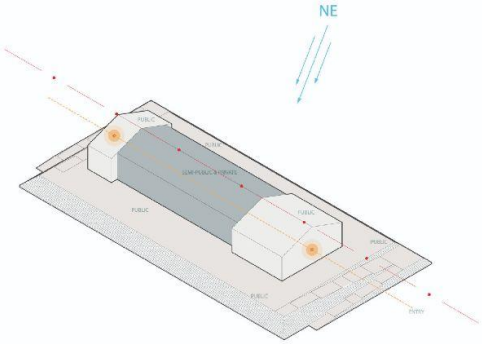
ABOVE Site plan. *(by Y. Konan)*

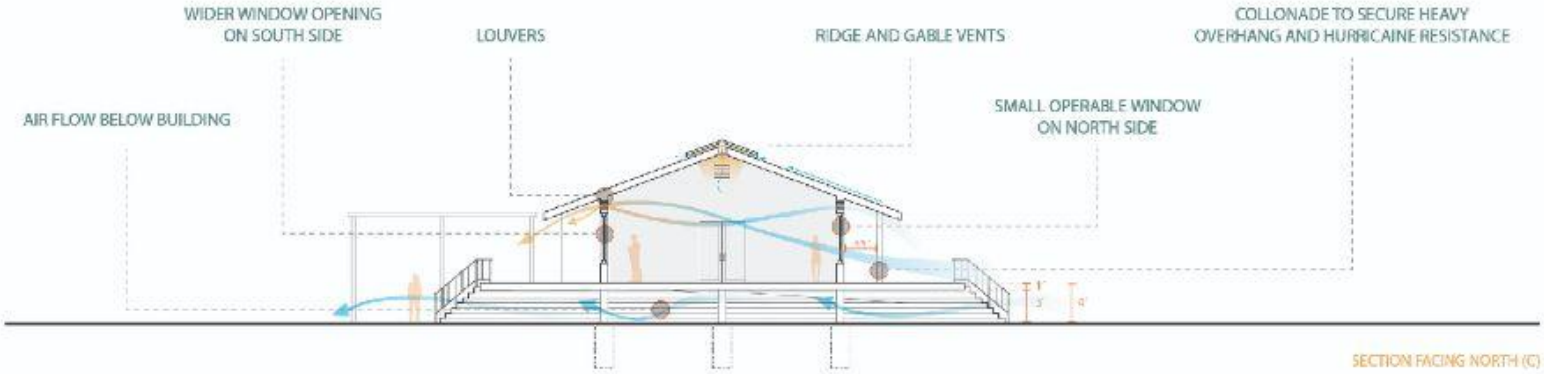
RIGHT ABOVE Ranger Station floor plan. *(by Y. Konan)*

