Building Resilience:
Proposed New Regulatory Standards for Managing Stormwater Risks

Department of Regulatory and Economic Resources, Division of Environmental Resources Management (RER-DERM)

Presenters:

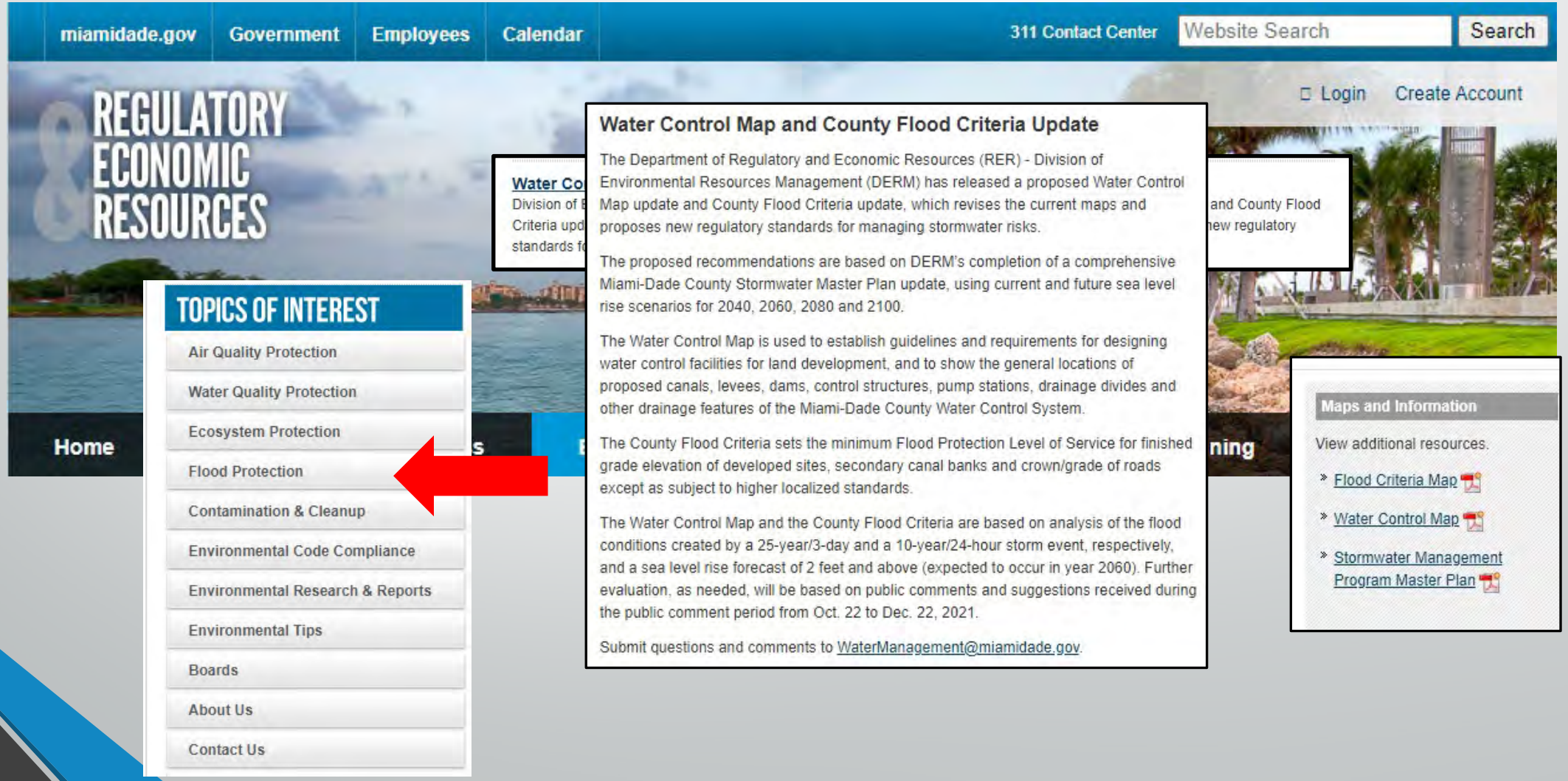
Alberto Pisani, PE, ENV SP (MDC)

Georgio Tachiev, PE, PhD (GIT)

Submit questions to: WaterManagement@miamidade.gov

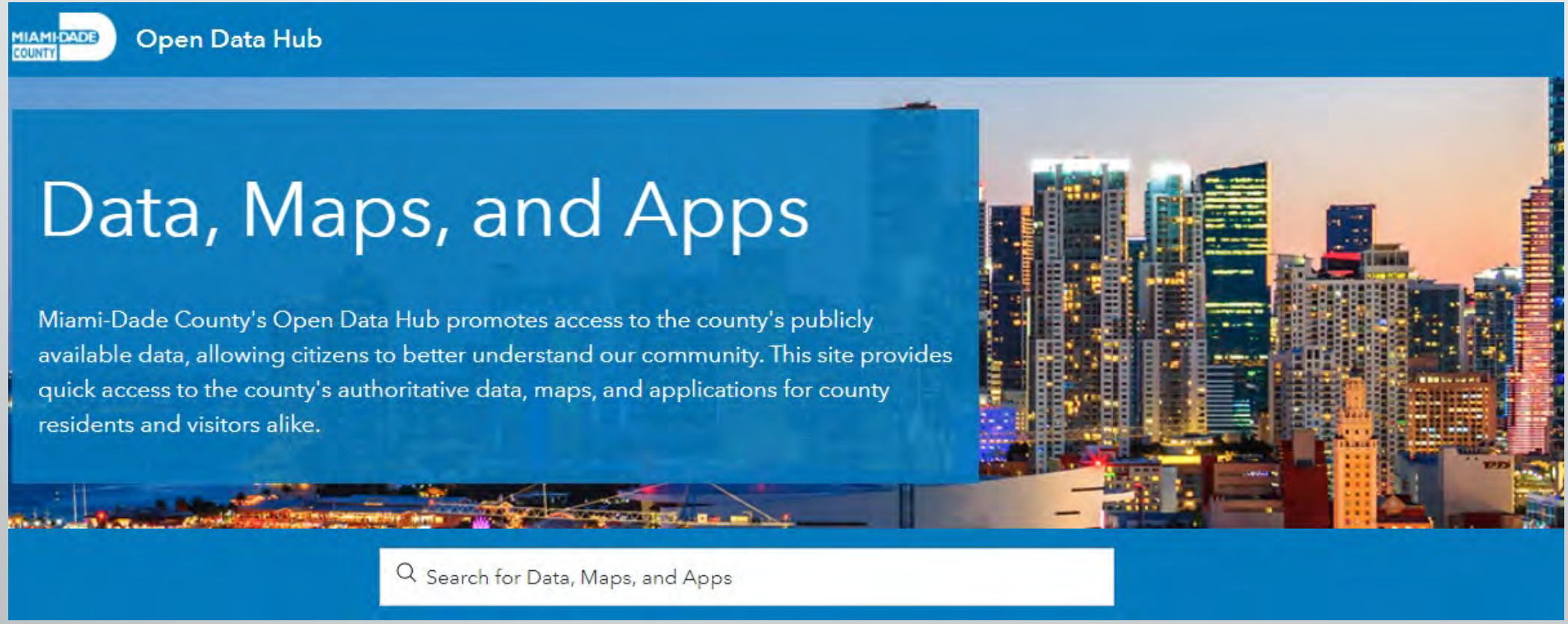
Access to Resources

https://www.miamidade.gov/environment/water-control-and-flood-criteria.asp



Access to Resources

GIS hub - https://gis-mdc.opendata.arcgis.com/



Search for "county flood criteria"

Regulatory Overview

Presenter:

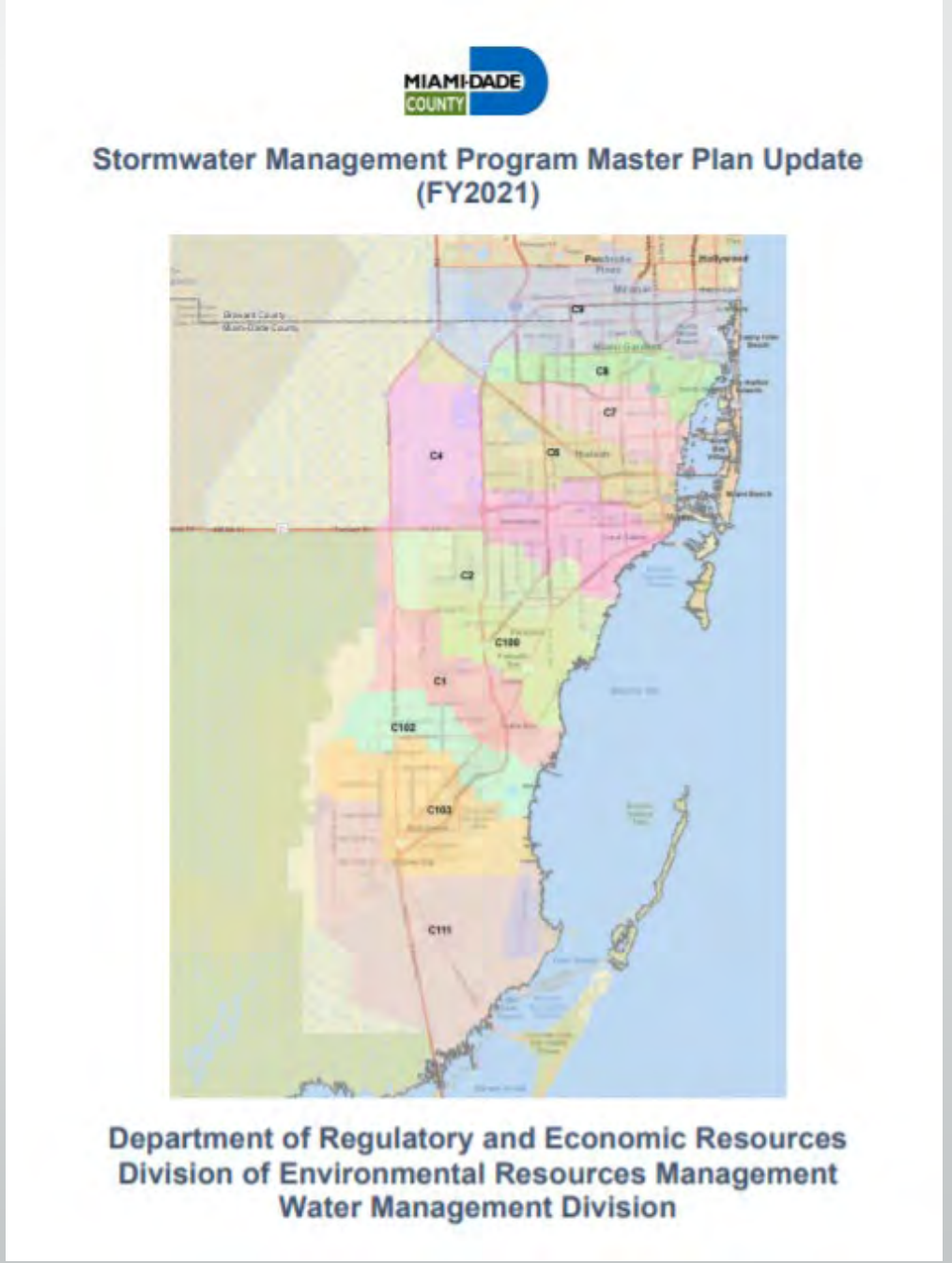
Alberto Pisani, PE, Env SP (MDC)

MIAMI-DADE COUNTY

Stormwater Master Plan

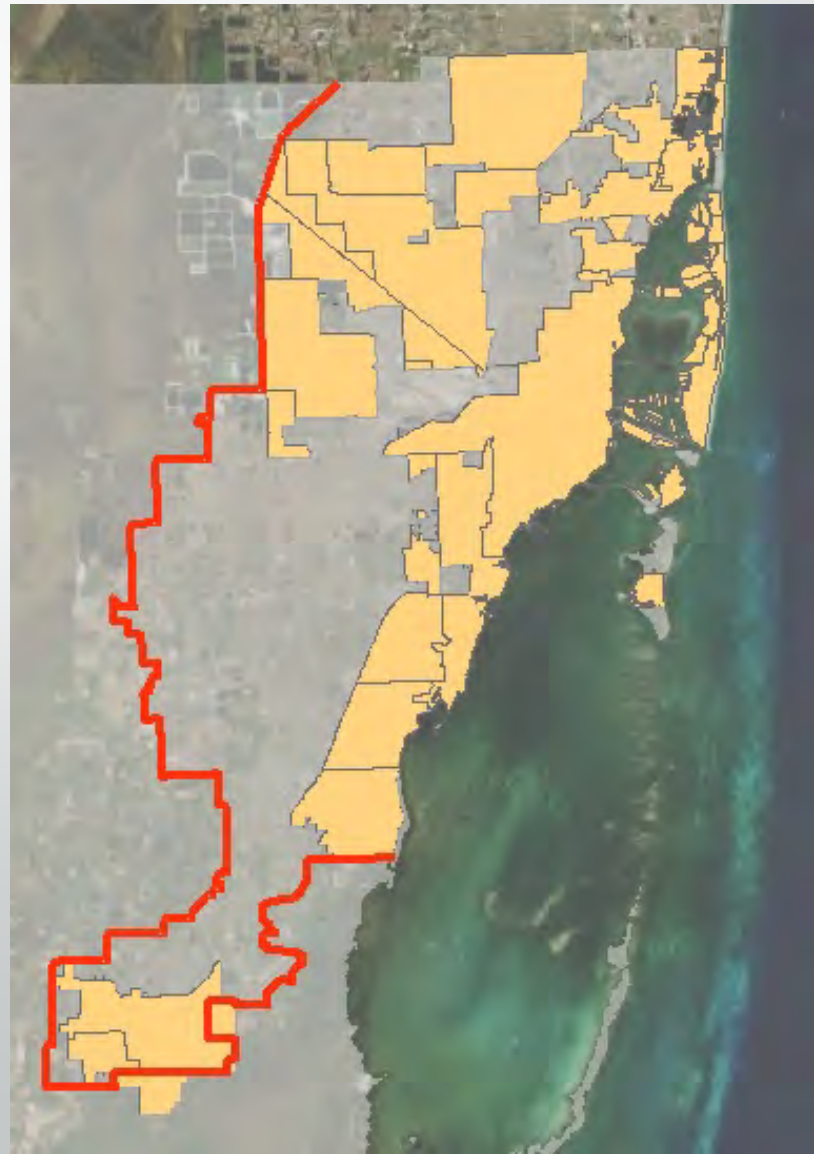
Brief History

- First developed in 1993
    - Established criteria for developing a watershed stormwater model
- First stormwater models developed between 1996 and 1998
- Substantial updates developed in segments for the major watersheds between 2003 and 2008
    - Identified water quantity and quality problems and provided strategies for reducing drainage and water quality impacts
- Continuous in-house updates

