CUMMINS | CEDERBERG
Coastal & Marine Engineering

Review of Miami-Dade Back Bay Coastal Storm Risk Management Study

Draft Integrated Feasibility Report and Programmatic Environmental Impact Statement
August 4, 2020

Comments by:
Jannek Cederberg, PE
Jason Cummins, PE

Introduction

The below comments are relative to the above referenced study for Miami-Dade County by the US Army Corps of Engineers. The comments are separated in three groups 1) Overall Plan, 2) Technical, and 3) Design Suggestions.

Overall Plan

1. Although the study offers depth of analysis in many areas, the principal cost component is the construction of the structural measures. However, analysis of alternative structural measures was not evident. We understand the study is limited by time and budget (i.e. 3x3), however, the cost implications of the selected measure will reach into the billions of dollars. Seems prudent to further evaluate alternative structural measures – e.g. the detailed level of design calculations for the preferred structural solution could have been allocated to exploring alternative solutions at a higher level. The ultimate structural solution is the key component driving subsequent economic and other analyses, and thus alternatives deserve greater examination.
2. The proposed plan does not reduce or attenuate storm surge reaching the shoreline and will only function up to the design water level. If failure occurs, e.g. higher storm surge or sea level rise elevation than designed for, failure will not be gradual and areas behind the wall will be flooded.

3. No information was provided and it is unclear if analysis on the detailed flow dynamics associated with variations in storm surge elevations was performed. It appears critical to understand the underlying flow dynamics of why/when/where storm surge is highest (hurricane direction, hurricane approach angle, wind or wave drive surge, etc.). Understanding the flow dynamics may provide opportunity for other solutions that would attenuate storm surge elevation prior to critical areas. The Report stipulates *authority is Public Law 84-71, June 15, 1955, which authorizes the inclusion of data on the behavior and frequency of hurricanes.*

4. The Report states: "*a wide variety of potential solutions were preliminarily considered for reducing flood risk to MDC."*

   Please elaborate on alternative solutions explored that perhaps are not clearly documented in the draft Report. It appears that structural measures were limited to a flood wall.

5. The Report states: "*In addition to more tradition structural and nonstructural features, NNBFs were evaluated to determine if they could potentially be used as stand-alone features or be used in tandem as a multi-dimensional feature with other structural or nonstructural features (measures) to help achieve project objectives….*

   Living shorelines and coral reefs were considered as well as possible NNBFs, however, no site-specific locations for these types of NNBFs were identified during plan formulation or during the Environmental Interagency Meetings so these NNBFs were not selected as potential NNBFs for this study and therefore, are not further discussed. Native vegetation plantings were determined to be the most feasible and cost-effective NNBF measure for this project.

   Anticipated non-feasibility of additional islands due to potential limitations in material availability and anticipated lack of cost effectiveness."

   Detailed information was not provided on reasons supporting the decision/approach. As previously mentioned, an analysis of the detailed flow dynamics may assist in identifying alternative methods for attenuating storm impacts. In addition, there appeared to be public preference on a natural solution, which warrants further exploration.

