Considerations for Beach Design: Incorporating Large Storms into Renourishment Projects

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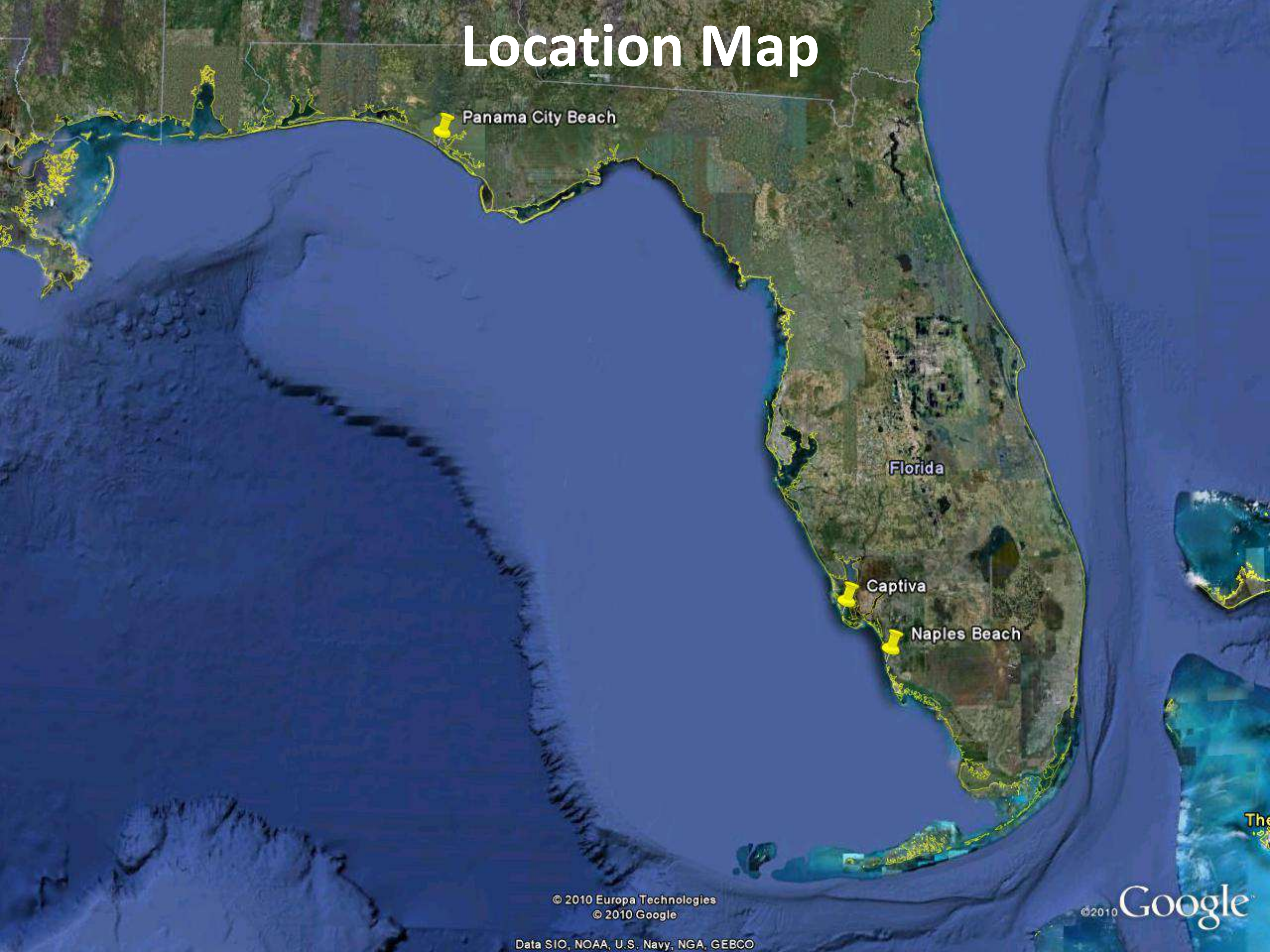
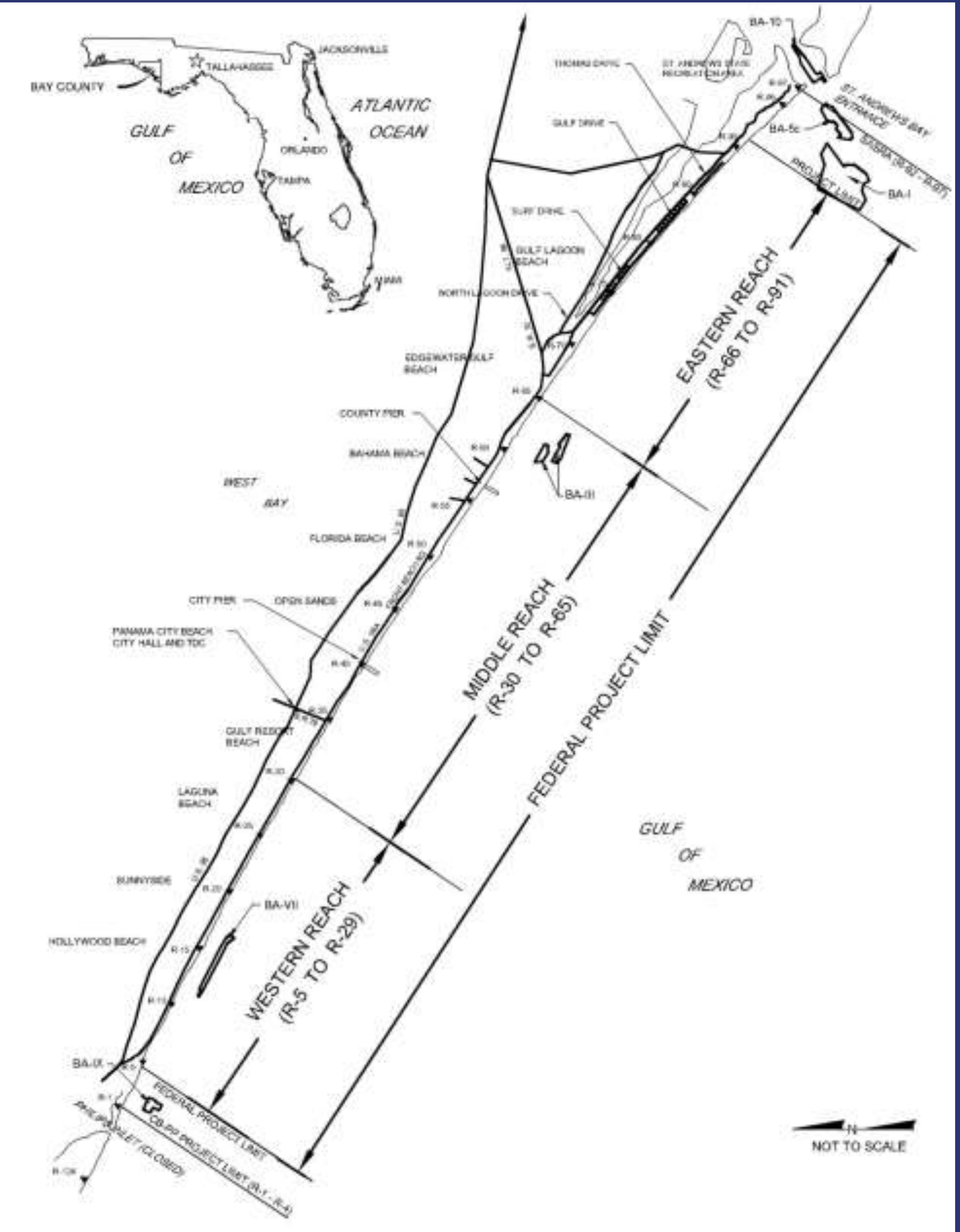
Presentation Overview