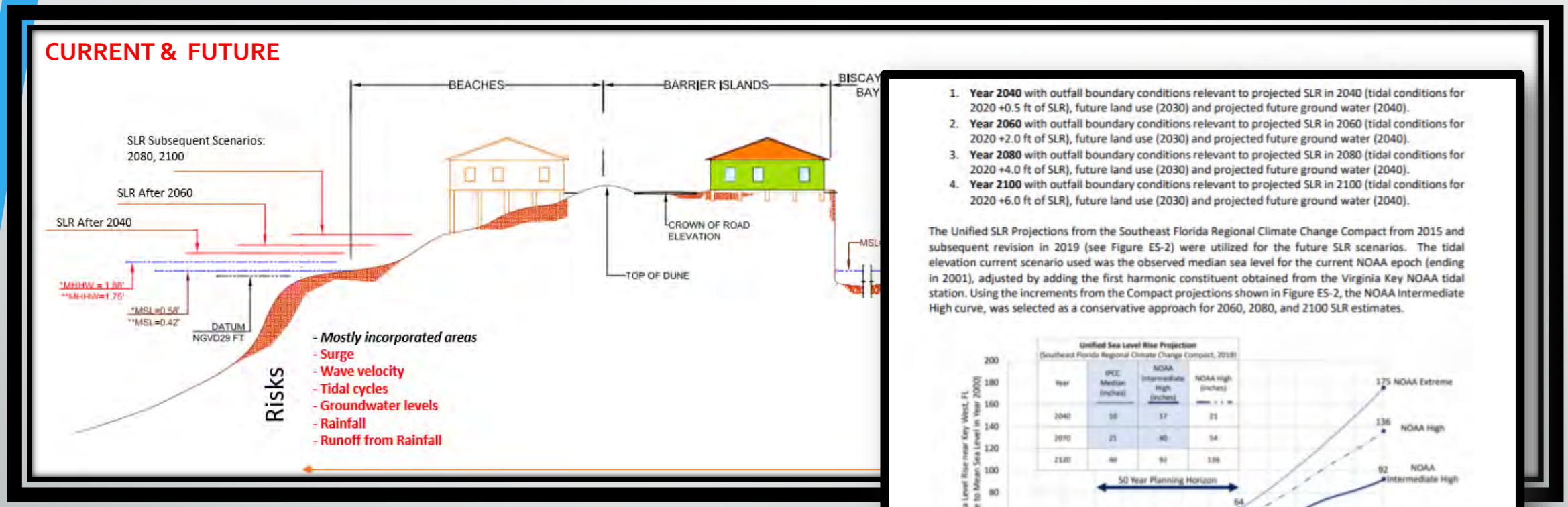


Stormwater Master Plan, County Flood Criteria, and Water Control Map

- Comprehensive Stormwater Master Plan (SWMP) update completed in 2021
- SWMP is implemented using the following elements:
    - Watershed Numerical Modeling
    - **County Flood Criteria (CFC) Map**
    - **Water Control Map (WCM)**
    - Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs)
    - Capital Improvement Plan (CIP)
    - Inspection, Operations, and Maintenance Plan (IOM)



Understanding Flood, Surge, & Groundwater Risks



1. **Year 2040** with outfall boundary conditions relevant to projected SLR in 2040 (tidal conditions for 2020 +0.5 ft of SLR), future land use (2030) and projected future ground water (2040).
2. **Year 2060** with outfall boundary conditions relevant to projected SLR in 2060 (tidal conditions for 2020 +2.0 ft of SLR), future land use (2030) and projected future ground water (2040).
3. **Year 2080** with outfall boundary conditions relevant to projected SLR in 2080 (tidal conditions for 2020 +4.0 ft of SLR), future land use (2030) and projected future ground water (2040).
4. **Year 2100** with outfall boundary conditions relevant to projected SLR in 2100 (tidal conditions for 2020 +6.0 ft of SLR), future land use (2030) and projected future ground water (2040).

The Unified SLR Projections from the Southeast Florida Regional Climate Change Compact from 2015 and subsequent revision in 2019 (see Figure ES-2) were utilized for the future SLR scenarios. The tidal elevation current scenario used was the observed median sea level for the current NOAA epoch (ending in 2001), adjusted by adding the first harmonic constituent obtained from the Virginia Key NOAA tidal station. Using the increments from the Compact projections shown in Figure ES-2, the NOAA Intermediate High curve, was selected as a conservative approach for 2060, 2080, and 2100 SLR estimates.

Scientists with the Southeast Florida Regional Climate Change Compact updated 2015 sea level rise predictions for 2019. These projections guide development in the counties. SOUTHEAST FLORIDA REGIONAL CLIMATE CHANGE COMPACT

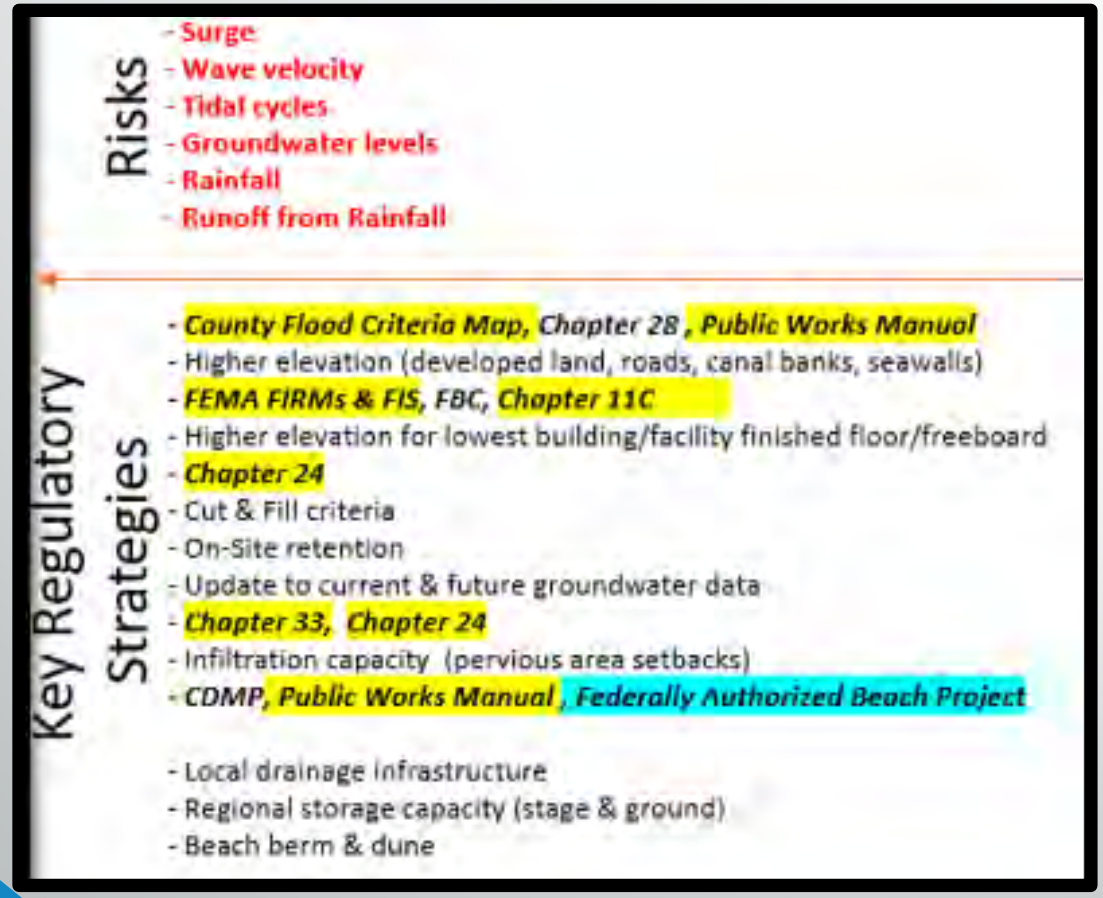
Figure ES-2. 2019 Unified Sea Level Rise Projections

- Miami-Dade SWMP 2021 update used the SE Florida Regional Compact projections for Sea Level Rise (SLR) for 2040, 2060, 2080, and 2100

MIAMI-DADE COUNTY

Updating Regulations to Increase Resilience

Beaches & Barrier Islands
Mostly Incorporated Areas



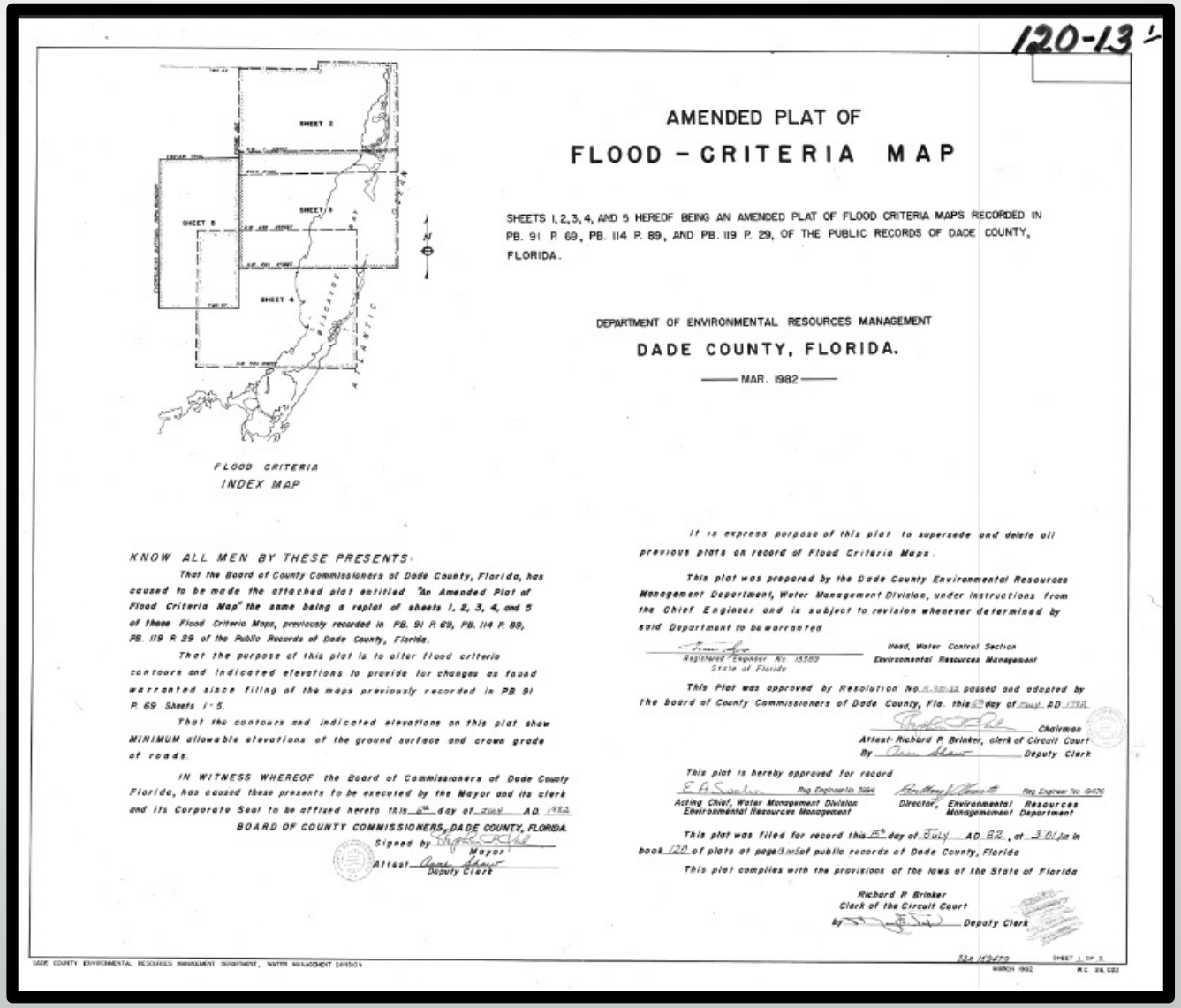
Coastal Ridge & Inland
UMSA & Incorporated Areas

- County is currently working on updates to key regulations and programs

MIAMI-DADE COUNTY

What is the County Flood Criteria

- Flood criteria elevations first established in October 1959
- Last modified in March 1982
- Recorded in PB 120, PAGE 13
- Based on highest groundwater level expected to occur after a 10YR/24HR rain event
- Contours establish minimum ground elevations and minimum crown of road
- Minimum elevation of 5' NGVD29 (3.45' NAVD88)



120-13

AMENDED PLAT OF

FLOOD - CRITERIA MAP

SHEETS 1, 2, 3, 4, AND 5 HEREOF BEING AN AMENDED PLAT OF FLOOD CRITERIA MAPS RECORDED IN PB. 91 P. 69, PB. 114 P. 89, AND PB. 119 P. 29, OF THE PUBLIC RECORDS OF DADE COUNTY, FLORIDA.

DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT

DADE COUNTY, FLORIDA.

MAR. 1982

FLOOD CRITERIA
INDEX MAP

KNOW ALL MEN BY THESE PRESENTS:

That the Board of County Commissioners of Dade County, Florida, has caused to be made the attached plat entitled "An Amended Plat of Flood Criteria Map" the same being a replat of sheets 1, 2, 3, 4, and 5 of those Flood Criteria Maps, previously recorded in PB. 91 P. 69, PB. 114 P. 89, PB. 119 P. 29 of the Public Records of Dade County, Florida.

That the purpose of this plat is to alter flood criteria contours and indicated elevations to provide for changes as found warranted since filing of the maps previously recorded in PB 91 P. 69 Sheets 1-5.

That the contours and indicated elevations on this plat show MINIMUM allowable elevations of the ground surface and crown grade of roads.

IN WITNESS WHEREOF the Board of Commissioners of Dade County Florida, has caused these presents to be executed by the Mayor and its clerk and its Corporate Seal to be affixed hereto this 6th day of July AD 1982

BOARD OF COUNTY COMMISSIONERS, DADE COUNTY, FLORIDA.

Signed by _____ Mayor

Attest _____ Deputy Clerk

It is express purpose of this plat to supersede and delete all previous plats on record of Flood Criteria Maps.

This plat was prepared by the Dade County Environmental Resources Management Department, Water Management Division, under instructions from the Chief Engineer and is subject to revision whenever determined by said Department to be warranted

_____ Registered Engineer No. 13589 State of Florida

_____ Head, Water Control Section Environmental Resources Management

This Plat was approved by Resolution No. R-[illegible]-82 passed and adopted by the board of County Commissioners of Dade County, Fla. this 6th day of July AD 1982

_____ Chairman

Attest: Richard P. Brinker, clerk of Circuit Court

By _____ Deputy Clerk

This plat is hereby approved for record

_____ Reg Engineer No 13644 Acting Chief, Water Management Division Environmental Resources Management

_____ Reg Engineer No 6476 Director, Environmental Resources Management Department

This plat was filed for record this 8th day of July AD 82, at 3:01 pm in book 120 of plats at page 13 of public records of Dade County, Florida

This plat complies with the provisions of the laws of the State of Florida

Richard P. Brinker
Clerk of the Circuit Court

by _____ Deputy Clerk

DADE COUNTY ENVIRONMENTAL RESOURCES MANAGEMENT DEPARTMENT, WATER MANAGEMENT DIVISION

SEA 149479 SHEET 1 OF 5

MARCH 1982

MIAMI-DADE COUNTY

Improving Resilience by Raising Elevation

			Buildings	Roads				Secondary Canals		Parcels	Seawalls	Beach Dune Protection
			Building Minimum Elevation of Lowest Floor is Above the Base Flood Elevation (BFE) by Adding a Freeboard	Crown of Road Minimum Elevation is the County Flood Criteria (CFC)	Road Drainage Design Criteria (To Control Run-Off from rainfall Generated by a Storm with Frequency Selected)			Top of Bank Minimum Elevation is the County Flood Criteria (CFC)	Conveyance System Design Criteria (To Control Flow and Storage/Detention from Rainfall Generated by a Storm with Frequency Selected)	Developed Land Minimum Elevation is the County Flood Criteria (CFC)	Minimum Top of Seawall Elevation is above County Flood Criteria Elevation (CFC)	Minimum Beach Dune Elevation is Above the FEMA Hurricane Surge - High Curve (for a 100 -Year Frequency)
Storm Event	Annual Chance of Being Equaled or Exceeded During any Year	Equivalent Number of Days for Annual Chance of Being Equaled or Exceeded During any Year	Building BFE	CFC	Evacuation Routes	Minor Arterials and Other Major Roads	Collectors and Other Residential Streets	CFC	Level of Service (LOS)	CFC	CFC	
5-Year	20%	73					●					
10-Year	10%	37		●		●		●		●	●	
25-Year	4%	15							●			
50-Year	2%	7										
100-Year	1%	4	●		●							●
500-Year	0.20%	Less than 1										
1000-Year	0.10%	Less than 0.5										
Key Regulations			FBC	MDC County Flood Criteria Map	MDC CDMP			MDC County Flood Criteria Map	MDC County Water Control Map	MDC County Flood Criteria Map	MDC County Flood Criteria Map	MDC CDMP
			FEMA FIRMs & FIS	MDC Chapter 28	FDOT Design Standards			MDC County Water Control Map	MDC Public Works Manual	MDC Chapter 28	MDC Chapter 24	MDC Chapter 24
			MDC Chapter 11C	MDC Public Works Manual	MDC Public Works Manual			MDC Chapter 24	SFWMD Stormwater Design Standards	MDC Chapter 33	MDC Chapter 33	MDC Chapter 33
				SFWMD Stormwater Design Standards	SFWMD Stormwater Design Standards			MDC Public Works Manual		MDC Chapter 24	MDC Public Works Manual	MDC Chapter 11C
				MDC Chapter 33	MDC Chapter 33					MDC Chapter 11C		USACE Beach Eosion Control & Hurricane Protection Project
				MDC Chapter 9	MDC Chapter 9					MDC Public Works Manual		FEMA Flood Insurance Study (FIS), Miami- Dade County
										SFWMD Stormwater Design Standards		

