APPENDIX I

Wiggins Pass Resource Investigation Report

Introduction

This resource investigation report was prepared in response to Collier County's planned reconfiguration of Wiggins Pass Inlet. Wiggins Pass is located along the coast of Collier County, near the northern County line (Figure 1). Barefoot Beach State Preserve lies to north, and Delnor-Wiggins Pass State Recreation Area lies to the south. On January 12, 2000, Collier County received the Florida Department of Environmental Protection (FDEP) Permit No. 0142538-001-JC to widen and deepen Wiggins Pass, with subsequent maintenance dredging every two years. Dredging operations were subsequently conducted in September 2000, November 2002, December 2004, and January 2007.

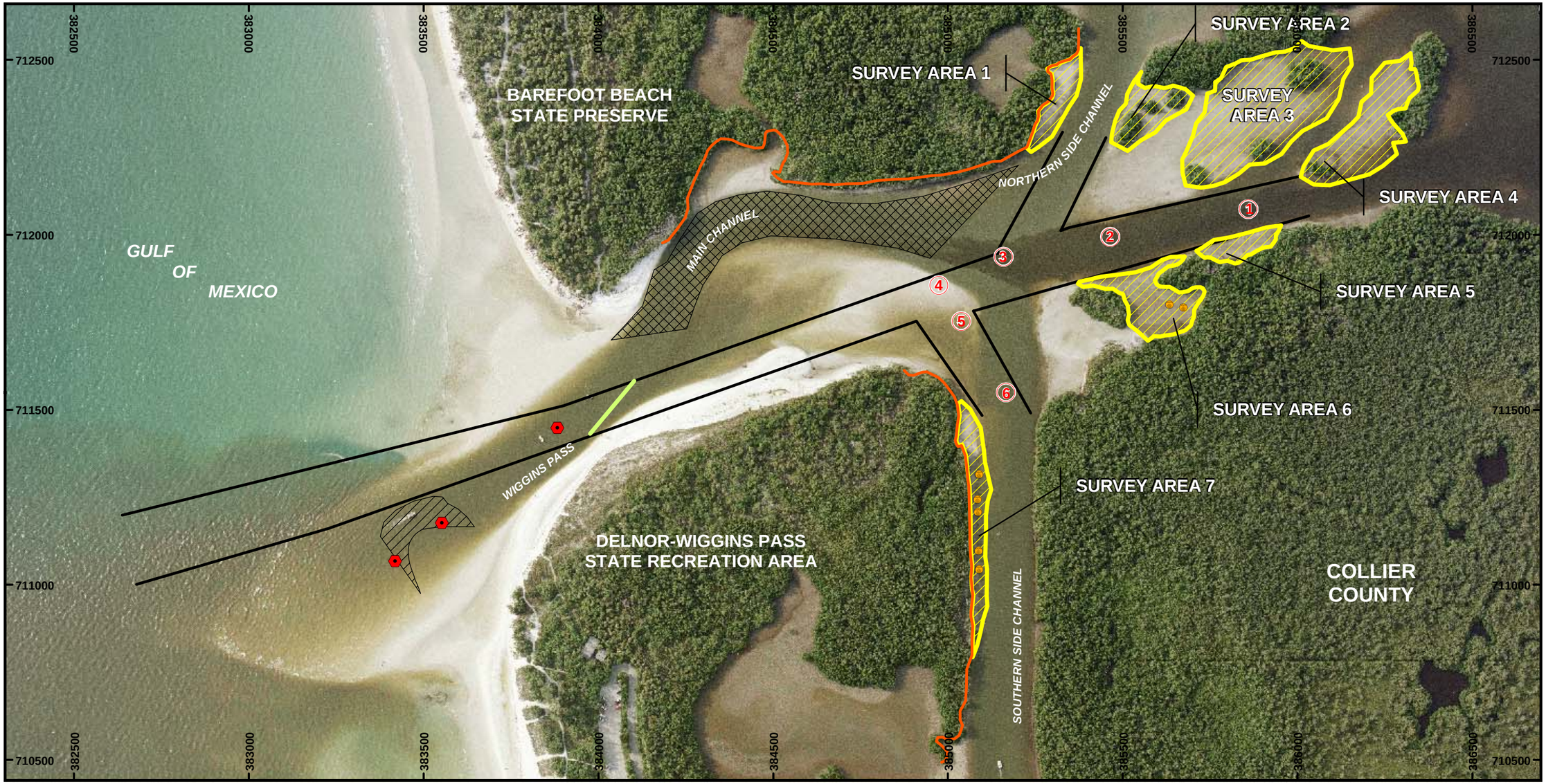
An initial model study for Wiggins Pass has found that the present channel design requires dredging at intervals less than 2 years (Humiston & Moore Engineers, 2007). That study recommended the re-establishment of the inlet in a more naturally occurring configuration that existed 30 years ago. Furthermore, recent modeling conducted by Coastal Planning & Engineering, Inc. (CPE) found that a straight interior channel would potentially incur less impacts on the adjacent shoreline and improve the existing project performance. Modifications to the flood shoal are required for this alternative. The purpose of this baseline resource report was to review historic data and conduct a field investigation to address potential habitat impacts within Wiggins Pass associated with the channel's reconfiguration; as such, the contents of this report will be suitable for use by the Wiggins Pass Modeling Committee and for an initial permit application.

Geological Features

The geology of the Wiggins Pass substrate has been presented in previous reports (Athena Technologies, 2006; CEC, 1990; USACE, 1980), which helped provide important background information for these investigations. In 2003, the nearshore hardbottom habitat was mapped by CPE in the vicinity of Wiggins Pass, as well as to the south. The extent of the hardbottom is currently being used as a guide for the maintenance dredging and disposal of Wiggins Pass sediments. No hardbottom habitats were identified inside the inlet.

Conversely, back in 1990, Coastal Engineering Consultants (CEC) identified a rock ledge located on an elevation between -7 and -10 ft NGVD at the entrance of the inlet. This ledge was considered a significant geological feature in 1990, and was used to restrict dredging and the channel location for the inlet. However, based on our 2008 survey investigations, this ledge is believed to be a soft feature, as described below.

Various substrate cores were taken within Wiggins Pass to record specific geologic features and as a prelude to dredging. The U.S. Army Corps of Engineers (USACE) conducted borings in the Wiggins Pass channel area in 1979 (USACE, 1980). The USACE did not discover a nearshore subsurface rock ledge, but did discover a hard, grey limestone layer located further offshore. The USACE defined the limits of the limestone layer with core and wash borings. The subsurface rock appears to be discontinuous and of limited size. The limits of the subsurface rock were between channel stations 2+00 and



NOTES:

1. COORDINATES ARE IN FEET BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY AERIALS CARTOGRAPHICS OF AMERICA, INC. DATE FLOWN JULY 24, 2006.
3. 2008 ENVIRONMENTAL FIELD INVESTIGATIONS PERFORMED BY CPE ON DECEMBER 10, 2008.
4. LOCATION OF ROCK LEDGE TAKEN FROM 1995 INLET MANAGEMENT PLAN (CPE 1995), BUT WAS ORIGINALLY IDENTIFIED BY CEC IN 1990.

LEGEND:

- 2008 SURVEYED SEAGRASS
- USACE 1979 CORES (APPROXIMATE LOCATION)
- (1) H&M VIBRACORES
- 2008 SURVEYED MANGROVE TREELINE
- PROPOSED CHANNEL
- SUSPECTED ROCK LEDGE (1995) CONFIRMED PEAT LEDGE (2008)
- SHOAL DISPOSAL AREA
- REPORTED ROCK LEDGE (CEC 1990) CONFIRMED SHELL HASH & SEDIMENT (2008)
- 2008 SURVEY AREAS

N

0 150 300 Feet

1 inch = 300 feet

TITLE:

WIGGINS PASS, COLLIER COUNTY 2008 RESOURCE INVESTIGATION REPORT

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 01/12/09	BY: HMV	COMM NO: 8500.58	**FIGURE 1**

G:\Collier\850055 DOCTORS & WIGGINS PASS MAINTENANCE DREDGE PLANS & SPECS\ MXD\FIELD SURVEY 010909.mxd

4+00 and approximately 40 ft wide. The rock layer appears to be discontinuous, since all borings did not strike rock. The top layer of rock varied between -9.0 to -10.0 ft NGVD. A core boring (CB-WP-1B; Sub-Appendix 1-A) showed the rock to be relatively soft, since a 140 lb hammer took between 3 to 4 drops to punch through the 0.2 to 0.3 ft of limestone. Much of this layer was previously removed, but some parts may be scattered outside the current channel limits.

Cores CB-WP-2 and CB-WP-3 describe the geology at the Gulf entrance of Wiggins Pass (Sub-Appendix 1-A). These cores show a layer of sandy shell over a layer of fine sand.

In 2006, cores were taken from the flood shoal at the intersection of the interior channels (Athena Technologies, 2006; Sub-Appendix 1-A). These cores showed similar features, with coarser sand and shell over a layer of fine sand. This characteristic of the substrate is an important feature for modeling the pass reconfiguration, which would effectively shift the flood shoal sand. The coarser sand can possibly be used as a temporary foundation for an emergent training dike. This emergent dike would block the old flood channel and allow the new southern flood channel to establish itself.

During our most recent surveys in December 2008, two locations were investigated and cleared of any hardbottom formations near the opening of Wiggins Pass into the Gulf of Mexico (Figure 1). The first location of suspected 'subsurface rock', which was originally identified in 1990 by CEC as a limestone platform in the middle of the channel, was actually confirmed by divers to be a matrix of shell hash and sediment substrates during the 2008 survey. The second location, which was suspected to contain a possible hardbottom outcropping, was documented by divers as a densely packed peat ledge that provided no biotic community substrate. Neither formation is suspected to form a significant geological feature that could provide long-term axial stability to the inlet. However, if further investigation is warranted for permitting purposes, additional vibracores can be taken at these two locations.

Fish Habitat

While various fish use the estuary system of Wiggins Pass as either developmental or feeding grounds, one species in particular has raised concern. The common snook, *Centropomus undecimalis*, are mostly found in mangrove fringed coastal waters, such as those within Wiggins Pass (Photograph 1). The inlet improvement can be made without displacement or impacts to mangroves. As juveniles utilize the back estuary as a developmental habitat, the adults congregate to the inlet opening to initiate spawning; male snook require a certain salinity within the water column for fertilization to occur. The Florida Wildlife Conservation Commission's designation for the common snook is a 'protected species of concern'. And while this designation is listed for the purposes of public awareness and commercial fishing, the listing does not carry any specific conservation regulations in regard to dredging activities. Furthermore, no critical habitat has been designated for snook, especially not within Wiggins Pass. In the Gulf region, closed season for snook occur during the months of December, January, February, May, June, July, and August.

Mangroves

Red mangroves, *Rhizophora mangle*, play an important role in estuarine environments, such as the back systems of Wiggins Pass. Mangroves help to protect and stabilize the low lying coastal lands, while serving as feeding, breeding, and nursery grounds for various fish, shellfish, birds, and other wildlife. The red mangroves that fringe the main and side channels of Wiggins Pass have a distinct transition with other salt tolerate vegetation, which was plotted in the Wiggins Pass GIS and shown in Figure 1. Along the northern edge of the main channel, in the select locations where the flood shoal is proposed to be moved per the realignment, elevations were taken at the mangrove root interface along the northern main channel of Wiggins Pass (Photograph 2). Roots were measured to be between -1 to -3 NGVD along the northern main channel. Along the northern and southern side channels, mangrove roots became exposed during peak low tide (Photograph 3), while being inundated under 1 to 2 ft of water during peak high tide.

Natural Resource Investigation of Seagrass

The navigation and positioning system used during the 2008 Wiggins Pass natural resource investigations was a Trimble AgGPS Differential Global Positioning System (DGPS) with Pro Beacon interfaced to the Coastal Oceanographic Hydrographic Data Collection and Processing program with correction from a U.S. Coast Guard Navigational Beacon. The Trimble Navigation system is designed for moderating precision static and dynamic processing applications. It provided real time and three dimension station coordinates and velocity measurements at once per second rate. The DGPS received the civilian signal from the Global Positioning System NAVSTAR satellites and the locator automatically acquired and simultaneously tracked GPS satellites while precisely measuring the code phase and Doppler phase shifts; it then computes position and velocity based on these changes. The DGPS automatically detected time, latitude, longitude, height, and velocity, at a once-per-second rate. Similarly, range rate corrections were computed every second, transmitted to the survey vessel via radio link, and were automatically applied to the onboard GPS receiver. This level of DGPS accuracy allowed the biologist to mark exactly where seagrass growth occurred within the pass. The Coastal Oceanographic Hydrographic Data Collection and Processing (HYPACK®) program was the navigation and hydrographic surveying system used to process all GPS seagrass position data.

A modified grid survey pattern was conducted by qualified marine biologists to document if natural resources (*e.g.*, seagrass, hardbottom substrates) were present in specific zoned areas within Wiggins Pass. A total of seven areas (~6.60 acres) were surveyed (Figure 1), the locations of which were pre-determined based on the results of previous investigations (Humiston & Moore Engineers, 2007). All of the surveyed areas were documented with underwater digital photography, regardless of whether natural resources were present or absent. When natural resources were present, taxonomic identification and digital photo documentation were carried out. Furthermore, accurate GIS fixes of specific natural resource locations were taken and stored for later comparisons.

Survey Area #1 was located in a shallow region along the westerly edge of red mangroves adjacent to the northern side channel (Figure 2). The survey area was approximately 0.41 acres and the water depth ranged from 1 to 2 ft. No seagrass was recorded, only sparse green macroalgae and turf growing out of a substrate that consisted of mostly unconsolidated mixed course sediment. The only sessile marine organisms documented was a small bed of *Crassostrea virginica* (American oysters), with barnacles adhering to the shells (Photograph 4).

Survey Areas #2, 3, & 4 were located to the east of Survey Area #1, adjacent to the northern edge of the main channel in Wiggins Pass (Figure 3). The survey areas varied (~0.58, 2.52, and 1.24 acres, respectively), but the water depth at low tide remained less than one foot. In all three of these survey areas, no seagrass or hardbottom substrates were found. A large bed of *C. virginica* was recorded in Survey Area #3 (Photograph 5), along with a submerged concrete pipe (Photograph 6). The bottom substrate was consistent with a mixture of course sand, fine sediment, and shell hash.

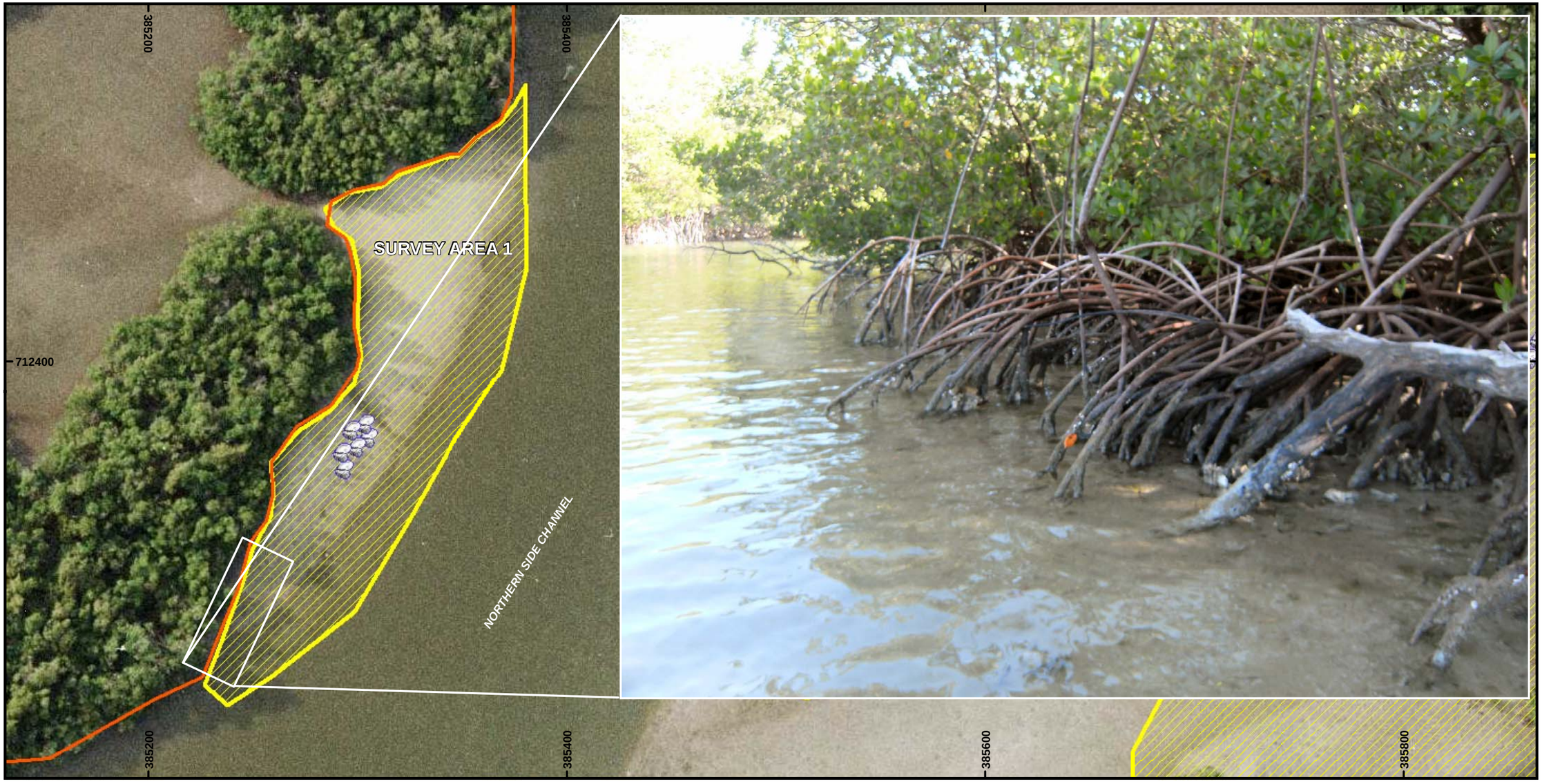
Survey Areas #5 & #6 were located directly opposite of the previously surveyed areas, positioning them along the southern edge of the main channel (Figure 4). While Survey Area #5 (~0.30 acres; 1-3 ft deep) found only a small oyster bed, Survey Area #6 (~0.83 acres; 1-3 ft deep) recorded a few flat, narrow blades of *Halodule wrightii* (shoal grass). These blades of seagrass were very sparse, with a total density less than 1 cm^2 (Photograph 7).