- History of Project Area
- Study Objectives
- Results
- Comparison with Previous Design Standards
- Conclusions & Recommendations

Location Map



Project Map



BAY COUNTY
TALLAHASSEE
JACKSONVILLE
ATLANTIC OCEAN
GULF OF MEXICO
ORLANDO
TAMPA
MIAMI
WEST BAY
EASTERN REACH (R-66 TO R-91)
MIDDLE REACH (R-30 TO R-65)
WESTERN REACH (R-5 TO R-29)
FEDERAL PROJECT LIMIT
GULF OF MEXICO
ST. ANDREWS BAY ENTRANCE
BA-10
BA-5c
BA-I
BA-III
BA-VII
BA-IX
PROJECT LIMIT
GULF DRIVE
THOMAS DRIVE
SURF DRIVE
GULF LAGOON BEACH
NORTH LAGOON DRIVE
EDGEWATER GULF BEACH
COUNTY PIER
BAHAMA BEACH
FLORIDA BEACH
CITY PIER
OPEN SANDS
PANAMA CITY BEACH CITY HALL AND TDC
GULF RESORT BEACH
LAGUNA BEACH
SUNNYSIDE
HOLLYWOOD BEACH
FEDERAL PROJECT LIMIT
PHILIPS INLET (CLOSED)
NOT TO SCALE

Project Details

- Template based upon the GRR Design
    - 6.6 ft-NAVD berm (1988 7 ft-NGVD contour)
    - 30 and 50 ft. design widths
    - Transitions near R-17

Project Reaches

REACH	PROFILES
Carillon Beach & Pinnacle Port	R1to R4
Western Reach	R5 to R29
Middle Reach	R30 to R65
Eastern Reach	R66 to R91