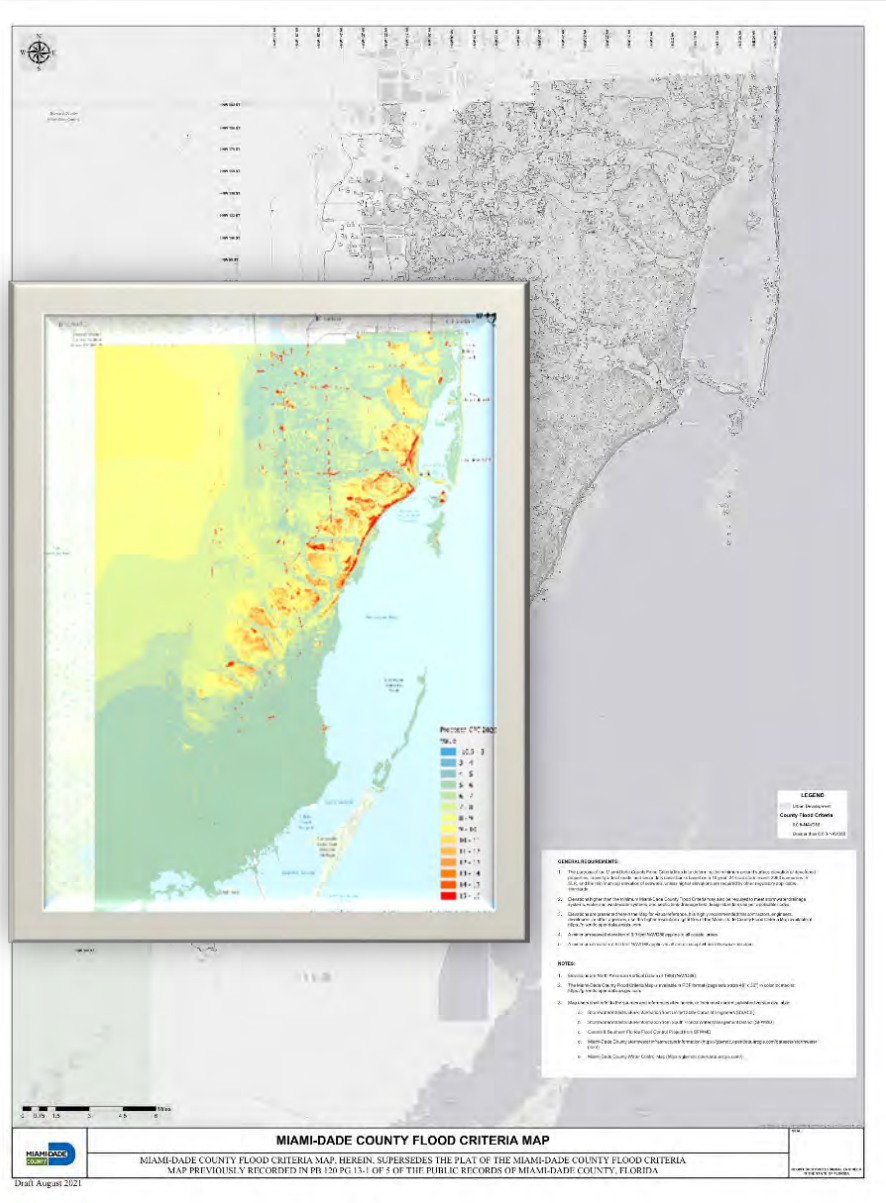
Note: Highlighted regulations are currently being updated using the results from the latest Miami-Dade County Stormwater Management Program – Master Plan Update (FY 21).
The USACE is currently conducting a re-authorization feasibility study for beach protection in Miami-Dade County. The USACE is also conducting a feasibility study for surge protection in the Bay, which may result in a separate Federal authorization.

County Flood Criteria (CFC)

The New County Flood Criteria Map

Criteria for the new CFC Map

- Update uses the highest of:
    1. Surface water levels from the 10YR/24HR event, with 2060 SLR
    2. Groundwater levels for 10YR/24HR event determined from nearly 30 years (1990 – 2020) of daily groundwater stage observations
    3. Current Miami-Dade CFC based on 10YR/24HR design event
    4. Existing topography (ground surface elevation)
    5. Minimum elevation raised to 6’ NAVD88 from 3.45’ NAVD88 in the old map



Improving Resilience via Higher Standards

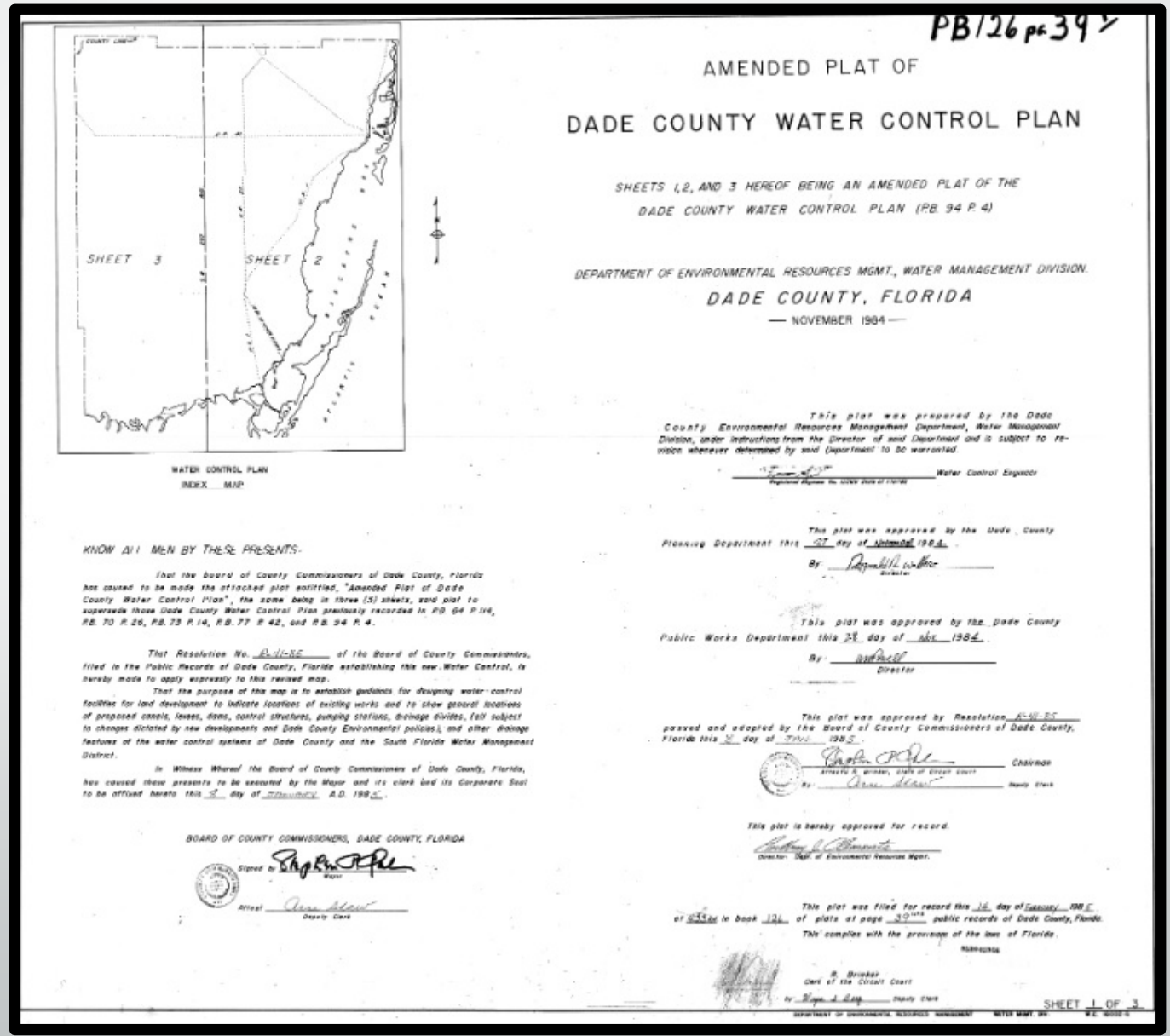
			Buildings	Roads				Secondary Canals		Parcels	Seawalls	Beach Dune Protection
			Building Minimum Elevation of Lowest Floor is Above the Base Flood Elevation (BFE) by Adding a Freeboard	Crown of Road Minimum Elevation is the County Flood Criteria (CFC)	Road Drainage Design Criteria (To Control Run-Off from rainfall Generated by a Storm with Frequency Selected)			Top of Bank Minimum Elevation is the County Flood Criteria (CFC)	Conveyance System Design Criteria (To Control Flow and Storage/Detention from Rainfall Generated by a Storm with Frequency Selected)	Developed Land Minimum Elevation is the County Flood Criteria (CFC)	Minimum Top of Seawall Elevation is above County Flood Criteria Elevation (CFC)	Minimum Beach Dune Elevation is Above the FEMA Hurricane Surge - High Curve (for a 100 -Year Frequency)
Storm Event	Annual Chance of Being Equaled or Exceeded During any Year	Equivalent Number of Days for Annual Chance of Being Equaled or Exceeded During any Year	Building BFE	CFC	Evacuation Routes	Minor Arterials and Other Major Roads	Collectors and Other Residential Streets	CFC	Level of Service (LOS)	CFC	CFC	
5-Year	20%	73					●					
10-Year	10%	37		●		●		●		●	●	
25-Year	4%	15							●			
50-Year	2%	7										
100-Year	1%	4	●		●							●
500-Year	0.20%	Less than 1										
1000-Year	0.10%	Less than 0.5										
Key Regulations			FBC	MDC County Flood Criteria Map	MDC CDMP			MDC County Flood Criteria Map	MDC County Water Control Map	MDC County Flood Criteria Map	MDC County Flood Criteria Map	MDC CDMP
			FEMA FIRMs & FIS	MDC Chapter 28	FDOT Design Standards			MDC County Water Control Map	MDC Public Works Manual	MDC Chapter 28	MDC Chapter 24	MDC Chapter 24
			MDC Chapter 11C	MDC Public Works Manual	MDC Public Works Manual			MDC Chapter 24	SFWMD Stormwater Design Standards	MDC Chapter 33	MDC Chapter 33	MDC Chapter 33
				SFWMD Stormwater Design Standards	SFWMD Stormwater Design Standards			MDC Public Works Manual		MDC Chapter 24	MDC Public Works Manual	MDC Chapter 11C
				MDC Chapter 33	MDC Chapter 33					MDC Chapter 11C		USACE Beach Eosion Control & Hurricane Protection Project
				MDC Chapter 9	MDC Chapter 9					MDC Public Works Manual		FEMA Flood Insurance Study (FIS), Miami- Dade County
										SFWMD Stormwater Design Standards		

Note : Highlighted regulations are currently being updated using the results from the latest Miami-Dade County Stormwater Management Program– Master Plan Update (FY 21).
The USACE is currently conducting a re-authorization feasibility study for beach protection in Miami-Dade County. The USACE is also conducting a feasibility study for surge protection in the Bay, which may result in a separate Federal authorization.

Water Control Map

What is the Water Control Map?

- Last modified in February 1985
- Recorded in PB 126, PAGE 39
- Provides location of existing and proposed canals, levees, dams, control structures, pumping stations, drainage divides, and other drainage features



PB 126 pg 39

AMENDED PLAT OF

DADE COUNTY WATER CONTROL PLAN

SHEETS 1, 2, AND 3 HEREOF BEING AN AMENDED PLAT OF THE DADE COUNTY WATER CONTROL PLAN (PB. 94 P. 4)

DEPARTMENT OF ENVIRONMENTAL RESOURCES MGMT., WATER MANAGEMENT DIVISION

DADE COUNTY, FLORIDA

— NOVEMBER 1984 —

SHEET 3 SHEET 2

WATER CONTROL PLAN INDEX MAP

KNOW ALL MEN BY THESE PRESENTS:

That the board of County Commissioners of Dade County, Florida has caused to be made the attached plat entitled, "Amended Plat of Dade County Water Control Plan", the same being in three (3) sheets, said plat to supersede those Dade County Water Control Plan previously recorded in PB 64 P 114, PB. 70 P. 26, PB. 73 P. 14, P.B. 77 P. 42, and P.B. 94 P. 4.

That Resolution No. R-1156-84 of the Board of County Commissioners, filed in the Public Records of Dade County, Florida establishing this new Water Control, is hereby made to apply expressly to this revised map.

That the purpose of this map is to establish guidelines for designing water control facilities for land development to indicate locations of existing works and to show general locations of proposed canals, levees, dams, control structures, pumping stations, drainage divides, (all subject to changes dictated by new developments and Dade County Environmental policies), and other drainage features of the water control systems of Dade County and the South Florida Water Management District.

In Witness Whereof the Board of County Commissioners of Dade County, Florida, has caused these presents to be executed by the Mayor and its clerk and its Corporate Seal to be affixed hereto this 4 day of January A.D. 1985.

BOARD OF COUNTY COMMISSIONERS, DADE COUNTY, FLORIDA

Signed by _____ Mayor

Attest _____ Deputy Clerk

This plat was prepared by the Dade County Environmental Resources Management Department, Water Management Division, under instructions from the Director of said Department and is subject to revision whenever determined by said Department to be warranted.

_____ Water Control Engineer

This plat was approved by the Dade County Planning Department this 27 day of September 1984.

By _____ Director

This plat was approved by the Dade County Public Works Department this 28 day of Nov 1984.

By _____ Director

This plat was approved by Resolution R-1156-84 passed and adopted by the Board of County Commissioners of Dade County, Florida this 4 day of Jan 1985.

_____ Chairman

Attest: H. Brinker, Clerk of Circuit Court

By _____ Deputy Clerk

This plat is hereby approved for record.

_____ Director, Dept. of Environmental Resources Mgmt.

This plat was filed for record this 14 day of February 1985 at 0355 in book 126 of plats at page 39 public records of Dade County, Florida.

This complies with the provisions of the laws of Florida.

H. Brinker
Clerk of the Circuit Court

by _____ Deputy Clerk

SHEET 1 OF 3

DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT WATER MGMT. DIV.