RIGHT BOTTOM Parti diagram. *(by Y. Konan)*

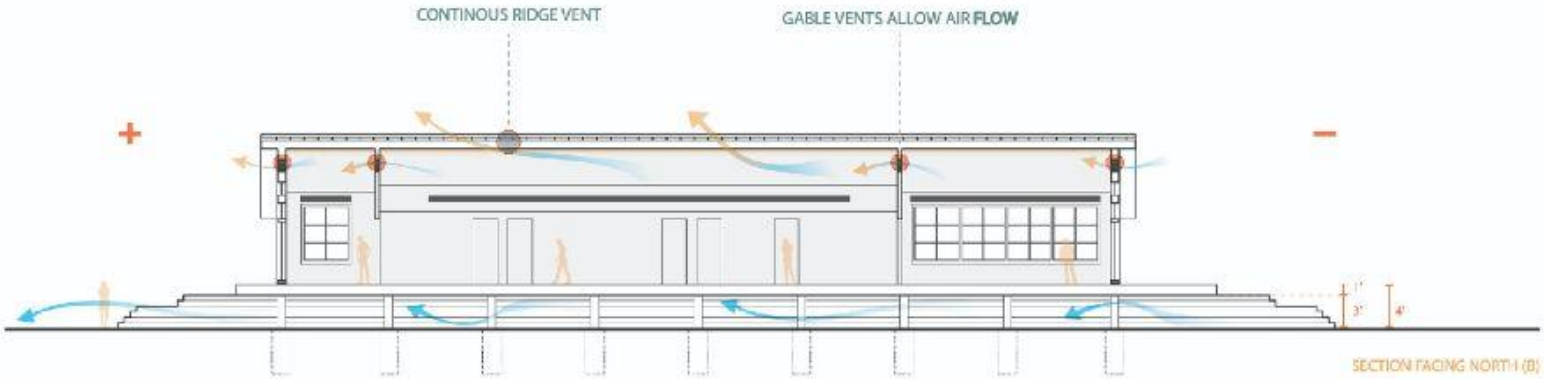


TOTAL: 3080 sqft



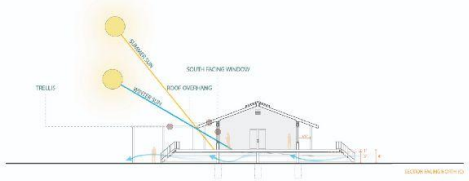


SECTION FACING NORTH (C)

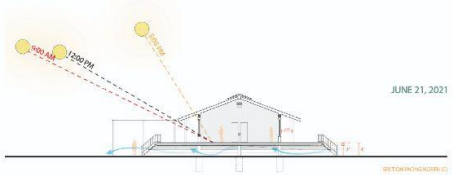


SECTION FACING NORTH (D)

SUMMER + WINTER

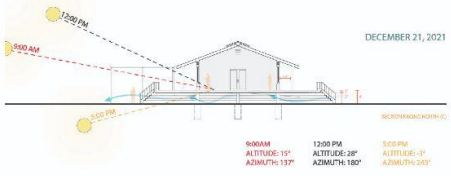


SUMMER



9:00AM	12:00 PM	5:00 PM
ALTITUDE: 37°	ALTITUDE: 70°	ALTITUDE: 28°
AZIMUTH: 87°	AZIMUTH: 133°	AZIMUTH: 272°

WINTER



9:00AM	12:00 PM	5:00 PM
ALTITUDE: 15°	ALTITUDE: 28°	ALTITUDE: 3°
AZIMUTH: 137°	AZIMUTH: 180°	AZIMUTH: 243°

Passive Solar Strategies

The Ranger Station design follows best practices for passive solar strategies in the Mid-Atlantic region. The rectangular volume is oriented with its long axis in the east-west direction. Deep overhangs are designed to block summer sun from heating the building, which will limit the need for energy intensive cooling in the summer. Allowing the winter sun to penetrate the building means that less energy expended on heating the building during winter months. And a trellis on the southern facade shades the outdoor gathering space at the Dunescape.

ABOVE Passive solar strategies (section). *(by Y. Konan)*

CENTER Summer solar angles. *(by Y. Konan)*

BOTTOM Winter solar angles. *(by Y. Konan)*

RIGHT Building sections and elevations. *(by Y. Konan)*

EAST ELEVATION

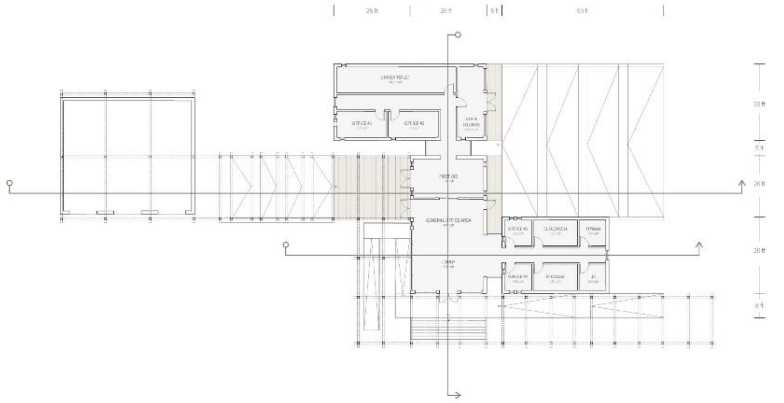
LATERAL SECTION (A)

NORTH ELEVATION

LONGITUDINAL SECTION (D)

