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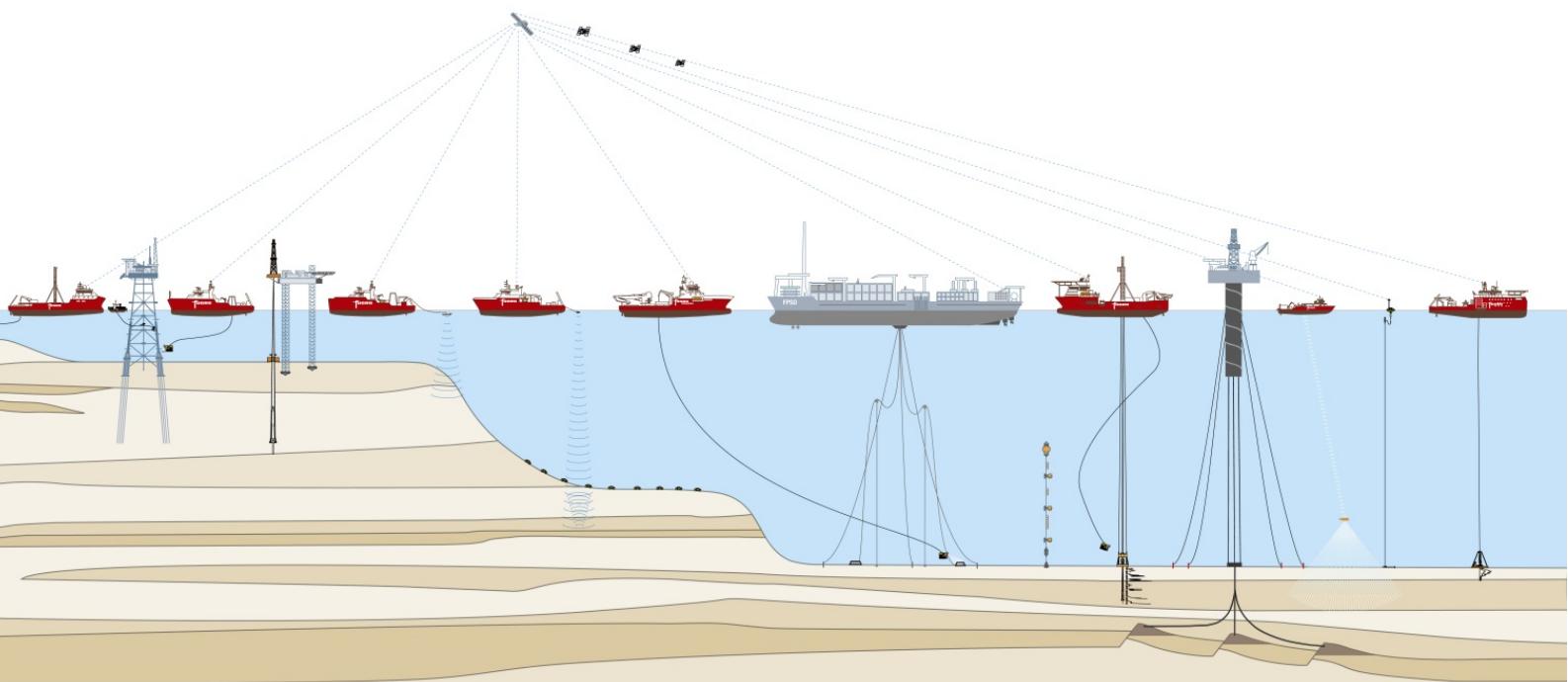
Meteocean Criteria Study
Horn Mountain, Gulf of Mexico

Fugro Document No.: 118910-0130-R5
17 August 2018

Anadarko Petroleum Corporation



Volume 1 of 1



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Metocean Criteria

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EXECUTIVE SUMMARY

This report has been prepared by Fugro on behalf of Anadarko Petroleum Corporation and presents the updated metocean design criteria for the Horn Mountain Field in Mississippi Canyon, Blocks 126 and 127, offshore Gulf of Mexico. The location of the site of interest is 28.866°N, 88.056°W in a water depth of approximately 1646 m (5400 ft), and is illustrated in the Frontispiece.

The information contained in this report includes:

- Hurricane criteria for winds, waves, currents and water levels.
- Sudden Hurricane criteria for winds, waves, and currents.
- Off-Peak Hurricane criteria for winds, waves, and currents.
- Winter Storm criteria for winds and waves.
- Loop Current criteria.
- Near Bed Current criteria.
- Operational criteria for winds, waves, current profile characterization, marine growth, air temperature and sea water properties.

The final omni-directional independent wind, wave and current criteria are summarized in Summary Tables I to XIII below.

Summary Table I Extreme Omni-directional Hurricane Wave Criteria.

Return Period	Hs [ft]	Tp [s]	Hmax [ft]	THmax [s]	Hc [ft]
10-years	34.2	13.1	60.1	11.8	38.1
25-years	41.2	14.1	72.4	12.7	45.9
50-years	45.9	14.7	80.6	13.2	51.1
100-years	50.3	15.2	88.4	13.7	56.0
200-years	54.4	15.7	95.7	14.1	60.6
1000-years	63.4	16.6	111.5	15.0	70.6

Summary Table II Extreme Omni-directional Hurricane Wind Criteria.

Return Period	Ws _{1-hr} [ft/s]	Ws _{10-min} [ft/s]	Ws _{1-min} [ft/s]	Ws _{3-sec} [ft/s]
10-years	95.6	105.1	117.3	133.2
25-years	118.7	132.0	149.2	171.5
50-years	135.4	151.9	173.2	200.9
100-years	151.7	171.7	197.4	230.8
200-years	167.7	191.4	221.8	261.3
1000-years	204.0	237.0	279.5	334.7

Summary Table III Extreme Omni-directional Hurricane Surface Current Criteria.

Depth	10-years Cs [ft/s]	25-years Cs [ft/s]	50-years Cs [ft/s]	100-years Cs [ft/s]	200-years Cs [ft/s]	1000-years Cs [ft/s]
Surface Speed	4.31	5.51	6.29	6.99	7.65	9.03

Summary Table IV Extreme Omni-directional Sudden Hurricane Wave Criteria.

Return Period	Hs [ft]	Tp [s]	Hmax [ft]	THmax [s]	Hc [ft]
10-years	18.3	10.1	32.2	9.1	19.3
25-years	23.4	11.0	41.3	9.9	24.8
50-years	27.2	11.5	48.0	10.4	28.8
100-years	30.9	12.0	54.5	10.8	32.7
200-years	34.6	12.4	60.9	11.2	36.6
1000-years	42.8	13.3	75.4	12.0	45.3

Summary Table V Extreme Omni-directional Sudden Hurricane Wind Criteria.

Return Period	Ws _{1-hr} [ft/s]	Ws _{10-min} [ft/s]	Ws _{1-min} [ft/s]	Ws _{3-sec} [ft/s]
10-years	61.7	66.7	73.0	81.2
25-years	77.1	83.9	92.7	104.1
50-years	88.7	97.2	108.1	122.2
100-years	100.4	110.7	123.8	141.0
200-years	112.1	124.3	139.9	160.3
1000-years	139.2	156.5	178.8	207.8

Summary Table VI Extreme Omni-directional Sudden Hurricane Surface Current Criteria.

Depth	10-years Cs [ft/s]	25-years Cs [ft/s]	50-years Cs [ft/s]	100-years Cs [ft/s]	200-years Cs [ft/s]	1000-years Cs [ft/s]
Surface Speed	2.28	3.02	3.58	4.14	4.70	6.00

Summary Table VII Extreme Omni-directional Off-Peak Hurricane Wave Criteria.

Return Period	Hs [ft]	Tp [s]	Hmax [ft]	THmax [s]	Hc [ft]
10-years	15.1	10.6	27.2	9.6	16.5
25-years	20.0	12.0	35.9	10.8	21.8
50-years	23.7	13.0	42.6	11.7	25.9
100-years	27.4	13.8	49.4	12.5	30.0
200-years	31.3	14.7	56.3	13.2	34.1
1000-years	40.2	16.4	72.4	14.7	43.9

Summary Table VIII Extreme Omni-directional Off-Peak Hurricane Wind Criteria.

Return Period	Ws _{1-hr} [ft/s]	Ws _{10-min} [ft/s]	Ws _{1-min} [ft/s]	Ws _{3-sec} [ft/s]
10-years	51.4	55.2	60.0	66.4
25-years	61.1	66.0	72.2	80.3
50-years	68.5	74.2	81.6	91.2
100-years	75.9	82.5	91.1	102.2
200-years	83.2	90.9	100.7	113.6
1000-years	100.3	110.6	123.7	140.8

Summary Table IX Extreme Omni-directional Off-Peak Hurricane Surface Current Criteria.

Depth	10-years Cs [ft/s]	25-years Cs [ft/s]	50-years Cs [ft/s]	100-years Cs [ft/s]	200-years Cs [ft/s]	1000-years Cs [ft/s]
Surface Speed	1.59	1.93	2.20	2.46	2.72	3.33

Summary Table X Extreme Omni-directional Winter Storm Wave Criteria.

Return Period	Hs [ft]	Tp [s]	Tz [s]	Hmax [ft]	THmax [s]	Hc [ft]
1-year	11.6	8.3	6.2	21.0	7.4	13.0
10-years	18.0	9.7	7.0	32.7	8.7	20.3
100-years	22.8	10.6	7.4	41.3	9.5	25.6

Summary Table XI Extreme Omni-directional Winter Storm Wind Criteria.

Return Period	Ws _{1-hr} [ft/s]	Ws _{10-min} [ft/s]	Ws _{1-min} [ft/s]	Ws _{3-sec} [ft/s]
1-year	50.2	53.9	58.6	64.7
10-years	67.1	72.7	79.8	89.1
100-years	81.1	88.5	98.0	110.3

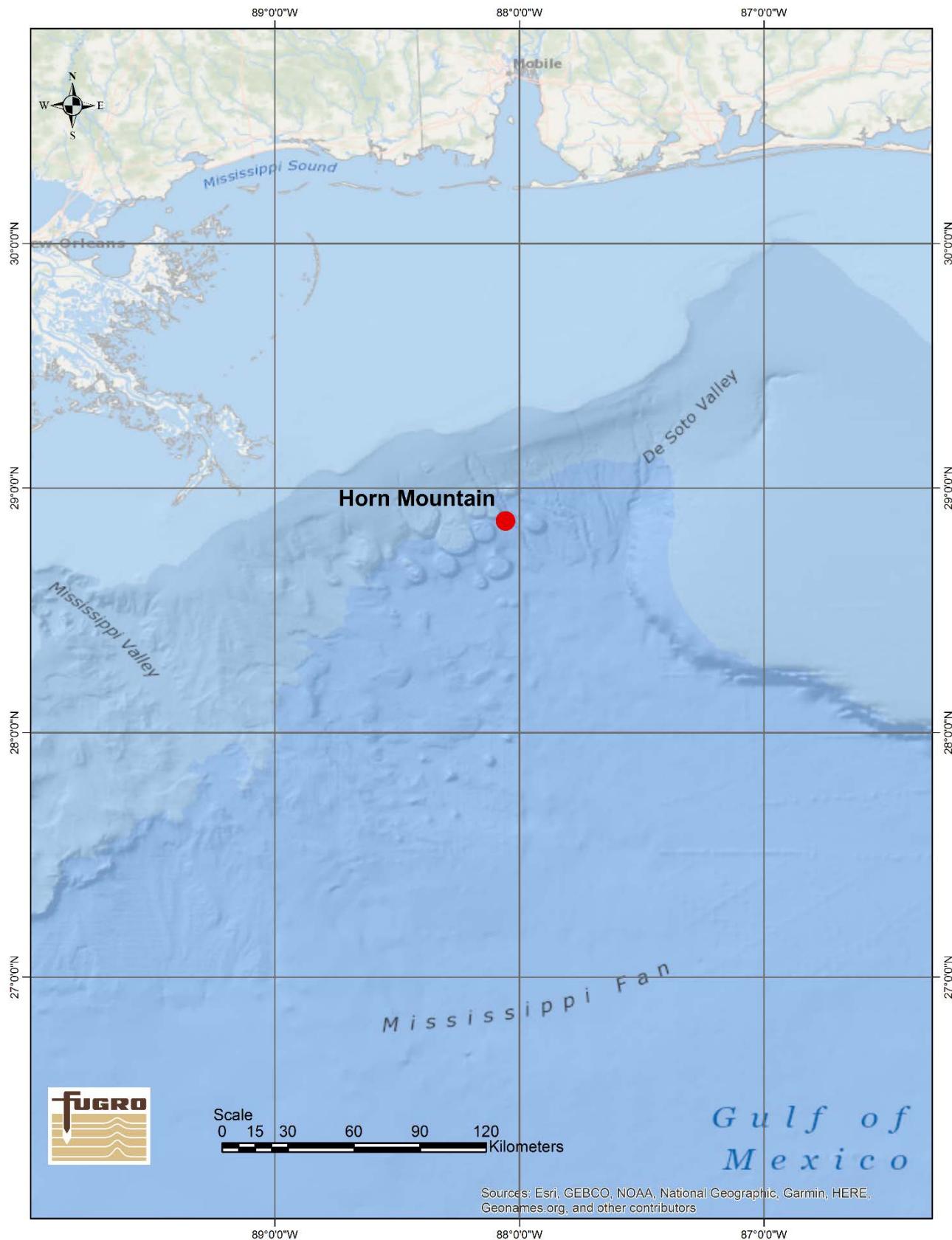
Summary Table XII Omni-directional Loop Current Criteria.

Return Period	1-year Cs [ft/s]	10-years Cs [ft/s]	25-years Cs [ft/s]	50-years Cs [ft/s]	100-years Cs [ft/s]
Loop Current Surface Speed	2.31	4.08	4.78	5.31	5.85

Summary Table XIII Near Bed Current Criteria.

Return Period	1-year Cs [ft/s]	10-year Cs [ft/s]	25-year Cs [ft/s]	50-year Cs [ft/s]	100-year Cs [ft/s]
Near Bed Speed at 5210ft depth	0.76	0.97	1.06	1.12	1.18

FRONTISPIECE



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1. INTRODUCTION

This report has been prepared by Fugro on behalf of Anadarko Petroleum Corporation and presents the updated metocean design criteria for the Horn Mountain Field in Mississippi Canyon, Blocks 126 and 127, offshore Gulf of Mexico. The location of the site of interest is 28.866°N, 88.056°W in a water depth of approximately 1646 m (5400 ft), and is illustrated in the Frontispiece. The information contained in this report includes:

- Hurricane criteria for winds, waves, currents and water levels.
- Sudden Hurricane criteria for winds, waves, and currents.
- Off-Peak Hurricane criteria for winds, waves, and currents.
- Winter Storm criteria for winds and waves.
- Loop Current criteria.
- Near Bed Current criteria.
- Operational criteria for winds, waves, current profile characterization, marine growth, air temperature and sea water properties.

1.1 Parameter Descriptions

Table 1.1 provides summary descriptions of the metocean primary parameters that are part of this study.

Table 1.1 Parameter Descriptions.

Parameter	Abbreviation	Comments	Units
Wind Speed	Ws	Mean wind speed at 10m (32.8 ft) above sea level. By default, 1-hour average unless otherwise stated.	ft/s
Wind Direction	Wd	The direction <u>from</u> which the winds are blowing in degrees true	°T
Significant Wave Height	Hs	Estimated from the wave energy spectrum, $H_s = 4\sqrt{m_0}$. Equivalent to the mean height (from wave crest to trough) of the highest one-third of the waves in a sea-state.	ft
Wave Direction	Mdir	The direction <u>from</u> which the mean waves are coming in degrees true	°T
Mean Zero-crossing Period	Tz	The average period of the zero-crossing waves.	s
Peak Period	Tp	The period associated with the peak in the wave energy spectrum.	s
Peak Period Low	Tp-low	The peak period with 99% percentile.	s
Peak Period High	Tp-high	The peak period with 1% percentile.	s
Maximum Crest Height	Hc	Highest wave crest above the mean water level over the measurement period. Waves are rarely exactly symmetrical about the mean sea level; Hc is not necessarily associated with the largest wave.	ft
Maximum Wave Height	Hmax	Largest individual wave within the measurement period. Defined as the largest vertical distance between a wave crest and its succeeding trough.	ft
Period of Maximum Wave	THmax	Wave period associated with the Maximum Wave.	s
Storm Surge Height	Hsur	Height of storm surges. Defined as the water level elevation due to sea surface pressure.	ft
Current Speed	Cs	Current speed	ft/s
Current Direction	Cd	The direction <u>from</u> which the currents are flowing in degrees true for all currents unless otherwise specified.	°T

Table 1.2 expresses the range of degrees for each directional sector referred to in the report. Eight directional sectors were used.

Table 1.2 Eight Directional Sectors.

Directional Sector	N	NE	E	SE	S	SW	W	NW
RANGE (°T)	337.5 ≤ 22.5	22.5 ≤ 67.5	67.5 ≤ 112.5	112.5 ≤ 157.5	157.5 ≤ 202.5	202.5 ≤ 247.5	247.5 ≤ 292.5	292.5 ≤ 337.5

2. HURRICANE CRITERIA

2.1 Omni-directional and Directional Hurricane Criteria

2.1.1 10-Year Return Period

Table 2.1 10-Year Hurricane – Maximum Wind Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for winds)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
N	NE	E	SE	S	SW	W	NW			
Hs (ft)	27.9	20.3	27.6	27.5	27.9	27.5	23.5	18.8	20.1	
Tp (s)	12.1	10.7	12.0	12.0	12.1	12.0	11.3	10.4	10.6	
Tp-low (s)	11.1	9.7	11.1	11.1	11.1	11.1	10.3	9.3	9.6	
Tp-high (s)	15.8	15.0	15.8	15.8	15.8	15.8	15.4	14.8	15.0	
Hmax (ft)	49.1	35.6	48.5	48.3	49.1	48.3	41.2	32.9	35.2	
THmax (s)	10.9	9.6	10.8	10.8	10.9	10.8	10.2	9.3	9.6	
Hc (ft)	31.1	22.6	30.7	30.6	31.1	30.6	26.1	20.9	22.3	
Spectral Shape	JONSWAP, $\gamma = 2.0$									
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	95.6	67.2	95.6	94.5	95.6	90.6	84.6	69.5	66.3	
Wind Speed (10 min@33 ft)	105.1	72.8	105.1	103.8	105.1	99.4	92.5	75.3	71.7	
Wind Speed (1 min@33 ft)	117.3	79.9	117.3	115.8	117.3	110.6	102.6	82.9	78.8	
Wind Speed (3 sec@33 ft)	133.2	89.3	133.2	131.4	133.2	125.2	115.8	92.6	87.9	
Wind Dir – Wave Dir (deg)	-23.6	-24.6	-23.6	-19.3	-11.9	-2.9	5.0	7.8	0.4	
Current Speed (ft/s)										
Surface	3.7	1.5	3.0	3.5	2.0	3.7	3.5	3.6	2.1	
Mid-Depth Speed	2.4	0.7	1.9	2.3	1.1	2.4	2.3	2.3	1.2	
0-Speed Depth (ft)	190.0	94.2	158.4	180.0	116.0	190.0	180.9	183.6	121.1	
Curr Dir – Wave Dir (deg)	52.7	63.0	52.7	51.5	54.6	58.8	62.5	66.0	71.1	
Water Level (ft)										
Surge	1.0									
Tidal Amplitude	1.4									
Total Water Level	32.2									

Note: All directions are °FROM

Table 2.2 10-Year Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5° - 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5° - 157.5°	157.5° - 202.5°	202.5° - 247.5°	247.5° - 292.5°	292.5° - 337.5°
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	34.2	16.9	24.0	32.8	34.2	33.4	22.6	16.2	14.7
Tp (s)	13.1	9.9	11.4	12.9	13.1	13.0	11.1	9.8	9.4
Tp-low (s)	12.2	8.9	10.4	12.0	12.2	12.1	10.1	8.7	8.4
Tp-high (s)	16.4	14.6	15.5	16.3	16.4	16.3	15.3	14.5	14.2
Hmax (ft)	60.1	29.6	42.1	57.7	60.1	58.7	39.6	28.4	25.8
THmax (s)	11.8	8.9	10.3	11.6	11.8	11.7	10.0	8.8	8.5
Hc (ft)	38.1	18.8	26.7	36.6	38.1	37.2	25.1	18.0	16.3
Spectral Shape	JONSWAP, $\gamma = 2.1$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	93.4	55.2	76.9	93.4	87.1	92.6	69.0	59.4	64.0
Wind Speed (10 min@33 ft)	102.5	59.3	83.7	102.5	95.3	101.6	74.8	64.1	69.2
Wind Speed (1 min@33 ft)	114.3	64.7	92.4	114.3	105.9	113.2	82.2	70.0	75.8
Wind Speed (3 sec@33 ft)	129.6	71.7	103.8	129.6	119.6	128.3	91.9	77.8	84.5
Wind Dir – Wave Dir (deg)	-19.7	-6.3	-24.0	-26.3	-19.7	-9.5	-0.5	3.3	-1.2
Current Speed (ft/s)									
Surface	3.9	1.4	1.3	3.2	3.5	2.8	3.9	3.2	2.2
Mid-Depth Speed	2.6	0.7	0.6	2.1	2.3	1.8	2.6	2.0	1.3
0-Speed Depth (ft)	199.1	88.9	86.1	168.6	180.7	152.3	199.1	166.8	123.2
Curr Dir – Wave Dir (deg)	43.9	52.3	56.3	49.6	43.9	46.6	54.4	56.5	47.5
Water Level (ft)									
Surge	1.0								
Tidal Amplitude	1.4								
Total Water Level	39.1								

Note: All directions are °FROM

Table 2.3 10-Year Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5° - 157.5	157.5° - 202.5	202.5° - 247.5	247.5° - 292.5	292.5° - 337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	24.4	8.6	6.5	18.3	23.9	24.4	18.6	17.9	12.5
Tp (s)	11.5	7.7	6.9	10.3	11.4	11.5	10.3	10.2	8.8
Tp-low (s)	10.5	6.6	5.8	9.2	10.4	10.5	9.3	9.2	7.8
Tp-high (s)	15.5	13.0	12.5	14.8	15.4	15.5	14.8	14.7	13.9
Hmax (ft)	42.9	15.1	11.5	32.2	42.0	42.9	32.6	31.5	21.9
THmax (s)	10.3	6.9	6.2	9.2	10.2	10.3	9.3	9.2	8.0
Hc (ft)	27.2	9.6	7.3	20.4	26.6	27.2	20.7	20.0	13.9
Spectral Shape	JONSWAP, $\gamma = 1.9$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	82.4	34.7	29.4	65.1	75.2	82.4	66.4	67.6	50.8
Wind Speed (10 min@33 ft)	89.9	37.0	31.2	70.5	81.8	89.9	71.8	73.3	54.6
Wind Speed (1 min@33 ft)	99.6	39.8	33.5	77.3	90.2	99.6	78.9	80.5	59.4
Wind Speed (3 sec@33 ft)	112.3	43.6	36.5	86.2	101.2	112.3	88.0	89.9	65.6
Wind Dir – Wave Dir (deg)	-19.1	29.2	-5.5	-19.0	-19.1	-12.3	-3.0	5.7	12.6
Current Speed (ft/s)									
Surface	4.3	3.5	3.4	3.5	4.3	4.3	4.3	4.3	4.0
Mid-Depth Speed	2.9	2.3	2.2	2.2	2.9	2.9	2.9	2.9	2.6
0-Speed Depth (ft)	215.8	181.5	176.0	179.1	215.8	215.8	215.8	214.0	201.7
Curr Dir – Wave Dir (deg)	38.0	63.1	47.3	37.9	38.0	47.9	64.5	82.3	92.4
Water Level (ft)									
Surge	1.0								
Tidal Amplitude	1.4								
Total Water Level	28.3								

Note: All directions are °FROM

2.1.2 25-Year Return Period

Table 2.4 25-Year Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
N	NE	E	SE	S	SW	W	NW		
Hs (ft)	35.2	25.8	34.8	34.6	35.2	34.7	29.7	23.8	25.7
Tp (s)	13.2	11.7	13.2	13.1	13.2	13.2	12.4	11.4	11.7
Tp-low (s)	12.3	10.7	12.3	12.3	12.3	12.3	11.4	10.4	10.7
Tp-high (s)	16.5	15.6	16.4	16.4	16.5	16.4	16.0	15.4	15.6
Hmax (ft)	61.9	45.3	61.1	60.8	61.9	61.0	52.1	41.8	45.1
THmax (s)	11.9	10.6	11.8	11.8	11.9	11.8	11.1	10.2	10.5
Hc (ft)	39.2	28.7	38.7	38.6	39.2	38.7	33.0	26.5	28.6
Spectral Shape	JONSWAP, $\gamma = 2.2$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	118.7	83.4	118.7	117.3	118.7	112.5	105.0	86.2	82.2
Wind Speed (10 min@33 ft)	132.0	91.1	132.0	130.4	132.0	124.7	116.0	94.3	89.8
Wind Speed (1 min@33 ft)	149.2	101.0	149.2	147.2	149.2	140.5	130.2	104.7	99.5
Wind Speed (3 sec@33 ft)	171.5	113.9	171.5	169.2	171.5	161.0	148.6	118.3	112.1
Wind Dir – Wave Dir (deg)	-23.6	-24.6	-23.6	-19.3	-11.9	-2.9	5.0	7.8	0.4
Current Speed (ft/s)									
Surface	4.7	1.8	3.8	4.5	2.4	4.7	4.3	4.5	2.7
Mid-Depth Speed	3.2	1.0	2.5	3.0	1.5	3.2	2.9	3.1	1.6
0-Speed Depth (ft)	231.2	106.7	192.8	222.4	134.7	231.2	216.7	226.0	143.8
Curr Dir – Wave Dir (deg)	52.7	63.0	52.7	51.5	54.6	58.8	62.5	66.0	71.1
Water Level (ft)									
Surge	1.3								
Tidal Amplitude	1.4								
Total Water Level	40.5								

Note: All directions are °FROM

Table 2.5 25-Year Hurricane – Maximum Wave Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for waves)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	41.2	20.3	28.9	39.6	41.2	40.2	27.2	19.5	17.7	
Tp (s)	14.1	10.7	12.3	13.8	14.1	13.9	12.0	10.5	10.1	
Tp-low (s)	13.2	9.7	11.3	13.0	13.2	13.1	11.0	9.5	9.1	
Tp-high (s)	16.9	15.0	15.9	16.8	16.9	16.8	15.8	14.9	14.7	
Hmax (ft)	72.4	35.7	50.8	69.5	72.4	70.7	47.7	34.2	31.0	
THmax (s)	12.7	9.6	11.0	12.5	12.7	12.5	10.8	9.5	9.1	
Hc (ft)	45.9	22.6	32.2	44.1	45.9	44.8	30.2	21.7	19.7	
Spectral Shape						JONSWAP, $\gamma = 2.3$				
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	110.3	63.2	90.1	110.3	102.2	109.0	80.2	68.9	75.1	
Wind Speed (10 min@33 ft)	122.2	68.3	98.8	122.2	112.7	120.7	87.4	74.7	81.7	
Wind Speed (1 min@33 ft)	137.5	74.8	109.9	137.5	126.2	135.6	96.8	82.1	90.2	
Wind Speed (3 sec@33 ft)	157.4	83.4	124.4	157.4	143.8	155.1	108.9	91.7	101.1	
Wind Dir – Wave Dir (deg)	-19.7	-6.3	-24.0	-26.3	-19.7	-9.5	-0.5	3.3	-1.2	
Current Speed (ft/s)										
Surface	4.7	1.5	1.5	3.9	4.3	3.3	4.7	3.8	2.6	
Mid-Depth Speed	3.2	0.8	0.7	2.6	2.9	2.2	3.2	2.5	1.6	
0-Speed Depth (ft)	231.0	95.3	93.3	200.1	213.4	173.9	231.0	194.2	140.1	
Curr Dir – Wave Dir (deg)	43.9	52.3	56.3	49.6	43.9	46.6	54.4	56.5	47.5	
Water Level (ft)										
Surge							1.3			
Tidal Amplitude							1.4			
Total Water Level							47.2			

Note: All directions are °FROM

Table 2.6 25-Year Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	30.9	10.4	7.5	23.1	30.2	30.9	23.2	22.5	15.4	
Tp (s)	12.6	8.2	7.2	11.2	12.5	12.6	11.3	11.1	9.6	
Tp-low (s)	11.6	7.2	6.2	10.2	11.5	11.6	10.3	10.1	8.6	
Tp-high (s)	16.1	13.5	12.7	15.4	16.1	16.1	15.4	15.3	14.4	
Hmax (ft)	54.2	18.3	13.1	40.6	53.0	54.2	40.8	39.5	27.1	
THmax (s)	11.3	7.4	6.5	10.1	11.2	11.3	10.1	10.0	8.6	
Hc (ft)	34.4	11.6	8.3	25.7	33.6	34.4	25.8	25.0	17.2	
Spectral Shape							JONSWAP, $\gamma = 2.1$			
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	101.2	40.1	31.8	79.3	91.7	101.2	80.6	82.7	61.1	
Wind Speed (10 min@33 ft)	111.6	42.8	33.8	86.4	100.6	111.6	87.9	90.3	65.9	
Wind Speed (1 min@33 ft)	125.0	46.3	36.3	95.6	112.0	125.0	97.3	100.0	72.1	
Wind Speed (3 sec@33 ft)	142.3	50.8	39.6	107.5	126.9	142.3	109.5	112.7	80.2	
Wind Dir – Wave Dir (deg)	-19.1	29.2	-5.5	-19.0	-19.1	-12.3	-3.0	5.7	12.6	
Current Speed (ft/s)										
Surface	5.5	4.5	4.3	4.4	5.5	5.5	5.5	5.5	5.1	
Mid-Depth Speed	3.8	3.0	2.9	3.0	3.8	3.8	3.8	3.8	3.5	
0-Speed Depth (ft)	267.9	224.1	217.0	221.0	267.9	267.9	267.9	265.5	249.9	
Curr Dir – Wave Dir (deg)	38.0	63.1	47.3	37.9	38.0	47.9	64.5	82.3	92.4	
Water Level (ft)										
Surge							1.3			
Tidal Amplitude							1.4			
Total Water Level							35.7			

Note: All directions are °FROM

2.1.3 50-Year Return Period

Table 2.7 50-Year Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
N	NE	E	SE	S	SW	W	NW		
Hs (ft)	40.5	29.8	40.0	39.8	40.5	40.0	34.2	27.5	29.7
Tp (s)	14.0	12.4	13.9	13.9	14.0	13.9	13.1	12.0	12.4
Tp-low (s)	13.1	11.5	13.1	13.0	13.1	13.1	12.2	11.1	11.5
Tp-high (s)	16.9	16.0	16.8	16.8	16.9	16.8	16.4	15.8	16.0
Hmax (ft)	71.1	52.3	70.3	70.0	71.1	70.3	60.0	48.3	52.3
THmax (s)	12.6	11.2	12.5	12.5	12.6	12.5	11.8	10.8	11.2
Hc (ft)	45.1	33.2	44.5	44.3	45.1	44.5	38.1	30.6	33.1
Spectral Shape	JONSWAP, $\gamma = 2.3$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	135.4	95.2	135.4	133.8	135.4	128.3	119.8	98.4	93.8
Wind Speed (10 min@33 ft)	151.9	104.6	151.9	150.1	151.9	143.5	133.4	108.3	103.1
Wind Speed (1 min@33 ft)	173.2	116.7	173.2	170.9	173.2	163.0	150.9	121.1	114.9
Wind Speed (3 sec@33 ft)	200.9	132.5	200.9	198.1	200.9	188.4	173.6	137.7	130.4
Wind Dir – Wave Dir (deg)	-23.6	-24.6	-23.6	-19.3	-11.9	-2.9	5.0	7.8	0.4
Current Speed (ft/s)									
Surface	5.4	2.0	4.4	5.2	2.8	5.4	4.9	5.3	3.0
Mid-Depth Speed	3.7	1.1	2.9	3.6	1.7	3.7	3.4	3.6	1.9
0-Speed Depth (ft)	261.1	115.7	217.7	253.1	148.3	261.1	242.7	256.7	160.3
Curr Dir – Wave Dir (deg)	52.7	63.0	52.7	51.5	54.6	58.8	62.5	66.0	71.1
Water Level (ft)									
Surge	1.5								
Tidal Amplitude	1.4								
Total Water Level	46.6								

Note: All directions are °FROM

Table 2.8 50-Year Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	45.9	22.6	32.2	44.1	45.9	44.8	30.3	21.7	19.7								
Tp (s)	14.7	11.1	12.8	14.4	14.7	14.5	12.5	11.0	10.6								
Tp-low (s)	13.9	10.1	11.9	13.6	13.9	13.7	11.5	10.0	9.5								
Tp-high (s)	17.2	15.3	16.2	17.1	17.2	17.1	16.1	15.2	15.0								
Hmax (ft)	80.6	39.8	56.6	77.5	80.6	78.8	53.2	38.1	34.6								
THmax (s)	13.2	10.0	11.5	13.0	13.2	13.1	11.2	9.9	9.5								
Hc (ft)	51.1	25.2	35.9	49.1	51.1	49.9	33.7	24.2	21.9								
Spectral Shape		JONSWAP, $\gamma = 2.4$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	121.8	68.6	99.1	121.8	112.3	120.0	87.7	75.3	82.7								
Wind Speed (10 min@33 ft)	135.7	74.4	109.1	135.7	124.5	133.6	96.0	81.9	90.3								
Wind Speed (1 min@33 ft)	153.6	81.8	122.0	153.6	140.3	151.1	106.7	90.3	100.0								
Wind Speed (3 sec@33 ft)	176.9	91.4	138.8	176.9	160.7	173.9	120.6	101.4	112.7								
Wind Dir – Wave Dir (deg)	-19.7	-6.3	-24.0	-26.3	-19.7	-9.5	-0.5	3.3	-1.2								
Current Speed (ft/s)																	
Surface	5.2	1.6	1.6	4.4	4.8	3.7	5.2	4.2	2.8								
Mid-Depth Speed	3.5	0.8	0.8	3.0	3.2	2.4	3.5	2.8	1.8								
0-Speed Depth (ft)	252.6	99.6	98.1	221.3	235.4	188.5	252.6	212.6	151.5								
Curr Dir – Wave Dir (deg)	43.9	52.3	56.3	49.6	43.9	46.6	54.4	56.5	47.5								
Water Level (ft)																	
Surge		1.5															
Tidal Amplitude		1.4															
Total Water Level		52.6															

Note: All directions are °FROM

Table 2.9 50-Year Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	35.0	11.6	8.0	26.2	34.2	35.0	26.2	25.4	17.3	
Tp (s)	13.2	8.6	7.5	11.8	13.1	13.2	11.8	11.7	10.0	
Tp-low (s)	12.3	7.5	6.4	10.8	12.2	12.3	10.8	10.7	9.0	
Tp-high (s)	16.5	13.7	12.9	15.7	16.4	16.5	15.7	15.6	14.6	
Hmax (ft)	61.5	20.4	14.1	46.0	60.1	61.5	46.1	44.6	30.4	
THmax (s)	11.9	7.7	6.7	10.6	11.8	11.9	10.6	10.5	9.0	
Hc (ft)	39.0	12.9	9.0	29.2	38.1	39.0	29.2	28.3	19.3	
Spectral Shape						JONSWAP, $\gamma = 2.2$				
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	113.5	43.6	33.3	88.4	102.4	113.5	89.8	92.4	67.7	
Wind Speed (10 min@33 ft)	125.9	46.7	35.4	96.9	112.9	125.9	98.4	101.4	73.3	
Wind Speed (1 min@33 ft)	141.9	50.6	38.1	107.7	126.5	141.9	109.5	113.0	80.6	
Wind Speed (3 sec@33 ft)	162.7	55.6	41.7	121.8	144.2	162.7	123.9	128.1	90.0	
Wind Dir – Wave Dir (deg)	-19.1	29.2	-5.5	-19.0	-19.1	-12.3	-3.0	5.7	12.6	
Current Speed (ft/s)										
Surface	6.3	5.1	4.9	5.1	6.3	6.3	6.3	6.2	5.8	
Mid-Depth Speed	4.4	3.5	3.4	3.5	4.4	4.4	4.4	4.4	4.1	
0-Speed Depth (ft)	301.6	251.6	243.6	248.2	301.6	301.6	301.6	298.9	281.1	
Curr Dir – Wave Dir (deg)	38.0	63.1	47.3	37.9	38.0	47.9	64.5	82.3	92.4	
Water Level (ft)										
Surge							1.5			
Tidal Amplitude							1.4			
Total Water Level							40.5			

Note: All directions are °FROM

2.1.4 100-Year Return Period

Table 2.10 100-Year Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)																	
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW		
Hs (ft)	45.6	33.7	45.1	44.9	45.6	45.1	38.6	31.1	33.7										
Tp (s)	14.6	13.0	14.6	14.5	14.6	14.6	13.7	12.6	13.0										
Tp-low (s)	13.8	12.1	13.8	13.7	13.8	13.8	12.9	11.7	12.1										
Tp-high (s)	17.2	16.4	17.2	17.1	17.2	17.2	16.7	16.1	16.4										
Hmax (ft)	80.2	59.2	79.2	78.9	80.2	79.3	67.8	54.6	59.2										
THmax (s)	13.2	11.7	13.1	13.1	13.2	13.1	12.3	11.3	11.7										
Hc (ft)	50.8	37.5	50.2	50.0	50.8	50.2	43.0	34.6	37.5										
Spectral Shape	JONSWAP, $\gamma = 2.4$																		
Wind Speed (ft/s)																			
Wind Speed (1 hr@33 ft)	151.7	106.7	151.7	150.0	151.7	143.8	134.3	110.3	105.2										
Wind Speed (10 min@33 ft)	171.7	117.9	171.7	169.6	171.7	162.1	150.6	122.1	116.2										
Wind Speed (1 min@33 ft)	197.4	132.4	197.4	194.7	197.4	185.6	171.6	137.4	130.4										
Wind Speed (3 sec@33 ft)	230.8	151.3	230.8	227.5	230.8	216.2	199.0	157.3	148.8										
Wind Dir – Wave Dir (deg)	-23.6	-24.6	-23.6	-19.3	-11.9	-2.9	5.0	7.8	0.4										
Current Speed (ft/s)																			
Surface	6.0	2.2	4.9	5.9	3.1	6.0	5.5	5.9	3.4										
Mid-Depth Speed	4.2	1.3	3.4	4.1	1.9	4.2	3.8	4.2	2.2										
0-Speed Depth (ft)	290.3	124.6	242.0	283.1	161.6	290.3	268.1	286.7	176.3										
Curr Dir – Wave Dir (deg)	52.7	63.0	52.7	51.5	54.6	58.8	62.5	66.0	71.1										
Water Level (ft)																			
Surge	1.7																		
Tidal Amplitude	1.4																		
Total Water Level	52.5																		

Note: All directions are °FROM

Table 2.11 100-Year Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	50.3	24.8	35.3	48.3	50.3	49.1	33.2	23.8	21.6								
Tp (s)	15.2	11.5	13.2	15.0	15.2	15.1	12.9	11.4	10.9								
Tp-low (s)	14.5	10.6	12.4	14.2	14.5	14.3	12.0	10.4	9.9								
Tp-high (s)	17.5	15.5	16.5	17.4	17.5	17.4	16.3	15.4	15.2								
Hmax (ft)	88.4	43.6	62.0	84.9	88.4	86.4	58.3	41.8	37.9								
THmax (s)	13.7	10.4	11.9	13.5	13.7	13.6	11.6	10.2	9.8								
Hc (ft)	56.0	27.6	39.3	53.8	56.0	54.7	36.9	26.5	24.0								
Spectral Shape		JONSWAP, $\gamma = 2.5$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	132.5	73.7	107.4	132.5	121.8	130.3	94.8	81.2	89.7								
Wind Speed (10 min@33 ft)	148.4	80.1	118.8	148.4	135.7	145.9	104.1	88.6	98.3								
Wind Speed (1 min@33 ft)	169.0	88.3	133.4	169.0	153.6	165.9	116.2	98.1	109.3								
Wind Speed (3 sec@33 ft)	195.7	98.9	152.5	195.7	176.9	191.9	131.8	110.5	123.7								
Wind Dir – Wave Dir (deg)	-19.7	-6.3	-24.0	-26.3	-19.7	-9.5	-0.5	3.3	-1.2								
Current Speed (ft/s)																	
Surface	5.6	1.7	1.7	4.9	5.2	4.0	5.6	4.6	3.1								
Mid-Depth Speed	3.9	0.9	0.9	3.3	3.6	2.7	3.9	3.1	1.9								
0-Speed Depth (ft)	272.7	103.7	102.5	241.1	256.0	202.1	272.7	229.9	162.1								
Curr Dir – Wave Dir (deg)	43.9	52.3	56.3	49.6	43.9	46.6	54.4	56.5	47.5								
Water Level (ft)																	
Surge		1.7															
Tidal Amplitude		1.4															
Total Water Level		57.7															

Note: All directions are °FROM

Table 2.12 100-Year Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	38.8	12.7	8.6	29.0	37.9	38.8	29.0	28.1	19.0	
Tp (s)	13.7	8.9	7.7	12.3	13.6	13.7	12.3	12.1	10.4	
Tp-low (s)	12.9	7.8	6.6	11.3	12.8	12.9	11.3	11.2	9.4	
Tp-high (s)	16.7	13.9	13.0	15.9	16.7	16.7	15.9	15.9	14.9	
Hmax (ft)	68.2	22.2	15.1	50.9	66.6	68.2	50.9	49.3	33.5	
THmax (s)	12.4	8.0	6.9	11.0	12.3	12.4	11.0	10.9	9.4	
Hc (ft)	43.2	14.1	9.6	32.3	42.2	43.2	32.2	31.3	21.2	
Spectral Shape							JONSWAP, $\gamma = 2.3$			
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	124.6	46.8	34.7	96.8	112.1	124.6	98.2	101.3	73.7	
Wind Speed (10 min@33 ft)	139.0	50.2	37.0	106.5	124.3	139.0	108.1	111.7	80.1	
Wind Speed (1 min@33 ft)	157.6	54.5	39.8	118.9	140.0	157.6	120.8	125.1	88.3	
Wind Speed (3 sec@33 ft)	181.8	60.0	43.6	135.1	160.4	181.8	137.3	142.4	99.0	
Wind Dir – Wave Dir (deg)	-19.1	29.2	-5.5	-19.0	-19.1	-12.3	-3.0	5.7	12.6	
Current Speed (ft/s)										
Surface	7.0	5.7	5.5	5.6	7.0	7.0	7.0	6.9	6.5	
Mid-Depth Speed	5.0	4.0	3.8	3.9	5.0	5.0	5.0	4.9	4.6	
0-Speed Depth (ft)	332.4	276.7	267.8	272.9	332.4	332.4	332.4	329.3	309.5	
Curr Dir – Wave Dir (deg)	38.0	63.1	47.3	37.9	38.0	47.9	64.5	82.3	92.4	
Water Level (ft)										
Surge							1.7			
Tidal Amplitude							1.4			
Total Water Level							44.9			

Note: All directions are °FROM

2.1.5 200-Year Return Period

Table 2.13 200-Year Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)																	
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW		
Hs (ft)	50.7	37.5	50.1	49.8	50.7	50.1	42.9	34.6	37.6										
Tp (s)	15.2	13.6	15.2	15.1	15.2	15.2	14.3	13.1	13.6										
Tp-low (s)	14.5	12.7	14.4	14.4	14.5	14.4	13.5	12.2	12.7										
Tp-high (s)	17.5	16.6	17.5	17.5	17.5	17.5	17.0	16.4	16.7										
Hmax (ft)	89.1	66.0	88.0	87.6	89.1	88.1	75.4	60.8	66.1										
THmax (s)	13.7	12.2	13.7	13.6	13.7	13.7	12.9	11.8	12.2										
Hc (ft)	56.5	41.8	55.8	55.5	56.5	55.8	47.8	38.5	41.9										
Spectral Shape	JONSWAP, $\gamma = 2.6$																		
Wind Speed (ft/s)																			
Wind Speed (1 hr@33 ft)	167.7	117.9	167.7	165.8	167.7	159.0	148.5	121.9	116.3										
Wind Speed (10 min@33 ft)	191.4	131.1	191.4	189.0	191.4	180.6	167.8	135.9	129.2										
Wind Speed (1 min@33 ft)	221.8	148.1	221.8	218.8	221.8	208.4	192.5	153.8	145.8										
Wind Speed (3 sec@33 ft)	261.3	170.3	261.3	257.5	261.3	244.5	224.8	177.1	167.4										
Wind Dir – Wave Dir (deg)	-23.6	-24.6	-23.6	-19.3	-11.9	-2.9	5.0	7.8	0.4										
Current Speed (ft/s)																			
Surface	6.7	2.4	5.5	6.5	3.4	6.7	6.1	6.6	3.8										
Mid-Depth Speed	4.7	1.4	3.8	4.6	2.2	4.7	4.3	4.7	2.5										
0-Speed Depth (ft)	318.9	133.2	265.9	312.6	174.6	318.9	292.9	316.1	192.1										
Curr Dir – Wave Dir (deg)	52.7	63.0	52.7	51.5	54.6	58.8	62.5	66.0	71.1										
Water Level (ft)																			
Surge	1.9																		
Tidal Amplitude	1.4																		
Total Water Level	58.4																		

Note: All directions are °FROM

Table 2.14 200-Year Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	54.4	26.9	38.2	52.3	54.4	53.2	35.9	25.7	23.3								
Tp (s)	15.7	11.9	13.7	15.4	15.7	15.5	13.3	11.7	11.3								
Tp-low (s)	15.0	10.9	12.8	14.7	15.0	14.8	12.5	10.7	10.3								
Tp-high (s)	17.7	15.7	16.7	17.6	17.7	17.6	16.5	15.6	15.4								
Hmax (ft)	95.7	47.2	67.1	91.9	95.7	93.5	63.1	45.2	41.0								
THmax (s)	14.1	10.7	12.3	13.9	14.1	14.0	12.0	10.5	10.2								
Hc (ft)	60.6	29.9	42.5	58.2	60.6	59.3	40.0	28.7	26.0								
Spectral Shape										JONSWAP, $\gamma = 2.7$							
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	142.5	78.5	115.3	142.5	130.7	140.1	101.4	86.9	96.3								
Wind Speed (10 min@33 ft)	160.6	85.5	128.0	160.6	146.3	157.6	111.8	95.1	105.9								
Wind Speed (1 min@33 ft)	183.7	94.5	144.4	183.7	166.4	180.1	125.2	105.6	118.3								
Wind Speed (3 sec@33 ft)	213.9	106.2	165.7	213.9	192.6	209.4	142.6	119.3	134.3								
Wind Dir – Wave Dir (deg)	-19.7	-6.3	-24.0	-26.3	-19.7	-9.5	-0.5	3.3	-1.2								
Current Speed (ft/s)																	
Surface	6.1	1.8	1.8	5.3	5.7	4.3	6.1	5.0	3.3								
Mid-Depth Speed	4.2	1.0	1.0	3.7	4.0	2.9	4.2	3.4	2.1								
0-Speed Depth (ft)	291.7	107.5	106.8	259.9	275.4	215.0	291.7	246.2	172.2								
Curr Dir – Wave Dir (deg)	43.9	52.3	56.3	49.6	43.9	46.6	54.4	56.5	47.5								
Water Level (ft)																	
Surge										1.9							
Tidal Amplitude										1.4							
Total Water Level										62.5							

Note: All directions are °FROM

Table 2.15 200-Year Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	42.3	13.6	9.1	31.6	41.3	42.3	31.5	30.6	20.7								
Tp (s)	14.2	9.2	7.8	12.7	14.1	14.2	12.7	12.5	10.8								
Tp-low (s)	13.4	8.1	6.8	11.8	13.3	13.4	11.7	11.6	9.7								
Tp-high (s)	17.0	14.1	13.2	16.2	16.9	17.0	16.2	16.1	15.1								
Hmax (ft)	74.4	24.0	16.0	55.5	72.6	74.4	55.4	53.7	36.3								
THmax (s)	12.8	8.2	7.0	11.4	12.7	12.8	11.4	11.3	9.7								
Hc (ft)	47.1	15.2	10.1	35.2	46.0	47.1	35.1	34.0	23.0								
Spectral Shape		JONSWAP, $\gamma = 2.3$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	134.9	49.8	36.0	104.5	121.1	134.9	106.0	109.6	79.3								
Wind Speed (10 min@33 ft)	151.4	53.4	38.4	115.5	134.9	151.4	117.1	121.3	86.5								
Wind Speed (1 min@33 ft)	172.5	58.1	41.4	129.5	152.7	172.5	131.4	136.4	95.6								
Wind Speed (3 sec@33 ft)	200.0	64.2	45.3	147.7	175.8	200.0	150.1	156.1	107.5								
Wind Dir – Wave Dir (deg)	-19.1	29.2	-5.5	-19.0	-19.1	-12.3	-3.0	5.7	12.6								
Current Speed (ft/s)																	
Surface	7.6	6.2	6.0	6.2	7.6	7.6	7.6	7.6	7.1								
Mid-Depth Speed	5.5	4.4	4.2	4.3	5.5	5.5	5.5	5.4	5.0								
0-Speed Depth (ft)	360.9	300.0	290.3	295.8	360.9	360.9	360.9	357.6	335.9								
Curr Dir – Wave Dir (deg)	38.0	63.1	47.3	37.9	38.0	47.9	64.5	82.3	92.4								
Water Level (ft)																	
Surge										1.9							
Tidal Amplitude										1.4							
Total Water Level										49.0							

Note: All directions are °FROM

2.1.6 1000-Year Return Period

Table 2.16 1000-Year Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)														
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W
Hs (ft)	62.1	46.2	61.4	61.1	62.1	61.5	52.7	42.5	46.4							
Tp (s)	16.5	14.7	16.4	16.4	16.5	16.4	15.5	14.2	14.7							
Tp-low (s)	15.9	13.9	15.8	15.8	15.9	15.8	14.8	13.4	14.0							
Tp-high (s)	18.1	17.2	18.1	18.1	18.1	18.1	17.6	17.0	17.2							
Hmax (ft)	109.2	81.3	107.9	107.4	109.2	108.1	92.5	74.8	81.6							
THmax (s)	14.8	13.2	14.8	14.7	14.8	14.8	13.9	12.8	13.3							
Hc (ft)	69.2	51.5	68.4	68.0	69.2	68.5	58.6	47.4	51.7							
Spectral Shape	JONSWAP, $\gamma = 2.8$															
Wind Speed (ft/s)																
Wind Speed (1 hr@33 ft)	204.0	143.4	204.0	201.6	204.0	193.4	180.6	148.2	141.4							
Wind Speed (10 min@33 ft)	237.0	161.6	237.0	234.0	237.0	223.5	207.4	167.5	159.2							
Wind Speed (1 min@33 ft)	279.5	185.0	279.5	275.6	279.5	262.2	241.8	192.2	182.0							
Wind Speed (3 sec@33 ft)	334.7	215.4	334.7	329.7	334.7	312.5	286.6	224.3	211.8							
Wind Dir – Wave Dir (deg)	-23.6	-24.6	-23.6	-19.3	-11.9	-2.9	5.0	7.8	0.4							
Current Speed (ft/s)																
Surface	8.2	2.9	6.7	8.1	4.0	8.2	7.4	8.2	4.6							
Mid-Depth Speed	5.9	1.8	4.7	5.8	2.7	5.9	5.3	5.9	3.1							
0-Speed Depth (ft)	383.7	152.8	319.9	379.2	204.0	383.7	349.2	382.7	227.8							
Curr Dir – Wave Dir (deg)	52.7	63.0	52.7	51.5	54.6	58.8	62.5	66.0	71.1							
Water Level (ft)																
Surge	2.4															
Tidal Amplitude	1.4															
Total Water Level	71.6															

Note: All directions are °FROM

Table 2.17 1000-Year Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	63.4	31.3	44.5	60.9	63.4	62.0	41.8	30.0	27.2								
Tp (s)	16.6	12.6	14.5	16.4	16.6	16.5	14.1	12.4	12.0								
Tp-low (s)	16.0	11.7	13.7	15.7	16.0	15.9	13.3	11.5	11.0								
Tp-high (s)	18.2	16.2	17.1	18.0	18.2	18.1	17.0	16.0	15.8								
Hmax (ft)	111.5	55.0	78.2	107.1	111.5	108.9	73.5	52.7	47.8								
THmax (s)	15.0	11.4	13.0	14.7	15.0	14.8	12.7	11.2	10.8								
Hc (ft)	70.6	34.8	49.6	67.9	70.6	69.0	46.6	33.4	30.3								
Spectral Shape		JONSWAP, $\gamma = 2.9$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	164.4	88.8	132.3	164.4	150.1	161.2	115.8	99.1	110.7								
Wind Speed (10 min@33 ft)	187.2	97.3	148.3	187.2	169.7	183.3	128.7	109.1	122.6								
Wind Speed (1 min@33 ft)	216.6	108.2	168.8	216.6	194.9	211.7	145.2	122.0	138.0								
Wind Speed (3 sec@33 ft)	254.8	122.3	195.4	254.8	227.7	248.6	166.7	138.8	158.0								
Wind Dir – Wave Dir (deg)	-19.7	-6.3	-24.0	-26.3	-19.7	-9.5	-0.5	3.3	-1.2								
Current Speed (ft/s)																	
Surface	7.0	2.0	2.0	6.3	6.6	4.9	7.0	5.8	3.8								
Mid-Depth Speed	5.0	1.1	1.1	4.4	4.7	3.4	5.0	4.1	2.5								
0-Speed Depth (ft)	332.8	115.7	115.9	300.4	317.4	242.8	332.8	281.4	194.0								
Curr Dir – Wave Dir (deg)	43.9	52.3	56.3	49.6	43.9	46.6	54.4	56.5	47.5								
Water Level (ft)																	
Surge		2.4															
Tidal Amplitude		1.4															
Total Water Level		73.0															

Note: All directions are °FROM

Table 2.18 1000-Year Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	49.7	15.7	10.1	37.1	48.6	49.7	36.9	35.8	24.0	
Tp (s)	15.1	9.7	8.2	13.5	15.0	15.1	13.5	13.3	11.4	
Tp-low (s)	14.4	8.6	7.1	12.6	14.2	14.4	12.6	12.4	10.4	
Tp-high (s)	17.4	14.4	13.4	16.6	17.4	17.4	16.6	16.5	15.5	
Hmax (ft)	87.4	27.7	17.8	65.2	85.4	87.4	64.8	62.9	42.3	
THmax (s)	13.6	8.7	7.3	12.2	13.5	13.6	12.1	12.0	10.3	
Hc (ft)	55.4	17.5	11.3	41.3	54.1	55.4	41.1	39.9	26.8	
Spectral Shape							JONSWAP, $\gamma = 2.5$			
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	156.7	56.0	38.8	120.9	140.2	156.7	122.4	126.9	91.1	
Wind Speed (10 min@33 ft)	177.8	60.3	41.4	134.6	157.7	177.8	136.4	141.8	100.0	
Wind Speed (1 min@33 ft)	204.9	65.8	44.7	152.3	180.2	204.9	154.5	161.0	111.3	
Wind Speed (3 sec@33 ft)	240.1	73.0	49.0	175.3	209.5	240.1	177.9	185.9	126.0	
Wind Dir – Wave Dir (deg)	-19.1	29.2	-5.5	-19.0	-19.1	-12.3	-3.0	5.7	12.6	
Current Speed (ft/s)										
Surface	9.0	7.4	7.1	7.3	9.0	9.0	9.0	8.9	8.4	
Mid-Depth Speed	6.5	5.3	5.1	5.2	6.5	6.5	6.5	6.5	6.0	
0-Speed Depth (ft)	421.0	349.2	337.7	344.2	421.0	421.0	421.0	417.2	391.6	
Curr Dir – Wave Dir (deg)	38.0	63.1	47.3	37.9	38.0	47.9	64.5	82.3	92.4	
Water Level (ft)										
Surge							2.4			
Tidal Amplitude							1.4			
Total Water Level							57.8			

Note: All directions are °FROM

2.2 Hurricane Duration and History

Table 2.19 Hurricane Significant Wave Height Duration and Event History.

Hours From Peak	Tall and Thin Tropical Cyclones*			Short and Wide Tropical Cyclones*				
	Normalized to Peak Value		100 yr Hs Event (ft)	100 yr Tp Event (s)	Normalized to Peak Value		100 yr Hs Event (ft)	100 yr Tp Event (s)
	Mean	Std Dev.			Mean	Std Dev.		
-24	0.20	0.09	10.2	8.2	0.39	0.23	19.6	10.5
-22	0.22	0.09	11.3	8.5	0.42	0.23	20.9	10.8
-20	0.25	0.10	12.6	8.9	0.45	0.22	22.5	11.1
-18	0.28	0.10	14.0	9.3	0.49	0.20	24.7	11.5
-16	0.31	0.10	15.4	9.6	0.55	0.18	27.4	12.0
-14	0.34	0.10	17.0	10.0	0.59	0.17	29.8	12.4
-12	0.38	0.10	19.3	10.5	0.63	0.15	31.9	12.7
-10	0.45	0.11	22.4	11.1	0.67	0.12	33.7	13.0
-8	0.53	0.13	26.5	11.8	0.70	0.10	35.4	13.3
-6	0.62	0.13	31.3	12.6	0.73	0.08	36.8	13.5
-4	0.74	0.10	37.4	13.5	0.76	0.05	38.0	13.6
-2	0.89	0.06	44.8	14.5	0.79	0.01	39.5	13.8
0	1.00	0.00	50.3	15.2	0.80	0.00	40.4	14.0
2	0.88	0.08	44.2	14.5	0.79	0.02	39.7	13.9
4	0.72	0.14	36.4	13.4	0.75	0.05	37.9	13.6
6	0.59	0.15	29.6	12.4	0.69	0.09	34.9	13.2
8	0.49	0.14	24.4	11.5	0.62	0.12	31.4	12.7
10	0.42	0.12	21.0	10.8	0.56	0.15	28.1	12.1
12	0.37	0.11	18.8	10.4	0.51	0.17	25.5	11.7
14	0.34	0.11	17.3	10.0	0.45	0.19	22.8	11.2
16	0.32	0.11	16.1	9.8	0.40	0.20	20.1	10.7
18	0.30	0.11	14.9	9.5	0.36	0.21	18.2	10.2
20	0.27	0.11	13.8	9.2	0.33	0.21	16.8	9.9
22	0.26	0.10	12.9	9.0	0.31	0.21	15.5	9.6
24	0.24	0.10	12.1	8.7	0.29	0.21	14.4	9.4

*Note: Short and wide hurricanes were observed to be weaker than tall and thin hurricanes. Short and wide storm statistics, 100 year Hs, and 100 year Tp values displayed above have been derived by applying a factor (0.80) of the ratio of maximum short and wide storm Hs to maximum tall and thin storm Hs.

Table 2.20 Hurricane Wind Speed Duration and Event History.

Hours From Peak	Tall and Thin Hurricanes*			Short and Wide Hurricanes*		
	Normalized to Peak Value		100 yr Ws Event (ft/s)	Normalized to Peak Value		100 yr Ws Event (ft/s)
	Mean	Std Dev.		Mean	Std Dev.	
-24	0.32	0.10	49.0	0.39	0.18	59.9
-22	0.33	0.10	50.5	0.41	0.17	62.2
-20	0.36	0.09	54.0	0.42	0.17	64.1
-18	0.38	0.10	57.1	0.44	0.16	67.5
-16	0.40	0.10	60.3	0.47	0.17	71.2
-14	0.42	0.10	63.8	0.49	0.16	75.0
-12	0.45	0.11	68.6	0.54	0.11	82.1
-10	0.50	0.12	75.4	0.58	0.09	87.5
-8	0.56	0.12	84.9	0.60	0.08	91.4
-6	0.64	0.12	97.5	0.64	0.06	96.8
-4	0.75	0.14	114.5	0.69	0.03	104.2
-2	0.87	0.10	132.3	0.72	0.02	109.8
0	1.00	0.00	151.7	0.75	0.00	113.4
2	0.75	0.24	113.5	0.72	0.03	109.8
4	0.70	0.15	105.5	0.69	0.04	104.6
6	0.63	0.15	95.9	0.63	0.08	95.6
8	0.55	0.14	83.7	0.58	0.11	87.2
10	0.50	0.13	75.2	0.53	0.14	80.2
12	0.45	0.10	67.9	0.49	0.16	74.8
14	0.41	0.09	62.8	0.47	0.15	70.6
16	0.39	0.10	58.5	0.43	0.15	65.6
18	0.36	0.10	54.6	0.40	0.16	60.4
20	0.34	0.10	51.5	0.38	0.14	57.4
22	0.33	0.09	49.8	0.36	0.13	55.0
24	0.31	0.09	47.1	0.34	0.14	52.2

*Note: Short and wide hurricanes were observed to be weaker than tall and thin hurricanes. Short and wide storm statistics, 100 year Ws values displayed above have been derived by applying a factor (0.75) of the ratio of maximum short and wide storm Ws to maximum tall and thin storm Ws.