MIAMI-DADE COUNTY

Criteria for the New Water Control Map

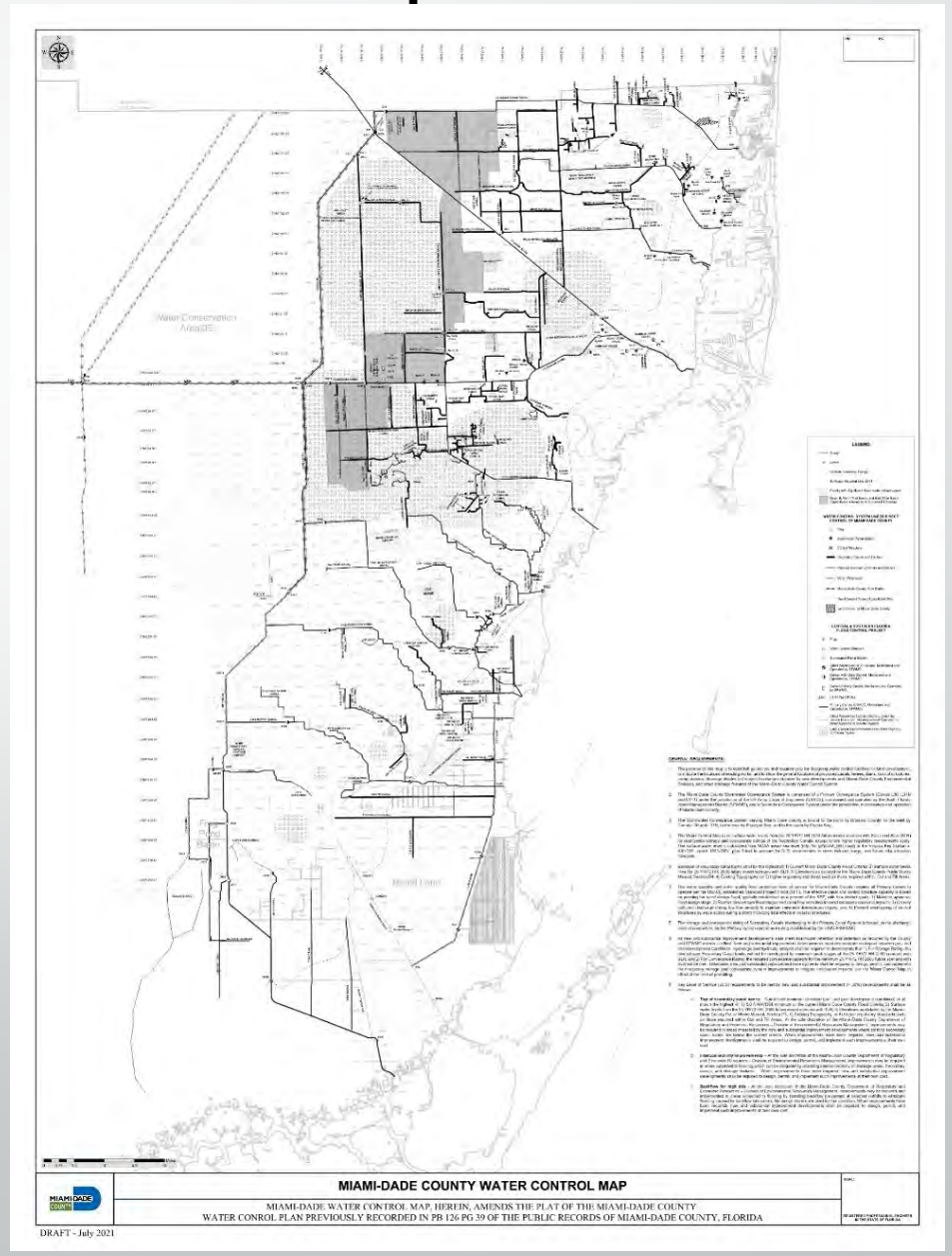
Update uses the most stringent of:

Level of Service

1. Higher regulatory standard based on surface water levels from the 25-YR/72-HR storm event under 2060 conditions (conveyance)
2. Higher regulatory applicable standards such as those required within Cut and Fill basins

Canal Bank Elevation

1. Higher regulatory standard based on surface water levels from the 25-YR/72-HR storm event under 2060 conditions (storage)
2. New CFC based on 10-YR/24-HR design event under 2060 conditions
3. Existing topography
4. Minimum elevation as dictated by the Miami-Dade County Public Works Manual



Data Development

Presenter:

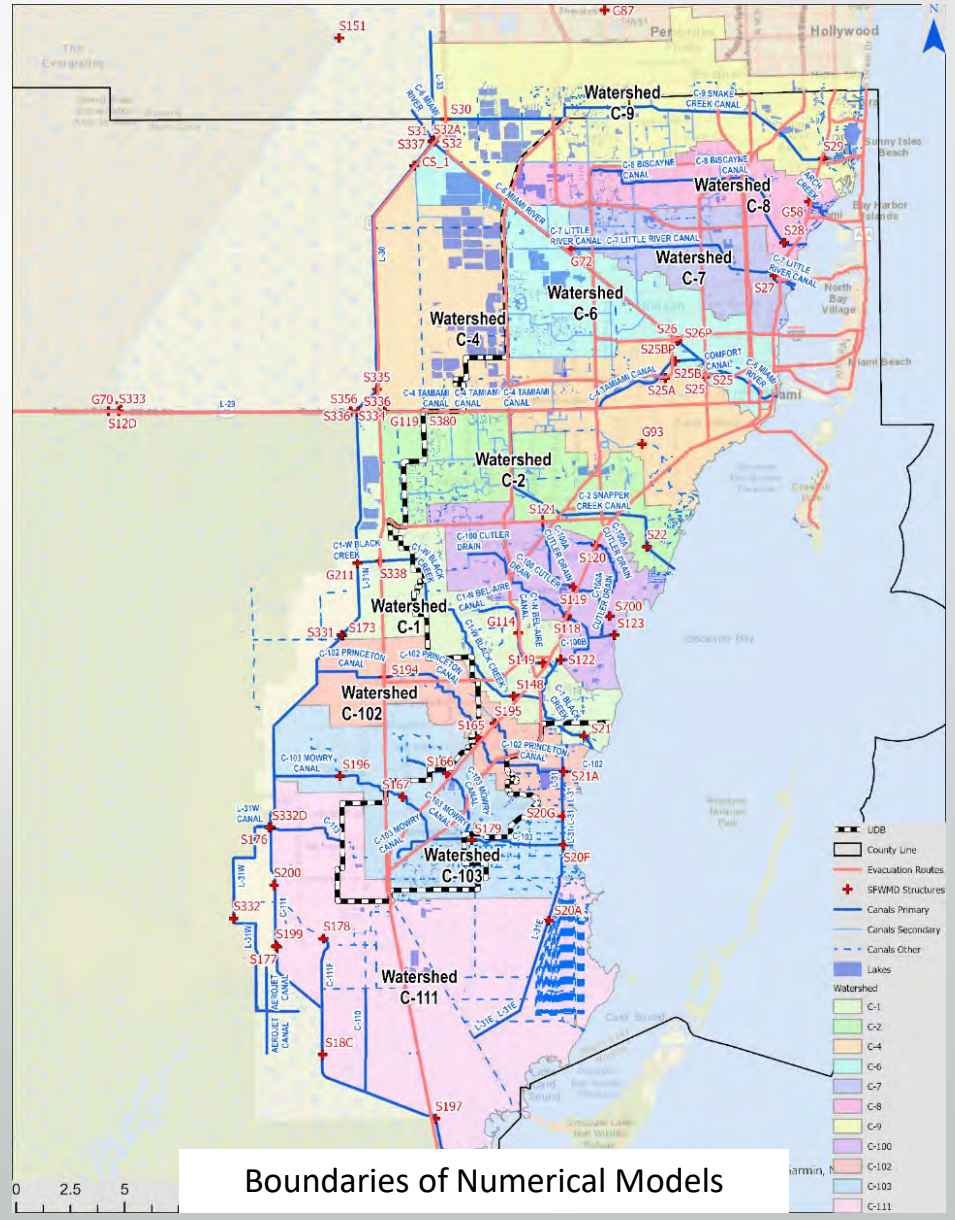
Georgio Tachiev, PE, PhD (GIT)

MIAMI-DADE COUNTY

Development of County Flood Criteria

MDC Watersheds and Numerical Models

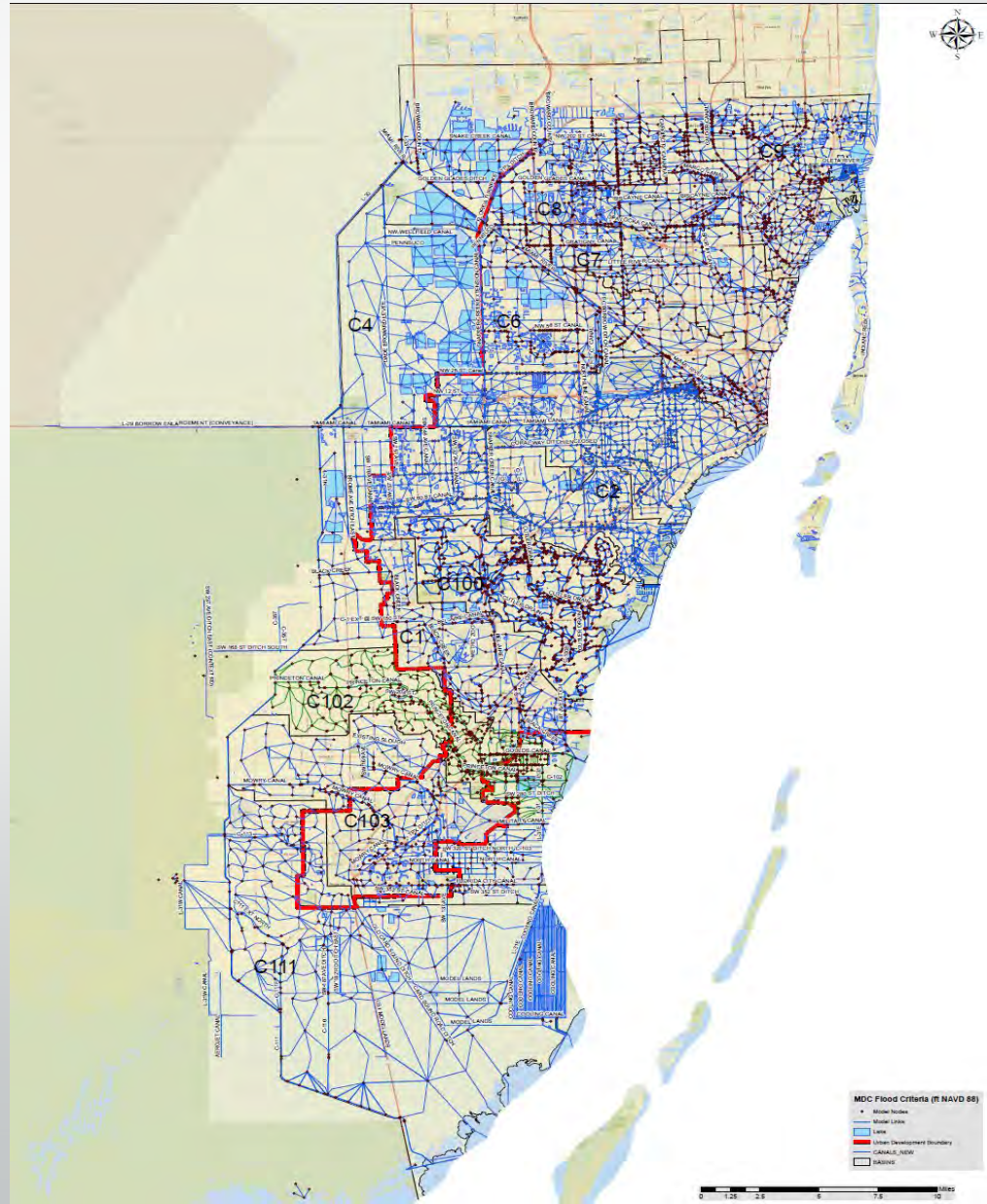
- CFC is Based on 11 numerical stormwater models, covering 780 square miles of urban areas
- The stormwater models estimate flood elevations in canals and inland for a range of design rainfall events, tidal elevations
- The objective is to address changes in hydrology, Sea Level Rise, initial groundwater conditions
- The design rainfall events are classified by the probability of storms with specific intensity occurring in any given year (the inverse of the probability is the recurring period)
- For example, rainfall with 1% probability is also known as rainfall with 100-year return period



Boundaries of Numerical Models

Stormwater Models Update

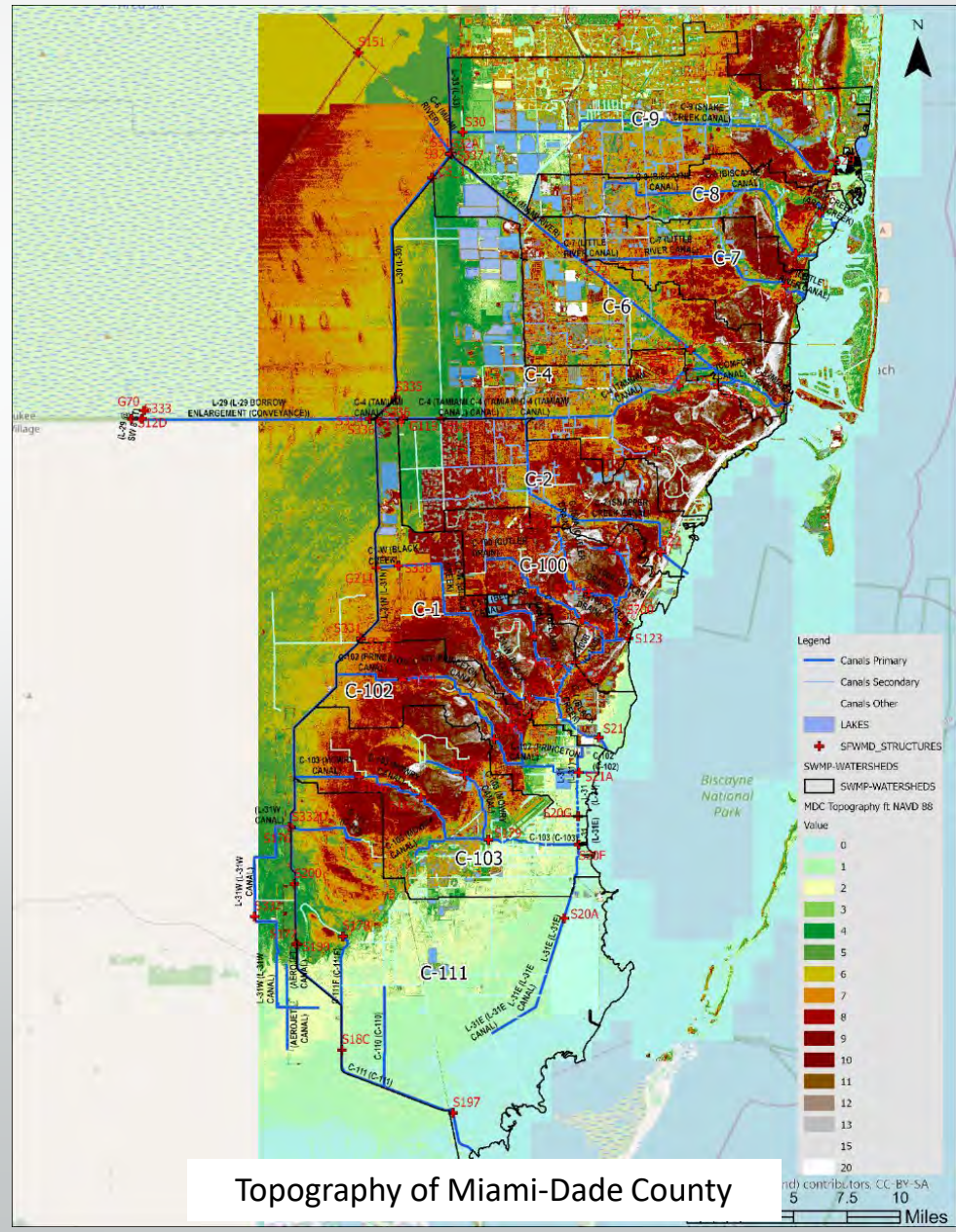
- The Stormwater Master Plan is based on eleven XPSWMM watershed numerical models to account for current and future County hydrologic and hydraulic conditions.
- The most recent update of the watershed numerical models was completed in 2020 and includes the study of over 780 square miles of inland and coastal areas.
- The updated models are based on the existing XPSWMM 1D hydrodynamic models with additional revisions, several basins were merged to better reflect latest hydrologic data and Storms
- The of sub-basins refined and doubled for better resolution and extended to the coast, and include 3,500 sub-basins
- More than 10,000 links with most recent updates of infrastructure (typically pipes greater than 1 ft),
- Land Use and soils were revised
- Runoff Curve Number based on TR-55 was applied for infiltration



