

Daytona Beach is centered on water, literally. The coastal city is half on the mainland and half on the barrier island that spans the east coast of Florida. Many tourists come to the city to enjoy the wide, white sand beaches; however, locals tend to prefer the Halifax River, an intracoastal river that runs from St. Augustine Inlet to Ponce Inlet to Mosquito Lagoon. Both the ocean and river host water sports and world-class fishing. The city is also in close proximity to the state's several natural springs. These cool, fresh water pools provide a serene escape from the salty coast. The city's access to these natural resources is the main reason for tourists and new residents to come to Daytona Beach. Team Daytona Beach wanted to capture this love of water in their house by incorporating systems that are water-efficient and non-intrusive.



Figure 1: Aerial view of Mosquito Lagoon¹



Figure 2: Spring head at Kelly Park

WATERING THE BEACH HOUSE

Team Daytona Beach tackled the water-efficiency of The BEACH House head on by addressing the main water system of the building, plumbing. The BEACH House utilizes a parallel, PEX plumbing system. A parallel system has separate lines running to each water fixture in the home. These systems are able to reduce water consumption by reducing the wait time for hot water. This is done by shortening the distance the hot water must travel through from the tank to the fixture in use. For example, water going to the shower of The BEACH House only has 10-feet of pipe to travel through in the parallel system. This distance would be increased if a traditional plumbing system designed to service both the bathroom and kitchen 16-feet away had been used. The separate lines connect to the hot and cold water supply at a central manifold. The manifold has valves on each line that allows for easy control of flow in each branch of the plumbing system. Having control over of water flow to each fixture simplifies routine maintenance by allowing the isolation of the fixture.

The BEACH House utilizes PEX, cross-linked polyethylene, as the primary supply lines. This piping is a smooth and flexible plastic that has a longer life than traditional rigid materials. The smooth surface of pipe reduces resistance to flow, lowering the required pumping power. The flexibility of PEX dampens water hammer and reduces pressure spikes in the line. These plumbing systems are also resistant to corrosion, an important feature for the salty environment of coastal Florida.²

RAINWATER HARVESTING IN THE SUNSHINE STATE

Florida may be known as the sunshine state, but it has one of the highest yearly average rainfalls in the country.³ The majority of the rain comes in the wet season between May and October. Despite a large rainfall, the state faces issues with water supply. The state's main water source, the Floridian Aquifer, has been losing water over the past years at an alarming rate. This reduction can be seen in the lowered water marks on the trees that line the rivers flowing from the aquifer's natural springs. Lower water levels are a result of a lessened flow rate from the springs. The flow rate is decreasing due to the increase in the amount of water pulled from the aquifer for human consumption. The majority of water supplied by the aquifer goes to agricultural irrigation and public supply. Damage to the ecosystems supported by the aquifer's springs occurs when water flow rates are reduced by 4-15 percent. In years with low rainfall, the Floridian Aquifer can see water flow rate reductions of up to 40 percent.⁴



Figure 3: Reduced water line on Cypress trees that line Morrison Spring Run⁵

While Team Daytona Beach deemed it unsafe to incorporate any water reclamation or recycling in the potable water system, water efficiency was incorporated into the edible garden and landscape design.

The BEACH House has an edible, hydroponic garden integrated into part of the railing on the south deck. Hydroponic gardens utilize flowing water as a medium to bring water and nutrients to the plants roots instead of soil. While it may seem like hydroponic gardens use more water than traditional soil gardens, the opposite is true. Hydroponic gardens use less water than traditional soil gardens because water is not lost to surrounding soil and evaporation. The garden uses a nutrient film technique (NFT), where plants are suspended in growing tubes and their roots hang down into channels (Figure 3). The NFT technique provides a continuous supply of water and nutrients to the plants by circulating the water through the channels. The recirculation aerates the water, eliminating the need for an air stone. The growing channel used are connected through standard piping connections, making it easy to customize the system. The homeowner can add or remove channels to create the perfect size garden.

The hydroponics system in The BEACH House aims to receive 100 percent of its water supply from rainwater collection off the south roof. The rainwater is collected and mixed with compost tea and feed to the plants in a closed-loop system. The compost tea comes from a compost barrel off the south deck that turns the homeowner’s food scraps into the herbs for their next dinner party.

The nutrient infused rainwater is circulated through the garden by an energy-efficient air-lift system. The airlift uses an air compressor instead of a pump. The unused water is routed back to the nutrient reservoir for recirculation. There is no waste from over watering and no damage from over watering. Plants receive only the nutrients they need, and excess is routed back to the reservoir for later use. The BEACH House’s hydroponics system eliminates the seeps and leaks involved with traditional gardening. Plants use only the water they need; water that is purely from the rain.