2.3 Hurricane Events with Hs Exceeding 20 ft

Table 2.21 Hurricane Events with Hs Exceeding 20 ft

Event Date	Storm Name	Max Hs (ft)
9/15/2004	IVAN, H-5	53.3
8/29/2005	KATRINA, H-5	42.8
9/12/1979	FREDERIC, H-4	41.7
10/4/1995	OPAL, H-4	40.0
9/27/1998	GEORGES, H-4	36.6
9/1/2008	GUSTAV, H-4	36.0
9/10/1965	BETSY, H-4	35.9
9/15/1960	ETHEL, H-5	35.4
8/28/2012	ISAAC, H-1	34.6
8/17/1969	CAMILLE, H-5	32.7
8/30/1950	BAKER, H-2	29.6
9/26/2002	ISIDORE, H-3	28.3
9/23/1975	ELOISE, H-3	28.3
9/24/1956	FLOSSY, H-1	27.2
9/2/1998	EARL, H-2	26.9
11/9/2009	IDA, H-2	26.8
9/11/2008	IKE, H-4	25.1
11/21/1985	KATE, H-3	24.2
9/26/1953	FLORENCE, H-3	22.0
9/23/2005	RITA, H-5	22.0

3. SUDDEN HURRICANE CRITERIA

3.1 Omni-directional and Directional Sudden Hurricane Criteria

3.1.1 10-Year Return Period

Table 3.1 10-Year Sudden Hurricane – Maximum Wind Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for winds)									
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5		
Hs (ft)	N	NE	E	SE	S	SW	W	NW				
Tp (s)	9.8	9.7	9.4	9.7	9.8	9.8	9.1	8.7	9.1			
Tp-low (s)	8.9	8.7	8.4	8.7	8.9	8.8	8.0	7.6	8.1			
Tp-high (s)	12.9	12.8	12.6	12.8	12.9	12.9	12.5	12.2	12.5			
Hmax (ft)	29.8	28.4	25.6	28.5	29.8	29.1	23.3	20.3	23.9			
THmax (s)	8.9	8.7	8.4	8.7	8.9	8.8	8.2	7.8	8.2			
Hc (ft)	17.9	17.0	15.4	17.1	17.9	17.5	14.0	12.2	14.3			
Spectral Shape	JONSWAP, $\gamma = 1.7$											
Wind Speed (ft/s)												
Wind Speed (1 hr@33 ft)	61.7	54.8	54.2	61.7	61.7	61.7	55.7	51.6	51.2			
Wind Speed (10 min@33 ft)	66.7	59.0	58.3	66.7	66.7	66.7	60.0	55.5	55.0			
Wind Speed (1 min@33 ft)	73.0	64.3	63.6	73.0	73.0	73.0	65.4	60.4	59.8			
Wind Speed (3 sec@33 ft)	81.2	71.2	70.4	81.2	81.2	81.2	72.5	66.8	66.1			
Wind Dir – Wave Dir (deg)	-10.4	-44.6	-28.9	-13.5	-10.4	-10.5	-4.5	5.3	1.9			
Current Speed (ft/s)												
Surface	1.94	1.43	0.88	1.38	1.70	1.67	1.94	1.41	1.06			
Mid-Depth Speed	0.70	0.57	0.43	0.56	0.64	0.64	0.70	0.57	0.48			
0-Speed Depth (ft)	107.2	84.2	60.0	82.2	96.6	95.3	107.2	83.8	67.8			
Curr Dir – Wave Dir (deg)	53.6	60.1	53.6	48.9	53.6	64.3	66.8	48.4	21.2			

Note: All directions are °FROM

Table 3.2 10-Year Sudden Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	18.3	13.2	13.6	13.0	18.3	18.3	16.4	13.0	7.3
Tp (s)	10.1	9.1	9.2	9.0	10.1	10.1	9.7	9.0	7.5
Tp-low (s)	9.2	8.0	8.1	8.0	9.2	9.2	8.8	8.0	6.2
Tp-high (s)	13.1	12.5	12.5	12.4	13.1	13.1	12.8	12.4	11.4
Hmax (ft)	32.2	23.3	24.0	22.9	32.2	32.2	28.8	22.9	12.8
THmax (s)	9.1	8.2	8.2	8.1	9.1	9.1	8.8	8.1	6.7
Hc (ft)	19.3	14.0	14.4	13.7	19.3	19.3	17.3	13.8	7.7
Spectral Shape	JONSWAP, $\gamma = 1.7$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	60.7	44.6	47.8	46.2	57.5	60.7	54.9	50.5	37.1
Wind Speed (10 min@33 ft)	65.5	47.7	51.2	49.4	62.0	65.5	59.0	54.1	39.5
Wind Speed (1 min@33 ft)	71.7	51.7	55.6	53.6	67.7	71.7	64.4	58.9	42.7
Wind Speed (3 sec@33 ft)	79.7	56.9	61.3	59.1	75.2	79.7	71.3	65.1	46.7
Wind Dir – Wave Dir (deg)	0.0	-12.3	-30.4	-27.8	-15.5	0.0	8.2	-2.5	-26.9
Current Speed (ft/s)									
Surface	2.12	1.11	0.86	0.93	1.28	2.04	2.12	1.81	1.41
Mid-Depth Speed	0.75	0.49	0.43	0.45	0.53	0.73	0.75	0.67	0.57
0-Speed Depth (ft)	115.0	70.4	59.2	62.3	77.8	111.6	115.0	101.5	83.6
Curr Dir – Wave Dir (deg)	52.6	65.5	50.2	50.8	45.9	52.6	72.8	82.2	61.2

Note: All directions are °FROM

Table 3.3 10-Year Sudden Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	13.9	5.8	6.5	7.3	12.8	13.9	9.0	8.3	8.9
Tp (s)	9.2	6.9	7.2	7.5	9.0	9.2	8.0	7.8	8.0
Tp-low (s)	8.2	5.7	5.9	6.3	7.9	8.2	6.8	6.6	6.8
Tp-high (s)	12.6	11.1	11.2	11.4	12.4	12.6	11.8	11.6	11.8
Hmax (ft)	24.5	10.2	11.4	12.9	22.6	24.5	15.8	14.6	15.7
THmax (s)	8.3	6.2	6.5	6.7	8.1	8.3	7.2	7.0	7.2
Hc (ft)	14.7	6.1	6.9	7.7	13.6	14.7	9.5	8.8	9.4
Spectral Shape	JONSWAP, $\gamma = 1.6$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	58.5	30.5	28.9	32.1	52.5	58.5	43.0	50.5	33.7
Wind Speed (10 min@33 ft)	63.1	32.3	30.7	34.1	56.4	63.1	46.0	54.2	35.9
Wind Speed (1 min@33 ft)	69.0	34.8	33.0	36.6	61.4	69.0	49.8	58.9	38.6
Wind Speed (3 sec@33 ft)	76.6	37.9	35.9	40.0	68.0	76.6	54.7	65.1	42.2
Wind Dir – Wave Dir (deg)	-16.0	8.0	-3.3	-12.1	-16.5	-16.0	-10.9	-2.9	5.4
Current Speed (ft/s)									
Surface	2.28	2.25	1.97	1.63	2.22	2.28	2.28	2.24	2.28
Mid-Depth Speed	0.79	0.78	0.71	0.62	0.78	0.79	0.79	0.78	0.79
0-Speed Depth (ft)	122.1	121.1	108.7	93.4	119.8	122.1	122.1	120.6	122.1
Curr Dir – Wave Dir (deg)	58.5	45.9	-10.6	10.8	41.0	58.5	71.0	90.8	104.7

Note: All directions are °FROM

3.1.2 25-Year Return Period

Table 3.4 25-Year Sudden Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)																	
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW		
Hs (ft)	21.8	20.6	18.8	20.9	21.8	21.2	16.8	14.6	17.3										
Tp (s)	10.7	10.5	10.2	10.5	10.7	10.6	9.8	9.4	9.9										
Tp-low (s)	9.9	9.7	9.3	9.7	9.9	9.8	8.9	8.4	9.0										
Tp-high (s)	13.4	13.3	13.1	13.3	13.4	13.3	12.9	12.6	13.0										
Hmax (ft)	38.4	36.4	33.2	36.8	38.4	37.3	29.7	25.7	30.6										
THmax (s)	9.6	9.5	9.2	9.5	9.6	9.5	8.8	8.4	8.9										
Hc (ft)	23.1	21.9	19.9	22.1	23.1	22.4	17.8	15.4	18.4										
Spectral Shape	JONSWAP, $\gamma = 1.8$																		
Wind Speed (ft/s)																			
Wind Speed (1 hr@33 ft)	77.1	68.5	67.7	77.1	77.1	77.1	69.6	64.5	63.9										
Wind Speed (10 min@33 ft)	83.9	74.2	73.4	83.9	83.9	83.9	75.4	69.8	69.1										
Wind Speed (1 min@33 ft)	92.7	81.5	80.6	92.7	92.7	92.7	83.0	76.5	75.8										
Wind Speed (3 sec@33 ft)	104.1	91.1	90.0	104.1	104.1	104.1	92.8	85.3	84.4										
Wind Dir – Wave Dir (deg)	-10.4	-44.6	-28.9	-13.5	-10.4	-10.5	-4.5	5.3	1.9										
Current Speed (ft/s)																			
Surface	2.39	1.68	1.04	1.70	2.14	2.05	2.39	1.75	1.24										
Mid-Depth Speed	0.82	0.64	0.47	0.64	0.75	0.73	0.82	0.65	0.52										
0-Speed Depth (ft)	127.1	95.5	66.9	96.4	116.2	112.0	127.1	98.5	75.8										
Curr Dir – Wave Dir (deg)	53.6	60.1	53.6	48.9	53.6	64.3	66.8	48.4	21.2										

Note: All directions are °FROM

Table 3.5 25-Year Sudden Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	23.4	17.0	17.5	16.7	23.4	23.4	21.0	16.7	9.3								
Tp (s)	11.0	9.8	10.0	9.8	11.0	11.0	10.6	9.8	8.1								
Tp-low (s)	10.2	8.9	9.0	8.9	10.2	10.2	9.8	8.9	6.9								
Tp-high (s)	13.5	12.9	13.0	12.9	13.5	13.5	13.3	12.9	11.9								
Hmax (ft)	41.3	29.9	30.8	29.4	41.3	41.3	37.0	29.4	16.5								
THmax (s)	9.9	8.9	9.0	8.8	9.9	9.9	9.5	8.8	7.3								
Hc (ft)	24.8	17.9	18.5	17.6	24.8	24.8	22.2	17.7	9.9								
Spectral Shape		JONSWAP, $\gamma = 1.9$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	75.2	52.1	56.9	55.8	69.7	75.2	66.4	60.7	45.2								
Wind Speed (10 min@33 ft)	81.8	55.9	61.3	60.0	75.6	81.8	71.9	65.6	48.4								
Wind Speed (1 min@33 ft)	90.3	60.9	66.9	65.5	83.1	90.3	78.9	71.7	52.5								
Wind Speed (3 sec@33 ft)	101.3	67.3	74.2	72.6	92.9	101.3	88.1	79.8	57.8								
Wind Dir – Wave Dir (deg)	0.0	-12.3	-30.4	-27.8	-15.5	0.0	8.2	-2.5	-26.9								
Current Speed (ft/s)																	
Surface	2.58	1.39	0.97	1.12	1.54	2.53	2.58	2.25	1.79								
Mid-Depth Speed	0.87	0.56	0.46	0.49	0.60	0.85	0.87	0.78	0.66								
0-Speed Depth (ft)	135.8	82.6	64.2	70.6	89.3	133.3	135.8	120.9	100.5								
Curr Dir – Wave Dir (deg)	52.6	65.5	50.2	50.8	45.9	52.6	72.8	82.2	61.2								

Note: All directions are °FROM

Table 3.6 25-Year Sudden Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	17.9		6.7	7.8	9.0	16.5	17.9	11.1	10.1	11.1
Tp (s)	10.0		7.3	7.6	8.0	9.8	10.0	8.6	8.3	8.6
Tp-low (s)	9.1		6.0	6.4	6.8	8.8	9.1	7.5	7.2	7.5
Tp-high (s)	13.0		11.3	11.5	11.8	12.9	13.0	12.2	12.0	12.2
Hmax (ft)	31.5		11.9	13.7	15.9	29.0	31.5	19.6	17.8	19.6
THmax (s)	9.0		6.6	6.9	7.2	8.8	9.0	7.7	7.5	7.7
Hc (ft)	18.9		7.1	8.2	9.5	17.4	18.9	11.8	10.7	11.7
Spectral Shape			JONSWAP, $\gamma = 1.7$							
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	72.9		34.8	32.8	37.1	64.7	72.9	51.8	62.8	39.4
Wind Speed (10 min@33 ft)	79.2		37.1	34.9	39.5	70.0	79.2	55.7	67.9	42.1
Wind Speed (1 min@33 ft)	87.3		40.0	37.5	42.6	76.7	87.3	60.6	74.4	45.5
Wind Speed (3 sec@33 ft)	97.8		43.7	41.0	46.7	85.6	97.8	67.0	82.8	49.9
Wind Dir – Wave Dir (deg)	-16.0		8.0	-3.3	-12.1	-16.5	-16.0	-10.9	-2.9	5.4
Current Speed (ft/s)										
Surface	3.02		2.99	2.62	2.16	2.95	3.02	3.02	2.97	3.02
Mid-Depth Speed	0.98		0.97	0.88	0.76	0.96	0.98	0.98	0.97	0.98
0-Speed Depth (ft)	155.0		153.8	137.3	117.0	152.1	155.0	155.0	153.0	155.0
Curr Dir – Wave Dir (deg)	58.5		45.9	-10.6	10.8	41.0	58.5	71.0	90.8	104.7

Note: All directions are °FROM

3.1.3 50-Year Return Period

Table 3.7 50-Year Sudden Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)																	
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW		
Hs (ft)	25.5	24.1	22.1	24.4	25.5	24.7	19.6	16.9	20.2										
Tp (s)	11.3	11.1	10.7	11.1	11.3	11.1	10.3	9.8	10.4										
Tp-low (s)	10.6	10.3	10.0	10.4	10.6	10.4	9.5	8.9	9.6										
Tp-high (s)	13.7	13.6	13.4	13.6	13.7	13.6	13.2	12.9	13.2										
Hmax (ft)	44.9	42.5	38.9	43.1	44.9	43.5	34.5	29.9	35.7										
THmax (s)	10.1	9.9	9.7	10.0	10.1	10.0	9.3	8.9	9.4										
Hc (ft)	26.9	25.5	23.3	25.9	26.9	26.1	20.7	17.9	21.4										
Spectral Shape	JONSWAP, $\gamma = 1.9$																		
Wind Speed (ft/s)																			
Wind Speed (1 hr@33 ft)	88.7	78.8	78.0	88.7	88.7	88.7	80.1	74.3	73.6										
Wind Speed (10 min@33 ft)	97.2	85.9	84.9	97.2	97.2	97.2	87.3	80.7	80.0										
Wind Speed (1 min@33 ft)	108.1	94.9	93.8	108.1	108.1	108.1	96.6	89.0	88.1										
Wind Speed (3 sec@33 ft)	122.2	106.7	105.5	122.2	122.2	122.2	108.7	99.8	98.8										
Wind Dir – Wave Dir (deg)	-10.4	-44.6	-28.9	-13.5	-10.4	-10.5	-4.5	5.3	1.9										
Current Speed (ft/s)																			
Surface	2.73	1.87	1.15	1.94	2.48	2.33	2.73	2.00	1.37										
Mid-Depth Speed	0.90	0.68	0.50	0.70	0.84	0.80	0.90	0.72	0.56										
0-Speed Depth (ft)	142.2	104.0	72.1	107.1	131.0	124.7	142.2	109.6	81.9										
Curr Dir – Wave Dir (deg)	53.6	60.1	53.6	48.9	53.6	64.3	66.8	48.4	21.2										

Note: All directions are °FROM

Table 3.8 50-Year Sudden Hurricane – Maximum Wave Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for waves)							
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	27.2	19.7	20.3	19.4	27.2	27.2	24.4	19.4	10.9	
Tp (s)	11.5	10.3	10.5	10.3	11.5	11.5	11.1	10.3	8.5	
Tp-low (s)	10.9	9.5	9.6	9.4	10.9	10.9	10.4	9.4	7.4	
Tp-high (s)	13.8	13.2	13.3	13.2	13.8	13.8	13.6	13.2	12.1	
Hmax (ft)	48.0	34.7	35.8	34.1	48.0	48.0	43.0	34.2	19.1	
THmax (s)	10.4	9.3	9.4	9.3	10.4	10.4	10.0	9.3	7.7	
Hc (ft)	28.8	20.8	21.5	20.5	28.8	28.8	25.8	20.5	11.5	
Spectral Shape							JONSWAP, $\gamma = 2.0$			
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	85.9	57.5	63.6	62.8	78.5	85.9	74.8	68.3	51.1	
Wind Speed (10 min@33 ft)	93.9	61.9	68.7	67.8	85.6	93.9	81.4	74.0	54.9	
Wind Speed (1 min@33 ft)	104.2	67.7	75.3	74.3	94.6	104.2	89.7	81.3	59.7	
Wind Speed (3 sec@33 ft)	117.7	75.1	83.9	82.7	106.3	117.7	100.7	90.8	66.0	
Wind Dir – Wave Dir (deg)	0.0	-12.3	-30.4	-27.8	-15.5	0.0	8.2	-2.5	-26.9	
Current Speed (ft/s)										
Surface	2.92	1.59	1.06	1.25	1.73	2.88	2.92	2.57	2.07	
Mid-Depth Speed	0.95	0.61	0.48	0.53	0.65	0.94	0.95	0.86	0.74	
0-Speed Depth (ft)	150.9	91.5	67.8	76.6	97.6	149.2	150.9	135.0	112.8	
Curr Dir – Wave Dir (deg)	52.6	65.5	50.2	50.8	45.9	52.6	72.8	82.2	61.2	

Note: All directions are °FROM

Table 3.9 50-Year Sudden Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	20.9	7.5	8.7	10.3	19.2	20.9	12.7	11.5	12.7								
Tp (s)	10.5	7.5	7.9	8.4	10.3	10.5	9.0	8.7	9.0								
Tp-low (s)	9.7	6.3	6.7	7.2	9.4	9.7	7.9	7.6	7.9								
Tp-high (s)	13.3	11.5	11.7	12.0	13.1	13.3	12.4	12.2	12.4								
Hmax (ft)	36.8	13.1	15.4	18.1	33.9	36.8	22.5	20.3	22.5								
THmax (s)	9.5	6.8	7.1	7.5	9.2	9.5	8.1	7.8	8.1								
Hc (ft)	22.1	7.9	9.3	10.9	20.3	22.1	13.5	12.2	13.5								
Spectral Shape		JONSWAP, $\gamma = 1.8$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	83.8	38.1	35.7	40.9	73.9	83.8	58.5	72.2	43.8								
Wind Speed (10 min@33 ft)	91.5	40.7	38.0	43.7	80.3	91.5	63.1	78.4	46.8								
Wind Speed (1 min@33 ft)	101.5	43.9	41.0	47.2	88.6	101.5	68.9	86.3	50.7								
Wind Speed (3 sec@33 ft)	114.4	48.1	44.9	51.9	99.3	114.4	76.6	96.7	55.8								
Wind Dir – Wave Dir (deg)	-16.0	8.0	-3.3	-12.1	-16.5	-16.0	-10.9	-2.9	5.4								
Current Speed (ft/s)																	
Surface	3.58	3.54	3.10	2.56	3.50	3.58	3.58	3.52	3.58								
Mid-Depth Speed	1.12	1.11	1.00	0.86	1.10	1.12	1.12	1.11	1.12								
0-Speed Depth (ft)	180.0	178.5	158.9	134.9	176.4	180.0	180.0	177.6	180.0								
Curr Dir – Wave Dir (deg)	58.5	45.9	-10.6	10.8	41.0	58.5	71.0	90.8	104.7								

Note: All directions are °FROM

3.1.4 100-Year Return Period

Table 3.10 100-Year Sudden Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
N	NE	E	SE	S	SW	W	NW		
Hs (ft)	29.1	27.5	25.3	28.0	29.1	28.2	22.3	19.3	23.1
Tp (s)	11.8	11.5	11.2	11.6	11.8	11.6	10.8	10.3	10.9
Tp-low (s)	11.2	10.9	10.5	11.0	11.2	11.0	10.0	9.4	10.2
Tp-high (s)	14.0	13.8	13.7	13.9	14.0	13.9	13.4	13.2	13.5
Hmax (ft)	51.4	48.5	44.6	49.4	51.4	49.7	39.3	34.0	40.8
THmax (s)	10.6	10.4	10.1	10.5	10.6	10.5	9.7	9.2	9.8
Hc (ft)	30.8	29.1	26.8	29.7	30.8	29.9	23.6	20.4	24.5
Spectral Shape	JONSWAP, $\gamma = 2.0$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	100.4	89.2	88.2	100.4	100.4	100.4	90.6	84.0	83.3
Wind Speed (10 min@33 ft)	110.7	97.7	96.6	110.7	110.7	110.7	99.3	91.8	90.9
Wind Speed (1 min@33 ft)	123.8	108.6	107.4	123.8	123.8	123.8	110.6	101.8	100.8
Wind Speed (3 sec@33 ft)	141.0	122.9	121.4	141.0	141.0	141.0	125.2	114.8	113.6
Wind Dir – Wave Dir (deg)	-10.4	-44.6	-28.9	-13.5	-10.4	-10.5	-4.5	5.3	1.9
Current Speed (ft/s)									
Surface	3.07	2.06	1.27	2.18	2.81	2.62	3.07	2.25	1.51
Mid-Depth Speed	0.99	0.73	0.53	0.76	0.93	0.88	0.99	0.78	0.59
0-Speed Depth (ft)	157.4	112.5	77.4	117.8	145.9	137.3	157.4	120.8	88.1
Curr Dir – Wave Dir (deg)	53.6	60.1	53.6	48.9	53.6	64.3	66.8	48.4	21.2

Note: All directions are °FROM

Table 3.11 100-Year Sudden Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	30.9	22.4	23.1	22.0	30.9	30.9	27.7	22.0	12.3								
Tp (s)	12.0	10.8	10.9	10.7	12.0	12.0	11.6	10.7	8.9								
Tp-low (s)	11.5	10.0	10.1	9.9	11.5	11.5	11.0	10.0	7.8								
Tp-high (s)	14.1	13.4	13.5	13.4	14.1	14.1	13.9	13.4	12.3								
Hmax (ft)	54.5	39.4	40.7	38.8	54.5	54.5	48.9	38.9	21.7								
THmax (s)	10.8	9.7	9.8	9.7	10.8	10.8	10.4	9.7	8.0								
Hc (ft)	32.7	23.7	24.4	23.3	32.7	32.7	29.3	23.3	13.0								
Spectral Shape		JONSWAP, $\gamma = 2.1$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	96.2	62.8	70.1	69.6	87.2	96.2	83.0	75.6	56.9								
Wind Speed (10 min@33 ft)	105.8	67.9	76.0	75.5	95.4	105.8	90.7	82.2	61.2								
Wind Speed (1 min@33 ft)	118.1	74.4	83.6	83.0	106.0	118.1	100.5	90.7	66.9								
Wind Speed (3 sec@33 ft)	134.1	82.8	93.5	92.9	119.8	134.1	113.3	101.8	74.2								
Wind Dir – Wave Dir (deg)	0.0	-12.3	-30.4	-27.8	-15.5	0.0	8.2	-2.5	-26.9								
Current Speed (ft/s)																	
Surface	3.26	1.78	1.14	1.39	1.91	3.23	3.26	2.88	2.34								
Mid-Depth Speed	1.04	0.66	0.50	0.56	0.70	1.03	1.04	0.94	0.80								
0-Speed Depth (ft)	165.8	100.2	71.4	82.5	105.8	164.6	165.8	148.8	124.9								
Curr Dir – Wave Dir (deg)	52.6	65.5	50.2	50.8	45.9	52.6	72.8	82.2	61.2								

Note: All directions are °FROM

Table 3.12 100-Year Sudden Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	23.9		8.2	9.7	11.6	22.0	23.9	14.4	12.9	14.4
Tp (s)	11.0		7.8	8.2	8.7	10.7	11.0	9.3	9.0	9.3
Tp-low (s)	10.3		6.6	7.1	7.6	9.9	10.3	8.3	7.9	8.3
Tp-high (s)	13.6		11.6	11.9	12.2	13.4	13.6	12.6	12.4	12.6
Hmax (ft)	42.1		14.4	17.1	20.4	38.7	42.1	25.3	22.7	25.4
THmax (s)	9.9		7.0	7.4	7.8	9.7	9.9	8.4	8.1	8.4
Hc (ft)	25.3		8.7	10.3	12.3	23.3	25.3	15.2	13.6	15.2
Spectral Shape			JONSWAP, $\gamma = 1.9$							
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	94.6		41.5	38.7	44.7	83.2	94.6	65.2	81.5	48.1
Wind Speed (10 min@33 ft)	104.0		44.3	41.2	47.9	90.8	104.0	70.6	88.9	51.6
Wind Speed (1 min@33 ft)	116.0		47.9	44.5	51.9	100.7	116.0	77.4	98.5	56.0
Wind Speed (3 sec@33 ft)	131.6		52.6	48.8	57.1	113.5	131.6	86.3	110.9	61.8
Wind Dir – Wave Dir (deg)	-16.0		8.0	-3.3	-12.1	-16.5	-16.0	-10.9	-2.9	5.4
Current Speed (ft/s)										
Surface	4.14		4.10	3.59	2.97	4.04	4.14	4.14	4.07	4.14
Mid-Depth Speed	1.26		1.25	1.12	0.96	1.24	1.26	1.26	1.25	1.26
0-Speed Depth (ft)	204.9		203.2	180.6	152.8	200.8	204.9	204.9	202.2	204.9
Curr Dir – Wave Dir (deg)	58.5		45.9	-10.6	10.8	41.0	58.5	71.0	90.8	104.7

Note: All directions are °FROM

3.1.5 200-Year Return Period

Table 3.13 200-Year Sudden Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)																	
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW		
Hs (ft)	32.8	31.0	28.5	31.6	32.8	31.8	25.1	21.6	26.0										
Tp (s)	12.2	12.0	11.7	12.1	12.2	12.1	11.2	10.7	11.3										
Tp-low (s)	11.8	11.5	11.1	11.6	11.8	11.6	10.5	9.9	10.7										
Tp-high (s)	14.2	14.1	13.9	14.1	14.2	14.1	13.7	13.4	13.7										
Hmax (ft)	57.8	54.6	50.3	55.7	57.8	56.0	44.2	38.1	45.8										
THmax (s)	11.0	10.8	10.5	10.9	11.0	10.9	10.1	9.6	10.2										
Hc (ft)	34.7	32.8	30.2	33.4	34.7	33.6	26.5	22.9	27.5										
Spectral Shape	JONSWAP, $\gamma = 2.1$																		
Wind Speed (ft/s)																			
Wind Speed (1 hr@33 ft)	112.1	99.5	98.5	112.1	112.1	112.1	101.1	93.8	92.9										
Wind Speed (10 min@33 ft)	124.3	109.6	108.4	124.3	124.3	124.3	111.5	103.0	102.0										
Wind Speed (1 min@33 ft)	139.9	122.6	121.2	139.9	139.9	139.9	124.8	114.8	113.7										
Wind Speed (3 sec@33 ft)	160.3	139.5	137.8	160.3	160.3	160.3	142.2	130.2	128.9										
Wind Dir – Wave Dir (deg)	-10.4	-44.6	-28.9	-13.5	-10.4	-10.5	-4.5	5.3	1.9										
Current Speed (ft/s)																			
Surface	3.41	2.25	1.39	2.42	3.14	2.90	3.41	2.50	1.65										
Mid-Depth Speed	1.08	0.78	0.56	0.83	1.01	0.95	1.08	0.85	0.63										
0-Speed Depth (ft)	172.5	121.1	82.6	128.6	160.7	150.0	172.5	132.0	94.2										
Curr Dir – Wave Dir (deg)	53.6	60.1	53.6	48.9	53.6	64.3	66.8	48.4	21.2										

Note: All directions are °FROM

Table 3.14 200-Year Sudden Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)															
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW	W	NW
Hs (ft)	34.6	25.0	25.8	24.6	34.6	34.6	31.0	24.6	13.8								
Tp (s)	12.4	11.2	11.3	11.1	12.4	12.4	12.0	11.1	9.2								
Tp-low (s)	12.0	10.5	10.6	10.4	12.0	12.0	11.5	10.4	8.2								
Tp-high (s)	14.3	13.7	13.7	13.6	14.3	14.3	14.1	13.6	12.5								
Hmax (ft)	60.9	44.1	45.4	43.3	60.9	60.9	54.6	43.4	24.3								
THmax (s)	11.2	10.1	10.2	10.0	11.2	11.2	10.8	10.0	8.3								
Hc (ft)	36.6	26.5	27.3	26.0	36.6	36.6	32.8	26.1	14.6								
Spectral Shape		JONSWAP, $\gamma = 2.2$															
Wind Speed (ft/s)																	
Wind Speed (1 hr@33 ft)	106.4	68.0	76.4	76.3	95.7	106.4	91.1	82.8	62.5								
Wind Speed (10 min@33 ft)	117.6	73.7	83.2	83.1	105.2	117.6	99.9	90.4	67.5								
Wind Speed (1 min@33 ft)	132.0	81.0	91.8	91.7	117.4	132.0	111.2	100.2	74.0								
Wind Speed (3 sec@33 ft)	150.8	90.5	103.1	103.0	133.3	150.8	126.0	112.9	82.3								
Wind Dir – Wave Dir (deg)	0.0	-12.3	-30.4	-27.8	-15.5	0.0	8.2	-2.5	-26.9								
Current Speed (ft/s)																	
Surface	3.58	1.97	1.21	1.51	2.09	3.57	3.58	3.18	2.60								
Mid-Depth Speed	1.12	0.71	0.52	0.59	0.74	1.12	1.12	1.02	0.87								
0-Speed Depth (ft)	180.3	108.7	74.9	88.2	113.8	179.8	180.3	162.3	136.7								
Curr Dir – Wave Dir (deg)	52.6	65.5	50.2	50.8	45.9	52.6	72.8	82.2	61.2								

Note: All directions are °FROM

Table 3.15 200-Year Sudden Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	26.9		8.9	10.7	12.9	24.7	26.9	16.0	14.3	16.0
Tp (s)	11.5		8.0	8.5	9.0	11.1	11.5	9.7	9.3	9.7
Tp-low (s)	10.8		6.8	7.3	7.9	10.4	10.8	8.7	8.3	8.7
Tp-high (s)	13.8		11.8	12.1	12.4	13.6	13.8	12.8	12.6	12.8
Hmax (ft)	47.4		15.7	18.9	22.7	43.6	47.4	28.2	25.1	28.3
THmax (s)	10.3		7.2	7.6	8.1	10.0	10.3	8.7	8.4	8.7
Hc (ft)	28.5		9.4	11.3	13.6	26.2	28.5	16.9	15.1	17.0
Spectral Shape			JONSWAP, $\gamma = 2.0$							
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	105.5		44.8	41.6	48.5	92.4	105.5	71.9	90.8	52.5
Wind Speed (10 min@33 ft)	116.6		47.9	44.4	52.0	101.4	116.6	78.1	99.6	56.4
Wind Speed (1 min@33 ft)	130.8		51.9	48.0	56.5	113.0	130.8	86.0	110.9	61.4
Wind Speed (3 sec@33 ft)	149.4		57.2	52.8	62.4	128.0	149.4	96.3	125.5	67.9
Wind Dir – Wave Dir (deg)	-16.0		8.0	-3.3	-12.1	-16.5	-16.0	-10.9	-2.9	5.4
Current Speed (ft/s)										
Surface	4.70		4.65	4.08	3.37	4.59	4.70	4.70	4.63	4.70
Mid-Depth Speed	1.41		1.40	1.25	1.07	1.38	1.41	1.41	1.39	1.41
0-Speed Depth (ft)	229.8		227.9	202.2	170.7	225.2	229.8	229.8	226.7	229.8
Curr Dir – Wave Dir (deg)	58.5		45.9	-10.6	10.8	41.0	58.5	71.0	90.8	104.7

Note: All directions are °FROM

3.1.6 1000-Year Return Period

Table 3.16 1000-Year Sudden Hurricane – Maximum Wind Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for winds)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	41.4	39.0	36.1	39.9	41.4	40.0	31.4	27.1	32.7	
Tp (s)	13.2	12.9	12.6	13.0	13.2	13.0	12.1	11.5	12.2	
Tp-low (s)	13.0	12.7	12.2	12.8	13.0	12.8	11.6	10.9	11.8	
Tp-high (s)	14.7	14.6	14.4	14.6	14.7	14.6	14.1	13.8	14.2	
Hmax (ft)	72.9	68.7	63.6	70.3	72.9	70.5	55.4	47.8	57.7	
THmax (s)	11.9	11.6	11.4	11.7	11.9	11.7	10.9	10.3	11.0	
Hc (ft)	43.8	41.3	38.2	42.2	43.8	42.3	33.3	28.7	34.6	
Spectral Shape	JONSWAP, $\gamma = 2.3$									
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	139.2	123.6	122.3	139.2	139.2	139.2	125.6	116.5	115.4	
Wind Speed (10 min@33 ft)	156.5	137.9	136.3	156.5	156.5	156.5	140.3	129.4	128.2	
Wind Speed (1 min@33 ft)	178.8	156.2	154.3	178.8	178.8	178.8	159.1	146.1	144.6	
Wind Speed (3 sec@33 ft)	207.8	180.1	177.8	207.8	207.8	207.8	183.6	167.8	166.0	
Wind Dir – Wave Dir (deg)	-10.4	-44.6	-28.9	-13.5	-10.4	-10.5	-4.5	5.3	1.9	
Current Speed (ft/s)										
Surface	4.20	2.70	1.66	2.98	3.92	3.56	4.20	3.08	1.97	
Mid-Depth Speed	1.28	0.90	0.63	0.97	1.21	1.12	1.28	0.99	0.71	
0-Speed Depth (ft)	207.7	140.9	94.8	153.6	195.3	179.5	207.7	157.9	108.4	
Curr Dir – Wave Dir (deg)	53.6	60.1	53.6	48.9	53.6	64.3	66.8	48.4	21.2	

Note: All directions are °FROM

Table 3.17 1000-Year Sudden Hurricane – Maximum Wave Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for waves)							
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	42.8	30.9	31.9	30.4	42.8	42.8	38.3	30.5	17.0	
Tp (s)	13.3	12.0	12.1	11.9	13.3	13.3	12.9	11.9	9.9	
Tp-low (s)	13.2	11.5	11.6	11.4	13.2	13.2	12.6	11.4	8.9	
Tp-high (s)	14.8	14.1	14.1	14.0	14.8	14.8	14.5	14.0	12.9	
Hmax (ft)	75.4	54.5	56.2	53.6	75.4	75.4	67.5	53.7	30.0	
THmax (s)	12.0	10.8	10.9	10.7	12.0	12.0	11.6	10.7	8.9	
Hc (ft)	45.3	32.7	33.8	32.2	45.3	45.3	40.6	32.2	18.0	
Spectral Shape							JONSWAP, $\gamma = 2.4$			
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	129.3	79.8	90.8	91.5	114.8	129.3	109.3	99.0	75.3	
Wind Speed (10 min@33 ft)	144.6	87.0	99.6	100.4	127.5	144.6	121.0	109.0	81.9	
Wind Speed (1 min@33 ft)	164.4	96.2	110.9	111.8	143.8	164.4	136.1	121.9	90.3	
Wind Speed (3 sec@33 ft)	190.0	108.3	125.5	126.6	164.9	190.0	155.7	138.7	101.4	
Wind Dir – Wave Dir (deg)	0.0	-12.3	-30.4	-27.8	-15.5	0.0	8.2	-2.5	-26.9	
Current Speed (ft/s)										
Surface	4.34	2.41	1.39	1.81	2.50	4.34	4.32	3.87	3.20	
Mid-Depth Speed	1.32	0.82	0.56	0.67	0.84	1.32	1.31	1.19	1.03	
0-Speed Depth (ft)	214.0	127.9	82.8	101.2	131.9	214.0	213.1	192.9	163.3	
Curr Dir – Wave Dir (deg)	52.6	65.5	50.2	50.8	45.9	52.6	72.8	82.2	61.2	

Note: All directions are °FROM

Table 3.18 1000-Year Sudden Hurricane – Maximum Current Case.

Parameter	Compass Direction	Omni-directional	Sector ('from' for currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Hs (ft)	33.9	10.6	13.0	15.8	31.1	33.9	19.7	17.5	19.8	
Tp (s)	12.4	8.4	9.0	9.6	12.0	12.4	10.4	9.9	10.4	
Tp-low (s)	11.9	7.3	8.0	8.7	11.5	11.9	9.5	9.0	9.5	
Tp-high (s)	14.3	12.1	12.4	12.8	14.1	14.3	13.2	13.0	13.2	
Hmax (ft)	59.7	18.6	22.9	27.9	54.8	59.7	34.8	30.8	35.0	
THmax (s)	11.1	7.6	8.1	8.7	10.8	11.1	9.3	9.0	9.3	
Hc (ft)	35.9	11.2	13.7	16.8	32.9	35.9	20.9	18.5	21.0	
Spectral Shape						JONSWAP, $\gamma = 2.1$				
Wind Speed (ft/s)										
Wind Speed (1 hr@33 ft)	130.7	52.5	48.4	57.4	113.8	130.7	87.4	112.5	62.6	
Wind Speed (10 min@33 ft)	146.4	56.4	51.8	61.8	126.3	146.4	95.7	124.8	67.6	
Wind Speed (1 min@33 ft)	166.5	61.4	56.3	67.5	142.4	166.5	106.3	140.6	74.0	
Wind Speed (3 sec@33 ft)	192.6	67.9	62.1	74.9	163.3	192.6	120.2	161.1	82.4	
Wind Dir – Wave Dir (deg)	-16.0	8.0	-3.3	-12.1	-16.5	-16.0	-10.9	-2.9	5.4	
Current Speed (ft/s)										
Surface	6.00	5.94	5.20	4.30	5.86	6.00	6.00	5.91	6.00	
Mid-Depth Speed	1.74	1.72	1.54	1.31	1.70	1.74	1.74	1.72	1.74	
0-Speed Depth (ft)	287.7	285.2	252.5	212.2	281.8	287.7	287.7	283.8	287.7	
Curr Dir – Wave Dir (deg)	58.5	45.9	-10.6	10.8	41.0	58.5	71.0	90.8	104.7	

Note: All directions are °FROM

3.2 Sudden Hurricane Duration and History

Table 3.19 Sudden Hurricane Significant Wave Height Duration and Event History.

Hours From Peak	Tall and Thin Tropical Cyclones*			Short and Wide Tropical Cyclones*				
	Normalized to Peak Value		100 yr Hs Event (ft)	100 yr Tp Event (s)	Normalized to Peak Value		100 yr Hs Event (ft)	100 yr Tp Event (s)
	Mean	Std Dev.			Mean	Std Dev.		
-24	0.21	0.09	6.4	7.2	0.34	0.16	10.5	8.4
-22	0.22	0.09	6.8	7.3	0.36	0.16	11.0	8.6
-20	0.23	0.10	7.1	7.4	0.38	0.16	11.7	8.8
-18	0.25	0.10	7.7	7.6	0.41	0.18	12.8	9.0
-16	0.27	0.11	8.5	7.9	0.44	0.18	13.6	9.2
-14	0.31	0.12	9.5	8.2	0.46	0.17	14.3	9.3
-12	0.36	0.13	11.1	8.6	0.48	0.14	14.9	9.5
-10	0.42	0.13	13.1	9.1	0.50	0.12	15.4	9.6
-8	0.50	0.13	15.6	9.6	0.51	0.09	15.8	9.7
-6	0.60	0.12	18.5	10.2	0.53	0.06	16.3	9.8
-4	0.74	0.11	22.8	10.9	0.55	0.04	16.9	9.9
-2	0.89	0.08	27.6	11.6	0.57	0.01	17.7	10.0
0	1.00	0.00	30.9	12.1	0.59	0.00	18.1	10.1
2	0.92	0.07	28.3	11.7	0.57	0.01	17.7	10.0
4	0.80	0.10	24.7	11.2	0.53	0.03	16.5	9.8
6	0.69	0.12	21.2	10.6	0.49	0.08	15.2	9.5
8	0.59	0.12	18.3	10.1	0.46	0.12	14.2	9.3
10	0.51	0.11	15.8	9.7	0.43	0.16	13.3	9.1
12	0.45	0.10	14.0	9.3	0.41	0.18	12.7	9.0
14	0.40	0.10	12.5	8.9	0.39	0.20	12.1	8.8
16	0.36	0.09	11.3	8.6	0.36	0.20	11.2	8.6
18	0.33	0.09	10.3	8.4	0.33	0.20	10.3	8.4
20	0.31	0.08	9.5	8.2	0.31	0.21	9.4	8.2
22	0.29	0.08	8.8	8.0	0.28	0.23	8.8	7.9
24	0.27	0.07	8.2	7.8	0.26	0.24	8.2	7.8

*Note: Short and wide hurricanes were observed to be weaker than tall and thin hurricanes. Short and wide storm statistics, 100 year Hs, and 100 year Tp values displayed above have been derived by applying a factor (0.59) of the ratio of maximum short and wide storm Hs to maximum tall and thin storm Hs.

Table 3.20 Sudden Hurricane Wind Speed Duration and Event History.

Hours From Peak	Tall and Thin Hurricanes*			Short and Wide Hurricanes*		
	Normalized to Peak Value		100 yr Ws Event (ft/s)	Normalized to Peak Value		100 yr Ws Event (ft/s)
	Mean	Std Dev.		Mean	Std Dev.	
-24	0.36	0.13	35.8	0.38	0.17	38.2
-22	0.38	0.13	37.7	0.40	0.16	40.1
-20	0.39	0.12	38.9	0.41	0.15	41.4
-18	0.40	0.12	39.7	0.42	0.15	42.7
-16	0.42	0.12	42.4	0.44	0.14	44.3
-14	0.46	0.11	46.4	0.46	0.12	46.6
-12	0.52	0.11	52.1	0.49	0.10	49.3
-10	0.56	0.12	55.7	0.52	0.09	51.9
-8	0.61	0.13	61.1	0.55	0.08	55.3
-6	0.68	0.14	68.1	0.59	0.08	59.3
-4	0.76	0.13	76.3	0.61	0.10	61.1
-2	0.86	0.09	86.8	0.64	0.10	64.4
0	1.00	0.00	100.4	0.69	0.00	69.0
2	0.73	0.30	73.6	0.65	0.04	65.7
4	0.70	0.19	70.6	0.62	0.06	61.9
6	0.70	0.16	69.8	0.57	0.08	57.6
8	0.62	0.18	62.3	0.53	0.08	53.1
10	0.55	0.17	55.6	0.50	0.10	49.7
12	0.49	0.13	49.5	0.47	0.12	47.6
14	0.48	0.15	48.4	0.46	0.13	45.7
16	0.46	0.17	46.4	0.43	0.13	42.8
18	0.44	0.17	44.1	0.39	0.13	39.1
20	0.43	0.15	42.8	0.36	0.15	36.1
22	0.42	0.15	42.0	0.34	0.17	33.8
24	0.42	0.16	41.8	0.32	0.20	32.5

*Note: Short and wide hurricanes were observed to be weaker than tall and thin hurricanes. Short and wide storm statistics, 100 year Ws values displayed above have been derived by applying a factor (0.69) of the ratio of maximum short and wide storm Ws to maximum tall and thin storm Ws.

3.3 Sudden Hurricane Events with Hs Exceeding 20 ft

Table 3.21 Sudden Hurricane Events with Hs Exceeding 20 ft.

Event Date	Storm Name	Max Hs (ft)
9/15/1960	ETHEL, H-5	35.4
9/24/1956	FLOSSY, H-1	27.2
9/2/1998	EARL, H-2	26.9
10/7/1996	JOSEPHINE, TS	20.7
8/30/1985	ELENA, H-3	20.1

4. OFF-PEAK HURRICANE CRITERIA

4.1 Omni-directional and Directional Off-Peak Hurricane Criteria

4.1.1 10-Year Return Period

Table 4.1 10-Year Off-Peak Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	14.4	11.5	14.4	14.2	10.8	12.0	9.8	8.5	8.0
Tp (s)	10.4	9.4	10.4	10.3	9.2	9.6	8.8	8.2	8.0
Tp-low (s)	9.5	8.5	9.5	9.4	8.2	8.7	7.8	7.3	7.0
Tp-high (s)	13.6	13.0	13.6	13.6	12.8	13.1	12.5	12.1	12.0
Hmax (ft)	26.0	20.8	26.0	25.5	19.4	21.7	17.7	15.3	14.3
THmax (s)	9.4	8.5	9.4	9.3	8.3	8.7	7.9	7.4	7.2
Hc (ft)	15.8	12.6	15.8	15.5	11.8	13.1	10.7	9.3	8.7
Spectral Shape	JONSWAP, $\gamma = 1.7$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	51.4	48.5	51.4	51.4	51.3	42.7	43.0	36.9	36.7
Wind Speed (10 min@33 ft)	55.2	52.0	55.2	55.2	55.1	45.7	46.0	39.3	39.1
Wind Speed (1 min@33 ft)	60.0	56.5	60.0	60.0	60.0	49.5	49.8	42.4	42.2
Wind Speed (3 sec@33 ft)	66.4	62.3	66.4	66.4	66.3	54.4	54.8	46.4	46.2
Wind Dir – Wave Dir (deg)	-17.6	-62.5	-35.8	-17.6	-3.7	6.9	12.5	7.8	-15.1
Current Speed (ft/s)									
Surface	1.1	1.0	0.8	0.9	1.1	1.1	1.0	0.9	1.0
Mid-Depth Speed	0.5	0.5	0.4	0.4	0.5	0.5	0.4	0.4	0.5
0-Speed Depth (ft)	64.4	60.8	51.3	55.3	64.3	64.4	57.8	56.4	61.8
Curr Dir – Wave Dir (deg)	46.5	28.9	25.2	46.5	67.8	76.1	68.6	51.7	39.4

Note: All directions are °FROM

Table 4.2 10-Year Off-Peak Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5° - 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5° - 157.5	157.5° - 202.5	202.5° - 247.5	247.5° - 292.5	292.5° - 337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	15.1	7.4	12.4	15.1	15.1	8.5	7.5	6.6	7.2
Tp (s)	10.6	7.7	9.8	10.6	10.6	8.2	7.8	7.4	7.7
Tp-low (s)	9.7	6.7	8.8	9.7	9.7	7.3	6.8	6.4	6.7
Tp-high (s)	13.8	11.8	13.2	13.8	13.8	12.2	11.8	11.5	11.7
Hmax (ft)	27.2	13.3	22.4	27.2	27.2	15.3	13.5	11.9	13.0
THmax (s)	9.6	7.0	8.8	9.6	9.6	7.4	7.0	6.6	6.9
Hc (ft)	16.5	8.1	13.6	16.5	16.5	9.3	8.2	7.2	7.9
Spectral Shape	JONSWAP, $\gamma = 1.7$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	47.3	37.4	44.8	45.6	47.3	33.4	35.7	35.1	35.5
Wind Speed (10 min@33 ft)	50.6	39.9	47.9	48.8	50.6	35.5	38.0	37.3	37.8
Wind Speed (1 min@33 ft)	55.0	43.0	51.9	53.0	55.0	38.2	41.0	40.2	40.8
Wind Speed (3 sec@33 ft)	60.6	47.1	57.2	58.3	60.6	41.8	44.8	44.0	44.6
Wind Dir – Wave Dir (deg)	-26.6	1.6	-55.0	-52.7	-26.6	-0.7	11.6	8.0	-3.3
Current Speed (ft/s)									
Surface	1.4	0.7	1.0	0.8	1.4	0.8	1.0	0.9	1.0
Mid-Depth Speed	0.6	0.3	0.5	0.4	0.6	0.4	0.5	0.4	0.4
0-Speed Depth (ft)	76.8	44.4	62.1	51.8	76.8	51.5	61.9	57.4	58.1
Curr Dir – Wave Dir (deg)	49.0	14.5	44.8	24.2	49.0	73.2	64.6	54.2	77.9

Note: All directions are °FROM

Table 4.3 10-Year Off-Peak Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	8.8	6.6	6.5	7.0	8.6	6.5	8.8	8.3	7.5
Tp (s)	8.4	7.4	7.3	7.6	8.3	7.3	8.4	8.2	7.8
Tp-low (s)	7.4	6.4	6.3	6.6	7.3	6.3	7.4	7.2	6.8
Tp-high (s)	12.3	11.5	11.5	11.7	12.2	11.5	12.3	12.1	11.8
Hmax (ft)	15.9	11.8	11.7	12.6	15.5	11.6	15.9	14.9	13.5
THmax (s)	7.5	6.6	6.6	6.8	7.5	6.6	7.5	7.3	7.0
Hc (ft)	9.7	7.2	7.1	7.7	9.4	7.1	9.7	9.0	8.2
Spectral Shape	JONSWAP, $\gamma = 1.5$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	37.5	29.1	28.8	34.9	37.5	32.8	34.2	32.6	36.8
Wind Speed (10 min@33 ft)	40.0	30.9	30.5	37.2	40.0	34.9	36.4	34.6	39.2
Wind Speed (1 min@33 ft)	43.2	33.2	32.8	40.1	43.2	37.5	39.2	37.2	42.3
Wind Speed (3 sec@33 ft)	47.3	36.1	35.7	43.8	47.3	41.0	42.8	40.7	46.3
Wind Dir – Wave Dir (deg)	2.9	32.0	-12.6	-24.3	-19.9	-11.0	-3.2	2.9	12.5
Current Speed (ft/s)									
Surface	1.6	1.5	1.3	1.5	1.6	1.5	1.6	1.6	1.6
Mid-Depth Speed	0.8	0.7	0.6	0.7	0.8	0.7	0.8	0.8	0.8
0-Speed Depth (ft)	87.8	84.0	76.4	83.5	87.8	85.5	87.8	87.8	87.8
Curr Dir – Wave Dir (deg)	80.9	75.8	47.9	37.4	40.6	52.6	68.1	80.9	84.1

Note: All directions are °FROM

4.1.2 25-Year Return Period

Table 4.4 25-Year Off-Peak Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)													
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5	N	NE	E	SE	S	SW
Hs (ft)	18.2	14.1	18.2	18.2	13.1	15.5	12.2	10.8	9.9						
Tp (s)	11.5	10.3	11.5	11.5	10.0	10.8	9.7	9.2	8.8						
Tp-low (s)	10.7	9.4	10.7	10.7	9.1	9.9	8.7	8.2	7.8						
Tp-high (s)	14.3	13.5	14.3	14.3	13.3	13.8	13.1	12.8	12.6						
Hmax (ft)	32.8	25.4	32.8	32.7	23.6	28.0	22.0	19.4	17.9						
THmax (s)	10.4	9.3	10.4	10.4	9.0	9.7	8.7	8.2	7.9						
Hc (ft)	19.9	15.4	19.9	19.8	14.3	17.0	13.4	11.8	10.8						
Spectral Shape	JONSWAP, $\gamma = 1.7$														
Wind Speed (ft/s)															
Wind Speed (1 hr@33 ft)	61.1	57.7	61.1	61.1	61.0	50.8	51.2	43.9	43.7						
Wind Speed (10 min@33 ft)	66.0	62.1	66.0	66.0	65.9	54.6	54.9	46.9	46.7						
Wind Speed (1 min@33 ft)	72.2	67.9	72.2	72.2	72.1	59.4	59.8	50.9	50.6						
Wind Speed (3 sec@33 ft)	80.3	75.3	80.3	80.3	80.2	65.6	66.1	55.9	55.7						
Wind Dir – Wave Dir (deg)	-17.6	-62.5	-35.8	-17.6	-3.7	6.9	12.5	7.8	-15.1						
Current Speed (ft/s)															
Surface	1.3	1.2	0.9	1.0	1.3	1.3	1.1	1.1	1.3						
Mid-Depth Speed	0.6	0.5	0.4	0.5	0.6	0.6	0.5	0.5	0.6						
0-Speed Depth (ft)	73.9	68.6	56.9	60.7	72.8	73.9	64.3	63.6	72.5						
Curr Dir – Wave Dir (deg)	46.5	28.9	25.2	46.5	67.8	76.1	68.6	51.7	39.4						

Note: All directions are °FROM

Table 4.5 25-Year Off-Peak Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5° - 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5° - 157.5	157.5° - 202.5	202.5° - 247.5	247.5° - 292.5	292.5° - 337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	20.0	9.7	16.4	20.0	20.0	11.2	9.9	8.7	9.5
Tp (s)	12.0	8.8	11.0	12.0	12.0	9.3	8.8	8.4	8.7
Tp-low (s)	11.2	7.8	10.1	11.2	11.2	8.4	7.8	7.4	7.7
Tp-high (s)	14.6	12.5	14.0	14.6	14.6	12.9	12.5	12.2	12.4
Hmax (ft)	35.9	17.5	29.5	35.9	35.9	20.2	17.8	15.7	17.1
THmax (s)	10.8	7.9	9.9	10.8	10.8	8.4	7.9	7.5	7.8
Hc (ft)	21.8	10.6	17.9	21.8	21.8	12.3	10.8	9.6	10.4
Spectral Shape	JONSWAP, $\gamma = 1.8$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	57.3	46.4	53.8	53.9	57.3	40.7	44.6	43.5	43.3
Wind Speed (10 min@33 ft)	61.7	49.6	57.8	58.0	61.7	43.5	47.7	46.5	46.2
Wind Speed (1 min@33 ft)	67.4	53.9	63.0	63.2	67.4	47.0	51.7	50.4	50.1
Wind Speed (3 sec@33 ft)	74.7	59.4	69.8	70.0	74.7	51.6	56.9	55.4	55.1
Wind Dir – Wave Dir (deg)	-26.6	1.6	-55.0	-52.7	-26.6	-0.7	11.6	8.0	-3.3
Current Speed (ft/s)									
Surface	1.7	0.8	1.3	0.9	1.7	1.1	1.3	1.2	1.2
Mid-Depth Speed	0.8	0.4	0.6	0.4	0.8	0.5	0.6	0.6	0.6
0-Speed Depth (ft)	92.5	51.1	73.9	57.0	92.5	62.9	74.0	69.7	71.4
Curr Dir – Wave Dir (deg)	49.0	14.5	44.8	24.2	49.0	73.2	64.6	54.2	77.9

Note: All directions are °FROM

Table 4.6 25-Year Off-Peak Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	10.6	7.8	7.8	8.1	10.2	7.4	10.6	9.9	9.0
Tp (s)	9.1	7.9	8.0	8.1	8.9	7.8	9.1	8.8	8.4
Tp-low (s)	8.1	6.9	7.0	7.1	7.9	6.8	8.1	7.8	7.4
Tp-high (s)	12.7	11.9	11.9	12.0	12.6	11.8	12.7	12.5	12.3
Hmax (ft)	19.1	14.0	14.1	14.6	18.3	13.4	19.1	17.7	16.1
THmax (s)	8.2	7.1	7.2	7.3	8.0	7.0	8.2	7.9	7.6
Hc (ft)	11.6	8.5	8.6	8.9	11.1	8.1	11.6	10.8	9.8
Spectral Shape	JONSWAP, $\gamma = 1.6$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	42.9	32.6	32.1	39.8	42.9	36.7	38.7	36.6	42.8
Wind Speed (10 min@33 ft)	45.8	34.7	34.1	42.4	45.8	39.1	41.2	39.0	45.7
Wind Speed (1 min@33 ft)	49.6	37.3	36.7	45.8	49.6	42.2	44.5	42.0	49.5
Wind Speed (3 sec@33 ft)	54.6	40.8	40.1	50.3	54.6	46.2	48.8	46.0	54.4
Wind Dir – Wave Dir (deg)	2.9	32.0	-12.6	-24.3	-19.9	-11.0	-3.2	2.9	12.5
Current Speed (ft/s)									
Surface	1.9	1.8	1.6	1.8	1.9	1.9	1.9	1.9	1.9
Mid-Depth Speed	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9
0-Speed Depth (ft)	104.4	99.8	90.5	99.1	104.4	101.6	104.4	104.4	104.4
Curr Dir – Wave Dir (deg)	80.9	75.8	47.9	37.4	40.6	52.6	68.1	80.9	84.1

Note: All directions are °FROM

4.1.3 50-Year Return Period

Table 4.7 50-Year Off-Peak Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	21.2	16.0	21.1	21.2	14.9	18.2	14.1	12.5	11.4
Tp (s)	12.3	10.9	12.3	12.3	10.6	11.5	10.3	9.8	9.4
Tp-low (s)	11.6	10.0	11.5	11.6	9.7	10.7	9.4	8.8	8.4
Tp-high (s)	14.8	13.9	14.8	14.8	13.7	14.3	13.5	13.2	12.9
Hmax (ft)	38.1	28.9	37.9	38.1	26.8	32.8	25.4	22.5	20.5
THmax (s)	11.1	9.8	11.1	11.1	9.5	10.4	9.3	8.8	8.5
Hc (ft)	23.1	17.5	23.0	23.1	16.3	19.9	15.4	13.7	12.5
Spectral Shape	JONSWAP, $\gamma = 1.8$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	68.5	64.6	68.5	68.5	68.4	57.0	57.3	49.2	49.0
Wind Speed (10 min@33 ft)	74.2	69.9	74.2	74.2	74.1	61.3	61.8	52.7	52.5
Wind Speed (1 min@33 ft)	81.6	76.6	81.6	81.6	81.5	67.0	67.5	57.3	57.0
Wind Speed (3 sec@33 ft)	91.2	85.4	91.2	91.2	91.0	74.3	74.9	63.3	63.0
Wind Dir – Wave Dir (deg)	-17.6	-62.5	-35.8	-17.6	-3.7	6.9	12.5	7.8	-15.1
Current Speed (ft/s)									
Surface	1.4	1.3	1.0	1.1	1.4	1.4	1.2	1.2	1.4
Mid-Depth Speed	0.7	0.6	0.5	0.5	0.7	0.7	0.6	0.6	0.7
0-Speed Depth (ft)	81.1	74.5	61.2	64.8	79.2	81.1	69.3	69.2	80.6
Curr Dir – Wave Dir (deg)	46.5	28.9	25.2	46.5	67.8	76.1	68.6	51.7	39.4

Note: All directions are °FROM

Table 4.8 50-Year Off-Peak Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	23.7	11.5	19.5	23.7	23.7	13.3	11.7	10.4	11.3
Tp (s)	13.0	9.4	11.9	13.0	13.0	10.1	9.5	9.0	9.4
Tp-low (s)	12.2	8.5	11.1	12.2	12.2	9.1	8.5	8.0	8.4
Tp-high (s)	15.1	13.0	14.5	15.1	15.1	13.4	13.0	12.7	12.9
Hmax (ft)	42.6	20.8	35.0	42.6	42.6	24.0	21.1	18.7	20.3
THmax (s)	11.7	8.5	10.7	11.7	11.7	9.0	8.5	8.1	8.4
Hc (ft)	25.9	12.6	21.3	25.9	25.9	14.5	12.8	11.3	12.3
Spectral Shape	JONSWAP, $\gamma = 1.9$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	65.0	53.3	60.7	60.3	65.0	46.3	51.4	49.9	49.2
Wind Speed (10 min@33 ft)	70.3	57.2	65.5	65.1	70.3	49.6	55.2	53.6	52.8
Wind Speed (1 min@33 ft)	77.1	62.4	71.7	71.2	77.1	53.9	60.1	58.3	57.4
Wind Speed (3 sec@33 ft)	86.0	69.0	79.7	79.1	86.0	59.3	66.4	64.4	63.3
Wind Dir – Wave Dir (deg)	-26.6	1.6	-55.0	-52.7	-26.6	-0.7	11.6	8.0	-3.3
Current Speed (ft/s)									
Surface	1.9	0.9	1.5	1.0	1.9	1.3	1.5	1.4	1.5
Mid-Depth Speed	0.9	0.4	0.7	0.5	0.9	0.6	0.7	0.7	0.7
0-Speed Depth (ft)	104.6	56.3	83.0	61.0	104.6	71.7	83.3	79.2	81.6
Curr Dir – Wave Dir (deg)	49.0	14.5	44.8	24.2	49.0	73.2	64.6	54.2	77.9

Note: All directions are °FROM

Table 4.9 50-Year Off-Peak Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	11.9	8.7	8.8	9.0	11.3	8.1	11.9	11.1	10.0
Tp (s)	9.6	8.3	8.4	8.4	9.4	8.1	9.6	9.3	8.9
Tp-low (s)	8.6	7.4	7.4	7.5	8.4	7.1	8.6	8.3	7.9
Tp-high (s)	13.1	12.2	12.3	12.3	12.9	12.0	13.1	12.9	12.6
Hmax (ft)	21.5	15.7	15.9	16.1	20.4	14.7	21.5	19.9	18.1
THmax (s)	8.6	7.5	7.6	7.6	8.4	7.3	8.6	8.3	8.0
Hc (ft)	13.0	9.5	9.7	9.8	12.4	8.9	13.0	12.1	11.0
Spectral Shape	JONSWAP, $\gamma = 1.6$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	47.3	35.3	34.6	43.4	46.9	39.7	42.0	39.6	47.3
Wind Speed (10 min@33 ft)	50.7	37.6	36.8	46.4	50.3	42.3	44.9	42.3	50.7
Wind Speed (1 min@33 ft)	55.1	40.5	39.7	50.3	54.6	45.8	48.6	45.7	55.1
Wind Speed (3 sec@33 ft)	60.7	44.3	43.4	55.3	60.2	50.2	53.4	50.1	60.7
Wind Dir – Wave Dir (deg)	2.9	32.0	-12.6	-24.3	-19.9	-11.0	-3.2	2.9	12.5
Current Speed (ft/s)									
Surface	2.2	2.1	1.9	2.1	2.2	2.1	2.2	2.2	2.2
Mid-Depth Speed	1.1	1.0	0.9	1.0	1.1	1.0	1.1	1.1	1.1
0-Speed Depth (ft)	116.9	111.7	101.2	110.9	116.9	113.7	116.9	116.9	116.9
Curr Dir – Wave Dir (deg)	80.9	75.8	47.9	37.4	40.6	52.6	68.1	80.9	84.1

Note: All directions are °FROM

4.1.4 100-Year Return Period

Table 4.10 100-Year Off-Peak Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
Hs (ft)	N	NE	E	SE	S	SW	W	NW	
Tp (s)	13.1	11.5	13.0	13.1	11.1	12.3	10.9	10.4	9.9
Tp-low (s)	12.4	10.6	12.3	12.4	10.2	11.5	10.0	9.4	9.0
Tp-high (s)	15.2	14.3	15.2	15.2	14.0	14.7	13.9	13.6	13.3
Hmax (ft)	43.5	32.4	43.0	43.5	30.0	37.5	28.7	25.6	23.2
THmax (s)	11.8	10.3	11.7	11.8	10.0	11.0	9.8	9.3	8.9
Hc (ft)	26.4	19.6	26.1	26.4	18.2	22.8	17.4	15.5	14.1
Spectral Shape	JONSWAP, $\gamma = 1.9$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	75.9	71.6	75.9	75.9	75.8	63.1	63.5	54.5	54.2
Wind Speed (10 min@33 ft)	82.5	77.7	82.5	82.5	82.4	68.2	68.6	58.6	58.3
Wind Speed (1 min@33 ft)	91.1	85.5	91.1	91.1	91.0	74.7	75.2	63.9	63.6
Wind Speed (3 sec@33 ft)	102.2	95.8	102.2	102.2	102.1	83.2	83.8	70.7	70.4
Wind Dir – Wave Dir (deg)	-17.6	-62.5	-35.8	-17.6	-3.7	6.9	12.5	7.8	-15.1
Current Speed (ft/s)									
Surface	1.6	1.4	1.1	1.2	1.5	1.6	1.3	1.3	1.6
Mid-Depth Speed	0.8	0.7	0.5	0.6	0.7	0.8	0.6	0.6	0.8
0-Speed Depth (ft)	88.7	80.4	65.4	68.9	85.6	88.3	74.2	74.7	88.7
Curr Dir – Wave Dir (deg)	46.5	28.9	25.2	46.5	67.8	76.1	68.6	51.7	39.4

Note: All directions are °FROM

Table 4.11 100-Year Off-Peak Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	27.4	13.4	22.6	27.4	27.4	15.4	13.6	12.0	13.1
Tp (s)	13.8	10.1	12.7	13.8	13.8	10.7	10.1	9.6	10.0
Tp-low (s)	13.2	9.1	11.9	13.2	13.2	9.8	9.2	8.7	9.0
Tp-high (s)	15.6	13.4	15.0	15.6	15.6	13.8	13.4	13.1	13.3
Hmax (ft)	49.4	24.1	40.6	49.4	49.4	27.8	24.4	21.7	23.6
THmax (s)	12.5	9.1	11.4	12.5	12.5	9.7	9.1	8.7	9.0
Hc (ft)	30.0	14.6	24.6	30.0	30.0	16.9	14.8	13.1	14.3
Spectral Shape	JONSWAP, $\gamma = 2.0$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	72.8	60.2	67.7	66.8	72.8	52.0	58.3	56.5	55.3
Wind Speed (10 min@33 ft)	79.0	65.0	73.4	72.3	79.0	55.9	62.9	60.8	59.5
Wind Speed (1 min@33 ft)	87.1	71.1	80.6	79.4	87.1	60.9	68.7	66.4	64.9
Wind Speed (3 sec@33 ft)	97.6	79.0	90.1	88.6	97.6	67.3	76.3	73.7	71.9
Wind Dir – Wave Dir (deg)	-26.6	1.6	-55.0	-52.7	-26.6	-0.7	11.6	8.0	-3.3
Current Speed (ft/s)									
Surface	2.2	1.0	1.7	1.1	2.2	1.4	1.7	1.6	1.7
Mid-Depth Speed	1.1	0.5	0.8	0.5	1.1	0.7	0.8	0.8	0.8
0-Speed Depth (ft)	116.8	61.6	92.2	65.1	116.8	80.7	92.7	88.8	92.0
Curr Dir – Wave Dir (deg)	49.0	14.5	44.8	24.2	49.0	73.2	64.6	54.2	77.9

Note: All directions are °FROM

Table 4.12 100-Year Off-Peak Hurricane – Maximum Current Case.

Parameter	Compass Direction	Sector ('from' for currents)							
		Omni-directional	337.5° - 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5° - 157.5	157.5° - 202.5	202.5° - 247.5	247.5° - 292.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	13.3	9.7	9.9	9.8	12.5	8.9	13.3	12.2	11.1
Tp (s)	10.0	8.7	8.8	8.8	9.8	8.4	10.0	9.7	9.3
Tp-low (s)	9.1	7.7	7.8	7.8	8.8	7.4	9.1	8.7	8.3
Tp-high (s)	13.4	12.5	12.5	12.5	13.2	12.3	13.4	13.1	12.9
Hmax (ft)	23.9	17.4	17.7	17.6	22.6	16.0	23.9	22.1	20.1
THmax (s)	9.0	7.9	7.9	7.9	8.8	7.6	9.0	8.7	8.4
Hc (ft)	14.5	10.5	10.8	10.7	13.7	9.7	14.5	13.4	12.2
Spectral Shape	JONSWAP, $\gamma = 1.6$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	51.9	37.9	37.1	47.0	51.0	42.6	45.4	42.7	51.9
Wind Speed (10 min@33 ft)	55.7	40.4	39.6	50.4	54.7	45.6	48.6	45.6	55.7
Wind Speed (1 min@33 ft)	60.7	43.7	42.7	54.7	59.5	49.3	52.7	49.4	60.7
Wind Speed (3 sec@33 ft)	67.1	47.9	46.8	60.3	65.8	54.2	58.0	54.3	67.1
Wind Dir – Wave Dir (deg)	2.9	32.0	-12.6	-24.3	-19.9	-11.0	-3.2	2.9	12.5
Current Speed (ft/s)									
Surface	2.5	2.3	2.1	2.3	2.5	2.4	2.5	2.5	2.5
Mid-Depth Speed	1.2	1.1	1.0	1.1	1.2	1.2	1.2	1.2	1.2
0-Speed Depth (ft)	129.5	123.6	111.9	122.8	129.5	125.9	129.5	129.5	129.5
Curr Dir – Wave Dir (deg)	80.9	75.8	47.9	37.4	40.6	52.6	68.1	80.9	84.1

Note: All directions are °FROM

4.1.5 200-Year Return Period

Table 4.13 200-Year Off-Peak Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	27.2	19.9	26.7	27.2	18.4	23.5	17.8	16.0	14.4
Tp (s)	13.8	12.0	13.7	13.8	11.6	12.9	11.4	10.9	10.4
Tp-low (s)	13.1	11.2	13.0	13.1	10.8	12.2	10.6	10.0	9.5
Tp-high (s)	15.6	14.6	15.5	15.6	14.3	15.1	14.2	13.9	13.6
Hmax (ft)	48.9	35.8	48.2	48.9	33.2	42.3	32.0	28.7	25.9
THmax (s)	12.4	10.8	12.3	12.4	10.4	11.6	10.3	9.8	9.4
Hc (ft)	29.7	21.7	29.2	29.7	20.1	25.7	19.4	17.4	15.7
Spectral Shape	JONSWAP, $\gamma = 2.0$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	83.2	78.5	83.2	83.2	83.1	69.2	69.7	59.8	59.5
Wind Speed (10 min@33 ft)	90.9	85.5	90.9	90.9	90.8	75.0	75.6	64.4	64.1
Wind Speed (1 min@33 ft)	100.7	94.6	100.7	100.7	100.6	82.5	83.1	70.5	70.1
Wind Speed (3 sec@33 ft)	113.6	106.3	113.6	113.6	113.4	92.2	92.9	78.3	77.9
Wind Dir – Wave Dir (deg)	-17.6	-62.5	-35.8	-17.6	-3.7	6.9	12.5	7.8	-15.1
Current Speed (ft/s)									
Surface	1.8	1.6	1.2	1.3	1.7	1.7	1.4	1.4	1.8
Mid-Depth Speed	0.8	0.7	0.6	0.6	0.8	0.8	0.7	0.7	0.8
0-Speed Depth (ft)	96.7	86.3	69.7	73.0	92.1	95.5	79.2	80.2	96.7
Curr Dir – Wave Dir (deg)	46.5	28.9	25.2	46.5	67.8	76.1	68.6	51.7	39.4

Note: All directions are °FROM

Table 4.14 200-Year Off-Peak Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	31.3	15.2	25.7	31.3	31.3	17.6	15.4	13.7	14.9
Tp (s)	14.7	10.7	13.4	14.7	14.7	11.4	10.7	10.2	10.6
Tp-low (s)	14.1	9.8	12.8	14.1	14.1	10.5	9.8	9.3	9.7
Tp-high (s)	16.1	13.8	15.4	16.1	16.1	14.2	13.8	13.5	13.7
Hmax (ft)	56.3	27.4	46.2	56.3	56.3	31.6	27.8	24.7	26.8
THmax (s)	13.2	9.6	12.1	13.2	13.2	10.2	9.7	9.2	9.5
Hc (ft)	34.1	16.6	28.1	34.1	34.1	19.2	16.9	15.0	16.3
Spectral Shape	JONSWAP, $\gamma = 2.1$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	80.7	67.3	74.8	73.3	80.7	57.8	65.3	63.1	61.4
Wind Speed (10 min@33 ft)	88.0	72.9	81.4	79.6	88.0	62.3	70.7	68.2	66.2
Wind Speed (1 min@33 ft)	97.4	80.0	89.8	87.8	97.4	68.0	77.6	74.7	72.5
Wind Speed (3 sec@33 ft)	109.6	89.4	100.7	98.4	109.6	75.5	86.5	83.2	80.7
Wind Dir – Wave Dir (deg)	-26.6	1.6	-55.0	-52.7	-26.6	-0.7	11.6	8.0	-3.3
Current Speed (ft/s)									
Surface	2.5	1.1	1.9	1.2	2.5	1.6	1.9	1.8	1.9
Mid-Depth Speed	1.2	0.5	0.9	0.6	1.2	0.8	0.9	0.9	0.9
0-Speed Depth (ft)	129.2	66.9	101.6	69.2	129.2	89.7	102.3	98.5	102.5
Curr Dir – Wave Dir (deg)	49.0	14.5	44.8	24.2	49.0	73.2	64.6	54.2	77.9

Note: All directions are °FROM

Table 4.15 200-Year Off-Peak Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	14.6	10.6	10.9	10.6	13.7	9.6	14.6	13.4	12.2
Tp (s)	10.5	9.1	9.2	9.1	10.2	8.7	10.5	10.1	9.7
Tp-low (s)	9.6	8.1	8.2	8.1	9.3	7.7	9.6	9.2	8.7
Tp-high (s)	13.6	12.7	12.8	12.7	13.5	12.5	13.6	13.4	13.1
Hmax (ft)	26.3	19.0	19.6	19.1	24.7	17.3	26.3	24.2	22.0
THmax (s)	9.4	8.2	8.3	8.2	9.2	7.8	9.4	9.1	8.7
Hc (ft)	16.0	11.6	11.9	11.6	15.0	10.5	16.0	14.7	13.4
Spectral Shape	JONSWAP, $\gamma = 1.7$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	56.4	40.6	39.7	50.7	55.0	45.6	48.8	45.7	56.4
Wind Speed (10 min@33 ft)	60.7	43.3	42.3	54.4	59.2	48.8	52.3	48.9	60.7
Wind Speed (1 min@33 ft)	66.3	46.9	45.7	59.2	64.6	53.0	56.8	53.1	66.3
Wind Speed (3 sec@33 ft)	73.5	51.4	50.2	65.4	71.6	58.3	62.7	58.5	73.5
Wind Dir – Wave Dir (deg)	2.9	32.0	-12.6	-24.3	-19.9	-11.0	-3.2	2.9	12.5
Current Speed (ft/s)									
Surface	2.7	2.6	2.3	2.6	2.7	2.6	2.7	2.7	2.7
Mid-Depth Speed	1.3	1.3	1.1	1.2	1.3	1.3	1.3	1.3	1.3
0-Speed Depth (ft)	142.0	135.5	122.5	134.6	142.0	138.0	142.0	142.0	142.0
Curr Dir – Wave Dir (deg)	80.9	75.8	47.9	37.4	40.6	52.6	68.1	80.9	84.1

Note: All directions are °FROM

4.1.6 1000-Year Return Period

Table 4.16 1000-Year Off-Peak Hurricane – Maximum Wind Case.