MIAMI-DADE COUNTY

Topography

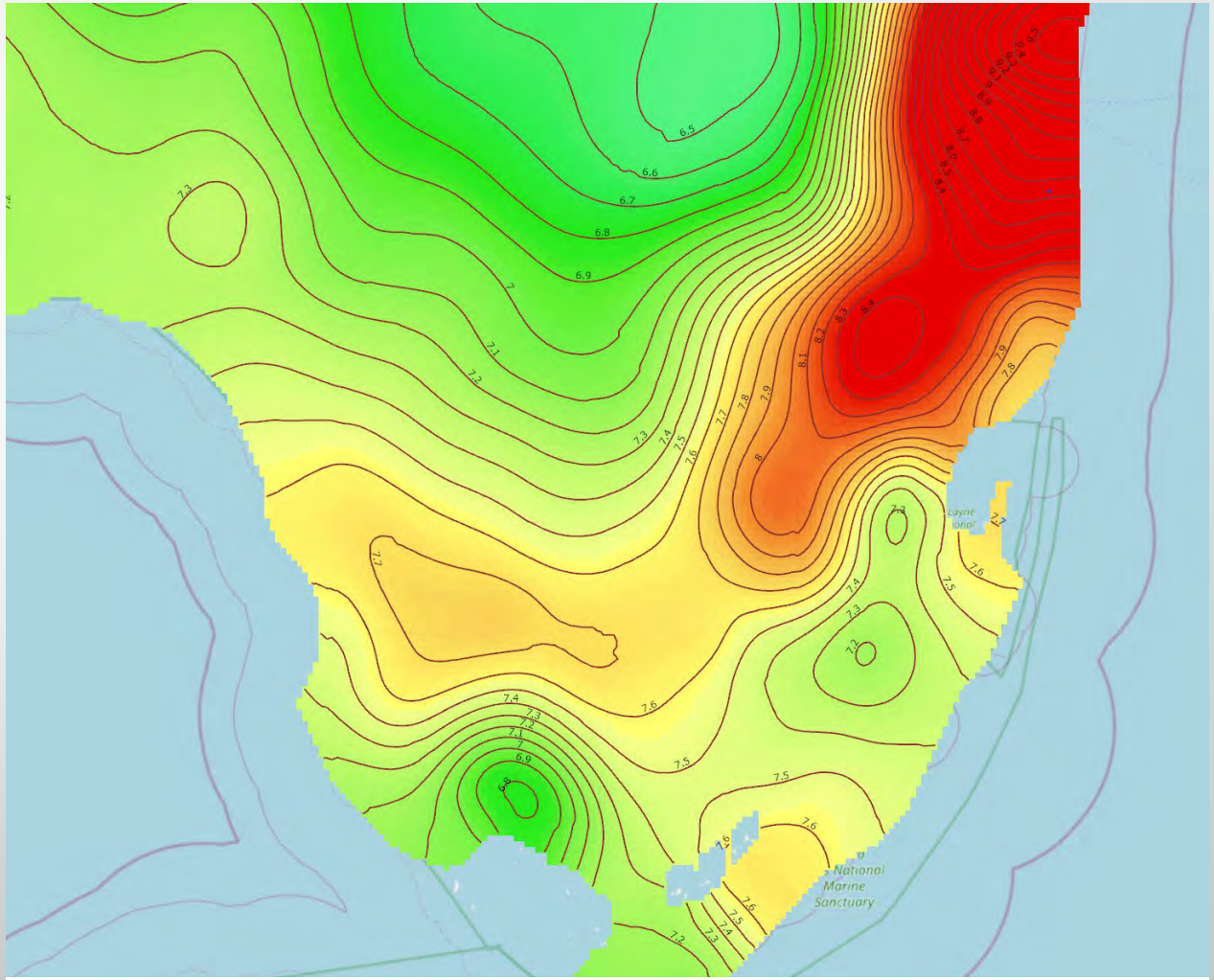
- Topography updated to latest LIDAR from 2018
- Resolution of 5 ft
- All information in the models developed in NAVD 88 datum
- Flood Mapping provided as raster files with resolution of 5 ft



Topography of Miami-Dade County

Design Rainfall

- Design Rainfall Volume from NOAA Atlas 14:
  - 24 and 72-hour storm duration with 0.001, 0.002, 0.01, 0.02, 0.04, 010 and 0.20 occurrence probability (5-, 10-, 25-, 50-, 100, 500- and 1000-yr return period)
  - NOAA Grid Raster Files based on 915 m resolution used to develop rainfall timeseries for each watershed
  - No changes are assumed for the future based on the National Climate Assessment Study from 2018, which lists Florida with less than 5% Changes in Total Rainfall Volume or Intensity
  - **County Flood Criteria was developed using 10-yr/24-hour events**



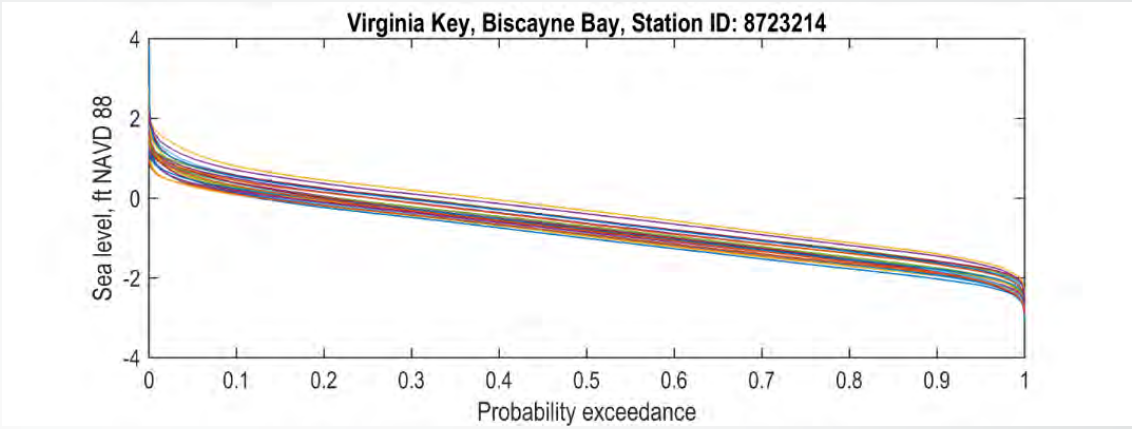
NOAA Atlas 14 Spatial Distribution of 10-yr 24-hr Design Event

MIAMI-DADE COUNTY

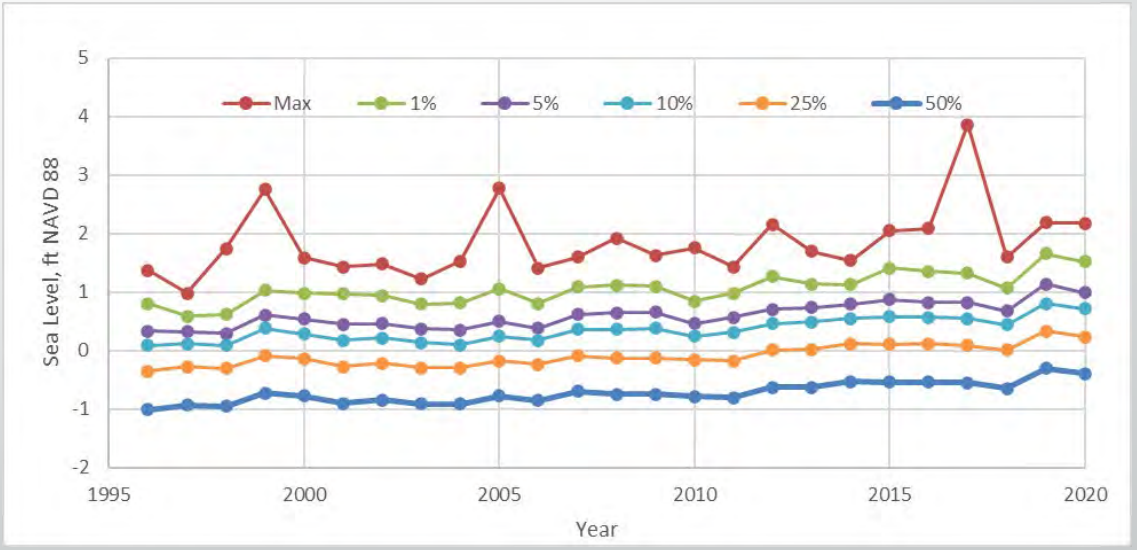
Tidal Boundaries

- Historical Sea Level Data analyzed to determine Annual Stage Duration
- Since 1996 there is consistent increase of the Stage-Duration Elevations
- The median increased 0.42 ft, while 5% increased by 0.66 ft, 1% increased by 0.72 ft
- 50% indicates 182.5 days of the year
- 5% indicates 16.5 days of the year
- 1% indicates 3.65 days of the year

Year	1%	5%	10%	50%	Total Annual Observations
1996	**0.80**	**0.33**	**0.09**	**-1.01**	**87840**
1997	0.59	0.32	0.12	-0.93	78971
1998	0.62	0.29	0.09	-0.95	80160
1999	1.03	0.61	0.38	-0.73	87600
2000	**0.98**	**0.54**	**0.28**	**-0.78**	**87840**
2001	0.97	0.45	0.17	-0.90	87596
2002	0.94	0.46	0.21	-0.85	87600
2003	0.79	0.37	0.14	-0.91	87600
2004	0.81	0.35	0.10	-0.91	87840
2005	1.06	0.50	0.24	-0.78	87600
2006	0.80	0.38	0.17	-0.86	87600
2007	1.09	0.62	0.36	-0.70	87600
2008	1.12	0.65	0.36	-0.75	87840
2009	1.10	0.66	0.38	-0.75	87600
2010	**0.84**	**0.46**	**0.24**	**-0.79**	**87600**
2011	0.98	0.57	0.31	-0.81	87600
2012	1.26	0.70	0.46	-0.63	87840
2013	1.14	0.73	0.49	-0.63	80640
2014	1.13	0.79	0.55	-0.53	87600
2015	1.41	0.87	0.58	-0.54	87600
2016	1.35	0.82	0.57	-0.54	85076
2017	1.32	0.82	0.55	-0.55	87600
2018	1.07	0.68	0.44	-0.65	87600
2019	1.66	1.14	0.80	-0.31	87600
2020	**1.52**	**0.99**	**0.71**	**-0.39**	**87827**



Annual Stage Duration for Virginia Key (ft NAVD 88)



Annual Changes of Stage Duration Probabilities

Future Scenarios

Four future scenarios:

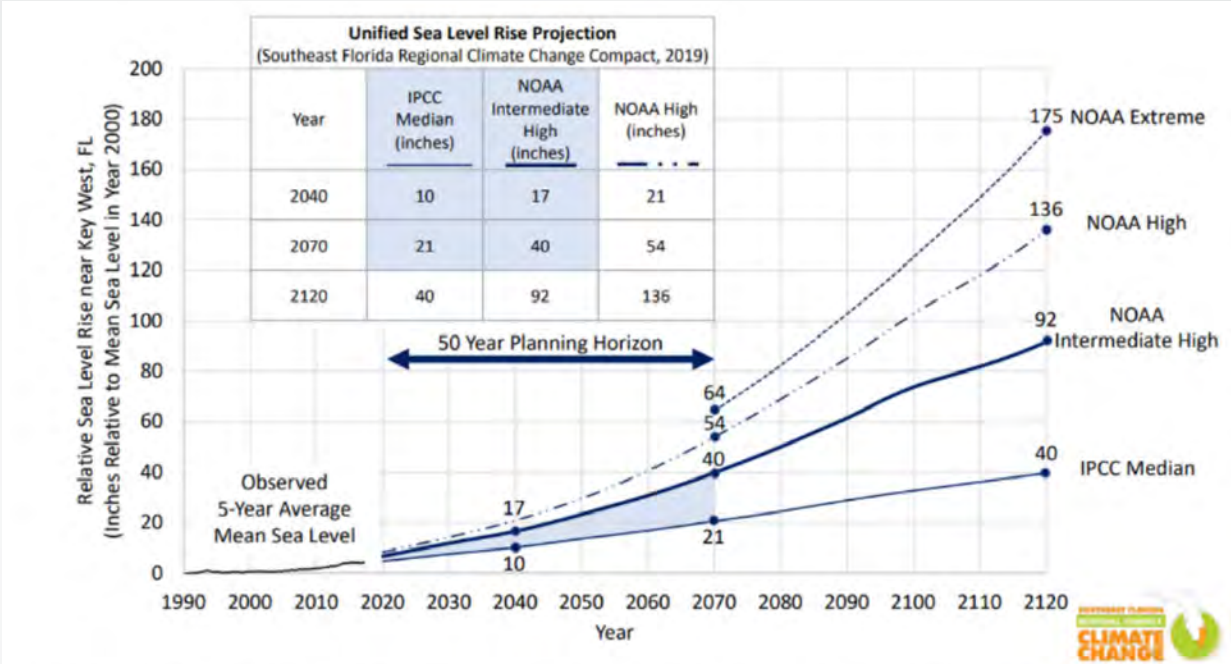
i. **Year 2040** projected SLR in 2040 (tidal conditions for 2020 +0.5 ft of SLR), future land use (2030) and future ground water (2040)

ii. **Year 2060** projected SLR in 2060 (tidal conditions for 2020 +2.0 ft of SLR), future land use (2030) and future ground water (2040)

iii. **Year 2080** projected SLR in 2080 (tidal conditions for 2020 +4.0 ft of SLR), future land use (2030) and future ground water (2040)

iv. **Year 2100** projected SLR in 2100 (tidal conditions for 2020 +6.0 ft of SLR), future land use (2030) and future ground water (2040)

County Flood Criteria Uses Scenario 2060



Scientists with the Southeast Florida Regional Climate Change Compact updated 2015 sea level rise predictions for 2019. These projections guide development in the counties. *SOUTHEAST FLORIDA REGIONAL CLIMATE CHANGE COMPACT*

Year	Sea Water Level increase in ft above the 2020 median	Sea Water Level Increase in inches above the 2020 median
2040	+0.5	+6
2060	+2.0	+24
2080	+4.0	+48
2100	+6.0	+72