Survey Area # 7 was located along the westerly edge of red mangroves adjacent to the southern side channel (Figure 5). The survey area was approximately ~0.72 acres and the water depth ranged from 1-4 ft. Within this area, random patches of *Halodule wrightii* (shoal grass) were recorded in very low densities, with no persistence of a continuous seagrass bed being evident.

Conclusions

No hardbottom formations were found within the channels of Wiggins Pass. The two aforementioned ‘potential hardbottom’ locations (the suspected subsurface rock ledge just outside Wiggins Pass and the possible outcropping just inside Wiggins Pass) were both cleared of any hard substrate and consisted of softer geological features. The only sessile organisms documented during the 2008 survey were the mollusks *Crassostrea virginica* (American oyster), with barnacles adhering to the shells. Currently, there are no protective restrictions in regard to *C. virginica* in the State of Florida.

Red mangroves line the main and side channels of Wiggins Pass, with their roots having cyclic access to tidal waters. In the State of Florida, mangroves are protected, thus, prohibiting their trimming or altering of any kind without specialized permits. The Mangrove Trimming and Preservation Act (2006) is enforced by the Florida Department of Environmental Protection and mandates that an individual permit must be applied for in order to conduct mangrove alteration or trimming. The term ‘trimming’ refers to the cutting of mangrove branches, twigs, limbs, and foliage, whereas, ‘altering’ means to



NOTES:

1. COORDINATES ARE IN FEET BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY AERIALS CARTOGRAPHICS OF AMERICA, INC. DATE FLOWN JULY 24, 2006.
3. 2008 ENVIRONMENTAL FIELD INVESTIGATIONS PERFORMED BY CPE ON DECEMBER 10, 2008.

LEGEND:

- 2008 SURVEYED OYSTER BEDS
- 2008 SURVEYED MANGROVE TREELINE
- 2008 SURVEY AREAS

0 25 50 Feet

1 inch = 50 feet

N

TITLE:

WIGGINS PASS, COLLIER COUNTY
2008 RESOURCE INVESTIGATION REPORT
SURVEY AREA 1

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 01/09/09	BY: HMV	COMM NO: 8500.58	FIGURE 2

G:\Collier\850055_DOCTORS_&_WIGGINS_PASS_MAINTENANCE_DREDGE_PLANS_&_SPECS_MXD\SURVEY_AREA_1_050910.mxd

NOTES:

1. COORDINATES ARE IN FEET BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY AERIALS CARTOGRAPHICS OF AMERICA, INC. DATE FLOWN JULY 24, 2006.
3. 2008 ENVIRONMENTAL FIELD INVESTIGATIONS PERFORMED BY CPE ON DECEMBER 10, 2008.

LEGEND:

2008 SURVEYED OYSTER BED

2008 SURVEY AREAS

0 50 100 Feet

1 inch = 100 feet

N

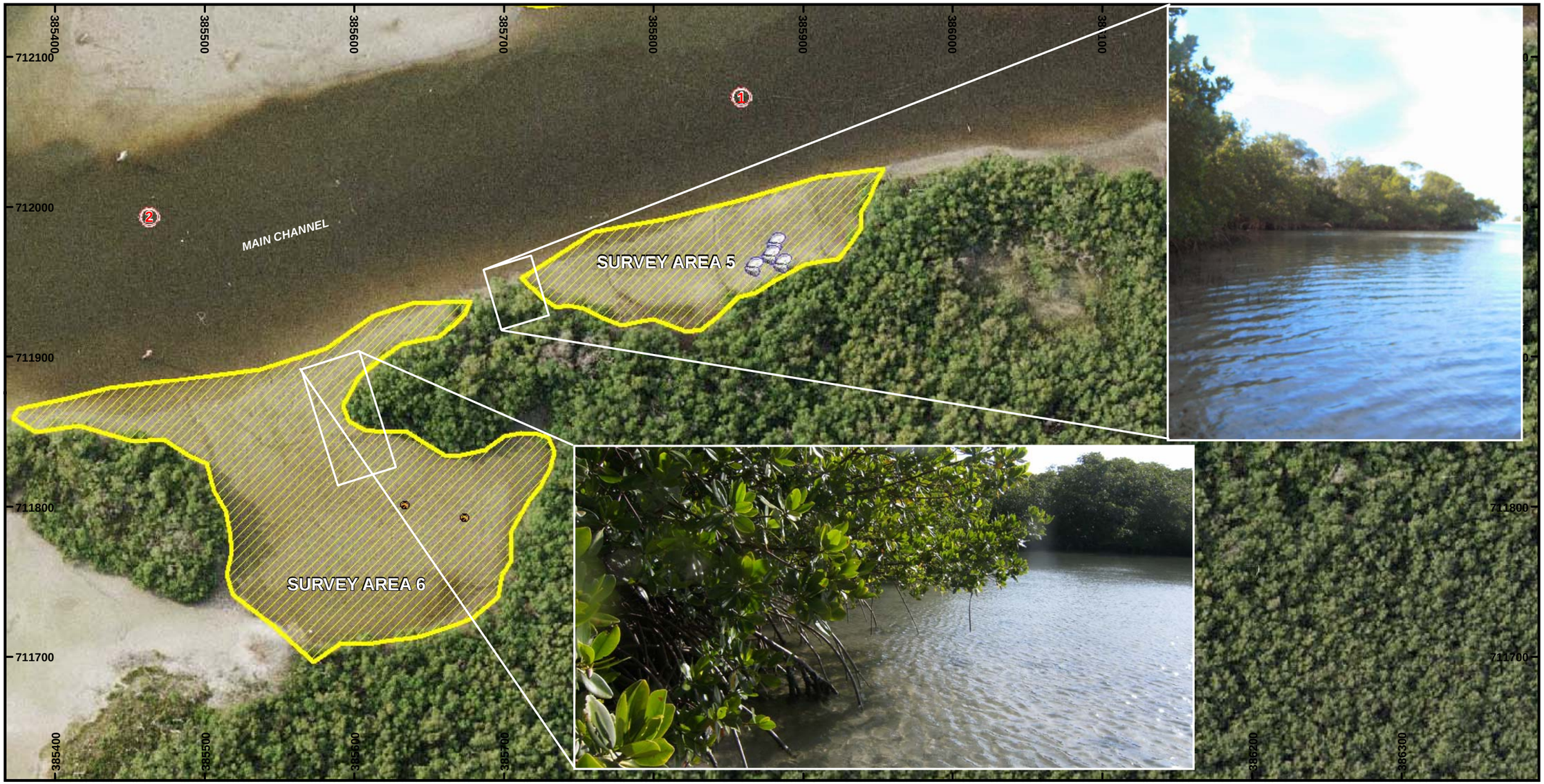
TITLE:

WIGGINS PASS, COLLIER COUNTY
2008 RESOURCE INVESTIGATION REPORT
SURVEY AREAS 2, 3 & 4

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 01/12/09	BY: HMV	COMM NO: 8500.58	**FIGURE 3**

G:\Collier\850055_DOCTORS_&_WIGGINS_PASS_MAINTENANCE_DREDGE_PLANS_&_SPECS_MXD\SURVEY_AREA_2_3_4_010909.mxd



NOTES:

1. COORDINATES ARE IN FEET BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY AERIALS CARTOGRAPHICS OF AMERICA, INC. DATE FLOWN JULY 24, 2006.
3. 2008 ENVIRONMENTAL FIELD INVESTIGATIONS PERFORMED BY CPE ON DECEMBER 10, 2008.

LEGEND:

- 2008 SURVEYED OYSTER BEDS
- 2008 SURVEYED SEAGRASS
- 1 H&M VIBRACORES
- 2008 SURVEY AREAS

0 35 70 Feet

1 inch = 70 feet

N

TITLE:

WIGGINS PASS, COLLIER COUNTY
2008 RESOURCE INVESTIGATION REPORT
SURVEY AREAS 5 & 6

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 01/12/09	BY: HMV	COMM NO: 8500.58	**FIGURE 4**

G:\Collier\850055_DOCTORS_&_WIGGINS_PASS_MAINTENANCE_DREDGE_PLANS_&_SPECS_MXD\SURVEY_AREA_5_6_010909.mxd

NOTES:

1. COORDINATES ARE IN FEET BASED ON FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY AERIALS CARTOGRAPHICS OF AMERICA, INC. DATE FLOWN JULY 24, 2006.
3. 2008 ENVIRONMENTAL FIELD INVESTIGATIONS PERFORMED BY CPE ON DECEMBER 10, 2008.

LEGEND:

- 2008 SURVEYED SEAGRASS
- 2008 SURVEYED MANGROVE TREELINE
- 2008 SURVEY AREAS

0 50 100 Feet

1 inch = 100 feet

N

TITLE:

WIGGINS PASS, COLLIER COUNTY
2008 RESOURCE INVESTIGATION REPORT
SURVEY AREA 7

COASTAL PLANNING & ENGINEERING, INC
2481 NW BOCA RATON BLVD.
BOCA RATON, FL 33431
PH. (561) 391-8102
FAX.(561) 391-9116

DATE: 01/12/09	BY: HMV	COMM NO: 8500.58	**FIGURE 5**

G:\Collier\850055 DOCTORS & WIGGINS PASS MAINTENANCE DREDGE PLANS & SPECS\ MXD\SURVEY AREA 7 010909.mxd

remove, defoliate, or destroy mangroves. Additionally, a professional mangrove trimmer is required to supervise all proposed activities.

Currently, the new proposed channel realignment of Wiggins Pass does not anticipate the harming of any mangrove tree vegetation. The mangrove roots need not be buried when the shoal is relocated, rather sand can be placed at an elevation no higher than -2 NGVD and stabilized with emergent training dikes. The temporary sand dikes can be positioned away from the mangroves. This will allow the roots of the red mangroves adequate tidal flow of water when the new southern channel establishes itself.

Based on our 2008 natural resource survey, it was shown that seagrass growth within Wiggins Pass is very limited in density during the winter season. Even in those survey areas where seagrass was present, there was no evidence that persistent seagrass beds are able to naturally sustain throughout the year. The fact that *Halodule wrightii* (shoal grass) was the only species of seagrass recorded further supplies evidence that the habitat within Wiggins Pass is not hospitable for other species of seagrass; shoal grass is known to colonize in areas where conditions are too harsh for turtle (*Thalassia testudinum*) and manatee (*Syringodium filiforme*) seagrass to grow (Meñez and Phillips, 1998).

The reconfiguration modeling of Wiggins Pass, performed by CPE, proposes that the sand dredged for the new flood (main) channel location will be used to backfill the existing channel location. This backfill of sand will mimic the existing flood shoal, and will be placed in such a way that the new shoal would not bury or impact the mangrove tree line along the northern side of the channel. Two emergent training dikes will be placed across the old channel and will support the new channel establishment. The courser material to be dredged will be used to build the training dikes and will cover the new flood shoal surface to the maximum extent possible. The region proposed for this action is illustrated in Figure 1, which will require detailed engineering plans and specifications for the dredging and disposal of sediments.

References

Athena Technologies. 2006. Drilling Logs of Wiggins Pass, October 2006.

Coastal Engineering Consultants, Inc. 1990. Plans for Wiggins Pass Maintenance Dredging, February 1990.

Coastal Planning & Engineering, Inc. 1995. Wiggins Pass Inlet Management Plan, Prepared for Board of County Commissioners, Collier County, FL.

Humiston & Moore Engineers. 2007. Wiggins Pass Study, Hydrodynamic and Sand Transport Modeling: Appendix C, Wiggins Pass Sea Grass Survey, August 2007.

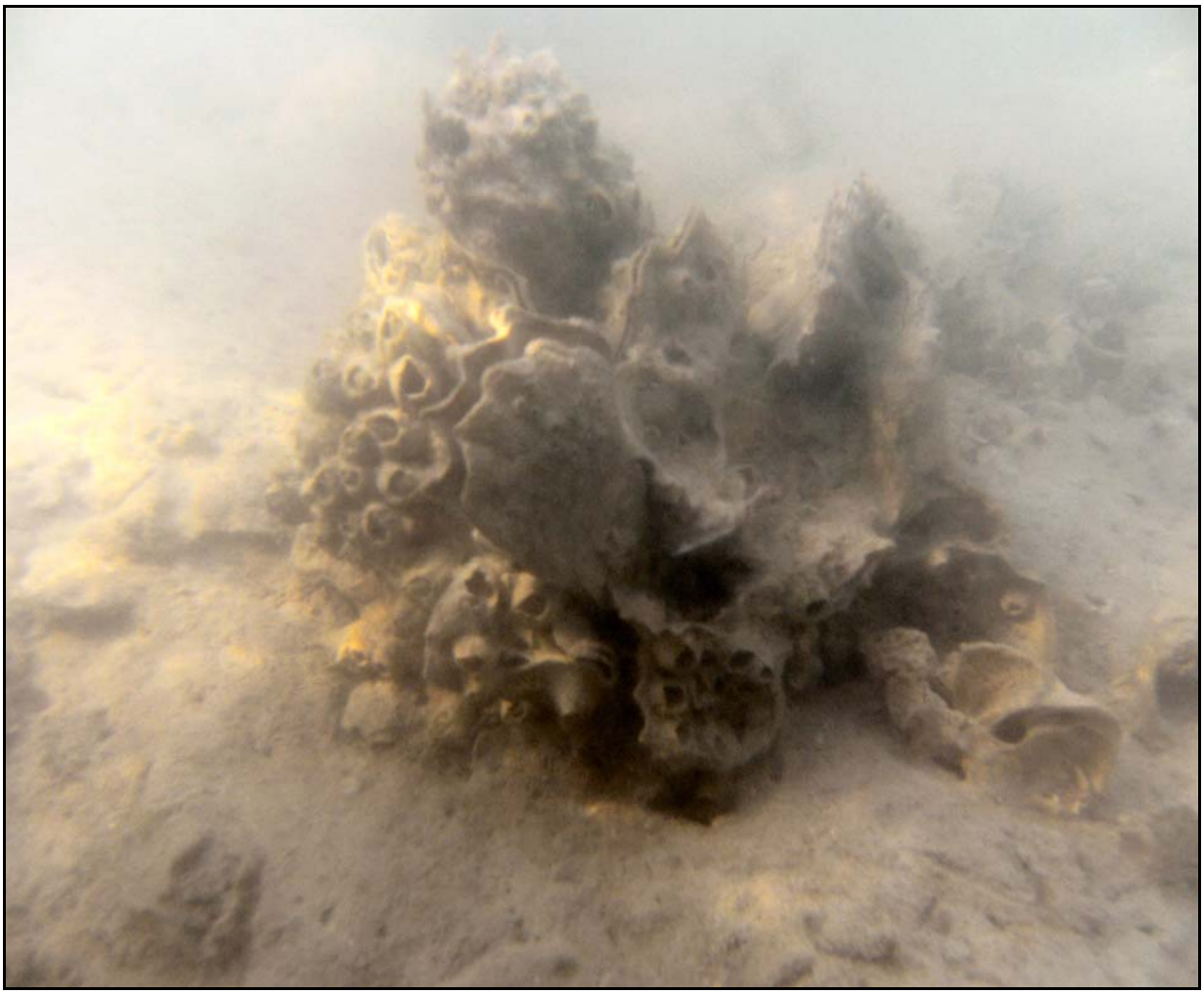
Meñez, E.G., and R.C. Phillips. 1998. Seagrasses. Smithsonian Institution Press. Washington, D.C.

U.S. Army Corps of Engineers (USACE). 1980. Detailed project Report: Wiggins Pass, Collier County, Florida, Jacksonville District, Jacksonville, FL.

Photograph 1. Common snook, *Centropomus undecimalis*, are known as a euryhaline species of fish, which gives them a preference towards the mangrove-fringed estuarine waters within Wiggins Pass. This adult, photographed along the southern side channel, is easily identified by its well-defined black lateral line and yellowish fins. Currently, there is no designated critical habitat for snook in the State of Florida.

Photograph 2. Close-up view of the northern main channel of Wiggins Pass. The top picture shows the profile of red mangrove trees fringing the channel, while the bottom picture distinctly shows how the mangrove roots become submerged with the high tide.

Photograph 3. The main and side channels of Wiggins Pass are lined with red mangrove trees (*Rhizophora mangle*). Their tall arching roots, also called prop roots, are distinct to this species and are continuously being inundated and exposed with the cyclic tides.



Photograph 4. Close-up view of *Crassostrea virginica* (American oysters), with barnacles adhering to the shells in Survey Area #1. While only sparse macroalgae was found along the sandy substrate, no seagrass was recorded in this area.

Photograph 5. Top-side view of Survey Area #3, showing persistent oyster beds throughout.

Photograph 6. Even though it is of an artificial nature, this submerged concrete pipe in Survey Area #3 was the only potential hardbottom substrate available for colonization.

Photograph 7. The seagrass species documented, *Halodule wrightii* (shoal grass), was recorded in very sparse amounts with Survey Areas #6 & #7. A common species to the Gulf of Mexico, the thin, narrow blades of *H. wrightii* can reach a maximum length of six inches.