Parameter	Omni-directional	Sector ('from' for winds)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
N	NE	E	SE	S	SW	W	NW		
Hs (ft)	34.2	24.4	33.4	34.2	22.5	29.7	22.1	20.0	17.8
Tp (s)	15.3	13.1	15.1	15.3	12.7	14.3	12.6	12.0	11.4
Tp-low (s)	14.8	12.4	14.6	14.8	11.9	13.7	11.8	11.2	10.6
Tp-high (s)	16.4	15.2	16.3	16.4	15.0	15.9	14.9	14.6	14.2
Hmax (ft)	61.5	43.9	60.1	61.5	40.5	53.4	39.7	35.9	32.1
THmax (s)	13.7	11.8	13.6	13.7	11.4	12.9	11.3	10.8	10.3
Hc (ft)	37.3	26.7	36.4	37.3	24.6	32.4	24.1	21.8	19.5
Spectral Shape	JONSWAP, $\gamma = 2.1$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	100.3	94.7	100.3	100.3	100.2	83.4	84.0	72.0	71.7
Wind Speed (10 min@33 ft)	110.6	104.0	110.6	110.6	110.4	91.1	91.8	78.2	77.8
Wind Speed (1 min@33 ft)	123.7	116.0	123.7	123.7	123.5	101.0	101.8	86.1	85.7
Wind Speed (3 sec@33 ft)	140.8	131.6	140.8	140.8	140.6	113.9	114.8	96.5	96.0
Wind Dir – Wave Dir (deg)	-17.6	-62.5	-35.8	-17.6	-3.7	6.9	12.5	7.8	-15.1
Current Speed (ft/s)									
Surface	2.2	1.8	1.4	1.5	2.0	2.1	1.6	1.7	2.2
Mid-Depth Speed	1.0	0.9	0.7	0.7	1.0	1.0	0.8	0.8	1.0
0-Speed Depth (ft)	115.5	99.9	79.6	82.4	107.0	112.2	90.7	93.0	115.5
Curr Dir – Wave Dir (deg)	46.5	28.9	25.2	46.5	67.8	76.1	68.6	51.7	39.4

Note: All directions are °FROM

Table 4.17 1000-Year Off-Peak Hurricane – Maximum Wave Case.

Parameter	Omni-directional	Sector ('from' for waves)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	40.2	19.6	33.0	40.2	40.2	22.6	19.9	17.6	19.2
Tp (s)	16.4	11.9	15.0	16.4	16.4	12.7	12.0	11.4	11.8
Tp-low (s)	16.1	11.1	14.5	16.1	16.1	12.0	11.2	10.5	11.0
Tp-high (s)	17.0	14.5	16.3	17.0	17.0	15.0	14.6	14.2	14.5
Hmax (ft)	72.4	35.3	59.5	72.4	72.4	40.7	35.8	31.7	34.5
THmax (s)	14.7	10.7	13.5	14.7	14.7	11.4	10.8	10.2	10.6
Hc (ft)	43.9	21.4	36.1	43.9	43.9	24.7	21.7	19.3	21.0
Spectral Shape	JONSWAP, $\gamma = 2.3$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	99.2	83.9	91.5	88.7	99.2	71.4	81.8	78.7	75.7
Wind Speed (10 min@33 ft)	109.3	91.6	100.4	97.1	109.3	77.4	89.3	85.7	82.4
Wind Speed (1 min@33 ft)	122.2	101.6	111.8	108.0	122.2	85.3	98.9	94.8	90.9
Wind Speed (3 sec@33 ft)	139.0	114.6	126.7	122.1	139.0	95.4	111.3	106.6	102.0
Wind Dir – Wave Dir (deg)	-26.6	1.6	-55.0	-52.7	-26.6	-0.7	11.6	8.0	-3.3
Current Speed (ft/s)									
Surface	3.1	1.4	2.3	1.4	3.1	2.1	2.4	2.3	2.4
Mid-Depth Speed	1.5	0.7	1.1	0.7	1.5	1.0	1.1	1.1	1.2
0-Speed Depth (ft)	158.2	79.4	123.5	78.8	158.2	111.0	124.7	121.3	127.1
Curr Dir – Wave Dir (deg)	49.0	14.5	44.8	24.2	49.0	73.2	64.6	54.2	77.9

Note: All directions are °FROM

Table 4.18 1000-Year Off-Peak Hurricane – Maximum Current Case.

Parameter	Omni-directional	Sector ('from' for currents)							
		337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
		N	NE	E	SE	S	SW	W	NW
Hs (ft)	17.7	12.7	13.2	12.6	16.5	11.3	17.7	16.2	14.8
Tp (s)	11.4	9.9	10.0	9.8	11.0	9.3	11.4	11.0	10.5
Tp-low (s)	10.6	8.9	9.1	8.9	10.2	8.4	10.6	10.1	9.6
Tp-high (s)	14.2	13.3	13.4	13.2	14.0	12.9	14.2	14.0	13.7
Hmax (ft)	31.9	22.9	23.8	22.7	29.6	20.3	31.9	29.2	26.6
THmax (s)	10.3	8.9	9.0	8.8	9.9	8.4	10.3	9.9	9.5
Hc (ft)	19.3	13.9	14.4	13.8	18.0	12.3	19.3	17.7	16.1
Spectral Shape	JONSWAP, $\gamma = 1.7$								
Wind Speed (ft/s)									
Wind Speed (1 hr@33 ft)	67.0	46.8	45.5	59.2	64.4	52.5	56.6	52.8	67.0
Wind Speed (10 min@33 ft)	72.5	50.1	48.7	63.8	69.7	56.4	61.0	56.7	72.5
Wind Speed (1 min@33 ft)	79.6	54.4	52.8	69.7	76.4	61.4	66.6	61.8	79.6
Wind Speed (3 sec@33 ft)	88.9	59.9	58.2	77.5	85.2	68.0	73.8	68.4	88.9
Wind Dir – Wave Dir (deg)	2.9	32.0	-12.6	-24.3	-19.9	-11.0	-3.2	2.9	12.5
Current Speed (ft/s)									
Surface	3.3	3.2	2.8	3.1	3.3	3.2	3.3	3.3	3.3
Mid-Depth Speed	1.6	1.5	1.4	1.5	1.6	1.6	1.6	1.6	1.6
0-Speed Depth (ft)	171.2	163.2	147.3	162.1	171.2	166.3	171.2	171.2	171.2
Curr Dir – Wave Dir (deg)	80.9	75.8	47.9	37.4	40.6	52.6	68.1	80.9	84.1

Note: All directions are °FROM

5. WINTER STORM CRITERIA

5.1 Omni-directional and Directional Winter Storm Criteria

5.1.1 1-Year Return Period

Table 5.1 1-Year Winter Storm.

Parameter	Compass Direction	Omni-directional	Sector ('from' for waves, winds and currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
Maximum Wave										
Hs (ft)		11.6	6.3	9.3	11.6	10.2	7.3	7.6	7.6	11.1
Tp (s)		8.3	6.7	7.7	8.3	7.9	7.0	7.1	7.1	8.2
Tz (s)		6.2	5.3	5.9	6.2	6.0	5.5	5.6	5.6	6.2
Hmax (ft)		21.0	11.5	16.9	21.0	18.4	13.3	13.8	13.8	20.2
THmax (s)		7.4	6.0	6.9	7.4	7.1	6.3	6.4	6.4	7.3
Hc (ft)		13.0	7.1	10.5	13.0	11.4	8.2	8.6	8.6	12.5
Wind Speed (1 hr@33 ft) (ft/s)		49.9	35.8	44.3	49.9	46.5	38.8	39.6	39.6	48.8
Wind Speed (3 sec@33 ft) (ft/s)		64.4	44.9	56.6	64.4	59.5	48.9	50.1	50.1	62.8
Current Speed Surface (ft/s)		0.75	0.54	0.66	0.75	0.70	0.58	0.59	0.59	0.73
Maximum Wind										
Wind Speed (1 hr@33 ft) (ft/s)		50.2	35.4	37.5	42.5	33.2	31.3	30.4	33.4	50.2
Wind Speed (10 min@33 ft) (ft/s)		53.9	37.7	39.9	45.4	35.3	33.2	32.3	35.5	53.9
Wind Speed (1 min@33 ft) (ft/s)		58.6	40.6	43.1	49.2	38.0	35.7	34.7	38.3	58.6
Wind Speed (3 sec@33 ft) (ft/s)		64.7	44.4	47.2	54.0	41.5	38.9	37.8	41.8	64.7

Note: All directions are °FROM

* Please refer to Section 10.9 Associated Current Profiles to find options for deriving associated current profiles using the associated surface current speed in this table.

5.1.2 10-Year Return Period

Table 5.2 10-Year Winter Storm.

Parameter	Compass Direction	Omni-directional	Sector ('from' for waves, winds and currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Maximum Wave										
Hs (ft)	18.0	9.9	14.6	18.0	15.8	11.4	11.9	11.9	11.9	17.3
Tp (s)	9.7	7.8	9.0	9.7	9.3	8.2	8.4	8.4	8.4	9.6
Tz (s)	7.0	6.0	6.6	7.0	6.7	6.2	6.3	6.3	6.3	6.9
Hmax (ft)	32.7	17.9	26.4	32.7	28.8	20.7	21.5	21.5	21.5	31.4
THmax (s)	8.7	7.0	8.1	8.7	8.3	7.4	7.5	7.5	7.5	8.6
Hc (ft)	20.3	11.1	16.4	20.3	17.8	12.9	13.4	13.4	13.4	19.5
Wind Speed (1 hr@33 ft) (ft/s)	63.9	45.8	56.7	63.9	59.4	49.6	50.6	50.6	50.6	62.4
Wind Speed (3 sec@33 ft) (ft/s)	84.3	58.5	73.9	84.3	77.9	63.8	65.3	65.3	65.3	82.3
Current Speed Surface (ft/s)	0.96	0.69	0.85	0.96	0.89	0.74	0.76	0.76	0.76	0.94
Maximum Wind										
Wind Speed (1 hr@33 ft) (ft/s)	67.1	47.3	50.1	56.8	44.4	41.8	40.7	44.7	44.7	67.1
Wind Speed (10 min@33 ft) (ft/s)	72.7	50.7	53.8	61.2	47.5	44.6	43.4	47.8	47.8	72.7
Wind Speed (1 min@33 ft) (ft/s)	79.8	55.0	58.5	66.8	51.5	48.3	47.0	51.8	51.8	79.8
Wind Speed (3 sec@33 ft) (ft/s)	89.1	60.7	64.6	74.1	56.7	53.1	51.6	57.1	57.1	89.1

Note: All directions are °FROM

* Please refer to Section 10.9 Associated Current Profiles to find options for deriving associated current profiles using the associated surface current speed in this table.

5.1.3 100-Year Return Period

Table 5.3 100-Year Winter Storm.

Parameter	Compass Direction	Omni-directional	Sector ('from' for waves, winds and currents)							
			337.5°-22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°-157.5	157.5°-202.5	202.5°-247.5	247.5°-292.5	292.5°-337.5
			N	NE	E	SE	S	SW	W	NW
Maximum Wave										
Hs (ft)		22.8	12.5	18.3	22.8	20.0	14.4	15.0	15.0	21.8
Tp (s)		10.6	8.5	9.8	10.6	10.1	9.0	9.1	9.1	10.4
Tz (s)		7.4	6.3	7.0	7.4	7.1	6.6	6.6	6.6	7.3
Hmax (ft)		41.3	22.6	33.3	41.3	36.2	26.1	27.1	27.1	39.6
THmax (s)		9.5	7.6	8.8	9.5	9.1	8.1	8.2	8.2	9.4
Hc (ft)		25.6	14.0	20.7	25.6	22.5	16.2	16.8	16.8	24.6
Wind Speed (1 hr@33 ft) (ft/s)		72.6	52.0	64.5	72.6	67.6	56.3	57.6	57.6	71.0
Wind Speed (3 sec@33 ft) (ft/s)		97.3	67.3	85.2	97.3	89.8	73.4	75.2	75.2	94.9
Current Speed Surface (ft/s)		1.09	0.78	0.97	1.09	1.01	0.85	0.86	0.86	1.06
Maximum Wind										
Wind Speed (1 hr@33 ft) (ft/s)		81.1	57.2	60.6	68.7	53.7	50.5	49.2	54.0	81.1
Wind Speed (10 min@33 ft) (ft/s)		88.5	61.6	65.4	74.4	57.7	54.2	52.7	58.1	88.5
Wind Speed (1 min@33 ft) (ft/s)		98.0	67.2	71.5	81.8	62.9	59.0	57.3	63.3	98.0
Wind Speed (3 sec@33 ft) (ft/s)		110.3	74.6	79.5	91.4	69.6	65.2	63.3	70.1	110.3

Note: All directions are °FROM

* Please refer to Section 10.9 Associated Current Profiles to find options for deriving associated current profiles using the associated surface current speed in this table.

5.2 Winter Storm Duration and History

Table 5.4 Winter Storm Significant Wave Height and Wind Speed Duration and Event History.

Hours From Peak	Significant Wave Height Hs			Wind Speed Ws			
	Normalized to Peak Value		100 yr Hs Event (ft)	100 yr Tp Event (s)	Normalized to Peak Value	100 yr Ws Event (ft/s)	
	Mean	Std Dev.			Mean		
-24	0.37	0.17	8.36	7.36	0.46	0.21	37.38
-22	0.40	0.18	9.06	7.58	0.49	0.23	39.45
-20	0.43	0.19	9.79	7.79	0.52	0.23	41.78
-18	0.47	0.19	10.59	8.02	0.55	0.21	44.38
-16	0.51	0.19	11.50	8.26	0.59	0.20	48.10
-14	0.56	0.18	12.78	8.58	0.64	0.19	51.55
-12	0.61	0.17	13.93	8.85	0.67	0.19	54.73
-10	0.67	0.16	15.18	9.13	0.72	0.18	58.59
-8	0.72	0.15	16.46	9.40	0.77	0.16	62.26
-6	0.80	0.12	18.12	9.73	0.81	0.15	65.73
-4	0.88	0.06	19.97	10.07	0.87	0.09	70.56
-2	0.96	0.02	21.76	10.39	0.93	0.05	75.73
0	1.00	0.00	22.76	10.56	1.00	0.00	81.11
2	0.97	0.02	22.04	10.44	0.92	0.07	74.97
4	0.91	0.06	20.67	10.20	0.87	0.10	70.48
6	0.84	0.08	19.15	9.92	0.83	0.11	67.64
8	0.78	0.11	17.75	9.66	0.80	0.12	64.79
10	0.72	0.13	16.42	9.39	0.75	0.14	61.03
12	0.67	0.14	15.14	9.12	0.70	0.17	56.64
14	0.62	0.15	14.10	8.89	0.66	0.17	53.48
16	0.58	0.15	13.23	8.69	0.63	0.18	50.87
18	0.55	0.15	12.51	8.51	0.60	0.19	48.81
20	0.52	0.14	11.81	8.34	0.58	0.20	46.87
22	0.49	0.14	11.05	8.14	0.55	0.21	44.47
24	0.44	0.12	10.04	7.87	0.52	0.22	41.99

6. LOOP CURRENT CRITERIA

6.1 Omni-directional All Data, High, Medium and Low Shear Loop Current Surface Current Speed Extremes, Associated Profiles and Normalization Factors

Table 6.1 Omni-directional Loop Current Extremes - All Data Low, Medium, and High Shear.

Profile	Current Speed (ft/s) for Return Period (years)				
	1-year	10-year	25-year	50-year	100-year
Loop Current All	2.31	4.08	4.78	5.31	5.85
Low Shear	0.91	2.05	2.50	2.84	3.18
Medium Shear	1.76	4.23	5.07	5.69	6.29
High Shear	0.71	2.81	3.21	3.48	3.72

Table 6.2 Omni-directional All Data Loop Current Surface Extremes, Associated Profiles and Normalization Factor.

Water Depth (ft)	Normalization Factor	Loop Current Surface Current Speed Extremes (ft/s), associated profiles and normalization factors				
		1-year	10-year	25-year	50-year	100-year
0	1.00	2.31	4.08	4.78	5.31	5.85
82	1.00	2.30	4.07	4.77	5.30	5.84
164	0.98	2.27	4.01	4.71	5.23	5.75
246	0.86	1.99	3.52	4.13	4.59	5.05
328	0.71	1.64	2.90	3.40	3.78	4.16
410	0.60	1.39	2.46	2.89	3.21	3.53
492	0.52	1.21	2.13	2.50	2.78	3.06
574	0.46	1.05	1.86	2.18	2.42	2.67
656	0.40	0.93	1.64	1.93	2.14	2.36
738	0.36	0.83	1.47	1.72	1.91	2.10
820	0.33	0.75	1.33	1.56	1.74	1.91
902	0.30	0.70	1.24	1.45	1.61	1.77
984	0.28	0.64	1.13	1.33	1.47	1.62
1066	0.26	0.60	1.06	1.25	1.39	1.52
1148	0.24	0.56	0.99	1.17	1.30	1.43
1230	0.23	0.54	0.95	1.11	1.24	1.36
1312	0.22	0.51	0.90	1.05	1.17	1.29
1394	0.21	0.47	0.84	0.98	1.09	1.20
1476	0.20	0.45	0.80	0.94	1.04	1.14
1558	0.19	0.44	0.77	0.90	1.00	1.11
1640	0.18	0.42	0.74	0.86	0.96	1.06
1722	0.17	0.40	0.70	0.83	0.92	1.01
1804	0.17	0.39	0.68	0.80	0.89	0.98
1886	0.16	0.37	0.65	0.77	0.85	0.94
1969	0.15	0.36	0.63	0.74	0.82	0.90
2051	0.15	0.35	0.62	0.72	0.80	0.88
2133	0.14	0.33	0.59	0.69	0.77	0.84
2215	0.14	0.33	0.58	0.68	0.75	0.83
2297	0.14	0.32	0.57	0.66	0.74	0.81
2379	0.14	0.32	0.56	0.65	0.73	0.80
2461	0.14	0.31	0.55	0.65	0.72	0.79
2543	0.13	0.30	0.53	0.62	0.68	0.75
2625	0.12	0.28	0.50	0.59	0.65	0.72
2707	0.11	0.26	0.46	0.54	0.61	0.67
2789	0.10	0.24	0.43	0.50	0.56	0.61
2871	0.10	0.22	0.39	0.46	0.51	0.56
2953	0.09	0.20	0.36	0.42	0.46	0.51
3035	0.08	0.18	0.32	0.38	0.42	0.46
3117	0.07	0.17	0.31	0.36	0.40	0.44
3199	0.07	0.17	0.30	0.35	0.39	0.43
3281	0.08	0.17	0.31	0.36	0.40	0.44

Table 6.3 Omni-directional High Shear Loop Current Surface Extremes, Associated Profiles and Normalization Factor.

Water Depth (ft)	Normalization Factor	Loop Current Surface Current Speed Extremes (ft/s), associated profiles and normalization factors				
		1-year	10-year	25-year	50-year	100-year
0	1.00	0.71	2.81	3.21	3.48	3.72
82	0.98	0.70	2.76	3.16	3.42	3.66
164	0.96	0.68	2.68	3.07	3.33	3.56
246	0.81	0.58	2.27	2.60	2.82	3.02
328	0.62	0.44	1.74	2.00	2.16	2.32
410	0.50	0.36	1.41	1.61	1.75	1.87
492	0.46	0.33	1.28	1.47	1.59	1.71
574	0.37	0.26	1.04	1.18	1.28	1.37
656	0.30	0.22	0.85	0.98	1.06	1.13
738	0.25	0.18	0.69	0.79	0.86	0.92
820	0.20	0.14	0.56	0.64	0.69	0.74
902	0.16	0.11	0.44	0.50	0.54	0.58
984	0.09	0.06	0.25	0.28	0.31	0.33
1066	0.10	0.07	0.28	0.32	0.34	0.37
1148	0.12	0.08	0.32	0.37	0.40	0.43
1230	0.13	0.09	0.37	0.43	0.46	0.49
1312	0.14	0.10	0.40	0.46	0.49	0.53
1394	0.15	0.11	0.42	0.48	0.52	0.55
1476	0.14	0.10	0.40	0.46	0.50	0.54
1558	0.14	0.10	0.40	0.46	0.50	0.54
1640	0.14	0.10	0.38	0.43	0.47	0.50
1722	0.13	0.09	0.37	0.42	0.45	0.49
1804	0.13	0.09	0.35	0.41	0.44	0.47
1886	0.12	0.09	0.34	0.39	0.42	0.45
1969	0.12	0.08	0.33	0.37	0.41	0.43
2051	0.11	0.08	0.32	0.37	0.40	0.42
2133	0.11	0.08	0.30	0.35	0.38	0.40
2215	0.11	0.08	0.30	0.34	0.37	0.40
2297	0.10	0.07	0.29	0.34	0.36	0.39
2379	0.10	0.07	0.29	0.33	0.36	0.39
2461	0.10	0.07	0.29	0.33	0.36	0.38
2543	0.10	0.07	0.27	0.31	0.34	0.36
2625	0.09	0.07	0.26	0.30	0.32	0.35
2707	0.09	0.06	0.24	0.27	0.30	0.32
2789	0.08	0.06	0.22	0.25	0.27	0.29
2871	0.07	0.05	0.20	0.23	0.25	0.26
2953	0.06	0.05	0.18	0.21	0.22	0.24
3035	0.06	0.04	0.17	0.19	0.21	0.22
3117	0.06	0.04	0.16	0.18	0.20	0.21
3199	0.06	0.04	0.16	0.18	0.20	0.21
3281	0.06	0.04	0.16	0.19	0.20	0.22

Table 6.4 Omni-directional Medium Shear Loop Current Surface Extremes, Associated Profiles and Normalization Factor.

Water Depth (ft)	Normalization Factor	Loop Current Surface Current Speed Extremes (ft/s), associated profiles and normalization factors				
		1-year	10-year	25-year	50-year	100-year
0	1.00	1.76	4.23	5.07	5.69	6.29
82	1.00	1.76	4.22	5.07	5.68	6.28
164	0.98	1.73	4.16	5.00	5.60	6.19
246	0.87	1.52	3.66	4.39	4.92	5.44
328	0.71	1.26	3.02	3.62	4.06	4.49
410	0.61	1.07	2.56	3.07	3.44	3.81
492	0.52	0.92	2.22	2.66	2.99	3.30
574	0.46	0.81	1.94	2.32	2.61	2.88
656	0.41	0.71	1.71	2.05	2.30	2.55
738	0.36	0.64	1.53	1.84	2.06	2.28
820	0.33	0.58	1.39	1.67	1.87	2.07
902	0.31	0.54	1.30	1.55	1.74	1.93
984	0.28	0.49	1.19	1.42	1.60	1.77
1066	0.26	0.46	1.12	1.34	1.50	1.66
1148	0.25	0.43	1.04	1.25	1.40	1.55
1230	0.24	0.41	0.99	1.19	1.34	1.48
1312	0.22	0.39	0.94	1.12	1.26	1.39
1394	0.21	0.36	0.87	1.05	1.18	1.30
1476	0.20	0.35	0.83	1.00	1.12	1.24
1558	0.19	0.33	0.80	0.96	1.08	1.19
1640	0.18	0.32	0.77	0.92	1.03	1.14
1722	0.17	0.31	0.73	0.88	0.99	1.09
1804	0.17	0.30	0.71	0.85	0.96	1.06
1886	0.16	0.28	0.68	0.82	0.92	1.01
1969	0.16	0.27	0.66	0.79	0.88	0.98
2051	0.15	0.27	0.64	0.77	0.86	0.96
2133	0.14	0.25	0.61	0.74	0.82	0.91
2215	0.14	0.25	0.60	0.72	0.81	0.90
2297	0.14	0.25	0.59	0.71	0.80	0.88
2379	0.14	0.24	0.58	0.70	0.78	0.87
2461	0.14	0.24	0.57	0.69	0.77	0.86
2543	0.13	0.23	0.55	0.66	0.74	0.82
2625	0.12	0.22	0.52	0.63	0.70	0.78
2707	0.11	0.20	0.48	0.58	0.65	0.72
2789	0.11	0.19	0.45	0.54	0.60	0.66
2871	0.10	0.17	0.41	0.49	0.55	0.61
2953	0.09	0.15	0.37	0.45	0.50	0.55
3035	0.08	0.14	0.34	0.40	0.45	0.50
3117	0.08	0.13	0.32	0.38	0.43	0.47
3199	0.07	0.13	0.31	0.37	0.42	0.46
3281	0.08	0.13	0.32	0.39	0.43	0.48

Table 6.5 Omni-directional Low Shear Loop Current Surface Extremes, Associated Profiles and Normalization Factor.

Water Depth (ft)	Normalization Factor	Loop Current Surface Current Speed Extremes (ft/s), associated profiles and normalization factors				
		1-year	10-year	25-year	50-year	100-year
0	1.00	0.91	2.05	2.50	2.84	3.18
82	1.00	0.91	2.04	2.49	2.84	3.18
164	1.01	0.92	2.07	2.52	2.87	3.21
246	0.89	0.82	1.83	2.23	2.54	2.84
328	0.83	0.76	1.70	2.08	2.36	2.65
410	0.79	0.72	1.61	1.97	2.24	2.51
492	0.64	0.58	1.30	1.59	1.81	2.02
574	0.57	0.52	1.17	1.43	1.63	1.82
656	0.53	0.48	1.08	1.32	1.50	1.68
738	0.48	0.44	0.98	1.20	1.36	1.53
820	0.49	0.45	1.01	1.23	1.40	1.57
902	0.53	0.49	1.09	1.32	1.50	1.69
984	0.55	0.50	1.12	1.37	1.55	1.74
1066	0.48	0.44	0.98	1.20	1.36	1.53
1148	0.40	0.37	0.82	1.00	1.14	1.27
1230	0.34	0.31	0.70	0.85	0.96	1.08
1312	0.30	0.27	0.61	0.75	0.85	0.95
1394	0.28	0.26	0.58	0.71	0.81	0.90
1476	0.27	0.25	0.55	0.68	0.77	0.86
1558	0.27	0.24	0.55	0.67	0.76	0.85
1640	0.25	0.23	0.51	0.62	0.70	0.79
1722	0.23	0.21	0.47	0.57	0.65	0.73
1804	0.22	0.20	0.45	0.54	0.62	0.69
1886	0.21	0.19	0.42	0.52	0.59	0.66
1969	0.20	0.18	0.40	0.49	0.55	0.62
2051	0.19	0.17	0.39	0.47	0.54	0.60
2133	0.18	0.16	0.37	0.45	0.51	0.57
2215	0.17	0.16	0.35	0.43	0.49	0.55
2297	0.17	0.15	0.34	0.42	0.47	0.53
2379	0.16	0.15	0.33	0.40	0.46	0.51
2461	0.16	0.14	0.32	0.39	0.44	0.49
2543	0.15	0.13	0.30	0.36	0.41	0.46
2625	0.13	0.12	0.28	0.34	0.38	0.43
2707	0.12	0.11	0.25	0.30	0.34	0.38
2789	0.11	0.10	0.22	0.27	0.31	0.34
2871	0.10	0.09	0.20	0.24	0.28	0.31
2953	0.09	0.08	0.18	0.22	0.25	0.28
3035	0.09	0.08	0.18	0.21	0.24	0.27
3117	0.09	0.08	0.18	0.21	0.24	0.27
3199	0.09	0.08	0.18	0.22	0.25	0.28
3281	0.09	0.08	0.17	0.21	0.24	0.27

6.2 Directional Loop Current Surface Current Speed Extremes, Associated Profile

6.2.1 1-Year All Data, High, Medium And Low Shear Current Surface Extremes And Associated Profiles

Table 6.6 1-year Directional All Data Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
N	NE	E	SE	S	SW	W	NW	
0	0.81	0.05	0.60	0.42	1.20	1.59	2.31	1.90
82	0.81	0.05	0.60	0.42	1.20	1.59	2.30	1.90
164	0.79	0.05	0.59	0.41	1.18	1.57	2.27	1.87
246	0.70	0.04	0.52	0.36	1.03	1.37	1.99	1.64
328	0.57	0.04	0.43	0.30	0.85	1.13	1.64	1.35
410	0.49	0.03	0.36	0.25	0.72	0.96	1.39	1.15
492	0.42	0.03	0.32	0.22	0.63	0.83	1.21	0.99
574	0.37	0.02	0.28	0.19	0.55	0.73	1.05	0.87
656	0.33	0.02	0.24	0.17	0.48	0.64	0.93	0.77
738	0.29	0.02	0.22	0.15	0.43	0.57	0.83	0.68
820	0.26	0.02	0.20	0.14	0.39	0.52	0.75	0.62
902	0.25	0.02	0.18	0.13	0.36	0.48	0.70	0.58
984	0.22	0.01	0.17	0.12	0.33	0.44	0.64	0.53
1066	0.21	0.01	0.16	0.11	0.31	0.41	0.60	0.50
1148	0.20	0.01	0.15	0.10	0.29	0.39	0.56	0.46
1230	0.19	0.01	0.14	0.10	0.28	0.37	0.54	0.44
1312	0.18	0.01	0.13	0.09	0.26	0.35	0.51	0.42
1394	0.17	0.01	0.12	0.09	0.25	0.33	0.47	0.39
1476	0.16	0.01	0.12	0.08	0.23	0.31	0.45	0.37
1558	0.15	0.01	0.11	0.08	0.23	0.30	0.44	0.36
1640	0.15	0.01	0.11	0.08	0.22	0.29	0.42	0.34
1722	0.14	0.01	0.10	0.07	0.21	0.28	0.40	0.33
1804	0.13	0.01	0.10	0.07	0.20	0.27	0.39	0.32
1886	0.13	0.01	0.10	0.07	0.19	0.25	0.37	0.30
1969	0.12	0.01	0.09	0.06	0.18	0.25	0.36	0.29
2051	0.12	0.01	0.09	0.06	0.18	0.24	0.35	0.29
2133	0.12	0.01	0.09	0.06	0.17	0.23	0.33	0.27
2215	0.11	0.01	0.09	0.06	0.17	0.23	0.33	0.27
2297	0.11	0.01	0.08	0.06	0.17	0.22	0.32	0.26
2379	0.11	0.01	0.08	0.06	0.16	0.22	0.32	0.26
2461	0.11	0.01	0.08	0.06	0.16	0.22	0.31	0.26
2543	0.10	0.01	0.08	0.05	0.15	0.21	0.30	0.24
2625	0.10	0.01	0.07	0.05	0.15	0.20	0.28	0.23
2707	0.09	0.01	0.07	0.05	0.14	0.18	0.26	0.22
2789	0.08	0.01	0.06	0.04	0.13	0.17	0.24	0.20
2871	0.08	0.00	0.06	0.04	0.12	0.15	0.22	0.18
2953	0.07	0.00	0.05	0.04	0.10	0.14	0.20	0.17
3035	0.06	0.00	0.05	0.03	0.10	0.13	0.18	0.15
3117	0.06	0.00	0.05	0.03	0.09	0.12	0.17	0.14
3199	0.06	0.00	0.04	0.03	0.09	0.12	0.17	0.14
3281	0.06	0.00	0.05	0.03	0.09	0.12	0.17	0.14

Table 6.7 1-year Directional High Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
N	NE	E	SE	S	SW	W	NW	
0	0.21	0.00	0.00	0.00	0.55	0.71	0.71	0.61
82	0.21	0.00	0.00	0.00	0.54	0.70	0.69	0.60
164	0.20	0.00	0.00	0.00	0.52	0.68	0.67	0.59
246	0.17	0.00	0.00	0.00	0.44	0.58	0.57	0.50
328	0.13	0.00	0.00	0.00	0.34	0.44	0.44	0.38
410	0.11	0.00	0.00	0.00	0.28	0.36	0.35	0.31
492	0.10	0.00	0.00	0.00	0.25	0.33	0.32	0.28
574	0.08	0.00	0.00	0.00	0.20	0.26	0.26	0.23
656	0.07	0.00	0.00	0.00	0.17	0.22	0.21	0.19
738	0.05	0.00	0.00	0.00	0.14	0.18	0.17	0.15
820	0.04	0.00	0.00	0.00	0.11	0.14	0.14	0.12
902	0.03	0.00	0.00	0.00	0.09	0.11	0.11	0.10
984	0.02	0.00	0.00	0.00	0.05	0.06	0.06	0.05
1066	0.02	0.00	0.00	0.00	0.05	0.07	0.07	0.06
1148	0.02	0.00	0.00	0.00	0.06	0.08	0.08	0.07
1230	0.03	0.00	0.00	0.00	0.07	0.09	0.09	0.08
1312	0.03	0.00	0.00	0.00	0.08	0.10	0.10	0.09
1394	0.03	0.00	0.00	0.00	0.08	0.11	0.11	0.09
1476	0.03	0.00	0.00	0.00	0.08	0.10	0.10	0.09
1558	0.03	0.00	0.00	0.00	0.08	0.10	0.10	0.09
1640	0.03	0.00	0.00	0.00	0.07	0.10	0.10	0.08
1722	0.03	0.00	0.00	0.00	0.07	0.09	0.09	0.08
1804	0.03	0.00	0.00	0.00	0.07	0.09	0.09	0.08
1886	0.03	0.00	0.00	0.00	0.07	0.09	0.09	0.07
1969	0.02	0.00	0.00	0.00	0.06	0.08	0.08	0.07
2051	0.02	0.00	0.00	0.00	0.06	0.08	0.08	0.07
2133	0.02	0.00	0.00	0.00	0.06	0.08	0.08	0.07
2215	0.02	0.00	0.00	0.00	0.06	0.08	0.08	0.07
2297	0.02	0.00	0.00	0.00	0.06	0.07	0.07	0.06
2379	0.02	0.00	0.00	0.00	0.06	0.07	0.07	0.06
2461	0.02	0.00	0.00	0.00	0.06	0.07	0.07	0.06
2543	0.02	0.00	0.00	0.00	0.05	0.07	0.07	0.06
2625	0.02	0.00	0.00	0.00	0.05	0.07	0.07	0.06
2707	0.02	0.00	0.00	0.00	0.05	0.06	0.06	0.05
2789	0.02	0.00	0.00	0.00	0.04	0.06	0.05	0.05
2871	0.02	0.00	0.00	0.00	0.04	0.05	0.05	0.04
2953	0.01	0.00	0.00	0.00	0.04	0.05	0.05	0.04
3035	0.01	0.00	0.00	0.00	0.03	0.04	0.04	0.04
3117	0.01	0.00	0.00	0.00	0.03	0.04	0.04	0.04
3199	0.01	0.00	0.00	0.00	0.03	0.04	0.04	0.03
3281	0.01	0.00	0.00	0.00	0.03	0.04	0.04	0.04

Table 6.8 1-year Directional Medium Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	0.62	0.00	0.04	0.10	0.91	1.21	1.76	1.45
82	0.62	0.00	0.04	0.10	0.91	1.21	1.76	1.45
164	0.61	0.00	0.04	0.10	0.90	1.20	1.73	1.43
246	0.53	0.00	0.03	0.09	0.79	1.05	1.52	1.25
328	0.44	0.00	0.03	0.07	0.65	0.87	1.26	1.03
410	0.37	0.00	0.02	0.06	0.55	0.73	1.07	0.88
492	0.32	0.00	0.02	0.06	0.48	0.64	0.92	0.76
574	0.28	0.00	0.02	0.05	0.42	0.56	0.81	0.66
656	0.25	0.00	0.02	0.04	0.37	0.49	0.71	0.59
738	0.22	0.00	0.01	0.04	0.33	0.44	0.64	0.52
820	0.20	0.00	0.01	0.03	0.30	0.40	0.58	0.48
902	0.19	0.00	0.01	0.03	0.28	0.37	0.54	0.44
984	0.17	0.00	0.01	0.03	0.26	0.34	0.49	0.41
1066	0.16	0.00	0.01	0.03	0.24	0.32	0.46	0.38
1148	0.15	0.00	0.01	0.03	0.23	0.30	0.43	0.36
1230	0.14	0.00	0.01	0.02	0.21	0.29	0.41	0.34
1312	0.14	0.00	0.01	0.02	0.20	0.27	0.39	0.32
1394	0.13	0.00	0.01	0.02	0.19	0.25	0.36	0.30
1476	0.12	0.00	0.01	0.02	0.18	0.24	0.35	0.29
1558	0.12	0.00	0.01	0.02	0.17	0.23	0.33	0.27
1640	0.11	0.00	0.01	0.02	0.17	0.22	0.32	0.26
1722	0.11	0.00	0.01	0.02	0.16	0.21	0.31	0.25
1804	0.10	0.00	0.01	0.02	0.15	0.20	0.30	0.24
1886	0.10	0.00	0.01	0.02	0.15	0.20	0.28	0.23
1969	0.10	0.00	0.01	0.02	0.14	0.19	0.27	0.22
2051	0.09	0.00	0.01	0.02	0.14	0.18	0.27	0.22
2133	0.09	0.00	0.01	0.02	0.13	0.18	0.25	0.21
2215	0.09	0.00	0.01	0.01	0.13	0.17	0.25	0.21
2297	0.09	0.00	0.01	0.01	0.13	0.17	0.25	0.20
2379	0.08	0.00	0.01	0.01	0.13	0.17	0.24	0.20
2461	0.08	0.00	0.01	0.01	0.12	0.16	0.24	0.20
2543	0.08	0.00	0.01	0.01	0.12	0.16	0.23	0.19
2625	0.08	0.00	0.00	0.01	0.11	0.15	0.22	0.18
2707	0.07	0.00	0.00	0.01	0.10	0.14	0.20	0.17
2789	0.06	0.00	0.00	0.01	0.10	0.13	0.19	0.15
2871	0.06	0.00	0.00	0.01	0.09	0.12	0.17	0.14
2953	0.05	0.00	0.00	0.01	0.08	0.11	0.15	0.13
3035	0.05	0.00	0.00	0.01	0.07	0.10	0.14	0.12
3117	0.05	0.00	0.00	0.01	0.07	0.09	0.13	0.11
3199	0.05	0.00	0.00	0.01	0.07	0.09	0.13	0.11
3281								

Table 6.9 1-year Directional Loop Low Shear Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
N	NE	E	SE	S	SW	W	NW	
0	0.46	0.04	0.49	0.34	0.80	0.80	0.91	0.86
82	0.46	0.04	0.49	0.34	0.80	0.79	0.91	0.86
164	0.47	0.04	0.50	0.34	0.81	0.80	0.92	0.87
246	0.41	0.04	0.44	0.30	0.72	0.71	0.82	0.77
328	0.38	0.03	0.41	0.28	0.67	0.66	0.76	0.71
410	0.36	0.03	0.39	0.27	0.63	0.63	0.72	0.68
492	0.29	0.03	0.31	0.22	0.51	0.51	0.58	0.55
574	0.26	0.02	0.28	0.19	0.46	0.46	0.52	0.49
656	0.24	0.02	0.26	0.18	0.42	0.42	0.48	0.45
738	0.22	0.02	0.24	0.16	0.39	0.38	0.44	0.41
820	0.23	0.02	0.24	0.17	0.40	0.39	0.45	0.42
902	0.24	0.02	0.26	0.18	0.42	0.42	0.49	0.45
984	0.25	0.02	0.27	0.19	0.44	0.44	0.50	0.47
1066	0.22	0.02	0.24	0.16	0.39	0.38	0.44	0.41
1148	0.18	0.02	0.20	0.14	0.32	0.32	0.37	0.34
1230	0.16	0.01	0.17	0.12	0.27	0.27	0.31	0.29
1312	0.14	0.01	0.15	0.10	0.24	0.24	0.27	0.26
1394	0.13	0.01	0.14	0.10	0.23	0.23	0.26	0.24
1476	0.12	0.01	0.13	0.09	0.22	0.22	0.25	0.23
1558	0.12	0.01	0.13	0.09	0.21	0.21	0.24	0.23
1640	0.11	0.01	0.12	0.08	0.20	0.20	0.23	0.21
1722	0.11	0.01	0.11	0.08	0.18	0.18	0.21	0.20
1804	0.10	0.01	0.11	0.07	0.17	0.17	0.20	0.19
1886	0.10	0.01	0.10	0.07	0.17	0.16	0.19	0.18
1969	0.09	0.01	0.10	0.07	0.16	0.16	0.18	0.17
2051	0.09	0.01	0.09	0.06	0.15	0.15	0.17	0.16
2133	0.08	0.01	0.09	0.06	0.14	0.14	0.16	0.15
2215	0.08	0.01	0.09	0.06	0.14	0.14	0.16	0.15
2297	0.08	0.01	0.08	0.06	0.13	0.13	0.15	0.14
2379	0.07	0.01	0.08	0.05	0.13	0.13	0.15	0.14
2461	0.07	0.01	0.08	0.05	0.12	0.12	0.14	0.13
2543	0.07	0.01	0.07	0.05	0.12	0.12	0.13	0.12
2625	0.06	0.01	0.07	0.05	0.11	0.11	0.12	0.12
2707	0.06	0.00	0.06	0.04	0.10	0.10	0.11	0.10
2789	0.05	0.00	0.05	0.04	0.09	0.09	0.10	0.09
2871	0.04	0.00	0.05	0.03	0.08	0.08	0.09	0.08
2953	0.04	0.00	0.04	0.03	0.07	0.07	0.08	0.08
3035	0.04	0.00	0.04	0.03	0.07	0.07	0.08	0.07
3117	0.04	0.00	0.04	0.03	0.07	0.07	0.08	0.07
3199	0.04	0.00	0.04	0.03	0.07	0.07	0.08	0.07
3281	0.04	0.00	0.04	0.03	0.07	0.07	0.08	0.07

6.2.2 10-Year High, Medium And Low Shear Current Surface Extremes And Associated Profiles

Table 6.10 10-year Directional All Data Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles								
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5	
N	NE	E	SE	S	SW	W	NW		
0	1.43	0.09	1.07	0.74	2.12	2.81	4.08	3.36	
82	1.42	0.09	1.06	0.73	2.11	2.81	4.07	3.35	
164	1.41	0.09	1.05	0.72	2.08	2.77	4.01	3.30	
246	1.23	0.08	0.92	0.64	1.83	2.43	3.52	2.90	
328	1.02	0.06	0.76	0.52	1.51	2.00	2.90	2.39	
410	0.86	0.05	0.64	0.44	1.28	1.70	2.46	2.03	
492	0.75	0.05	0.56	0.39	1.11	1.47	2.13	1.76	
574	0.65	0.04	0.49	0.34	0.97	1.28	1.86	1.53	
656	0.58	0.04	0.43	0.30	0.85	1.13	1.64	1.35	
738	0.51	0.03	0.38	0.26	0.76	1.01	1.47	1.21	
820	0.47	0.03	0.35	0.24	0.69	0.92	1.33	1.10	
902	0.43	0.03	0.32	0.22	0.64	0.85	1.24	1.02	
984	0.40	0.02	0.30	0.20	0.59	0.78	1.13	0.93	
1066	0.37	0.02	0.28	0.19	0.55	0.73	1.06	0.88	
1148	0.35	0.02	0.26	0.18	0.52	0.69	0.99	0.82	
1230	0.33	0.02	0.25	0.17	0.49	0.66	0.95	0.78	
1312	0.31	0.02	0.23	0.16	0.47	0.62	0.90	0.74	
1394	0.29	0.02	0.22	0.15	0.44	0.58	0.84	0.69	
1476	0.28	0.02	0.21	0.14	0.41	0.55	0.80	0.66	
1558	0.27	0.02	0.20	0.14	0.40	0.53	0.77	0.63	
1640	0.26	0.02	0.19	0.13	0.38	0.51	0.74	0.61	
1722	0.25	0.02	0.18	0.13	0.37	0.49	0.70	0.58	
1804	0.24	0.01	0.18	0.12	0.35	0.47	0.68	0.56	
1886	0.23	0.01	0.17	0.12	0.34	0.45	0.65	0.54	
1969	0.22	0.01	0.16	0.11	0.33	0.43	0.63	0.52	
2051	0.22	0.01	0.16	0.11	0.32	0.42	0.62	0.51	
2133	0.21	0.01	0.15	0.11	0.31	0.41	0.59	0.48	
2215	0.20	0.01	0.15	0.10	0.30	0.40	0.58	0.48	
2297	0.20	0.01	0.15	0.10	0.29	0.39	0.57	0.47	
2379	0.20	0.01	0.15	0.10	0.29	0.38	0.56	0.46	
2461	0.19	0.01	0.14	0.10	0.29	0.38	0.55	0.45	
2543	0.18	0.01	0.14	0.09	0.27	0.36	0.53	0.43	
2625	0.18	0.01	0.13	0.09	0.26	0.35	0.50	0.41	
2707	0.16	0.01	0.12	0.08	0.24	0.32	0.46	0.38	
2789	0.15	0.01	0.11	0.08	0.22	0.29	0.43	0.35	
2871	0.14	0.01	0.10	0.07	0.20	0.27	0.39	0.32	
2953	0.12	0.01	0.09	0.06	0.19	0.25	0.36	0.29	
3035	0.11	0.01	0.08	0.06	0.17	0.22	0.32	0.27	
3117	0.11	0.01	0.08	0.06	0.16	0.21	0.31	0.25	
3199	0.10	0.01	0.08	0.05	0.16	0.21	0.30	0.25	
3281	0.11	0.01	0.08	0.06	0.16	0.21	0.31	0.25	

Table 6.11 10-year Directional High Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	10-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	0.84	0.00	0.00	0.00	2.15	2.81	2.77	2.41
82	0.83	0.00	0.00	0.00	2.11	2.76	2.72	2.37
164	0.80	0.00	0.00	0.00	2.05	2.68	2.65	2.31
246	0.68	0.00	0.00	0.00	1.74	2.27	2.25	1.95
328	0.52	0.00	0.00	0.00	1.34	1.74	1.72	1.50
410	0.42	0.00	0.00	0.00	1.08	1.41	1.39	1.21
492	0.39	0.00	0.00	0.00	0.98	1.28	1.27	1.10
574	0.31	0.00	0.00	0.00	0.79	1.04	1.02	0.89
656	0.26	0.00	0.00	0.00	0.65	0.85	0.84	0.73
738	0.21	0.00	0.00	0.00	0.53	0.69	0.69	0.60
820	0.17	0.00	0.00	0.00	0.43	0.56	0.55	0.48
902	0.13	0.00	0.00	0.00	0.34	0.44	0.43	0.38
984	0.07	0.00	0.00	0.00	0.19	0.25	0.25	0.21
1066	0.08	0.00	0.00	0.00	0.21	0.28	0.27	0.24
1148	0.10	0.00	0.00	0.00	0.25	0.32	0.32	0.28
1230	0.11	0.00	0.00	0.00	0.29	0.37	0.37	0.32
1312	0.12	0.00	0.00	0.00	0.31	0.40	0.39	0.34
1394	0.13	0.00	0.00	0.00	0.32	0.42	0.41	0.36
1476	0.12	0.00	0.00	0.00	0.31	0.40	0.40	0.35
1558	0.12	0.00	0.00	0.00	0.31	0.40	0.40	0.35
1640	0.11	0.00	0.00	0.00	0.29	0.38	0.38	0.33
1722	0.11	0.00	0.00	0.00	0.28	0.37	0.36	0.31
1804	0.11	0.00	0.00	0.00	0.27	0.35	0.35	0.31
1886	0.10	0.00	0.00	0.00	0.26	0.34	0.34	0.29
1969	0.10	0.00	0.00	0.00	0.25	0.33	0.32	0.28
2051	0.10	0.00	0.00	0.00	0.25	0.32	0.32	0.28
2133	0.09	0.00	0.00	0.00	0.23	0.30	0.30	0.26
2215	0.09	0.00	0.00	0.00	0.23	0.30	0.30	0.26
2297	0.09	0.00	0.00	0.00	0.23	0.29	0.29	0.25
2379	0.09	0.00	0.00	0.00	0.22	0.29	0.29	0.25
2461	0.09	0.00	0.00	0.00	0.22	0.29	0.28	0.25
2543	0.08	0.00	0.00	0.00	0.21	0.27	0.27	0.24
2625	0.08	0.00	0.00	0.00	0.20	0.26	0.26	0.22
2707	0.07	0.00	0.00	0.00	0.18	0.24	0.24	0.21
2789	0.07	0.00	0.00	0.00	0.17	0.22	0.22	0.19
2871	0.06	0.00	0.00	0.00	0.15	0.20	0.20	0.17
2953	0.05	0.00	0.00	0.00	0.14	0.18	0.18	0.16
3035	0.05	0.00	0.00	0.00	0.13	0.17	0.17	0.14
3117	0.05	0.00	0.00	0.00	0.12	0.16	0.16	0.14
3199	0.05	0.00	0.00	0.00	0.12	0.16	0.16	0.14
3281	0.05	0.00	0.00	0.00	0.12	0.16	0.16	0.14

Table 6.12 10-year Directional Medium Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	10-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.48	0.00	0.10	0.25	2.20	2.92	4.23	3.48
82	1.48	0.00	0.10	0.25	2.19	2.91	4.22	3.48
164	1.46	0.00	0.09	0.25	2.16	2.87	4.16	3.43
246	1.28	0.00	0.08	0.22	1.90	2.52	3.66	3.01
328	1.06	0.00	0.07	0.18	1.57	2.08	3.02	2.48
410	0.90	0.00	0.06	0.15	1.33	1.77	2.56	2.11
492	0.78	0.00	0.05	0.13	1.15	1.53	2.22	1.83
574	0.68	0.00	0.04	0.12	1.01	1.34	1.94	1.59
656	0.60	0.00	0.04	0.10	0.89	1.18	1.71	1.41
738	0.54	0.00	0.03	0.09	0.79	1.06	1.53	1.26
820	0.49	0.00	0.03	0.08	0.72	0.96	1.39	1.15
902	0.45	0.00	0.03	0.08	0.67	0.89	1.30	1.07
984	0.42	0.00	0.03	0.07	0.62	0.82	1.19	0.98
1066	0.39	0.00	0.03	0.07	0.58	0.77	1.12	0.92
1148	0.37	0.00	0.02	0.06	0.54	0.72	1.04	0.86
1230	0.35	0.00	0.02	0.06	0.52	0.69	0.99	0.82
1312	0.33	0.00	0.02	0.06	0.49	0.65	0.94	0.77
1394	0.31	0.00	0.02	0.05	0.45	0.60	0.87	0.72
1476	0.29	0.00	0.02	0.05	0.43	0.57	0.83	0.69
1558	0.28	0.00	0.02	0.05	0.42	0.55	0.80	0.66
1640	0.27	0.00	0.02	0.05	0.40	0.53	0.77	0.63
1722	0.26	0.00	0.02	0.04	0.38	0.51	0.73	0.60
1804	0.25	0.00	0.02	0.04	0.37	0.49	0.71	0.58
1886	0.24	0.00	0.02	0.04	0.35	0.47	0.68	0.56
1969	0.23	0.00	0.01	0.04	0.34	0.45	0.66	0.54
2051	0.22	0.00	0.01	0.04	0.33	0.44	0.64	0.53
2133	0.21	0.00	0.01	0.04	0.32	0.42	0.61	0.50
2215	0.21	0.00	0.01	0.04	0.31	0.42	0.60	0.50
2297	0.21	0.00	0.01	0.04	0.31	0.41	0.59	0.49
2379	0.20	0.00	0.01	0.03	0.30	0.40	0.58	0.48
2461	0.20	0.00	0.01	0.03	0.30	0.40	0.57	0.47
2543	0.19	0.00	0.01	0.03	0.28	0.38	0.55	0.45
2625	0.18	0.00	0.01	0.03	0.27	0.36	0.52	0.43
2707	0.17	0.00	0.01	0.03	0.25	0.33	0.48	0.40
2789	0.16	0.00	0.01	0.03	0.23	0.31	0.45	0.37
2871	0.14	0.00	0.01	0.02	0.21	0.28	0.41	0.34
2953	0.13	0.00	0.01	0.02	0.19	0.26	0.37	0.31
3035	0.12	0.00	0.01	0.02	0.18	0.23	0.34	0.28
3117	0.11	0.00	0.01	0.02	0.17	0.22	0.32	0.26
3199	0.11	0.00	0.01	0.02	0.16	0.21	0.31	0.26
3281	0.11	0.00	0.01	0.02	0.17	0.22	0.32	0.27

Table 6.13 10-year Directional Low Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	10-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.03	0.09	1.10	0.76	1.79	1.78	2.05	1.92
82	1.03	0.09	1.10	0.76	1.79	1.78	2.04	1.92
164	1.04	0.09	1.12	0.77	1.81	1.80	2.07	1.94
246	0.92	0.08	0.99	0.68	1.60	1.59	1.83	1.71
328	0.86	0.08	0.92	0.63	1.49	1.48	1.70	1.60
410	0.81	0.07	0.87	0.60	1.41	1.40	1.61	1.51
492	0.66	0.06	0.70	0.48	1.14	1.13	1.30	1.22
574	0.59	0.05	0.63	0.44	1.03	1.02	1.17	1.10
656	0.55	0.05	0.58	0.40	0.95	0.94	1.08	1.02
738	0.50	0.04	0.53	0.37	0.86	0.86	0.98	0.92
820	0.51	0.05	0.55	0.38	0.89	0.88	1.01	0.95
902	0.55	0.05	0.59	0.40	0.95	0.94	1.09	1.02
984	0.56	0.05	0.60	0.42	0.98	0.97	1.12	1.05
1066	0.49	0.04	0.53	0.37	0.86	0.86	0.98	0.92
1148	0.41	0.04	0.44	0.30	0.72	0.71	0.82	0.77
1230	0.35	0.03	0.37	0.26	0.61	0.60	0.70	0.65
1312	0.31	0.03	0.33	0.23	0.54	0.53	0.61	0.57
1394	0.29	0.03	0.31	0.22	0.51	0.51	0.58	0.55
1476	0.28	0.02	0.30	0.21	0.49	0.48	0.55	0.52
1558	0.28	0.02	0.29	0.20	0.48	0.48	0.55	0.51
1640	0.26	0.02	0.27	0.19	0.44	0.44	0.51	0.48
1722	0.24	0.02	0.25	0.17	0.41	0.41	0.47	0.44
1804	0.22	0.02	0.24	0.17	0.39	0.39	0.45	0.42
1886	0.21	0.02	0.23	0.16	0.37	0.37	0.42	0.40
1969	0.20	0.02	0.22	0.15	0.35	0.35	0.40	0.37
2051	0.20	0.02	0.21	0.14	0.34	0.34	0.39	0.36
2133	0.18	0.02	0.20	0.14	0.32	0.32	0.37	0.34
2215	0.18	0.02	0.19	0.13	0.31	0.31	0.35	0.33
2297	0.17	0.02	0.18	0.13	0.30	0.30	0.34	0.32
2379	0.17	0.01	0.18	0.12	0.29	0.29	0.33	0.31
2461	0.16	0.01	0.17	0.12	0.28	0.28	0.32	0.30
2543	0.15	0.01	0.16	0.11	0.26	0.26	0.30	0.28
2625	0.14	0.01	0.15	0.10	0.24	0.24	0.28	0.26
2707	0.12	0.01	0.13	0.09	0.22	0.21	0.25	0.23
2789	0.11	0.01	0.12	0.08	0.19	0.19	0.22	0.21
2871	0.10	0.01	0.11	0.07	0.17	0.17	0.20	0.19
2953	0.09	0.01	0.10	0.07	0.16	0.16	0.18	0.17
3035	0.09	0.01	0.09	0.07	0.15	0.15	0.18	0.16
3117	0.09	0.01	0.09	0.07	0.15	0.15	0.18	0.16
3199	0.09	0.01	0.10	0.07	0.16	0.15	0.18	0.17
3281	0.09	0.01	0.09	0.06	0.15	0.15	0.17	0.16

6.2.3 25-Year High, Medium And Low Shear Current Surface Extremes And Associated Profiles

Table 6.14 25-year Directional All Data Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles								
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5	
N	NE	E	SE	S	SW	W	NW		
0	1.67	0.10	1.25	0.86	2.48	3.30	4.78	3.94	
82	1.67	0.10	1.25	0.86	2.48	3.29	4.77	3.93	
164	1.65	0.10	1.23	0.85	2.44	3.25	4.71	3.87	
246	1.45	0.09	1.08	0.74	2.15	2.85	4.13	3.40	
328	1.19	0.07	0.89	0.61	1.77	2.35	3.40	2.80	
410	1.01	0.06	0.76	0.52	1.50	1.99	2.89	2.38	
492	0.88	0.05	0.65	0.45	1.30	1.73	2.50	2.06	
574	0.76	0.05	0.57	0.39	1.13	1.50	2.18	1.80	
656	0.67	0.04	0.50	0.35	1.00	1.33	1.93	1.59	
738	0.60	0.04	0.45	0.31	0.89	1.19	1.72	1.42	
820	0.55	0.03	0.41	0.28	0.81	1.08	1.56	1.29	
902	0.51	0.03	0.38	0.26	0.75	1.00	1.45	1.19	
984	0.46	0.03	0.35	0.24	0.69	0.91	1.33	1.09	
1066	0.44	0.03	0.33	0.22	0.65	0.86	1.25	1.03	
1148	0.41	0.03	0.31	0.21	0.61	0.80	1.17	0.96	
1230	0.39	0.02	0.29	0.20	0.58	0.77	1.11	0.92	
1312	0.37	0.02	0.27	0.19	0.55	0.72	1.05	0.87	
1394	0.34	0.02	0.26	0.18	0.51	0.68	0.98	0.81	
1476	0.33	0.02	0.24	0.17	0.49	0.65	0.94	0.77	
1558	0.32	0.02	0.24	0.16	0.47	0.62	0.90	0.74	
1640	0.30	0.02	0.23	0.16	0.45	0.60	0.86	0.71	
1722	0.29	0.02	0.22	0.15	0.43	0.57	0.83	0.68	
1804	0.28	0.02	0.21	0.14	0.41	0.55	0.80	0.66	
1886	0.27	0.02	0.20	0.14	0.40	0.53	0.77	0.63	
1969	0.26	0.02	0.19	0.13	0.38	0.51	0.74	0.61	
2051	0.25	0.02	0.19	0.13	0.38	0.50	0.72	0.59	
2133	0.24	0.01	0.18	0.12	0.36	0.48	0.69	0.57	
2215	0.24	0.01	0.18	0.12	0.35	0.47	0.68	0.56	
2297	0.23	0.01	0.17	0.12	0.35	0.46	0.66	0.55	
2379	0.23	0.01	0.17	0.12	0.34	0.45	0.65	0.54	
2461	0.23	0.01	0.17	0.12	0.34	0.45	0.65	0.53	
2543	0.22	0.01	0.16	0.11	0.32	0.43	0.62	0.51	
2625	0.21	0.01	0.15	0.11	0.31	0.41	0.59	0.48	
2707	0.19	0.01	0.14	0.10	0.28	0.38	0.54	0.45	
2789	0.18	0.01	0.13	0.09	0.26	0.35	0.50	0.41	
2871	0.16	0.01	0.12	0.08	0.24	0.32	0.46	0.38	
2953	0.15	0.01	0.11	0.08	0.22	0.29	0.42	0.34	
3035	0.13	0.01	0.10	0.07	0.20	0.26	0.38	0.31	
3117	0.13	0.01	0.09	0.06	0.19	0.25	0.36	0.30	
3199	0.12	0.01	0.09	0.06	0.18	0.24	0.35	0.29	
3281	0.13	0.01	0.09	0.07	0.19	0.25	0.36	0.30	

Table 6.15 25-year Directional High Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	25-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	0.96	0.00	0.00	0.00	2.46	3.21	3.17	2.76
82	0.95	0.00	0.00	0.00	2.42	3.16	3.12	2.71
164	0.92	0.00	0.00	0.00	2.35	3.07	3.03	2.64
246	0.78	0.00	0.00	0.00	1.99	2.60	2.57	2.24
328	0.60	0.00	0.00	0.00	1.53	2.00	1.97	1.72
410	0.48	0.00	0.00	0.00	1.24	1.61	1.59	1.39
492	0.44	0.00	0.00	0.00	1.13	1.47	1.45	1.26
574	0.36	0.00	0.00	0.00	0.91	1.18	1.17	1.02
656	0.29	0.00	0.00	0.00	0.75	0.98	0.96	0.84
738	0.24	0.00	0.00	0.00	0.61	0.79	0.79	0.68
820	0.19	0.00	0.00	0.00	0.49	0.64	0.63	0.55
902	0.15	0.00	0.00	0.00	0.38	0.50	0.50	0.43
984	0.09	0.00	0.00	0.00	0.22	0.28	0.28	0.24
1066	0.10	0.00	0.00	0.00	0.24	0.32	0.31	0.27
1148	0.11	0.00	0.00	0.00	0.28	0.37	0.37	0.32
1230	0.13	0.00	0.00	0.00	0.33	0.43	0.42	0.37
1312	0.14	0.00	0.00	0.00	0.35	0.46	0.45	0.39
1394	0.14	0.00	0.00	0.00	0.37	0.48	0.47	0.41
1476	0.14	0.00	0.00	0.00	0.35	0.46	0.46	0.40
1558	0.14	0.00	0.00	0.00	0.35	0.46	0.46	0.40
1640	0.13	0.00	0.00	0.00	0.33	0.43	0.43	0.37
1722	0.13	0.00	0.00	0.00	0.32	0.42	0.41	0.36
1804	0.12	0.00	0.00	0.00	0.31	0.41	0.40	0.35
1886	0.12	0.00	0.00	0.00	0.30	0.39	0.38	0.33
1969	0.11	0.00	0.00	0.00	0.29	0.37	0.37	0.32
2051	0.11	0.00	0.00	0.00	0.28	0.37	0.36	0.31
2133	0.10	0.00	0.00	0.00	0.27	0.35	0.34	0.30
2215	0.10	0.00	0.00	0.00	0.26	0.34	0.34	0.30
2297	0.10	0.00	0.00	0.00	0.26	0.34	0.33	0.29
2379	0.10	0.00	0.00	0.00	0.25	0.33	0.33	0.29
2461	0.10	0.00	0.00	0.00	0.25	0.33	0.33	0.28
2543	0.09	0.00	0.00	0.00	0.24	0.31	0.31	0.27
2625	0.09	0.00	0.00	0.00	0.23	0.30	0.29	0.26
2707	0.08	0.00	0.00	0.00	0.21	0.27	0.27	0.24
2789	0.07	0.00	0.00	0.00	0.19	0.25	0.25	0.21
2871	0.07	0.00	0.00	0.00	0.17	0.23	0.22	0.20
2953	0.06	0.00	0.00	0.00	0.16	0.21	0.20	0.18
3035	0.06	0.00	0.00	0.00	0.15	0.19	0.19	0.17
3117	0.06	0.00	0.00	0.00	0.14	0.18	0.18	0.16
3199	0.05	0.00	0.00	0.00	0.14	0.18	0.18	0.16
3281	0.06	0.00	0.00	0.00	0.14	0.19	0.18	0.16