Tidal Boundary Conditions Modeled

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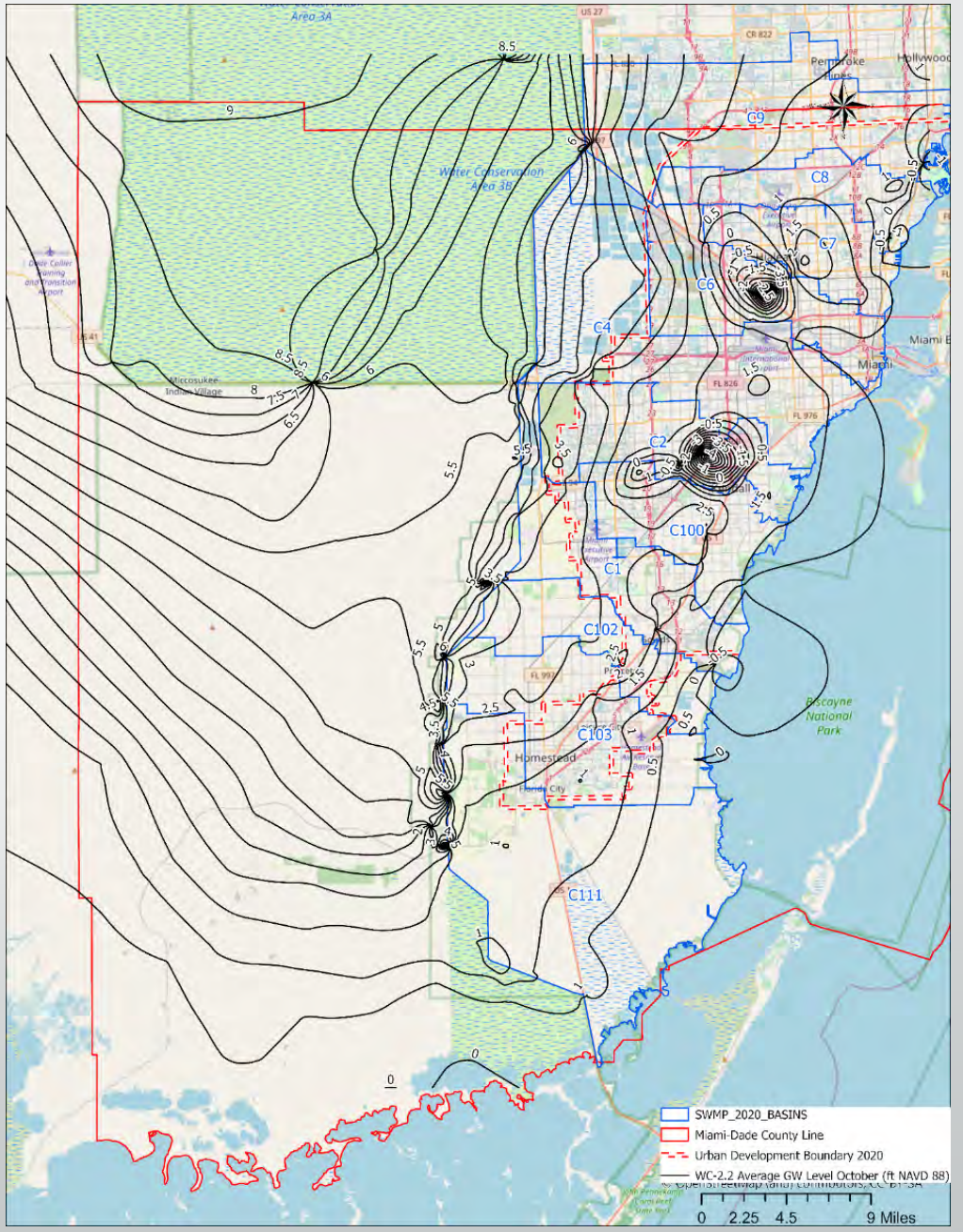
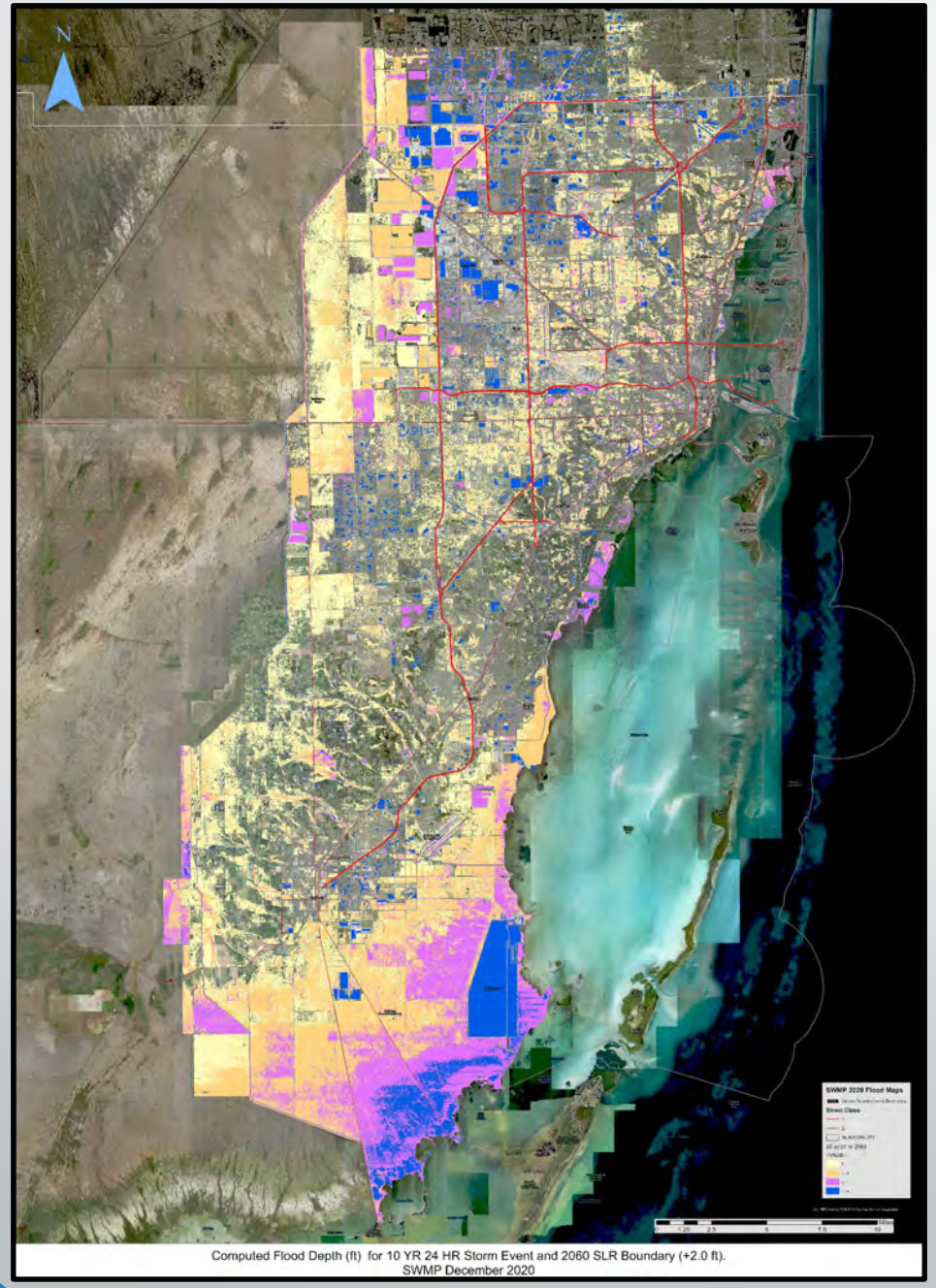
Groundwater

- Groundwater Maps updated with 2010-2020 data
- Future groundwater elevations provided by Miami-Dade Water and Sewer Department for 2040
- Future GW levels applied for the simulation of future conditions

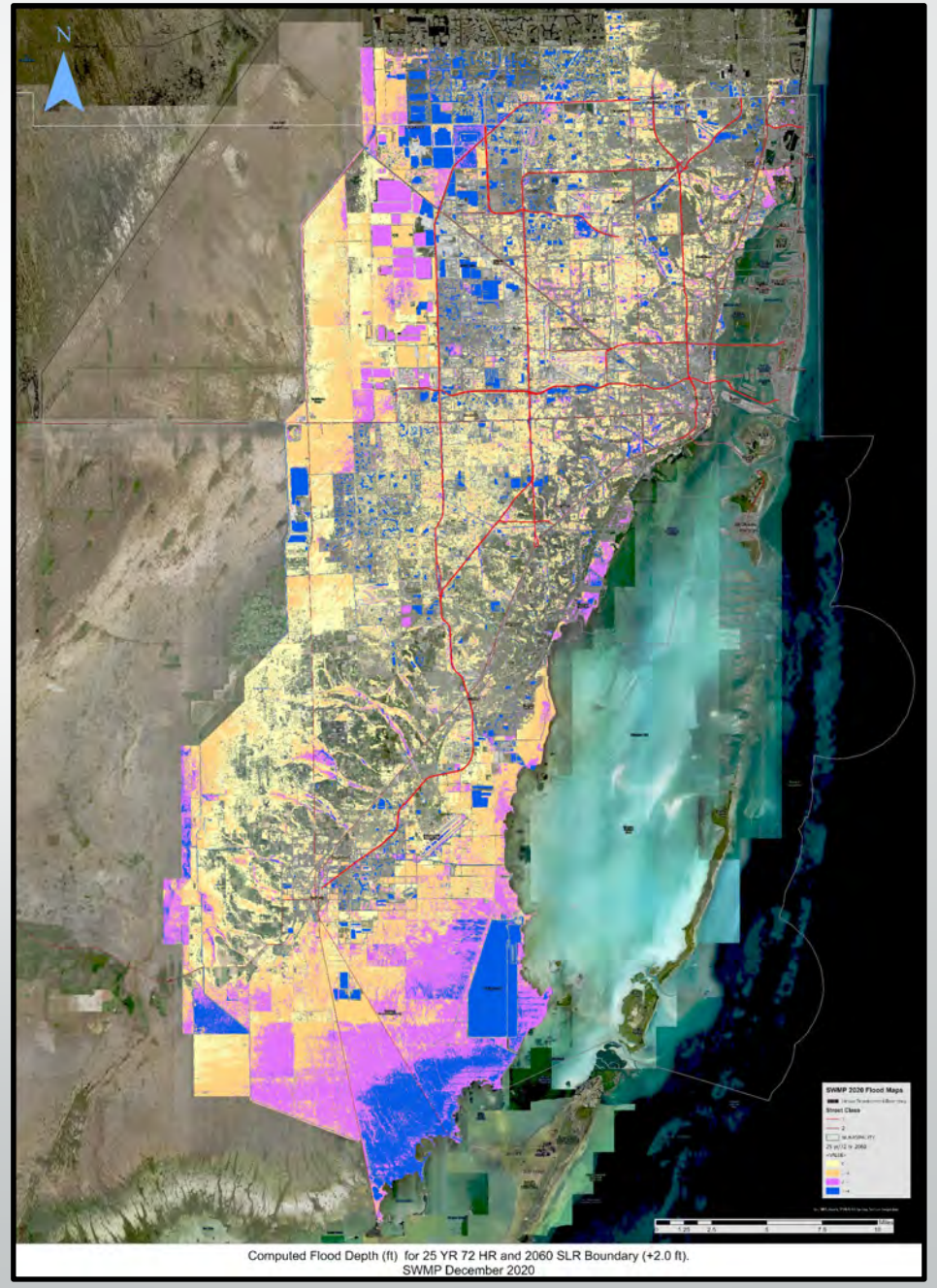


Flood Map 10YR 24 HR, 2060 Conditions



Computed Flood Depth (ft) for 10 YR 24 HR Storm Event and 2060 SLR Boundary (+2.0 ft).
SWMP December 2020

Flood Map 25YR 72 HR, 2060 Conditions



Computed Flood Depth (ft) for 25 YR 72 HR and 2060 SLR Boundary (+2.0 ft).
SWMP December 2020

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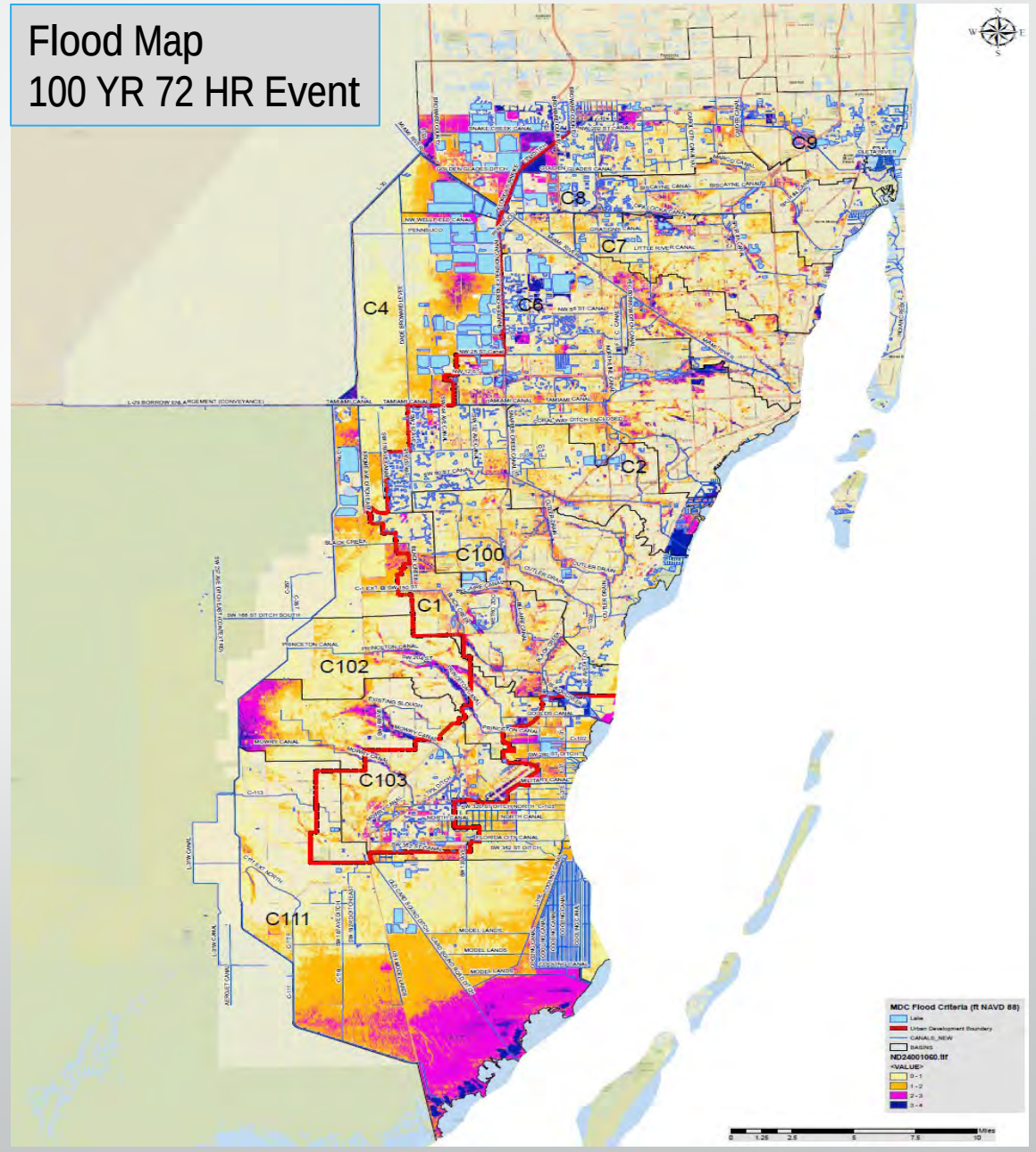
Model Applications

- Developed Flood Maps for future scenarios 2019, 2040, 2060 and 2100, including 5, 10, 25, 50, 100, 500 and 1000 YR events for 24 and 72 hours duration
- Models were applied to update Miami-Dade County's Flood Criteria (based on 10 YR / 24 HR event under 2060 conditions) and Water Control Maps (based on 25 YR / 72 HR event under 2060 conditions)
- Provide analysis of alternative mitigation strategies,
  - including installation of backflow preventers,
  - updates of levee banks
  - improving interconnectivity of the stormwater system and
  - installation of pumping components



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What's Changing and How Does it Impact You?