Note: CB-PP added to the Federal project area in 2009

Panama City Beach History

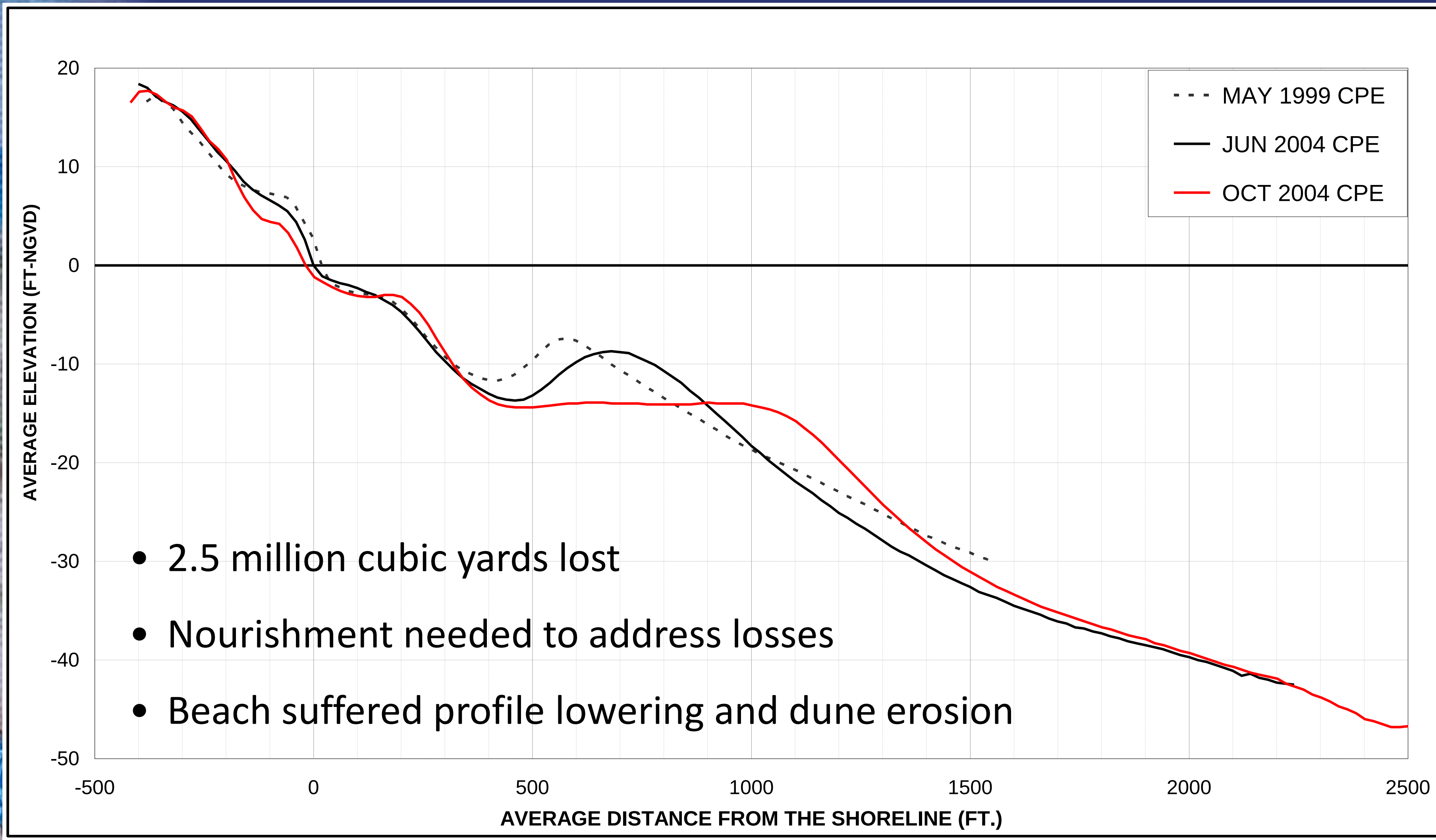
- Nourished initially in 1998/1999
  - 9 million cubic yards over 17.5 miles
  - Avg. MHW shoreline Change (May 1999 to June 2004)
    - -23.3 feet
  - Avg. Volumetric Change (May 1999 to June 2004)
    - -669,626 cubic yards
  - Project performed above expectations
    - 85% of as-built volume remained in 2004

And then….

Hurricane Ivan

Hurricane Ivan

- Impacts study area in 2004
- One of most destructive hurricanes to impact Panhandle