Table 6.16 25-year Directional Medium Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	25-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.78	0.00	0.12	0.30	2.64	3.50	5.07	4.18
82	1.77	0.00	0.11	0.30	2.63	3.49	5.07	4.17
164	1.75	0.00	0.11	0.30	2.60	3.45	5.00	4.11
246	1.54	0.00	0.10	0.26	2.28	3.03	4.39	3.61
328	1.27	0.00	0.08	0.22	1.88	2.50	3.62	2.98
410	1.08	0.00	0.07	0.18	1.60	2.12	3.07	2.53
492	0.93	0.00	0.06	0.16	1.38	1.84	2.66	2.19
574	0.81	0.00	0.05	0.14	1.21	1.60	2.32	1.91
656	0.72	0.00	0.05	0.12	1.07	1.42	2.05	1.69
738	0.64	0.00	0.04	0.11	0.95	1.27	1.84	1.51
820	0.59	0.00	0.04	0.10	0.87	1.15	1.67	1.38
902	0.54	0.00	0.04	0.09	0.81	1.07	1.55	1.28
984	0.50	0.00	0.03	0.08	0.74	0.98	1.42	1.17
1066	0.47	0.00	0.03	0.08	0.70	0.92	1.34	1.10
1148	0.44	0.00	0.03	0.07	0.65	0.86	1.25	1.03
1230	0.42	0.00	0.03	0.07	0.62	0.82	1.19	0.98
1312	0.39	0.00	0.03	0.07	0.58	0.78	1.12	0.93
1394	0.37	0.00	0.02	0.06	0.55	0.72	1.05	0.86
1476	0.35	0.00	0.02	0.06	0.52	0.69	1.00	0.82
1558	0.34	0.00	0.02	0.06	0.50	0.66	0.96	0.79
1640	0.32	0.00	0.02	0.05	0.48	0.63	0.92	0.76
1722	0.31	0.00	0.02	0.05	0.46	0.61	0.88	0.73
1804	0.30	0.00	0.02	0.05	0.44	0.59	0.85	0.70
1886	0.29	0.00	0.02	0.05	0.42	0.56	0.82	0.67
1969	0.28	0.00	0.02	0.05	0.41	0.54	0.79	0.65
2051	0.27	0.00	0.02	0.05	0.40	0.53	0.77	0.63
2133	0.26	0.00	0.02	0.04	0.38	0.51	0.74	0.61
2215	0.25	0.00	0.02	0.04	0.38	0.50	0.72	0.60
2297	0.25	0.00	0.02	0.04	0.37	0.49	0.71	0.58
2379	0.24	0.00	0.02	0.04	0.36	0.48	0.70	0.57
2461	0.24	0.00	0.02	0.04	0.36	0.48	0.69	0.57
2543	0.23	0.00	0.01	0.04	0.34	0.45	0.66	0.54
2625	0.22	0.00	0.01	0.04	0.33	0.43	0.63	0.52
2707	0.20	0.00	0.01	0.03	0.30	0.40	0.58	0.48
2789	0.19	0.00	0.01	0.03	0.28	0.37	0.54	0.44
2871	0.17	0.00	0.01	0.03	0.25	0.34	0.49	0.40
2953	0.16	0.00	0.01	0.03	0.23	0.31	0.45	0.37
3035	0.14	0.00	0.01	0.02	0.21	0.28	0.40	0.33
3117	0.13	0.00	0.01	0.02	0.20	0.26	0.38	0.31
3199	0.13	0.00	0.01	0.02	0.19	0.26	0.37	0.31
3281	0.14	0.00	0.01	0.02	0.20	0.27	0.39	0.32

Table 6.17 25-year Directional Low Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	25-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.26	0.11	1.35	0.93	2.19	2.17	2.50	2.34
82	1.26	0.11	1.35	0.93	2.19	2.17	2.49	2.34
164	1.27	0.11	1.36	0.94	2.21	2.19	2.52	2.36
246	1.12	0.10	1.20	0.83	1.96	1.94	2.23	2.09
328	1.05	0.09	1.12	0.77	1.82	1.81	2.08	1.95
410	0.99	0.09	1.06	0.73	1.73	1.71	1.97	1.85
492	0.80	0.07	0.86	0.59	1.39	1.38	1.59	1.49
574	0.72	0.06	0.77	0.53	1.25	1.24	1.43	1.34
656	0.67	0.06	0.71	0.49	1.16	1.15	1.32	1.24
738	0.60	0.05	0.65	0.45	1.05	1.04	1.20	1.13
820	0.62	0.06	0.67	0.46	1.08	1.07	1.23	1.16
902	0.67	0.06	0.71	0.49	1.16	1.15	1.32	1.24
984	0.69	0.06	0.74	0.51	1.20	1.19	1.37	1.28
1066	0.60	0.05	0.65	0.45	1.05	1.04	1.20	1.12
1148	0.50	0.04	0.54	0.37	0.88	0.87	1.00	0.94
1230	0.43	0.04	0.46	0.32	0.74	0.74	0.85	0.79
1312	0.38	0.03	0.40	0.28	0.65	0.65	0.75	0.70
1394	0.36	0.03	0.38	0.26	0.62	0.62	0.71	0.67
1476	0.34	0.03	0.36	0.25	0.59	0.59	0.68	0.63
1558	0.34	0.03	0.36	0.25	0.58	0.58	0.67	0.62
1640	0.31	0.03	0.33	0.23	0.54	0.54	0.62	0.58
1722	0.29	0.03	0.31	0.21	0.50	0.50	0.57	0.54
1804	0.27	0.02	0.29	0.20	0.48	0.47	0.54	0.51
1886	0.26	0.02	0.28	0.19	0.45	0.45	0.52	0.48
1969	0.25	0.02	0.26	0.18	0.43	0.42	0.49	0.46
2051	0.24	0.02	0.26	0.18	0.41	0.41	0.47	0.44
2133	0.22	0.02	0.24	0.17	0.39	0.39	0.45	0.42
2215	0.22	0.02	0.23	0.16	0.38	0.38	0.43	0.40
2297	0.21	0.02	0.23	0.16	0.37	0.36	0.42	0.39
2379	0.20	0.02	0.22	0.15	0.35	0.35	0.40	0.38
2461	0.20	0.02	0.21	0.14	0.34	0.34	0.39	0.36
2543	0.18	0.02	0.20	0.13	0.32	0.31	0.36	0.34
2625	0.17	0.01	0.18	0.13	0.29	0.29	0.34	0.32
2707	0.15	0.01	0.16	0.11	0.26	0.26	0.30	0.28
2789	0.14	0.01	0.14	0.10	0.24	0.23	0.27	0.25
2871	0.12	0.01	0.13	0.09	0.21	0.21	0.24	0.23
2953	0.11	0.01	0.12	0.08	0.20	0.19	0.22	0.21
3035	0.11	0.01	0.12	0.08	0.19	0.19	0.21	0.20
3117	0.11	0.01	0.12	0.08	0.19	0.19	0.21	0.20
3199	0.11	0.01	0.12	0.08	0.19	0.19	0.22	0.20
3281	0.11	0.01	0.11	0.08	0.19	0.19	0.21	0.20

6.2.4 50-Year High, Medium And Low Shear Current Surface Extremes And Associated Profiles

Table 6.18 50-year Directional All Data Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
N	NE	E	SE	S	SW	W	NW	
0	1.86	0.11	1.39	0.96	2.76	3.67	5.31	4.37
82	1.86	0.11	1.39	0.96	2.76	3.66	5.30	4.37
164	1.83	0.11	1.37	0.94	2.72	3.61	5.23	4.31
246	1.61	0.10	1.20	0.83	2.38	3.17	4.59	3.78
328	1.32	0.08	0.99	0.68	1.97	2.61	3.78	3.11
410	1.12	0.07	0.84	0.58	1.67	2.21	3.21	2.64
492	0.97	0.06	0.73	0.50	1.45	1.92	2.78	2.29
574	0.85	0.05	0.63	0.44	1.26	1.67	2.42	2.00
656	0.75	0.05	0.56	0.39	1.11	1.48	2.14	1.76
738	0.67	0.04	0.50	0.34	0.99	1.32	1.91	1.57
820	0.61	0.04	0.45	0.31	0.90	1.20	1.74	1.43
902	0.56	0.03	0.42	0.29	0.84	1.11	1.61	1.33
984	0.52	0.03	0.39	0.27	0.77	1.02	1.47	1.21
1066	0.49	0.03	0.36	0.25	0.72	0.96	1.39	1.14
1148	0.45	0.03	0.34	0.23	0.67	0.89	1.30	1.07
1230	0.43	0.03	0.32	0.22	0.64	0.85	1.24	1.02
1312	0.41	0.03	0.31	0.21	0.61	0.81	1.17	0.96
1394	0.38	0.02	0.29	0.20	0.57	0.75	1.09	0.90
1476	0.36	0.02	0.27	0.19	0.54	0.72	1.04	0.86
1558	0.35	0.02	0.26	0.18	0.52	0.69	1.00	0.83
1640	0.34	0.02	0.25	0.17	0.50	0.66	0.96	0.79
1722	0.32	0.02	0.24	0.17	0.48	0.63	0.92	0.76
1804	0.31	0.02	0.23	0.16	0.46	0.61	0.89	0.73
1886	0.30	0.02	0.22	0.15	0.44	0.59	0.85	0.70
1969	0.29	0.02	0.21	0.15	0.43	0.57	0.82	0.67
2051	0.28	0.02	0.21	0.14	0.42	0.55	0.80	0.66
2133	0.27	0.02	0.20	0.14	0.40	0.53	0.77	0.63
2215	0.26	0.02	0.20	0.14	0.39	0.52	0.75	0.62
2297	0.26	0.02	0.19	0.13	0.38	0.51	0.74	0.61
2379	0.25	0.02	0.19	0.13	0.38	0.50	0.73	0.60
2461	0.25	0.02	0.19	0.13	0.37	0.50	0.72	0.59
2543	0.24	0.01	0.18	0.12	0.36	0.47	0.68	0.56
2625	0.23	0.01	0.17	0.12	0.34	0.45	0.65	0.54
2707	0.21	0.01	0.16	0.11	0.31	0.42	0.61	0.50
2789	0.19	0.01	0.15	0.10	0.29	0.38	0.56	0.46
2871	0.18	0.01	0.13	0.09	0.27	0.35	0.51	0.42
2953	0.16	0.01	0.12	0.08	0.24	0.32	0.46	0.38
3035	0.15	0.01	0.11	0.08	0.22	0.29	0.42	0.35
3117	0.14	0.01	0.10	0.07	0.21	0.27	0.40	0.33
3199	0.14	0.01	0.10	0.07	0.20	0.27	0.39	0.32
3281	0.14	0.01	0.11	0.07	0.21	0.28	0.40	0.33

Table 6.19 50-year Directional High Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	50-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	N	NE	E	SE	S	SW	W	NW
82	1.04	0.00	0.00	0.00	2.67	3.48	3.44	2.99
164	1.03	0.00	0.00	0.00	2.62	3.42	3.38	2.94
246	1.00	0.00	0.00	0.00	2.55	3.33	3.28	2.86
328	0.85	0.00	0.00	0.00	2.16	2.82	2.79	2.42
410	0.65	0.00	0.00	0.00	1.66	2.16	2.14	1.86
492	0.52	0.00	0.00	0.00	1.34	1.75	1.73	1.50
574	0.48	0.00	0.00	0.00	1.22	1.59	1.57	1.37
656	0.39	0.00	0.00	0.00	0.98	1.28	1.27	1.10
738	0.32	0.00	0.00	0.00	0.81	1.06	1.04	0.91
820	0.26	0.00	0.00	0.00	0.66	0.86	0.85	0.74
902	0.21	0.00	0.00	0.00	0.53	0.69	0.69	0.60
984	0.16	0.00	0.00	0.00	0.42	0.54	0.54	0.47
1066	0.09	0.00	0.00	0.00	0.24	0.31	0.30	0.26
1148	0.10	0.00	0.00	0.00	0.26	0.34	0.34	0.30
1230	0.12	0.00	0.00	0.00	0.31	0.40	0.40	0.35
1312	0.14	0.00	0.00	0.00	0.35	0.46	0.46	0.40
1394	0.15	0.00	0.00	0.00	0.38	0.49	0.49	0.42
1476	0.16	0.00	0.00	0.00	0.40	0.52	0.51	0.45
1558	0.15	0.00	0.00	0.00	0.38	0.50	0.49	0.43
1640	0.15	0.00	0.00	0.00	0.38	0.50	0.49	0.43
1722	0.14	0.00	0.00	0.00	0.36	0.47	0.47	0.40
1804	0.14	0.00	0.00	0.00	0.35	0.45	0.45	0.39
1886	0.13	0.00	0.00	0.00	0.34	0.44	0.43	0.38
1969	0.13	0.00	0.00	0.00	0.32	0.42	0.42	0.36
2051	0.12	0.00	0.00	0.00	0.31	0.41	0.40	0.35
2133	0.12	0.00	0.00	0.00	0.30	0.40	0.39	0.34
2215	0.11	0.00	0.00	0.00	0.29	0.38	0.37	0.32
2297	0.11	0.00	0.00	0.00	0.28	0.37	0.37	0.32
2379	0.11	0.00	0.00	0.00	0.28	0.36	0.36	0.31
2461	0.11	0.00	0.00	0.00	0.28	0.36	0.36	0.31
2543	0.11	0.00	0.00	0.00	0.27	0.36	0.35	0.31
2625	0.10	0.00	0.00	0.00	0.26	0.34	0.34	0.29
2707	0.10	0.00	0.00	0.00	0.25	0.32	0.32	0.28
2789	0.09	0.00	0.00	0.00	0.23	0.30	0.29	0.26
2871	0.08	0.00	0.00	0.00	0.21	0.27	0.27	0.23
2953	0.07	0.00	0.00	0.00	0.19	0.25	0.24	0.21
3035	0.07	0.00	0.00	0.00	0.17	0.22	0.22	0.19
3117	0.06	0.00	0.00	0.00	0.16	0.21	0.21	0.18
3199	0.06	0.00	0.00	0.00	0.15	0.20	0.20	0.17
3281	0.06	0.00	0.00	0.00	0.15	0.20	0.19	0.17

Table 6.20 50-year Directional Medium Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	50-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.99	0.00	0.13	0.34	2.96	3.93	5.69	4.68
82	1.99	0.00	0.13	0.34	2.95	3.92	5.68	4.68
164	1.96	0.00	0.13	0.33	2.91	3.87	5.60	4.61
246	1.72	0.00	0.11	0.29	2.56	3.40	4.92	4.05
328	1.42	0.00	0.09	0.24	2.11	2.80	4.06	3.34
410	1.21	0.00	0.08	0.21	1.79	2.38	3.44	2.84
492	1.05	0.00	0.07	0.18	1.55	2.06	2.99	2.46
574	0.91	0.00	0.06	0.16	1.35	1.80	2.61	2.15
656	0.81	0.00	0.05	0.14	1.20	1.59	2.30	1.90
738	0.72	0.00	0.05	0.12	1.07	1.42	2.06	1.70
820	0.66	0.00	0.04	0.11	0.97	1.29	1.87	1.54
902	0.61	0.00	0.04	0.10	0.91	1.20	1.74	1.44
984	0.56	0.00	0.04	0.10	0.83	1.10	1.60	1.32
1066	0.53	0.00	0.03	0.09	0.78	1.04	1.50	1.24
1148	0.49	0.00	0.03	0.08	0.73	0.97	1.40	1.16
1230	0.47	0.00	0.03	0.08	0.70	0.92	1.34	1.10
1312	0.44	0.00	0.03	0.08	0.65	0.87	1.26	1.04
1394	0.41	0.00	0.03	0.07	0.61	0.81	1.18	0.97
1476	0.39	0.00	0.03	0.07	0.58	0.77	1.12	0.92
1558	0.38	0.00	0.02	0.06	0.56	0.75	1.08	0.89
1640	0.36	0.00	0.02	0.06	0.54	0.71	1.03	0.85
1722	0.35	0.00	0.02	0.06	0.51	0.68	0.99	0.81
1804	0.33	0.00	0.02	0.06	0.50	0.66	0.96	0.79
1886	0.32	0.00	0.02	0.05	0.48	0.63	0.92	0.75
1969	0.31	0.00	0.02	0.05	0.46	0.61	0.88	0.73
2051	0.30	0.00	0.02	0.05	0.45	0.60	0.86	0.71
2133	0.29	0.00	0.02	0.05	0.43	0.57	0.82	0.68
2215	0.28	0.00	0.02	0.05	0.42	0.56	0.81	0.67
2297	0.28	0.00	0.02	0.05	0.41	0.55	0.80	0.65
2379	0.27	0.00	0.02	0.05	0.41	0.54	0.78	0.64
2461	0.27	0.00	0.02	0.05	0.40	0.53	0.77	0.64
2543	0.26	0.00	0.02	0.04	0.38	0.51	0.74	0.61
2625	0.25	0.00	0.02	0.04	0.37	0.49	0.70	0.58
2707	0.23	0.00	0.01	0.04	0.34	0.45	0.65	0.54
2789	0.21	0.00	0.01	0.04	0.31	0.41	0.60	0.49
2871	0.19	0.00	0.01	0.03	0.29	0.38	0.55	0.45
2953	0.18	0.00	0.01	0.03	0.26	0.35	0.50	0.41
3035	0.16	0.00	0.01	0.03	0.24	0.31	0.45	0.37
3117	0.15	0.00	0.01	0.03	0.22	0.30	0.43	0.35
3199	0.15	0.00	0.01	0.02	0.22	0.29	0.42	0.34
3281	0.15	0.00	0.01	0.03	0.23	0.30	0.43	0.36

Table 6.21 50-year Directional Low Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	50-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.43	0.13	1.53	1.05	2.49	2.47	2.84	2.66
82	1.43	0.13	1.53	1.05	2.48	2.47	2.84	2.66
164	1.44	0.13	1.55	1.07	2.51	2.49	2.87	2.69
246	1.28	0.11	1.37	0.94	2.22	2.21	2.54	2.38
328	1.19	0.11	1.27	0.88	2.07	2.05	2.36	2.21
410	1.13	0.10	1.21	0.83	1.96	1.95	2.24	2.10
492	0.91	0.08	0.97	0.67	1.58	1.57	1.81	1.69
574	0.82	0.07	0.88	0.60	1.42	1.41	1.63	1.52
656	0.76	0.07	0.81	0.56	1.32	1.31	1.50	1.41
738	0.69	0.06	0.74	0.51	1.20	1.19	1.36	1.28
820	0.71	0.06	0.76	0.52	1.23	1.22	1.40	1.31
902	0.76	0.07	0.81	0.56	1.32	1.31	1.50	1.41
984	0.78	0.07	0.84	0.58	1.36	1.35	1.55	1.45
1066	0.69	0.06	0.74	0.51	1.19	1.19	1.36	1.28
1148	0.57	0.05	0.61	0.42	1.00	0.99	1.14	1.07
1230	0.48	0.04	0.52	0.36	0.84	0.84	0.96	0.90
1312	0.43	0.04	0.46	0.32	0.74	0.74	0.85	0.80
1394	0.41	0.04	0.44	0.30	0.71	0.70	0.81	0.76
1476	0.39	0.03	0.41	0.29	0.67	0.67	0.77	0.72
1558	0.38	0.03	0.41	0.28	0.66	0.66	0.76	0.71
1640	0.35	0.03	0.38	0.26	0.62	0.61	0.70	0.66
1722	0.33	0.03	0.35	0.24	0.57	0.57	0.65	0.61
1804	0.31	0.03	0.33	0.23	0.54	0.54	0.62	0.58
1886	0.30	0.03	0.32	0.22	0.51	0.51	0.59	0.55
1969	0.28	0.02	0.30	0.21	0.49	0.48	0.55	0.52
2051	0.27	0.02	0.29	0.20	0.47	0.47	0.54	0.50
2133	0.26	0.02	0.27	0.19	0.44	0.44	0.51	0.48
2215	0.25	0.02	0.26	0.18	0.43	0.43	0.49	0.46
2297	0.24	0.02	0.26	0.18	0.42	0.41	0.47	0.44
2379	0.23	0.02	0.25	0.17	0.40	0.40	0.46	0.43
2461	0.22	0.02	0.24	0.16	0.39	0.38	0.44	0.41
2543	0.21	0.02	0.22	0.15	0.36	0.36	0.41	0.39
2625	0.19	0.02	0.21	0.14	0.33	0.33	0.38	0.36
2707	0.17	0.02	0.18	0.13	0.30	0.30	0.34	0.32
2789	0.15	0.01	0.16	0.11	0.27	0.27	0.31	0.29
2871	0.14	0.01	0.15	0.10	0.24	0.24	0.28	0.26
2953	0.13	0.01	0.14	0.09	0.22	0.22	0.25	0.24
3035	0.12	0.01	0.13	0.09	0.21	0.21	0.24	0.23
3117	0.12	0.01	0.13	0.09	0.21	0.21	0.24	0.23
3199	0.12	0.01	0.13	0.09	0.22	0.21	0.25	0.23
3281	0.12	0.01	0.13	0.09	0.21	0.21	0.24	0.23

6.2.5 100-Year High, Medium And Low Shear Current Surface Extremes And Associated Profiles

Table 6.22 100-year Directional All Data Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	1-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
N	NE	E	SE	S	SW	W	NW	
0	2.05	0.13	1.53	1.05	3.04	4.03	5.85	4.81
82	2.04	0.13	1.53	1.05	3.03	4.03	5.84	4.80
164	2.02	0.12	1.51	1.04	2.99	3.97	5.75	4.74
246	1.77	0.11	1.32	0.91	2.62	3.48	5.05	4.16
328	1.46	0.09	1.09	0.75	2.16	2.87	4.16	3.43
410	1.24	0.08	0.92	0.64	1.83	2.43	3.53	2.91
492	1.07	0.07	0.80	0.55	1.59	2.11	3.06	2.52
574	0.93	0.06	0.70	0.48	1.39	1.84	2.67	2.20
656	0.83	0.05	0.62	0.43	1.22	1.63	2.36	1.94
738	0.74	0.05	0.55	0.38	1.09	1.45	2.10	1.73
820	0.67	0.04	0.50	0.34	0.99	1.32	1.91	1.57
902	0.62	0.04	0.46	0.32	0.92	1.22	1.77	1.46
984	0.57	0.04	0.42	0.29	0.84	1.12	1.62	1.33
1066	0.53	0.03	0.40	0.28	0.79	1.05	1.52	1.26
1148	0.50	0.03	0.37	0.26	0.74	0.98	1.43	1.17
1230	0.48	0.03	0.36	0.25	0.71	0.94	1.36	1.12
1312	0.45	0.03	0.34	0.23	0.67	0.89	1.29	1.06
1394	0.42	0.03	0.31	0.22	0.62	0.83	1.20	0.99
1476	0.40	0.02	0.30	0.21	0.59	0.79	1.14	0.94
1558	0.39	0.02	0.29	0.20	0.57	0.76	1.11	0.91
1640	0.37	0.02	0.28	0.19	0.55	0.73	1.06	0.87
1722	0.35	0.02	0.26	0.18	0.53	0.70	1.01	0.83
1804	0.34	0.02	0.26	0.18	0.51	0.67	0.98	0.80
1886	0.33	0.02	0.25	0.17	0.49	0.65	0.94	0.77
1969	0.32	0.02	0.24	0.16	0.47	0.62	0.90	0.74
2051	0.31	0.02	0.23	0.16	0.46	0.61	0.88	0.73
2133	0.30	0.02	0.22	0.15	0.44	0.58	0.84	0.69
2215	0.29	0.02	0.22	0.15	0.43	0.57	0.83	0.68
2297	0.28	0.02	0.21	0.15	0.42	0.56	0.81	0.67
2379	0.28	0.02	0.21	0.14	0.42	0.55	0.80	0.66
2461	0.28	0.02	0.21	0.14	0.41	0.55	0.79	0.65
2543	0.26	0.02	0.20	0.14	0.39	0.52	0.75	0.62
2625	0.25	0.02	0.19	0.13	0.37	0.50	0.72	0.59
2707	0.23	0.01	0.17	0.12	0.35	0.46	0.67	0.55
2789	0.21	0.01	0.16	0.11	0.32	0.42	0.61	0.50
2871	0.20	0.01	0.15	0.10	0.29	0.39	0.56	0.46
2953	0.18	0.01	0.13	0.09	0.27	0.35	0.51	0.42
3035	0.16	0.01	0.12	0.08	0.24	0.32	0.46	0.38
3117	0.15	0.01	0.11	0.08	0.23	0.30	0.44	0.36
3199	0.15	0.01	0.11	0.08	0.22	0.30	0.43	0.35
3281	0.16	0.01	0.12	0.08	0.23	0.31	0.44	0.37

Table 6.23 100-year Directional High Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	100-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.12	0.00	0.00	0.00	2.85	3.72	3.68	3.20
82	1.10	0.00	0.00	0.00	2.81	3.66	3.62	3.15
164	1.07	0.00	0.00	0.00	2.73	3.56	3.52	3.06
246	0.91	0.00	0.00	0.00	2.31	3.02	2.98	2.60
328	0.69	0.00	0.00	0.00	1.78	2.32	2.29	1.99
410	0.56	0.00	0.00	0.00	1.43	1.87	1.85	1.61
492	0.51	0.00	0.00	0.00	1.31	1.71	1.69	1.47
574	0.41	0.00	0.00	0.00	1.05	1.37	1.36	1.18
656	0.34	0.00	0.00	0.00	0.87	1.13	1.12	0.97
738	0.28	0.00	0.00	0.00	0.71	0.92	0.91	0.79
820	0.22	0.00	0.00	0.00	0.57	0.74	0.73	0.64
902	0.17	0.00	0.00	0.00	0.45	0.58	0.58	0.50
984	0.10	0.00	0.00	0.00	0.25	0.33	0.33	0.28
1066	0.11	0.00	0.00	0.00	0.28	0.37	0.36	0.32
1148	0.13	0.00	0.00	0.00	0.33	0.43	0.42	0.37
1230	0.15	0.00	0.00	0.00	0.38	0.49	0.49	0.42
1312	0.16	0.00	0.00	0.00	0.41	0.53	0.52	0.45
1394	0.17	0.00	0.00	0.00	0.42	0.55	0.55	0.48
1476	0.16	0.00	0.00	0.00	0.41	0.54	0.53	0.46
1558	0.16	0.00	0.00	0.00	0.41	0.54	0.53	0.46
1640	0.15	0.00	0.00	0.00	0.39	0.50	0.50	0.43
1722	0.15	0.00	0.00	0.00	0.37	0.49	0.48	0.42
1804	0.14	0.00	0.00	0.00	0.36	0.47	0.47	0.41
1886	0.14	0.00	0.00	0.00	0.35	0.45	0.45	0.39
1969	0.13	0.00	0.00	0.00	0.33	0.43	0.43	0.37
2051	0.13	0.00	0.00	0.00	0.33	0.42	0.42	0.37
2133	0.12	0.00	0.00	0.00	0.31	0.40	0.40	0.35
2215	0.12	0.00	0.00	0.00	0.31	0.40	0.39	0.34
2297	0.12	0.00	0.00	0.00	0.30	0.39	0.39	0.34
2379	0.12	0.00	0.00	0.00	0.30	0.39	0.38	0.33
2461	0.11	0.00	0.00	0.00	0.29	0.38	0.38	0.33
2543	0.11	0.00	0.00	0.00	0.28	0.36	0.36	0.31
2625	0.10	0.00	0.00	0.00	0.26	0.35	0.34	0.30
2707	0.10	0.00	0.00	0.00	0.24	0.32	0.31	0.27
2789	0.09	0.00	0.00	0.00	0.22	0.29	0.29	0.25
2871	0.08	0.00	0.00	0.00	0.20	0.26	0.26	0.23
2953	0.07	0.00	0.00	0.00	0.18	0.24	0.24	0.21
3035	0.07	0.00	0.00	0.00	0.17	0.22	0.22	0.19
3117	0.06	0.00	0.00	0.00	0.16	0.21	0.21	0.18
3199	0.06	0.00	0.00	0.00	0.16	0.21	0.21	0.18
3281	0.06	0.00	0.00	0.00	0.17	0.22	0.21	0.19

Table 6.24 100-year Directional Medium Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	100-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	2.20	0.00	0.14	0.37	3.27	4.34	6.29	5.18
82	2.20	0.00	0.14	0.37	3.26	4.33	6.28	5.17
164	2.17	0.00	0.14	0.37	3.22	4.27	6.19	5.10
246	1.91	0.00	0.12	0.32	2.83	3.75	5.44	4.48
328	1.57	0.00	0.10	0.27	2.33	3.10	4.49	3.70
410	1.33	0.00	0.09	0.23	1.98	2.63	3.81	3.14
492	1.16	0.00	0.07	0.20	1.71	2.28	3.30	2.72
574	1.01	0.00	0.07	0.17	1.50	1.99	2.88	2.37
656	0.89	0.00	0.06	0.15	1.32	1.76	2.55	2.10
738	0.80	0.00	0.05	0.14	1.18	1.57	2.28	1.87
820	0.73	0.00	0.05	0.12	1.08	1.43	2.07	1.71
902	0.67	0.00	0.04	0.11	1.00	1.33	1.93	1.59
984	0.62	0.00	0.04	0.11	0.92	1.22	1.77	1.45
1066	0.58	0.00	0.04	0.10	0.86	1.15	1.66	1.37
1148	0.54	0.00	0.04	0.09	0.81	1.07	1.55	1.28
1230	0.52	0.00	0.03	0.09	0.77	1.02	1.48	1.22
1312	0.49	0.00	0.03	0.08	0.72	0.96	1.39	1.15
1394	0.46	0.00	0.03	0.08	0.68	0.90	1.30	1.07
1476	0.43	0.00	0.03	0.07	0.64	0.85	1.24	1.02
1558	0.42	0.00	0.03	0.07	0.62	0.82	1.19	0.98
1640	0.40	0.00	0.03	0.07	0.59	0.79	1.14	0.94
1722	0.38	0.00	0.02	0.07	0.57	0.75	1.09	0.90
1804	0.37	0.00	0.02	0.06	0.55	0.73	1.06	0.87
1886	0.35	0.00	0.02	0.06	0.53	0.70	1.01	0.83
1969	0.34	0.00	0.02	0.06	0.51	0.67	0.98	0.80
2051	0.33	0.00	0.02	0.06	0.50	0.66	0.96	0.79
2133	0.32	0.00	0.02	0.05	0.47	0.63	0.91	0.75
2215	0.31	0.00	0.02	0.05	0.47	0.62	0.90	0.74
2297	0.31	0.00	0.02	0.05	0.46	0.61	0.88	0.72
2379	0.30	0.00	0.02	0.05	0.45	0.60	0.87	0.71
2461	0.30	0.00	0.02	0.05	0.44	0.59	0.86	0.70
2543	0.29	0.00	0.02	0.05	0.42	0.56	0.82	0.67
2625	0.27	0.00	0.02	0.05	0.40	0.54	0.78	0.64
2707	0.25	0.00	0.02	0.04	0.37	0.50	0.72	0.59
2789	0.23	0.00	0.02	0.04	0.34	0.46	0.66	0.55
2871	0.21	0.00	0.01	0.04	0.32	0.42	0.61	0.50
2953	0.19	0.00	0.01	0.03	0.29	0.38	0.55	0.46
3035	0.18	0.00	0.01	0.03	0.26	0.35	0.50	0.41
3117	0.17	0.00	0.01	0.03	0.25	0.33	0.47	0.39
3199	0.16	0.00	0.01	0.03	0.24	0.32	0.46	0.38
3281	0.17	0.00	0.01	0.03	0.25	0.33	0.48	0.40

Table 6.25 100-year Directional Low Shear Loop Current Surface Extremes and Associated Profiles.

Water depth (ft)	100-year Directional Loop Current Surface Current Speed Extremes (ft/s) and associated profiles							
	337.5°- 22.5°	22.5° - 67.5°	67.5° - 112.5°	112.5°- 157.5	157.5°- 202.5	202.5°- 247.5	247.5°- 292.5	292.5°- 337.5
	N	NE	E	SE	S	SW	W	NW
0	1.60	0.14	1.71	1.18	2.78	2.76	3.18	2.98
82	1.60	0.14	1.71	1.18	2.78	2.76	3.18	2.98
164	1.62	0.14	1.73	1.19	2.81	2.79	3.21	3.01
246	1.43	0.13	1.53	1.06	2.49	2.47	2.84	2.66
328	1.33	0.12	1.43	0.98	2.32	2.30	2.65	2.48
410	1.26	0.11	1.35	0.93	2.20	2.18	2.51	2.35
492	1.02	0.09	1.09	0.75	1.77	1.76	2.02	1.90
574	0.92	0.08	0.98	0.68	1.59	1.58	1.82	1.71
656	0.85	0.08	0.91	0.63	1.47	1.46	1.68	1.58
738	0.77	0.07	0.82	0.57	1.34	1.33	1.53	1.43
820	0.79	0.07	0.85	0.58	1.38	1.37	1.57	1.47
902	0.85	0.08	0.91	0.63	1.48	1.47	1.69	1.58
984	0.88	0.08	0.94	0.65	1.52	1.51	1.74	1.63
1066	0.77	0.07	0.82	0.57	1.34	1.33	1.53	1.43
1148	0.64	0.06	0.69	0.47	1.12	1.11	1.27	1.19
1230	0.54	0.05	0.58	0.40	0.95	0.94	1.08	1.01
1312	0.48	0.04	0.51	0.35	0.83	0.83	0.95	0.89
1394	0.45	0.04	0.49	0.34	0.79	0.79	0.90	0.85
1476	0.43	0.04	0.46	0.32	0.75	0.75	0.86	0.81
1558	0.43	0.04	0.46	0.32	0.74	0.74	0.85	0.80
1640	0.40	0.04	0.42	0.29	0.69	0.69	0.79	0.74
1722	0.37	0.03	0.39	0.27	0.64	0.63	0.73	0.68
1804	0.35	0.03	0.37	0.26	0.61	0.60	0.69	0.65
1886	0.33	0.03	0.35	0.24	0.58	0.57	0.66	0.62
1969	0.31	0.03	0.33	0.23	0.54	0.54	0.62	0.58
2051	0.30	0.03	0.32	0.22	0.53	0.52	0.60	0.56
2133	0.29	0.03	0.31	0.21	0.50	0.49	0.57	0.53
2215	0.28	0.02	0.30	0.20	0.48	0.48	0.55	0.52
2297	0.27	0.02	0.29	0.20	0.47	0.46	0.53	0.50
2379	0.26	0.02	0.28	0.19	0.45	0.45	0.51	0.48
2461	0.25	0.02	0.27	0.18	0.43	0.43	0.49	0.46
2543	0.23	0.02	0.25	0.17	0.40	0.40	0.46	0.43
2625	0.22	0.02	0.23	0.16	0.38	0.37	0.43	0.40
2707	0.19	0.02	0.21	0.14	0.33	0.33	0.38	0.36
2789	0.17	0.02	0.18	0.13	0.30	0.30	0.34	0.32
2871	0.16	0.01	0.17	0.11	0.27	0.27	0.31	0.29
2953	0.14	0.01	0.15	0.11	0.25	0.25	0.28	0.27
3035	0.14	0.01	0.15	0.10	0.24	0.24	0.27	0.25
3117	0.14	0.01	0.15	0.10	0.24	0.24	0.27	0.26
3199	0.14	0.01	0.15	0.10	0.24	0.24	0.28	0.26
3281	0.14	0.01	0.15	0.10	0.24	0.24	0.27	0.25

6.3 Loop Current Events Statistics, Percentage Occurrence Table and Rose Plots

The site was impacted by the Loop Current / Loop Current Eddy 0.79% of the time.

Table 6.26 All-year Loop Current/Eddy Surface Current Speeds Statistics

COMBINED PERIOD (1985 to 2016 – not continuous)	STATISTICS														
	Surface Current Speed (ft/s)				EXCEEDENCE PERCENTILE FOR Surface Current Speed (ft/s)										
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	30	20	10	5	2	1
All Year	0.02	1.70	6.22	0.86	0.25	0.37	0.57	0.73	1.56	2.06	2.37	2.85	3.26	3.74	4.16

6.3.1 All Data

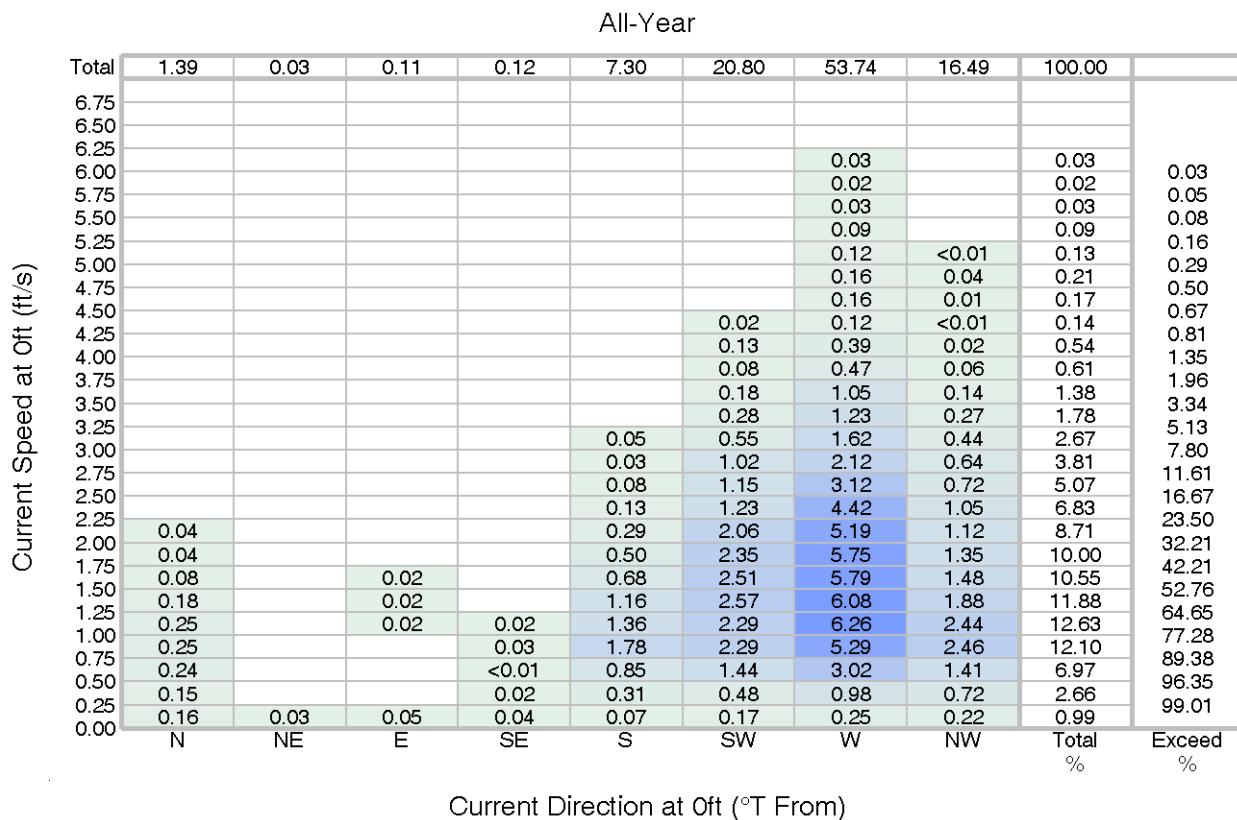


Figure 6.1 Percentage Occurrence of Surface Current Speed and Direction for all data

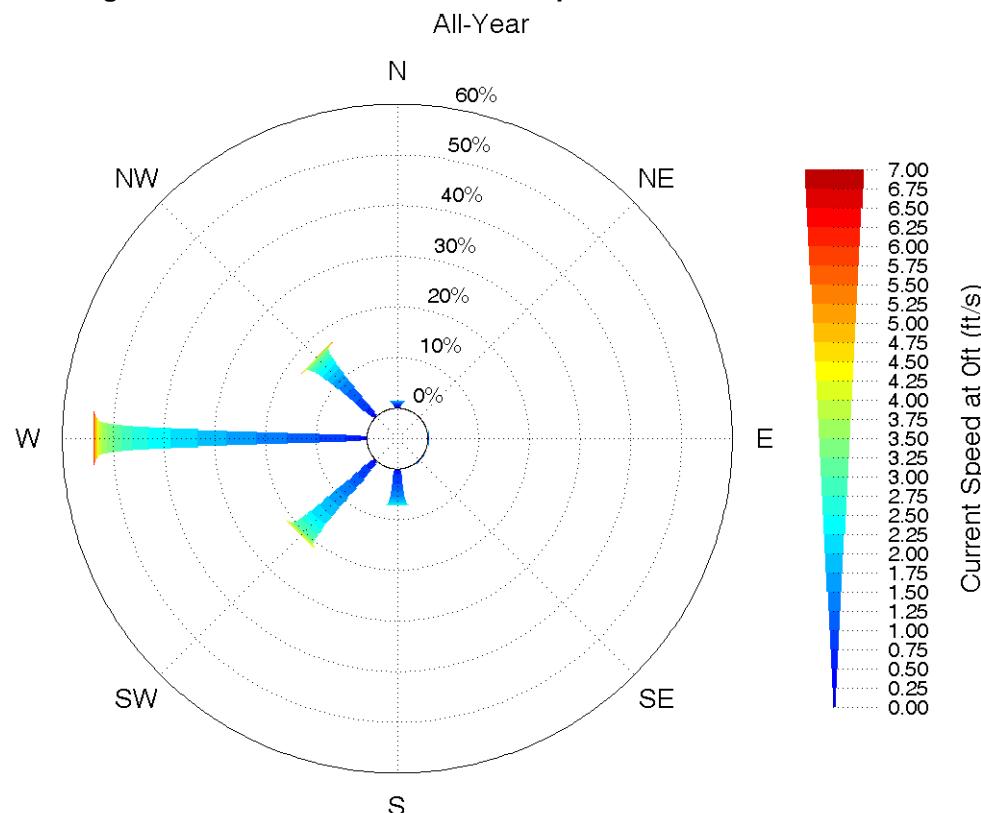


Figure 6.2 Rose Plot of Loop Current Surface Current Speed for all data

6.3.2 High Shear Events

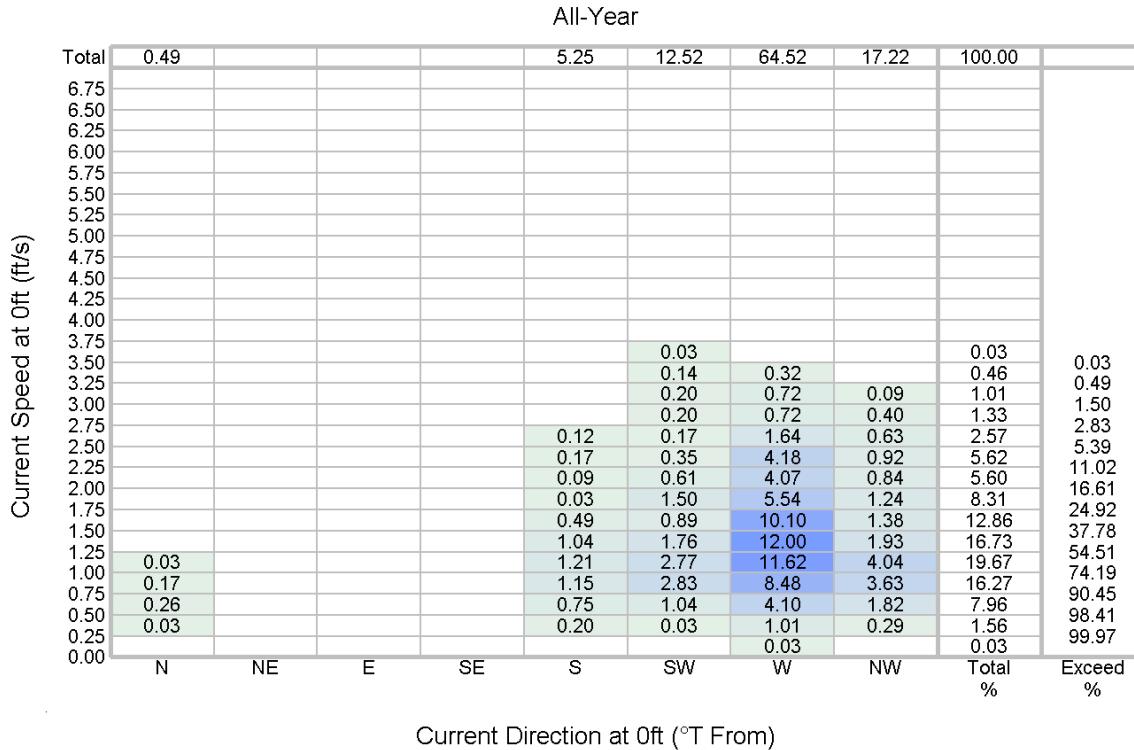


Figure 6.3 Percentage Occurrence of Surface Current Speed and Direction during high shear events

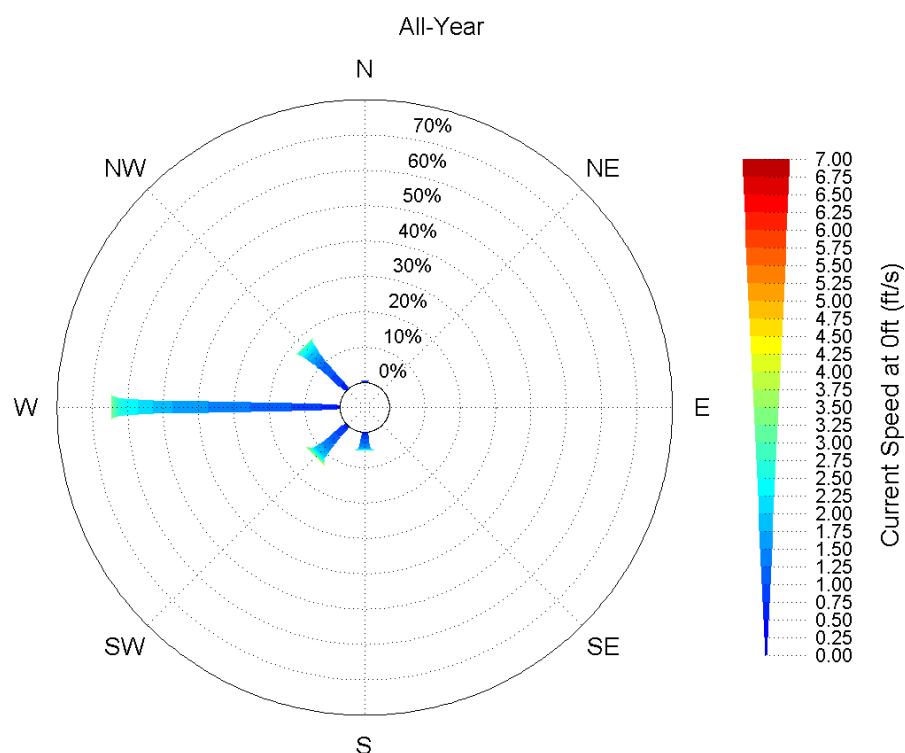


Figure 6.4 Rose Plot of Loop Current Surface Current Speed during high shear events

6.3.3 Medium Shear Events

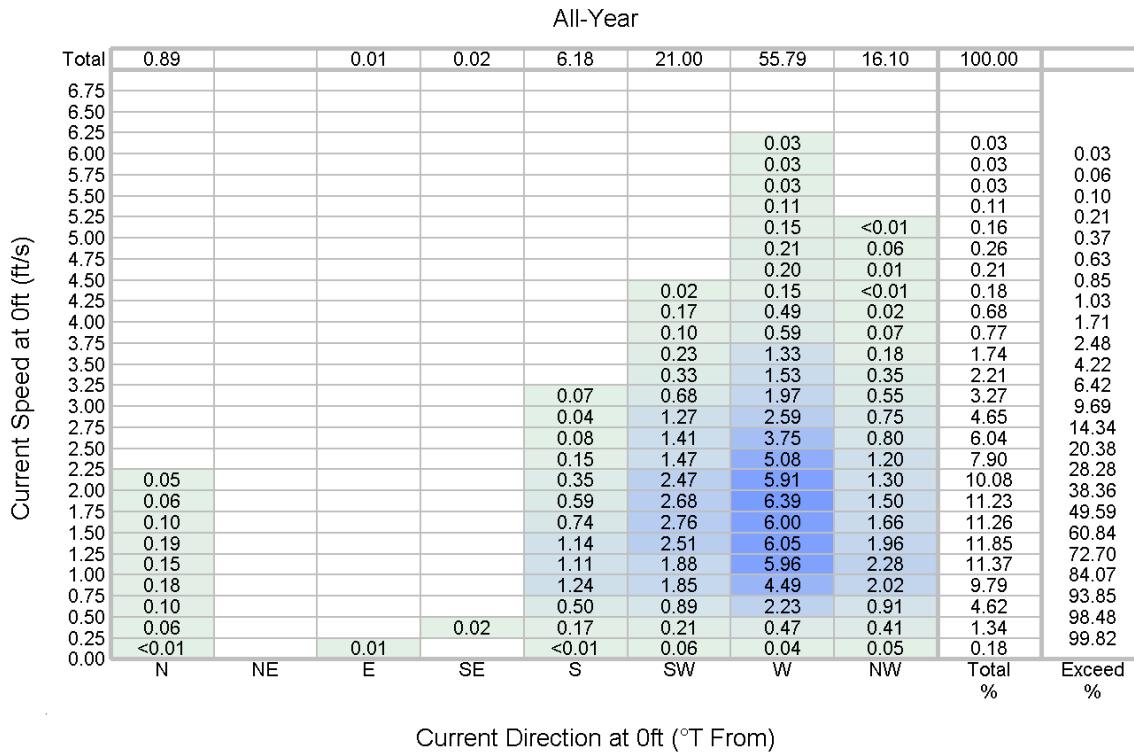


Figure 6.5 Percentage Occurrence of Surface Current Speed and Direction during medium shear events

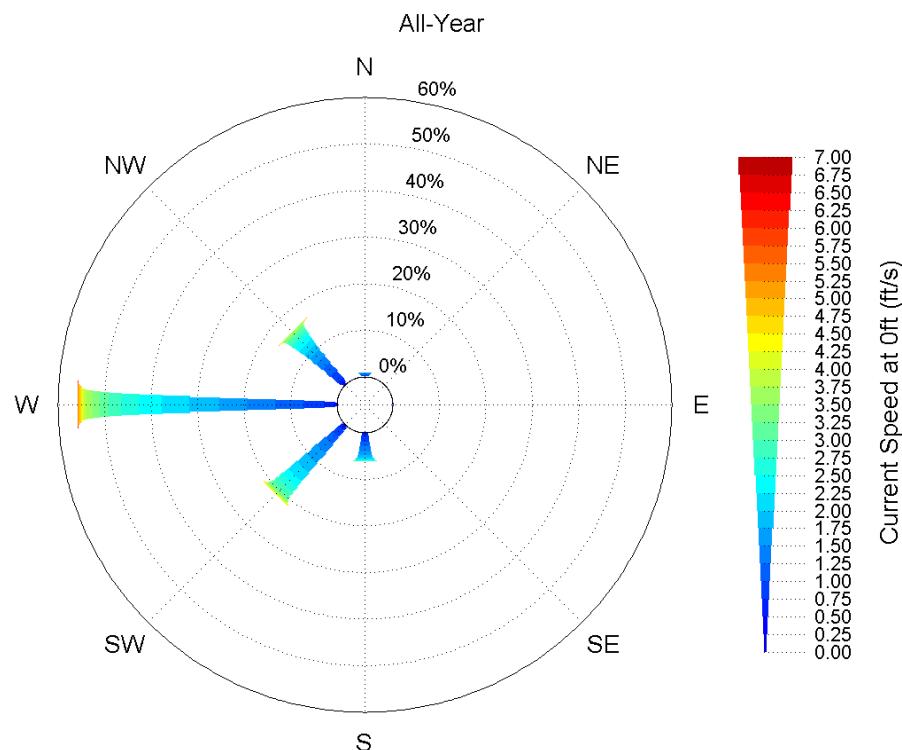


Figure 6.6 Rose Plot of Loop Current Surface Current Speed during medium shear events

6.3.4 Low Shear Events

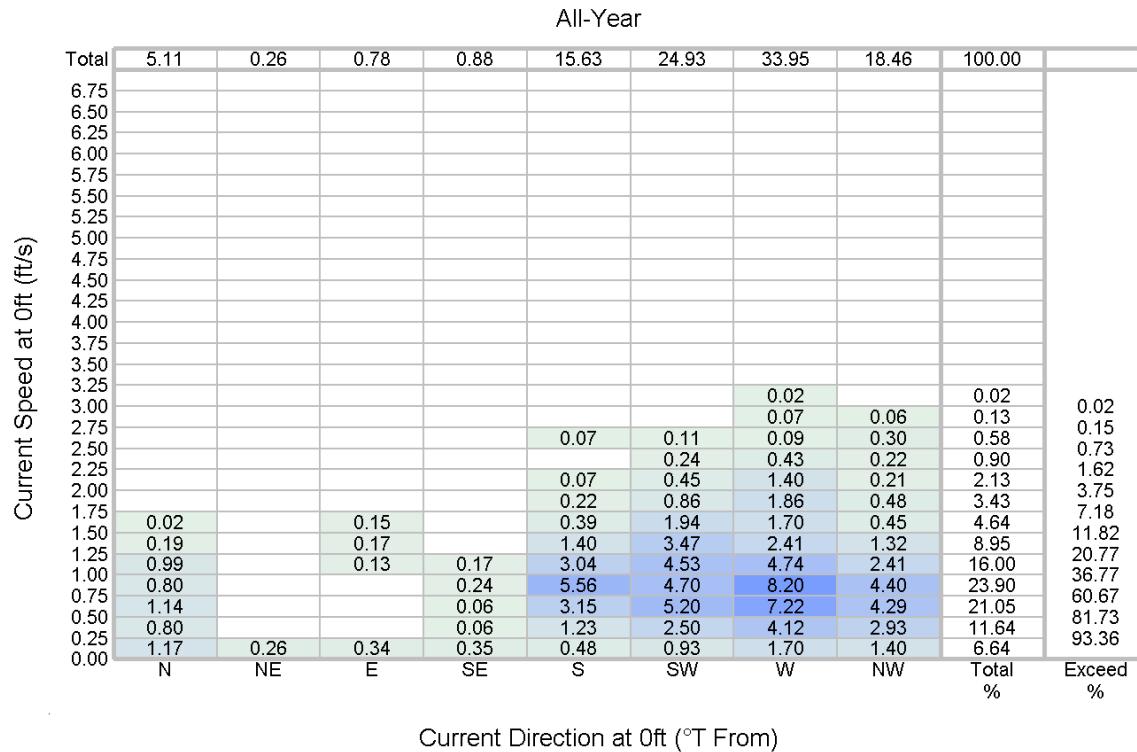


Figure 6.7 Percentage Occurrence of Surface Current Speed and Direction during low shear events

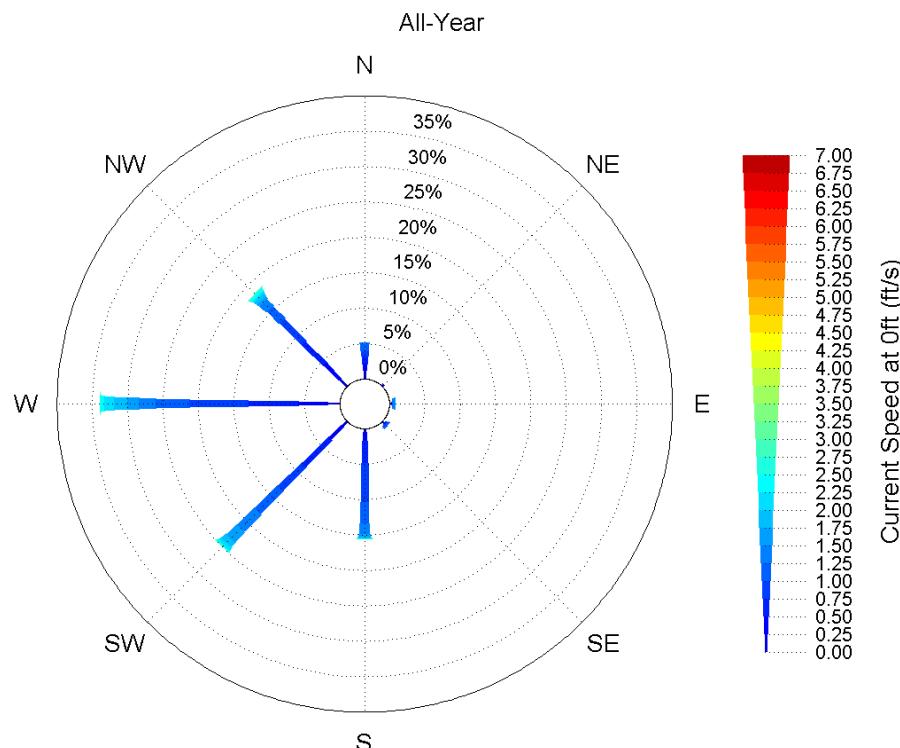


Figure 6.8 Rose Plot of Loop Current Surface Current Speed during low shear events

6.4 Loop Current Event Duration and History

Table 6.27 100-year Extreme Loop Current Event

Hours From Peak	Normalization Factor	Speed (ft/s)
-96	0.03	0.19
-90	0.09	0.54
-84	0.15	0.89
-78	0.21	1.25
-72	0.27	1.60
-66	0.33	1.95
-60	0.39	2.31
-54	0.46	2.66
-48	0.52	3.01
-42	0.58	3.37
-36	0.64	3.72
-30	0.70	4.07
-24	0.76	4.43
-18	0.82	4.78
-12	0.88	5.13
-6	0.94	5.49
0	1.00	5.84
6	0.94	5.49
12	0.88	5.13
18	0.82	4.78
24	0.76	4.43
30	0.70	4.07
36	0.64	3.72
42	0.58	3.37
48	0.52	3.01
54	0.46	2.66
60	0.39	2.31
66	0.33	1.95
72	0.27	1.60
78	0.21	1.25
84	0.15	0.89
90	0.09	0.54
96	0.03	0.19
-96	0.03	0.19

Table 6.28 Loop Current events impacting Horn Mountain.

Year	Name
1985	X8585M-e
1986	X8687M-e
1987	LittleJupiter-h
1989	Nelson-hx
1991	Triton-hx
1993	xtra-m
1994	Yucatan-hx
1995	Unnamed-h
1995	XZAPP-e
1996	Devian-h
1998	gyre-m
1999	Haskell-h
1999	Jugger-m
1999	Unnamed-h
2000	Lazy-h
2001	Nansen-h
2002	QE-2-h
2003	Sargassum-h
2004	Ulysses-h
2005	Vortex-h
2007	Zorro-h
2011	Loop_GtoH-h
2013	Loop_N2toO-f
2014	Lazarus-f
2015	Olympus-f

6.5 Client Requested Loop Current Eddy Events Duration

Table 6.29 Client Requested Loop Current Eddy Events Duration

Eddy	Start Date	End Date	Duration (days)
Loop_GtoH-h (2011)	4 July 2011	5 July 2011	2
Loop_N2toO-f (2013)	30 July 2015	16 August 2015	18
Lazarus-f (2014)	8 September 2014	11 September 2014	7
	20 September 2014	22 September 2014	
Olympus-f (2015)	22 August 2015	30 August 2015	12
	15 September 2015	17 September 2015	

7. NEAR BED CURRENT CRITERIA

7.1 Omni-directional and Directional Near Bed Current Criteria

7.1.1 1-Year Return Period

Table 7.1 1-Year Near Bed Current.

Depth	1-Year Return Period Current Speed (ft/s)								
	Omni	N	NE	E	SE	S	SW	W	NW
5210ft	0.76	0.76	0.74	0.53	0.58	0.54	0.57	0.58	0.54

7.1.2 10-Year Return Period

Table 7.2 10-Year Near Bed Current.

Depth	10-Year Return Period Current Speed (ft/s)								
	Omni	N	NE	E	SE	S	SW	W	NW
5210ft	0.97	0.97	0.95	0.68	0.75	0.69	0.74	0.74	0.69

7.1.3 25-Year Return Period

Table 7.3 25-Year Near Bed Current.

Depth	25-Year Return Period Current Speed (ft/s)								
	Omni	N	NE	E	SE	S	SW	W	NW
5210ft	1.06	1.06	1.04	0.74	0.82	0.75	0.80	0.80	0.75

7.1.4 50-Year Return Period

Table 7.4 50-Year Near Bed Current.

Depth	50-Year Return Period Current Speed (ft/s)								
	Omni	N	NE	E	SE	S	SW	W	NW
5210ft	1.12	1.12	1.10	0.78	0.87	0.80	0.85	0.85	0.80

7.1.5 100-Year Return Period

Table 7.5 100-Year Near Bed Current.