Presenter:

Alberto Pisani, PE, Env SP (MDC)

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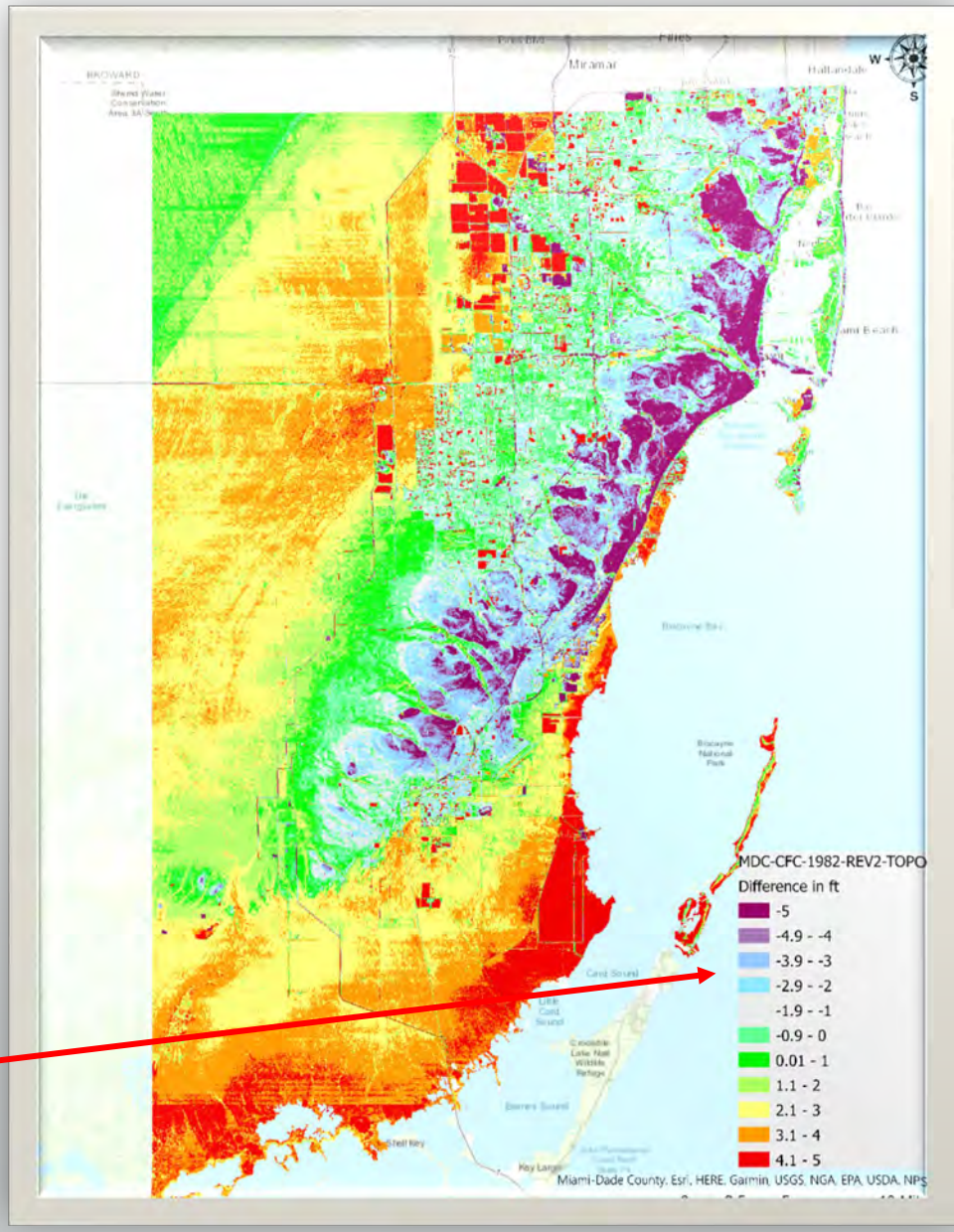
The New County Flood Criteria Map

Comparing the old CFC Map to Existing Topography

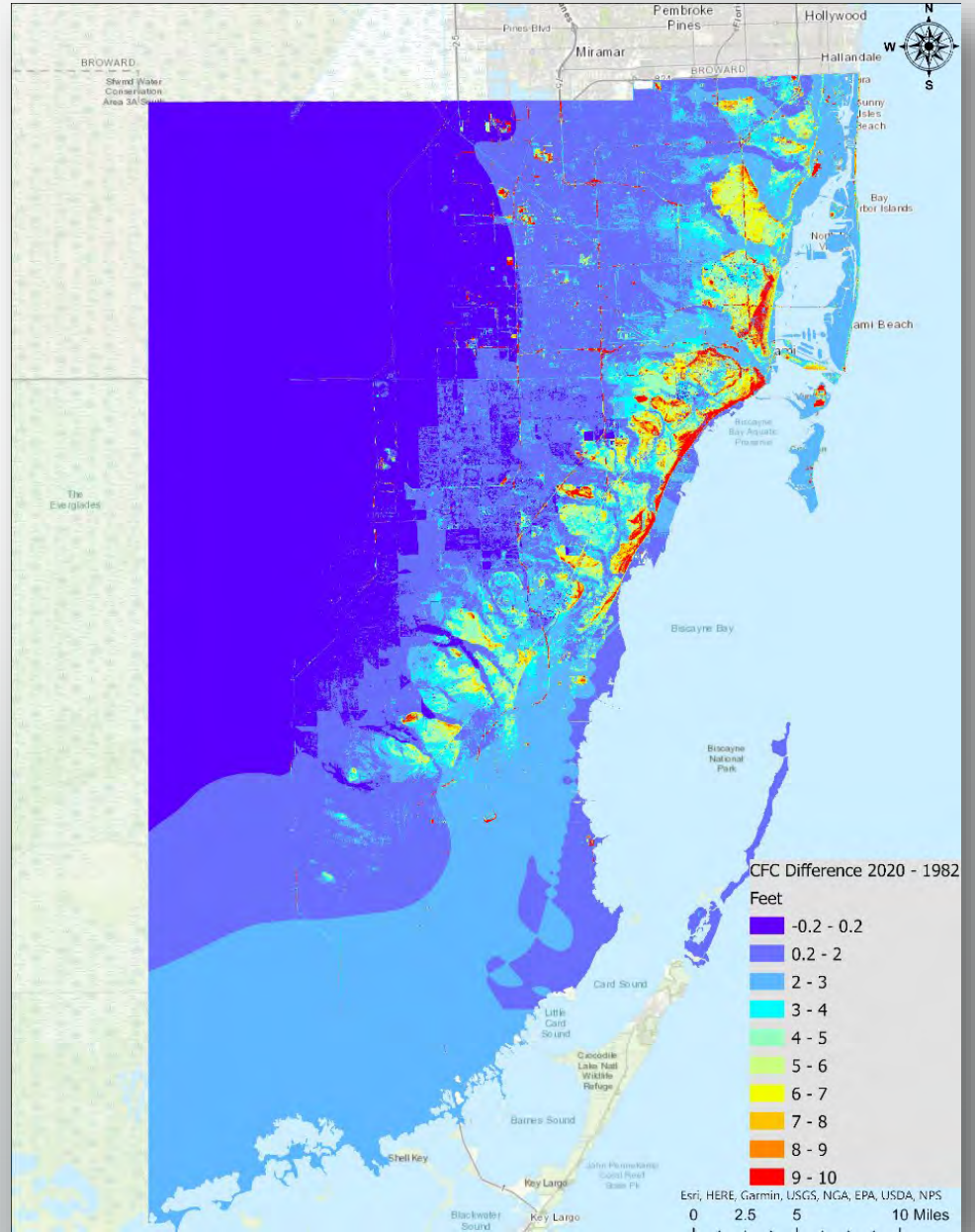
- New Data (including future forecasts):
    - Topographic elevation available since 2018 (5' grid resolution)
    - Rainfall (NOAA)
    - Groundwater (USGS)
    - Imperviousness (USGS)
    - Soils (USDA-NRCS)
    - Current and Future Land Use (MDC)



Existing topography elevations are generally higher than the old CFC for most of the urbanized areas (shown with negative values for the calculated "Difference in Feet")

Difference Between New & Old CFC Elevations

- Many changes are the result of the existing topography being higher than the old CFC map
- Changes in coastal areas 2.5′ higher (effective change may be only 1′ to 2′ higher when considering that the old CFC map was lower than topography in certain areas)
- No significant changes in the coastal ridge area
- Changes west of the coastal ridge between 0 and 1′ higher
- Changes in the south between 2′ to 3′



New County Flood Criteria Elevations Build Resilience

	Areas in Watersheds (East of L30, L31N and C111)			
	Square Miles with Higher CFC in New Map		Square Miles with No Change in CFC in New Map	
UMSA or Incorporated Areas	Developed	Vacant	Developed	Vacant
UMSA	389 (72%)	151 (28%)	50 (42%)	70 (58%)
Incorporated	138 (82%)	30 (18%)	Less than 0.5 (75%)	Less than 0.2 (25%)

Note: Areas in watersheds include all of the urbanized areas

- Average increase of new CFC for all watersheds is 2.55'
- New CFC requirements reflect:
  - Minimum elevation change from 3.45' to 6' NAVD88 which includes 0.5' of SLR from 1983 to 2020, and the forecasted 2' of SLR between 2020 to 2060.
  - Design event model for 10-year, 24-hour scenario implements all recent infrastructure changes, future scenarios for groundwater, new topography, and other significant data updates.

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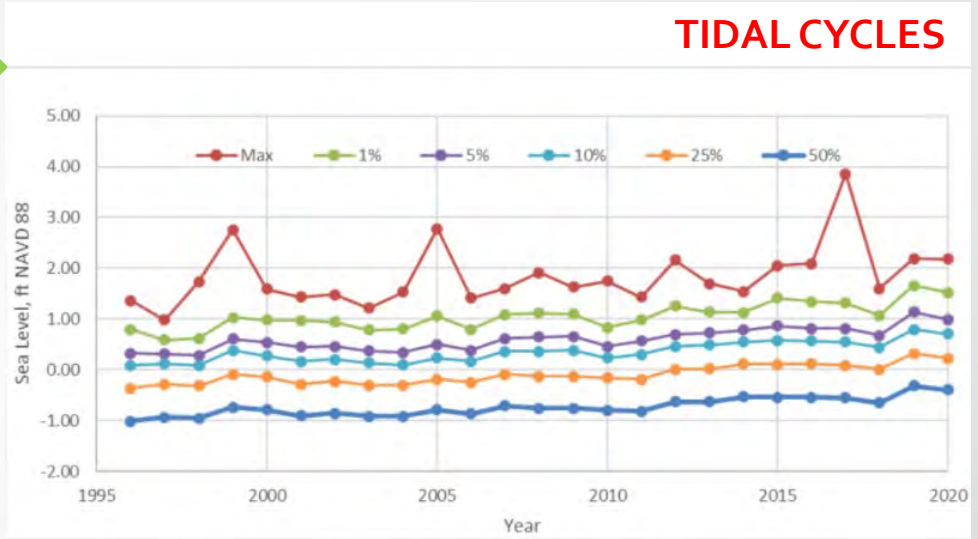
Improved Protection from New CFC

- Analyzed historical tidal cycles and storm surge events
- A minimum CFC elevation of 6' NAVD88 is anticipated to protect from maximum tide cycles & storm surge up to a 25-year storm event for the planning horizon through 2060

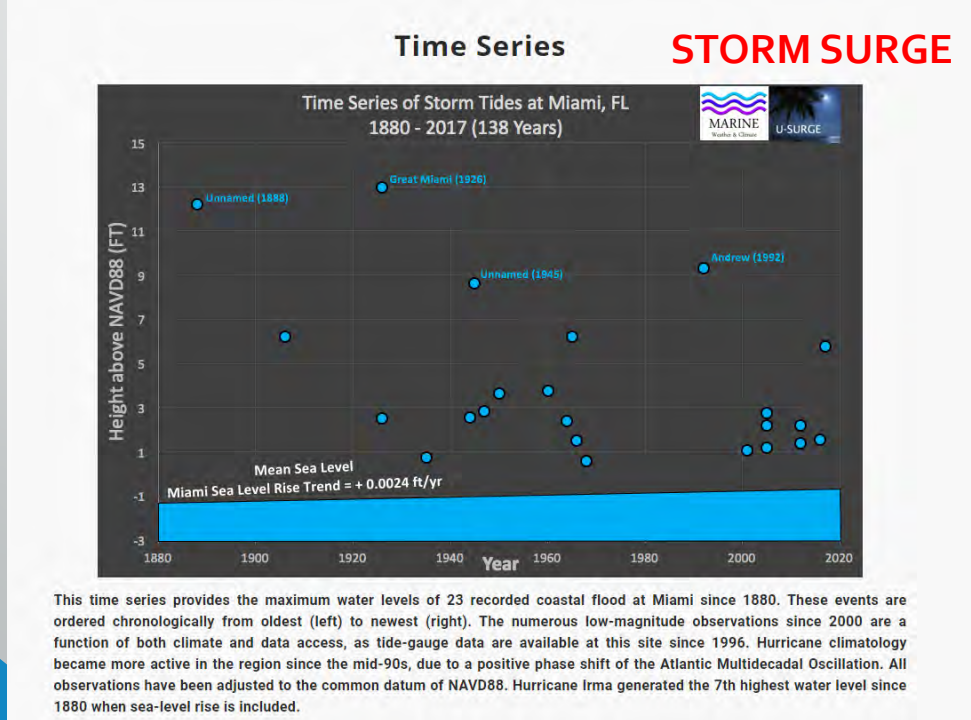
6' NAVD88

TIDAL CYCLES



Stage Exceedance (ft NAVD 88)

STORM SURGE



This time series provides the maximum water levels of 23 recorded coastal flood at Miami since 1880. These events are ordered chronologically from oldest (left) to newest (right). The numerous low-magnitude observations since 2000 are a function of both climate and data access, as tide-gauge data are available at this site since 1996. Hurricane climatology became more active in the region since the mid-90s, due to a positive phase shift of the Atlantic Multidecadal Oscillation. All observations have been adjusted to the common datum of NAVD88. Hurricane Irma generated the 7th highest water level since 1880 when sea-level rise is included.