SUB-APPENDIX I-A

Selected Core Logs

1. Jacksonville District Corps of Engineers 1979 Logs
CB-WP-1B
CB-WP-2
CB-WP-3

2. Athena Technologies 2006
WP-06-03
WP-06-04
WP-06-05

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Jacksonville District

SHEET 1 OF 1 SHEETS

1. PROJECT	WIGGINS PASS
2. LOCATION (Coordinates or Station)	STA: 22+85 RGE: ℄ (BASELINE B)
3. DRILLING AGENCY	Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number)	CB-WP-1B
5. NAME OF DRILLER	R.GORDON
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	13.0'
10. SIZE AND TYPE OF BIT	See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Acker
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	1
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 1/16/79 COMPLETED 1/16/79
17. ELEVATION TOP OF HOLE	-7.0
18. TOTAL CORE RECOVERY FOR BORING	51 %
19. [illegible]	
	GEOLOGIST: R. KRETCHMAN

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-7.0	0.0					-7.0 Bls/0.5 ft.
			SAND, fine, quartz, gray (SP)	50	1	SPLIT SPOON Washed
-9.0	2.0					-9.0
-9.3	2.3		LIMESTONE, hard, gray	100		-9.3 " " 4
			SAND, fine, quartz, gray (SP)	50	2	Washed " "
-20.0	13.0					-20.0
			NOTES: 1. SAMPLES OF SAND TAKEN FROM WASH WATER.			140# hammer with 30" drop used on 2.0' split spoon. (1-3/8" I.D. X 2" O.D.)

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE.

(TRANSLUCENT)

PROJECT: WIGGINS PASS

PLATE 20D

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION: Jacksonville District	Hole No.: CB-WP-2
1. PROJECT: WIGGINS PASS		10. SIZE AND TYPE OF BIT: See Remarks	SHEET 1 OF 1 SHEETS
2. LOCATION (Coordinates or Station): STA: 21+50 RGE: ℄ (BASELINE B)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: Corps of Engineers		12. MANUFACTURER'S DESIGNATION OF DRILL: Acker	
4. HOLE NO. (As shown on drawing title and file number): CB-WP-2		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: UNDISTURBED:	
5. NAME OF DRILLER: R. GORDON		14. TOTAL NUMBER CORE BOXES: 1	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: Tidal	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE: STARTED 1/11/79 COMPLETED 1/11/79	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE: -6.0	
9. TOTAL DEPTH OF HOLE: 13.5'		18. TOTAL CORE RECOVERY FOR BORING: 33 %	
		19. GEOLOGIST: R. KRETCHMAN	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-6.0	0.0					Bit or Barrel -6.0 Bls/0.5 ft.
			SHELL, sandy	30	1	SPLIT SPOON Pushed -7.5
				30	2	" " Pushed -9.0
				35	3	" " 1 5 6 8 -10.5 9
-12.0	6.0			35	4	" " 5 8 -12.0 9
			SAND, fine, quartz, gray, slightly silty, (SP)	30	5	" " 10 12 -13.5 10
				20	6	" " 6 7 -15.0 8
				50	7	" " 5 8 -16.5 9
				50	8	" " 10 10 -18.0 10
-19.5	13.5			30	9	" " 10 9 -19.5 10
						140# hammer with 30" drop used on 2.0' split spoon. (1-3/8" I.D. X 2" O.D.)

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT [illegible] PAGE

PLATE 21D

DRILLING LOG | DIVISION: South Atlantic | INSTALLATION: Jacksonville District | SHEET 1 OF 1 SHEETS

1. PROJECT: HIGGINS PASS
2. LOCATION (Coordinates or Station): STA: 14+70 RGE: ℄ (BASELINE B)
3. DRILLING AGENCY: Corps of Engineers
4. HOLE NO. (As shown on drawing title and file number): CB-WP-3
5. NAME OF DRILLER: R.GORDON
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 7.5'
10. SIZE AND TYPE OF BIT: See Remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: Acker
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED: | UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 1/17/79 | COMPLETED 1/17/79
17. ELEVATION TOP OF HOLE: -7.5
18. TOTAL CORE RECOVERY FOR BORING: 34 %
19. [redacted]
GEOLOGIST: R. KRETCHMAN

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
						BIT OR BARREL
-7.5	0.0					-7.5 Bls/0.5 ft.
			SHELLS, sandy	20	1	SPLIT SPOON Pushed -9.0 1 1
				30	2	" " -10.5 1 3 8
-12.0	4.5			30	3	" " -12.0 3 5 10
			SAND, fine, quartz, tan (SP)	60	4	" " -13.5 5 6 7
				30	5	" " -15.0 3 5 9
-15.0	7.5					140# hammer with 30" drop used on 2.0' split spoon. (1-3/8" I.D. X 2" O.D.)

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT PLATE 22D

Hole No. WP-06-03

DRILLING LOG	**DIVISION** South Atlantic	**INSTALLATION**	**SHEET 1 OF 1 SHEETS**

1. PROJECT Wiggins Pass, October 2006	**10. SIZE AND TYPE OF BIT** 3" Vibracore
2. LOCATION *(Coordinates or Station)* 385158.25E, 711937.75N, NAD83	**11. DATUM FOR ELEVATION SHOWN** *(TBM or MSL)* N/A
3. DRILLING AGENCY Athena Technologies	**12. MANUFACTURER'S DESIGNATION OF DRILL** Athena Technologies Vibracore System
4. HOLE NO. *(As shown on drawing title and title number)* WP-06-03	**13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN** — DISTURBED 0 — UNDISTURBED 0
5. NAME OF DRILLER Sexton	**14. TOTAL NUMBER CORE BOXES** 2
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED_____DEG. FROM VERT	**15. ELEVATION GROUND WATER** Tidal
7. THICKNESS OF OVERBURDEN N/A	**16. DATE HOLE** — STARTED 31 OCT 06 — COMPLETED 31 OCT 06
8. DEPTH DRILLED INTO ROCK 0	**17. ELEVATION TOP OF HOLE** 8.3' Water Depth
9. TOTAL DEPTH OF HOLE 11.5'	**18. TOTAL CORE RECOVERY FOR BORING** 8.8'
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
			0-2.1': 5GY6/1 TO 5 Y6/1 mottled sand. Slightly muddy from 1.5-2.1. SP d50: 0.16mm, %Passing #200: 4.2			Samples: WP-06-03-A 0-2.1', WP-06-03-B 2.1-6.1',WP-06-03-C 6.1-8.9'
	-5		2.1-6.1': 5Y8/1 to 10YR4/2 clean, fine grained sand. SP d50: 0.20mm, %Passing #200: 2.3			
			6.1-8.8': Mixed sand and shell fragments. N6 to 5Y8/1 color. GC d50: 0.29mm, %Passing #200: 3.5, % Gravel: 11.4			
	-10					
	-15					
	-20					

Hole No. WP-06-04

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT	Wiggins Pass, October 2006
2. LOCATION *(Coordinates or Station)*	384972.51E, 711856.56N, NAD83
3. DRILLING AGENCY	Athena Technologies
4. HOLE NO. *(As shown on drawing title and title number)*	WP-06-04
5. NAME OF DRILLER	Sexton
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED_____DEG. FROM VERT
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	12.5'
10. SIZE AND TYPE OF BIT	3" Vibracore
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	N/A
12. MANUFACTURER'S DESIGNATION OF DRILL	Athena Technologies Vibracore System
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: 0 / UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 31 OCT 06 / COMPLETED 31 OCT 06
17. ELEVATION TOP OF HOLE	2.5' Water Depth
18. TOTAL CORE RECOVERY FOR BORING	10.7'
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
	0		0-4.1': N7 sand with moderate shell content decreasing downcore. SW d50: 0.21mm, %Passing #200: 1.2, %Gravel: 11.9			Samples: WP-06-04-A 0-4.1', WP-06-04-B 4.1-7.0',WP-06-04-C 7.0-10.5'
	-5		4.1-7.0': Mottled 5GY4/1 veryfine sand and N6-N7 sand. SP d50: 0.17mm, %Passing #200: 4.1			
	-10		7.0-10.5': Mottled 10YR4/2 to 5Y6/1 fine sand. Burrowed SP d50: 0.20mm, %Passing #200: 3.1			
	-15					
	-20					

Hole No. WP-06-05

DRILLING LOG	DIVISION: South Atlantic	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT	Wiggins Pass, October 2006
2. LOCATION *(Coordinates or Station)*	385037.21E, 711753.80N, NAD83
3. DRILLING AGENCY	Athena Technologies
4. HOLE NO. *(As shown on drawing title and title number)*	WP-06-05
5. NAME OF DRILLER	Sexton
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED_____DEG. FROM VERT
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	10.2'
10. SIZE AND TYPE OF BIT	3" Vibracore
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	N/A
12. MANUFACTURER'S DESIGNATION OF DRILL	Athena Technologies Vibracore System
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: 0 / UNDISTURBED: 0
14. TOTAL NUMBER CORE BOXES	2
15. ELEVATION GROUND WATER	Tidal
16. DATE HOLE	STARTED 31 OCT 06 / COMPLETED 31 OCT 06
17. ELEVATION TOP OF HOLE	4.0' Water Depth
18. TOTAL CORE RECOVERY FOR BORING	8.3'
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
			0-2.4': N7 to 5Y8/1 sand and shell fragments. SW d50: 0.20mm, %Passing #200: 1.1, %Gravel: 3.9			Samples: WP-06-05-A 0-2.4', WP-06-05-B 2.4-8.3'
	-5		2.4-8.3': Mottled 5GY6/1 and N6-N7 sand. SP d50: 0.20mm, %Passing #200: 1.3			
	-10					
	-15					
	-20					

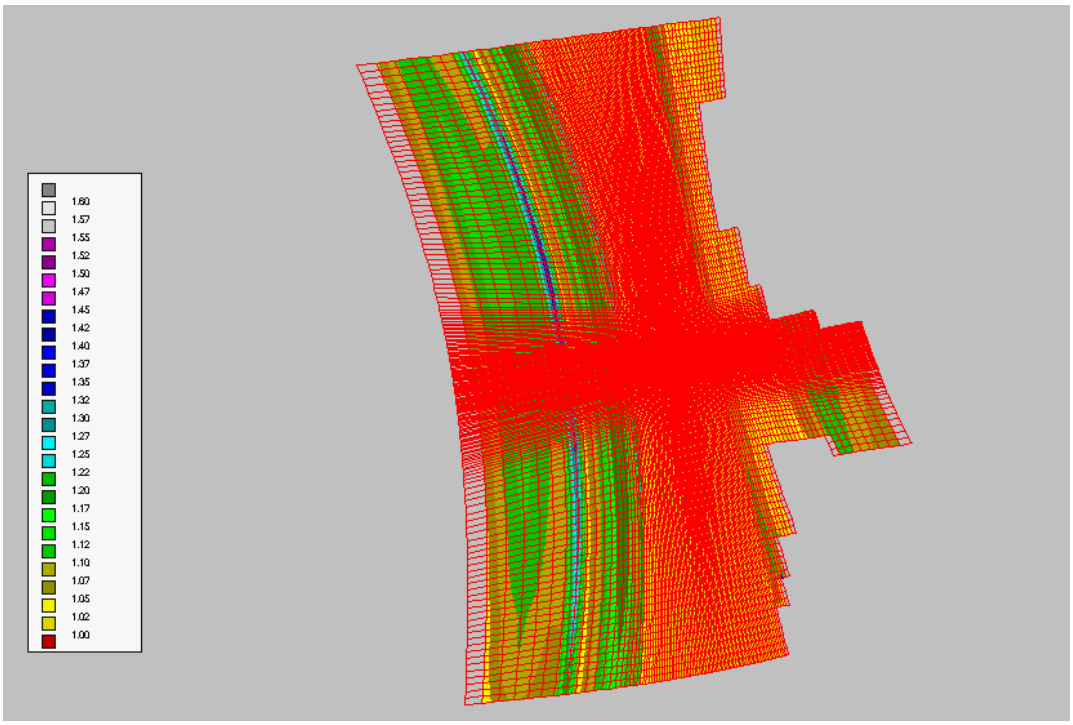
APPENDIX II
MODEL PARAMETERS AND GRID PROPERTIES

Wave model parameters	
Gravity	9.81 m/s2
Water Density	1025 kg/m3
Minimum Depth for Computations	0.05 m
Spectra Type	Jonswap
Peak Enhancement Factor	3.3
Directional space	circle
Number of directions	36
Lowest frequency	0.05 hz
Highest Frequency	1 Hz
Number of Frequency bins	24
Depth Induced Breaking - Alpha	0.5
Depth Induced breaking - Gamma	1
Bottom Friction (Jonswap)	0.035
Diffraction smoothing coefficient	0.2
Diffraction smoothing steps	5
Frequency shift	activated
Refraction	activated
Wind growth	deactivated
Whitecapping	deactivated
Quadruplets	deactivated
Grid	Yes
Percent accuracy to accept iteration	98%
Maximum number of iterations	15

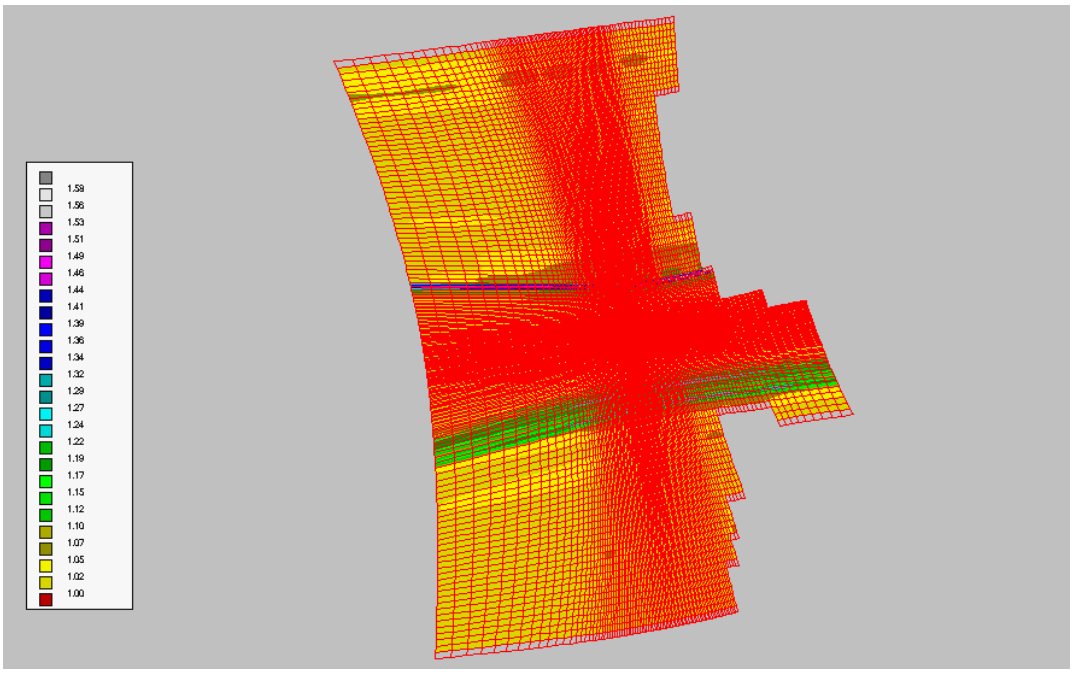
Flow model parameters	
Number of vertical layers	5
Domain decomposition	No
Timestep	30 s
West boundary type	Water level - Harmonic
West boundary amplitude	0.3 m
West Boundary Reflection Parameter alfa	50
North Boundary Type	Neumann - Timeseries
South Boundary Type	Neumann - Timeseries
Gravity	9.81 m/s2
Water Density	1000 kg/m3
Roughness Chezy	50
Stress formulation due to wave forces	Fredsoe
Horizontal eddy viscosity	1
Horizontal eddy diffusivity	5
3-D turbulence model	K-Epsilon
Advection scheme for momentum	cyclic
Advection scheme for transport	cyclic
Horizontal forester filter	activated
Freshwater discharges	no

Sediment and Morphology Model Parameters	
Reference density for rhindered setting	1600 kg/m3
Specific Density	2650 kg/m3
Dry Bed Density	1600 kg/m3
Median Diameter	0.35 mm
Update bathymetry during simulation	Yes
Spin up period	740 min
Minimum depth for sediment calculation	0.1 m
vanRijn reference height factor	1
Threshold sediment thickness	0.05 m
Estimated ripple height factor	2
Dry cell erosion factor (thetsd)	0.5
Multiplication factor for suspended sediment reference concentration (SUS)	0.75
Multiplication factor for bed-load transport vector magnitude	0.75
Wave-related (orbital motions) suspended sed. transport factor	0.1
Wave-related (orbital motions) bed-load sed. transport factor	0.1