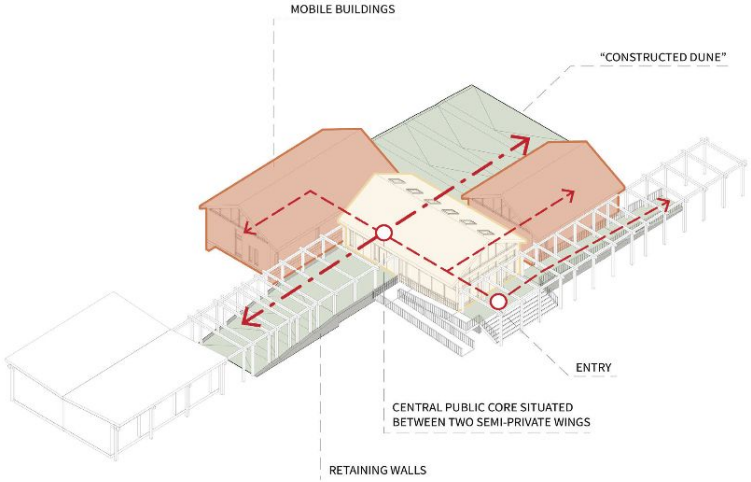
THE GATHERING

ABOVE The Gathering. Perspective view to public gathering and educational area at Ranger Station. *(by Y. Konan)*



TOTAL
3475 sqft

SCALE: 1/16" = 1'-0"



Site and Building Organization

Assateague Promenade features a parking lot transformed into a landscape with increased permeability, more efficient vehicular traffic, and new pedestrian paths and experiences.

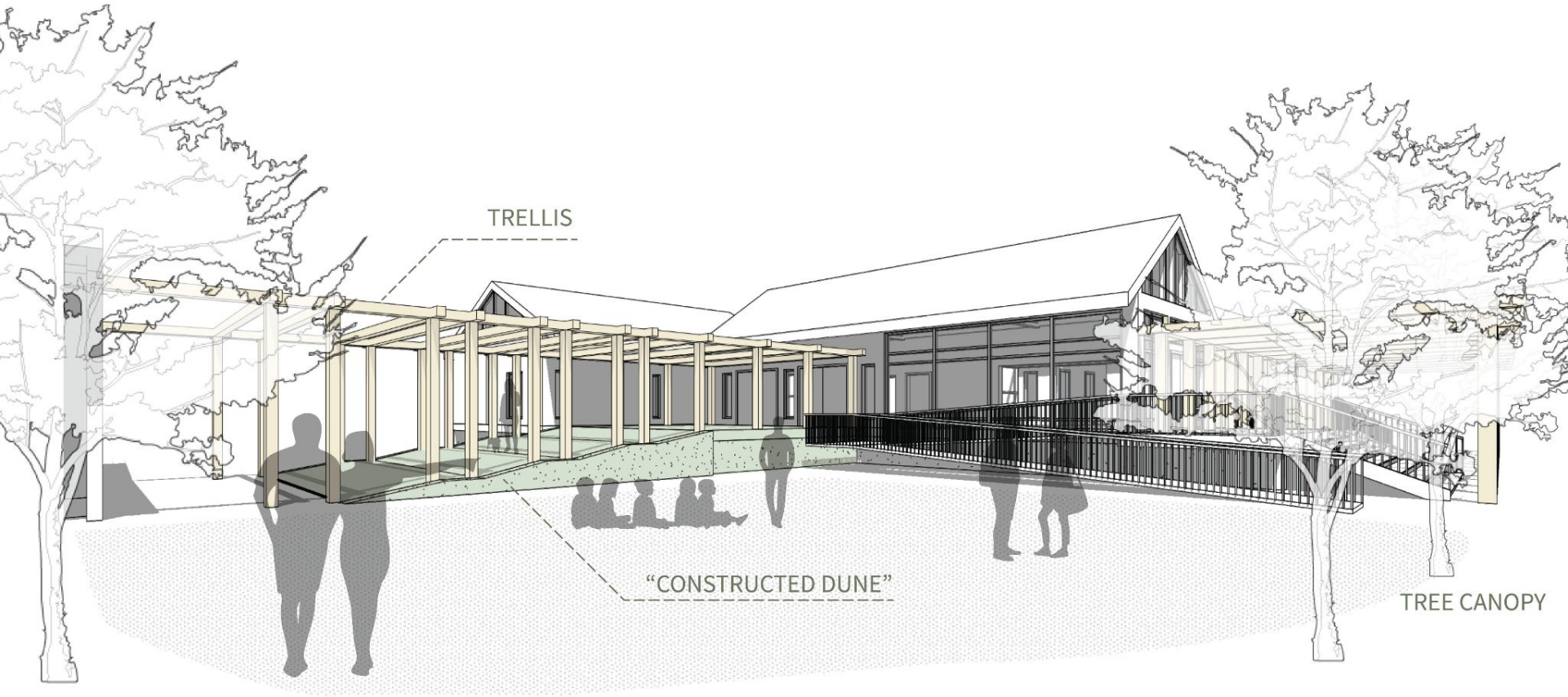
The program of the Ranger Station is distributed among three wings of the Z-shaped building. The public wing features camper check-in spaces and well as administration spaces for staff. The first-aid area is located in this wing, but shielded from the view of the public. The western wing includes staff offices, lounge, and bathroom, while the eastern wing includes office space, service, and storage.

