EXHIBIT F

DEP AGREEMENT NO. 22RRE09

COASTAL RESILIENCE PARTNERSHIP OF SOUTHEAST PALM BEACH COUNTY VULNERABILITY ASSESSMENT UPDATE

City of Boynton Beach

Final Project Report

August 2022

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Part I. Executive Summary

The Coastal Resilience Partnership of Southeast Palm Beach County (CRP) completed a Climate Change Vulnerability Assessment (CCVA) for the jurisdictions of Boynton Beach, Boca Raton, Delray Beach, Highland Beach, Ocean Ridge, Lantana, Lake Worth Beach, and a portion of unincorporated Palm Beach County in July of 2021. The CRP CCVA 2021 meets many of the requirements of the new Resilient Florida Grant Program (Section 380.093, Florida Statute (F.S.)), but the analysis needed to be expanded to include the National Oceanic and Atmospheric Administration (NOAA) intermediate-low and intermediate-high sea level rise projections for 2040 and 2070 to be fully compliant. The new analysis updated the storm surge and tidal flooding vulnerability assessment for all critical assets per the statute. Both storm surge and tidal flooding were included in the original 2021 CCVA but the climate scenarios differed from Resilient Florida, so the updates were necessary.

This project produced an official modification to the original CRP CCVA 2021 report, documented in Appendix 9 which was submitted as the final Task 3 deliverable (Technical Memorandum) per the grant agreement. The full report can be viewed here: https://discover.pbcgov.org/resilience/PDF/20210903_ADA_CCVA_FinalReport.pdf

Part II. Methodology

Sea Level Rise

The sea level rise estimates were updated using the 2017 NOAA intermediate-low and NOAA intermediate-high projections to 2040 and to 2070 to comply with Section 380.093, F.S. The total rise was calculated using guidance available in the "Unified Sea Level Rise Projection Southeast Florida, 2019 Update" from the Southeast Florida Regional Climate Change Compact. The curves for the Key West gauge were used to maintain consistency with the original CRP CCVA (2021) and to estimate the most conservative estimate of rise. This resulted in the estimated future rise relative to 2020 as shown in Table 1 below. Please note, the values below represented in feet and inches have been rounded to the nearest tenths place and whole number, respectively.

Table 1: Sea Level Rise relative to 2020 estimated from 2017 NOAA Intermediate-High and Intermediate-Low Curves.

Estimate of Future Sea Level Rise relative to 2020				
Current (2020)	**2017 NOAA Intermediate Low Curves**		**2017 NOAA Intermediate High Curves**	
	2040	**2070**	**2040**	**2070**
0	0.4 ft (**4 in**)	1.0 ft (**11 in**)	0.8 ft (**10 in**)	2.8 ft (**33 in**)

Tidal Flooding

The estimated sea level rise shown in Table 1 were added to 2020 King Tide flood elevation to develop inundation depths and extents. The King Tide flood elevation was established using the Adaptation Action Elevation (AAE) as defined by Brizaga in the July 2021 CCVA Report. Brizaga' s AAE is defined as the 98th percentile daily higher high water. This was established as 2.2 ft NAVD for the Lake Worth Pier Gauge. Table 2 below shows the future high tide flood elevations.

Table 2: King Tide flooding with sea level rise from 2017 NOAA Intermediate-High and Intermediate-Low Curves. Elevations in feet NAVD-88.