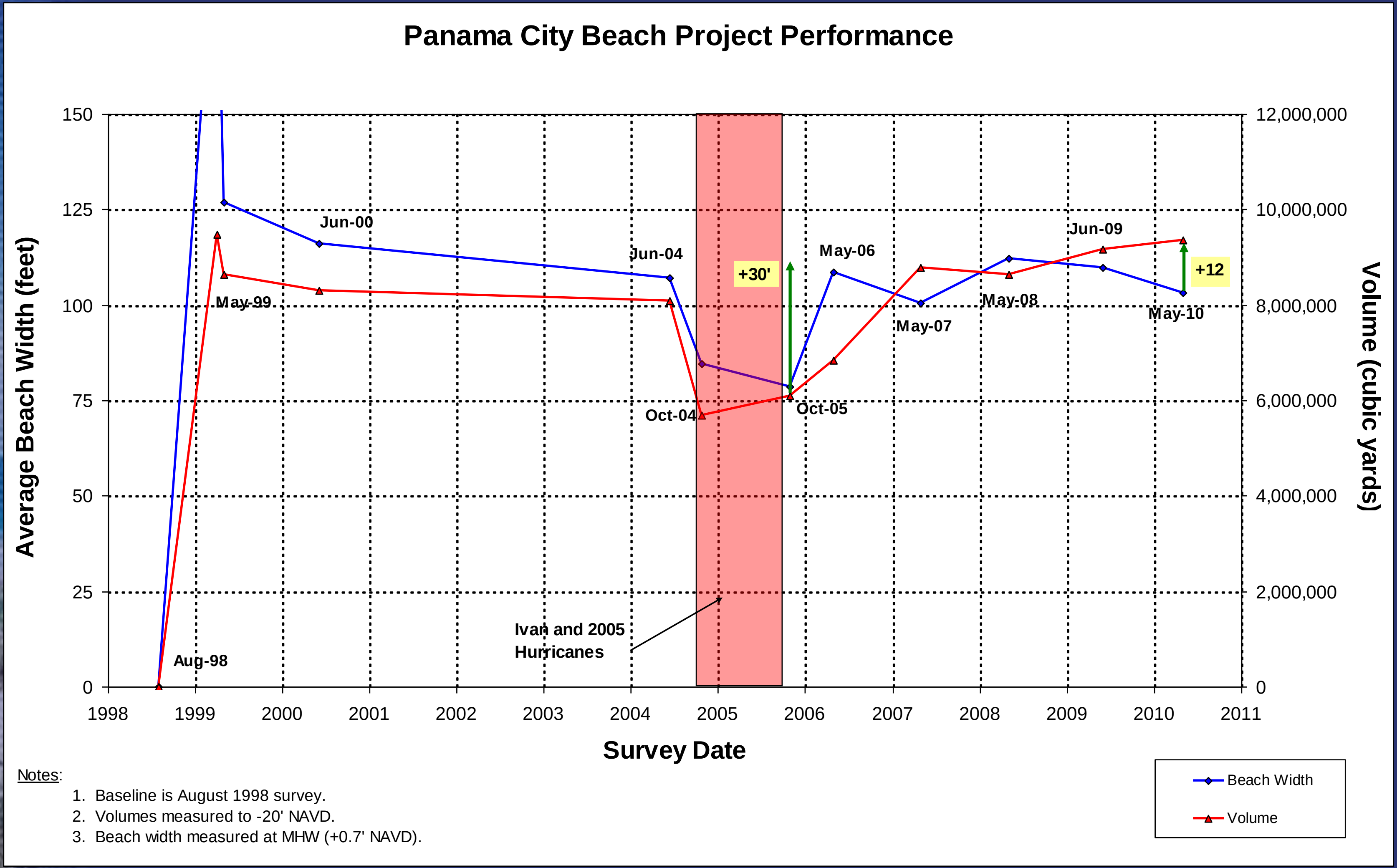
- 2.5 million cubic yards lost
- Nourishment needed to address losses
- Beach suffered profile lowering and dune erosion

Panama City Beach History (continued)

Volume required to Address Storm Losses & Restore Beach

Hurricane Loss Replacement (FCCE)	2,411,560
Renourishment Volume (CG)	1,549,270
Total	3,960,830

- Renourished in 2005/2006
  - 3.3 million cubic yards
    - Fill volume reduced due to borrow area limitations
  - Hurricane Dennis, Katrina, and Wilma impact the area during construction
    - Loss unmeasurable due to construction
    - Estimated at least 1.5 million cubic yards lost
    - Western and Eastern Reach impacted the greatest



- 2005-6 project advanced shoreline approximately 30 ft.
- Beach did not fully recover to pre-Ivan conditions
    - Active profile still gaining sand 5 years later
- Beach remains ~12 ft. short of volumetric expectations

Objectives of Study

- Analyze impacts that various periods have upon advanced nourishment
    - periods of recovery
    - major storms
    - calm periods/mild weather
- Policy versus Implementation
- Another means to create robust beaches

Advanced Nourishment

- "Sacrificial Sand"
- Maintains the design fill section during the initial renourishment interval
    - Time of completion of the project to the next scheduled renourishment

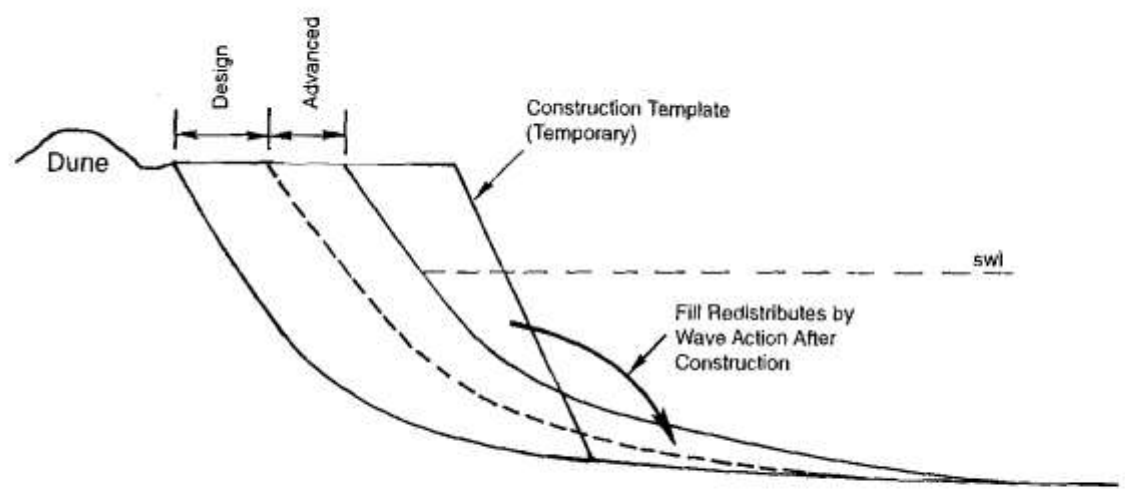


FIGURE D-5 The construction template.