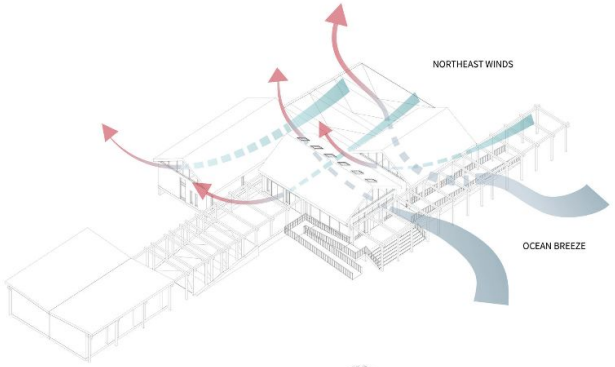
The buiding is constructed on intermittent foundation walls, and the eastern and western wings of the building are designed to be mobile and can be moved during major storm events to prevent damage.

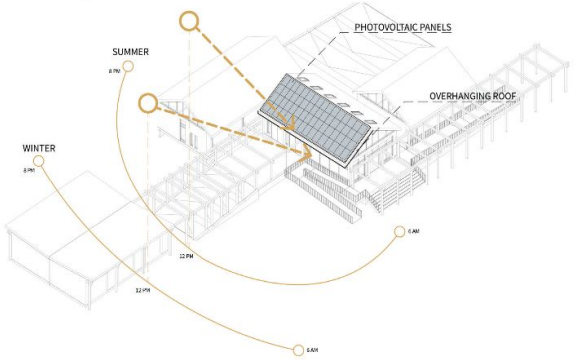
ABOVE Site plan. *(by S. Jamero and J.Lee)*

ABOVE RIGHT Ranger Station floor plan. *(by S. Jamero and J.Lee)*

BOTTOM RIGHT Parti diagram. *(by S.Jamero and J. Lee)*


TRELLIS
"CONSTRUCTED DUNE"
TREE CANOPY





Passive Solar and Ventilation

Passive solar strategies at the building include an overhang that is designed to help mitigate summer sun while allowing winter sun to penetrate the building. Photovoltaic panels are introduced on the southern roof for passive energy production.

The building is cooled through passive ventilation strategies that allow prevailing winds and ocean breezes to move hot air out of the building via high windows and gable vents.

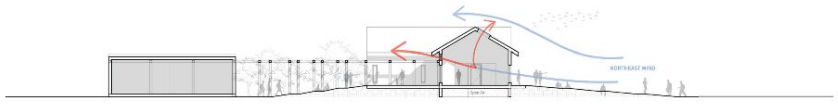
ABOVE Passive ventilation diagram. *(by S. Jamero and J. Lee)*

BOTTOM Passive solar diagram. *(by S. Jamero and J. Lee)*

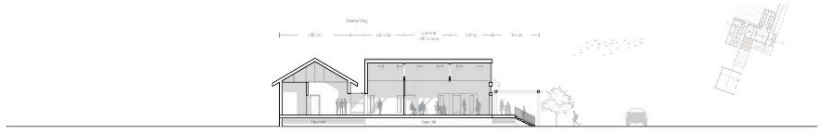
RIGHT Building sections and elevations. *(by S. Jamero and J. Lee)*