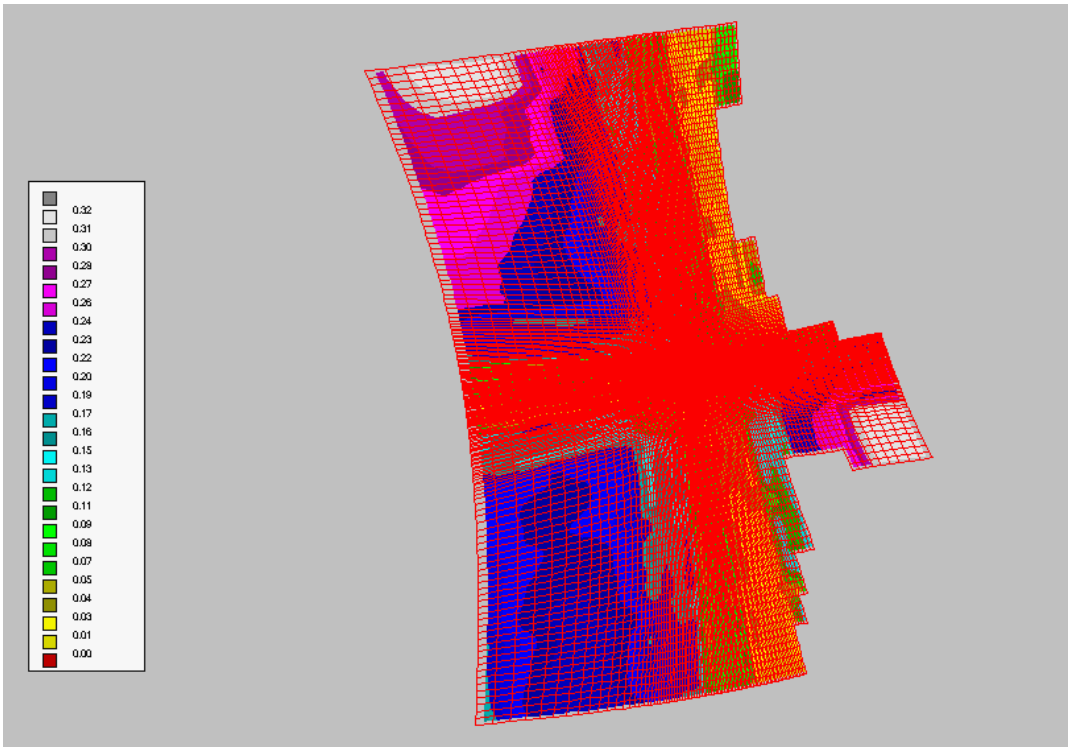
Flow and Morphology Grid Properties



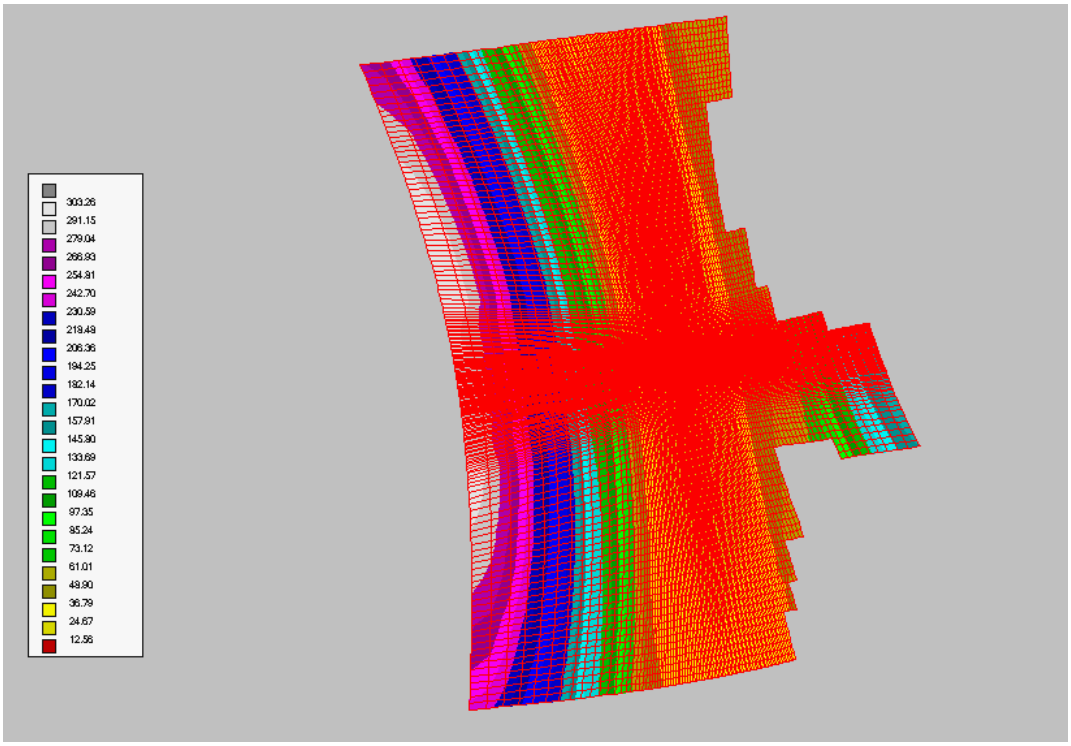
M smoothness



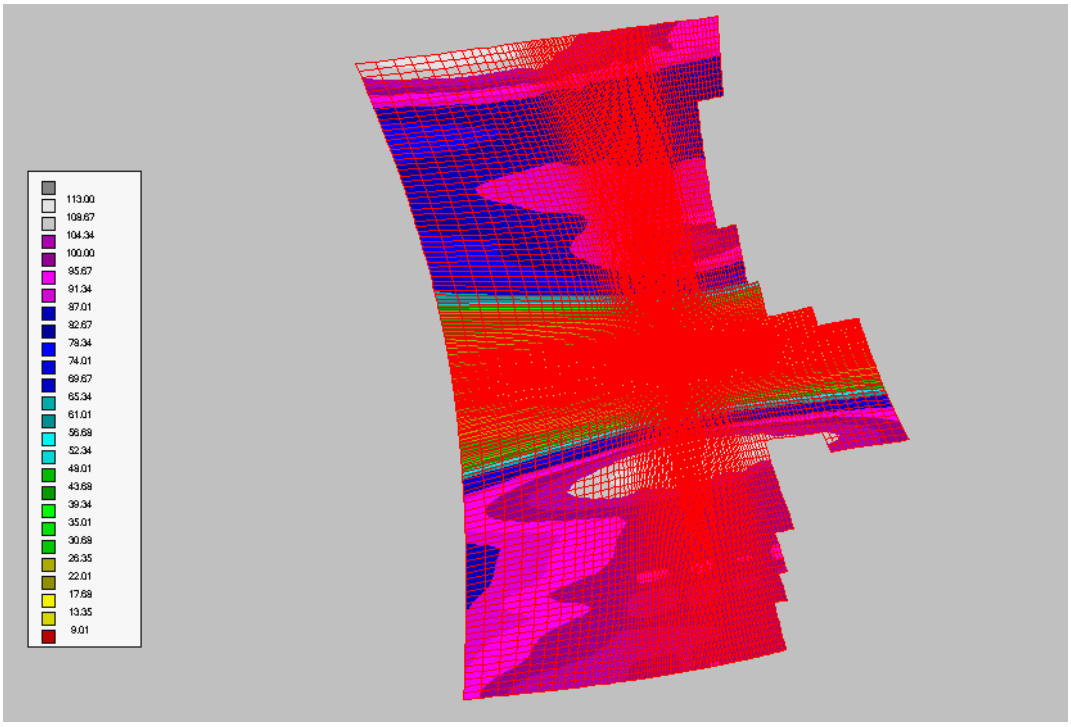
N smoothness



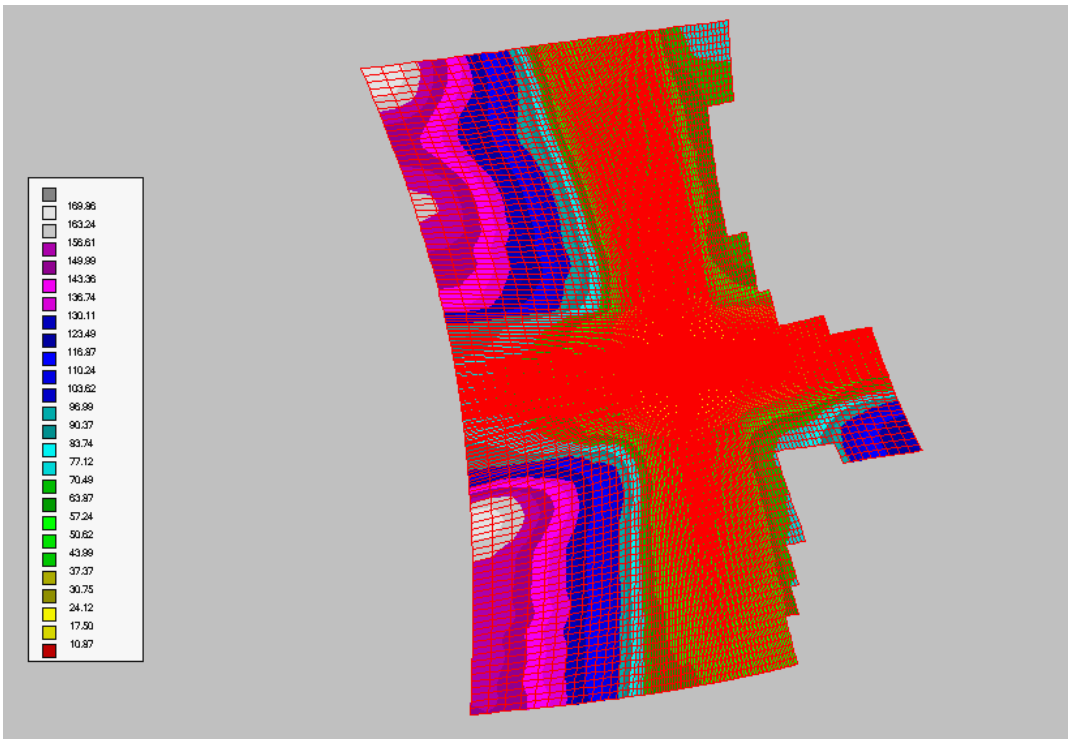
Orthogonality



Cell size (m), M direction



Cell size (m), N direction



Grid resolution

APPENDIX III

NUMERICAL MODEL CALIBRATION MODEL (SENSITIVITY ANALYSIS)

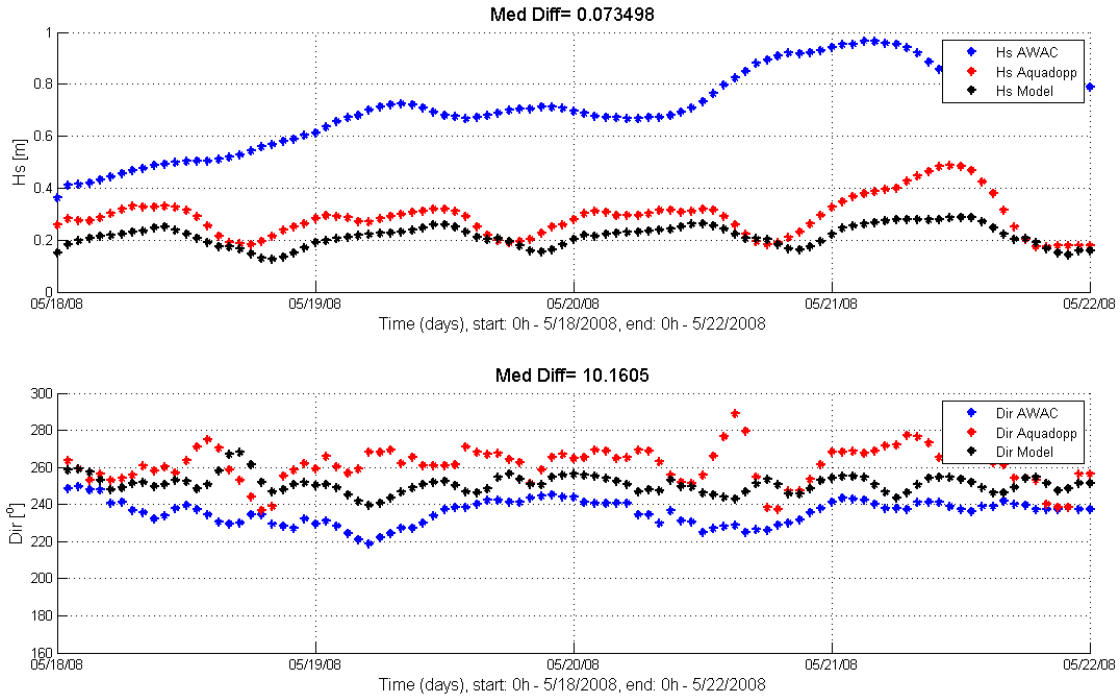


Figure A1 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and without wind-growth processes. Jonswap bottom friction coefficient = 0.067, depth-induced breaking alfa parameter = 1 and depth-induced breaking gamma parameter = 0.73. These are default model parameters.

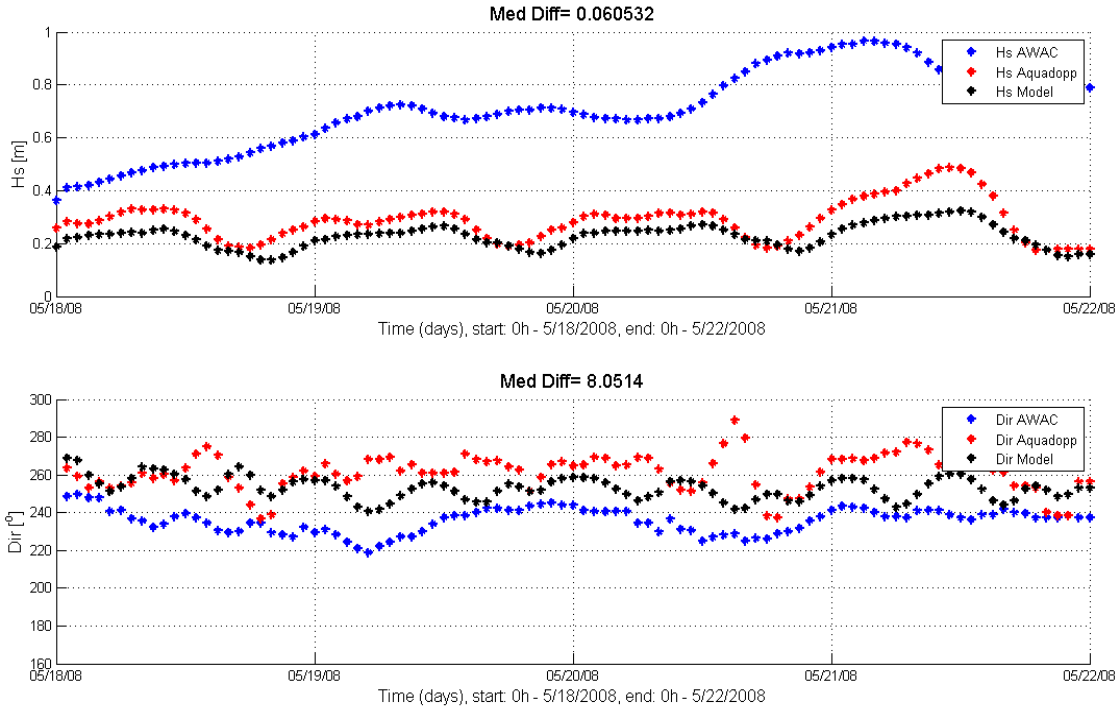


Figure A2 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and wind-growth processes activated. Jonswap bottom friction coefficient = 0.067, depth-induced breaking alfa parameter = 1 and depth-induced breaking gamma parameter = 0.73.

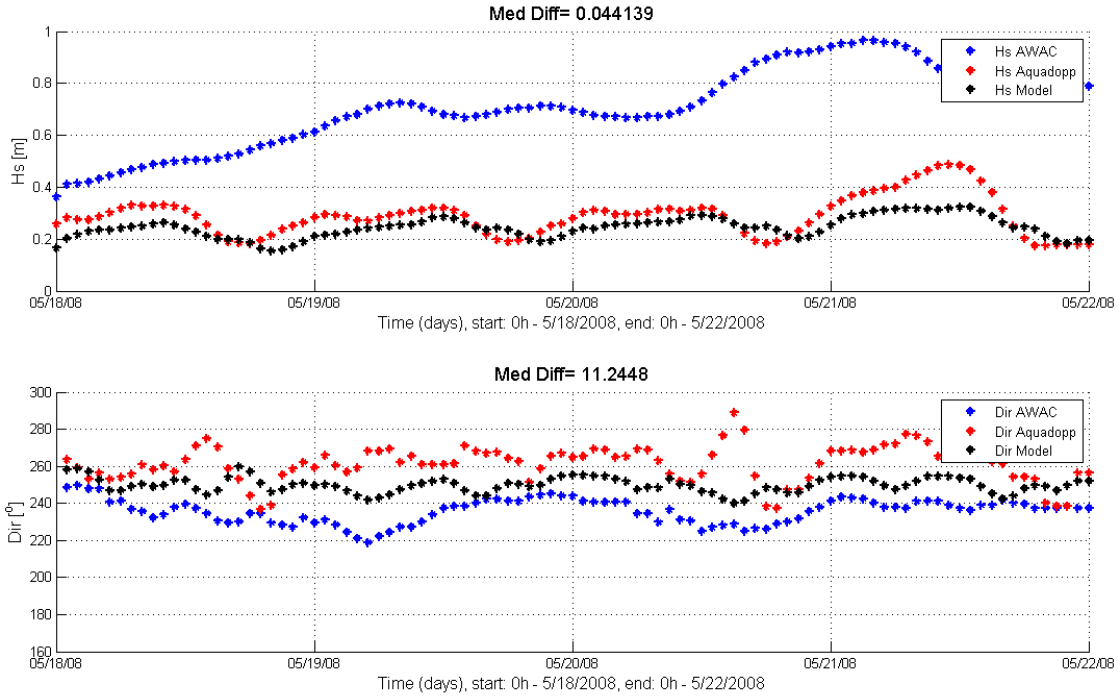


Figure A3 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and without wind-growth processes. Jonswap bottom friction coefficient = 0.0335, depth-induced breaking alfa parameter = 1 and depth-induced breaking gamma parameter = 0.73.