Advanced Nourishment Calculations

"Traditional Method"

- Based on long-term shoreline recession
  - Historic/background erosion rates
  - Tends to favor non-storm periods
- Erosion rates were generalized for many areas in the original project
  - Did not account for small areas with higher erosion rates

Historical Shoreline Analysis Rates

Stations	Shoreline Change Rate (ft/yr)
0+00 to 410+00 (R-1 to R-38)	-0.5
410+00 to 830+00 (R-38 to R-81)	0.5
830+00 to 990+00 (R-81 to R-97)	-2.1

Note: from 1994 GRR

R-1 to R-81 time period = 1855/1872 to 1988

R-81 to R-97 time period = 1934 to 1988

Fill Volume from PCB GRR (1994)

STATION	FILL* BEHIND ECL (CY)	DESIGN** FILL VOLUME (CY)	OVERFILL (CY)	ADVANCE* NOURISHMENT (CY)	'88-'99* EROSION LOSSES (CY)	TOTAL CONSTRUCTION VOLUME (CY)
6,530	0	0	0	0	0	0
7,700	6,839	17,550	5,265	4,079	7,605	34,499
10,000	26,888	69,000	20,700	8,018	14,950	112,668
12,500	29,226	75,000	22,500	8,715	16,250	122,465
15,000	29,226	75,000	22,500	8,715	16,250	122,465
17,500	29,226	75,000	22,500	8,715	16,250	122,465
19,200	19,874	68,000	20,400	5,926	11,050	105,376
20,000	9,352	40,000	12,000	2,789	5,200	59,989
22,500	29,226	125,000	37,500	8,715	16,250	187,465
25,000	29,226	125,000	37,500	8,715	16,250	187,465
27,500	29,226	125,000	37,500	8,715	16,250	187,465
30,000	29,226	125,000	37,500	8,715	16,250	187,465
32,500	25,929	125,000	37,500	8,715	16,250	187,465
35,000	33,906	125,000	37,500	8,715	16,250	187,465
37,500	31,713	125,000	37,500	8,715	16,250	187,465
40,000	31,713	125,000	37,500	8,715	16,250	187,465
41,000	12,685	50,000	15,000	3,486	6,500	74,986
42,500	19,028	75,000	22,500	3,922	7,313	108,734
45,000	31,713	125,000	37,500	4,357	8,125	174,982
47,500	31,713	125,000	37,500	4,357	8,125	174,982
50,000	31,713	125,000	37,500	4,357	8,125	174,982
52,500	32,018	125,000	37,500	4,357	8,125	174,982
55,000	33,894	125,000	37,500	4,357	8,125	174,982
57,500	33,894	125,000	37,500	4,357	8,125	174,982
60,000	33,894	125,000	37,500	4,357	8,125	174,982
62,500	33,894	125,000	37,500	4,357	8,125	174,982
65,000	33,894	125,000	37,500	4,357	8,125	174,982
67,500	33,894	125,000	37,500	4,357	8,125	174,982
70,000	33,894	125,000	37,500	4,357	8,125	174,982
72,500	33,894	125,000	37,500	4,357	8,125	174,982
75,000	33,351	125,000	37,500	4,357	8,125	174,982
77,500	20,631	125,000	37,500	4,357	8,125	174,982
80,000	20,631	125,000	37,500	4,357	8,125	174,982
82,500	20,631	125,000	37,500	4,357	8,125	174,982
82,900	3,301	20,000	6,000	697	1,300	27,997
85,000	17,330	105,000	31,500	17,351	32,351	186,201
87,500	20,631	125,000	37,500	36,954	68,900	268,354
90,000	20,631	125,000	37,500	36,954	68,900	268,354
92,500	20,631	125,000	37,500	36,954	68,900	268,354
93,900	11,553	70,000	21,000	20,694	38,584	150,278
95,450	6,395	38,750	11,625	22,911	42,718	116,004
TOTALS	1,016,528	4,153,300	1,245,990	366,314	683,020	6,448,624

* includes 30% overfill

** Design volume includes fill behind ECL

Advanced Nourishment Calculations

"Traditional Method"

Region	Advanced Nourish (C.Y.)	30 % Overfill	Total (C.Y.)
CPP (R1-4)	108,814	32,644	141,458
West (R5-28)	170,283	51,085	221,368
Middle (R29-65)	3,383	1,015	4,398
East (R66-91)	93,533	28,060	121,593
TOTAL (R5-91)	267,199	80,160	347,359

- Calculated in same manor as 1994 values
  - Time period = May 1999 to June 2004
  - 30 % overfill vs the 10 % used today
- Approximately 350,000 cubic yards needed based upon traditional method

Advanced Nourishment Calculations

Incorporating Storm into Adv. Nourishment

- Long term erosion PLUS a major storm considered
- Profiles analyzed on an individual basis
  - No regional rates
  - Allows for areas with higher erosion to get more sand
- Creates more robust beach profiles

Advanced Nourishment Calculations

Incorporating Storm into Traditional

Reach	Advanced Nourish (C.Y.)	Overfill (C.Y.)	Total
CB-PP (R1-4)	212,818	21,282	234,099
West (R5-29)	779,059	77,906	856,965
Middle (R30-65)	135,302	13,530	148,832
East (R66-91)	355,866	35,587	391,453
TOTAL (R1-91)	1,483,045	148,305	1,631,350