SOUTHEAST ELEVATION SCALE: 1/8" = 1'-0"

LONGITUDINAL SECTION SCALE: 1/8" = 1'-0"

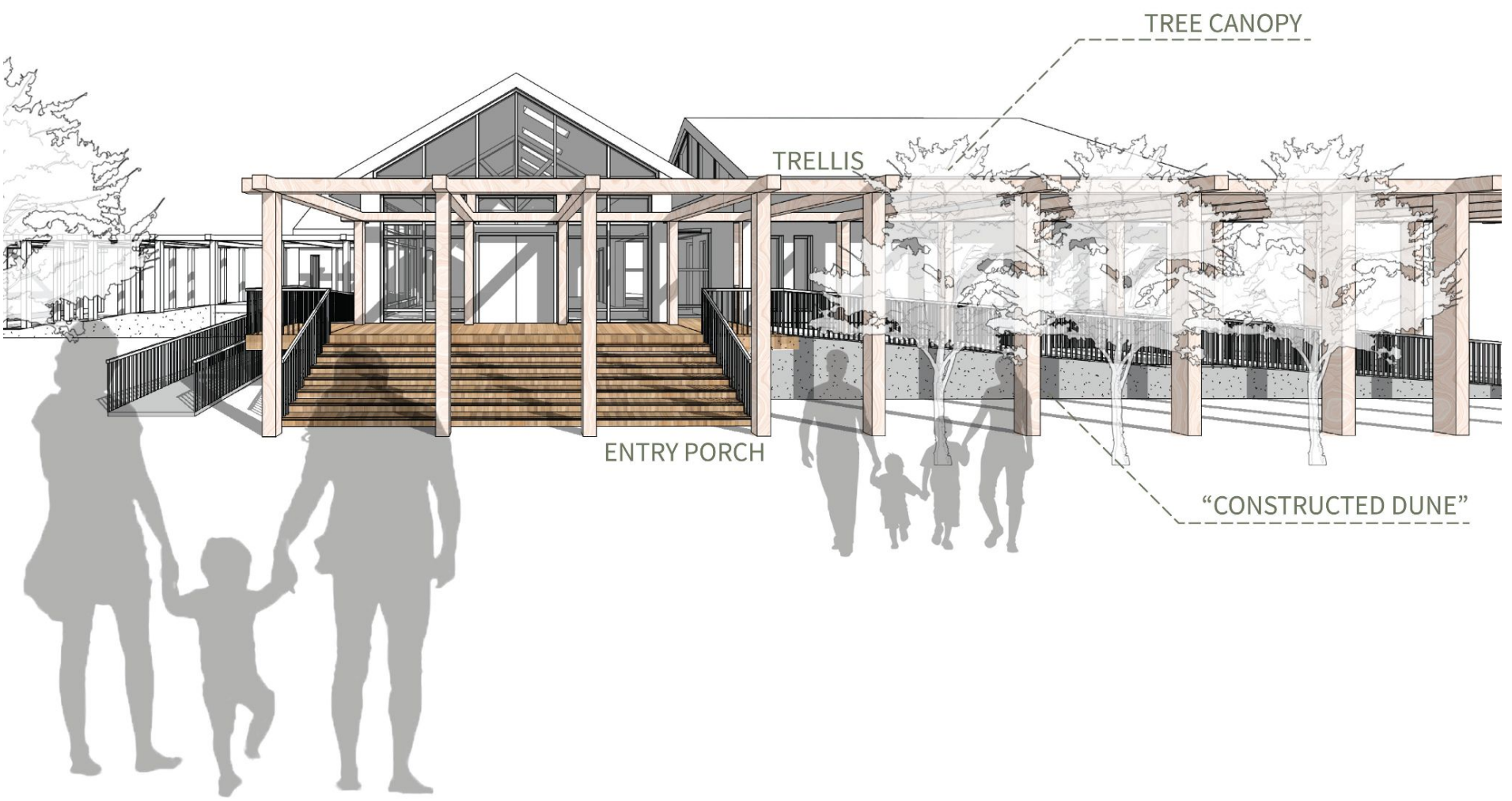


SITE SECTION

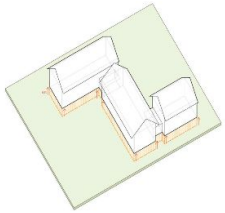


TRANSVERSE SECTION SCALE: 1/8" = 1'-0"