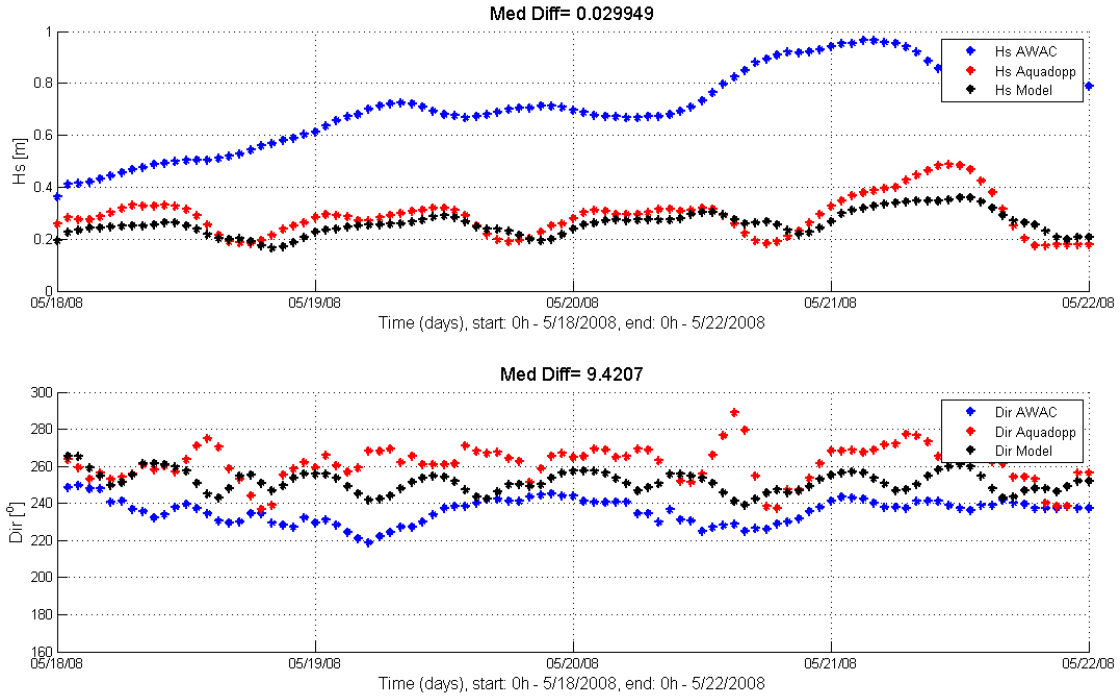


Figure A4 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and wind-growth processes activated. Jonswap bottom friction coefficient = 0.035, depth-induced breaking alfa parameter = 1 and depth-induced breaking gamma parameter = 0.73.

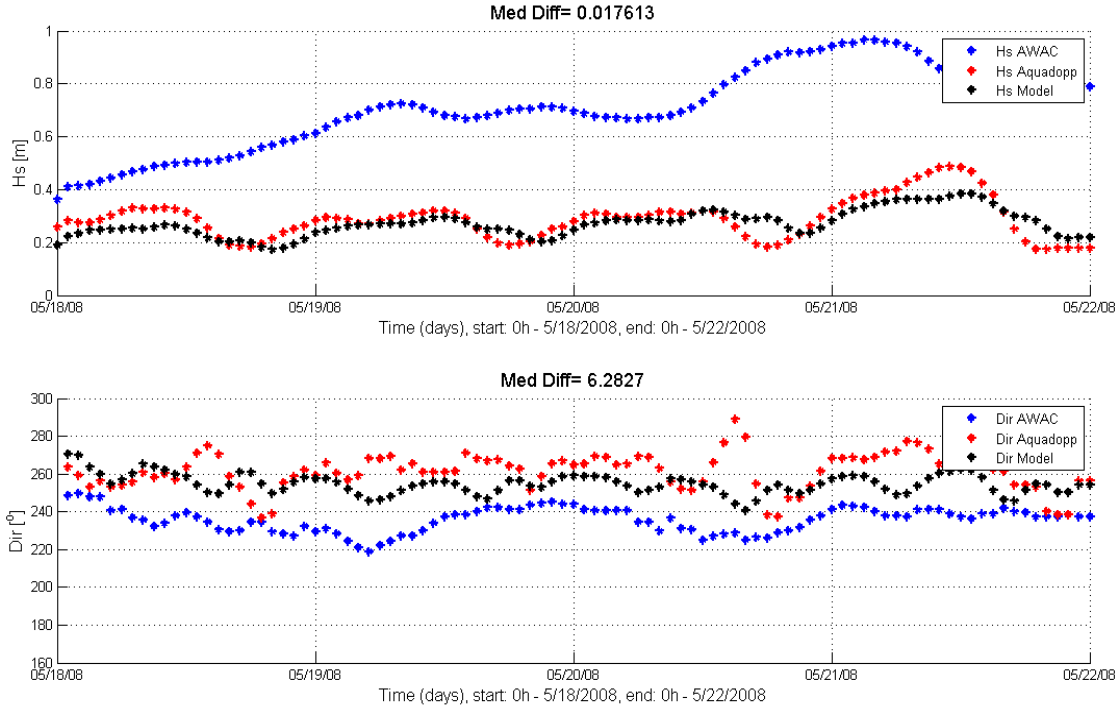


Figure A5 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and wind-growth processes activated. Jonswap bottom friction coefficient = 0.067, depth-induced breaking alfa parameter = 1 and depth-induced breaking gamma parameter = 1.

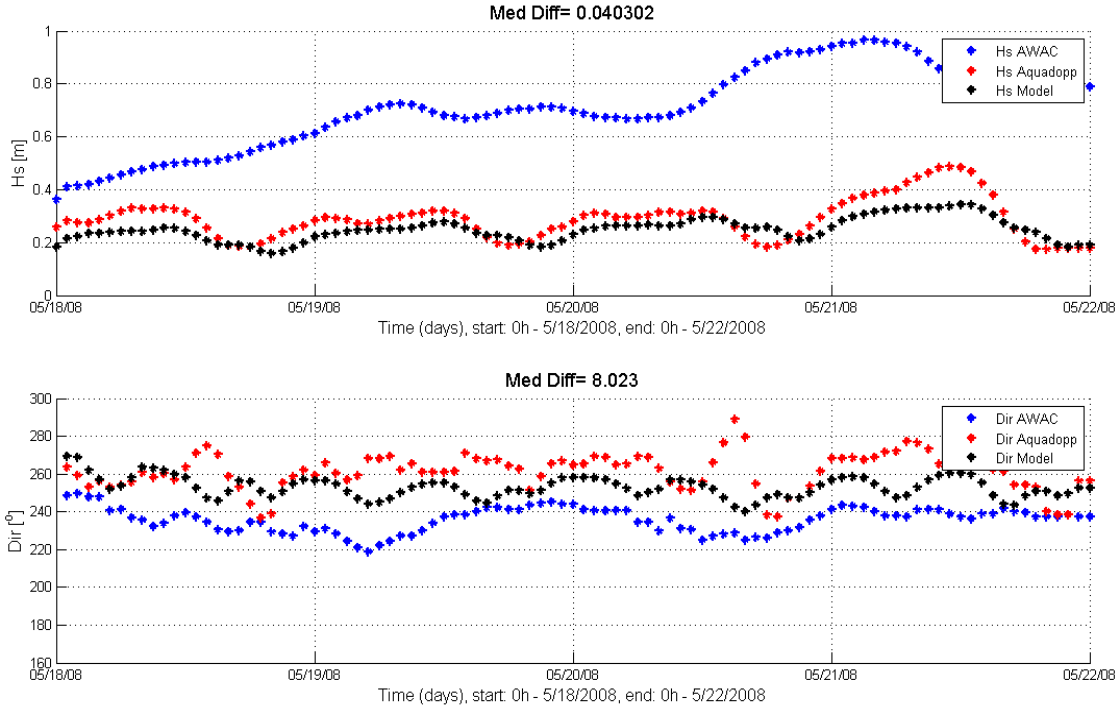


Figure A6 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and wind-growth processes activated. Jonswap bottom friction coefficient = 0.067, depth-induced breaking alfa parameter = 0.5 and depth-induced breaking gamma parameter = 0.73.

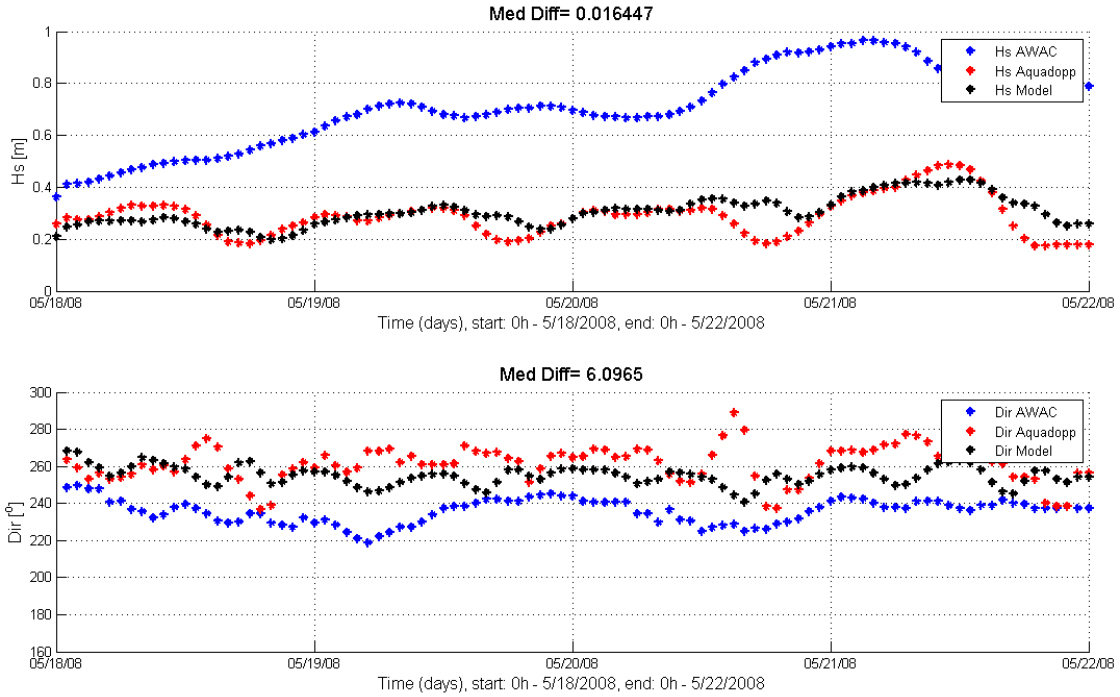


Figure A7 – Significant wave height (upper panel) and peak wave direction (lower panel) measured at AWAC, Aquadopp and simulated by the Delft3D model. Scenario with wave-current interaction and wind-growth processes activated. Jonswap bottom friction coefficient = 0.0335, depth-induced breaking alfa parameter = 0.5 and depth-induced breaking gamma parameter = 1.

Results from Flow Model Sensitivity Simulations

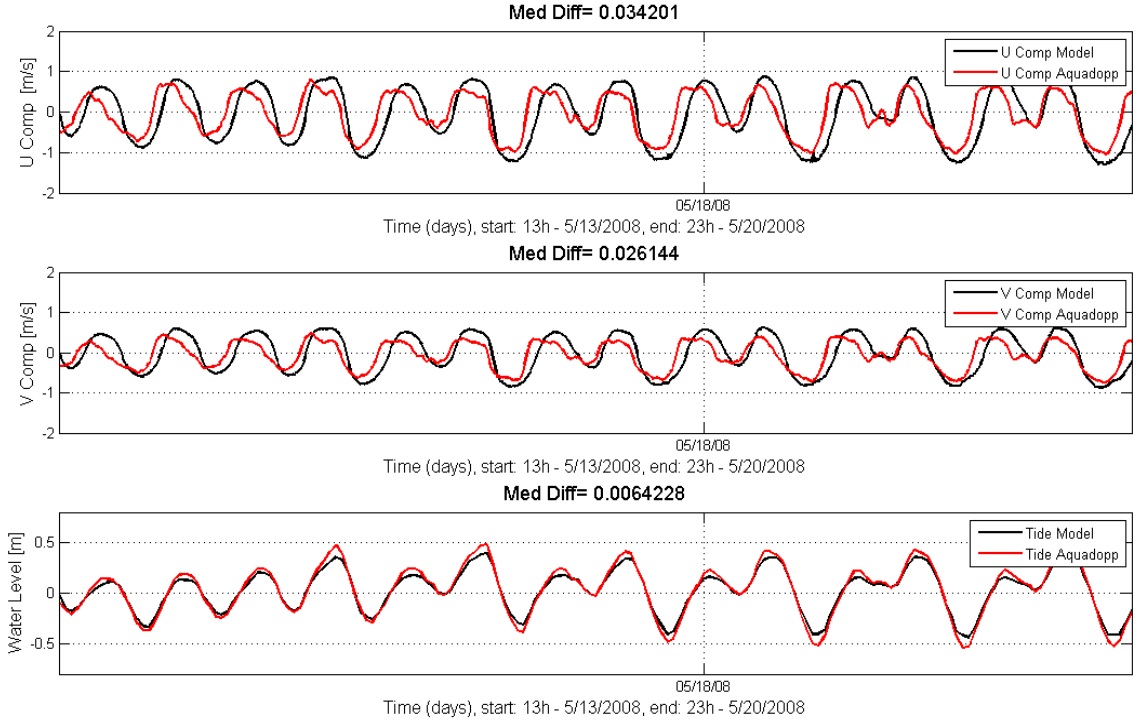


Figure A8 – Comparison between measured and simulated current U component, current V component and water level, Wiggins Pass, May 13 to May 23. Chezy = 65 $m^{0.5}s^{-1}$ (model default value).

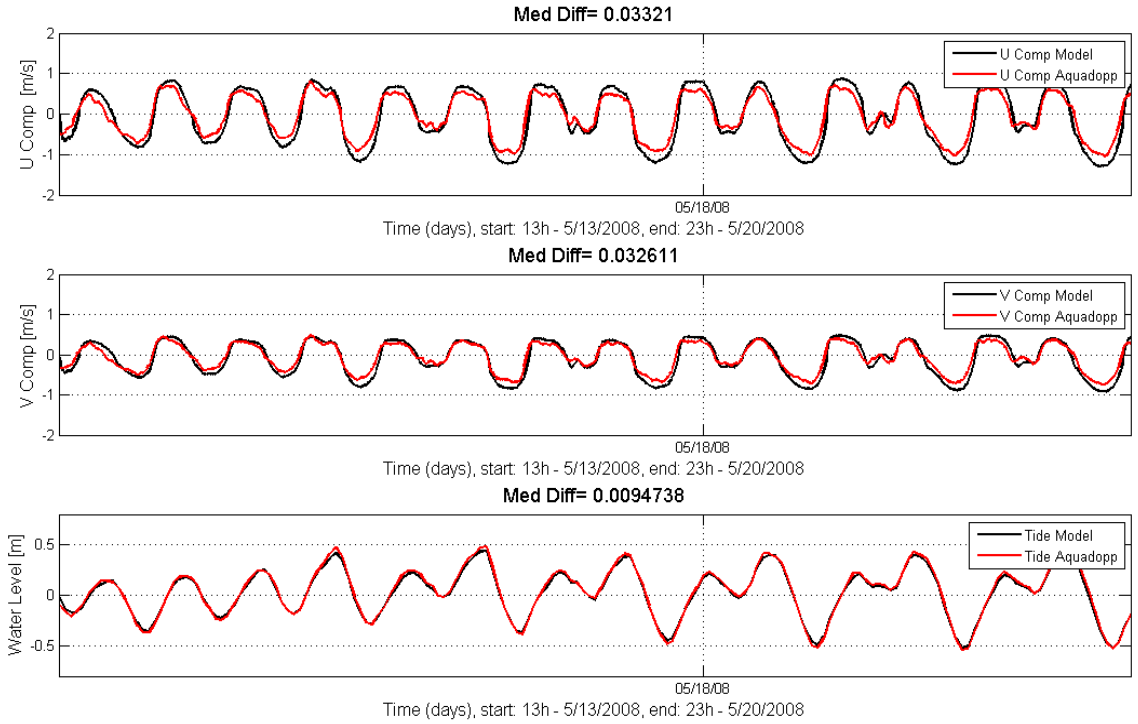


Figure A9 – Comparison between measured and simulated current U component, current V component and water level, Wiggins Pass, May 13 to May 23. Chezy = 55 $m^{0.5}s^{-1}$.

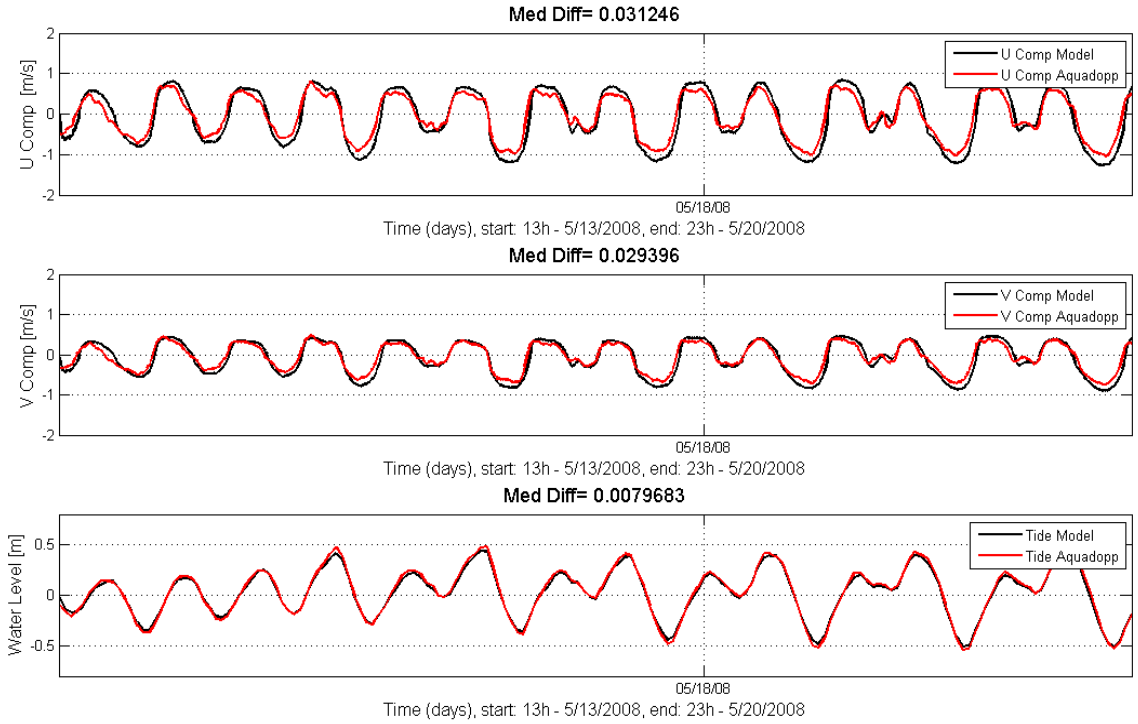


Figure A10– Comparison between measured and simulated current U component, current V component and water level, Wiggins Pass, May 13 to May 23. Chezy = 50 $m^{0.5}s^{-1}$.