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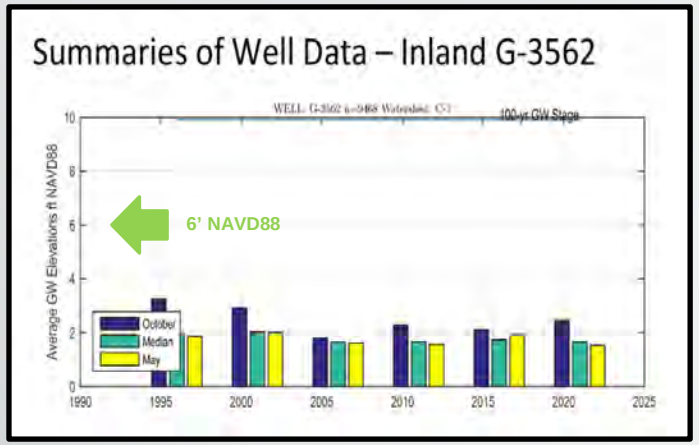
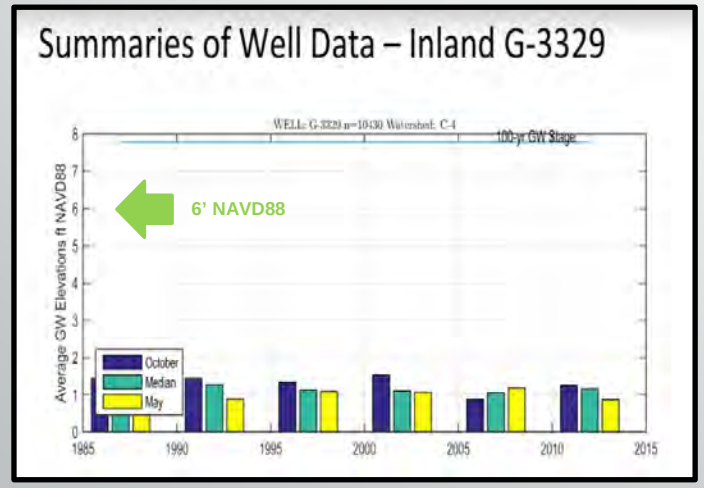
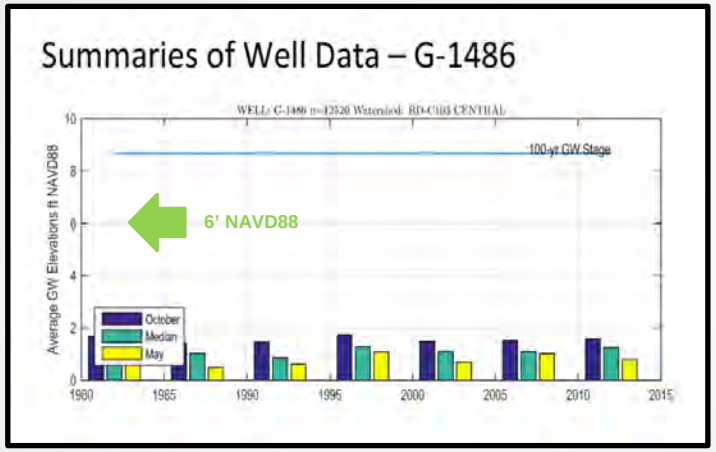
Improved Protection from New CFC

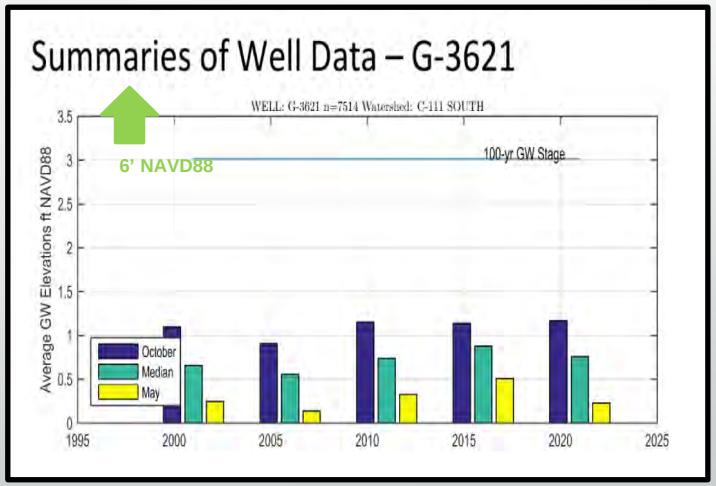
Inland



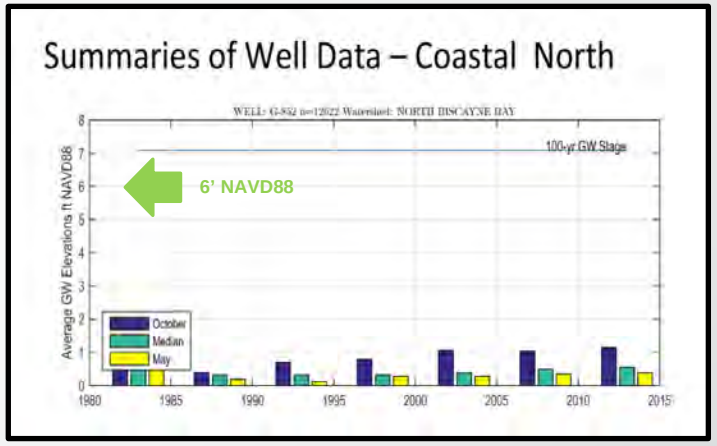


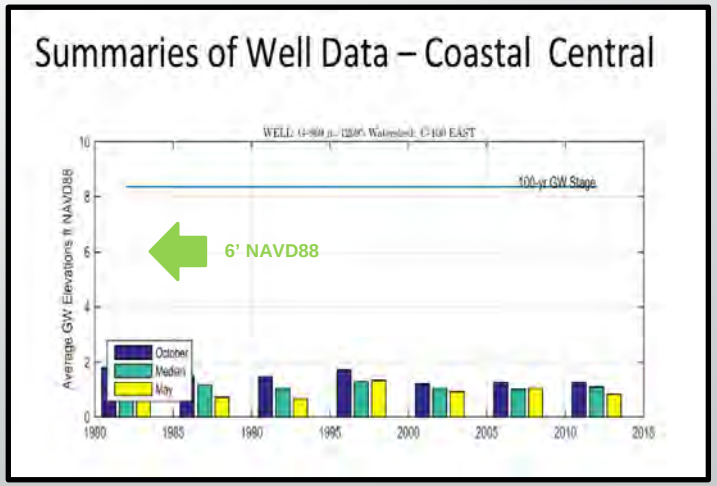
Central





Coastal





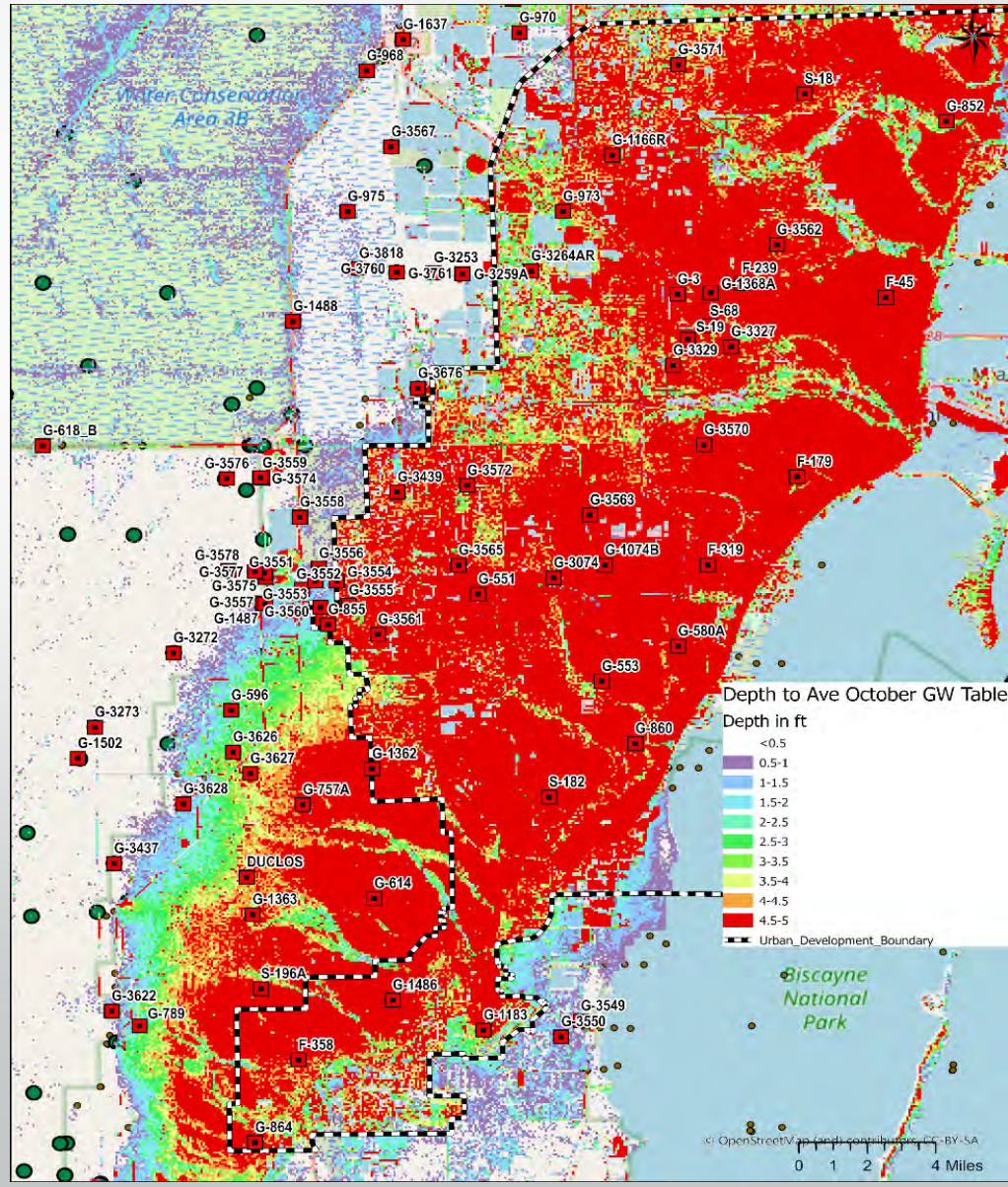
- A minimum CFC elevation of 6' NAVD88 is anticipated to protect from groundwater flooding up to a 25-year storm event for the planning horizon through 2060.

Improved Protection from New CFC

Difference Between October Water Table & Topography

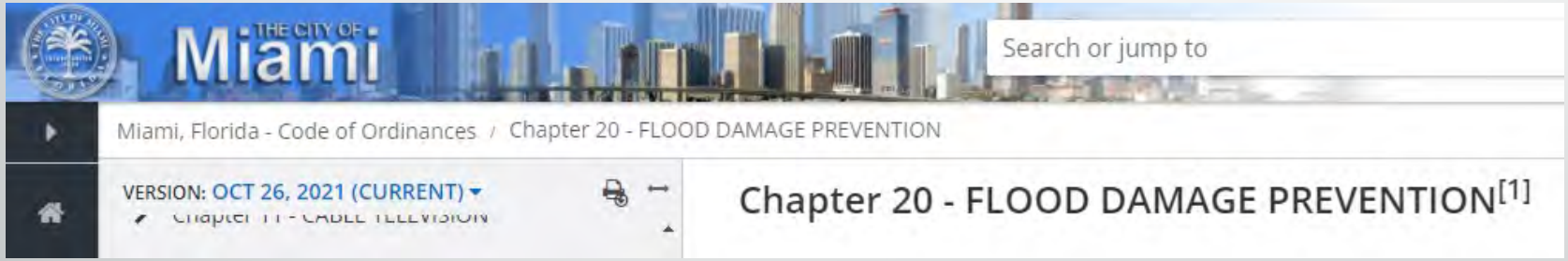
- A minimum CFC elevation of 6′ NAVD88 increases the "water table to ground freeboard" for the planning horizon through 2060.
- Based on 170 groundwater wells within Miami-Dade County:
  - Max October GW Table = 5.71′ NAVD88
  - Min October GW Table = -8.08′ NAVD88
  - Median October GW Table = 1.71′ NAVD88
  - Max Depth to GW Table = 14.02 ft
  - Min Depth to GW Table = -1.37 ft (flooded)
  - Median Depth to GW Table = 4.38 ft

Note: GW levels are strongly correlated to the water levels in the primary conveyance system



How Does the New CFC Impact Municipalities?

- New CFC Map exceeds current requirements for many municipalities
- A few municipalities have direct reference to County Flood Criteria in their code, many do not specifically set a lot or other minimum elevation requirement
- Municipality must make reference to meeting County requirements or require compliance with the County Flood Criteria
- Seawall minimum elevation shall comply with County Flood Criteria (6' NAVD88)



(7) Require that all new subdivision proposals and other proposed developments include within such proposals base flood elevation data according to the City of Miami's flood insurance rate map (FIRM) information, and existing grade and crown of adjacent road elevation information according to Dade County flood criteria information.

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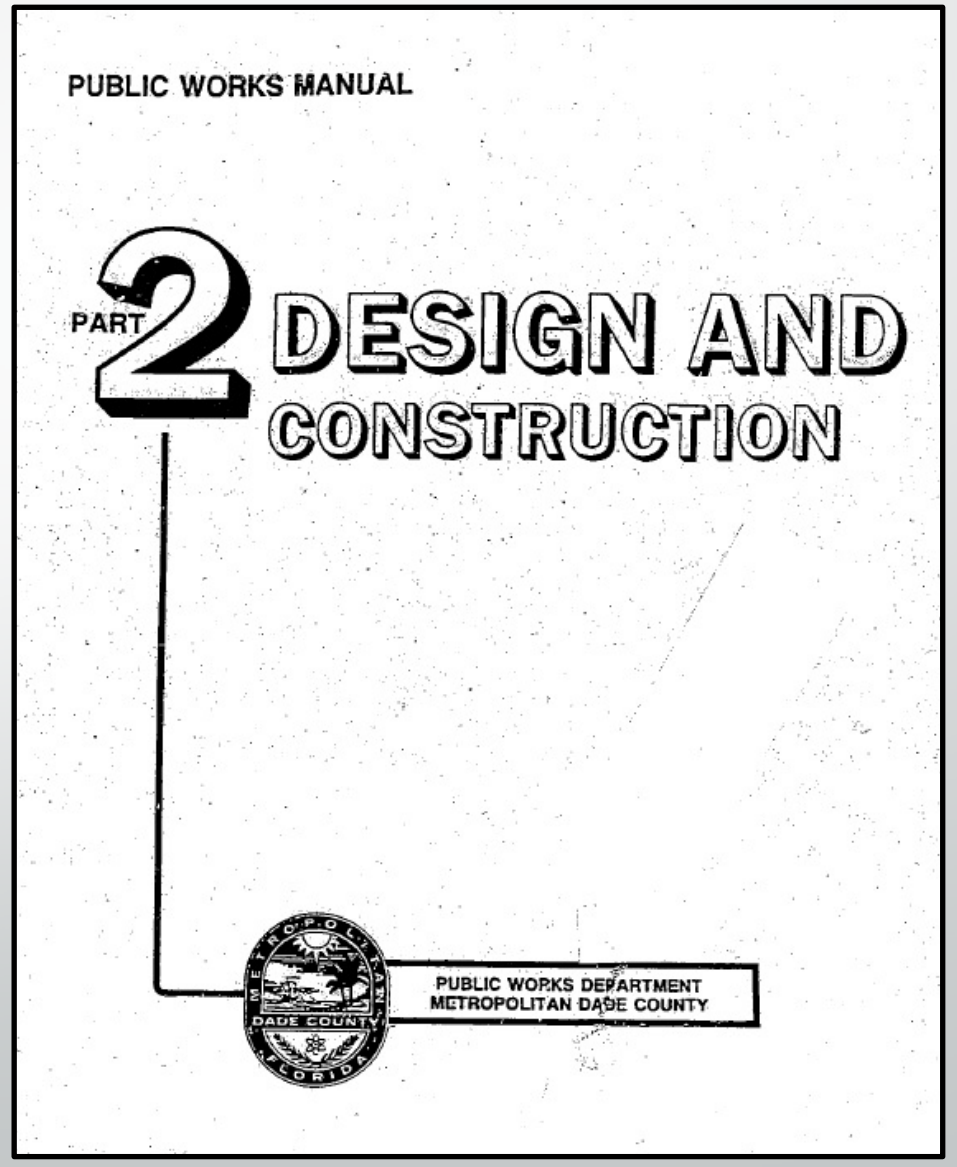
How Does the New CFC Impact Designers?

- Following the public comment period, the new CFC map will be presented to the Board of County Commissioners for approval.
- Once approved and recorded, the new CFC map will supersede the current CFC map.
- References in Public Works Manual will be updated.
- New developments or substantial improvements must comply with elevation requirements of the new CFC map.
- New CFC map will provide increased protection against flood risks.



Conclusions

- Miami-Dade County applied a set of models and analyses to determine proposed changes of parcel elevations, canal banks, seawalls, and bulkheads to adapt to rising sea levels and mitigate inland flooding risk
- These changes will better address the uncertainty of future hydrology, using NOAA's estimates for rainfall and sea level rise
- Prepares a roadmap for the most optimized gradual adaptation to future conditions
- Integral component of ongoing regulatory updates to address Flood Protection Level of Service – one piece of the resiliency puzzle

MIAMI-DADE COUNTY

Questions?

Submit questions to:
WaterManagement@miamidade.gov

Moderators:

Amy Cook (MDC)
Elius Nortelus, PE (MDC)