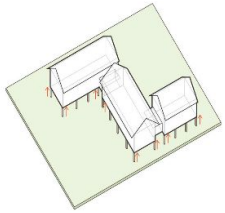
NORTHEAST ELEVATION SCALE: 1/8" = 1'-0"


TREE CANOPY
TRELLIS
ENTRY PORCH
“CONSTRUCTED DUNE”

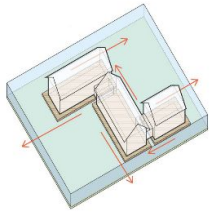
Elevated Building for Flooding



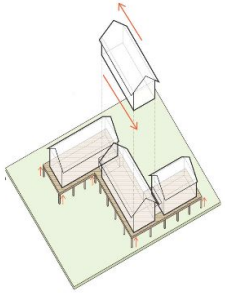
CRAB Elevation Guideline



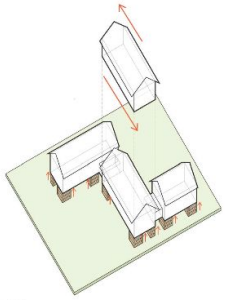
1. Pilotis Structure



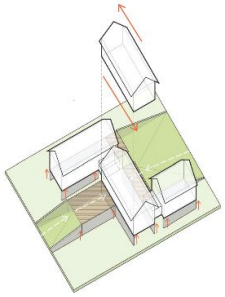
2. Floating Structure:
Mobile deck with massing on top



3. Mobile Structure:
Permanent deck



4. Temporary
Wood Pallets



5. Storm Ready
Foundation Walls

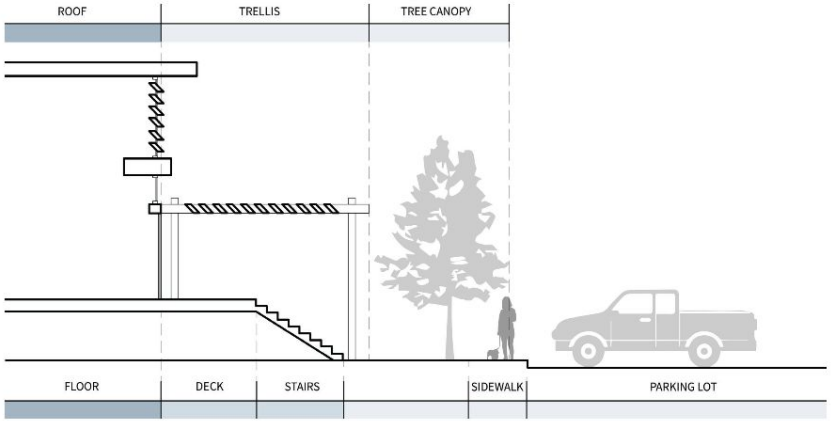
Design Strategies

The need for the building to be elevated such that finished floor is 4'-0" above the ground (based on CRAB standards) opens many design possibilities for linking building and landscape. In the project, the elevated building is supported by a series of foundation walls elevate the building, serve as retaining walls that shape the "constructed dune," and allow air flow below the building. The semi-private wings of the building can be relocated in anticipation of major storm events.

The project also explores the design principle of "ecotones" between building and landscape. At the entry sequence to the building, visitors experience different degrees of permeability both above them and below. Visitors walk under a tree canopy, followed by a trellis, before finally entering under the impermeable canopy of the roof building. On the ground, the parking lot is designed with a high degree of permeability, followed by a semi-permeable deck, and finally the non-permeable floor of the building.

ABOVE *Strategies for elevating building for flooding. (by S.Jamero and J. Lee)*

RIGHT *"Ecotones" between building and landscape. (by S. Jamero and J.Lee)*



PERMEABLE

SEMI - PERMEABLE

NON - PERMEABLE