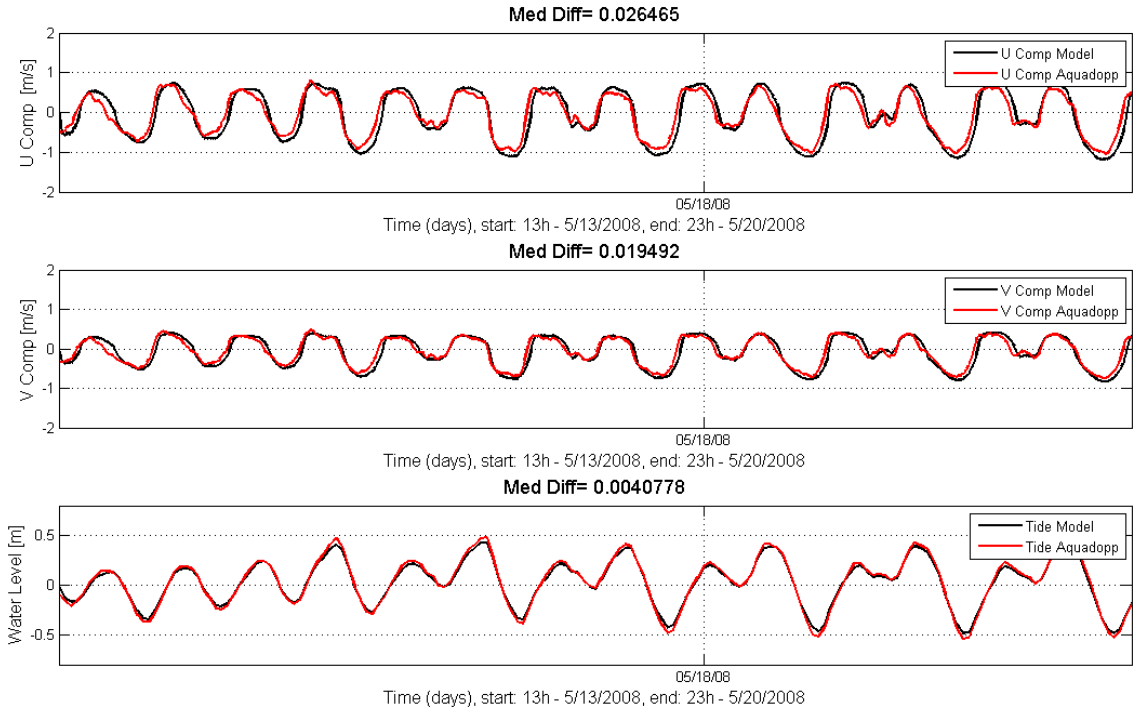


Figure 1 – Comparison between measured and simulated current U component, current V component and water level, Wiggins Pass, May 13 to May 23. Chezy = 40 $m^{0.5}s^{-1}$.

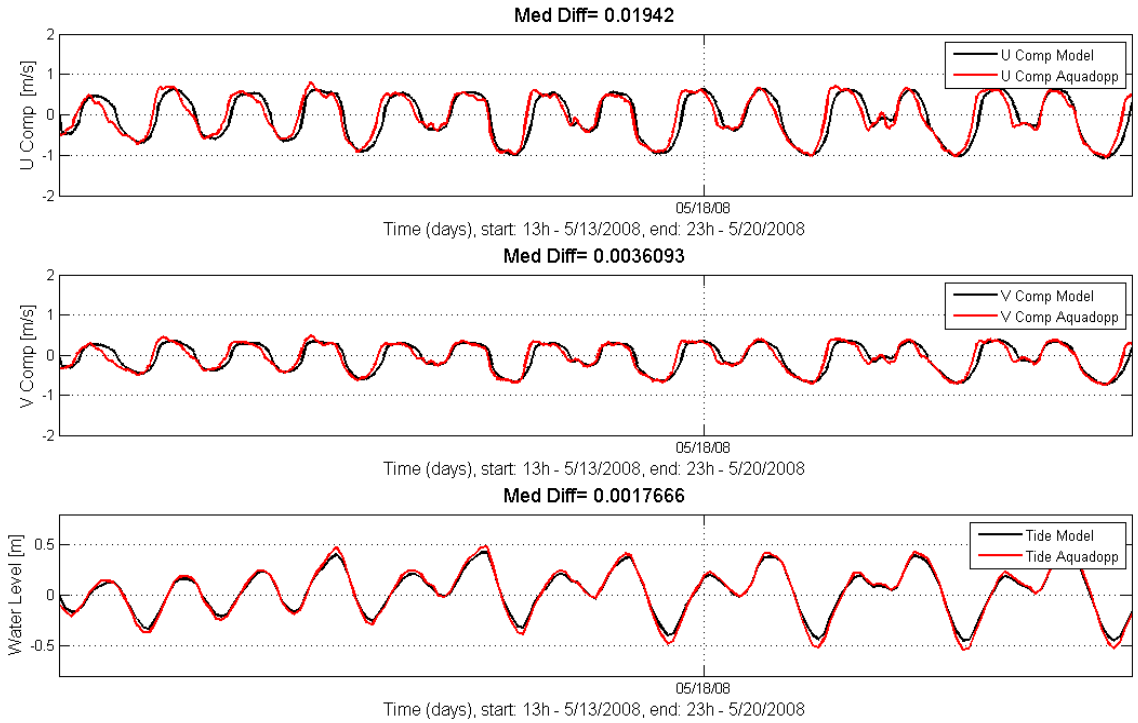


Figure 2 – Comparison between measured and simulated current U component, current V component and water level, Wiggins Pass, May 13 to May 23. Chezy = 30 $m^{0.5}s^{-1}$.

APPENDIX IV

MEETING MINUTES

MINUTES OF THE MEETING OF THE WIGGINS PASS MODELING EVALUATION WORK GROUP

Naples, Florida, April 3, 2008

LET IT BE REMEMBERED, that the Wiggins Pass Modeling Discussion Group in and for the County of Collier having conducted business herein, met on this date at 9:00 A.M. at the Coastal Zone Management Office at 3300 Santa Barbara Blvd. Naples, Florida with the following members present:

Group Leader: Heidi Kulpa
John Findley
Doug Finlay
Jon Staiger
Nicole Ryan
Srivivas Tammisetti (Excused)
Donna Caron (Excused)
Paul Sullivan (Excused)
Bryan Fluech (Absent)
Thomas Crowe

ALSO PRESENT:
Gary McAlpin, Coastal Zone Mgmt. Director
Robert Steiger, Park Manager, Delnor-Wiggins Pass
Christina Olson, Environmental Specialist, FL Park Service
Stephen Keehn, Coastal Planning and Engineering, Inc.

1. Purpose of Introduction by Heidi Kulpa

Gary McAlpin, Coastal Zone Management Director noted the meeting was a publicly warned meeting with summary minutes unless an individual states "on the record" at which point the comments will be transcribed verbatim.

It was noted that Robert Steiger, Delnor Wiggins State Park Manager and Christina Olson, Environmental Specialist for the Florida Park Service will attend the meetings.

Ms. Kulpa, Group Leader provided an overview of the creation of the Group, its function and process. She circulated the following documents to the Work Group:

1. "Wiggins Pass Modeling Evaluation Work Group" which outlined why the Group was created as well as a general overview of the Group's process.
2. A letter from Nicole Ryan of the Conservancy of Southwest Florida to John Sorey, III, Chairman, Coastal Advisory Committee re: "Next Phase of Numerical Modeling of Structural Alternatives at Wiggins Pass" dated December 13, 2007.
3. An email from Christina Olsen, Environmental Specialist for the Florida Park Service to various parties dated November 13, 2007 subject: "Draft Summary of Oct 22/23 Wiggins Pass Workshop".

Gary McAlpin noted the intent of the Work Group should be to identify a number of separate items to review in the modeling process for providing long term solutions to the stabilization and maintenance of Wiggins Pass (as opposed to the current 12-18 month re-occurring dredging program.) Stephen Keehn, of Coastal Planning and Engineering, Inc. will provide an evaluation of these items for review by the Work Group, who would narrow the choice down to possibly 2-3 preferred options to be forwarded to the Coastal Advisory Committee, the Tourist Development Council and ultimately the Board of County Commissioners for consideration.

A discussion ensued regarding any short term solutions for safety that may need to be implemented such as maintenance of navigation aids, etc. It was noted that the ultimate "Master Plan" for the solution may include a short term list (placement navigation aids, etc.) a mid term list and a long term list. Some of this may require modification of the existing inlet management plan, however changing the 3 foot draft regulation would not be in the scope.

Mr. Findley noted that the County's response to safety issues is much improved in recent years, and has witnessed immediate responses to these issues when they are identified.

It was noted that there is an April 14, 2008 meeting of the Estuary Conservation Association which the status of the Pass may be discussed. It was recommended that Heidi Kulpa attend the meeting for informational purposes.

Gary McAlpin noted that the County will take steps to ensure the Pass remains open over the next year. This may require additional dredging cycles before the Work Group completes its task.
It was noted that it is important to define the parameter of dredging which includes an approximate 8.5 foot depth cut to provide the 3 foot draft depth. The Coast Guard provides requirements for calculating this provision.
Gary McAlpin stated he can provide the Coast Guard graphic to anyone interested in reviewing it.

2. Modeling Capabilities by CP & E (Coastal Planning and Engineering)

Stephen Keehn, P.E. of Coastal Planning and Engineering, Inc. provided a Power Point presentation regarding the availability of computer modeling for providing long term solutions to the stabilization and maintenance of the Pass. There will be data collected such as wave patterns and velocities, wind flows, tidal flows, etc. to build the models.
The presentation provided examples of the capabilities of the modeling highlighting projects completed in Panama City, Florida and Rich Inlet, North Carolina, etc.
It was noted along with the modeling, a set of "evaluation criteria" should be developed to aid in prioritizing the possible solutions.
The Rich Inlet, North Carolina project utilized a "non structural solution" incorporating a sand dike.
The objective is to return the Pass to its naturally occurring condition (as close as possible) in the 1970's and 1980's (a channel 600 feet long with an acceptable depth of water.)

3. Brainstorming solutions for evaluation

Following the presentation the Group identified the following "9 Potential Alternatives" to be evaluated:

1. Re-establishment of the ebb shoal
2. Re-alignment of the interior channel of the Pass
3. Re-alignment of exterior channel of the Pass
4. A combination of some or all of the elements identified in #'s 1-3
5. Status Quo, (continue with the existing program and determine a dredging schedule to maintain the 3 foot draft requirement)
6. Other possible re-alignment options such as modifications to the channels that enter the Pass from the north and south (Little Hickory Bay and Turkey Bay channels)
7. Temporary segmented breakwater erosion control structures
8. Temporary T-groin structures
9. A combination of #'s 7 and 8

It was noted that all involved parties should realize that the Pass will continue to require maintenance activities such as periodic dredging. The goal is to provide long

term stabilization of the Pass with a greater interval between dredging or maintenance requirements than currently exists.

It was noted that the term "temporary" should be defined by the Group and these options may work to enhance and accelerate stabilization of the Pass.

It was noted that Stephen Keehn has the ability to create a matrix with parameters including, but not limited to, pass safety, costs, environmental impacts, long term performance, etc. that could assist in ranking the potential solutions.

It was noted when the options are narrowed down, an expert or group of experts will need to be consulted to review the proposals. Any individual may submit a consultant for consideration by the Work Group to Gary McAlpin via email.

It was noted that the Work Group is subject to the Sunshine Law and not to discuss the group's business amongst each other outside of a warned meeting, or send each other an email regarding Group business.

The members identified the following 3 primary goals for the Wiggins Pass Evaluation Modeling Group:

1. To ensure public safety and reduce County liability in utilization of the Pass
2. To prevent the erosion occurring at Barefoot Beach
3. To provide a solution with the least environmental impact

A secondary goal was identified:

4. To provide a solution in the most cost effective manner possible to achieve long term stabilization of the Pass without sacrificing goal #'s 1-3

Christina Olson recommended the Group define the parameters for "environmental impact" and suggested the following:

1. Erosion impacts on adjacent areas
2. Impacts on Seagrass beds
3. Impacts on the benthic communities
4. Impacts created by modifying the shoals
5. Impacts on mangrove habitat (added by Gary McAlpin)

It was noted that existing documents generated by or through the Department of Environmental Protection may provide direction in this area.

Ms. Ryan recommended that any solutions meet the intent of the mission statements and policies of Delnor Wiggins State Park, Barefoot Beach Preserve and/or any subsequent areas leased by Collier County.

The Group identified the following management activities to be included in the overall solution:

1. Navigation marker maintenance plan
2. A plan for outreach and education for boaters and public or commercial enterprises involved in providing related marine services (i.e., signs at marinas and County boat launches, written information provided to boat slip lessees, etc.)

Stephen Keehn noted that it will take approximately 2-3 months to provide the modeling analysis of the different potential alternatives back to the Group. Information on re-establishment of the ebb shoal alternative may be ready in 2-3 weeks.

The Group discussed possible topics for the next meeting which may include:
1. An update of alternative #1 (re-establishment of the ebb shoals)
2. Review of technical experts to be utilized
3. Discussion of the proposed matrix evaluation criteria with consideration given to the goals and management issues discussed herein.

It was noted that on-going monitoring or data collection (as opposed to one time) may be advantageous to assist in providing a long term solution to the stabilization of the Pass.

4. Next meeting and time
The next meeting will be June 5, 2008 at 9:00AM

There being no further business for the good of the County, the meeting was adjourned by the Group Leader at 11:55 A.M.

Wiggins Pass Modeling Evaluation Work Group

_____
Heidi Kulpa, Group Leader

These minutes approved by the Work Group on _____
as presented_____ or as amended _____.

MINUTES OF THE MEETING OF THE WIGGINS PASS MODELING EVALUATION WORK GROUP

Naples, Florida, June 5, 2008

LET IT BE REMEMBERED, that the Wiggins Pass Modeling Evaluation Work Group in and for the County of Collier having conducted business herein, met on this date at 9:00 A.M. at the Coastal Zone Management Office at 3300 Santa Barbara Blvd. Naples, Florida with the following members present:

Group Leader: Heidi Kulpa
John Findley
Doug Finlay
Jon Staiger
Nicole Ryan
Srivivas Tammisetti
Donna Caron (excused)
Paul Sullivan
Bryan Fluech
Thomas Crowe

ALSO PRESENT:

Gary McAlpin, Coastal Zone Management Director
Christina Olson, Environmental Specialist, FL. Park Service

I. **Ms. Kulpa** called the meeting to order at 9:00AM

II. A quorum was established. *It was noted that Robert Caron was sitting in for Donna Caron as a liaison.*

III. ***Mr. Staiger moved to approve the minutes of the April 3, 2008 meeting subject to the following correction:***
Page 4, paragraph 7 – addition of primary goal #4. *To lengthen dredging cycles.*
Second by Mr. Crowe. Carried unanimously 9 – 0.

IV. **Ms. Kulpa** stated that it would be advisable for the group to develop a Mission Statement. The Group determined that a 3-member subgroup comprised of Ms. Ryan, Mr. Fluech and Mr. Findley should develop draft language for the statement and submit it to the Group for approval. It was noted that it should be sent out for comment to all Group members before the next meeting.

Christina Olson wanted to ensure the Florida Park Service is kept informed of any issues and forwarded any correspondence in reference to the Group's activities.

V. **Stephen Keehn, PE and Lindino Benedet, Oceanographer of Coastal Planning and Engineering, Inc.** presented a Power Point presentation entitled "Wiggins Pass DELFT 3D Numerical Modeling Preliminary Results." The slide show is available on the Coastal Zone Management website.
Lindino Benedet recapped the work to date and provided preliminary modeling results of the existing conditions that create circumstances that lead to the infilling of the Pass from transported sediments.
The preliminary results from the modeling indicate that the Pass and related sediment transports are primarily affected by wave patterns that occur from South to North. It was noted this finding is different from historic conclusions, which indicated that the Wiggins Pass is affected by a wave pattern from North to South.

Stephen Keehn presented a sediment budget from 2004-2007 (an analysis of volumetric changes of sediments in a defined area), which generally supports this preliminary finding.

In conclusion they noted the following:

- The results are preliminary and the data needs refining and verification
- Sanibel and its shoals effect net transport direction
- There is room for improvement in the cross sectional design to reduce annual sedimentation
- Initial indications are that dredged sediments could be placed much closer to the inlet
- In first 1-3 yrs, there is no sedimentation north of inlet (ebb shoal growth)

It was noted that with this new data and modeling, simply placing the dredged sand in more strategic locations might aid in increasing the dredging cycle.