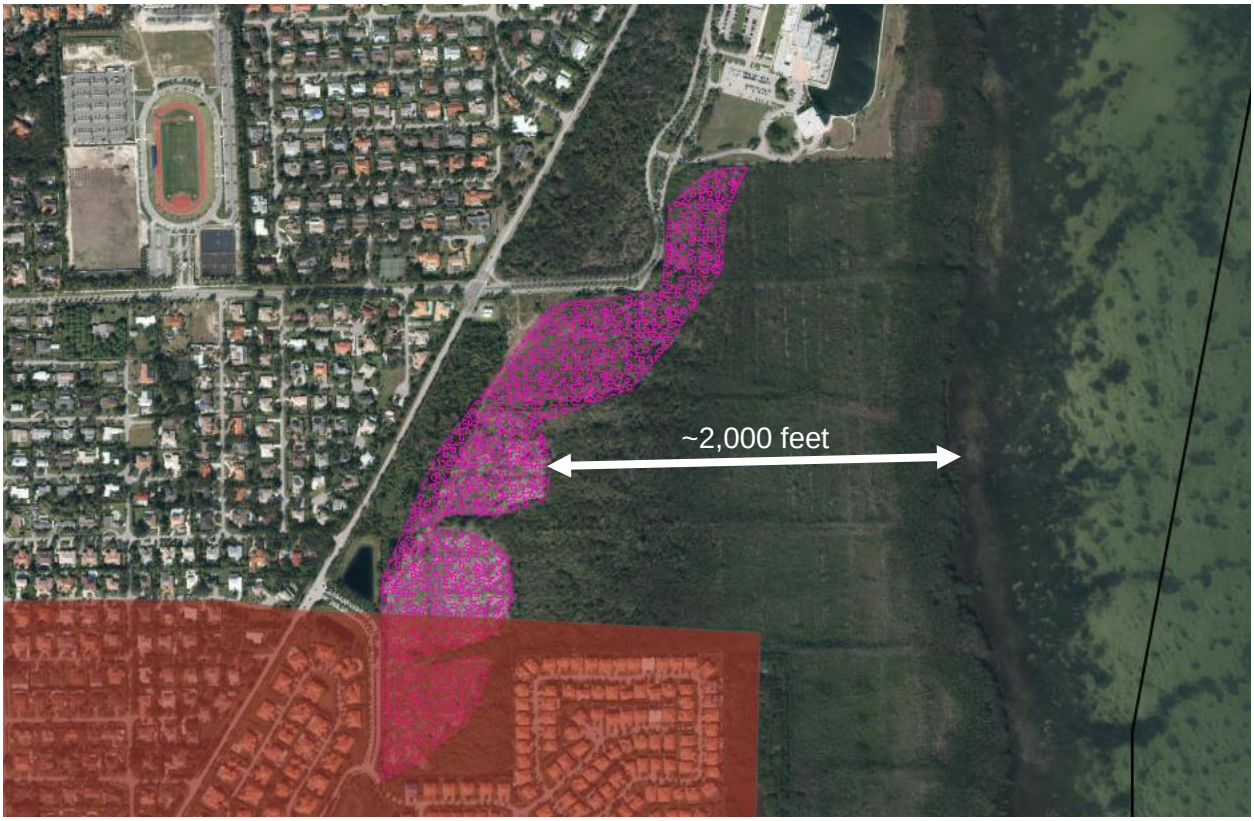
6. The Report states: "*Mooring and recreational boating at the Brickell Floodwall would be permanently prohibited resulting in adverse, significant impacts."*

   Given the economic importance of boating in Miami and limited facilities, this appears to be a significant impact.

7. The Report states: "*The Cutler Bay NNBF Site would serve to provide storm surge dissipation benefits as well as a multitude of beneficial impacts to natural resources and water quality."*

   The plan proposes planting of mangroves in a smaller site in Cutler Bay (refer to image on the following page). This area is already heavily vegetated with mangroves, and while the planting of mangroves should be a benefit for the environment, the small additional increase of mangroves landward of existing mangroves is not anticipated to have a significant additional effect on storm

surge flooding in the area. No analysis on the effects of this addition in comparison to existing conditions were provided in engineering analyses.



Source:
https://usacenao.maps.arcgis.com/apps/CrowdsourceReporter/index.html?appid=00abfd78e3534ed5b02a6369141afe87&webmap=bc83a81d21cb4e3b8e767930102c1859&layer=Comment_Symbology_08272019_1061

8. The flood benefits for the Miami River and Little River are contingent on the flood walls and flood gates keeping storm surge out. What is the recommendation for building code requirements for construction behind the flood wall relative to flood levels?
9. The plan does not appear to consider improving resiliency against storm surge flooding through the building code. Please incorporate recommendations.
10. The City of Miami is currently evaluating a minimum seawall elevation of +6.0 feet NAVD with the structural capacity to be raised to +8.0 feet NAVD. How will potential code changes like this impact the economic analysis?
11. Flooding from inland sources is not included and lower lying areas may still flood. Given the expanse of inland area considered in the economic analysis, the proportional influence of storm surge vs stormwater impacts to property may change with distance from shoreline. Considering

the other flooding sources may change the economic effectiveness of the proposed solutions and should be evaluated further prior to making a recommendation on the solution.