- Time period = May 1999 to Oct. 2004
- 10 % overfill factor used

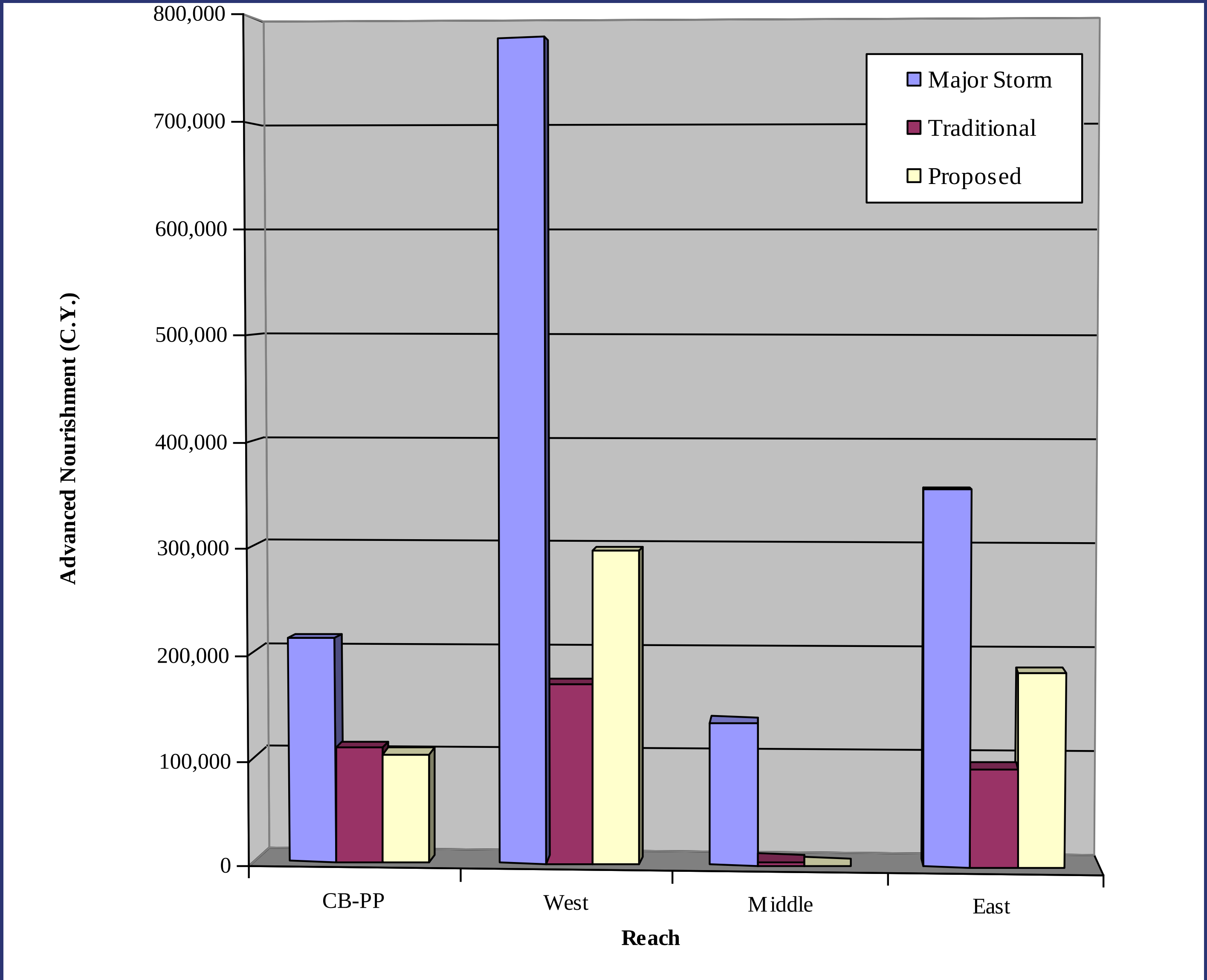
Advanced Nourishment Calculations

Major Storm, Recovery, and Calm Periods

Reach	Advanced Nourish (C.Y.)	Overfill (C.Y.)	Total
CB-PP (R1-4)	102,687	10,269	112,956
West (R5-29)	297,873	29,787	327,660
Middle (R30-65)	170	17	187
East (R66-91)	183,925	18,393	202,318
TOTAL (R1-91)	584,655	58,466	643,121

- Time period = May 1999 to May 2010
- 10 % overfill factor used

Comparison



800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Advanced Nourishment (C.Y.)
Major Storm
Traditional
Proposed
CB-PP
West
Middle
East
Reach