Depth	100-Year Return Period Current Speed (ft/s)								
	Omni	N	NE	E	SE	S	SW	W	NW
5210ft	1.18	1.18	1.17	0.83	0.92	0.85	0.90	0.90	0.84

7.2 Associated Near Bed Current Profile

7.2.1 1-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Table 7.6 1-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Depth [ft]	Normalization Factor	Omni-directional	337.5°	22.5°	67.5°	112.5°	157.5°	202.5°	247.5°	247.5°	292.5°
			- 22.5°	- 67.5°	- 112.5°	- 157.5	- 202.5	- 247.5	- 292.5	- 337.5	
		N	NE	E	SE	S	SW	W	NW		
3425	0.27	0.20	0.20	0.20	0.14	0.16	0.14	0.15	0.15	0.15	0.14
3478	0.32	0.24	0.24	0.24	0.17	0.19	0.17	0.18	0.18	0.18	0.17
3530	0.36	0.27	0.27	0.27	0.19	0.21	0.19	0.21	0.21	0.21	0.19
3583	0.36	0.27	0.27	0.27	0.19	0.21	0.19	0.21	0.21	0.21	0.19
3635	0.33	0.25	0.25	0.25	0.18	0.19	0.18	0.19	0.19	0.19	0.18
3688	0.38	0.29	0.29	0.28	0.20	0.22	0.21	0.22	0.22	0.22	0.20
3740	0.39	0.29	0.29	0.29	0.20	0.23	0.21	0.22	0.22	0.22	0.21
3793	0.35	0.27	0.27	0.26	0.19	0.21	0.19	0.20	0.20	0.20	0.19
3845	0.36	0.27	0.27	0.27	0.19	0.21	0.20	0.21	0.21	0.21	0.19
3898	0.36	0.27	0.27	0.26	0.19	0.21	0.19	0.20	0.20	0.20	0.19
3950	0.36	0.27	0.27	0.27	0.19	0.21	0.19	0.21	0.21	0.21	0.19
4003	0.36	0.27	0.27	0.27	0.19	0.21	0.19	0.21	0.21	0.21	0.19
4055	0.36	0.27	0.27	0.27	0.19	0.21	0.19	0.21	0.21	0.21	0.19
4108	0.39	0.29	0.29	0.29	0.20	0.23	0.21	0.22	0.22	0.22	0.21
4160	0.42	0.32	0.32	0.31	0.22	0.25	0.23	0.24	0.24	0.24	0.23
4213	0.44	0.33	0.33	0.33	0.23	0.26	0.24	0.25	0.25	0.25	0.24
4265	0.41	0.31	0.31	0.31	0.22	0.24	0.22	0.24	0.24	0.24	0.22
4318	0.39	0.30	0.30	0.29	0.21	0.23	0.21	0.22	0.23	0.23	0.21
4370	0.36	0.27	0.27	0.27	0.19	0.21	0.20	0.21	0.21	0.21	0.19
4423	0.35	0.26	0.26	0.26	0.18	0.20	0.19	0.20	0.20	0.20	0.19
4475	0.35	0.27	0.27	0.26	0.19	0.21	0.19	0.20	0.20	0.20	0.19
4528	0.37	0.28	0.28	0.27	0.19	0.21	0.20	0.21	0.21	0.21	0.20
4580	0.37	0.28	0.28	0.28	0.20	0.22	0.20	0.21	0.21	0.21	0.20
4633	0.35	0.27	0.27	0.26	0.19	0.21	0.19	0.20	0.20	0.20	0.19
4685	0.39	0.30	0.30	0.29	0.21	0.23	0.21	0.23	0.23	0.23	0.21
4738	0.44	0.33	0.33	0.33	0.23	0.26	0.24	0.25	0.25	0.25	0.24
4790	0.49	0.37	0.37	0.36	0.26	0.28	0.26	0.28	0.28	0.28	0.26
4843	0.55	0.42	0.42	0.41	0.29	0.32	0.30	0.32	0.32	0.32	0.30
4895	0.58	0.44	0.44	0.43	0.31	0.34	0.32	0.33	0.34	0.34	0.31
4948	0.64	0.48	0.48	0.48	0.34	0.37	0.35	0.37	0.37	0.37	0.34
5000	0.69	0.52	0.52	0.51	0.36	0.40	0.37	0.39	0.39	0.39	0.37
5052	0.73	0.55	0.55	0.54	0.38	0.43	0.39	0.42	0.42	0.42	0.39
5105	0.78	0.59	0.59	0.58	0.41	0.46	0.42	0.45	0.45	0.45	0.42
5157	0.84	0.63	0.63	0.62	0.44	0.49	0.45	0.48	0.48	0.48	0.45
5210	1.00	0.76	0.76	0.74	0.53	0.58	0.54	0.57	0.58	0.58	0.54

7.2.2 10-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Table 7.7 10-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Depth [ft]	Normalization Factor	Omni-directional	337.5°	22.5°	67.5°	112.5°	157.5°	202.5°	247.5°	247.5°	292.5°
			-	-	-	-	-	-	-	-	-
			N	NE	E	SE	S	SW	W	NW	
3425	0.27	0.26	0.26	0.25	0.18	0.20	0.18	0.20	0.20	0.20	0.18
3478	0.32	0.31	0.31	0.30	0.22	0.24	0.22	0.23	0.24	0.24	0.22
3530	0.36	0.35	0.35	0.34	0.24	0.27	0.25	0.26	0.27	0.27	0.25
3583	0.36	0.35	0.35	0.34	0.24	0.27	0.25	0.27	0.27	0.27	0.25
3635	0.33	0.32	0.32	0.32	0.23	0.25	0.23	0.24	0.25	0.25	0.23
3688	0.38	0.37	0.37	0.36	0.26	0.29	0.26	0.28	0.28	0.28	0.26
3740	0.39	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.29	0.29	0.27
3793	0.35	0.34	0.34	0.34	0.24	0.26	0.24	0.26	0.26	0.26	0.24
3845	0.36	0.35	0.35	0.35	0.25	0.27	0.25	0.27	0.27	0.27	0.25
3898	0.36	0.34	0.34	0.34	0.24	0.27	0.25	0.26	0.26	0.26	0.24
3950	0.36	0.35	0.35	0.34	0.24	0.27	0.25	0.26	0.27	0.27	0.25
4003	0.36	0.35	0.35	0.34	0.24	0.27	0.25	0.26	0.27	0.27	0.25
4055	0.36	0.35	0.35	0.34	0.24	0.27	0.25	0.26	0.26	0.26	0.25
4108	0.39	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.29	0.29	0.27
4160	0.42	0.41	0.41	0.40	0.29	0.32	0.29	0.31	0.31	0.31	0.29
4213	0.44	0.43	0.43	0.42	0.30	0.33	0.31	0.32	0.33	0.33	0.30
4265	0.41	0.40	0.40	0.39	0.28	0.31	0.28	0.30	0.30	0.30	0.28
4318	0.39	0.38	0.38	0.37	0.26	0.29	0.27	0.29	0.29	0.29	0.27
4370	0.36	0.35	0.35	0.35	0.25	0.27	0.25	0.27	0.27	0.27	0.25
4423	0.35	0.34	0.34	0.33	0.23	0.26	0.24	0.25	0.26	0.26	0.24
4475	0.35	0.34	0.34	0.34	0.24	0.26	0.24	0.26	0.26	0.26	0.24
4528	0.37	0.35	0.35	0.35	0.25	0.27	0.25	0.27	0.27	0.27	0.25
4580	0.37	0.36	0.36	0.35	0.25	0.28	0.26	0.27	0.27	0.27	0.26
4633	0.35	0.34	0.34	0.34	0.24	0.27	0.25	0.26	0.26	0.26	0.24
4685	0.39	0.38	0.38	0.38	0.27	0.30	0.27	0.29	0.29	0.29	0.27
4738	0.44	0.43	0.43	0.42	0.30	0.33	0.30	0.32	0.32	0.32	0.30
4790	0.49	0.47	0.47	0.46	0.33	0.37	0.34	0.36	0.36	0.36	0.34
4843	0.55	0.53	0.53	0.53	0.37	0.41	0.38	0.40	0.41	0.38	
4895	0.58	0.57	0.57	0.56	0.40	0.44	0.40	0.43	0.43	0.40	
4948	0.64	0.62	0.62	0.61	0.43	0.48	0.44	0.47	0.47	0.47	0.44
5000	0.69	0.66	0.66	0.65	0.46	0.51	0.47	0.50	0.51	0.47	
5052	0.73	0.71	0.71	0.70	0.49	0.55	0.51	0.54	0.54	0.50	
5105	0.78	0.76	0.76	0.74	0.53	0.59	0.54	0.57	0.58	0.54	
5157	0.84	0.81	0.81	0.80	0.57	0.63	0.58	0.61	0.62	0.58	
5210	1.00	0.97	0.97	0.95	0.68	0.75	0.69	0.74	0.74	0.69	

7.2.3 25-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Table 7.8 25-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Depth [ft]	Normalization Factor	Omni-directional	337.5°	22.5°	67.5°	112.5°	157.5°	202.5°	247.5°	247.5°	292.5°
			- 22.5°	- 67.5°	- 112.5°	- 157.5	- 202.5	- 247.5	- 292.5	- 337.5	
		N	NE	E	SE	S	SW	W	NW		
3425	0.27	0.28	0.28	0.28	0.20	0.22	0.20	0.21	0.21	0.21	0.20
3478	0.32	0.34	0.34	0.33	0.23	0.26	0.24	0.25	0.26	0.26	0.24
3530	0.36	0.38	0.38	0.37	0.26	0.29	0.27	0.29	0.29	0.29	0.27
3583	0.36	0.38	0.38	0.37	0.27	0.29	0.27	0.29	0.29	0.29	0.27
3635	0.33	0.35	0.35	0.35	0.25	0.27	0.25	0.27	0.27	0.27	0.25
3688	0.38	0.40	0.40	0.40	0.28	0.31	0.29	0.30	0.31	0.29	0.29
3740	0.39	0.41	0.41	0.40	0.28	0.32	0.29	0.31	0.31	0.29	0.29
3793	0.35	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.28	0.28	0.26
3845	0.36	0.38	0.38	0.38	0.27	0.30	0.27	0.29	0.29	0.29	0.27
3898	0.36	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.29	0.29	0.27
3950	0.36	0.38	0.38	0.37	0.27	0.29	0.27	0.29	0.29	0.29	0.27
4003	0.36	0.38	0.38	0.37	0.27	0.29	0.27	0.29	0.29	0.29	0.27
4055	0.36	0.38	0.38	0.37	0.26	0.29	0.27	0.29	0.29	0.29	0.27
4108	0.39	0.41	0.41	0.40	0.28	0.32	0.29	0.31	0.31	0.29	0.29
4160	0.42	0.45	0.45	0.44	0.31	0.35	0.32	0.34	0.34	0.34	0.32
4213	0.44	0.47	0.47	0.46	0.33	0.36	0.33	0.35	0.36	0.33	0.33
4265	0.41	0.43	0.43	0.43	0.30	0.34	0.31	0.33	0.33	0.33	0.31
4318	0.39	0.41	0.41	0.41	0.29	0.32	0.29	0.31	0.31	0.29	0.29
4370	0.36	0.38	0.38	0.38	0.27	0.30	0.27	0.29	0.29	0.29	0.27
4423	0.35	0.37	0.37	0.36	0.26	0.28	0.26	0.28	0.28	0.28	0.26
4475	0.35	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.28	0.28	0.26
4528	0.37	0.39	0.39	0.38	0.27	0.30	0.28	0.29	0.29	0.29	0.27
4580	0.37	0.39	0.39	0.39	0.27	0.30	0.28	0.30	0.30	0.30	0.28
4633	0.35	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.28	0.28	0.27
4685	0.39	0.42	0.42	0.41	0.29	0.32	0.30	0.32	0.32	0.32	0.30
4738	0.44	0.46	0.46	0.46	0.32	0.36	0.33	0.35	0.35	0.35	0.33
4790	0.49	0.51	0.51	0.51	0.36	0.40	0.37	0.39	0.39	0.39	0.37
4843	0.55	0.58	0.58	0.57	0.41	0.45	0.41	0.44	0.44	0.44	0.41
4895	0.58	0.62	0.62	0.61	0.43	0.48	0.44	0.47	0.47	0.47	0.44
4948	0.64	0.68	0.68	0.67	0.47	0.52	0.48	0.51	0.52	0.52	0.48
5000	0.69	0.72	0.72	0.71	0.50	0.56	0.52	0.55	0.55	0.55	0.51
5052	0.73	0.77	0.77	0.76	0.54	0.60	0.55	0.58	0.59	0.59	0.55
5105	0.78	0.82	0.82	0.81	0.57	0.64	0.59	0.62	0.63	0.63	0.58
5157	0.84	0.88	0.88	0.87	0.62	0.68	0.63	0.67	0.67	0.67	0.63
5210	1.00	1.06	1.06	1.04	0.74	0.82	0.75	0.80	0.80	0.80	0.75

7.2.4 50-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Table 7.9 50-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Depth [ft]	Normalization Factor	Omni-directional	337.5°	22.5°	67.5°	112.5°	157.5°	202.5°	247.5°	292.5°	292.5°
			- 22.5°	- 67.5°	- 112.5°	- 157.5	- 202.5	- 247.5	- 292.5	- 337.5	
		N	NE	E	SE	S	SW	W	NW		
3425	0.27	0.30	0.30	0.29	0.21	0.23	0.21	0.23	0.23	0.23	0.21
3478	0.32	0.36	0.36	0.35	0.25	0.28	0.25	0.27	0.27	0.27	0.25
3530	0.36	0.40	0.40	0.40	0.28	0.31	0.29	0.30	0.31	0.29	
3583	0.36	0.40	0.40	0.40	0.28	0.31	0.29	0.31	0.31	0.29	
3635	0.33	0.37	0.37	0.37	0.26	0.29	0.27	0.28	0.28	0.26	
3688	0.38	0.43	0.43	0.42	0.30	0.33	0.30	0.32	0.33	0.30	
3740	0.39	0.43	0.43	0.43	0.30	0.33	0.31	0.33	0.33	0.31	
3793	0.35	0.40	0.40	0.39	0.28	0.31	0.28	0.30	0.30	0.28	
3845	0.36	0.41	0.41	0.40	0.28	0.31	0.29	0.31	0.31	0.29	
3898	0.36	0.40	0.40	0.39	0.28	0.31	0.28	0.30	0.30	0.28	
3950	0.36	0.40	0.40	0.40	0.28	0.31	0.29	0.31	0.31	0.29	
4003	0.36	0.40	0.40	0.40	0.28	0.31	0.29	0.31	0.31	0.29	
4055	0.36	0.40	0.40	0.39	0.28	0.31	0.29	0.30	0.31	0.28	
4108	0.39	0.43	0.43	0.43	0.30	0.33	0.31	0.33	0.33	0.31	
4160	0.42	0.47	0.47	0.47	0.33	0.37	0.34	0.36	0.36	0.34	
4213	0.44	0.49	0.49	0.49	0.35	0.38	0.35	0.38	0.38	0.35	
4265	0.41	0.46	0.46	0.45	0.32	0.36	0.33	0.35	0.35	0.33	
4318	0.39	0.44	0.44	0.43	0.31	0.34	0.31	0.33	0.33	0.31	
4370	0.36	0.41	0.41	0.40	0.28	0.31	0.29	0.31	0.31	0.29	
4423	0.35	0.39	0.39	0.38	0.27	0.30	0.28	0.29	0.30	0.28	
4475	0.35	0.40	0.40	0.39	0.28	0.31	0.28	0.30	0.30	0.28	
4528	0.37	0.41	0.41	0.40	0.29	0.32	0.29	0.31	0.31	0.29	
4580	0.37	0.42	0.42	0.41	0.29	0.32	0.30	0.31	0.32	0.30	
4633	0.35	0.40	0.40	0.39	0.28	0.31	0.28	0.30	0.30	0.28	
4685	0.39	0.44	0.44	0.43	0.31	0.34	0.32	0.33	0.34	0.31	
4738	0.44	0.49	0.49	0.48	0.34	0.38	0.35	0.37	0.37	0.35	
4790	0.49	0.55	0.55	0.54	0.38	0.42	0.39	0.41	0.42	0.39	
4843	0.55	0.62	0.62	0.61	0.43	0.48	0.44	0.47	0.47	0.44	
4895	0.58	0.65	0.65	0.64	0.46	0.51	0.47	0.50	0.50	0.46	
4948	0.64	0.72	0.72	0.71	0.50	0.56	0.51	0.54	0.55	0.51	
5000	0.69	0.77	0.77	0.75	0.54	0.59	0.55	0.58	0.58	0.54	
5052	0.73	0.82	0.82	0.80	0.57	0.63	0.58	0.62	0.62	0.58	
5105	0.78	0.87	0.87	0.86	0.61	0.68	0.62	0.66	0.67	0.62	
5157	0.84	0.94	0.94	0.92	0.65	0.72	0.67	0.71	0.71	0.66	
5210	1.00	1.12	1.12	1.10	0.78	0.87	0.80	0.85	0.85	0.80	

7.2.5 100-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Table 7.10 100-Year Return Period Omni-directional and Directional Associated Near Bed Current Profile

Depth [ft]	Normalization Factor	Omni-directional	337.5°	22.5°	67.5°	112.5°	157.5°	202.5°	247.5°	292.5°
			-	-	-	-	-	-	-	-
			N	NE	E	SE	S	SW	W	NW
3425	0.27	0.32	0.32	0.31	0.22	0.24	0.23	0.24	0.24	0.22
3478	0.32	0.38	0.38	0.37	0.26	0.29	0.27	0.29	0.29	0.27
3530	0.36	0.43	0.43	0.42	0.30	0.33	0.30	0.32	0.32	0.30
3583	0.36	0.43	0.43	0.42	0.30	0.33	0.31	0.32	0.33	0.30
3635	0.33	0.39	0.39	0.39	0.28	0.31	0.28	0.30	0.30	0.28
3688	0.38	0.45	0.45	0.44	0.32	0.35	0.32	0.34	0.34	0.32
3740	0.39	0.46	0.46	0.45	0.32	0.35	0.33	0.35	0.35	0.32
3793	0.35	0.42	0.42	0.41	0.29	0.32	0.30	0.32	0.32	0.30
3845	0.36	0.43	0.43	0.42	0.30	0.33	0.31	0.33	0.33	0.31
3898	0.36	0.42	0.42	0.41	0.29	0.33	0.30	0.32	0.32	0.30
3950	0.36	0.43	0.43	0.42	0.30	0.33	0.30	0.32	0.32	0.30
4003	0.36	0.43	0.43	0.42	0.30	0.33	0.30	0.32	0.32	0.30
4055	0.36	0.42	0.42	0.42	0.30	0.33	0.30	0.32	0.32	0.30
4108	0.39	0.46	0.46	0.45	0.32	0.35	0.33	0.35	0.35	0.32
4160	0.42	0.50	0.50	0.49	0.35	0.39	0.36	0.38	0.38	0.36
4213	0.44	0.52	0.52	0.52	0.37	0.41	0.37	0.40	0.40	0.37
4265	0.41	0.49	0.49	0.48	0.34	0.38	0.35	0.37	0.37	0.35
4318	0.39	0.46	0.46	0.46	0.32	0.36	0.33	0.35	0.35	0.33
4370	0.36	0.43	0.43	0.42	0.30	0.33	0.31	0.32	0.33	0.30
4423	0.35	0.41	0.41	0.40	0.29	0.32	0.29	0.31	0.31	0.29
4475	0.35	0.42	0.42	0.41	0.29	0.32	0.30	0.32	0.32	0.30
4528	0.37	0.43	0.43	0.43	0.30	0.33	0.31	0.33	0.33	0.31
4580	0.37	0.44	0.44	0.43	0.31	0.34	0.31	0.33	0.33	0.31
4633	0.35	0.42	0.42	0.41	0.29	0.32	0.30	0.32	0.32	0.30
4685	0.39	0.47	0.47	0.46	0.33	0.36	0.33	0.35	0.36	0.33
4738	0.44	0.52	0.52	0.51	0.36	0.40	0.37	0.39	0.40	0.37
4790	0.49	0.58	0.58	0.57	0.40	0.45	0.41	0.44	0.44	0.41
4843	0.55	0.65	0.65	0.64	0.45	0.50	0.47	0.49	0.50	0.46
4895	0.58	0.69	0.69	0.68	0.48	0.54	0.49	0.52	0.53	0.49
4948	0.64	0.76	0.76	0.75	0.53	0.59	0.54	0.58	0.58	0.54
5000	0.69	0.81	0.81	0.80	0.57	0.63	0.58	0.61	0.62	0.58
5052	0.73	0.86	0.86	0.85	0.60	0.67	0.62	0.65	0.66	0.61
5105	0.78	0.92	0.92	0.91	0.65	0.71	0.66	0.70	0.70	0.66
5157	0.84	0.99	0.99	0.97	0.69	0.77	0.71	0.75	0.75	0.70
5210	1.00	1.18	1.18	1.17	0.83	0.92	0.85	0.90	0.90	0.84

7.3 Monthly and Annual Frequency of Occurrence for Near Bed Current Speed

All-Year

Total	16.87	21.16	12.93	9.41	8.93	10.04	9.72	10.94	100.00	
Current Speed at 5209.9739ft (ft/s)	<0.01	<0.01							<0.01	
0.80	0.02	<0.01							0.02	
0.75	0.03	<0.01							0.04	0.03
0.70	0.06	0.03							0.09	0.06
0.65	0.06	0.04		<0.01			<0.01	<0.01	0.11	0.15
0.60	0.11	0.11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.24	0.26
0.55	0.13	0.18	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.36	0.50
0.50	0.17	0.29	0.05	0.03	0.01	0.03	0.03	0.04	0.66	0.86
0.45	0.24	0.52	0.12	0.08	0.04	0.11	0.07	0.10	1.29	1.52
0.40	0.43	0.80	0.27	0.23	0.14	0.21	0.19	0.20	2.46	2.81
0.35	0.72	1.31	0.50	0.36	0.34	0.42	0.36	0.35	4.37	5.27
0.30	1.24	2.12	0.97	0.61	0.56	0.84	0.78	0.81	7.92	9.64
0.25	2.19	2.81	1.67	1.07	1.12	1.37	1.18	1.37	12.79	17.55
0.20	3.23	3.88	2.49	1.62	1.62	1.92	1.79	2.06	18.61	30.34
0.15	4.08	4.60	3.22	2.32	2.30	2.24	2.33	2.75	23.85	48.95
0.10	3.27	3.63	2.76	2.36	2.07	2.19	2.28	2.41	20.96	72.80
0.05	0.88	0.82	0.87	0.71	0.72	0.70	0.70	0.84	6.24	93.76
0.00	N	NE	E	SE	S	SW	W	NW	Total %	Exceed %

Current Direction at 5209.9739ft (°T From)

Figure 7.1 Joint Frequency Distributions for Near Bed Current Speeds by Direction – All-Year

January

Total	23.44	23.31	12.33	9.21	8.37	6.11	6.63	10.59	100.00	
Current Speed at 5209.9739ft (ft/s)										
0.80										
0.75										
0.70										
0.65		0.05							0.05	
0.60		0.11							0.11	
0.55		0.02	0.23					0.07	0.02	0.34
0.50		0.05	0.23					0.05		0.32
0.45		0.20	0.34	0.02		0.07		0.02	0.09	0.75
0.40		0.81	0.52	0.07	0.25	0.05				1.70
0.35		1.40	1.38	0.16	0.25	0.09		0.05	0.07	3.39
0.30		1.52	1.90	0.57	0.57	0.18	0.05	0.16	0.34	5.27
0.25		3.01	2.69	1.36	1.31	0.75	0.54	0.25	0.86	11.93
0.20		5.20	4.48	2.06	1.45	1.49	1.13	0.81	2.06	22.70
0.15		5.77	5.57	3.42	2.31	2.35	1.92	1.97	3.51	41.39
0.10		4.57	4.87	3.60	2.56	2.60	2.15	2.60	2.78	68.21
0.05		0.88	0.95	1.09	0.52	0.79	0.32	0.66	0.86	93.94
0.00	N	NE	E	SE	S	SW	W	NW	Total %	Exceed %

Current Direction at 5209.9739ft (°T From)

Figure 7.2 Joint Frequency Distributions for Near Bed Current Speeds by Direction – January

February

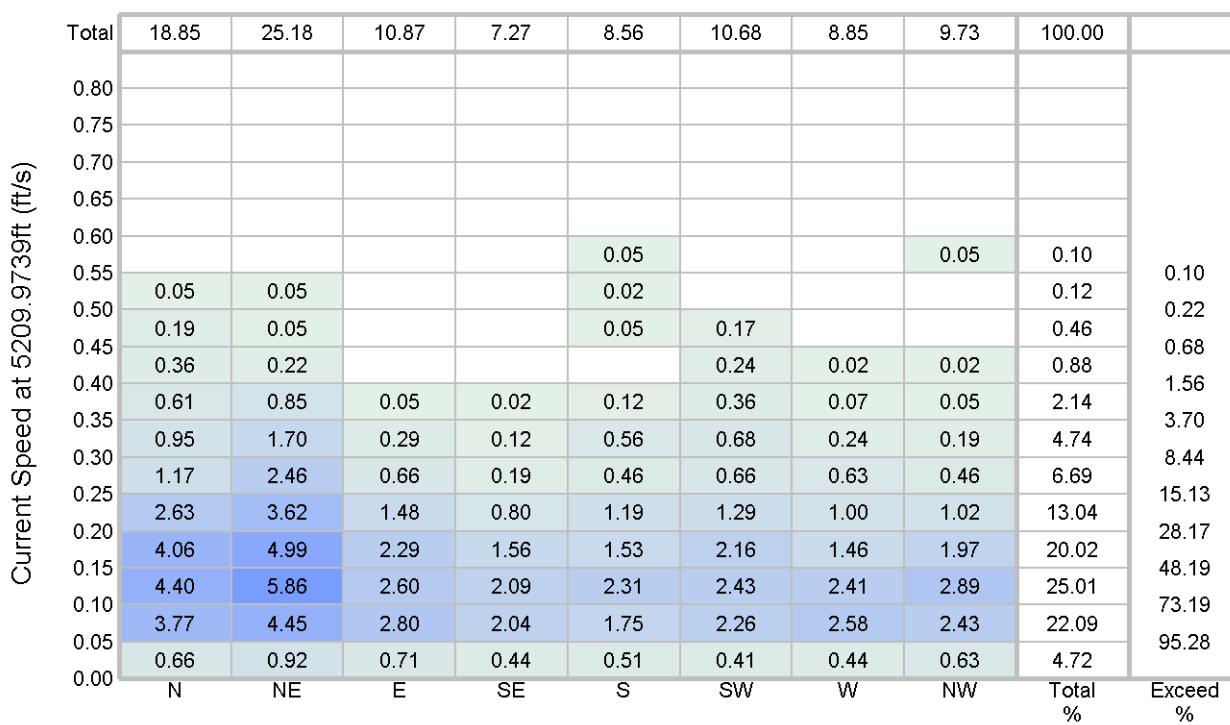


Figure 7.3 Joint Frequency Distributions for Near Bed Current Speeds by Direction – February

March

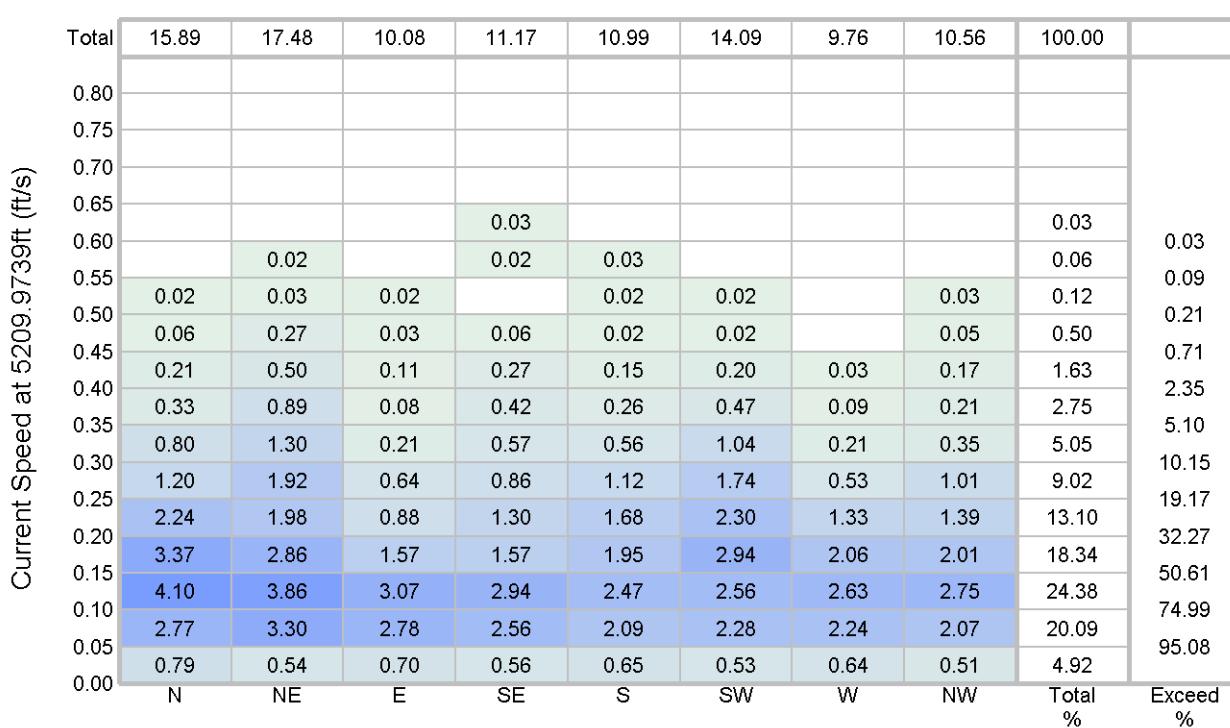


Figure 7.4 Joint Frequency Distributions for Near Bed Current Speeds by Direction – March

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METOCEAN CRITERIA STUDY, HORN MOUNTAIN, GULF OF MEXICO

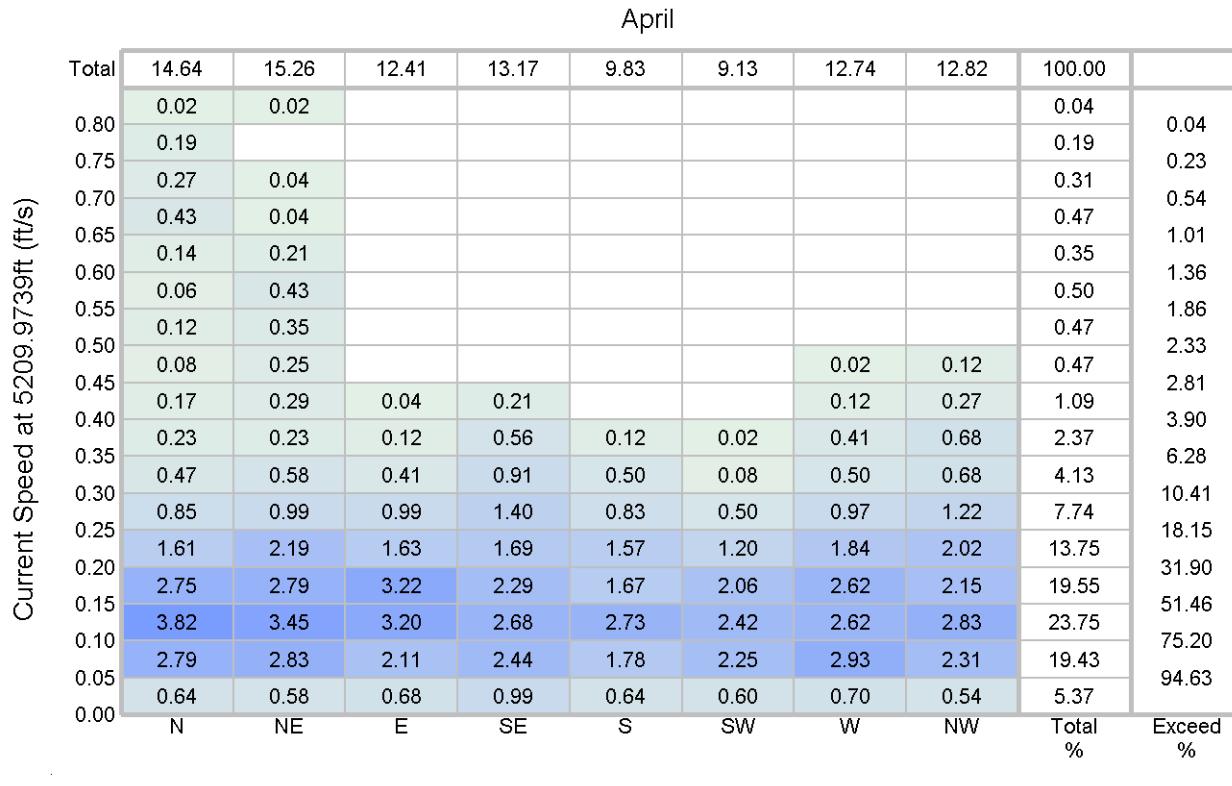


Figure 7.5 Joint Frequency Distributions for Near Bed Current Speeds by Direction – April

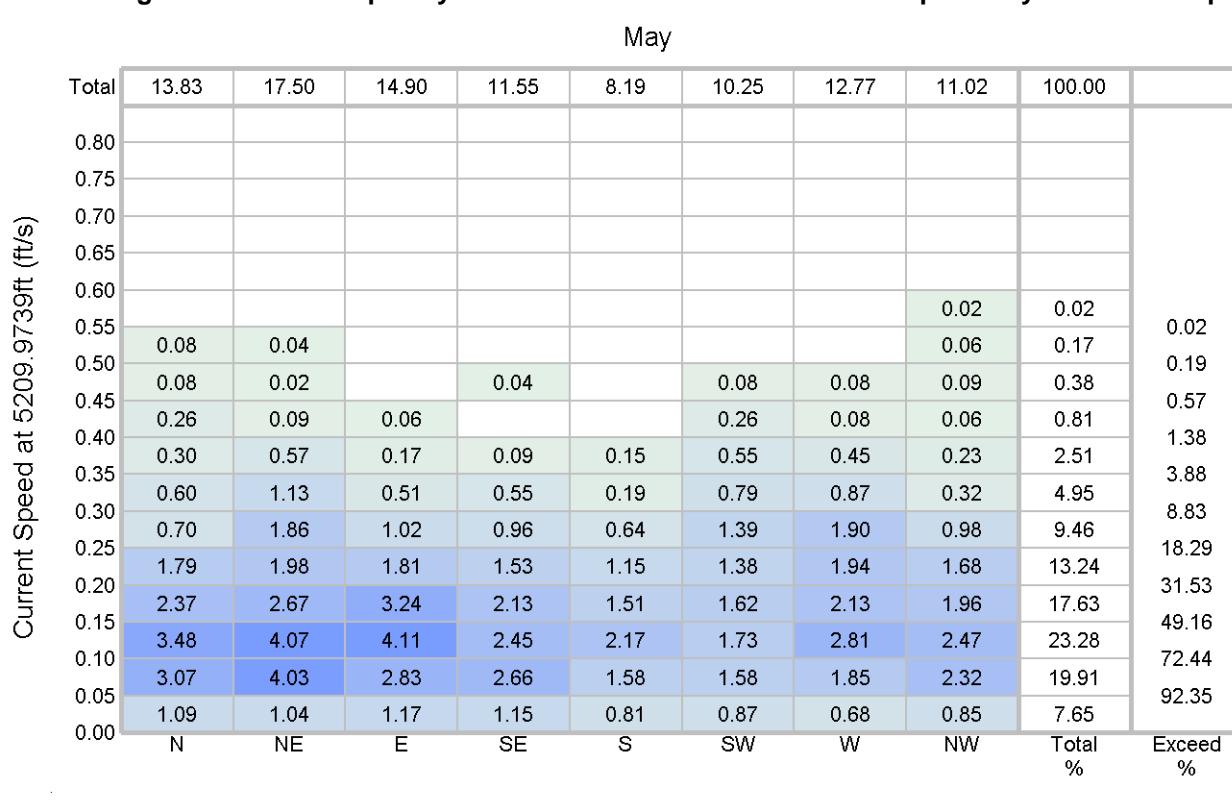


Figure 7.6 Joint Frequency Distributions for Near Bed Current Speeds by Direction – May

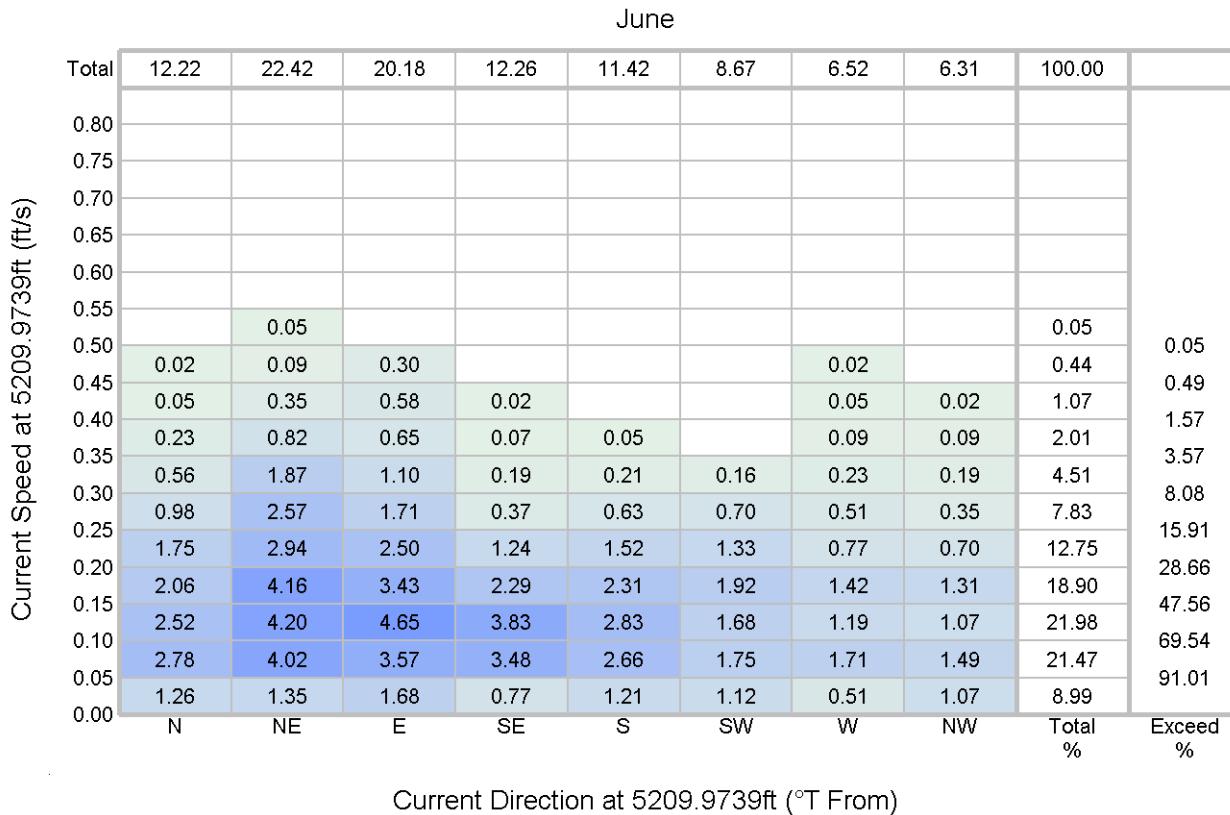


Figure 7.7 Joint Frequency Distributions for Near Bed Current Speeds by Direction – June

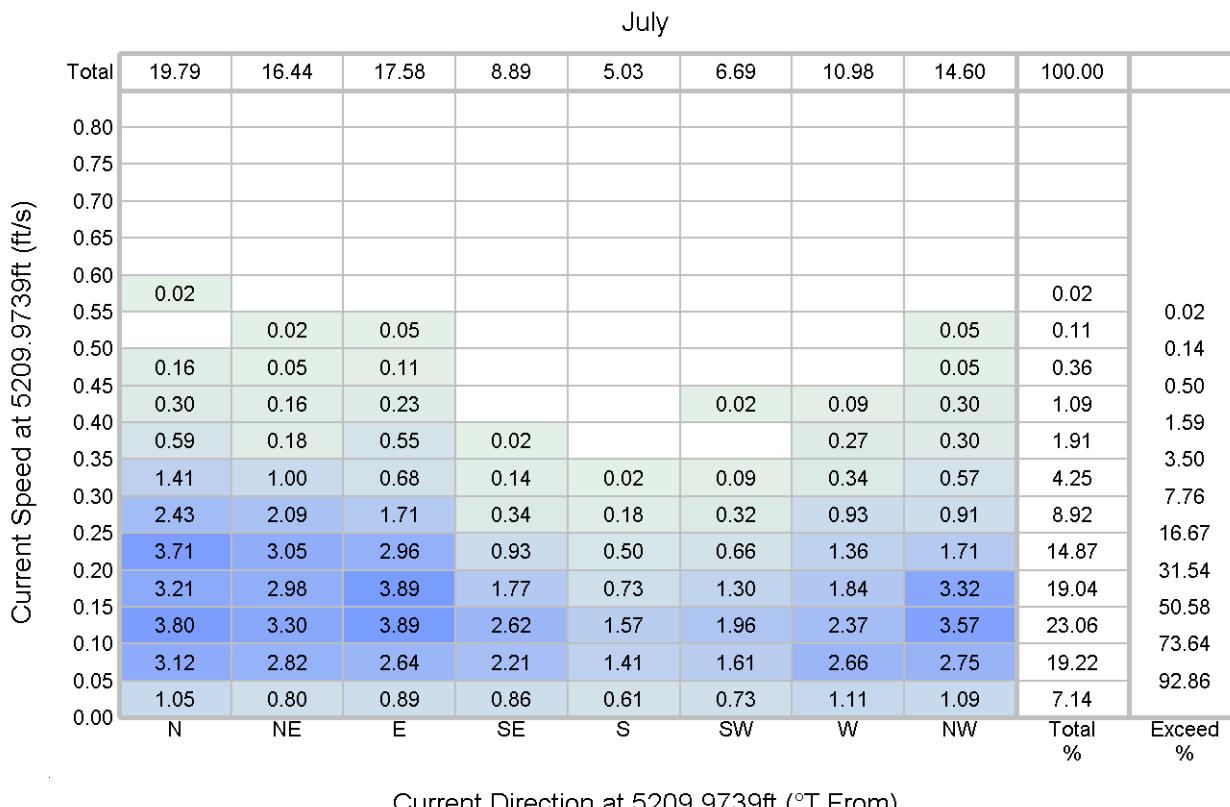
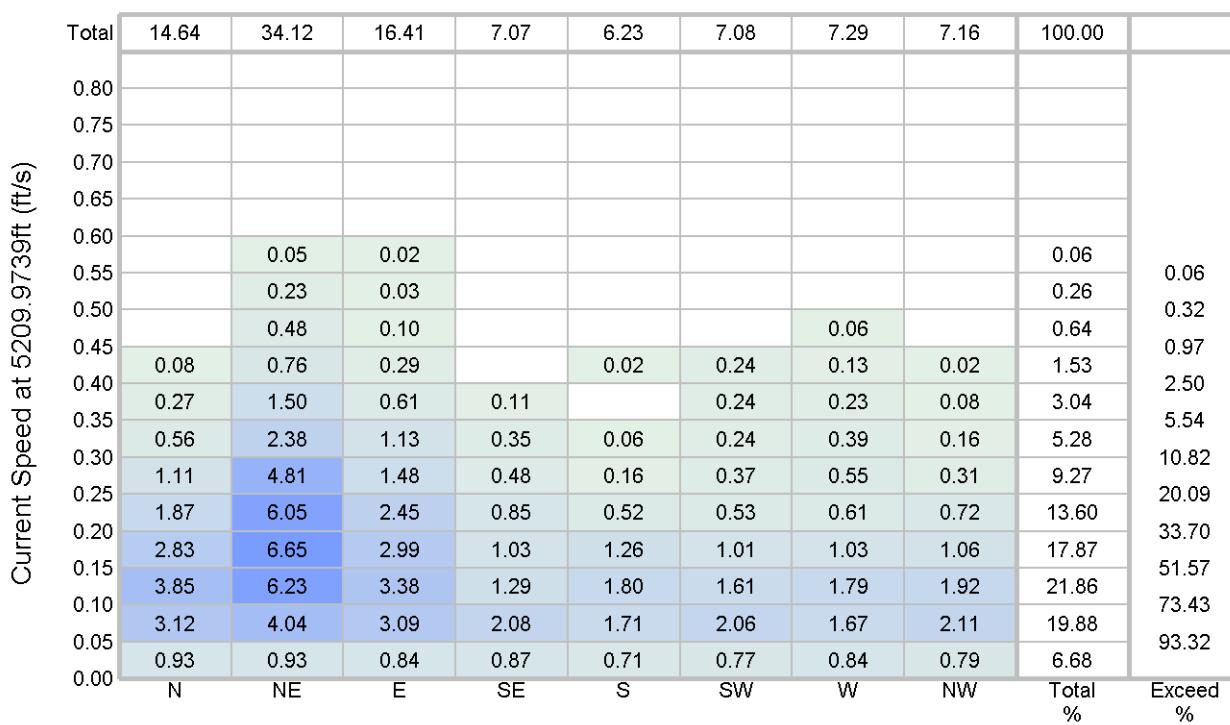


Figure 7.8 Joint Frequency Distributions for Near Bed Current Speeds by Direction – July

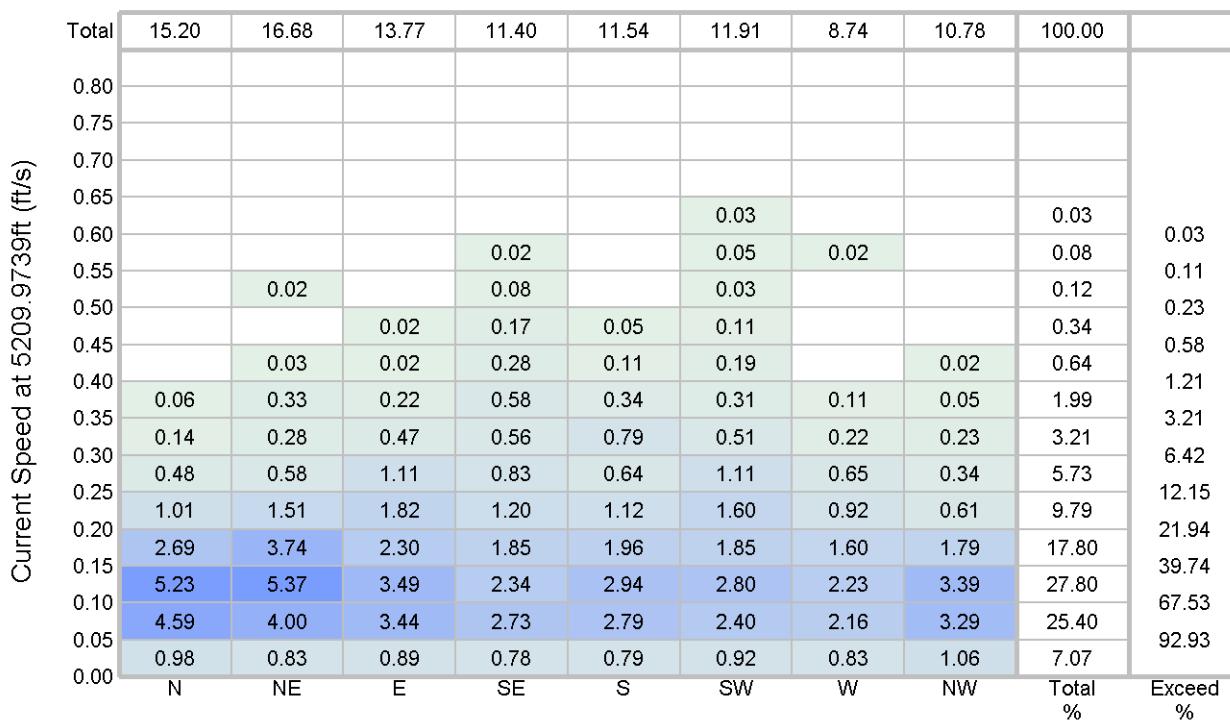
August



Current Direction at 5209.9739ft (°T From)

Figure 7.9 Joint Frequency Distributions for Near Bed Current Speeds by Direction – August

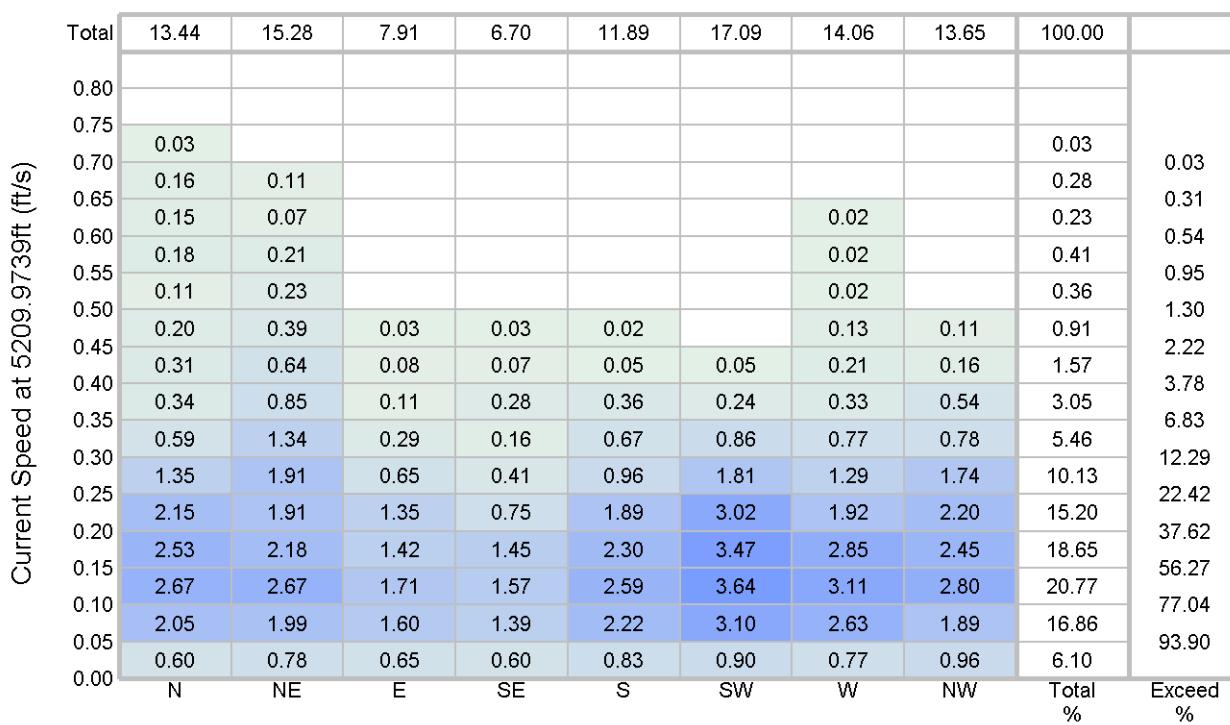
September



Current Direction at 5209.9739ft (°T From)

Figure 7.10 Joint Frequency Distributions for Near Bed Current Speeds by Direction – September

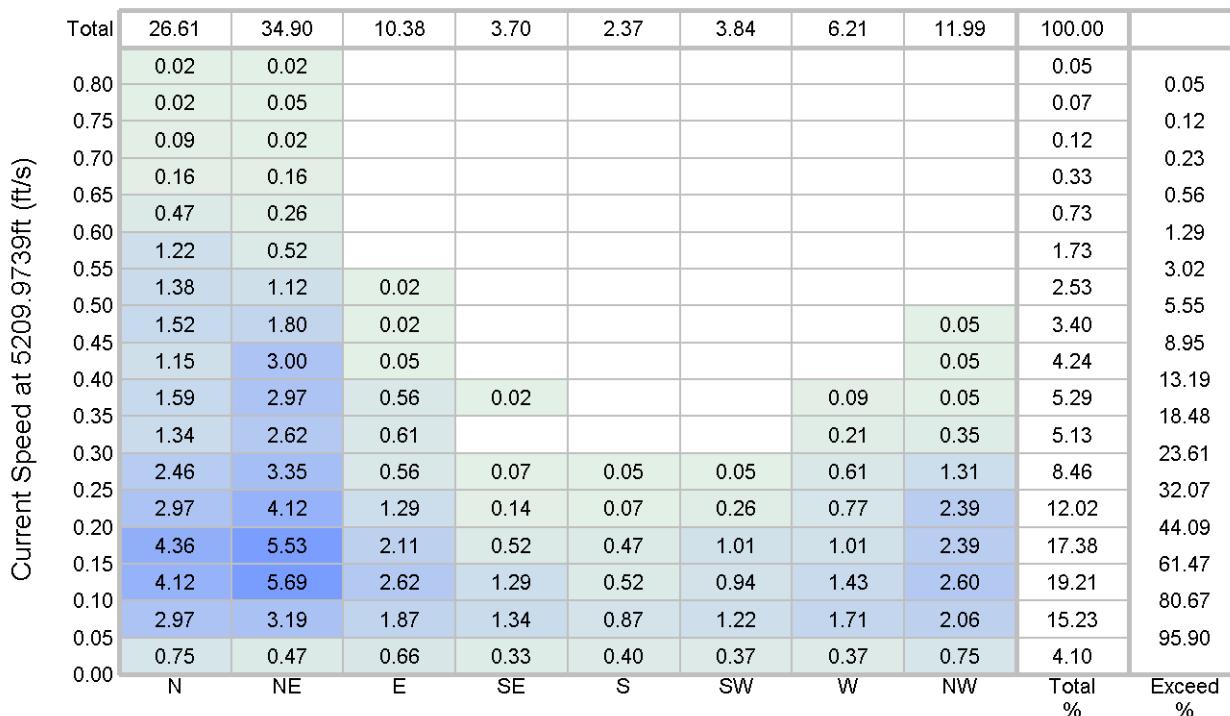
October



Current Direction at 5209.9739ft (°T From)

Figure 7.11 Joint Frequency Distributions for Near Bed Current Speeds by Direction – October

November



Current Direction at 5209.9739ft (°T From)

Figure 7.12 Joint Frequency Distributions for Near Bed Current Speeds by Direction – November

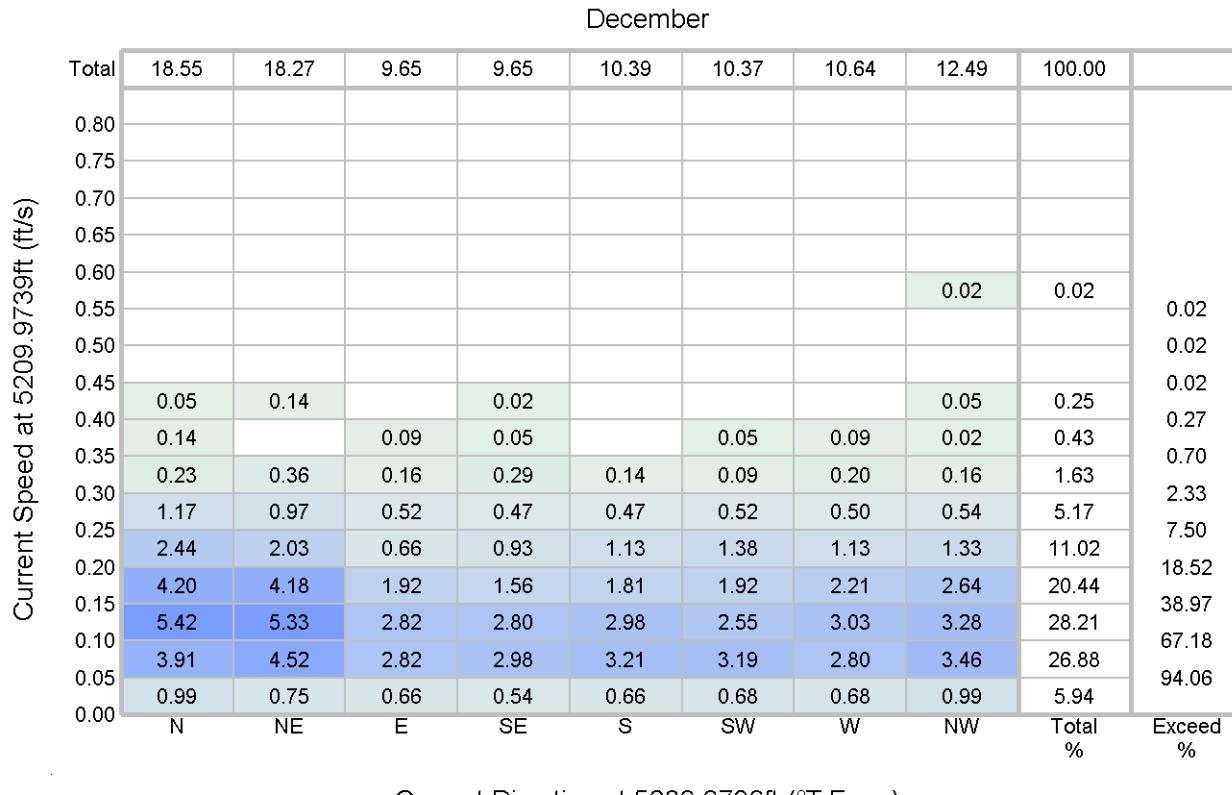


Figure 7.13 Joint Frequency Distributions for Near Bed Current Speeds by Direction – December

7.4 Monthly and Annual Exceedance Statistics for Near Bed Current Speed

Table 7.11 Monthly and Annual Near Bed Current Speed Statistics and Exceedance

COMBINED PERIOD (2006 to 2009)	STATISTICS											
	Current Speed at 5210ft [ft/s]				EXCEEDENCE PERCENTILE FOR Current Speed at 5210ft [ft/s]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	0.01	0.15	0.63	0.09	0.03	0.04	0.05	0.06	0.13	0.26	0.32	0.43
February	0.01	0.16	0.59	0.09	0.03	0.04	0.05	0.07	0.15	0.29	0.33	0.43
March	0.00	0.17	0.64	0.09	0.02	0.03	0.05	0.07	0.15	0.30	0.35	0.43
April	0.00	0.18	0.83	0.11	0.02	0.03	0.05	0.07	0.15	0.30	0.37	0.65
May	0.00	0.16	0.55	0.09	0.02	0.03	0.04	0.06	0.15	0.29	0.33	0.42
June	0.00	0.16	0.52	0.09	0.02	0.02	0.04	0.05	0.14	0.29	0.33	0.41
July	0.00	0.16	0.56	0.09	0.02	0.03	0.04	0.06	0.15	0.28	0.33	0.42
August	0.00	0.17	0.59	0.10	0.02	0.03	0.04	0.06	0.15	0.31	0.36	0.44
September	0.00	0.15	0.63	0.09	0.02	0.03	0.04	0.06	0.13	0.26	0.32	0.41
October	0.00	0.18	0.74	0.11	0.02	0.03	0.04	0.06	0.17	0.32	0.38	0.54
November	0.00	0.22	0.81	0.14	0.03	0.04	0.06	0.08	0.18	0.44	0.51	0.62
December	0.01	0.14	0.59	0.07	0.03	0.03	0.05	0.06	0.13	0.24	0.27	0.33
All Year	0.00	0.17	0.83	0.10	0.02	0.03	0.05	0.06	0.15	0.30	0.35	0.49

8. DATA SOURCES

8.1 GOMOS2014

GOMOS (Gulf of Mexico Oceanographic Study) is Oceanweather's comprehensive hindcast database and suite of derivative product for the Gulf of Mexico. It was designed to serve as a follow-on to the Joint Industry Projects (JIP) carried out at Oceanweather in the decades of 1980s and 1990s that addressed the hurricane generated metocean extremes, winter storm extremes and continuous operational wind and wave data in the Gulf of Mexico. Nowadays, GOMOS dataset has become the industry standard and has been incorporated into the publications of the API (American Petroleum Institute) for offshore design and operational criteria in the Gulf of Mexico.

GOMOS2014 is the most updated version of GOMOS database including all the hurricane events up to the 2014 season. GOMOS2014 consists of three main hindcast databases and derivative statistics. These databases address respectively the following storm populations and periods:

- (1) 407 tropical storms and hurricanes from the period 1900-2014.
- (2) 111 extra-tropical/winter storm hindcasts from the period 1950-2014.
- (3) 35-year continuous hindcast of the period 1980-2014.

The Hurricane, Sudden Hurricane and Off-Peak Hurricane wind, wave and current criteria were derived from the GOMOS2014 grid points listed in Table 8.1 for the period 1950-2014. These points were selected for the following reasons:

- A sufficient spacing (75-150 km) was desired to capture the storm population that crossed the region of interest.
- An approximate east-to-west axis was utilized in the analysis. This pattern captures the main storm tracks through the Gulf of Mexico near the site of interest.

Table 8.1 Tropical Storm GOMOS2014 Grid Points.

GRID POINT	POINT LOCATION	LATITUDE (°N)	LONGITUDE (°W)	DEPTH (m)
T4035283	Far West	28.25	88.8125	1522
T4036162	Mid West	28.5	88.375	1845
T4037419	Center	28.875	88.0625	1626
T4038013	Mid East	29.0625	87.5625	1469
T4038196	Far East	29.125	87.25	986

Figure 9.1 in Section 9 below shows the location of the Horn Mountain field (center point) for which criteria has been derived (red dot); the yellow dots are the locations of the five GOMOS2014 model grid points employed for criteria derivation.

The Winter Storm wind, wave and current criteria were derived from the GOMOS2014 grid point listed in Table 8.2 for the period 1950-2014.

Table 8.2 Winter Storm GOMOS2014 Grid Point.

GRID POINT	LATITUDE (°N)	LONGITUDE (°W)	DEPTH (m)
E4037419	28.875	88.0625	1626.448

The Operational wind and wave criteria were derived from the GOMOS2014 grid point listed in Table 8.3 for the period 1980-2014.

Table 8.3 Operational GOMOS2014 Grid Point.

GRID POINT	LATITUDE (°N)	LONGITUDE (°W)	DEPTH (m)
O4009375	28.875	88.0	1741.654

During the generation of this metocean criteria report, Oceanweather Inc. released an update to the GOMOS2014 hindcast. GOMOS2017 includes the years 2015 through 2017. Although several significant storms entered into the Gulf of Mexico during these years, especially during 2017, the impact on the extremes presented in this report is likely to be negligible.

The following table shows the storms entering into the Gulf of Mexico between 2015 and 2017.

Type	Name	Date
Tropical Storm	Bill	Jun 16-18, 2015
Tropical Storm	Colin	Jun 5-7, 2016
Tropical Storm	Danielle	Jun 19-21, 2016
Hurricane	Earl	Aug 2-6, 2016
Hurricane	Hermine	Aug 28-Sep 3, 2016
Tropical Storm	Cindy	Jun 20-23, 2017
Tropical Storm	Emily	Jul 30-Aug 1, 2017
Hurricane	Franklin	Aug 7-10, 2017
Major Hurricane	Harvey	Aug 17-Sep 1, 2017
Major Hurricane	Irma	Aug 30-Sep 12, 2017
Hurricane	Katia	Sep 5-8, 2017
Hurricane	Nate	Oct 4-8, 2017
Tropical Storm	Phillippe	Oct 28-29, 2017

8.2 Loop Current and Loop Current Eddy Data

The Gulf Eddy Model (GEM), developed by the CASE EJIP, is considered the best existing tool for objective preparation of eddy design and operating criteria in the deepwater leases of the Gulf of Mexico. The tool has integrated observations of current speed within eddies (both directly measured and inferred) with theoretical modelling of current speeds, to produce a set of files and programs that can be used to derive eddy current conditions for any location within the northern Gulf of Mexico. The latest version GEM42 was used in this study.

Input files to the software have been developed within the JIP that comprise:

- Size, location and surface current information for 91 eddies that have been shed from the Loop Current in the years 1985-2016.
- Current profile information to be used in association with the surface-based parameters.

The GEM42 software utilizes these files to produce a time history of currents and (optionally) depth profiles at user-specified locations within the Gulf. The Loop Current Eddy criteria was derived from GEM42 calculations at the coordinates of the client site (28.866°N , 88.056°W) and at three additional sites in around the client site: one site 30km to the west, one site 30km to the south and one site 30km to the east. The additional sites are employed to account for the variability in extreme currents around the client site.

8.3 Measured Currents

Measured current data from the Horn Mountain platform, available through the NOAA National Data Buoy Center (NDBC – www.ndbc.noaa.gov), were employed in the Near Bed Current criteria and Current Profile Characterization. Data from the NTL Station 42374 (Horn Mountain Platform) from 2005 to 2018 for the upper water column (40m to about 550m) and data from the NTL Station 42374 from 2006 to 2009 for the lower water column (1044m to 1620m) were used in the analysis. Both datasets had a 20-min sampling rate. Datasets were quality controlled and post-processed following standard procedures as described in Section 13.

8.4 Modelled Currents

Modelled currents, to be used in support of the Current Profile Characterization analysis, were sourced from Gulf of Mexico (GoM) HYCOM. GoM HYCOM is a nowcast-forecast system developed by the HYCOM consortium. It has a $1/25^\circ$ equatorial resolution and latitudinal resolution of $1/25^\circ \cos(\text{lat})$ or ~ 3.5 km with 27 vertical levels. The operational model is run in real time at the Naval Oceanographic Office (NAVOCEANO) and delivers 7-day forecasts daily. Atmospheric forcing for the operational model comes from the NAVy Global Environmental Model (NAVGEM). A reanalysis run has also been performed, spanning a period of 20 years from 01 Jan 1993 to 31 Dec 2012, which provides 3-hourly outputs. Atmospheric forcing from the reanalysis model comes from the National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR). Data assimilation is performed using the Navy Coupled Ocean Data Assimilation (NCODA) system.

Three-hourly current profiles from GoM HYCOM from 2005 to 2018 at the model grid point closest to the client site were extracted and employed in the Current Profile Characterization.

8.5 Tides

Tidal levels at the client site were derived from the Oregon State University Gulf of Mexico TPXO7.2 tidal model, with a grid resolution of $1/45^\circ$. The harmonic constituents in this model were derived from various satellite altimeter data (TOPEX/POSEIDON, TOPEX/TANDEM, ERS, GFO) and other sets of data (i.e. tide gauges) which were inverted and assimilated into a global barotropic tidal model. The model constituents (M2, S2, N2, K2, K1, O1, P1, and Q1) were accessed using TMD (Tide Model Driver), a MATLAB package that allows the user to create tidal predictions from the harmonic constituents for a specified location and duration.

8.6 Seawater Properties

Seawater properties were sourced from the GoM HYCOM model described above. Data from 1993 to 2012 at the model grid point closest to the client site were extracted and employed in the calculation of operational criteria for seawater temperature and salinity. Dissolved oxygen data in the vicinity of the client site was sourced from the Ocean Climate Laboratory (OCL) database - National Oceanographic Data Center (NODC). All Conductivity-Temperature-Depth (CTD) casts available from 2007 to 2017 in a box of $2^\circ \times 1^\circ$ centered at the client site were employed.

8.7 Air Temperature

Near surface air temperature was sourced from the Climate Forecast System Reanalysis (CFSR). CFSR is a uniform, continuous, and best-estimate record of the state of the ocean-atmosphere interaction for use in climate monitoring and diagnostics. The reanalysis method kept the model's software constant and ran the model retrospectively from January 1979 through March 2011. CFSR hindcast data are available at 0.312° grid resolution and cover the period from 1979 to 2010 in 6-hourly intervals. From 01 January 2011 CFSR has been extended by NCEP's Climate Forecast System Version 2 (CFSV2) operational model. Until the operational CFS is changed, the data produced by CFSV2 can be considered as a seamless extension to CFSR. CFSR was designed and executed as a global, high resolution, coupled atmosphere-ocean-land surface-sea ice system to provide the best estimate of the state of these coupled domains over this period.

Near-surface air temperature from 2005 to 2015 at the model grid point closest to the client site were employed in the calculation of near surface air temperature operational criteria.

8.8 Marine Growth

Marine Growth information was sourced from the following Industry guidelines:

- API RP 2MET, Final Draft, 2013: Derivation of Metocean Design and Operating Conditions.
- Det Norske Veritas, 2007: Environmental Conditions and Environmental Loads. Recommended Practice DNV-RP-C205.
- Norsok Standard N-003, 2007: Actions and action effects.

9. HURRICANE CRITERIA METHODOLOGY

9.1 Definition of Hurricane

The term “hurricane” is used to describe both tropical storms and hurricanes. The hurricane criteria in this report have been derived using the Oceanweather GOMOS hindcast, which includes all tropical systems that occurred within the Gulf of Mexico from 1900 to 2014. A tropical storm is defined as a storm system with a low pressure center with wind speeds of between 34 and 64 knots (63 and 119 km/h). A hurricane is a system with winds of at least 64 knots (119 km/h).

9.2 Hurricane Tracks

The North Atlantic Best Track database was used to derive the Hurricane tracks seen below in Figure 9.1 Tropical Revolving Storms (TRS) tracks around the site of interest. The gray circle has a 93 mi (150 km) radius. The red dot is the location of the client site. The yellow dots are the selected GOMOS2014 pooling points within 93 mi (150 km) radius of the target site. The North Atlantic Best Track database is maintained by the forecasters and researchers at the National Tropical Cyclone Centre in Miami, Florida. The Hurricane track database covers all the historical Hurricanes until 2016.

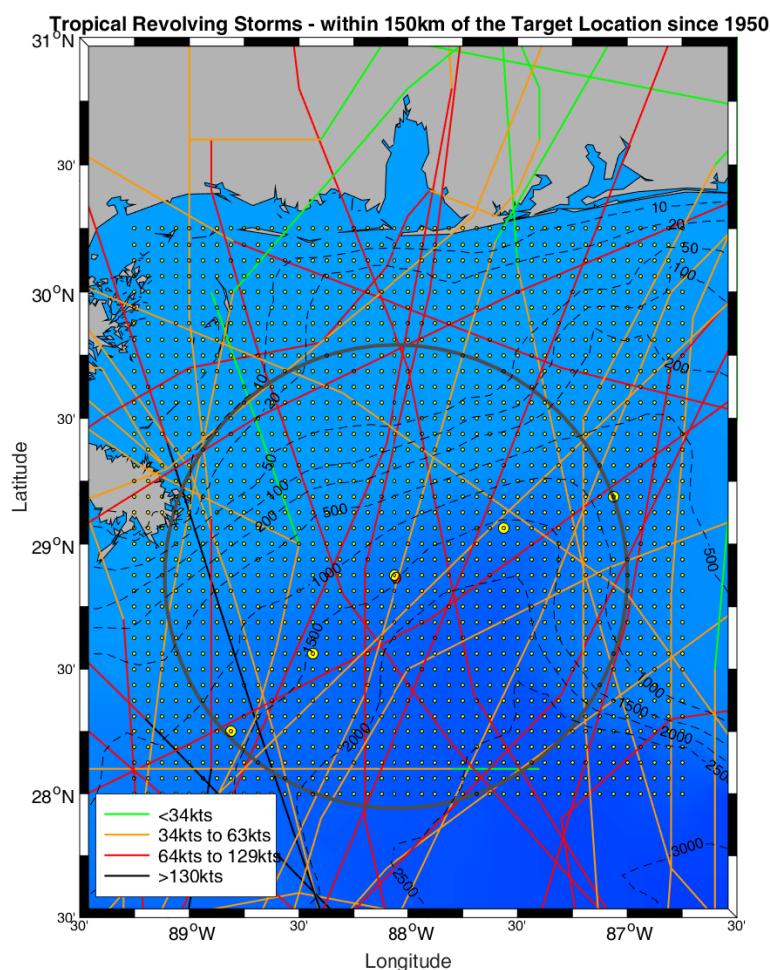


Figure 9.1 Tropical Revolving Storms (TRS) tracks around the site of interest. The gray circle has a 93 mi (150 km) radius. The red dot is the location of the client site. The yellow dots are the selected GOMOS2014 pooling points.

9.3 Hurricane Criteria Derivation

The 10-, 25-, 50-, 100-, 200- and 1000-year Hurricane criteria were derived from the GOMOS2014 dataset using the methodology described in the following sections.

In this study, Hurricane criteria were calculated for three conditions:

- Hurricane criteria considering all months of the year (referred to as “Hurricane” criteria).
- Hurricane criteria considering all hurricanes, which became a named storm within 48 hours of reaching either the site or the 28°N latitude line (referred to as “Sudden Hurricane” criteria).
- Hurricane criteria considering all months of the year except August, September and October (referred to as “Off-Peak Hurricane” criteria).

The general methodology is the same for all conditions, with the following exceptions:

- Sudden Hurricane criteria does not include extreme analysis of water level.
- Off-Peak Hurricane criteria does not include extreme analysis of water level, nor the extreme events duration and history.

9.3.1 Omni-directional Independent Criteria

The independent omni-directional Hurricane wind, wave and current cases were based on analysis of hindcast data from GOMOS2014 points near the site of interest. Extreme value analysis was carried out on a subset of peak hurricane wind speeds, wave heights and current speeds from the GOMOS2014 data. The analysis considered 200 storm events from 1950 to 2014. Since the peaks from each grid point were pooled, the resulting database represented 325 years (65 years * 5 grid points) with a total of 1000 hurricanes.

The Peaks Over Threshold (POT) method consisted of declustering the data by selecting peak events to produce a set of independent and identically distributed observations. This method was then employed to derive the 10-, 25-, 50-, 100-, 200-, and 1000-year criteria. The number of peaks exceeding a given level, divided by the number of years of record, gave the rate of exceedance which could then be used to find the expected number of occurrences in a specified period of time.