12. For many buildings, significant sea level rise will have to occur before flooding from a 100-year storm becomes significant, which will likely be at least 20-30 years out with the SLR projection adopted in the study. If the 100-year storm surge elevation can be attenuated prior to reaching specific sites, this would provide reserve capacity for buildings designed to existing design elevation requirements to account for SLR.
13. Phasing of a potential project appears critical given scale and impact. For the areas with flood gates and floodwalls, benefits will only occur when and if entire project is complete. Were any considerations given to phasing?

Technical

14. Many buildings identified as flood prone are likely of older construction (i.e. prior to elevation criteria). Was remaining service life considered for the structures? I.e. protecting a building with only 20 years of service life left for a design condition anticipated to occur in 40 years. Could this be more efficiently addressed through building code changes?
15. If a 100-year storm event occurs, it is likely there will be significant wind damage and thus buildings protected by the proposed flood wall may still experience significant damage (including water damage). The wind damage would likely present a proportionally higher impact on older structures not meeting recent building code (similar to the storm surge flooding). How would including the effect of wind or rain damage impact the cost-benefit analysis?
16. Flooding maps are difficult to interpret due to legend choice (e.g. 2.16845, 5.20288, 9.321035), i.e. difficult to distinguish if flooding is 3 inches or 2 feet. Recommend updating legend(s) with smaller intervals and even values.
17. Was impact of floodwall presence to nearby property values included in economic analysis?
18. The Report states *"A more detailed interior flooding analysis will be evaluated in the PED phase of this study."*

    Preliminary considerations to interior flooding appear appropriate and is recommended under this phase, as the solution may worsen these conditions. In addition, the cost benefit may be eschewed to the positive, as the proportionality of the floodwall prevention of damage is high if the only source of damage is storm surge.
19. The permeable sub-surface limestone layer prevalent in Miami-Dade County typically allows water to flow under seawalls causing flooding in adjacent low areas despite protection from seawalls. The potential impacts of this appears unclear in the report.

20. A specific constraint identified in the Report is to "*avoid flooding solutions for the study area that would induce increased flooding issues in locations outside the study area*." The proposed floodwall appears to impede inundation of areas upland of the wall, however, please elaborate on the potential worsening of conditions adjacent to or fronting the floodwall due to the impedance of storm surge flow (e.g. Brickell Key). Further, will the proposed floodwall result in changes to the forthcoming FEMA flood maps and associated insurance premiums for existing buildings?

21. The Report states: "*due to the presence of bedrock close to the ground surface, sheet pile-based I-walls would not be feasible because sheet piles cannot be driven into bedrock*."

    Although limestone layers may be encountered, marine structures at other nearby sites (e.g. Port Miami) are constructed utilizing steel sheet and/or combination piling systems.

22. Recommend, if not already completed as part of the present study, to compare debris removal cost assumptions used in model with recent efforts following Hurricane Irma in City of Miami.

23. Damage curves for buildings appear to be based on Northeast (NE) US. Was there given any consideration relative to damage curve variation based on the different building codes between Miami-Dade County and NE US?

24. How is damage distributed in the model relative to new and old structures (i.e. pre- and post-building code changes stemming from Hurricane Andrew)?

25. Recommend to test/calibrate economic model utilizing recent impacts associated with Hurricane Irma. Calculating impacts from Hurricane Irma may provide an indication of accuracy of model.

26. Water levels and associated flooding depths appear significantly overestimated in the economic model. The Report states the flooding level in the economic model to be dictated by 12 "save points" spread out for the various areas analyzed. For example, the flooding associated with the analysis of the flood wall at Miami River, Brickell and downtime Miami appears based on one single "save point" at the mouth of the Miami River, refer to the Report's Figure 4 below. The wave height for a 100-year event at that "save point" is listed at 7.25 feet for a 100-year storm event. Based on the model documentation, the economic model includes 70% of the wave height in the water level to determine flood impacts, associated damage and cost. This would mean 5.1 feet is added to the storm surge level for the entire Miami River model area including far inland. While this may be appropriate at the mouth of Miami River, it appears to *significantly overestimate flooding in all other areas* not directly fronting the Bay, refer to the Report's Figures 4 and 7 below. As a comparison, the storm surge value is only +7.3 feet NAVD and +10.6 feet NAVD for year 2018 and 2079 (with SLR) respectively. Thus, if existing ground elevation is at +6 feet NAVD, the resulting water depth in 2018 is 1.3 feet, however, it is our understanding a water depth of 6.4 feet would have been used in the economic model. Overestimation of flooding will lead to an associated overestimate in damage cost, which will positively skew the benefit cost ratio of the floodwall solution. Areas with significantly different wave condition variations should be split in smaller areas. In addition, regions of higher ground elevations may restrict the reach of

flooding if lower water elevations were deemed appropriate and result in overall reduction in flood impact footprint. Please update an economic model based on the above.