Lindino Benedet stated that based on the modeling, the natural conditions promote the infilling of the Pass creating a water depth of 2 feet near the westerly end.
Gary McAlpin noted if this is a fact then the option of "status quo" or doing nothing should be considered, as this would be inconsistent with the Inlet Management Plan, which requires the Pass provide navigation for a 3-foot draft vessel.
Christina Olson noted that upon completion of the study, the solution might trigger a refinement of the inlet management plan.

VI. The following activities were noted for the next meeting:

- Discussion of the Mission Statement
- **Stephen Keehn** will provide the Group with a preliminary matrix to assist in ranking the potential alternatives
- Discussion and review of any available data and related modeling for potential non structural alternatives #1-6 as identified in the first meeting

The following was noted:

- Discussion of Non-structural alternatives should take priority in a potential solution
- In depth analysis of the potential alternatives (comparisons of environmental effects, costs, etc.) should not take place until the Group has narrowed the field down to 2-3 choices based on the modeling

Mr. Findley provided a report of the existing depths at the Pass noting the highest water condition at low tide is approximately 3' 2" (3 feet, 2 inches).
Gary McAlpin noted that based on that information, a "Notice to Mariners" was going out listing the depths in the area and related safety aspects for individuals utilizing the Pass.

VII. The next meeting is August 12, 2008.

There being no further business for the good of the County, the meeting was adjourned by order of the chair at 11:01 A.M.

*****

***Please note: Minutes were numbered for organizational purposes since no Agenda was provided.*

June 5, 2008

Wiggins Pass Modeling Evaluation Work Group

_____

Heidi Kulpa, Group Leader

These minutes approved by the Work Group on _____as presented_____ or as amended _____.

MINUTES OF THE MEETING OF THE WIGGINS PASS MODELING EVALUATION WORK GROUP

Naples, Florida, August 12, 2008

LET IT BE REMEMBERED, that the Wiggins Pass Modeling Evaluation Work Group in and for the County of Collier having conducted business herein, met on this date at 9:00 A.M. at the Collier County Government Center, Health Department, Building "H", 2nd Floor, Rm. 216, Naples Florida with the following members present:

Group Leader: Heidi Kulpa
John Findley
Doug Finlay (Excused)
Jon Staiger
Nicole Ryan
Mark Latch
Donna Caron
Paul Sullivan
Bryan Fluech
Thomas Crowe

ALSO PRESENT:
Gary McAlpin, Coastal Zone Management Director
Robert Steiger, Park Manager, Delnor-Wiggins S.P.
Sally Cole Braem, Environmental Spec., Florida Park Service

- **Call to Order**
  Group Leader Kulpa called the meeting to order at 9:00AM

- **Sunshine Law Notification**
  Gary McAlpin, Coastal Zone Management Director, reminded the group that it operates under the guidelines of the Sunshine Law, with the meeting publicly noticed and minutes being recorded for publication.

- **Roll Call**
  Roll call was taken and a quorum was established.

- **Introduction of New/Replacement Members**
  Mark Latch, Asst. Bureau Chief for the Bureau of Natural and Cultural Resources, Florida Park Service has replaced former group member Srivivas Tammisetti.
  Sally Cole Braem, Environmental Specialist II, Florida Park Service, District 4 has replaced Christina Olsen as Environmental Liaison for the Florida Park Service.

- **Approval of Last Meeting Minutes**
  Mr. Sullivan moved to approve the minutes subject to the following correction:
  Page 3, line #5 - from "nothing should be considered …" to "nothing *cannot* be considered…"
  Second by Mr. Staiger. Carried unanimously 9-0.

    - **Comments from Public Participation from last meeting**
      Gary McAlpin noted that an item has been added to the agenda to allow for Public Comments.

    - **Recap of Last Meeting**
      Gary McAlpin recapped the previous meeting and outlined the purpose of today's meeting which is to review the modeling progress and discuss the evaluation criteria for proposed solutions for long-term stabilization of Wiggins Pass.

    - **Last Meeting Follow-up**
      - Mission Statement Progress
        Ms. Kulpa moved to approve the following mission statement for the Wiggins Pass Modeling Evaluation Work Group:
        "*Examine the modeling study results and recommend environmentally and economically sound methods to maintain Wiggins Pass as a safe navigable waterway by minimizing shoreline erosion and achieving long term stabilization of Wiggins Pass through a collaborative process involving Wiggins Pass stakeholders input."*
        Second by Mr. Staiger. Carried unanimously 9-0.

- Other
  None

- **Modeling Progress/CP&E**
  Stephen Keehn, PE and Lindino Benedet, Oceanographer of Coastal Planning and Engineering, Inc. recapped the last meeting and noted, as reported, the Pass is primarily affected by wave action from the South to North. They clarified the Pass does have influences from North to South wave direction; however the net effect of sediment activity in area of the Pass is caused by the South to North wave activity.

  They provided a Power Point Slideshow Presentation regarding the status of their Delft 3D Numerical Modeling Study including work completed since the last meeting. The work included the placing of instruments in the field to collect data on wave patterns and water current activity in the area to be utilized in developing the modeling of alternative solutions to the long-term stabilization of the Pass. They noted, 8 potential solutions have been modeled through the Delft 3D program for their overall effectiveness in achieving the goals of the Discussion Group.
  These solutions provide a variety of possible alterations in the area of the Pass (re-channeling, placing of sand dikes, etc.), none of which would be considered "structural alternatives."
  The modeling showed the morphology of the Pass over a 1-year time frame upon completion of the proposed solutions. The morphology indicated widths, lengths and depths, etc. of the channel during the 1 year time period.
  After review of the modeling, they have determined that the most effective alternative solutions are #3 (permitted channel + Flood + N-S + dike) and #8 (new channel #2 + Flood + N-S + dike).
  They noted the next step would be to select the most optimal solutions as determined by the Discussion Group and perform the modeling over a longer time frame (4-5 year morphology).
  A copy of the Slideshow has been posted on the Coastal Zone Management website.

  A discussion ensued regarding the alternatives potential impacts on Barefoot Beach and Delnor-Wiggins State Park Beach, analyzing wave climates over a longer time frame (20-year period), etc.

  Lindino Benedet noted that the modeling is based on the initial information obtained and each model takes a substantial amount of time to run, expanding the model to analyze the impacts with longer wave climate data and would be completed as part of the study when the alternatives are narrowed from 8 to fewer as determined by the Discussion Group.

- **Evaluation Criteria discussion**
  Stephen Keehn and Lindino Benedet presented a preliminary matrix that will aid in evaluating the 8 alternative solutions. This information is part of the slideshow. The matrix would be used to evaluate the merits of the alternatives proposed and aid in the

Discussion Groups ultimate voting for optimal alternative. Further, it needs to be expanded to include Geological and Environmental parameters.

Gary McAlpin suggested the Group Members move forward on evaluating alternatives #3 and #8.
Robert Steiger, Delnor-Wiggins State Park Manager stated he was under the impression that the solution was to focus on allowing the Pass to return to its 1970 condition as opposed to re-channeling the Pass.
Lindino Benedet noted that this is possible, however the condition would allow a Pass depth of 2-3', not the 8-9'depth required for navigation of a 3 foot draft vessel.
Gary McAlpin noted that the depth of 2-3' would not satisfy the inlet management plan. Further, he recommended that the evaluation of the alternatives address possible impacts on wildlife and/or fish habitats, Barefoot Beach and Delnor-Wiggins Beach.
Sally Braem, Environmental Specialist, Florida State Park noted that the impact on the shoals and benthic communities should be addressed as well.

- **Follow-up for next meeting**
  Following the discussion the Group determined to focus on alternatives #3 and #8 in the following manner:

  1) Analyze 20-year storm data (wave and currents patterns, etc.) for the model
  2) Conduct a 4-5 year simulation for the morphology of the Pass based on each alternative
  3) Analyze the concept of repairing Barefoot Beach to its natural condition and study its morphology over the 4-5 year simulation period of each alternative
  4) Analyze impacts on Delnor-Wiggins State Park for each alternative
  5) Obtain input regarding impacts on Snook habitats for each alternative
  6) Analyze impact on the various environmental communities for each alternative
  7) Incorporate any necessary geological considerations into the evaluation

  Ms. Ryan recommended that an additional alternative be added to the 2 chosen which would provide for the best alternative that would not require the re-channeling of the Pass.
  The Group determined to add this scenario to the alternatives previously chosen requiring a total of three alternatives to be evaluated.

- **Public Comment**
  Doug Fee supported the examination of 3 alternatives and recommended that the Group conduct any necessary public meetings with the results of the 3 alternatives to gain public support for the final decision.

  David Roellig noted that the channel would need to maintain a high enough velocity to "self flush." This may require some type of structural measure to "train the channel."

Gary McAlpin stated that all "non-structural" alternatives should be exhausted before examining "structural" alternatives.

Mr. Sullivan noted that in may be advisable at this point to examine a "structural" alternative; as opposed to waiting until a later date if it is determined that "non-structural" alternatives will not provide the goal of long-term stabilization of the Pass.

It was determined to exhaust the "non-structural" alternatives before proceeding on evaluating "structural" alternatives.

- **Next Meeting**
  The next meeting is scheduled for October 22, 2008.

There being no further business for the good of the County, the meeting was adjourned by order of the chair at 10:42 A.M.

Wiggins Pass Modeling Evaluation Work Group

_____

Heidi Kulpa, Group Leader

These minutes approved by the Work Group on _____
as presented_____ or as amended _____.

MINUTES OF THE MEETING OF THE WIGGINS PASS MODELING EVALUATION WORK GROUP

Naples, Florida, October 22, 2008

LET IT BE REMEMBERED, that the Wiggins Pass Modeling Evaluation Work Group in and for the County of Collier having conducted business herein, met on this date at 9:00 A.M. at Collier County Government Center, Health Department Building "H", 2nd Floor, Rm. 216. Naples, Florida with the following members present:

Group Leader: Heidi Kulpa
John Findley
Doug Finlay
Jon Staiger
Nicole Ryan
Mark Latch (Excused)
Donna Caron (Excused)
Paul Sullivan
Bryan Fluech (Excused)
Thomas Crowe

ALSO PRESENT: Gary McAlpin, Coastal Zone Management Director

- **Call To Order**
  Group Leader Heidi Kulpa called the meeting to order at 9:00 a.m.

- **Roll Call**
  Roll call was taken and a quorum was established.
  Jeff Riley, Florida Park Service and Sally Cole Braem, Environmental Spec., Florida Park Service were also in attendance along with Consultants Stephen Keehn, PE and Lindino Benedet, Oceanographer of Coastal Planning and Engineering, Inc.

- **Sunshine Law Notification**
  Gary McAlpin, Director, Coastal Zone Management stated the Discussion Group is subject to the Sunshine Law and two or more members of various County Boards may be present and the subject matter may be discussed at future Board meetings.

- **Approval of Minutes from 8/12/08 meeting**
  Mr. Finlay moved to approve the minutes of the August 12, 2008 meeting. Second by Mr. Staiger. Carried unanimously 7-0.

- **Review significant insights to date**
  - **Do Nothing is not an option because of non-compliance to IMP**
  - **Sand transport in this area is hampered by the effects of Sanibel and appears to flow south to north**
  - **Dead zone for sand transport in the R15 area**

  Gary McAlpin reviewed the previous findings referenced above.

  Lindino Benedet of Coastal Planning and Engineering re-iterated the area in the immediate vicinity of the Pass is primarily affected by net sand transport from a South to North wave direction.

  Group Leader Heidi Kulpa reviewed the Discussion Groups area of focus for the alternatives proposed:

  1) Analyze 20-year storm data (wave and currents patterns, etc.) for the model
  2) Conduct a 4-5 year simulation for the morphology of the Pass based on each alternative
  3) Analyze the concept of repairing Barefoot Beach to its natural condition and study its morphology over the 4-5 year simulation period of each alternative
  4) Analyze impacts on Delnor-Wiggins State Park for each alternative
  5) Obtain input regarding impacts on Snook habitats for each alternative
  6) Analyze impact on the various environmental communities for each alternative
  7) Incorporate any necessary geological considerations into the evaluation

Stephen Keehn of Coastal Planning and Engineering provided an overview of the preliminary Environmental Resource Assessments regarding Sea Grasses and Snook Habitat.
He noted the following:

- Information was obtained from the National Marine Fisheries Service.
- Snook's habitat includes mangrove areas and congregates in inlets to spawn.
- Snook is listed as a species of concern with no specific conservation regulations for dredging activities.
- No particular conservation areas or critical habitats have been identified in the Wiggins Pass area.
- No habitats of concern (including Seagrasses) were identified in the area of proposed work.
- The Seagrass information was based on physical reconnaissance via divers.
- There are some mangrove "areas of concern" on the northern side of the Pass.
- There is no proposal to "bury this area" (mangrove areas).
- The initial reconnaissance work is preliminary and will be finalized under a subsequent contract.

He further indicated the following:

- Preliminary geological data has been collected and reviewed regarding the composition of the sea bottom in the area.
- Further investigation is necessary to determine any possible removal of limestone, etc.

Gary McAlpin summarized and Stephen Keehn agreed, the reconnaissance indicates none of the alternatives under consideration would be eliminated due to environmental or geo-technical reasons or concerns.
When finalized, this information will be incorporated into a report and posted on the Coastal Zone Management website.

- **Presentation of The three Modeling Alternatives**
  - **Model the effects of straightening the interior and exterior channels**
  - **Model the effects of straightening the interior channel but not the exterior channel**
  - **Model the effects of not straightening the interior channel but straightening the exterior channel**

A copy of this presentation (Wiggins Pass Delft3D Numerical Modeling and Calibration & Channel Enhancement Alternatives dated October 22, 2008) conducted by Lindino Benedet and Stephen Keehn will be available on the Collier County Coastal Advisory Committee Website at http://www.colliergov.net/Index.aspx?page=2390.

Lindino Benedet reviewed the data utilized in running the morphology models for the alternatives, which include wave conditions and current velocities, data from previous studies etc. This data is necessary to ensure the model depicts the morphology as accurately as possible.
Based on input from previous meetings and subsequent analysis their work has now been refined to study the following 4 alternatives:

4 Alternatives (for long term stabilization of Wiggins Pass)
1) *Currently Permitted channel - (250 ft. wide, 13 ft. deep.)*
2) *New Straight Channel with Hydraulic Enhancements – Straight channel (200 ft. wide, 11 ft. deep), flood shoal cut, sand dikes to direct the flow.*
3) *Permitted Channel with Hydraulic Enhancements – Straight channel as permitted (250 ft wide, 13 ft deep), flood shoal cut, sand dikes to direct the flow.*
4) *New Realigned Channel – Realigned Channel following natural ebb jet, 200 ft wide, 11 ft. deep.*

The 4 alternatives were modeled for the morphology of the Pass on 1 year, 2year and 4 year time frames, as well as a significant Hurricane Event.

Lindino Benedet and Stephen Keehn provided a detailed technical overview of individual morphology models for the 4 alternatives proposed.
It was noted Stephen Keehn has completed a concept design which combines alternatives #2 and 3.

Group Leader, Heidi Kulpa, reviewed the purpose of the Mission given to the Group:
1. *Provide a safe channel for boating.*
2. *Address the erosion at Barefoot Beach.*
3. *Lengthen the dredge cycle and accomplish it with the least effect on the environment.*
4. *The solution needs to be economically effective.*

Speaker
Marcia Cravens, **Mangrove Action Group**, requested clarification on the data used to develop the models and if information such as tidal prisms, velocities of currents, etc. were taken into account.
Stephen Keehn and Lindino Benedet noted the model is calibrated utilizing numerous factors (sediment transport, wave velocities, etc.). It is a "state of the art" program for modeling the effects (including changing tidal prisms, current velocities, etc) created on the Pass by each of the proposed alternatives.

He provided a summary of the Group's Decision Matrix shown on pages 60-63 of the presentation.

Among other conclusions in the presentation, he noted the following:

- Of all the alternatives tested (16 total), alternatives 2 and 3 were the only ones which accomplish the goals of the Discussion Group.
- Alternative #2 provides slightly more stability to the Pass than alternative #3.
- Alternative #4, provides a more long -term navigable channel, but noted without installation of a permanent structure, a significant amount of erosion on the south end of Barefoot Beach would occur.
- Sedimentation rates in the model decrease with time as expected, after 2 years, quasi-equilibrium is reached and there is minimal additional sedimentation.
- Beach fill between markers R-13 and R-15 is recommended (creating minimal effects on the channel and a net positive effect on Barefoot Beach.)
- During extreme hurricane years, no matter what steps are taken, (other than installations of permanent structures) the channel gets filled in at a 4 year "normal rate." An emergency response plan for the event should be incorporated into the final solution.

Speaker

Marcia Cravens asked if the modeling takes environmental considerations into account (as well as navigation factors.)
Lindino Benedet noted the model does not address environmental considerations; however the Group's area of focus includes environmental concerns.

Gary McAlpin read the approved Mission Statement into the Record "*Examine the modeling study results and recommend environmentally and economically sound methods to maintain Wiggins Pass as a safe navigable waterway by minimizing shoreline erosion and achieving long term stabilization of Wiggins Pass through a collaborative process involving Wiggins Pass stakeholders input."*

He suggested returning the South End of Barefoot Beach to its "original condition" be considered in the final solution and polled the Group for their recommendations on narrowing the focus on the individual alternatives.