Team Daytona Beach’s hydroponic garden is ADA compliant. The implementation of the growing channels on the deck railing places the crops at easily accessible locations, which provides an undemanding means of obtaining fresh, edible plants.

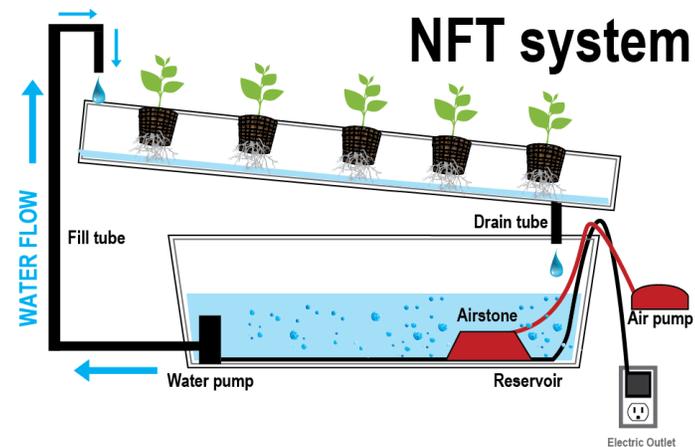


Figure 4: Schematic of a Nutrient Film Technique⁶

A RESILIENT BEACHSCAPE

Florida is a diverse ecosystem ranging from stark, cactus covered dunes to lush, foliage filled jungles. However, Daytona Beach is best known for its classic beachscapes. Team Daytona Beach wanted to capture this coastal essence in The BEACH House. To do this, the team incorporated the sweeping grasses and swaying palms beachscapes are known for.

The team worked with a local landscaping architect to choose native, drought resistant plants. The BEACH House is surrounded by planters of sand cordgrass and pink muhly grass. Both are native Florida plants that have a high salt tolerance, allowing them to thrive in the harsh, coastal environment. European Fan Palms decorate the porches, and, although they are not indigenous, they are cold-tolerant and well-adapted to coastal conditions.

The grasses are placed in three, separate planters around the house. They will be in long rows, giving the feel of beach dunes, while also providing a screen for some of The BEACH House's plumbing components and temporary foundation. The stately palms will be kept in large pots; one on the north porch to welcome the homeowners, and one on the south deck.

Upon our team's return to Daytona Beach, all landscaping will be planted around Embry-Riddle Aeronautical University's Daytona Beach campus.



Figure 5: Pink Muhly Grass Flower⁷



Figure 6: Sand Cordgrass⁸



Figure 7: European Fan Palm Seeds⁹

Recycling and Reclamation

Team Daytona Beach holds safety above all other criteria in their design selection. The target demographic for The BEACH House is an older family. This group is more susceptible to health risks

¹ “The Mosquito Lagoon And Indian River Lagoon of Central Florida Is Known As Redfish Capital.” ShrimpNFishFlorida™ Shrimping Fishing Forums, 22 Jan. 2016, www.shrimpnfishflorida.com/forums/threads/the-mosquito-lagoon-and-indian-river-lagoonof-central-florida-is-known-as-redfish-capital.5983/.

² plasticpipe.org/pdf/design-pex-plumbing-systems.pdf, Aug. 10, 2017

³ ‘Annual Precipitation for Selected Locations’, “National Climate Report – Annual 2015 Precipitation Anomalies”, National Centers for Environmental Information – National Climate Report, National Oceanic and Atmospheric Administration, ncdc.noaa.gov/sotc/national/2015/13/supplemental/page-2

caused by contaminated water. No explicit effort was made by Team Daytona Beach to reclaim or reuse water due to the potentially detrimental health effects.

⁴ “The Floridian Aquifer”, Florida Springs Institute- Floridian Aquifer, The Floridian Spring Institute, floridaspringsinstitute.org/Floridian-aquifer

⁵ “Morrison Spring Run”, *Home/Northwest Florida Water Management District*, www.nwfwater.com/.

⁶ Datkn, Sonny. “How to Grow Hydroponically – Overview of Grow Systems”. SD Hydro, 11 May 2012, sdhydroponics.com/2012/11/how-to-grow-hydroponically-overview-of-grow-systems/.

⁷ “Muhly Grass”. *Cherrylake*. 11 Apr. 2017, cherrylake.com/muhly_grass/.

⁸ “Sand Cordgrass”. *Cherrylake*. 11 Apr. 2017, cherrylake.com/sand_cordgrass/.

⁹ “European Fan Palm”. *Cherrylake*. 11 Apr. 2017, cherrylake.com/European_fan_palm/.