The Exponential (EXP), Fisher-Tippett 1 (FT1), Generalized Pareto (GP), and Weibull 3 (W3) distributions were tested for goodness-of-fit to the GOMOS2014 data using the method of least squares (LS), maximum likelihood (MLE) or the method of moments (MoM). The best fits for 10-, 25-, 50-, 100-, 200-, and 1000-year wave height, wind speed and current speed are summarized in Table 9.1.

Table 9.1 Hurricane Extreme Omni-directional Winds, Waves and Currents.

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values					
					10-year	25-year	50-year	100-year	200-year	1000-year
Total Hs (m)	W3	LS	6.65	100	10.4	12.6	14.0	15.3	16.6	19.3
Ws 1-hr (m/s)	W3	LS	19.35	101	29.1	36.2	41.3	46.2	51.1	62.2
Cs-sfc (m/s)	W3	MoM	0.70	101	1.3	1.7	1.9	2.1	2.3	2.8

To complete the omni-directional hurricane cases, associated parameters were derived. These included peak period (T_p), maximum wave height (H_{max}), crest height (H_c), surge height (H_{sur}) and additional current variables.

9.3.2 Directional Independent Criteria

Hurricane directional criteria are given in Table 9.2 to Table 9.4. Detailed descriptions of the computations are presented below.

Hurricane hindcast data from the five GOMOS2014 grid points were separately partitioned into eight equal directional sectors for each month on the basis of wave, wind, and current direction. The maxima of the five grid points from each directional sector for each month were selected and used to estimate a single set of maximum directional relative magnitudes for each month. The highest of the relative magnitudes for each directional sector, regardless of the month of occurrence, was then selected as the all year relative magnitude for that directional sector. In order to derive the directional extreme significant wave heights, wind speed, and surface current for the 10-, 25-, 50-, 100-, 200- and 1000-year return periods, the relative magnitudes were then applied to the n-year extreme criteria.

Table 9.2 Relative Magnitude of GOMOS2014 Hurricane Significant Wave Height by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.49	0.60	0.96	1.00	0.92	0.66	0.34	0.43
T4036162	0.46	0.70	0.86	1.00	0.91	0.63	0.39	0.32
T4037419	0.41	0.47	0.78	1.00	0.80	0.55	0.37	0.26
T4038013	0.39	0.46	0.63	1.00	0.92	0.54	0.43	0.27
T4038196	0.48	0.49	0.62	1.00	0.98	0.57	0.47	0.36
Design	0.49	0.70	0.96	1.00	0.98	0.66	0.47	0.43

Table 9.3 Relative Magnitude of GOMOS2014 Hurricane Wind Speed by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.67	1.00	0.82	0.78	0.72	0.50	0.66	0.64
T4036162	0.70	0.70	0.97	1.00	0.91	0.66	0.66	0.69
T4037419	0.61	1.00	0.92	0.95	0.78	0.75	0.71	0.62
T4038013	0.58	0.61	0.99	1.00	0.83	0.72	0.59	0.57
T4038196	0.64	0.76	0.93	1.00	0.95	0.89	0.73	0.69
Design	0.70	1.00	0.99	1.00	0.95	0.89	0.73	0.69

Table 9.4 Relative Magnitude of GOMOS2014 Hurricane Surface Current Speed by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.73	0.79	0.80	0.87	0.99	1.00	0.96	0.83
T4036162	0.70	0.62	0.75	1.00	1.00	0.99	0.96	0.81
T4037419	0.82	0.69	0.76	1.00	1.00	0.96	0.96	0.92
T4038013	0.77	0.66	0.69	0.88	0.98	1.00	0.99	0.90
T4038196	0.75	0.64	0.65	0.89	0.95	1.00	0.99	0.89
Design	0.82	0.79	0.80	1.00	1.00	1.00	0.99	0.92

9.3.3 Associated Directional Wave, Wind and Surface Current

The various extremes such as wind, wave and current are derived as independent variables. In the potentially most conservative design case, one can say that the extreme wave event coincides simultaneously with the extreme wind event and the extreme current event in directions most likely to cause design or operational failure. In nature, this is unlikely to occur and the derivation of associated extremes is a method of providing a selection of more realistic design cases.

For associated wind, wave and surface current during hurricane conditions, the GOMOS2014 dataset was used. Firstly, the data of the primary factor (e.g., wind, wave or current) are divided into eight directional sectors. Secondly, the associated factors corresponding to the primary factor at the same time step are determined. Thirdly, regressions are done for each directional sector between the primary factor and associated factors. These relationships are used to calculate the associated parameters for each return periods and each directional sector. All relationships are presented in Figure 9.2 to Figure 9.10. In each figure, the blue points represent the scatter between the primary and the secondary parameter for a specific directional sector. The primary parameter is then separated into binned values and each orange point represents the average of all blue points that fall in a specific bin. The regression relationships are calculated based on the orange points. All figures present parameters in SI units.

Note, only the primary factor is guaranteed from a certain directional sector. To determine the direction of the associated parameters, please refer to the angular difference.

9.3.3.1 Significant Wave Height Associated Parameter Plots by Directional Sector

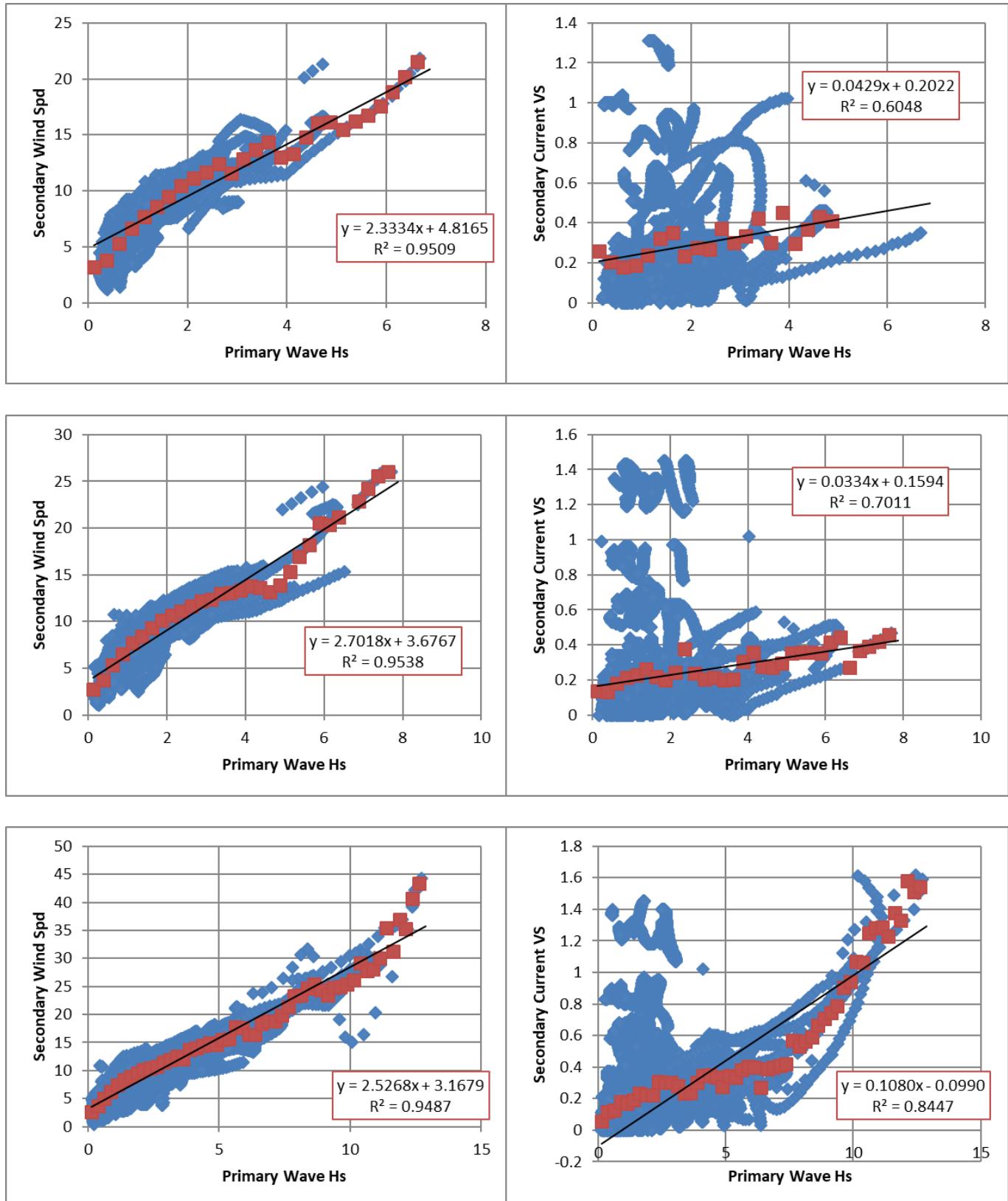


Figure 9.2 Hurricane Associated Wind Speed and Current Speed for Primary Wave – N, NE and E (from top to bottom).

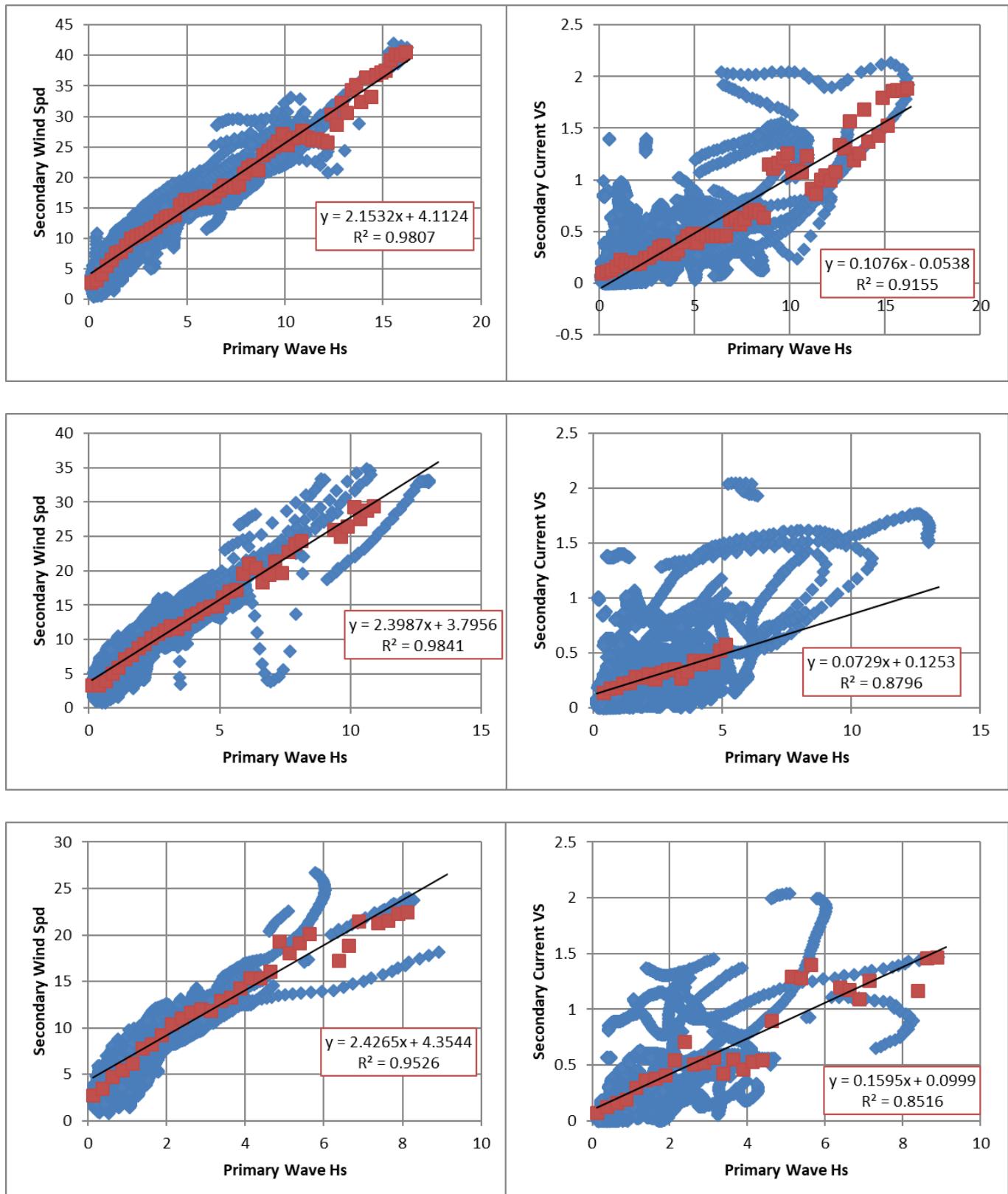


Figure 9.3 Hurricane Associated Wind Speed and Current Speed for Primary Wave – SE, S and SW (from top to bottom).

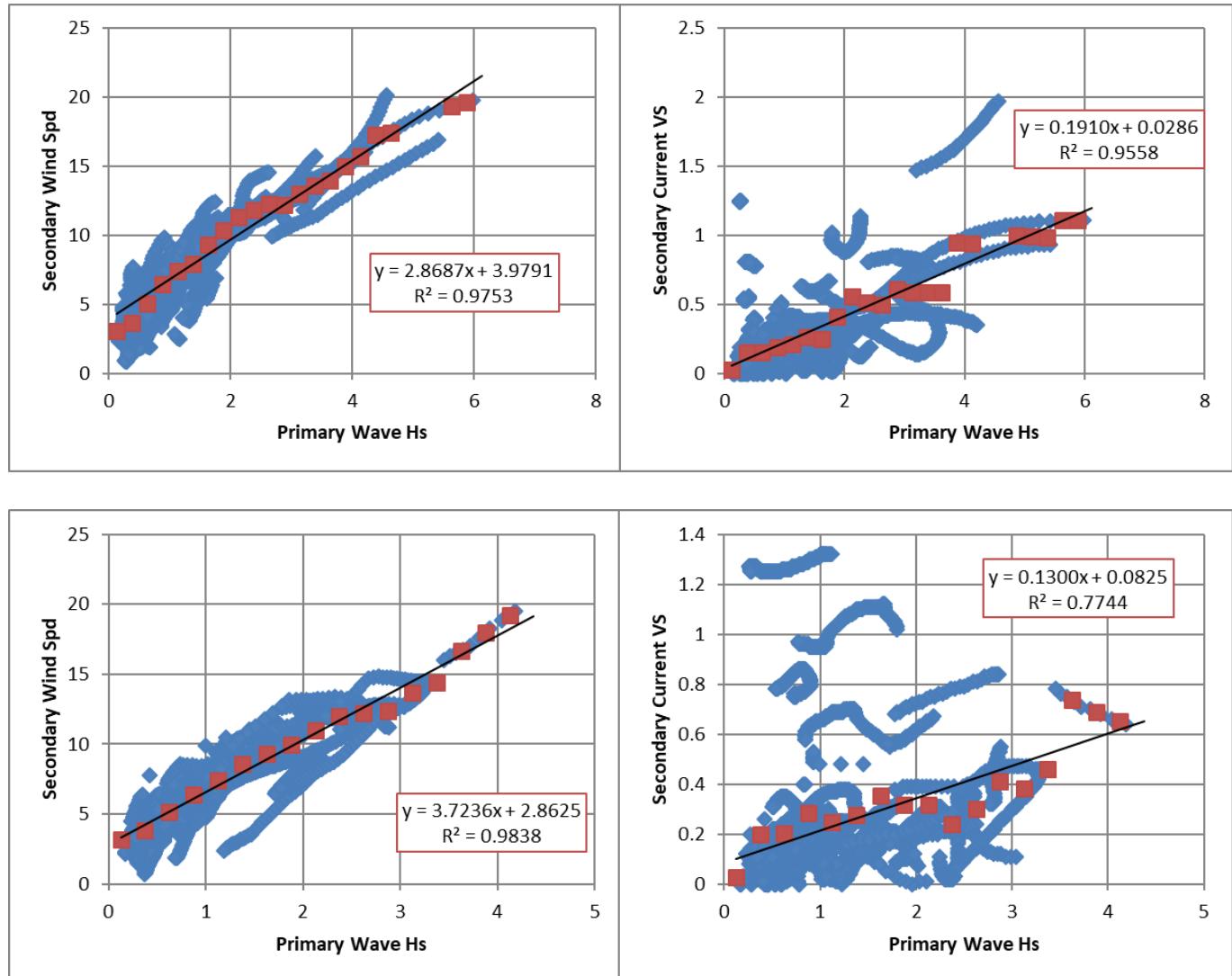


Figure 9.4 Hurricane Associated Wind Speed and Current Speed for Primary Wave – W and NW (from top to bottom).

9.3.3.2 Wind Speed Associated Parameter Plots by Directional Sector

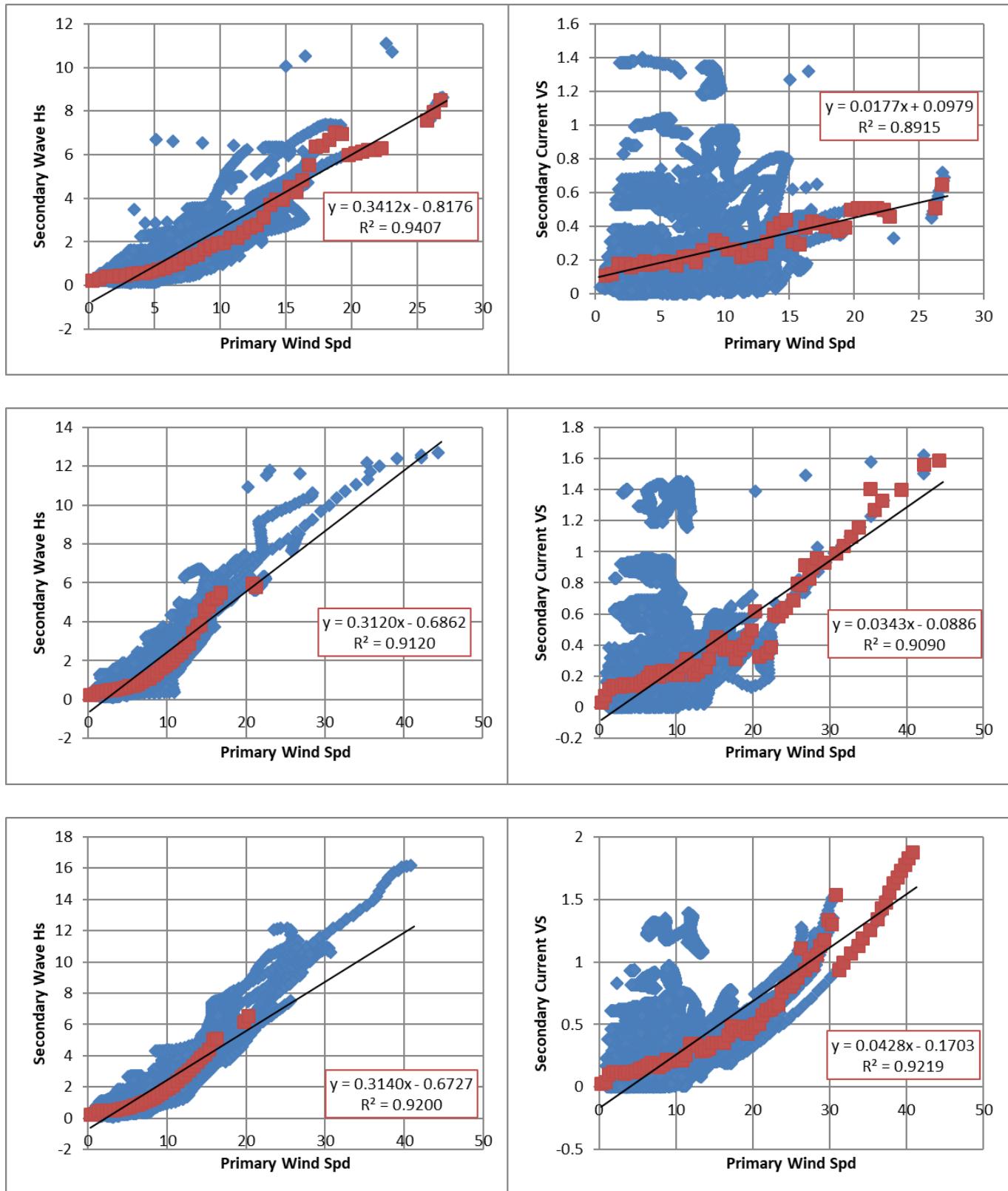


Figure 9.5 Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – N, NE and E (from top to bottom).

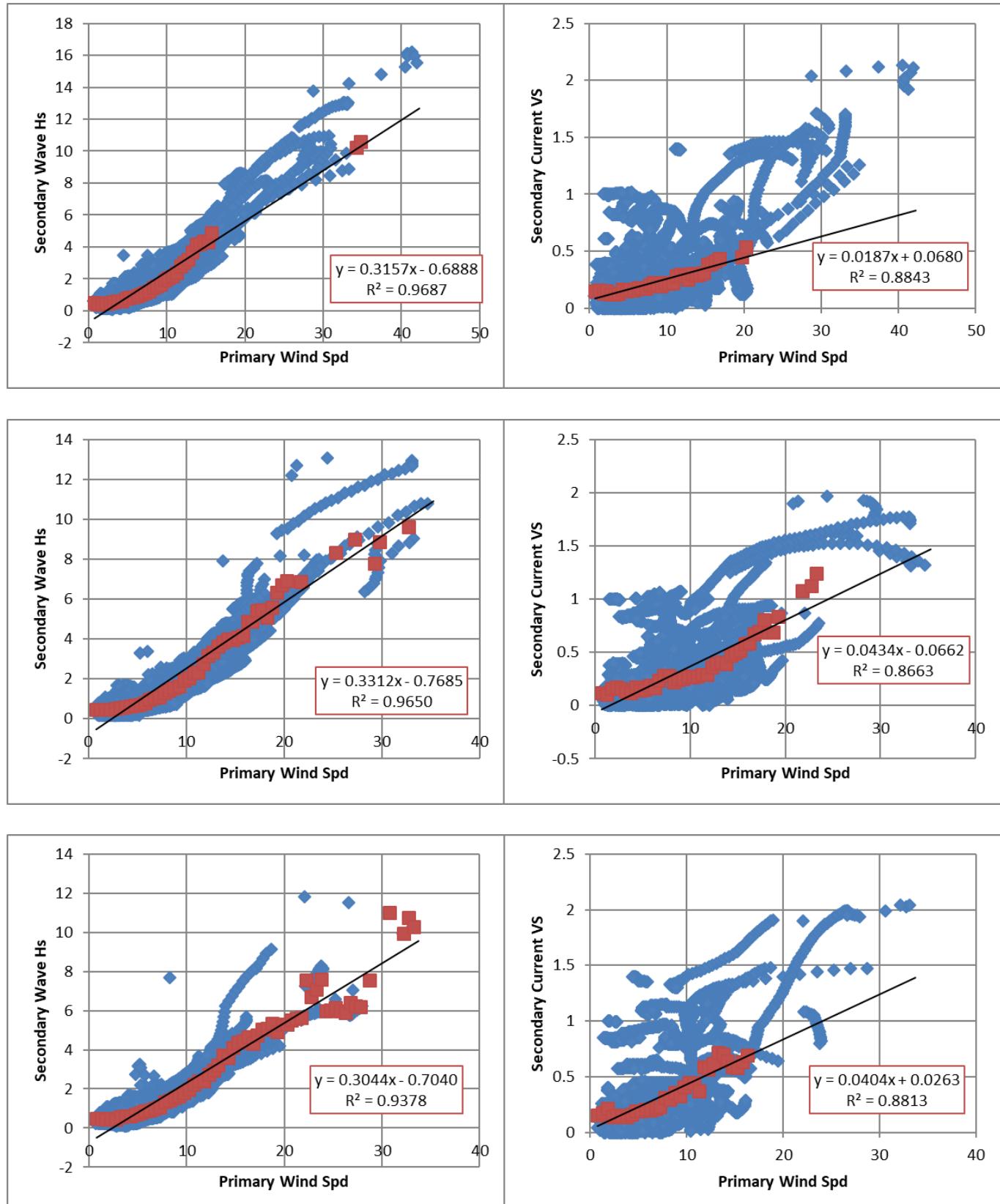


Figure 9.6 Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – SE, S and SW (from top to bottom).

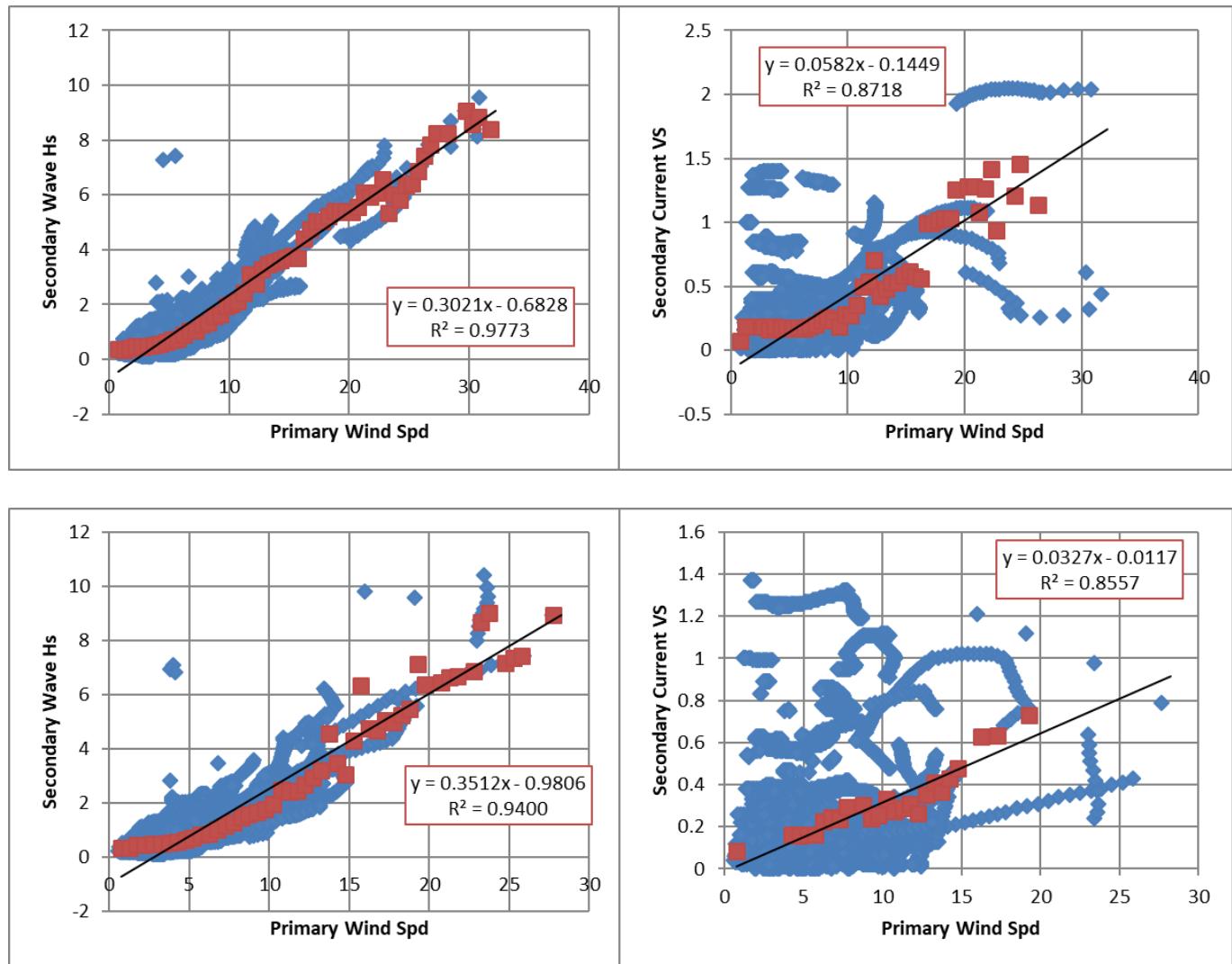


Figure 9.7 Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – W and NW (from top to bottom).

9.3.3.3 Current Speed Associated Parameter Plots by Directional Sector

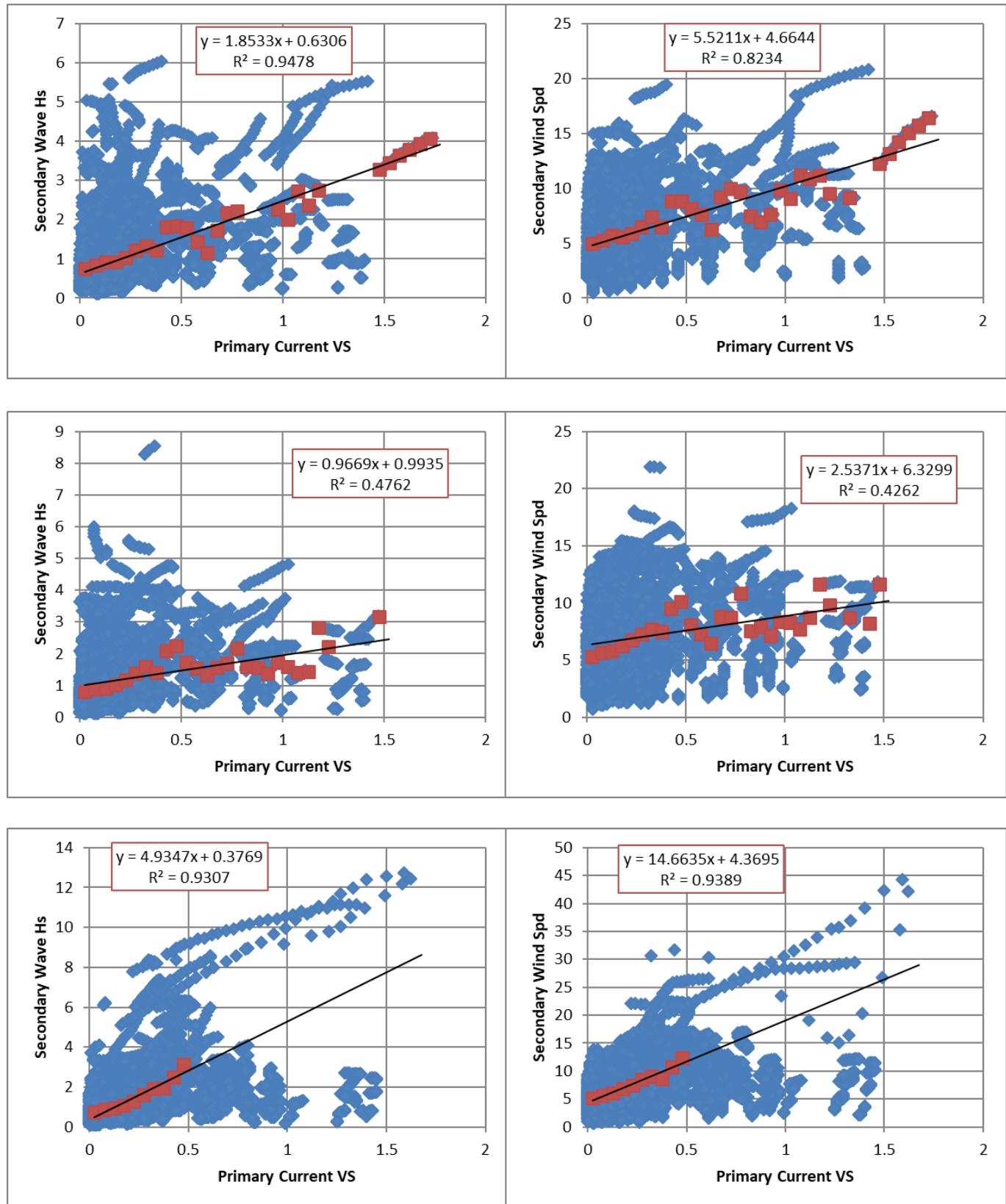


Figure 9.8 Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – N, NE and E (from top to bottom).

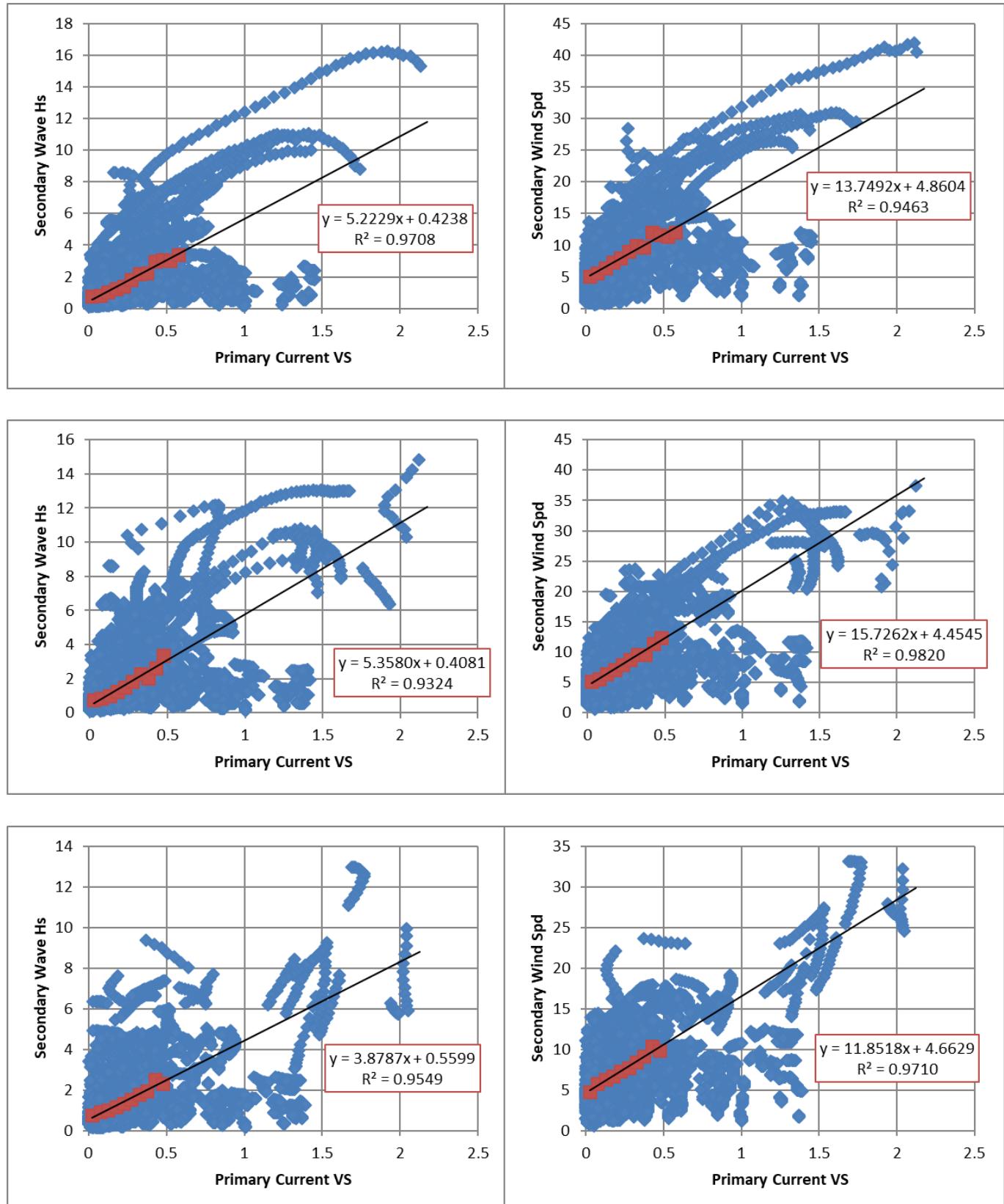


Figure 9.9 Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – SE, S and SW (from top to bottom).

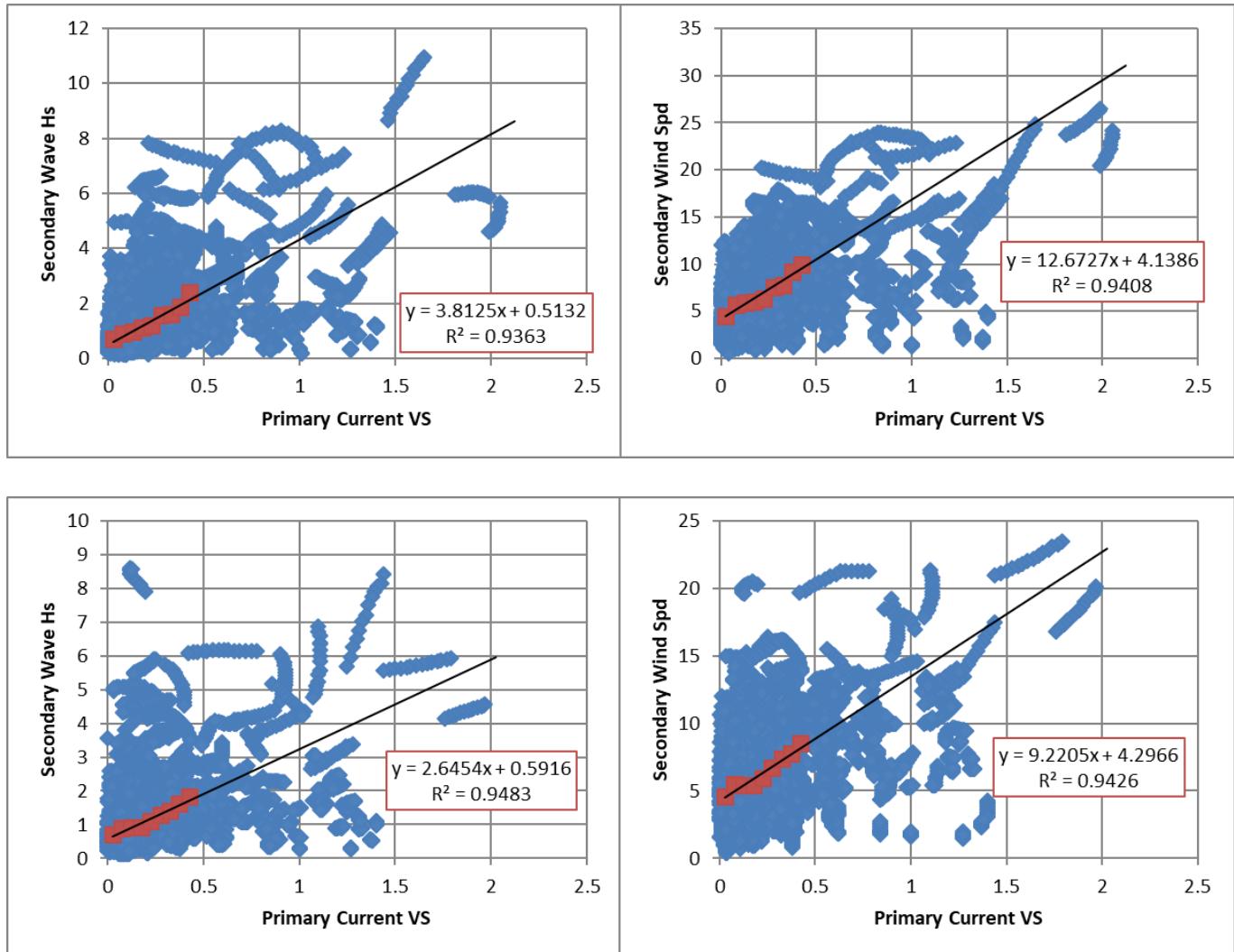


Figure 9.10 Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – W and NW (from top to bottom).

9.3.4 Associated Tp

Data from GOMOS2014 grid point T4037419 were used to create an omni-directional joint frequency distribution of Tp conditional on Hs. The mode of each conditional distribution was then estimated for each primary parameter class interval. In addition, the 99 and 1 percent exceedance values were derived for each conditional distribution. The Hurricane regression analysis of Tp-mode against Hs is shown in Figure 9.11.

The ratio of the 99-percent exceedance Tp to Tp-mode and the ratio of the 1-percent exceedance Tp to Tp-mode are shown in Figure 9.12 and Figure 9.13. These regression equations have been used to derive the range of peak period values (Tp-low, Tp, and Tp-high) presented in the Hurricane criteria.

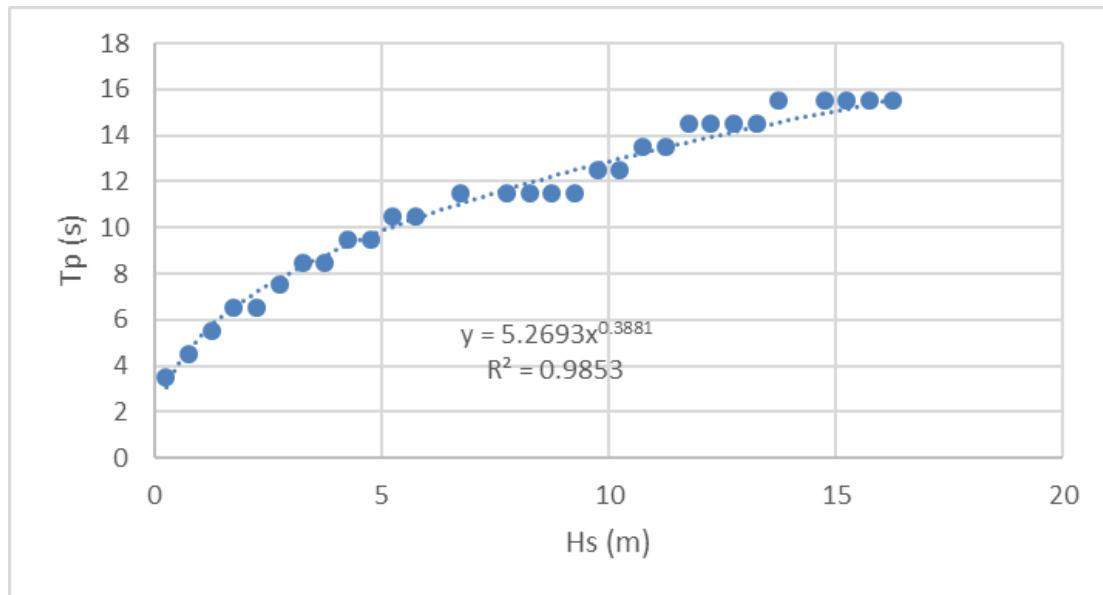


Figure 9.11 Hurricane Regression Analysis; H_s vs. T_p -mode.

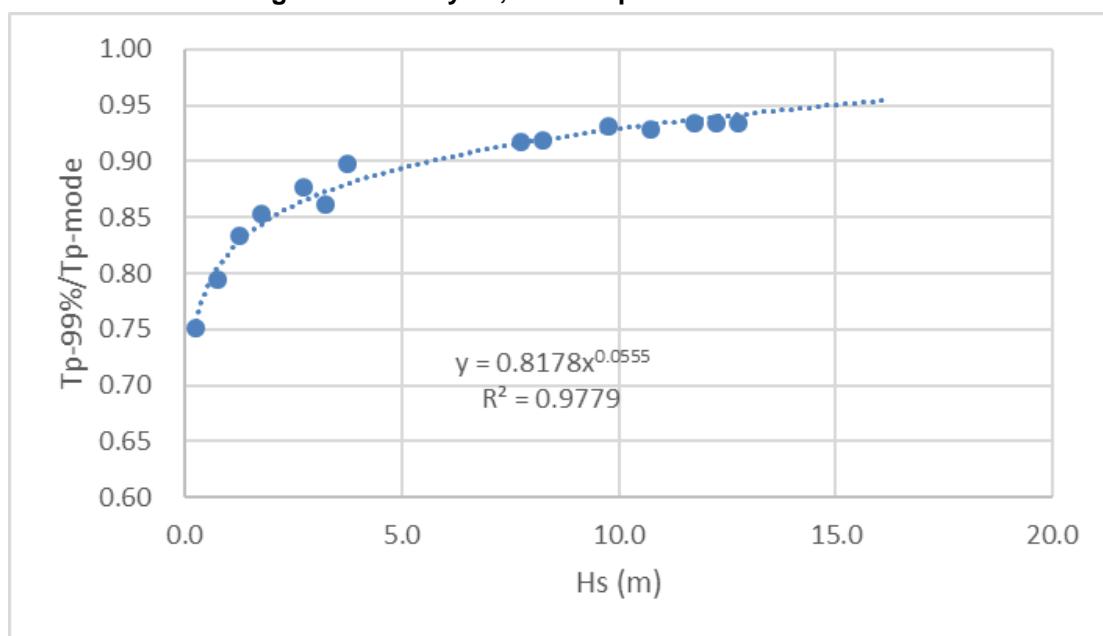


Figure 9.12 Hurricane Regression Analysis T_p low; H_s vs. T_p -99% exceedance/ T_p -mode.

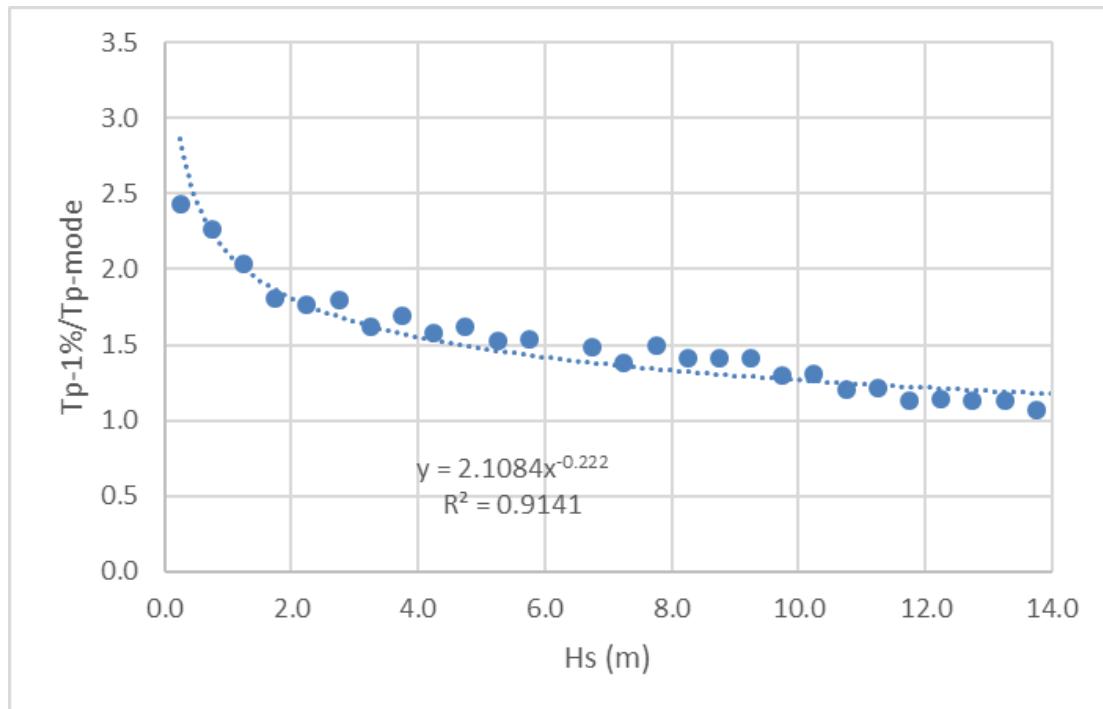


Figure 9.13 Hurricane Regression Analysis Tp high; Hs vs. Tp-1% exceedance/Tp-mode.

9.3.5 Associated Hc and Hmax

Time series data from GOMOS2014 dataset grid point T4037419 were processed using the EXWAN program to produce a representative crest height for each individual storm. The ratio of crest heights to the highest Hs recorded in each storm was then calculated. A regression equation was then developed and used to derive the respective crest heights. Figure 9.14 shows the Hurricane regression analysis of Hs vs Hc.

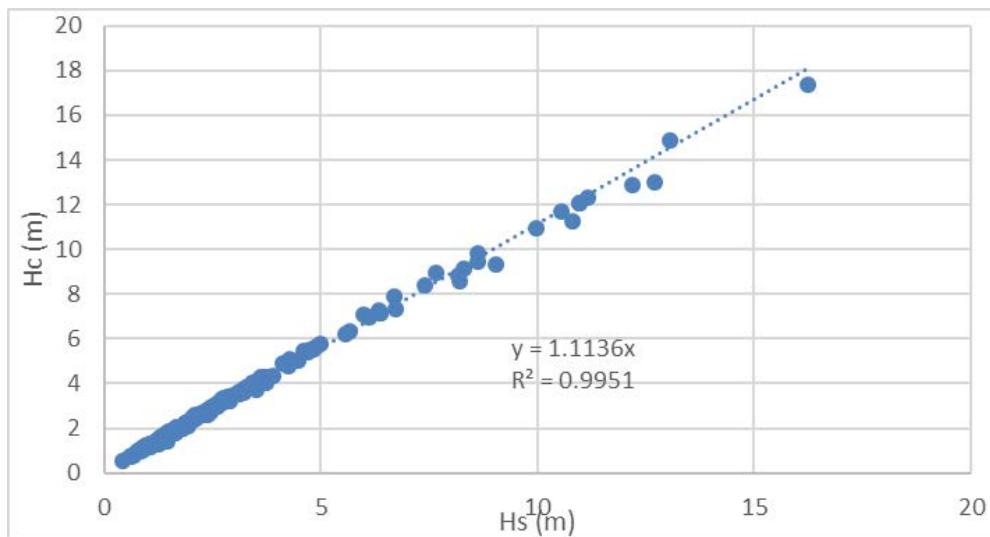


Figure 9.14 Hurricane Regression Analysis; Hs vs Hc.

The maximum wave height was calculated using EXWAN and the 2-parameter Weibull distribution proposed by Forristall. The values used for A and B were the Forristall default values for A and B, 2.13 and 8.42 respectively. As with the crest heights, the ratio of maximum heights to the highest Hs recorded in each storm was then calculated. A regression equation was then developed and used to derive the respective maximum wave heights for each significant wave height. Figure 9.15 shows the Hurricane regression analysis of Hmax vs Hs.

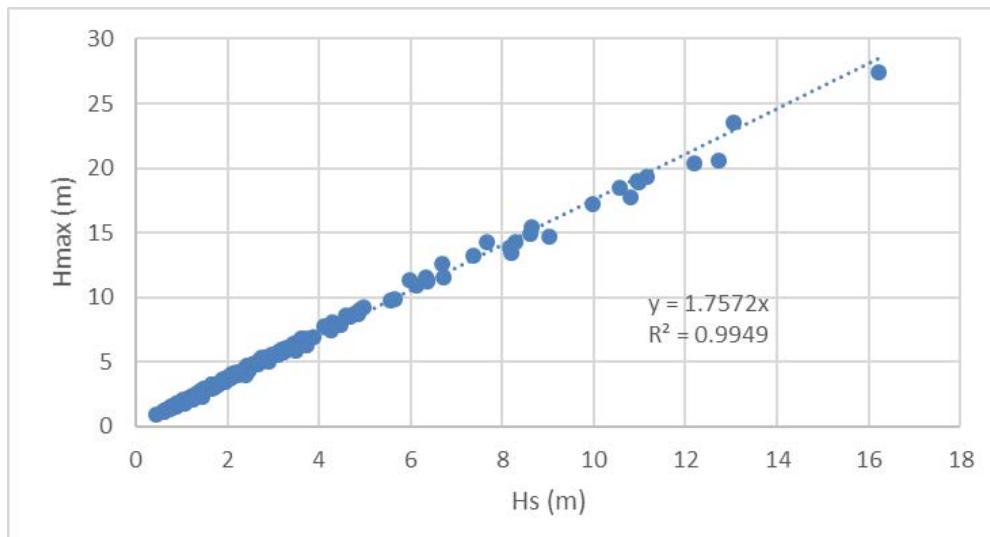


Figure 9.15 Hurricane Regression Analysis; Hs vs Hmax.

9.3.6 Associated THmax

The associated THmax values presented in the Hurricane criteria tables have been derived based on a $0.9 \times T_p$ relationship.

9.3.7 Associated JONSWAP Peak Enhancement Factor

One-dimensional spectral data downloaded from NDBC 42038 at 27.421 N, 92.555 W during 2005 were analysed to derive a regression analysis between γ and Hs for hurricane sea states. Based on previous Industry guidance, the specific analysis for the period during Hurricane Katrina gave the best relationship and estimated values of γ . Figure 9.16 shows the regression analysis and equation employed to derive γ for each significant wave height.

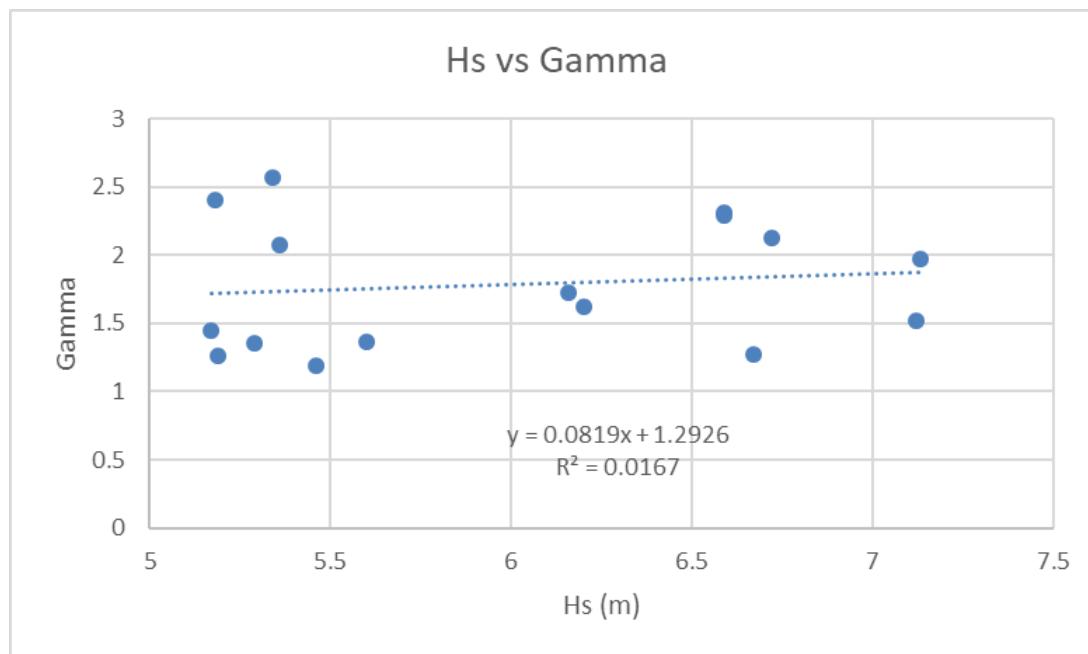


Figure 9.16 Hurricane Katrina Regression Analysis; Hs vs gamma.

9.3.8 Associated Surge

To derive the extreme storm surge, extreme value analysis was carried out on a subset of peak hurricane water level values from the GOMOS2014 data at the grid point T4037419 (after the tidal signal was removed).

The Peaks Over Threshold (POT) method consisted of declustering the data by selecting peak events to produce a set of independent and identically distributed observations. This method was then employed to derive the 10-, 25-, 50-, 100-, 200- and 1000-year criteria. The number of peaks exceeding a given level, divided by the number of years of record, gave the rate of exceedance which could then be used to find the expected number of occurrences in a specified period of time.

The Exponential (EXP), Fisher-Tippett 1 (FT1), Generalized Pareto (GP), and Weibull 3 (W3) distributions were tested for goodness-of-fit to the data using the method of least squares (LS), maximum likelihood (MLE) or the method of moments (MoM). The best fits for 10-, 25-, 50-, 100-, 200- and 1000-year storm surge are summarized in Table 9.5.

Table 9.5 Hurricane Extreme Omni-directional Storm Surge.

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values					
					10-year	25-year	50-year	100-year	200-year	1000-year
Storm Surge (m)	W3	LS	0.18	40	0.3	0.4	0.5	0.5	0.6	0.7

9.3.9 Extreme Total Water Level

The extreme total water level (EWL) shown in the tropical storm criteria tables is calculated as

$$EWL = \sqrt{(Wave\ Crest\ Height + Surge)^2 + tide^2}$$

based on ISO 19902:2007, assuming storm surge is expected to occur at the same time as the wave crest height.

9.3.10 Angular Difference

Angular differences were calculated for each of wind, wave and current primary conditions for all directional sectors:

- Wind direction – total wave direction
- Current direction – total wave direction

Calculations were carried out on a subset of wind, wave and current values from the GOMOS2014 data at the grid point T4037419. For each parameter, all hurricane peak values were extracted including all values within the 12 hours preceding each peak and 12 hours after each peak for wind and current and within 24 hours for waves. Moreover, only values above the following minimum limits were extracted:

- Significant wave height above ~ 5 ft (1.5m)
- Wind speed above ~ 36 ft/s (11 m/s)
- Surface current speed above ~ 1 ft/s (0.3 m/s)

Figure 9.17 to Figure 9.22 present the results of the regression analysis, showing the best fit polynomial trend line together with the equation.

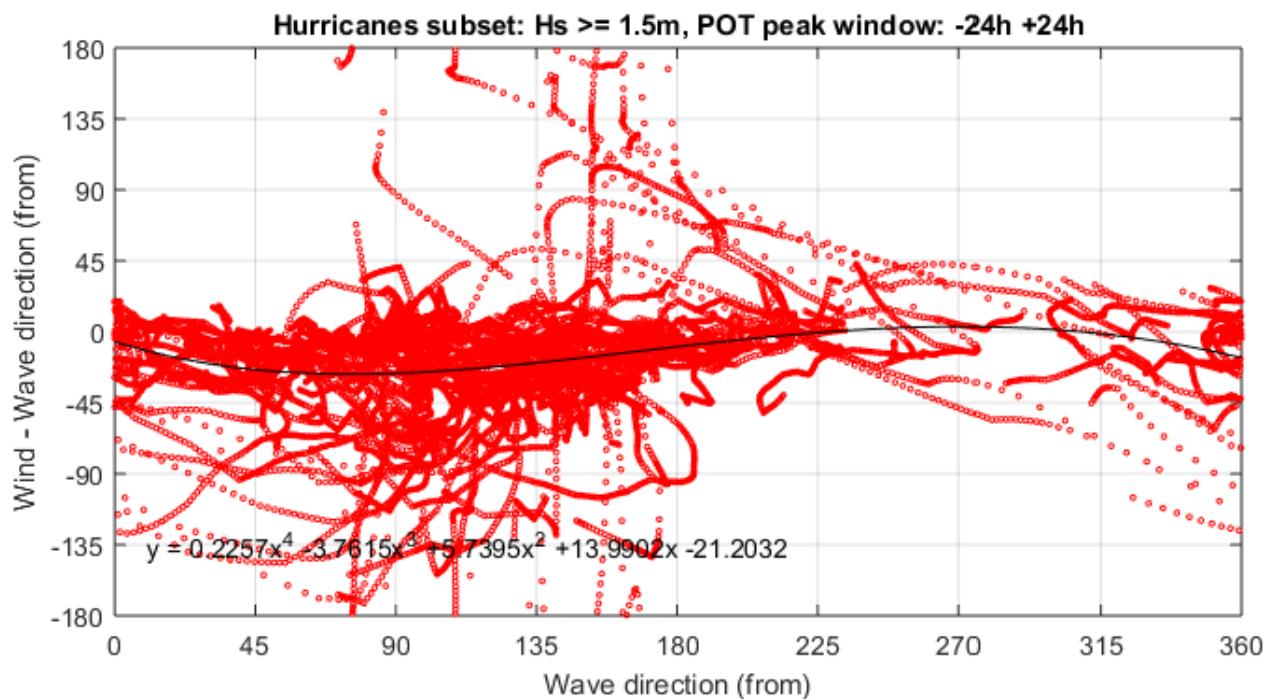


Figure 9.17 Regression Analysis: Wind and Wave Angular Difference, Hurricane Wave Primary.

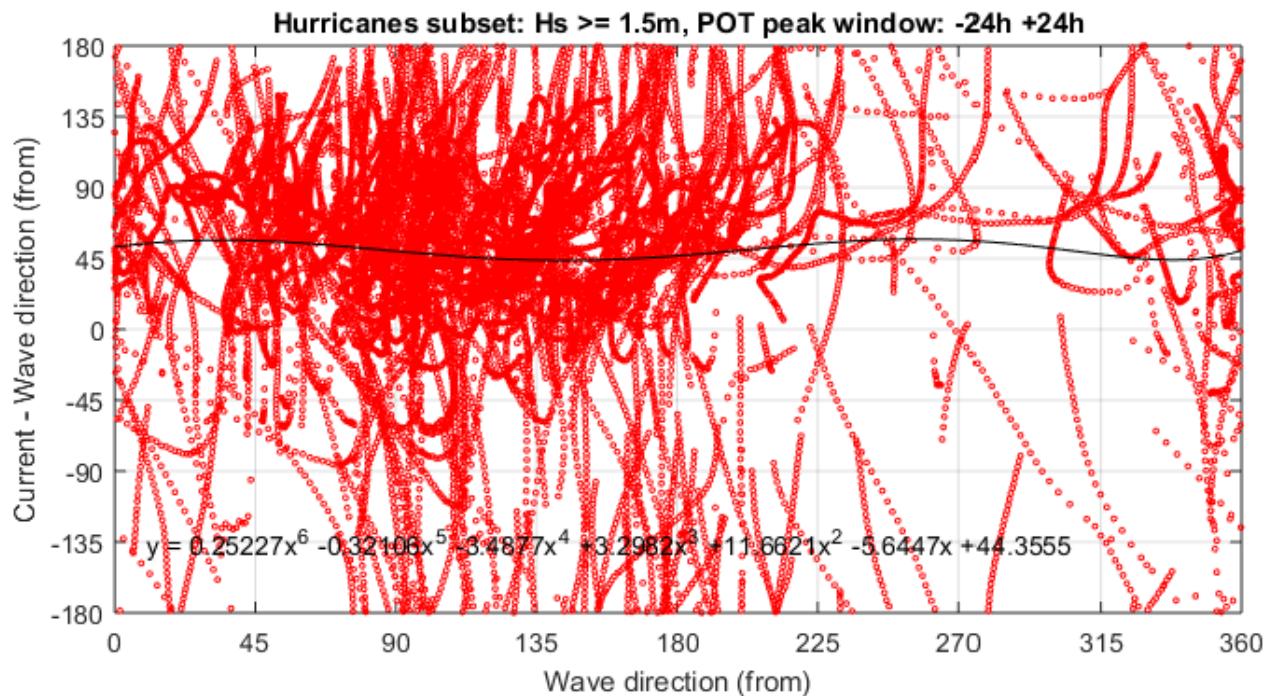


Figure 9.18 Regression Analysis; Current and Wave Angular Difference, Hurricane Wave Primary.

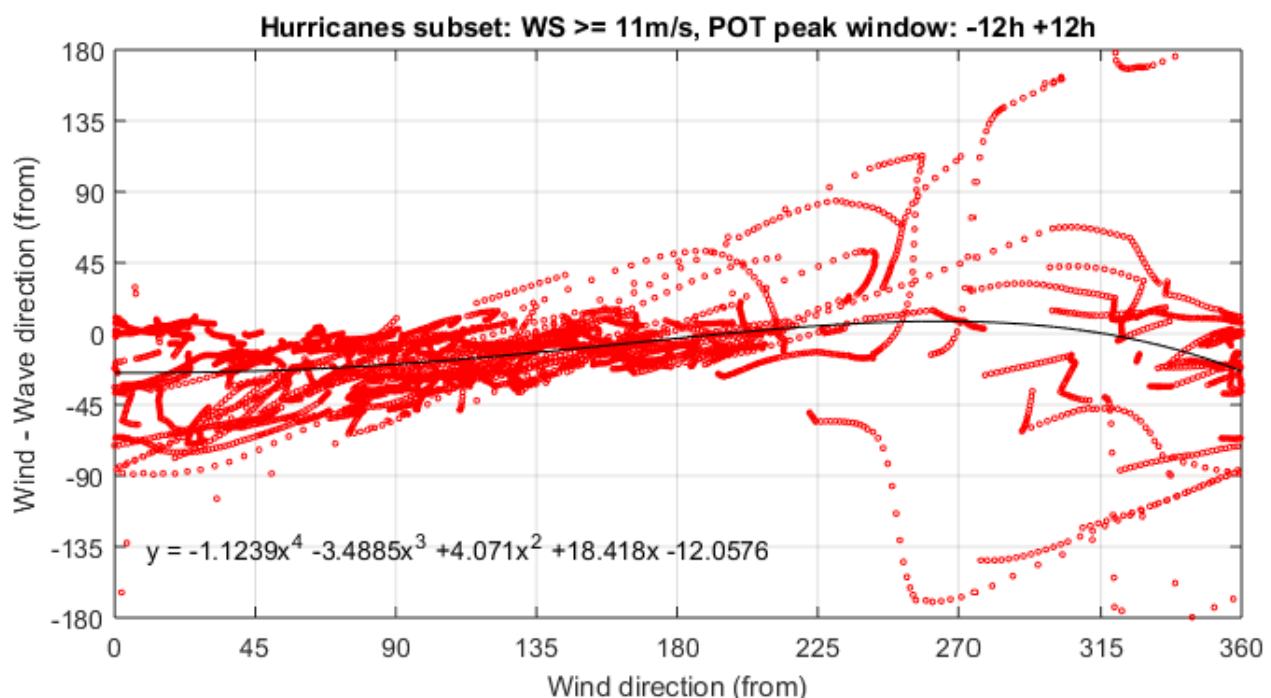


Figure 9.19 Regression Analysis: Wind and Wave Angular Difference, Hurricane Wind Primary.