***Mr. Findley** – Alternative #'s 2 and 3 appear to be the most optimal identified. Favors alternative #2 at this point.*
***Ms. Kulpa** – Focus on alternative #2.*
***Mr. Finlay** – Prefers alternatives #2 or 3.*
***Ms. Ryan** – Alternative #1 eliminated; need final Environmental Assessment and Report for remaining alternatives to make final decision.*
***Mr. Staiger** – Focus on alternatives #'s 2 or 3, favors #2 as it may be more cost effective based on less width and depth cut of channels, etc. to achieve solution.*
***Jeff Riley, Florida Park Service** favors alternative #2.*
***Mr. Sullivan** – Need for final Environmental Assessment, favors #2 based on cost effectiveness.*

Mr. Crowe *– Favors alternatives #2 and 3, need final economic considerations for both alternatives.*

It was noted the channel will require dredging in January as scheduled. This will be accomplished under the existing permit, or if possible a permit modification to place the dredged sand in a more strategic location.

Lindino Benedet noted an alternative solution involving the combination of #'s 2 and 3 will be analyzed in its relations to the goals set forth by the Group.

Lindino Benedet reviewed the future tasks:

- Refine the best alternative and simulate it for 1year, 2year and 4year with beach fill placement. The final alternative will be a combination of #2 and 3.
- Write final modeling report and provide recommendations to the detailed design phase and new permit application.
- Refine Decision Matrix for scenarios of comparison.

- **Presentation of Results of the environmental resource assessment of The Wiggins Pass Flood shoal areas.**
  Previously discussed.

- **Discussion of consideration for Snook habitat**
  Previously discussed.

- **Public Comments**
  Speakers
  Marcia Cravens asked if there are any examples where a modeling solution has been constructed.
  Lindino Benedet referenced Rich Inlet in North Carolina, North Topsail Beach, NC and Bogue Inlet, NC as examples.

  Joe Moreland recognized the work being completed by the Discussion Group.

  Doug Fee thanked the Consultants and the County. He noted the removal of rock that may be required for a particular alternative may have an impact on sand transports and erosion at Barefoot Beach.
  Stephen Keehn noted the geologic considerations need to be finalized. Alternatives #2 and 3 seek to minimize the amount of rock removed.
  Gary McAlpin stated they are unsure how much rock, if any, may need to be removed. He recommended the Consultants proceed on their work to make the determinations and provide the Final Reports necessary to make a decision. He noted the Final Reports are intended to be available 30 days prior to an applicable Group meeting.

The Group determined a combination solution utilizing elements of alternatives #2 and 3 should be presented for the Groups consideration.

Gary McAlpin requested the Consultants analyze the impact of restoring Barefoot Beach to its "original condition" as part of the final solution.

- **Next Meeting date**
  It was noted the next meeting will tentatively be held in January, 2009.
  Gary McAlpin reported Group Leader, Heidi Kulpa is re-locating out of the area and is resigning from the Group.
  Mr. Staiger nominated John Findley for "Group Leader." Being no other nominations, Mr. Findley is Group Leader.

  The Group recognized the efforts of Heidi Kulpa.

There being no further business for the good of the County, the meeting was adjourned by order of the chair at 11:59 A.M.

Wiggins Pass Modeling Evaluation Work Group

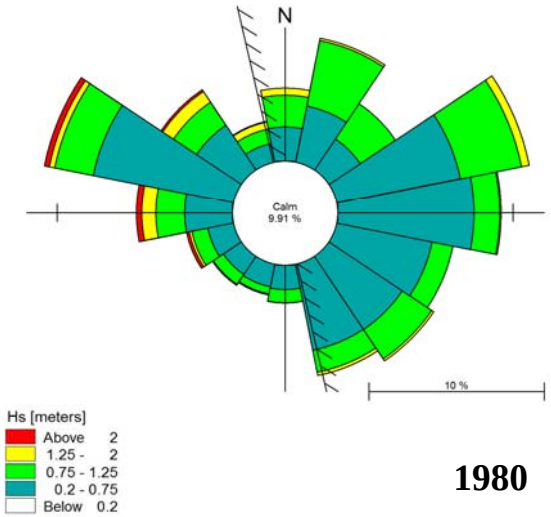
_____

Heidi Kulpa, Group Leader

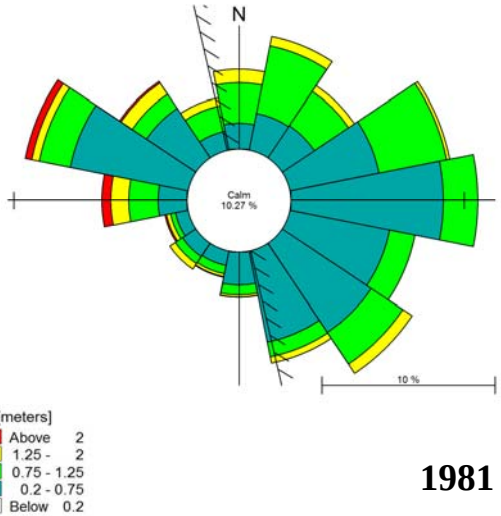
These minutes approved by the Work Group on _____
as presented_____ or as amended _____.

APPENDIX V

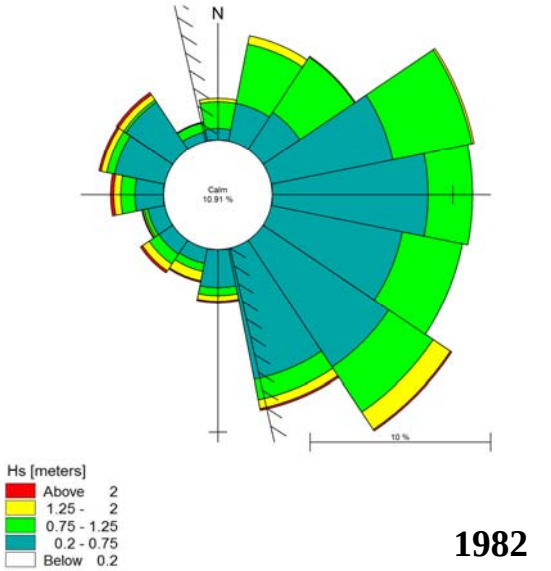
WIS HINDCAST WAVE DATA
ANNUAL WAVE ROSES



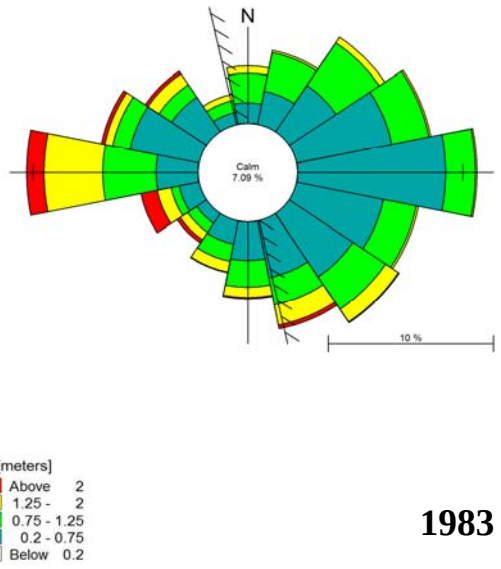
1980



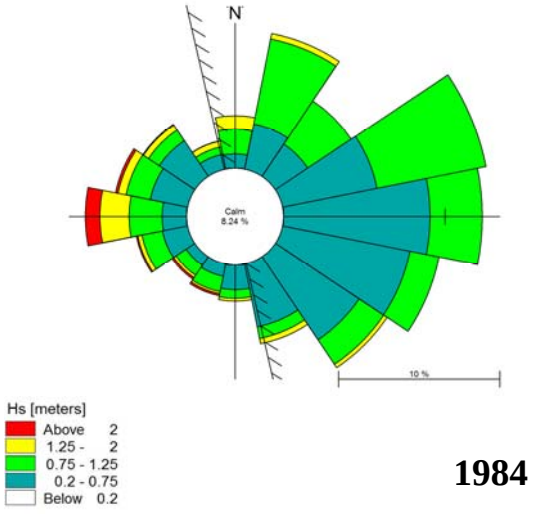
1981



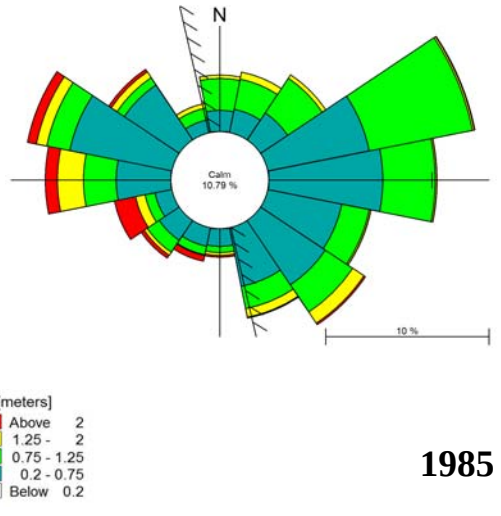
1982



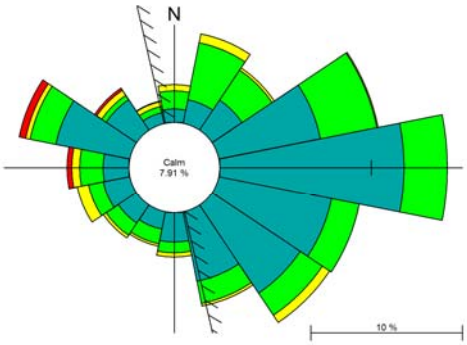
1983



1984

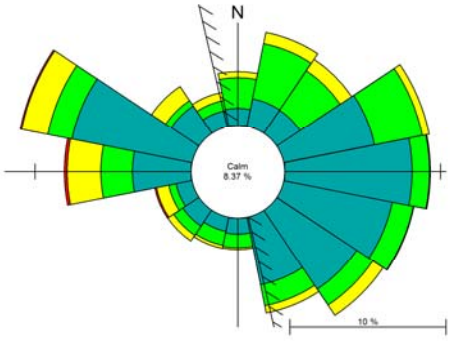


1985



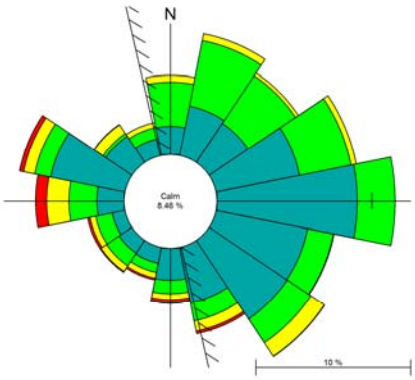
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1986



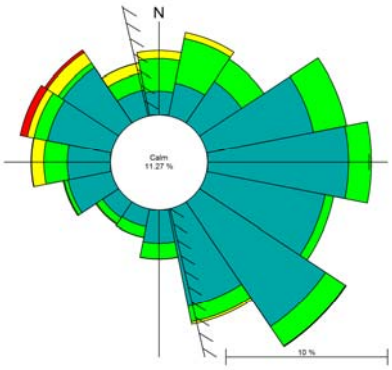
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1987



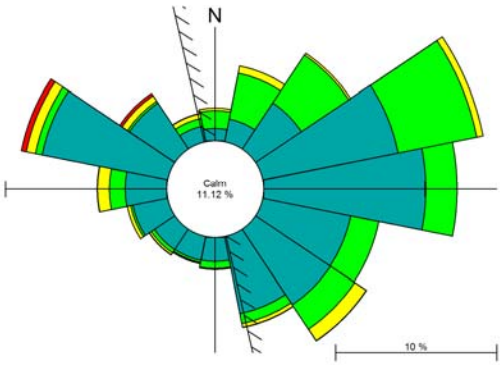
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1988



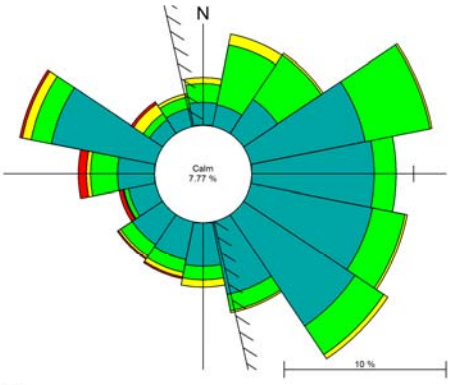
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1989



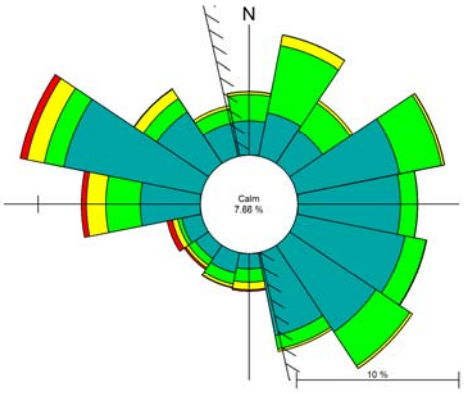
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1990



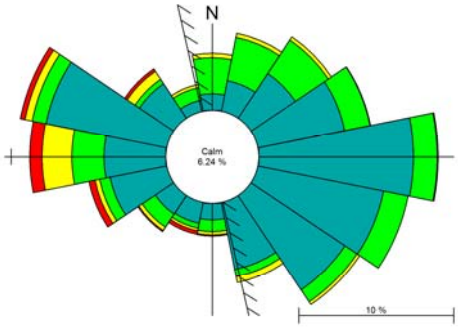
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1991



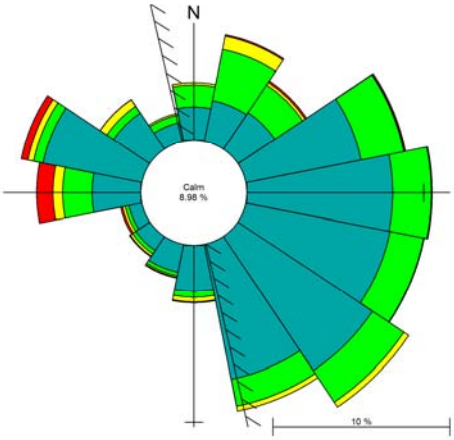
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1992



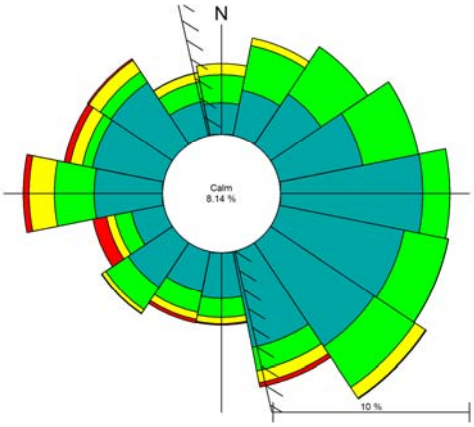
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1993



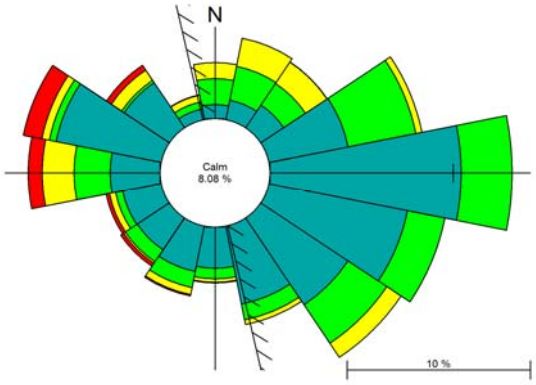
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1994



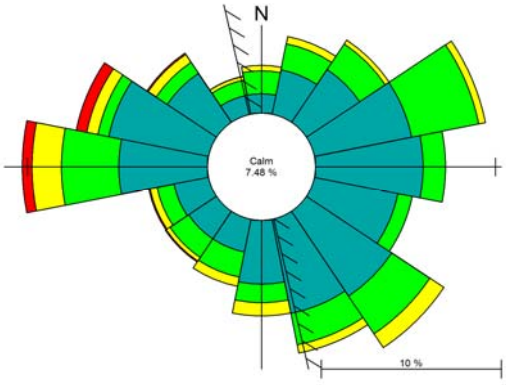
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1995



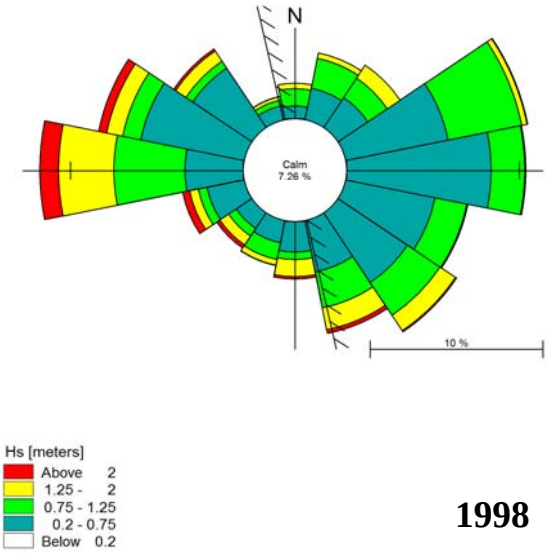
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1996



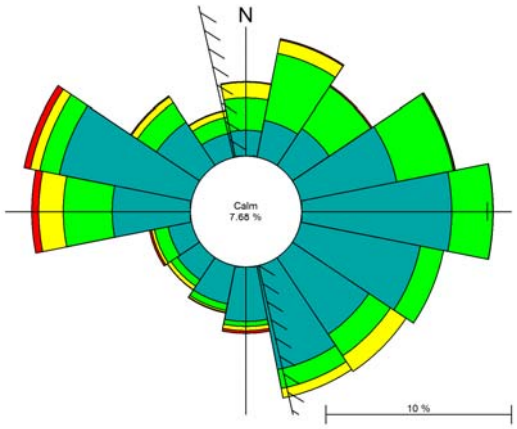
Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

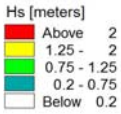
1997


N
Calm
7.26 %
10 %

Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1998


N
Calm
7.68 %
10 %


Hs [meters]
Above 2
1.25 - 2
0.75 - 1.25
0.2 - 0.75
Below 0.2

1999