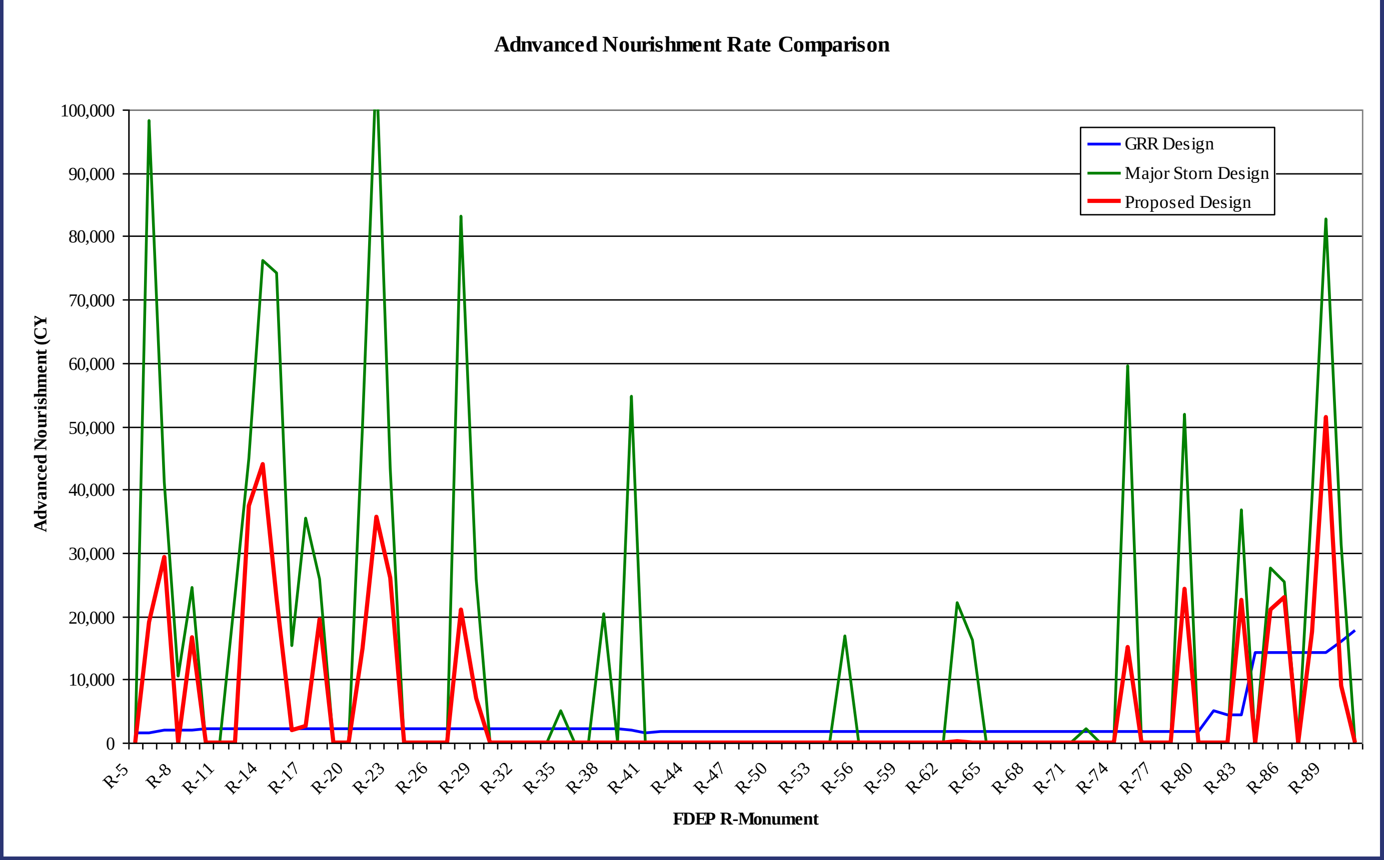
Observations

STORM EVENT	YEAR	VOLUMTRIC CHANGES (C.Y.)
Hurricane Opal	1995	-3,200,000
Hurricane Earl and Georges	1998	-844,000
Five-Year Monitoring	1999-2004	-717,000
Hurricane Ivan	2004	-2,500,000
Hurricane Katrina and Others	2005	-2,100,000
Four-Year Monitoring	2006-2010	2,839,900

- Major storm approx. every 5 years
- Offshore losses can recover after major storms
- Experiencing shoreline recovery, however sand not in its intended design location