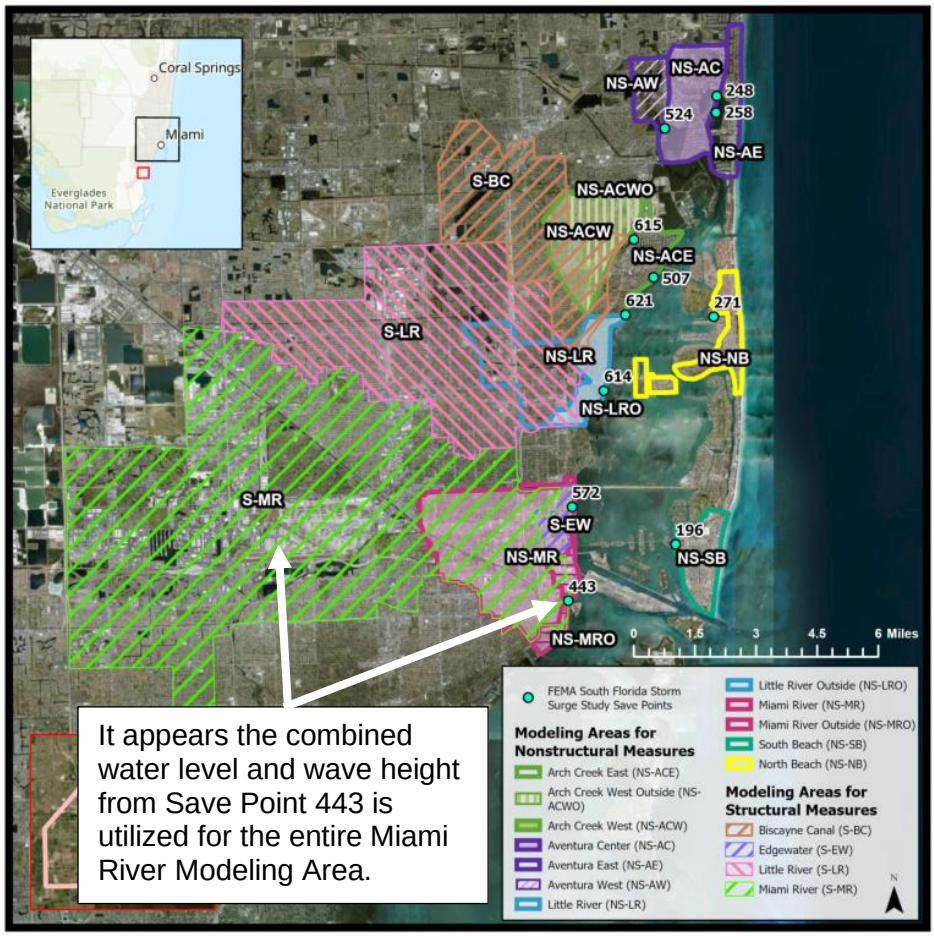


Figure 4. Modeled Areas with Save Points within Refined Focus Areas

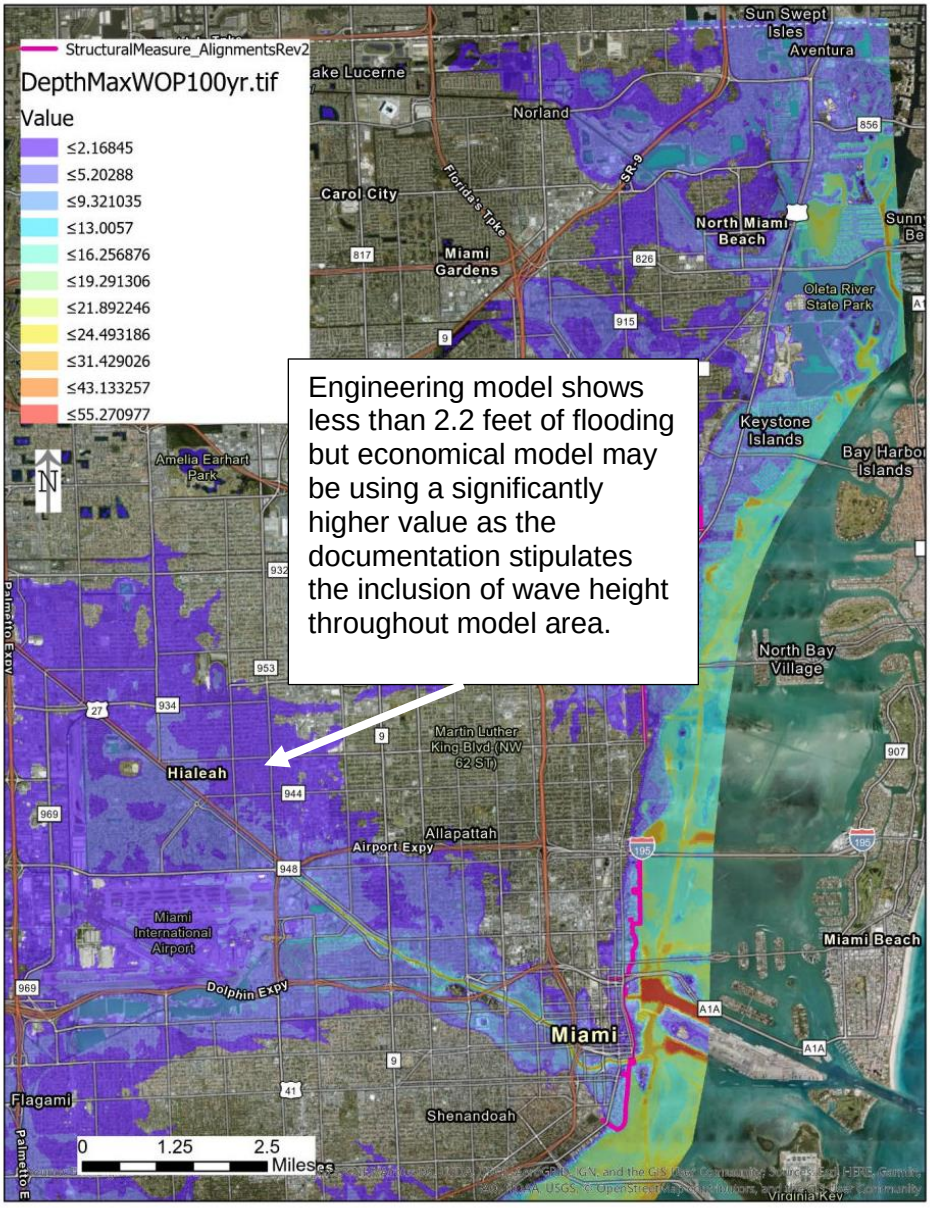


Figure 7.7. Depth (feet) Inundation layer from HEC-RAS for the Without Project and Without Precipitation at 1% 2079 SWL including SLR and Storm Surge. All focus areas - Scenario 1.

Design Suggestions

27. Recommend evaluating the actual flow dynamics associated with high storm surge conditions, e.g. storm surge relative to track of hurricane, approach angel, primarily wind or wave driven. This would further allow for analyzing the effects of strategic attenuation methods such as semi-

connected spoil islands, flood channels, reefs, mangroves, etc. These could serve as either blocking or reducing storm surge from specific directions.

28. Recommend evaluating hybrid solutions based on measures that would attenuate storm surge elevation, even if partially, prior to arrival in area of concern and potentially allow for less intrusive or phased urban solutions, as well as greater cost efficiency. For example, if there is a way to reduce storm surge by even 1 to 3 feet via outside measures, this may make other solutions more practical or reduce flood wall elevation requirements. In addition, the risk of failure is not dependent on a single mechanism.

29. If a floodwall or upland barrier is ultimately the preferred solution, considerations should be given to incorporate within existing infrastructure. For example, the flood wall/barrier could be incorporated along a road and act as partial foundation for an elevated park above the road.