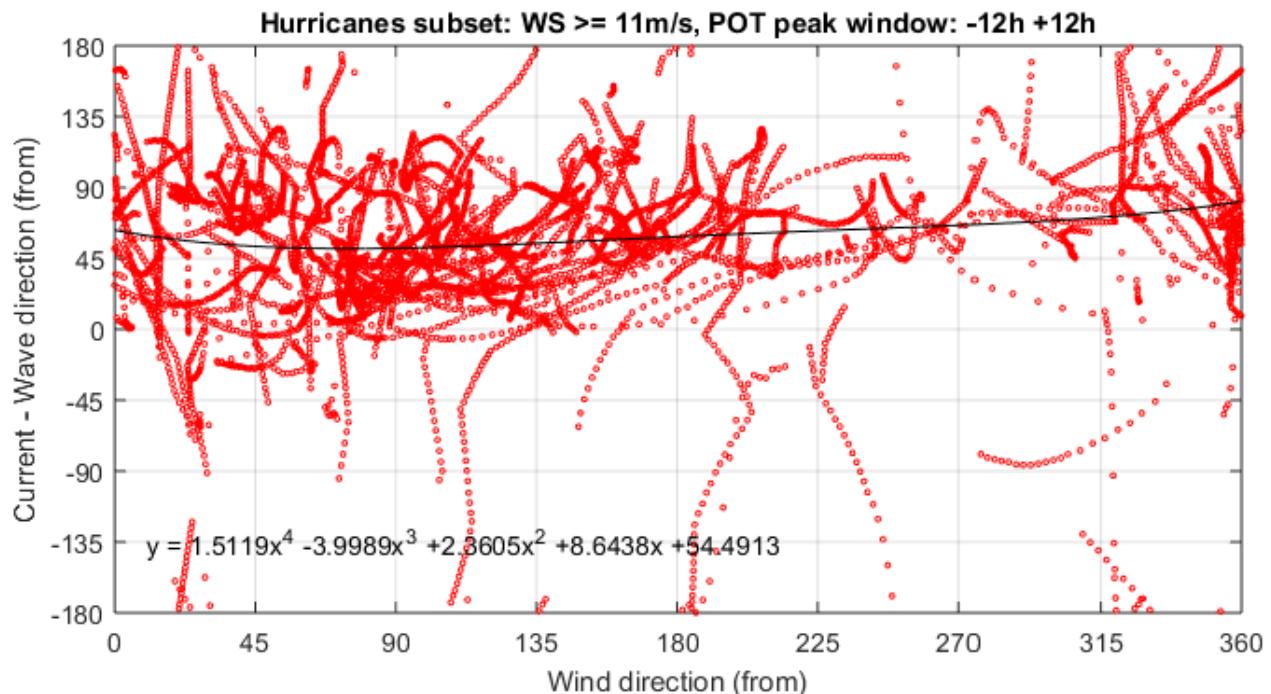


Figure 9.20 Regression Analysis; Current and Wave Angular Difference, Hurricane Wind Primary

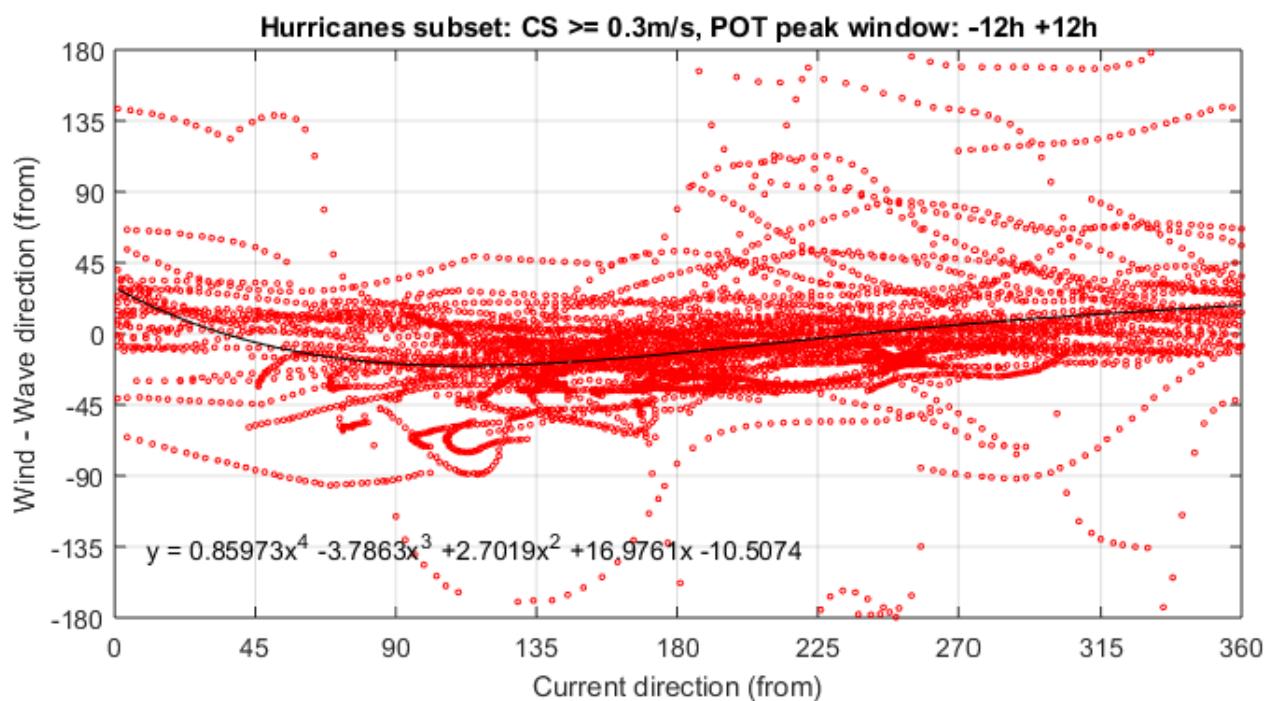


Figure 9.21 Regression Analysis: Wind and Wave Angular Difference, Hurricane Current Primary.

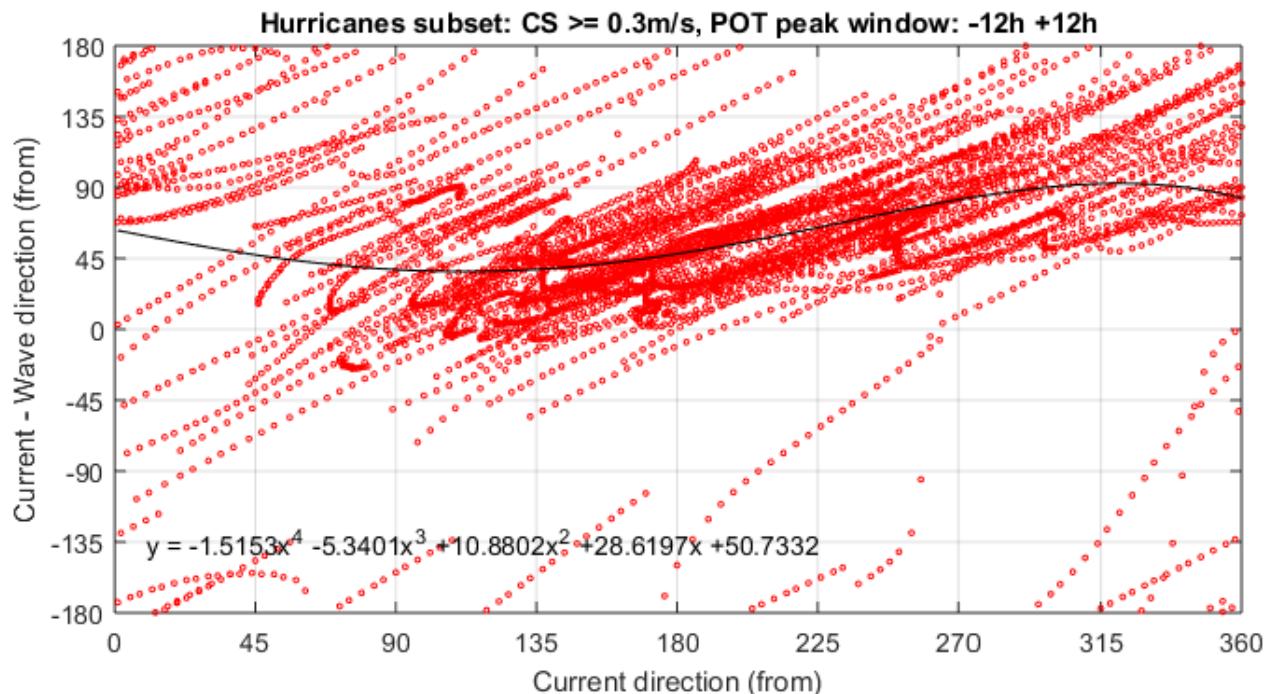


Figure 9.22 Regression Analysis; Current and Wave Angular Difference, Hurricane Current Primary.

9.3.11 Extreme Hurricane Event Duration and History

Storm histories for the 20 most severe events at GOMOS2014 grid point T4037419 were considered in the analysis. Time series of wave height and wind speed for individual storms were organized such that the maximum Hs or Ws for each event represented effective time zero. This allowed the build-up and decrease to be normalized for all identified storm events.

Figure 9.23 and Figure 9.24 display the wave and wind magnitudes of the events examined.

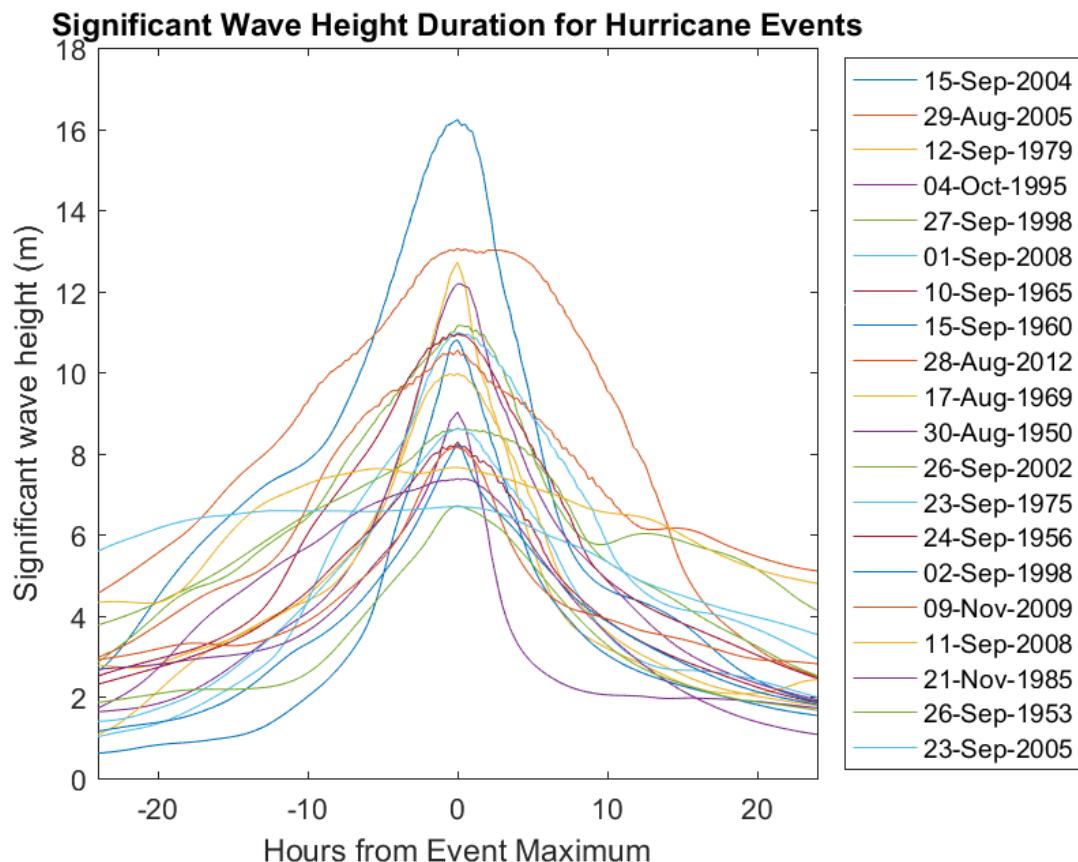


Figure 9.23 GOMOS2014 T4037419 Hurricane Storm Events Considered for Hs Duration Analysis.

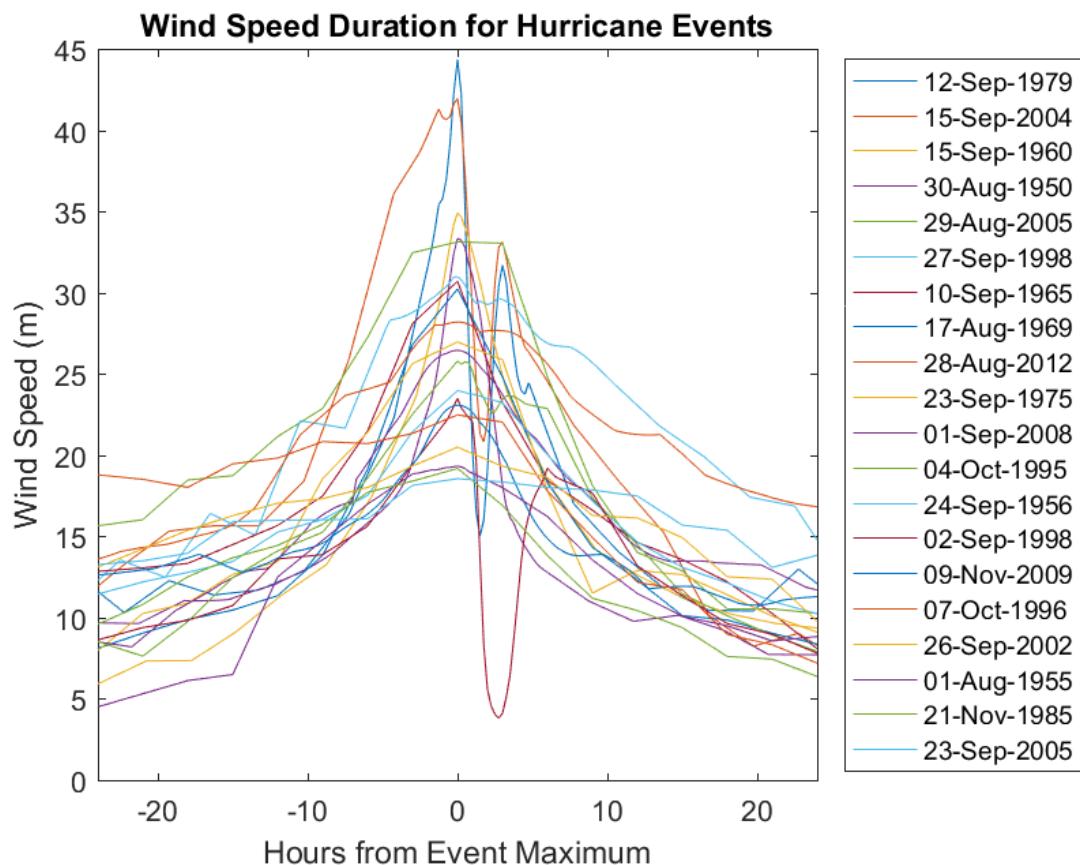


Figure 9.24 GOMOS2014 T4037419 Hurricane Storm Events Considered for Ws Duration Analysis.

Two storm populations were identified among the most severe events. Less severe storms in which peak conditions tend to move slow and last longer were categorized as “wide and flat”, while stronger and faster storms (shorter lasting peak conditions) were categorized as “tall and thin”.

9.3.12 Wind Profile

Based on the API RP 2MET guidelines, measurements of representative offshore conditions, in strong, nearly neutrally stable atmospheric wind conditions, suggest that the mean wind speed profile $U_w(z)$ in storm conditions can be more accurately described by a logarithmic profile as given in Equation (A.2):

$$U_{w,1h}(z) = U_{wo} [1 + C \ln(z/z_r)] \quad (\text{A.2})$$

where

- $U_{w,1h}(z)$ is the 1 hr sustained wind speed at a height z above mean sea level.
- U_{wo} is the 1 hr sustained wind speed at the reference elevation z_r and is the standard reference speed for sustained winds.
- C is a dimensionally dependent coefficient, the value of which is dependent on the reference elevation and the wind speed, U_{wo} . For $z_r = 10\text{m}$, $C = (0.0573) (1 + 0.15 U_{wo})^{1/2}$ where U_{wo} is in units of meters per second (m/s).
- z is the height above mean sea level.
- z_r is the reference elevation above mean sea level ($z_r = 10\text{m}$).

For the same storm conditions, the mean wind speed for averaging times shorter than 1 h may be expressed by Equation (A.3) using the 1 hr sustained wind speed $U_{w,1h}(z)$ of Equation (A.2):

$$U_{w,T}(z) = U_{w,1h}(z) [1 - 0.41 I_u(z) \ln(T/T_0)] \quad (\text{A.3})$$

where additionally

- $U_{w,T}(z)$ is the sustained wind speed at height z above mean sea level, averaged over a time interval $T < 3600\text{s}$;
- $U_{w,1h}(z)$ is the 1 hr sustained wind speed at height z above mean sea level, see Equation (A.2);
- T is the time averaging interval with $T < T_0 = 3600\text{s}$;
- T_0 is the standard reference time averaging interval for wind speed of 1 hr = 3600 s;

$I_u(z)$ is the dimensionally dependent wind turbulence intensity at a height z above mean sea level, given by Equation (A.4), where U_{wo} is in units of meters per second (m/s):

$$I_u(z) = (0.06) [1 + 0.043 U_{wo}] (z/z_r)^{-0.22} \quad (\text{A.4})$$

Equations (A.3) and (A.4) were employed to derive the 10min, 1min, and 3sec wind speeds presented in this report.

9.3.13 Current Profile

Data from GOMOS2014 grid point T4037419 were used to derive the current speed at mid-depth and the depth of zero speed. These two parameters are available as part of the hurricane GOMOS2014 database. For each surface current speed storm peak, the concurrent current speed at mid-depth and the depth of zero speed were extracted. Regression equations were developed and used to derive the respective current speed at mid-depth and the depth of zero speed. Those analyses and regression equations are presented in Figure 9.25 and Figure 9.26.

Please note that the current profile information, together with all surface current statistics, represent the storm-driven current component only. They do not include any background current component. A background current of 0.2 knots may be added as per API guidelines. That same background current of 0.2 knots may be applied below the storm current.

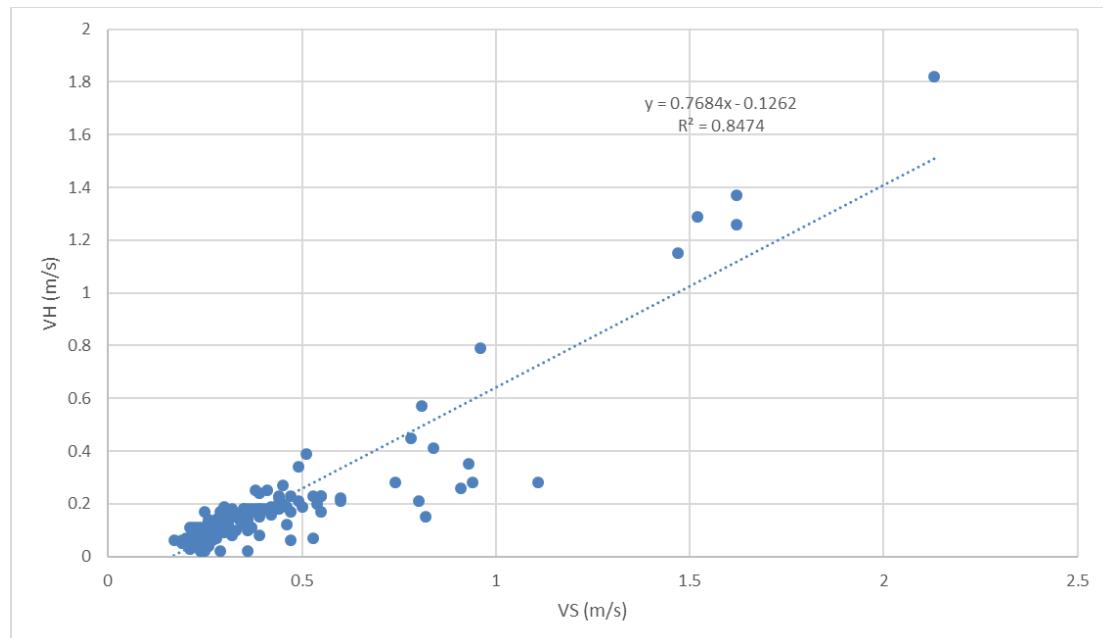


Figure 9.25 Regression Analysis; Hurricane Surface current speed vs mid depth current speed.

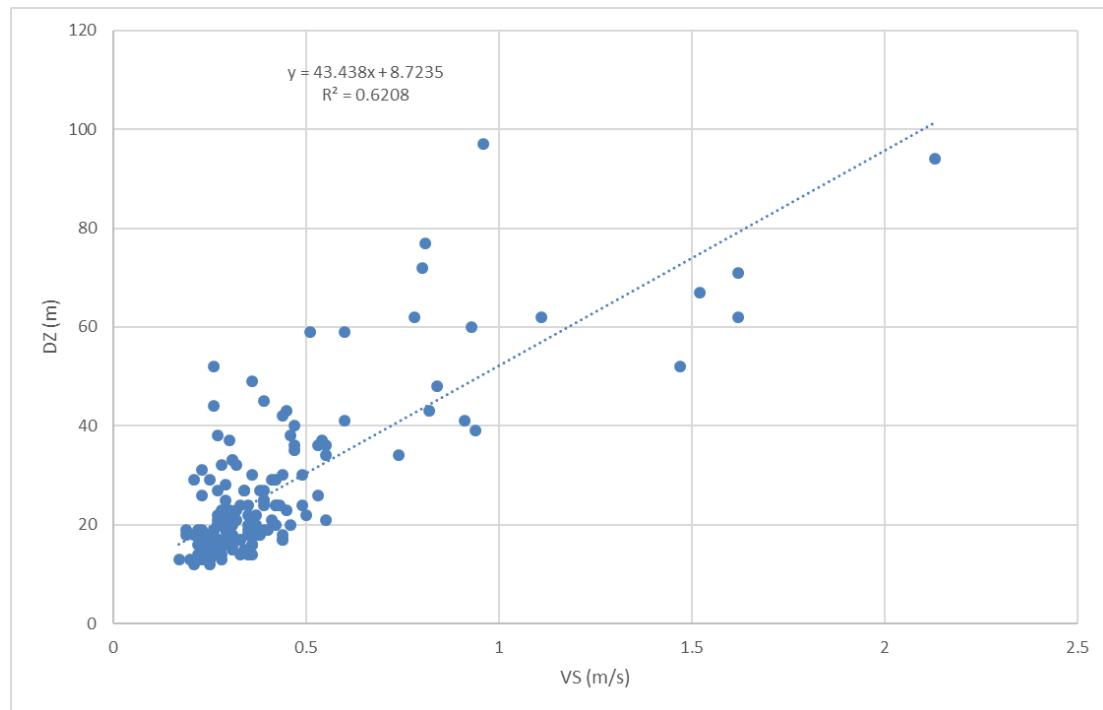


Figure 9.26 Regression Analysis; Hurricane Surface current speed vs depth of zero speed.

9.4 Sudden Hurricane Criteria Derivation

The methodology used for the derivation of the Sudden Hurricane criteria was the same as that for the Hurricane criteria. Sudden Hurricanes were defined as storms which became a named storm within 48 hours of reaching either the site or the 28°N latitude line.

9.4.1 Omni-directional Independent Criteria

Table 9.6 Sudden Hurricane Extreme Omni-directional Winds, Waves and Currents.

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values					
					10-year	25-year	50-year	100-year	200-year	1000-year
Total Hs (m)	W3	MoM	1.37	250	5.6	7.1	8.3	9.4	10.5	13.0
Ws 1-hr (m/s)	W3	LS	14.63	75	18.8	23.5	27.1	30.6	34.2	42.4
Cs-sfc (m/s)	EXP	LS	0.16	267	0.7	0.9	1.1	1.3	1.4	1.8

9.4.2 Directional Independent Criteria

Table 9.7 Relative Magnitude of GOMOS2014 Sudden Hurricane Significant Wave Height by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.33	0.63	0.68	1.00	0.79	0.72	0.52	0.37
T4036162	0.31	0.57	0.58	0.88	1.00	0.67	0.54	0.35
T4037419	0.37	0.59	0.57	0.55	1.00	0.77	0.55	0.26
T4038013	0.63	0.67	0.70	0.70	1.00	0.90	0.71	0.40
T4038196	0.72	0.75	0.71	0.72	1.00	0.86	0.71	0.36
Design	0.72	0.75	0.71	1.00	1.00	0.90	0.71	0.40

Table 9.8 Relative Magnitude of GOMOS2014 Sudden Hurricane Wind Speed by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.56	0.64	1.00	0.73	0.70	0.62	0.59	0.51
T4036162	0.54	0.58	0.85	1.00	0.92	0.80	0.54	0.52
T4037419	0.64	0.64	0.68	1.00	0.99	0.69	0.63	0.55
T4038013	0.89	0.88	0.72	1.00	0.90	0.90	0.84	0.76
T4038196	0.86	0.84	0.73	0.97	1.00	0.86	0.81	0.83
Design	0.89	0.88	1.00	1.00	1.00	0.90	0.84	0.83

Table 9.9 Relative Magnitude of GOMOS2014 Sudden Hurricane Surface Current Speed by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.89	0.83	0.72	0.98	1.00	0.99	0.92	0.89
T4036162	0.84	0.76	0.64	0.98	1.00	0.99	0.99	0.91
T4037419	0.70	0.63	0.59	0.59	1.00	1.00	0.94	0.82
T4038013	0.99	0.87	0.72	0.66	0.94	0.95	0.95	1.00
T4038196	0.98	0.81	0.71	0.69	0.91	0.90	0.93	1.00
Design	0.99	0.87	0.72	0.98	1.00	1.00	0.99	1.00

9.4.3 Associated Directional Wave, Wind and Surface Current

9.4.3.1 Significant Wave Height Associated Parameter Plots by Directional Sector

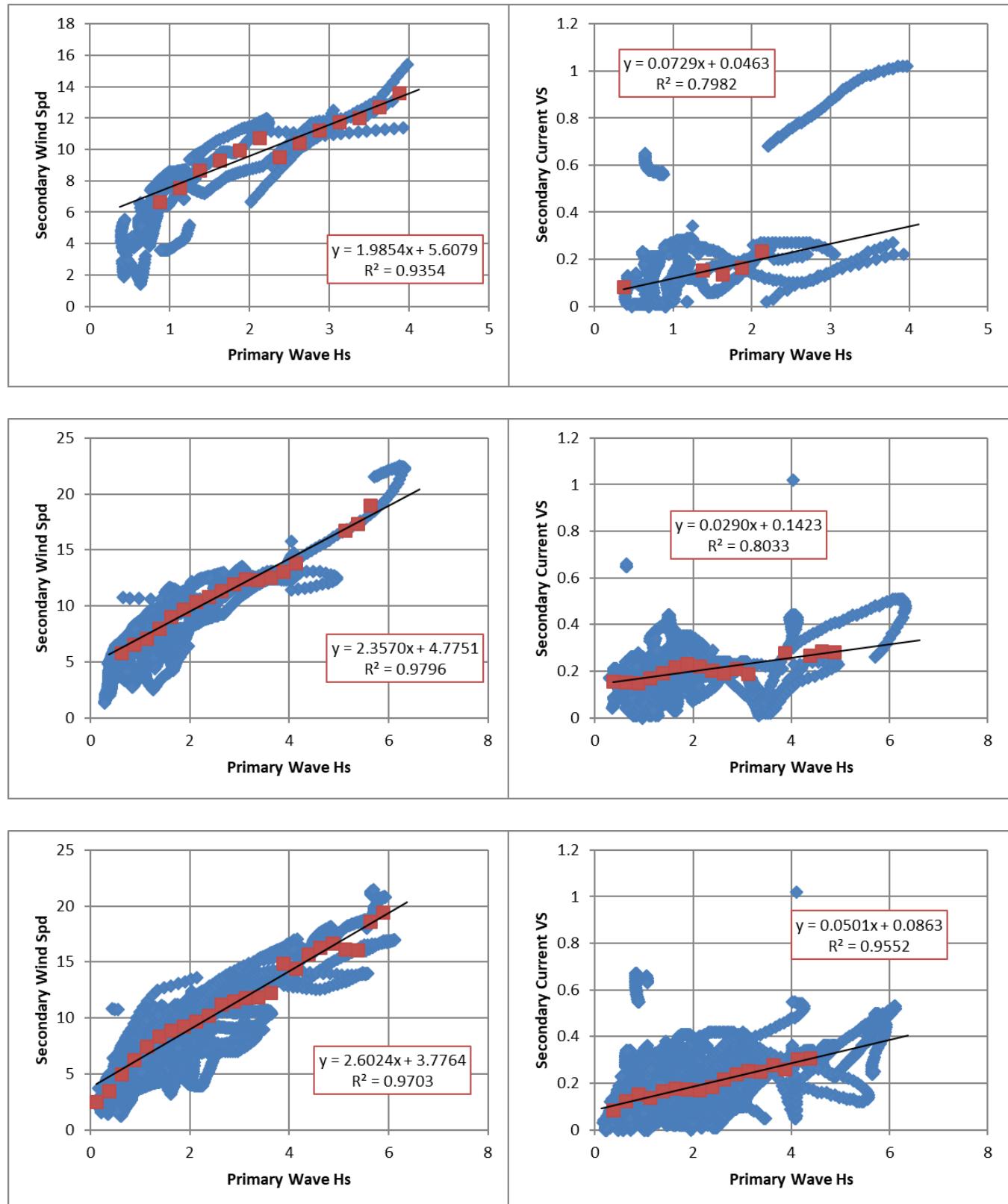


Figure 9.27 Sudden Hurricane Associated Wind Speed and Current Speed for Primary Wave – N, NE and E (from top to bottom).

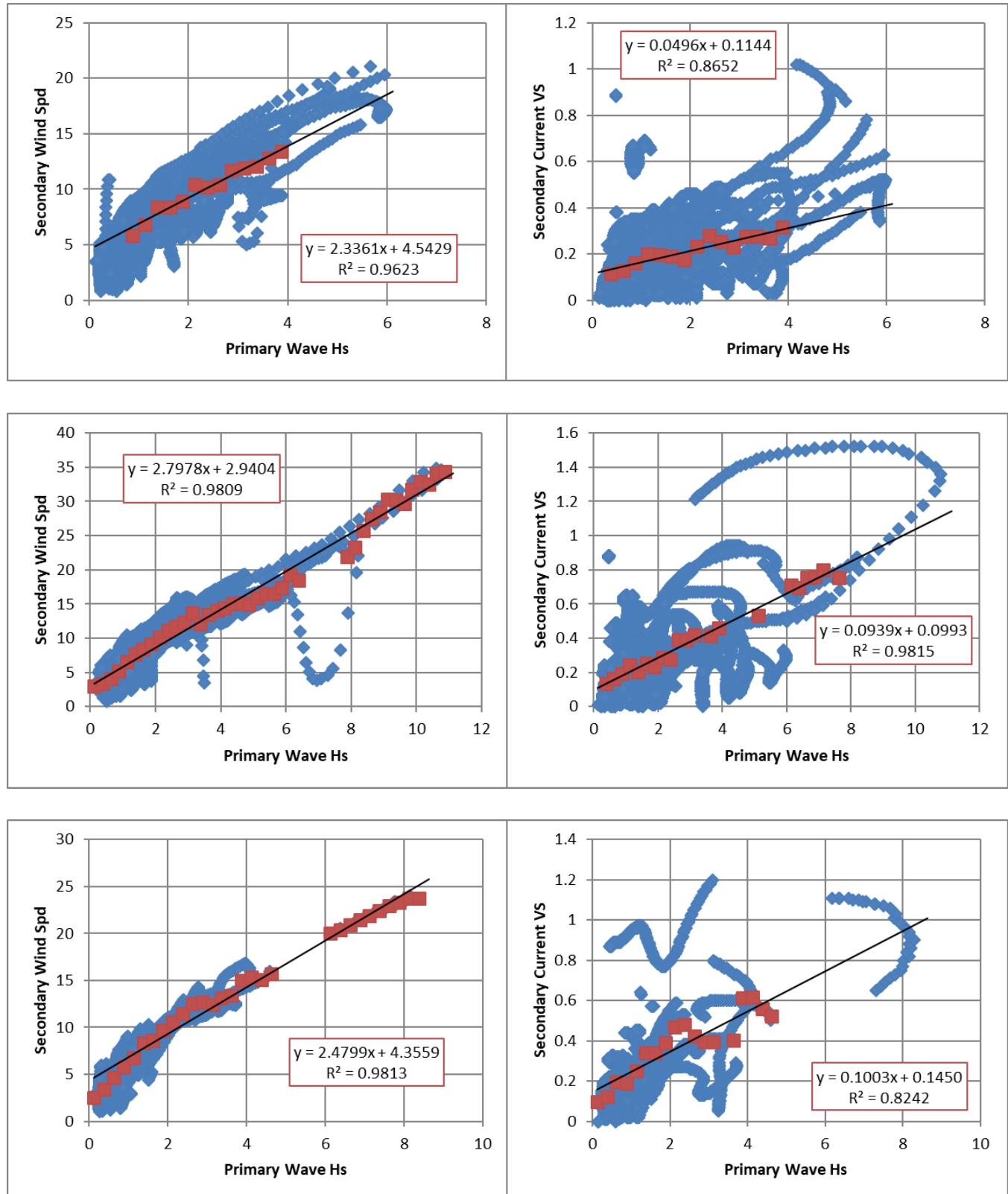


Figure 9.28 Sudden Hurricane Associated Wind Speed and Current Speed for Primary Wave – SE, S and SW (from top to bottom).

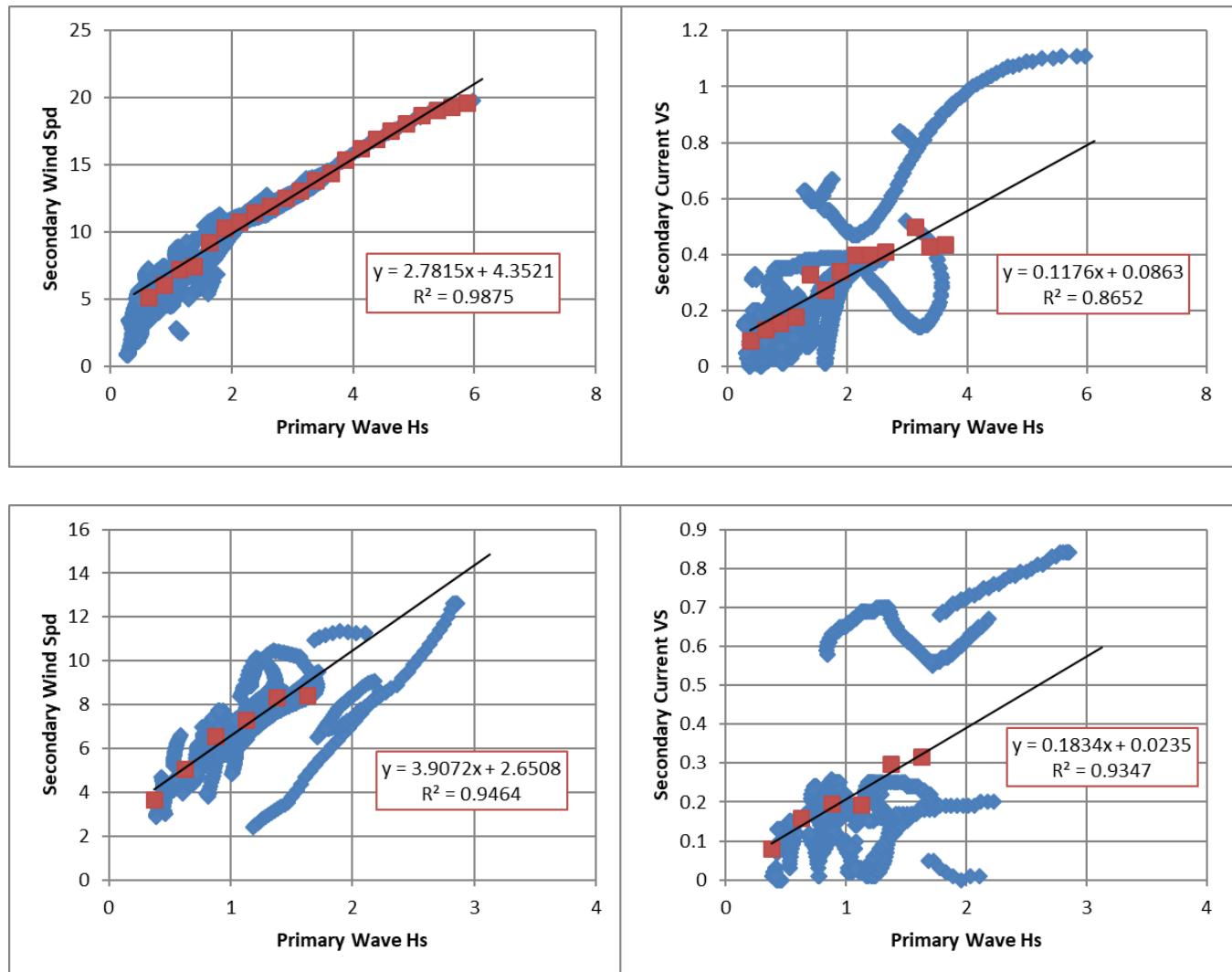


Figure 9.29 Sudden Hurricane Associated Wind Speed and Current Speed for Primary Wave – W and NW (from top to bottom).

9.4.3.2 Wind Speed Associated Parameter Plots by Directional Sector

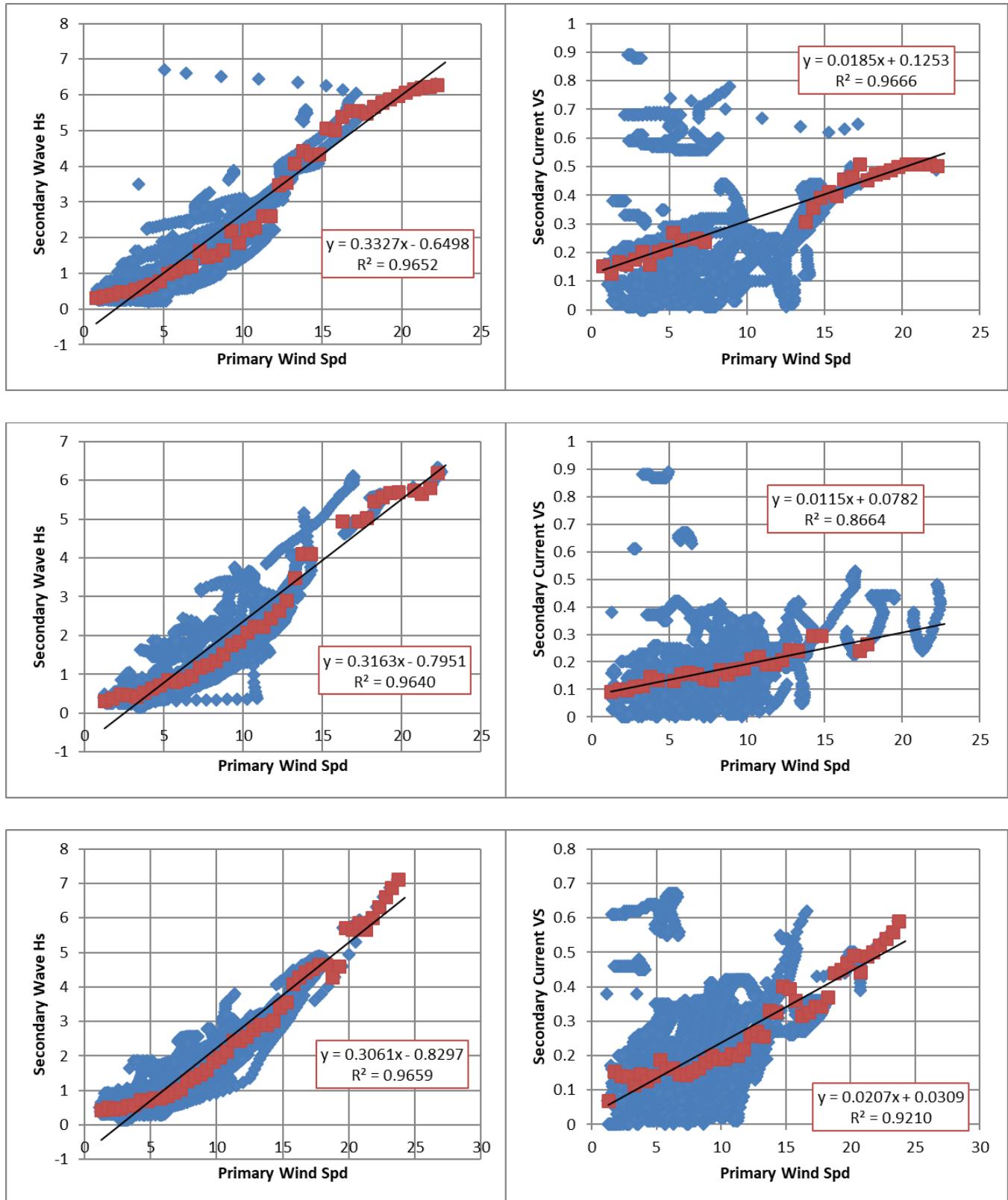


Figure 9.30 Sudden Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – N, NE and E (from top to bottom).

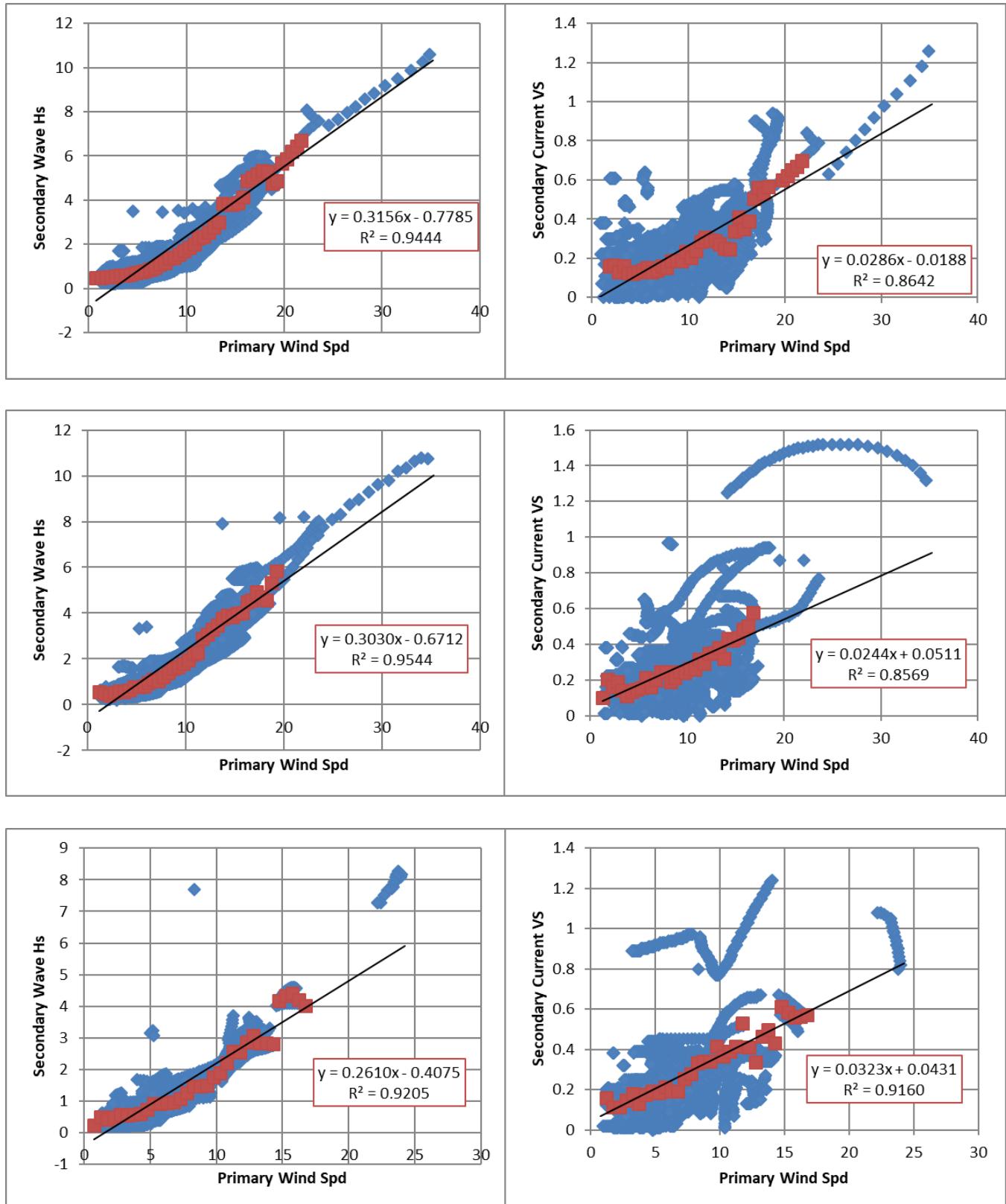


Figure 9.31 Sudden Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – SE, S and SW (from top to bottom).

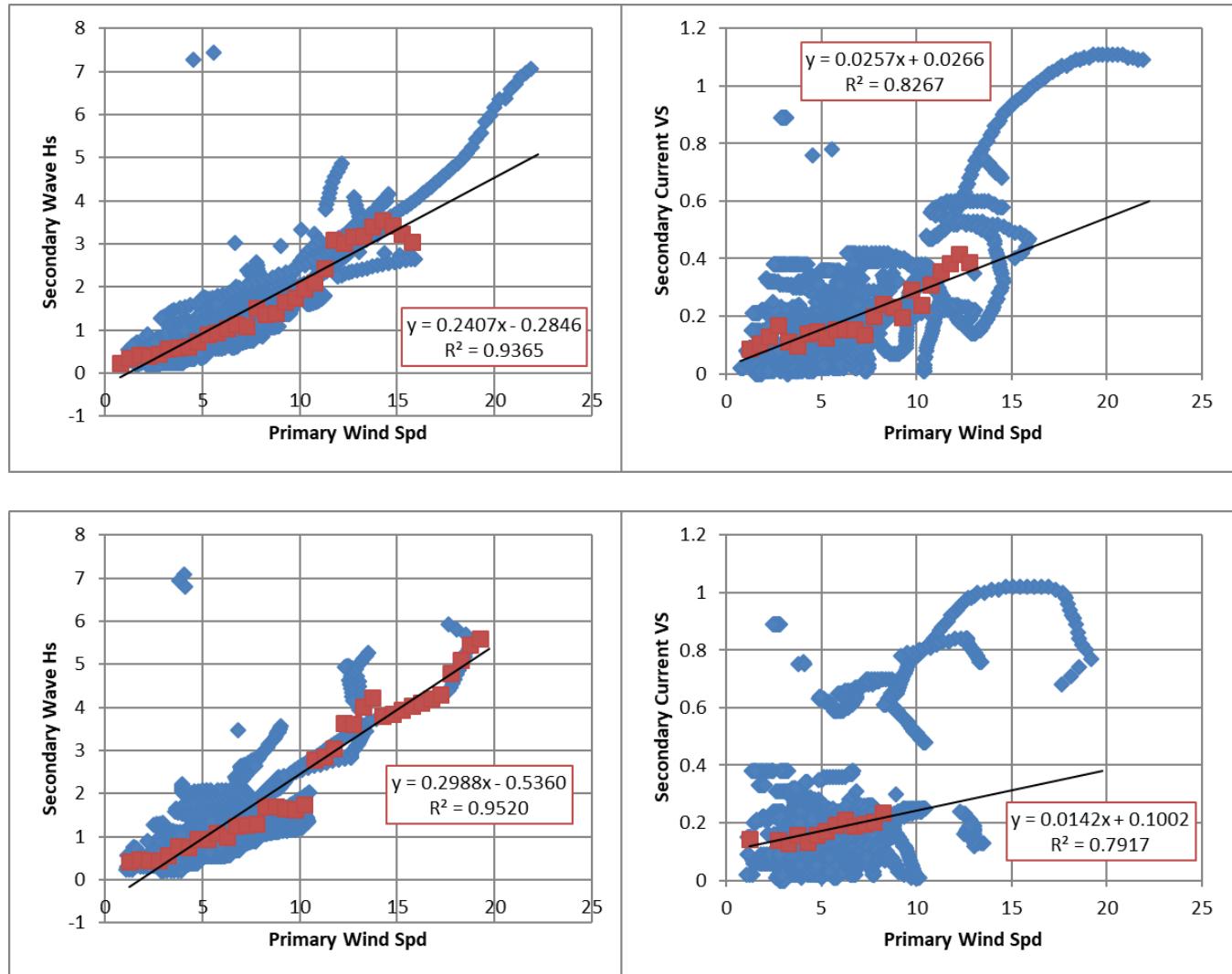


Figure 9.32 Sudden Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – W and NW (from top to bottom).

9.4.3.3 Current Speed Associated Parameter Plots by Directional Sector

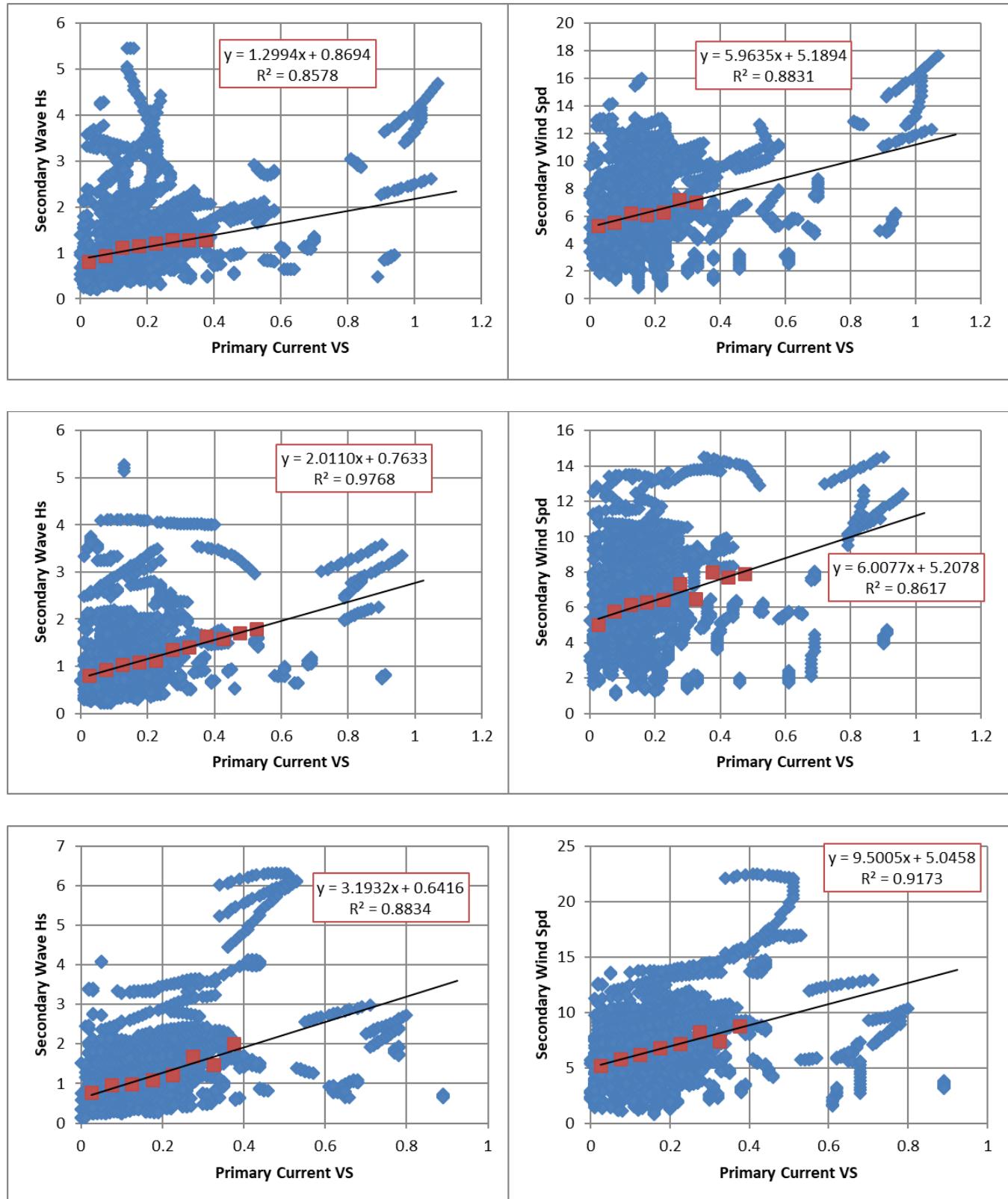


Figure 9.33 Sudden Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – N, NE and E (from top to bottom).

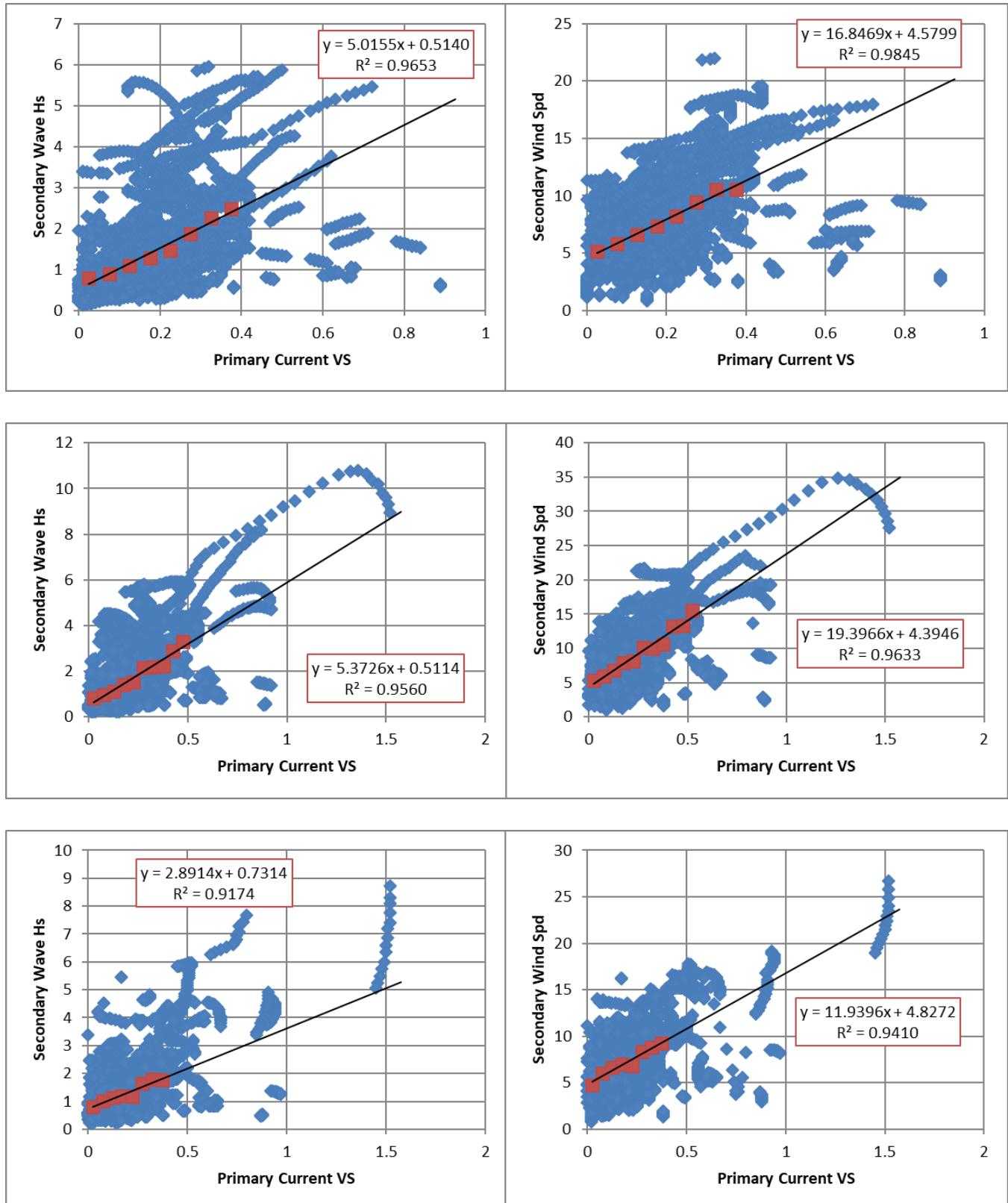


Figure 9.34 Sudden Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – SE, S and SW (from top to bottom).

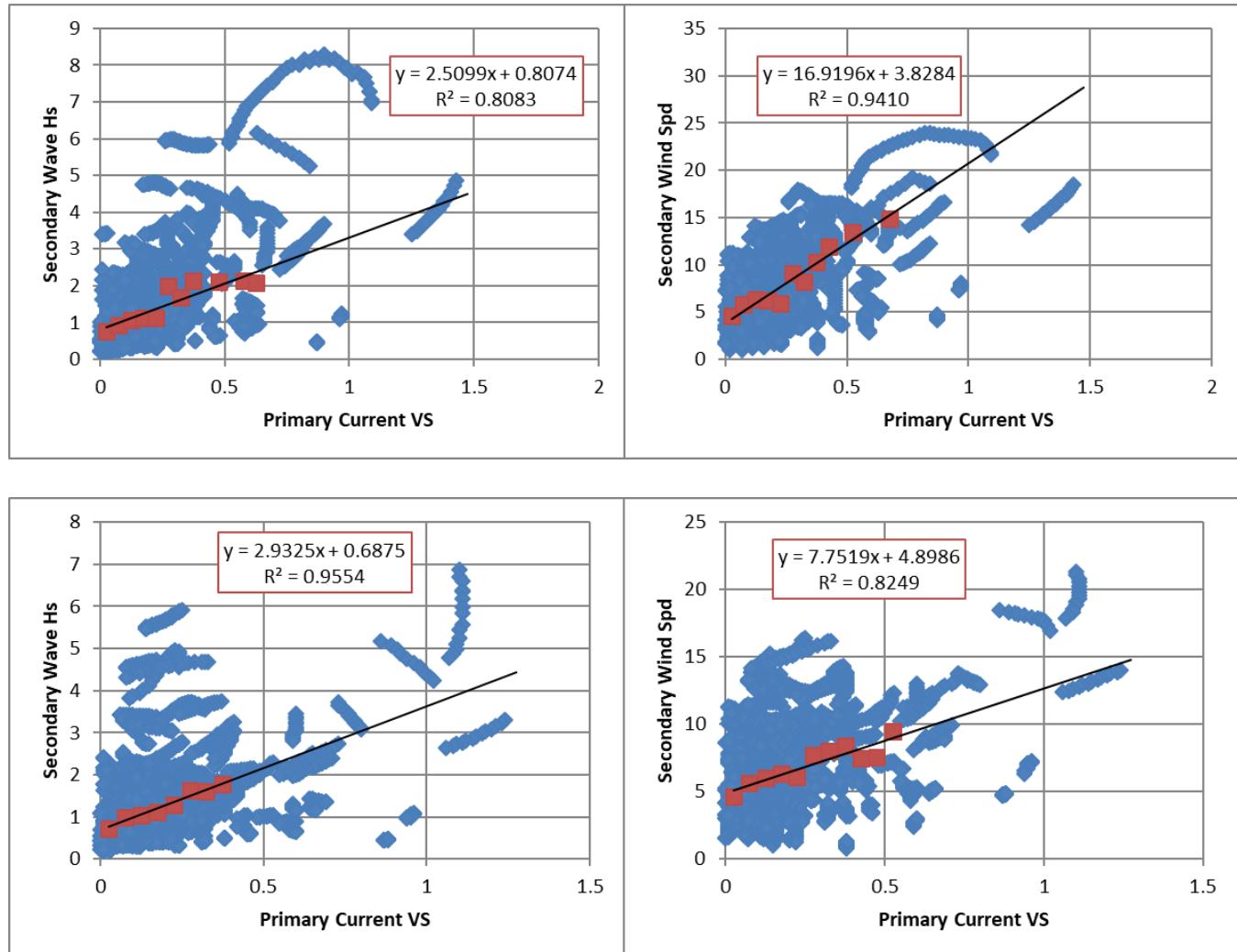


Figure 9.35 Sudden Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – W and NW (from top to bottom).

9.4.4 Associated Tp

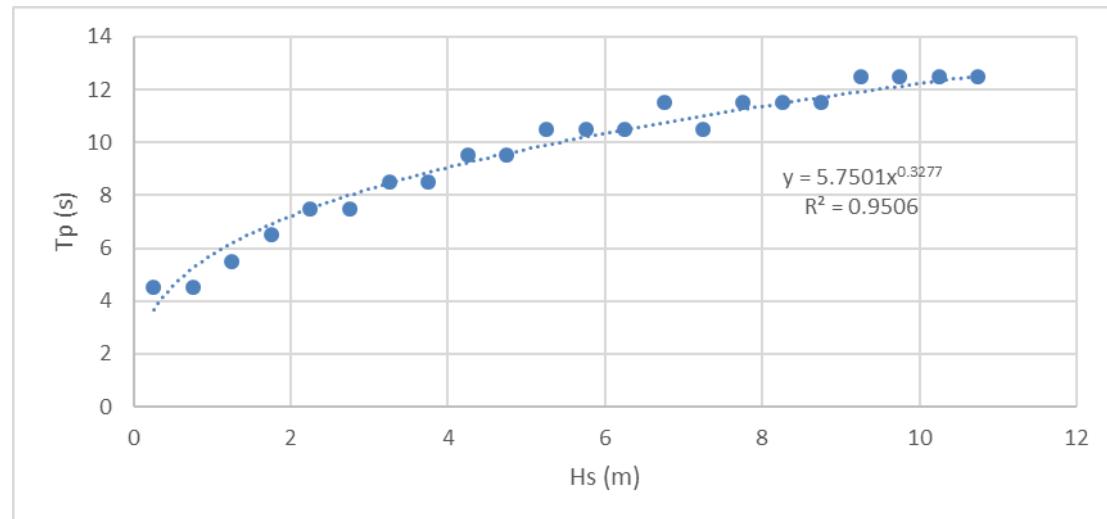


Figure 9.36 Sudden Hurricane Regression Analysis; H_s vs. T_p -mode.

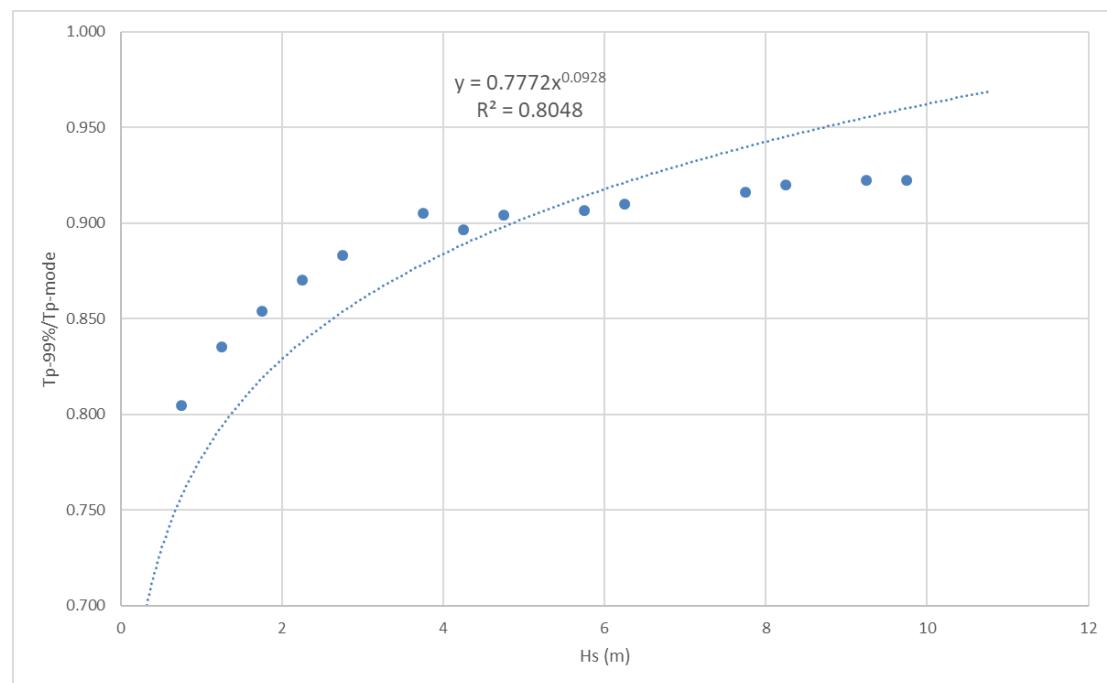


Figure 9.37 Sudden Hurricane Regression Analysis Tp low; H_s vs. $T_{p-99\%}$ exceedance/ T_p -mode.

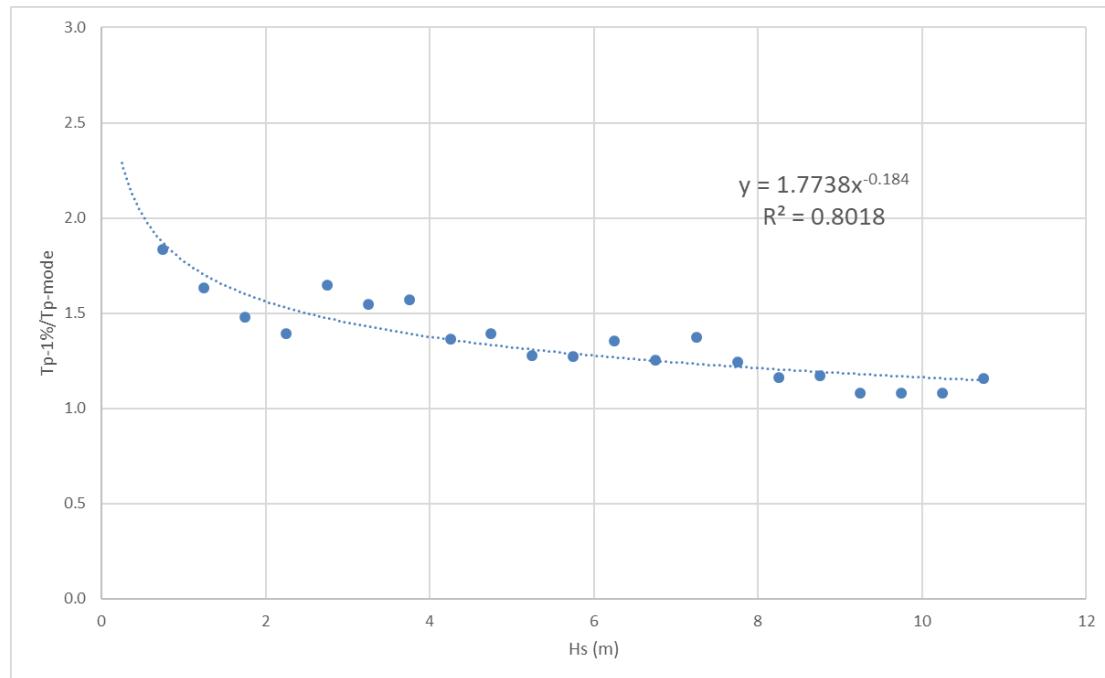


Figure 9.38 Sudden Hurricane Regression Analysis T_p high; H_s vs. $T_{p-1\%}$ exceedance/ T_p -mode.