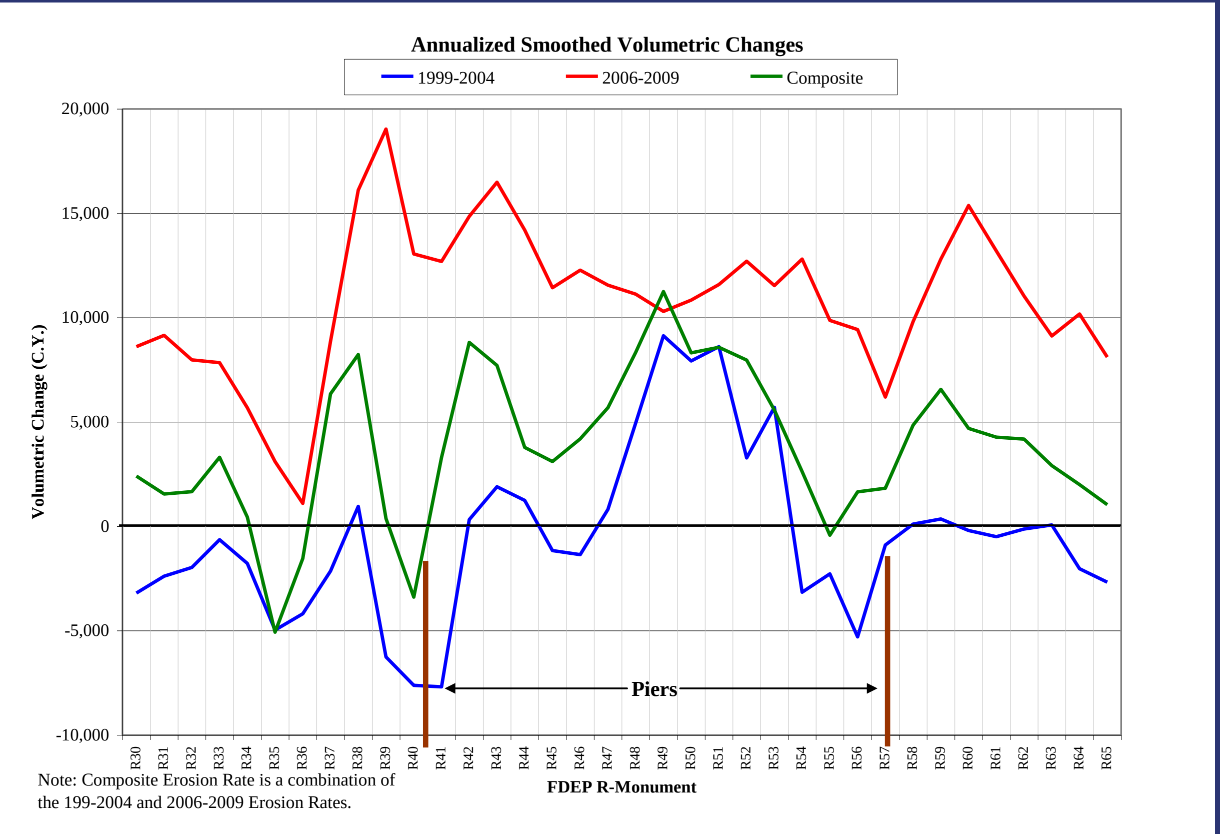
Benefits of New Method vs Traditional

- Design beach less impacted after major storms
  - Helps minimize tourism losses
- Aids design when there is small template design criteria



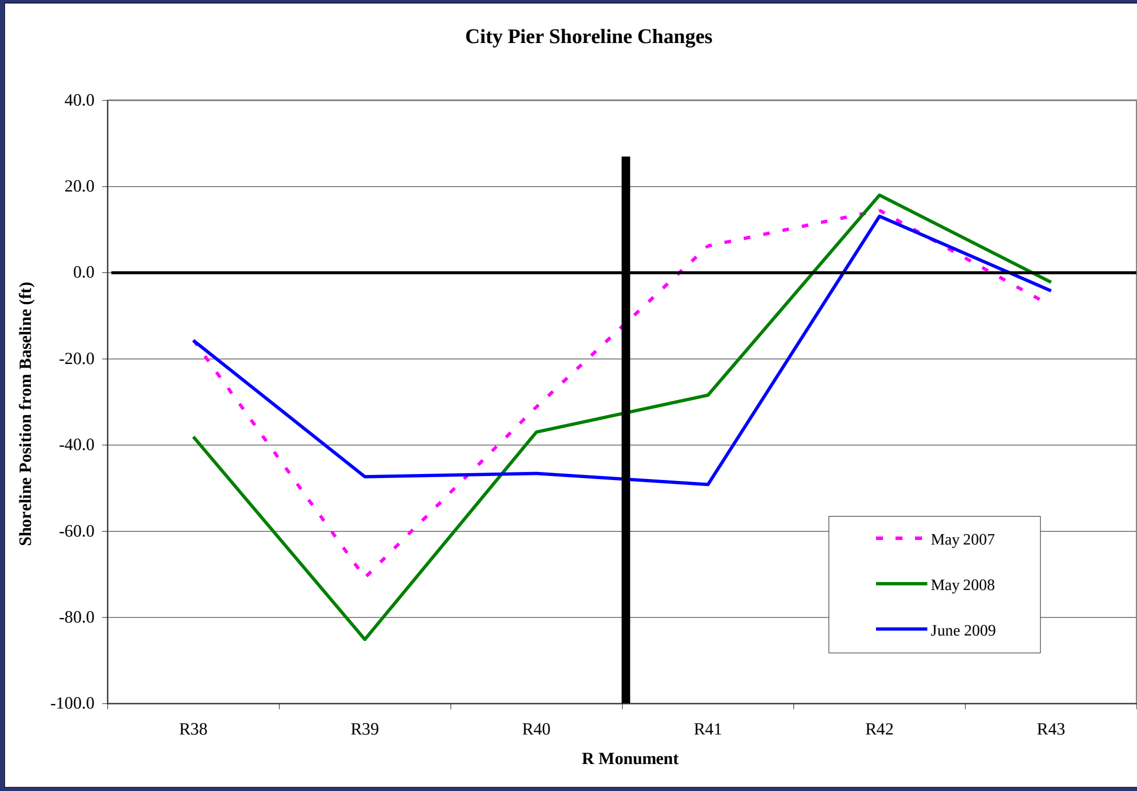
Other Observations found within Panama City during Study

- Pier Effects
  - City and County Piers act like groins
  - Observed typical updrift/downdrift effects



Other Observations found within Panama City during Study

- Both piers were damaged in recent storms and both were removed and then re-constructed
  - Removed in 2008; Rebuilt in 2009
- When structures removed, accretional filet lost and less erosion downdrift



Conclusions

Incorporating major storms into advanced nourishment creates more robust beaches able to weather storms until full recovery/restoration has occurred

- Enough sand must remain to support tourism/business

- Aids in policy where long term or quick permits are not feasible
  - Can cause a delay implementing storm recovery projects

- Storms are driving factor for renourishment in Panama City Beach
  - Major storm impacts area approximately every 5 years

- Recovery is still occurring 5 to 6 years after major storms
  - Sand is still observed recovering from the offshore

Thank You!