Current King Tide (2020)	2017 NOAA Intermediate Low Curves		2017 NOAA Intermediate High Curves	
	2040	2070	2040	2070
	Current + 4"	Current + 11"	Current + 10"	Current + 33"
2.2 ft NAVD	**2.6** ft NAVD	**3.2** ft NAVD	**3.0** ft NAVD	**5.0** ft NAVD

Inundation depths and extents were created for areas connected directly to tidal waterbodies. Seawalls were not explicitly included unless they were reflected in the LIDAR datasets (which is uncommon in southern Palm Beach County). Engineering judgement was used to determine areas directly connected to tidal waterbodies based on:

- South Florida Water Management District (SFWMD) tidal structures and canals (SFWMD, 2022)
- Lake Worth Drainage District (LWDD) tidal structures and canals (LWDD, 2022)
- Aerial imagery (ESRI et al, 2022)
- 2016 Palm Beach County DEM (Digital Elevation Model) average vertical error (Dewberry, 2018)

Storm Surge

The estimated sea level rise values shown in Table 1 were added to existing storm surge flood elevations to develop inundation depths. Existing storm surge elevations were developed from the Effective 2017 FEMA Special Flood Hazard Areas (SFHA) Base Flood Elevations (BFEs) (FEMA, 2017b). It should be noted that the preliminary 2019 FEMA SFHAs BFEs (FEMA, 2019) are up to 4 feet higher within parts of the assessment area but were not used for this analysis since they were still preliminary when this analysis was completed.

To be conservative and maintain consistency with the first phase of the CRP CCVA, the 2017 FEMA BFEs were adjusted for sea level rise. According to the 2017 FEMA Flood Insurance Study (FIS) Report, coastal stillwater elevations developed in 1977 were used as starting elevations for the wave runup analysis to develop the coastal SFHAs. Therefore, for this analysis, the 2017 FEMA BFEs were adjusted to account for sea level rise from 1977. The historic rate of rise at the NOAA Lake Worth Pier gauge is 3.81 mm/year (0.0125 ft/year), this result is a rise of approximately 0.5 feet between 1977 and 2020. Therefore, 0.5 feet was added to the 2017 FEMA BFEs to establish current 2020 flood elevations.

The minimum and maximum storm surge elevations used for the study area are shown in **Table** below. The minimum elevations were used along the most inland portions of the storm surge flooding while the maximum elevation was used along the coast. Elevations vary between the minimum and maximum elevations based on the 2017 FEMA BFEs.

Table 3: Storm surge minimum and maximum elevations used within the study area with sea level rise from 2017 NOAA Intermediate-High and Intermediate-Low curves. Elevations in feet NAVD.

	Current 2020 BFEs (2017 BFE + 0.5') (ft NAVD)	NOAA INT-LOW		NOAA INT-HIGH	
		2040	2070	2040	2070
		Current + 4" (ft NAVD)	Current + 11" (ft NAVD)	Current + 10" (ft NAVD)	Current + 33" (ft NAVD)
Minimum	6.5	6.9	7.5	7.3	9.3
Maximum	13.5	13.9	14.5	14.3	16.3

Inundation depths and extents were created for areas connected directly to tidal waterbodies. Seawalls were not explicitly included unless they were reflected in the LIDAR datasets (which is uncommon in southern Palm Beach County). Engineering judgement was used to determine areas directly connected to tidal waterbodies based on available information including:

- South Florida Water Management District (SFWMD) tidal structures and canals (SFWMD, 2022)
- Lake Worth Drainage District (LWDD) tidal structures and canals (LWDD, 2022)
- Aerial imagery (ESRI et al, 2022)
- 2016 Palm Beach County DEM (Digital Elevation Model) average vertical error (Dewberry, 2018)

Updated Asset Vulnerability Analysis

Once the tidal flooding and storm surge elevation information was updated to comply with Section 380.093, F.S., the asset data for the CRP jurisdictions was analyzed against the updated elevations.

The update included 80 permutations (2 time horizons x 2 sea level rise scenarios x 2 flood threats x 10 asset categories). The 10 asset categories were based on the previous asset categories used in the 2021 CCVA. The Resilient Florida Grant Program (Section 380.093, Florida Statute (F.S.)) specified analysis of asset categories for transportation assets and evacuation routes; critical infrastructure; critical community and emergency facilities; and natural, cultural, and historic resources.

