

MIAMI BEACH

COMMITTEE MEMORANDUM

TO: Public Safety and Neighborhood Quality of Life Committee Members

FROM: Alina T. Hudak, City Manager

DATE: May 23, 2023

SUBJECT: **DISCUSSION REGARDING THE PRACTICALITY OF 3D PRINTING OF ‘LIVING’ SEAWALLS.**

HISTORY:

At its May 4, 2022 meeting, the City Commission approved a referral to the Public Safety and Neighborhood Quality of Life Committee (PSNQLC) to discuss the practicality of 3D printing of “living” seawalls, item C4J.

At its January 11, 2023 meeting, the PSNQLC members discussed the item at length and made a motion for Public Works to explore the feasibility of a seawall pilot project using 3D printed concrete seawall panels (3D panels).

The 3D panels are intended as a replacement for traditional concrete panels used in seawall construction. Compared to traditional, flat seawall panels (Figure 1), the 3D panels (Figure 2) have a raised surface that proposes to improve environmental conditions by creating complex habitats for marine organisms to grow and forage. As directed, the Public Works Department further investigated the 3D panels that will be produced by an upcoming Miami-Dade County based manufacturer, Kind Designs.



Figure 1. Seawall constructed with traditional flat concrete seawall panels



Figure 2. Rendering of a 3D panel by Kind Designs

ANALYSIS

Update on Pilot Projects in Miami-Dade County

No 3D printed concrete seawall panels have been installed, as of March 2023. Kind Designs has printed 3D panels for testing in the Netherlands and expects to begin manufacturing the 3D panels in a warehouse located in Miami-Dade County in April 2023. A local seawall construction contractor, Dock & Marine Construction Company, plans to install the 3D panels on client projects as soon as the 3D panels are available. No known environmental or building permits have been requested or issued for seawalls specifying the use of 3D panels.

Two planned seawall pilot projects located in Miami-Dade County were previously discussed in PSNQL Committee: a private seawall replacement (100 linear feet) on the Miami River and a private seawall replacement in Key Biscayne. The Miami River

project has not yet submitted a permit application for the 3D panels; the Key Biscayne project has been defunded and there are no plans for implementation at this time.

Miami Beach Seawall Pilot Feasibility

A seawall pilot project with 3D panels is expected to have a similar cost and a similar construction installation method as constructing the seawall with the traditional pre-cast concrete panels specified in the City's Public Works Manual. The 3D panels can be used to meet the City's requirement of the top of cap seawall elevation of +5.7 feet (NAVD). Compared to a traditional seawall project, the project timeline for 3D panels is expected to be 3 to 9 months longer due to permitting.

Cost

The total capital cost of a seawall project is expected to be similar for seawalls using 3D panels as for seawalls using traditional concrete panels. The average cost for a typical, 40 – 100 linear foot City of Miami Beach seawall project is \$3,550/linear foot (in 2023 dollars): \$850/linear foot for design and \$2700/linear foot for construction, based on recent City projects. Structural testing of the 3D panels suggests that the 3D panels will have a 50-year design life, similar to traditional concrete panels. Accordingly, the frequency of replacement is expected to be similar, indicating a comparable equivalent annual cost for seawalls with 3D panels as for seawalls with concrete panels.

If the permitting agencies consider the 3D panels to have an environmental mitigation value, then this may reduce or eliminate the need for installation of rip-rap in the vicinity of 3D panel seawalls, thereby reducing the overall project cost. The costs of other seawall components such as the precast piles and the concrete cap is expected to be unchanged, regardless of the type of panel.

Permitting

The permitting process for a traditional seawall (no environmental resources impacts) has a typical duration of 6 months. The Public Works Department anticipates that the permitting timeframe will be approximately 9 – 12 months for a seawall with 3D panels, considering that this is a new and untested technology that may be closely scrutinized by the regulatory agencies.

At least three regulatory agencies are typically responsible for issuing permits for seawall projects. These agencies are Miami-Dade County Department of Environmental Resources Management (DERM), South Florida Water Management District (SFWMD), and U.S. Army Corps of Engineers. These permitting agencies have not issued a permit for a seawall using 3D panels, nor have they provided an estimate of the duration of the permitting process for seawalls using 3D panels. Kind Designs has had initial discussions with Miami-Dade County DERM, and DERM is supportive of a pilot project to evaluate the 3D panels in lieu of riprap mitigation that is currently required.

Potential Locations for City Pilot

In collaboration with Kind Designs and the City's Environmental Department, the Public Works Department used the following criteria to evaluate potential locations for a seawall pilot project using 3D panels:

Table 1. Seawall Pilot Evaluation Criteria

Criteria	Optimal Range	Rationale
Seawall Replacement Priority	High	Seawalls with high replacement priority are due for replacement in the near-term, irrespective of the pilot program.
Seawall Length	50 ft – 100 ft	This length is relatively short, keeping costs low for the pilot program.
Boat Traffic	Minimal	Wave activity from boats can discourage growth of marine life on the proposed seawalls.
Water Depth	2 ft – 5 ft	This is the appropriate depth for encouraging growth of marine life. Shallow depths decrease available surface area of the panels for growth of marine life.
Stormwater Outfalls	None or Low Velocity Flow	Rapid flow of stormwater through an outfall located on a seawall can discourage growth of marine life.
Existing Marine Life	Yes	The existence of marine organisms such as coral in the vicinity of the seawall suggests optimal growth conditions at the seawall.
Proximity to Biscayne Bay	Close	Proximity to Biscayne Bay generally improves water quality and flushing conditions compared to constricted canals.

Over 30 City-owned seawalls of medium to high replacement priority were considered for the pilot program. Based on these criteria, four locations are potential candidates for the seawall pilot project:

Table 2. Recommended Seawall Pilot Locations

Location	Seawall Length (linear feet)	Recommendation for Pilot
W 60 th Street,	46 ft	High

East of Pine Tree Drive		
42 nd Street, West of Indian Creek Drive	49 ft	Medium-High
Ray Street, South of South Shore Drive	49 ft	Medium-High
Northwest corner of 41 st Street and Indian Creek Drive	86 ft	Medium-High

CONCLUSION:

Following the recommendation of the PSNQLC members to explore the feasibility of a seawall pilot program using 3D printed concrete seawall panels (3D panels), the Administration has identified four feasible locations for the program, as well as a consultant to design 3D panel seawalls.

Applicable Area

Citywide

Is this a "Residents Right to Know" item, pursuant to City Code Section 2-14?

Yes

Does this item utilize G.O. Bond Funds?

No

ATTACHMENTS:

Description

[Commission referral to PSNQLC](#)

Type

Other