

Engineer #1:

Several advances have been made in the last 30 years. Miami is now a place focused less on tourist attractions like late night party scenes and warm sun and beaches; rather it is a spot with the mangroves, canals and raised beds as well as its reefs that people can explore. The path to innovation was arduous as rising sea levels threatened Miami (as it did many coastal cities). About 30 years ago, the flooding occurring due to this rising sea levels had made several damages to infrastructure and private property. The South Beach was at a massive disadvantage being completely surrounded by water and only connected to the greater part of Miami through bridges. These bridges also were not most prepared to face the issue at hand. The Netherlands' approach to flooding were a source of inspiration for early solutions to the problem. The Netherlands' Eastern Scheldt barrier which protects the country's coast against storm damage by strategically opening and closing gates was used as an early blueprint for the Miami Barrier. The Miami Barrier implemented had major issues withstanding the amount of water coming into the coast as well as complaints from the local public of its appearance and effectiveness. The effectiveness of the barrier made it difficult to support more projects similar to it. All the while more implementations of emissions control were put into place in the US as a whole to limit the exacerbation of climate change. This meant that certain technologies at the time were limited and newer more Eco-friendly technologies arose. With an emphasis on efficiency and clean energy, more "green" infrastructures were used. For example, a project to create a wall (similar to the New Orleans' levy) was put forth. Yet due to concerns of structural integrity and fear of strong flooding, a different technology was put in place.

This technology was a buildup, otherwise known as dunes. Where the ground was elevated and injected (with sand) along with highways built atop of it. The elevated highways atop the dunes gave an extra purpose to them. The dunes have been quite effective but also have support from other technologies (Figure 1). There was a movement for the integration of natural and man-made barriers. The natural barriers being the mangroves and wetlands build up. The mangroves were a time-consuming project which only now (2040) the benefits can be seen with its effect on flood management and attraction for Eco-tourists. The mangroves create more protection from oncoming waves and storm damage to Miami.

Through the last 15 years the infrastructure has been built with the idea of increasing sea levels, which has led to more high rises, and build ups of all forms of infrastructure. Houses closer to the coast now have to be above sea level by a few feet and have flooding proof basements. Highways have also been built higher along with all bridges. New project ideas for the future include implementation of more technologies such as underwater (at least water resistant) transportation with tunnels. There has even been planning on the front of building an



Figure 1. Coastal Miami Beach and Dunes (Shutterstock)

underwater hotel or possibly an underwater observatory/city center as an attraction for tourists in the next 50 years. Miami has really embraced its identity as an outdoors location and has used the forming technologies in sea level rise protection to create a real niche.

Engineer #2:

After about twenty years have passed, Miami has introduced many forms of new technology and new innovative ideas that have allowed people to live in areas with high rates of flooding due to the increased sea level. The use of mangroves, dunes, artificial reefs, a new bullet train system, and elevated homes and infrastructure have all allowed Miami to once again be a habitable area. As a city, Miami has worked to embrace its identity of being a place where one can explore outdoors. Their goal as a city is to make helpful changes to help improve the living conditions with increased sea level but also to maintain a visual look close to what it was in the past.

One of the ways scientists worked to reduce impact of the rising sea level is through the use of mangroves. The implementation of mangroves allows for the reduction in the height and energy of wind and waves passing through them. This in fact reduces the waves or winds ability to erode sediments and to cause damage. Other cities have attempted to build up walls but have found that this was not necessarily a successful approach to prevent flooding. Mangroves help to preserve structures such as dunes and sea walls since it reduces the power of the waves and wind. Mangroves have tightly packed roots and low branches which present a great obstacle to waves passing through, compared to trees with areas with few or no roots above the ground (Figure 2). Another important part that mangroves play are tied to the ability to hold carbon. Large

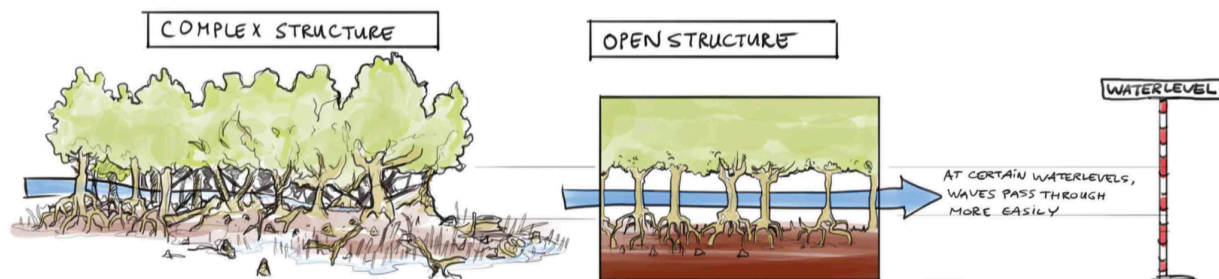


Figure 2. Mangroves Reduce Wave Damage (Spalding, 2014, p. 16)

quantities of carbon are held in both the roots of the tree above the ground and in their soils. This is unlike what typical tropical forests do with carbon emissions, the mangroves retain carbon and store carbon emissions in their soils where it remains for many years. This is possible because the conditions of the plant allow for the preservation of organic material by preventing breakdown by bacteria.

Another change to the environment has been seen through the introduction of more dunes on the beach. Dunes play a similar role as do mangroves since they can slow down the buildup of waves which in turn will reduce the impact the land receives from storms. The mangroves are close to land, whereas dunes are on the beach which is a place where mangroves cant survive.

Both the implementation of dunes and mangroves tie to Miami's goal of continuing to be location based off of outdoor activities. Visitors can take trips to Miami and spend time kayaking through mangroves or snorkeling through reefs.

Additionally, the increased use of elevated home and infrastructure have become widely used in the Miami area. In order to assist with the travel to Miami for their eco-tourism attractions, an elevated bullet train has been built that travels from Boston to Miami (Figure 3). This train is elevated so that its travel along the coast can avoid flooded streets. The use of the bullet train also helps the environment and reduces emissions compared to the use of an airplane or driving in a car.



Figure 3. Elevated Bullet Train (PTI, 2016)

More specifically in Miami, the government has now forced all homeowners to raise their homes using an engineering technique involving pilings that are placed deep into the ground (Figure 4). Raising homes allows for the prevention of possible flooding and evacuations for homeowners in this area during storms with flooding. Overall, these improvements have helped during times of flooding and dangerous storms but they have also helped with the reduction of emissions released into our environment which has slowed down the increase in sea level for the first time in many years. Miami hopes to continue to make improvements as time goes on



Figure 4. Elevated Home (House Plans)