The 4 asset categories specified were spread across 9 of the 10 categories* used in the CRP CCVA 2021. The categories included:

- Energy and Communications
- Health and Medical
- Public Safety and Government Owned
- Natural
- Commercial and Industrial
- Parks and Cultural Property
- Residential
- Transportation Facilities
- Roads

*Food Infrastructure was also assessed but did not include assets listed from 380.093 F.S.

Appendix 9 includes a table (Table A9-4) showing how the specific critical asset categories called out in Resilient Florida intersect with each of the CRP CCVA 2021 categories.

The analysis tool AccelAdapt (Fernleaf, 2022) was updated with the new horizons, updated scenarios, and updated threats (https://sepbc.acceladapt.com/). A screen shot of AccelAdapt is shown below in Figure A9-3.

Part III. Outcome

The Tidal Flooding and Storm Surge rasters corresponding with the 2017 NOAA Intermediate-High and Intermediate-Low curves did not visually appear significantly different than the CCVA project as finalized in July 2021 - primarily because each scenario was within a few inches. These differences (a few inches) are virtually undetectable upon visual inspection and are very close to the uncertainty created through both the use of the LIDAR data and subsequent inundation modeling. **So, while the data is now fully compliant with Resilient Florida (as of 2022), the update did not appreciably change the results for tidal flooding and storm surge.**

The CRP was consulted on updating analysis datasets in AccelAdapt to use the flood elevations aligning with the 2017 NOAA Intermediate-High and Intermediate-Low curves that satisfy the Resilient Florida Grant Program (Section 380.093, Florida Statute (F.S.)). The CRP agreed to having datasets updated with corresponding values.

Additionally, as seen previously in Table 1, the resulting values for future sea level rise are 4-, 11-, 10- and 33-inches corresponding with NOAA intermediate-low values for 2040 and 2070 and with NOAA intermediate-high values for 2040 and 2070, respectively. For the asset analyses, the 11" SLR scenario appears to provide a reasonable estimate for the NOAA Intermediate-High 2040 scenario as well as the NOAA Intermediate-Low 2070 scenario; therefore, the 11" SLR was used to reflect both. Vulnerability at the census tract level of analysis did not change when using this parameter.

All analytics for the updated datasets can be found within the AccelAdapt program.

In summary, the project met all goals and expected performance measures that were set out. It successfully produced a statutorily compliant dataset for tidal flooding and storm surge, resulting in a "comprehensive vulnerability assessment" (as defined in 62S-8.002) for each of the seven CRP municipalities. Remaining areas of improvement include further updates to the analysis to address items identified as "optional" in 380.093(3)(d)1. and 380.093(3)(d)2., F.S.

Part IV. Further Recommendations

Next steps for the CRP include further updating the Vulnerability Assessment to address items defined as "optional" by the Resilient Florida statute. This update would entail new analyses for rainfall flooding and compound flooding, which the CRP aims to conduct once the South Florida Water Management District releases its future rainfall modeling results and Palm Beach County adopts revised FEMA coastal flood hazard maps. These updates could include addressing the following items for full compliance with the statutory requirements for vulnerability assessments in subsection 380.093(3), F.S.:

- To the extent practicable, analysis geographically displays the number of tidal flood days expected for each scenario and planning horizon.
- Higher frequency storm analyzed for exposure of a critical asset.
- To the extent practicable, rainfall-induced flooding was considered using spatiotemporal analysis or existing hydrologic and hydraulic modeling results.
- Depth of rainfall-induced flooding for 100-year storm and 500-year storm event.
- To the extent practicable, compound flooding or the combination of tidal, storm surge, and rainfall-induced flooding.

Beyond these updates to the regional Vulnerability Assessment, each CRP municipality will proceed with further adaptation planning and implementation activities, including but not limited to the following:

- Collecting field data as needed to assess specific vulnerabilities of critical assets (e.g., shoreline infrastructure)
- Developing Critical Asset Adaptation Action Plans
- Adopting Adaptation Action Area designations
- Implementing recommendations in the Portfolio of Adaptation & Mitigation Strategies (included in the original CRP CCVA 2021 report)