9.4.5 Associated Hc and Hmax

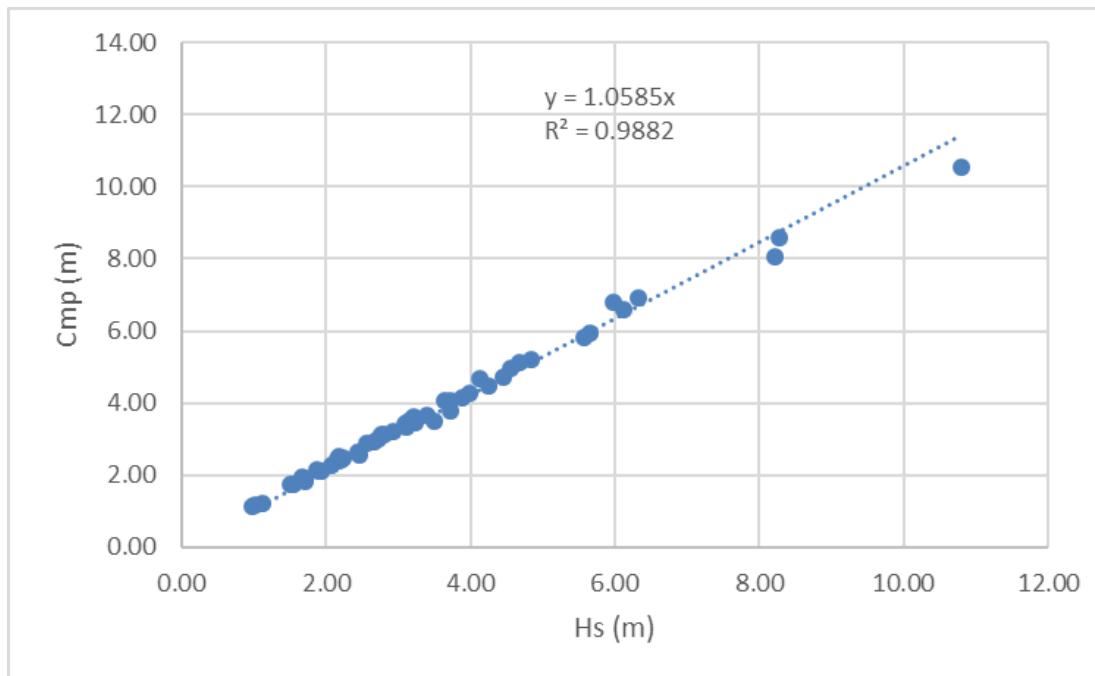


Figure 9.39 Sudden Hurricane Regression Analysis; H_s vs H_c .

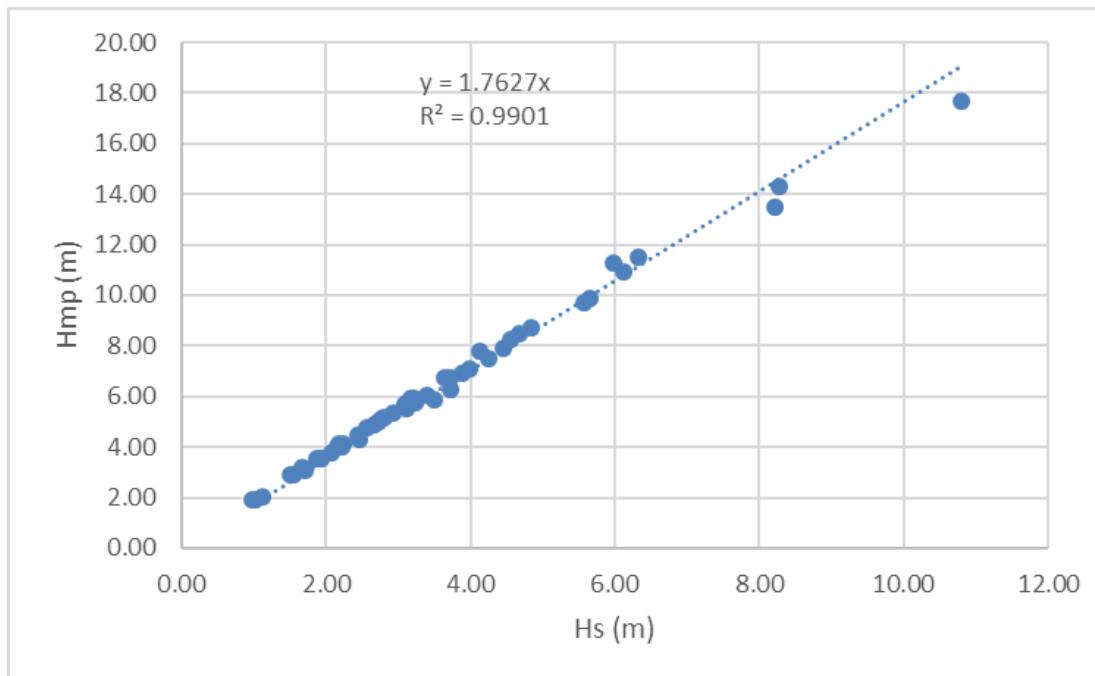


Figure 9.40 Sudden Hurricane Regression Analysis; H_s vs H_{max} .

9.4.6 Associated THmax

The associated THmax values presented in the Sudden Hurricane criteria tables have been derived based on a $0.9 \times T_p$ relationship.

9.4.7 Associated JONSWAP Peak Enhancement Factor

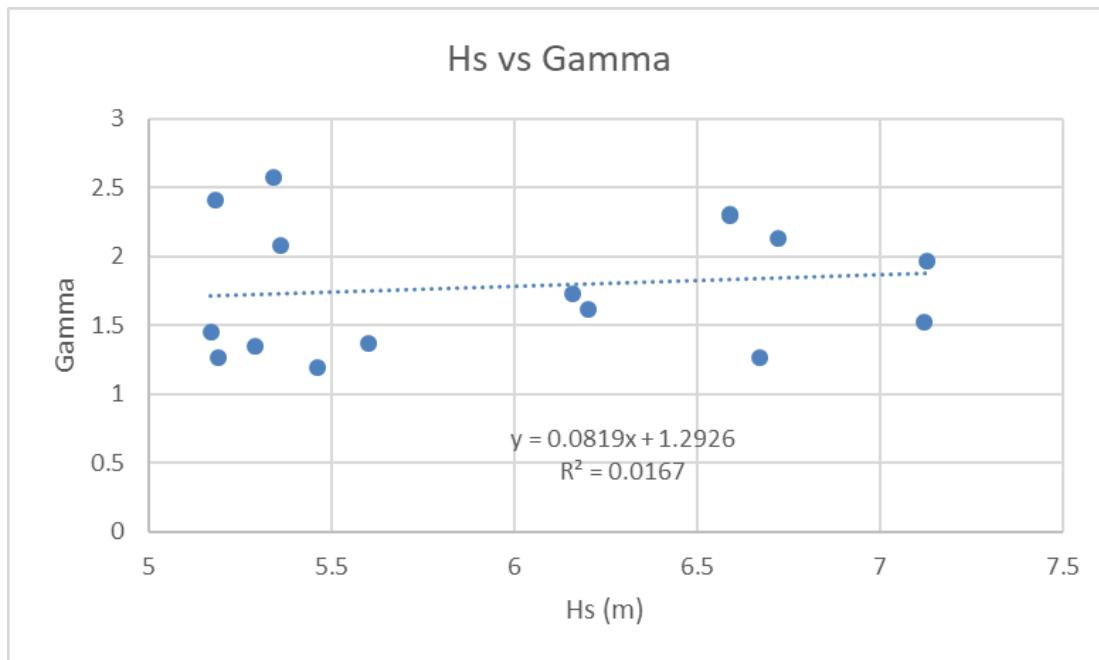


Figure 9.41 Sudden Hurricane Regression Analysis; Hs vs gamma.

9.4.8 Angular Difference

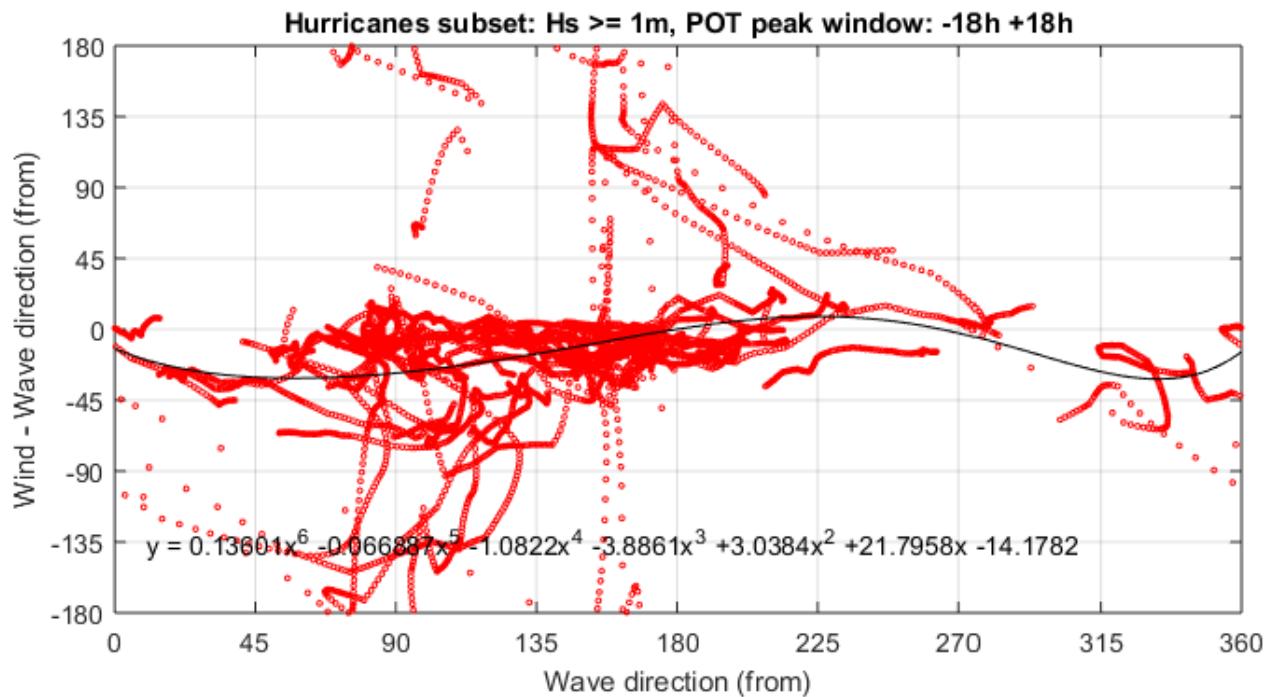


Figure 9.42 Regression Analysis: Wind and Wave Angular Difference, Sudden Hurricane Wave Primary.

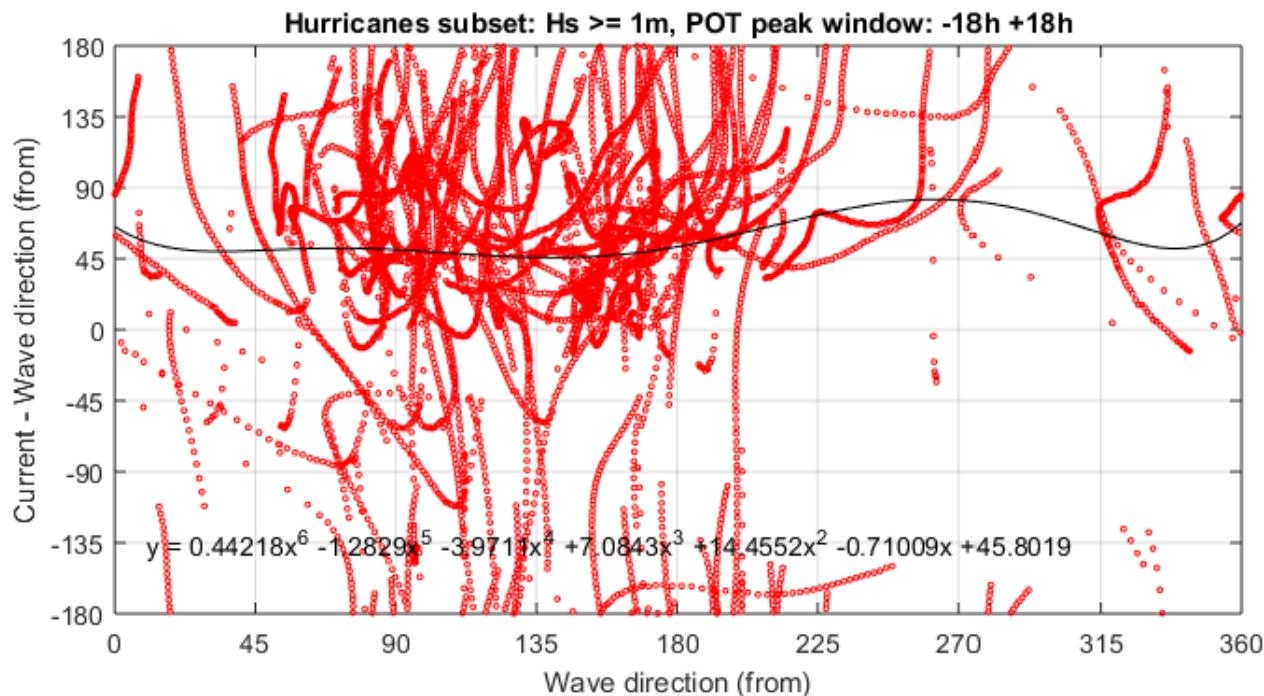


Figure 9.43 Regression Analysis; Current and Wave Angular Difference, Sudden Hurricane Wave Primary.

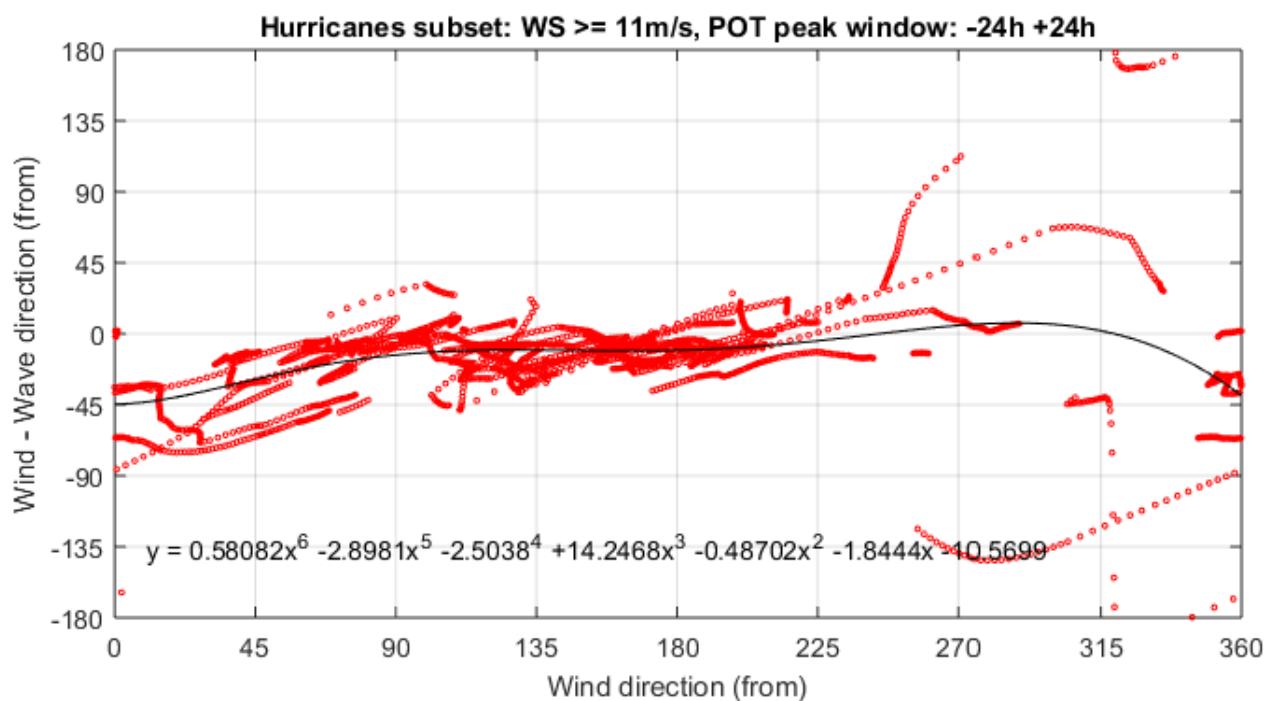


Figure 9.44 Regression Analysis: Wind and Wave Angular Difference, Sudden Hurricane Wind Primary.

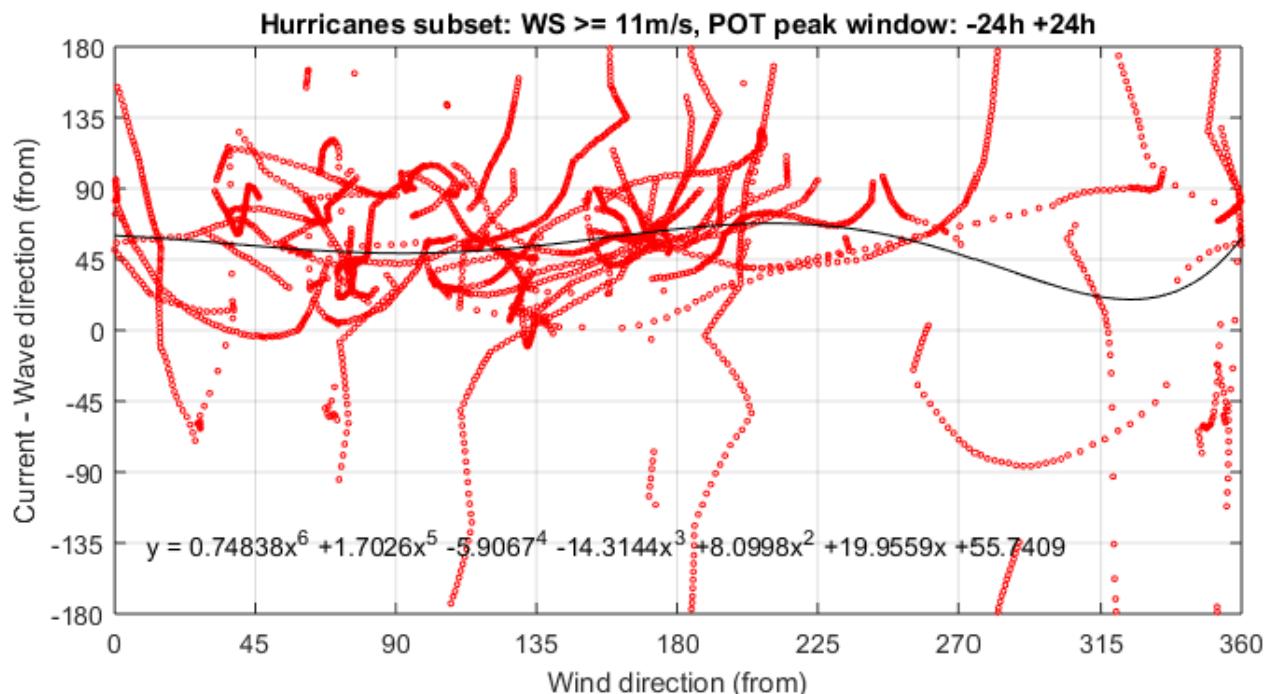


Figure 9.45 Regression Analysis; Current and Wave Angular Difference, Sudden Hurricane Wind Primary.

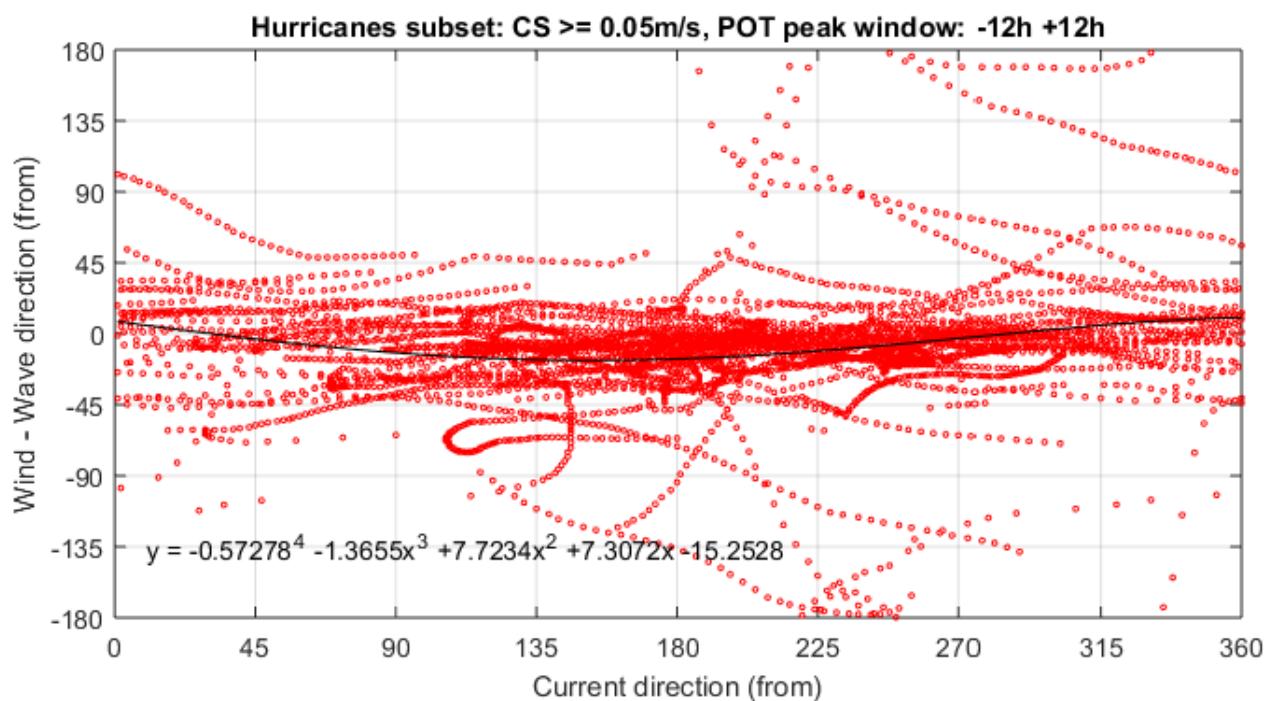


Figure 9.46 Regression Analysis: Wind and Wave Angular Difference, Sudden Hurricane Current Primary.

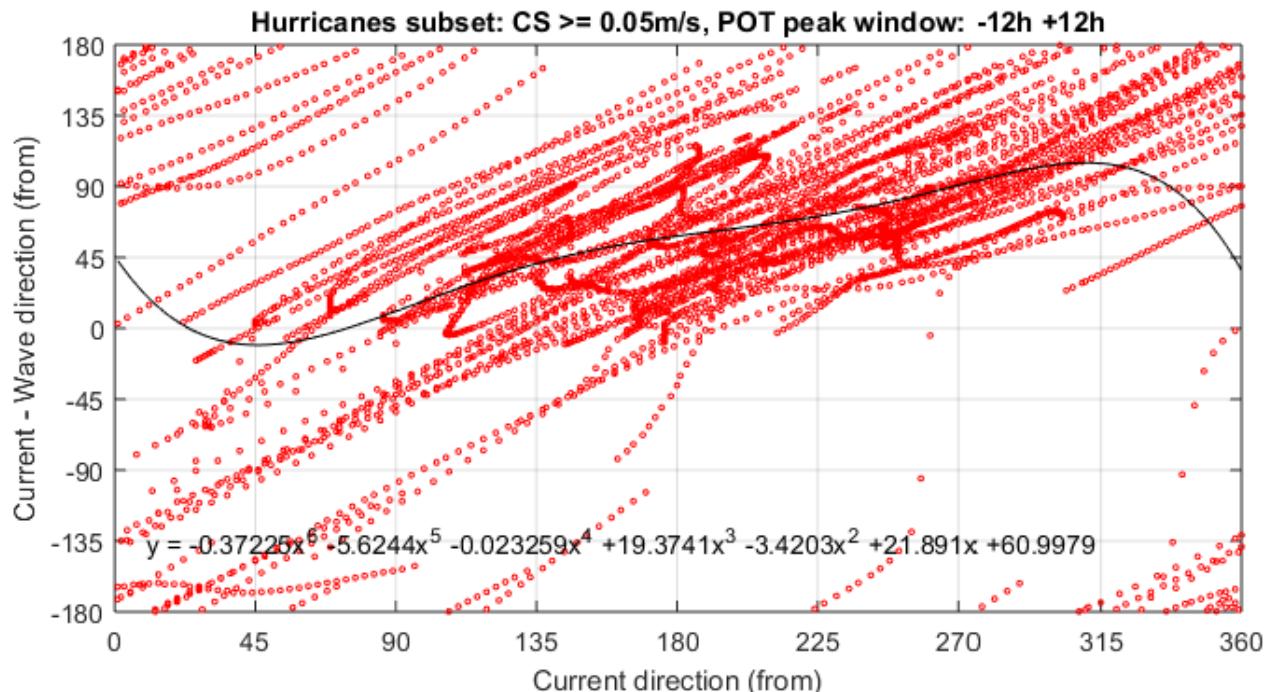


Figure 9.47 Regression Analysis; Current and Wave Angular Difference, Sudden Hurricane Current Primary.

9.4.9 Extreme Sudden Hurricane Event Duration and History

Storm histories for the 20 most severe sudden hurricane events at GOMOS2014 grid point T4037419 were considered in the analysis. Time series of wave height and wind speed for individual storms were organized such that the maximum Hs or Ws for each event represented effective time zero. This allowed the build-up and decrease to be normalized for all identified storm events.

Figure 9.48 and Figure 9.49 display the wave and wind magnitudes of the events examined.

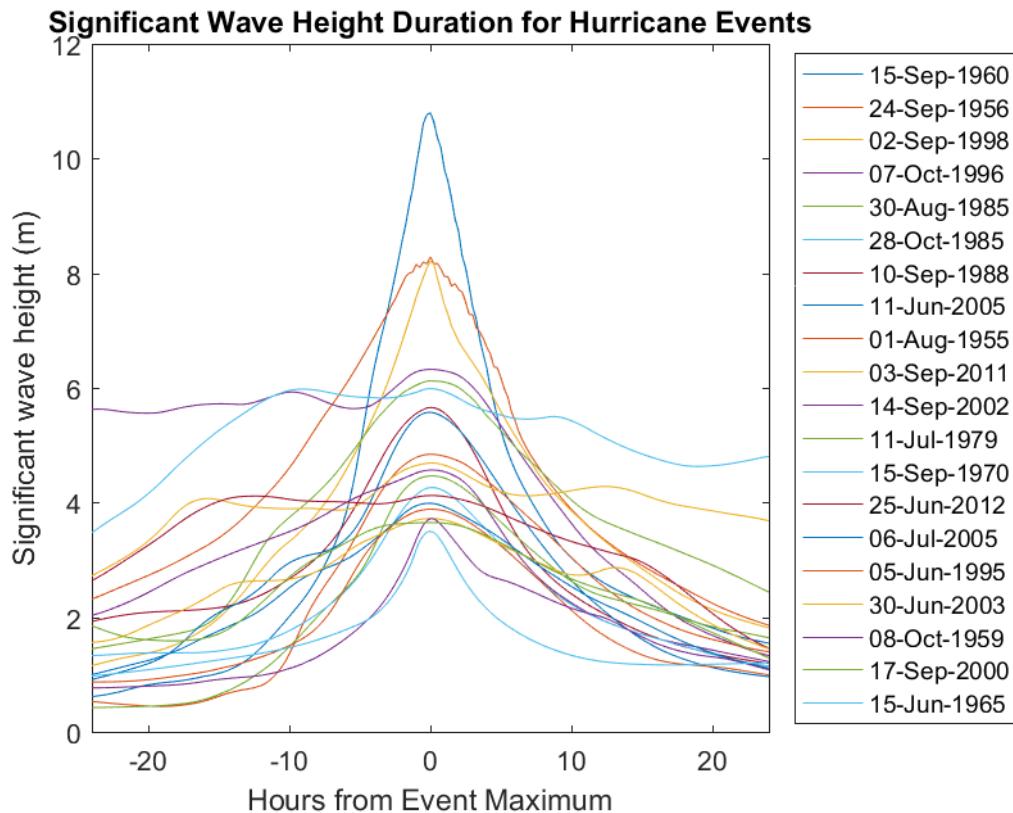


Figure 9.48 GOMOS2014 T4037419 Sudden Hurricane Storm Events Considered for Hs Duration Analysis.

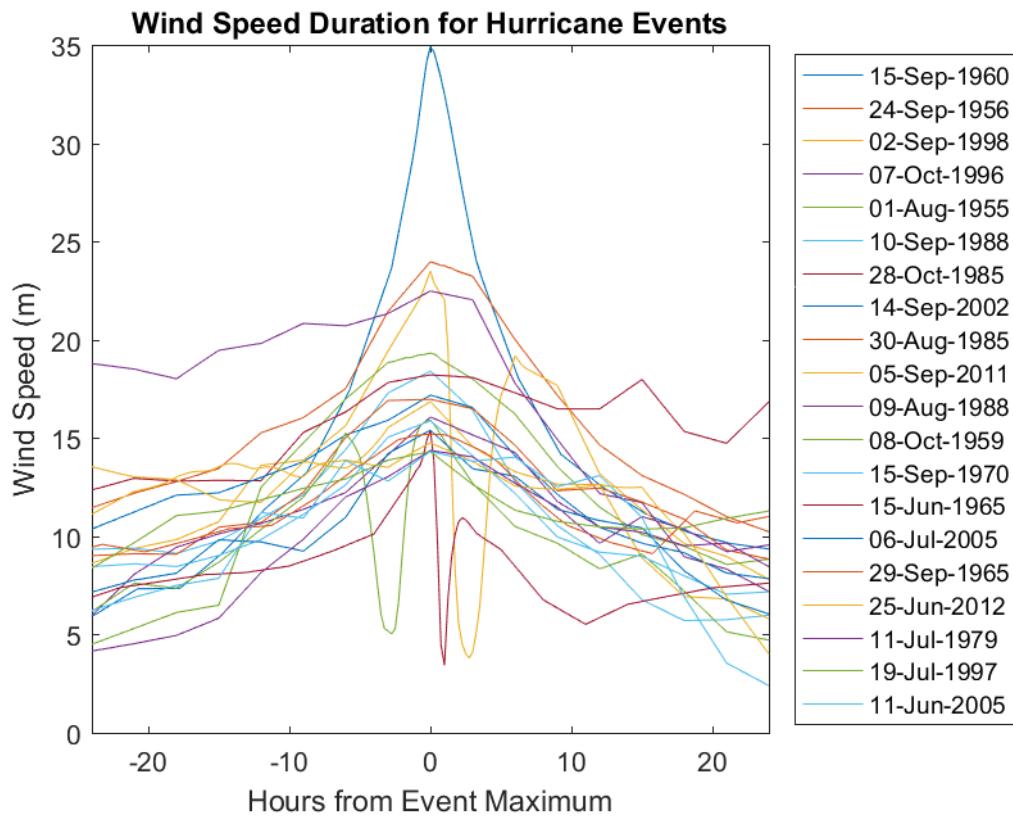


Figure 9.49 GOMOS2014 T4037419 Sudden Hurricane Storm Events Considered for Ws Duration Analysis.

Two storm populations were identified among the most severe events. Less severe storms in which peak conditions tend to move slow and last longer were categorized as “wide and flat”, while stronger and faster storms (shorter lasting peak conditions) were categorized as “tall and thin”.

9.4.10 Wind Profile

Wind profile for Sudden Hurricanes is calculated similarly to the methodology for hurricanes (Section 9.3.12).

9.4.11 Current Profile

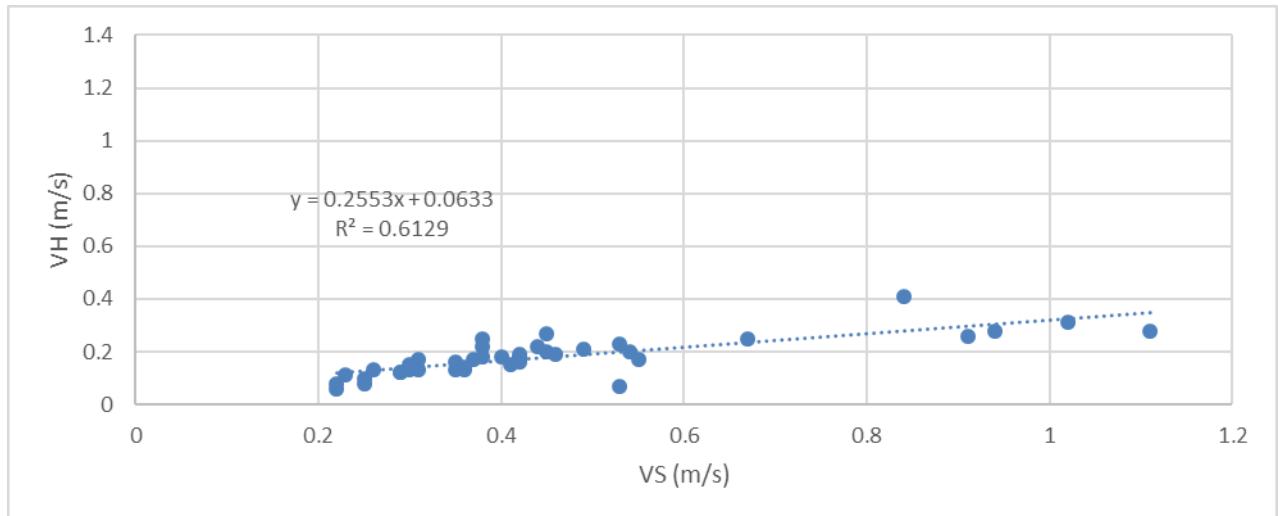


Figure 9.50 Regression Analysis; Sudden Hurricane Surface current speed vs mid depth current speed.

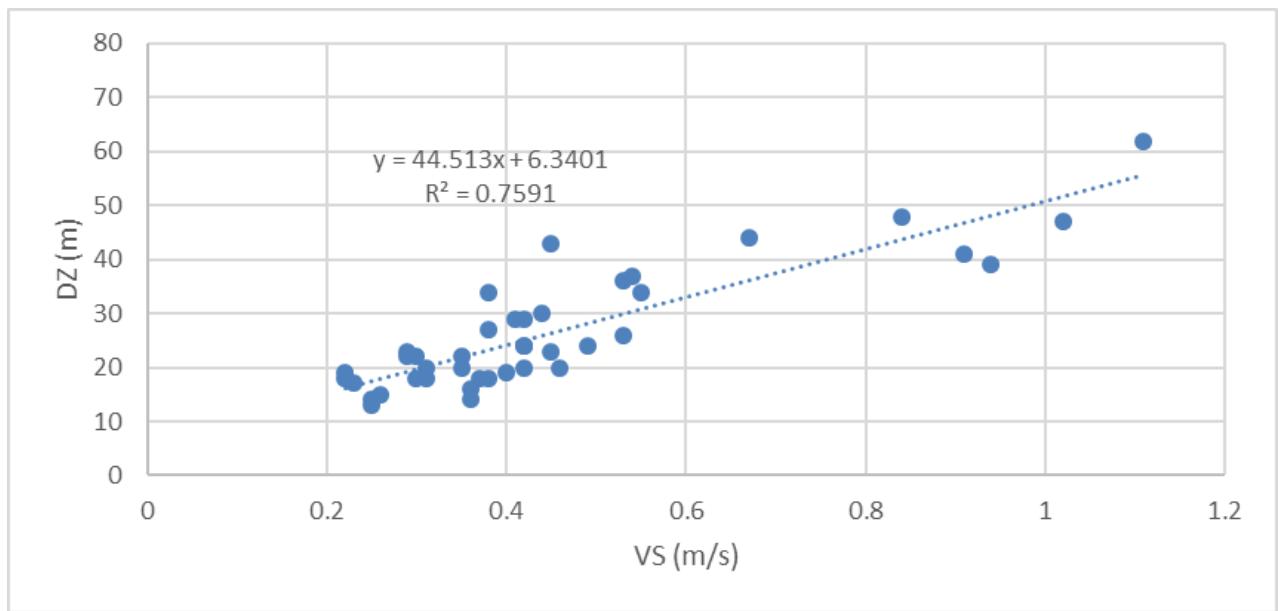


Figure 9.51 Regression Analysis; Sudden Hurricane Surface current speed vs depth of zero speed.

9.5 Off-Peak Hurricane Criteria Derivation

The methodology used for the derivation of the Off-Peak Hurricane criteria was the same as that for the Hurricane criteria. Off-Peak Hurricanes were defined as all hurricanes happening in months except August, September and October.

9.5.1 Omni-directional Independent Criteria

Table 9.10 Off-Peak Hurricane Extreme Omni-directional Winds, Waves and Currents.

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values					
					10-year	25-year	50-year	100-year	200-year	1000-year
Total Hs (m)	W3	LS	2.09	175	4.6	6.1	7.2	8.4	9.5	12.3
Ws 1-hr (m/s)	EXP	MLE	10.71	150	15.7	18.6	20.9	23.1	25.4	30.6
Cs-sfc (m/s)	EXP	LS	0.22	306	0.5	0.6	0.7	0.7	0.8	1.0

9.5.2 Directional Independent Criteria

Table 9.11 Relative Magnitude of GOMOS2014 Off-Peak Hurricane Significant Wave Height by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.49	0.74	1.00	0.39	0.56	0.47	0.43	0.48
T4036162	0.37	0.75	0.76	1.00	0.50	0.43	0.43	0.38
T4037419	0.38	0.80	0.90	1.00	0.55	0.46	0.44	0.40
T4038013	0.37	0.82	1.00	0.84	0.49	0.40	0.43	0.38
T4038196	0.31	0.76	1.00	0.74	0.51	0.49	0.41	0.35
Design	0.49	0.82	1.00	1.00	0.56	0.49	0.44	0.48

Table 9.12 Relative Magnitude of GOMOS2014 Off-Peak Hurricane Wind Speed by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.62	1.00	0.80	0.63	0.70	0.53	0.59	0.57
T4036162	0.69	0.69	1.00	1.00	0.75	0.60	0.54	0.54
T4037419	0.83	0.82	1.00	1.00	0.78	0.63	0.63	0.64
T4038013	0.94	1.00	0.94	0.97	0.79	0.70	0.72	0.71
T4038196	0.89	1.00	0.85	0.85	0.83	0.84	0.70	0.66
Design	0.94	1.00	1.00	1.00	0.83	0.84	0.72	0.71

Table 9.13 Relative Magnitude of GOMOS2014 Off-Peak Hurricane Surface Current Speed by Direction.

GRID POINT	N	NE	E	SE	S	SW	W	NW
T4035283	0.80	0.77	0.94	0.94	0.71	0.99	1.00	0.93
T4036162	0.89	0.79	0.74	1.00	0.84	0.89	0.94	0.94
T4037419	0.95	0.85	0.81	0.84	0.95	0.99	1.00	1.00
T4038013	0.91	0.85	0.88	0.86	0.97	1.00	1.00	0.98
T4038196	0.79	0.67	0.89	0.80	0.75	0.96	1.00	0.95
Design	0.95	0.85	0.94	1.00	0.97	1.00	1.00	1.00

9.5.3 Associated Directional Wave, Wind and Surface Current

9.5.3.1 Significant Wave Height Associated Parameter Plots by Directional Sector

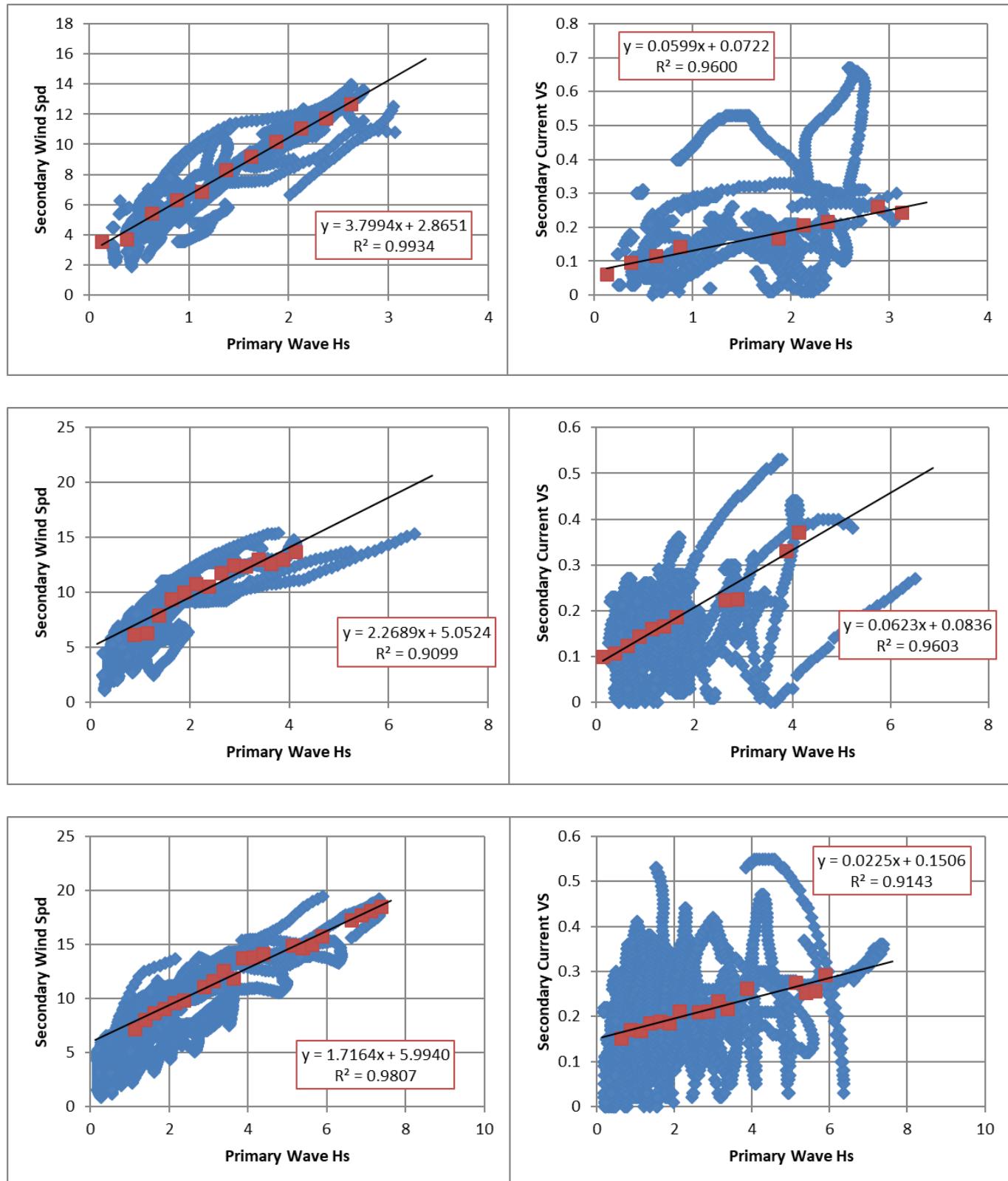


Figure 9.52 Off-Peak Hurricane Associated Wind Speed and Current Speed for Primary Wave – N, NE and E (from top to bottom).

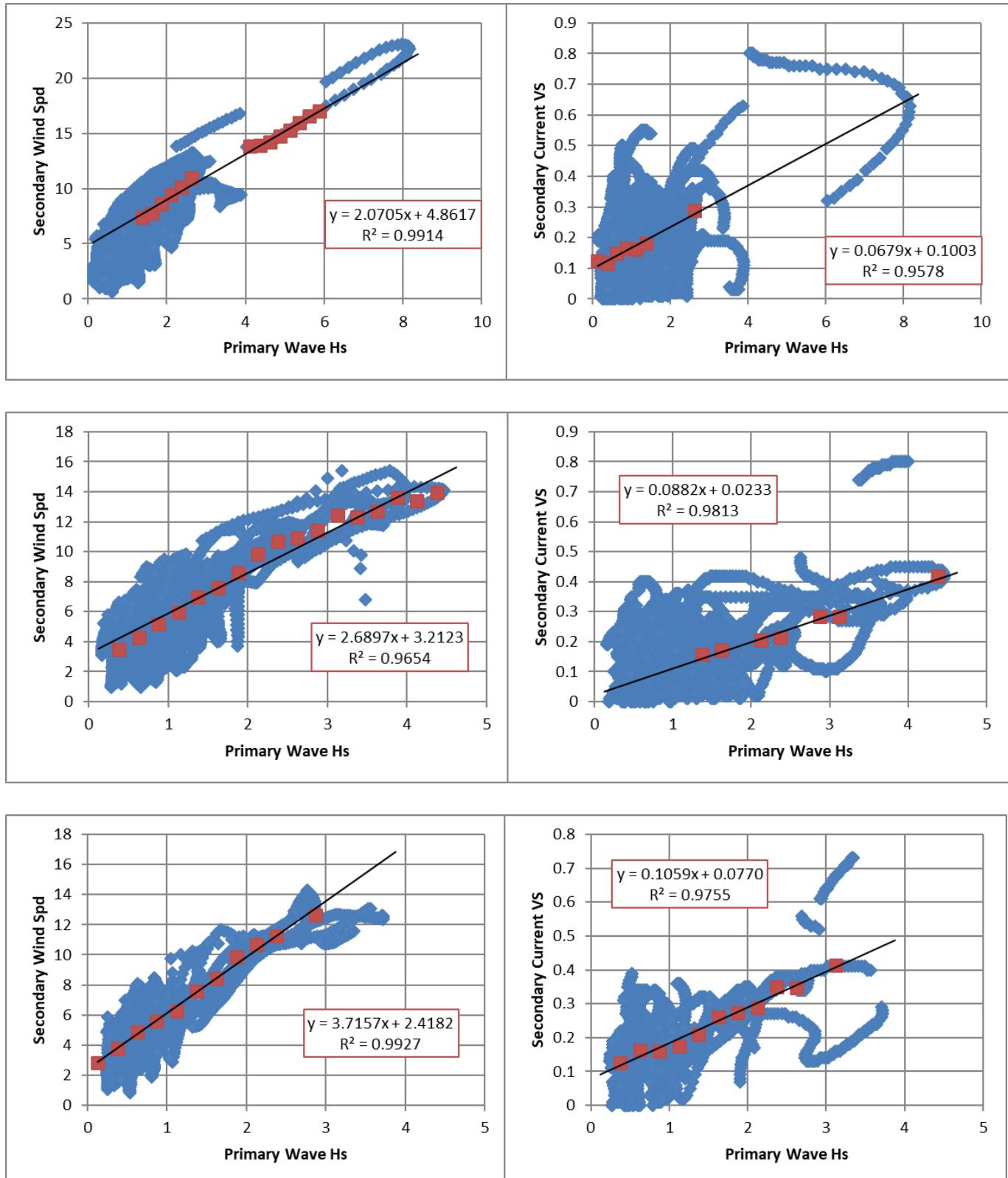


Figure 9.53 Off-Peak Hurricane Associated Wind Speed and Current Speed for Primary Wave – SE, S and SW (from top to bottom).

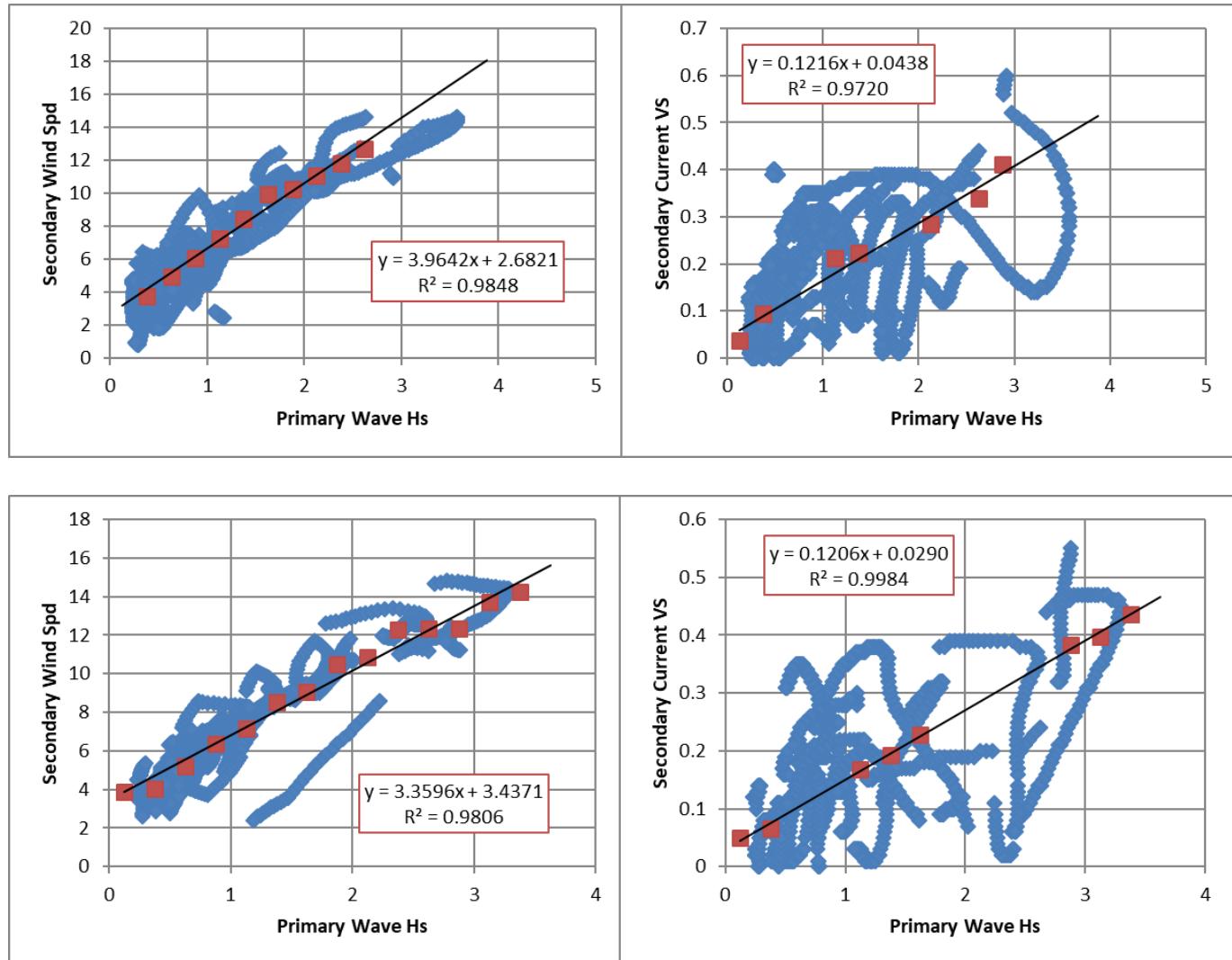


Figure 9.54 Off-Peak Hurricane Associated Wind Speed and Current Speed for Primary Wave – W and NW (from top to bottom).

9.5.3.2 Wind Speed Associated Parameter Plots by Directional Sector

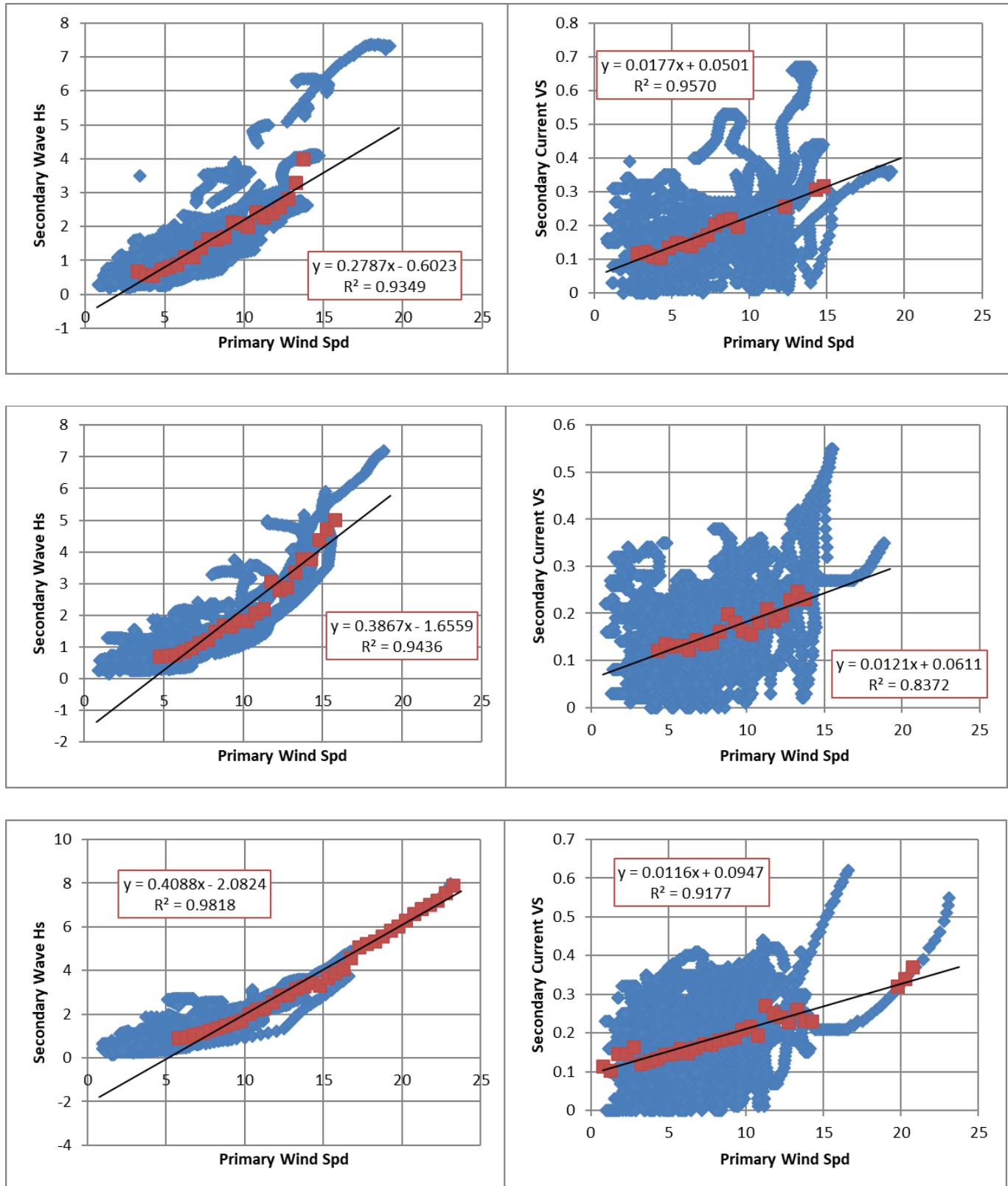


Figure 9.55 Off-Peak Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – N, NE and E (from top to bottom).

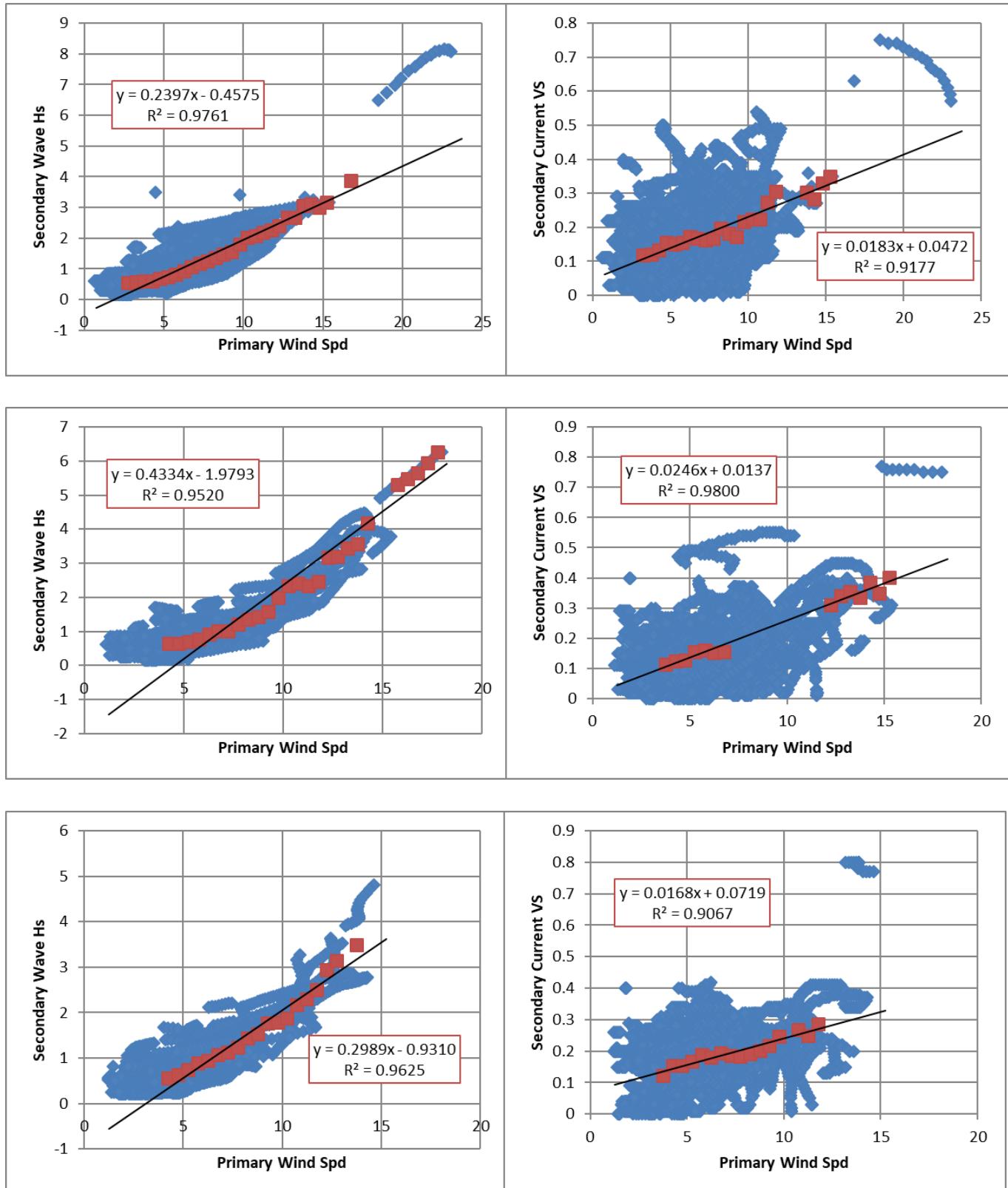


Figure 9.56 Off-Peak Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – SE, S and SW (from top to bottom).

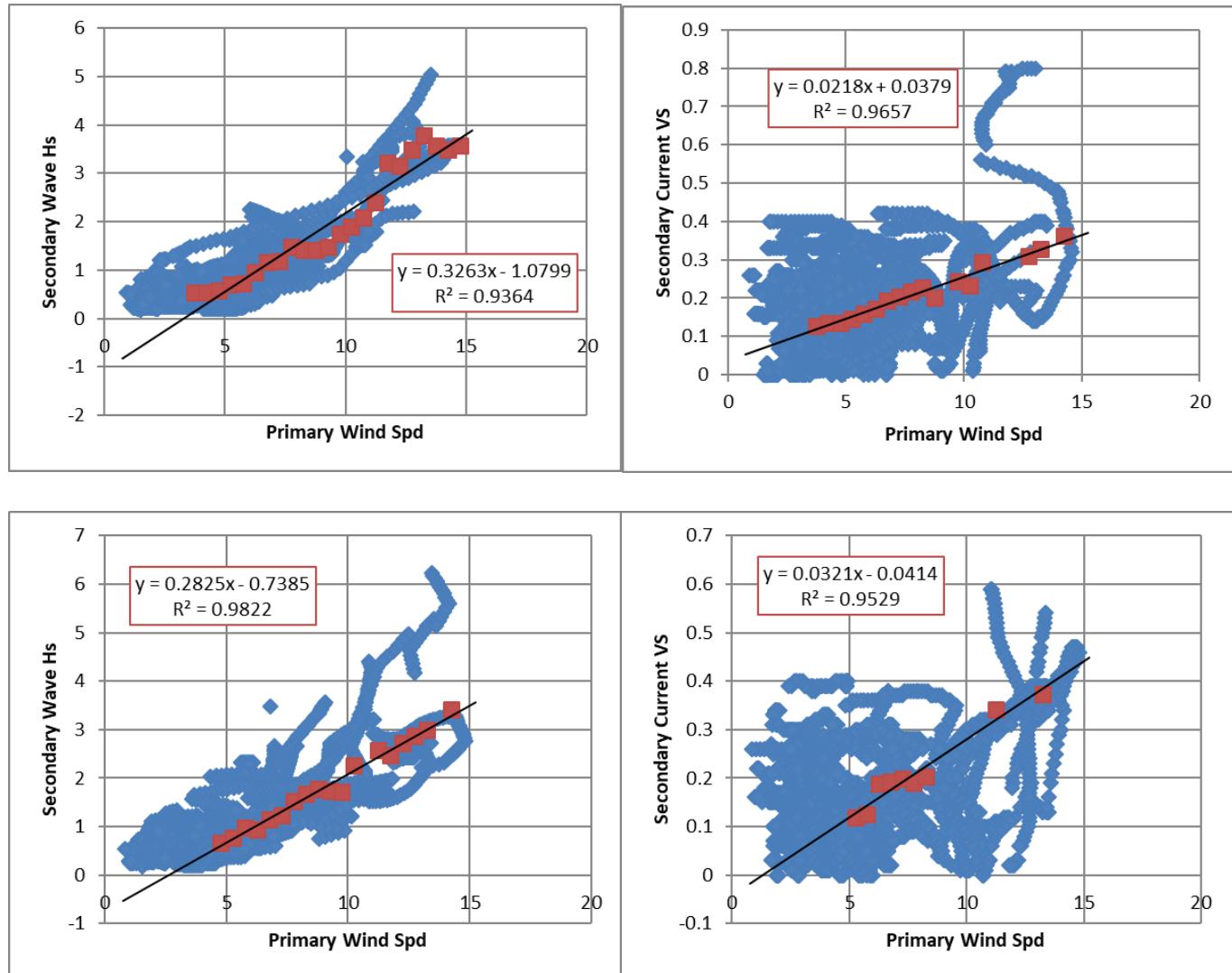


Figure 9.57 Off-Peak Hurricane Associated Significant Wave Height and Current Speed for Primary Wind – W and NW (from top to bottom).

9.5.3.3 Current Speed Associated Parameter Plots by Directional Sector

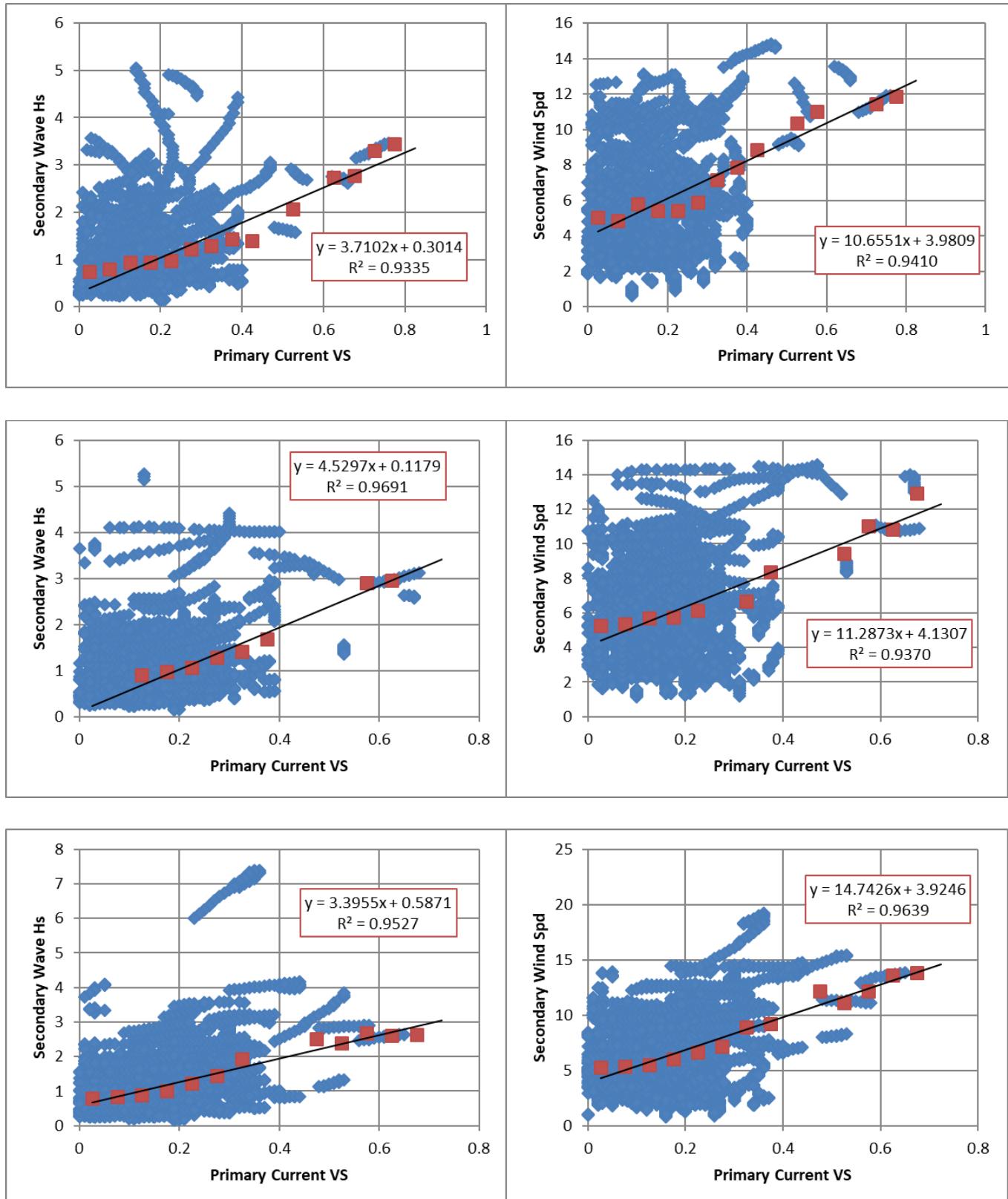


Figure 9.58 Off-Peak Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – N, NE and E (from top to bottom).

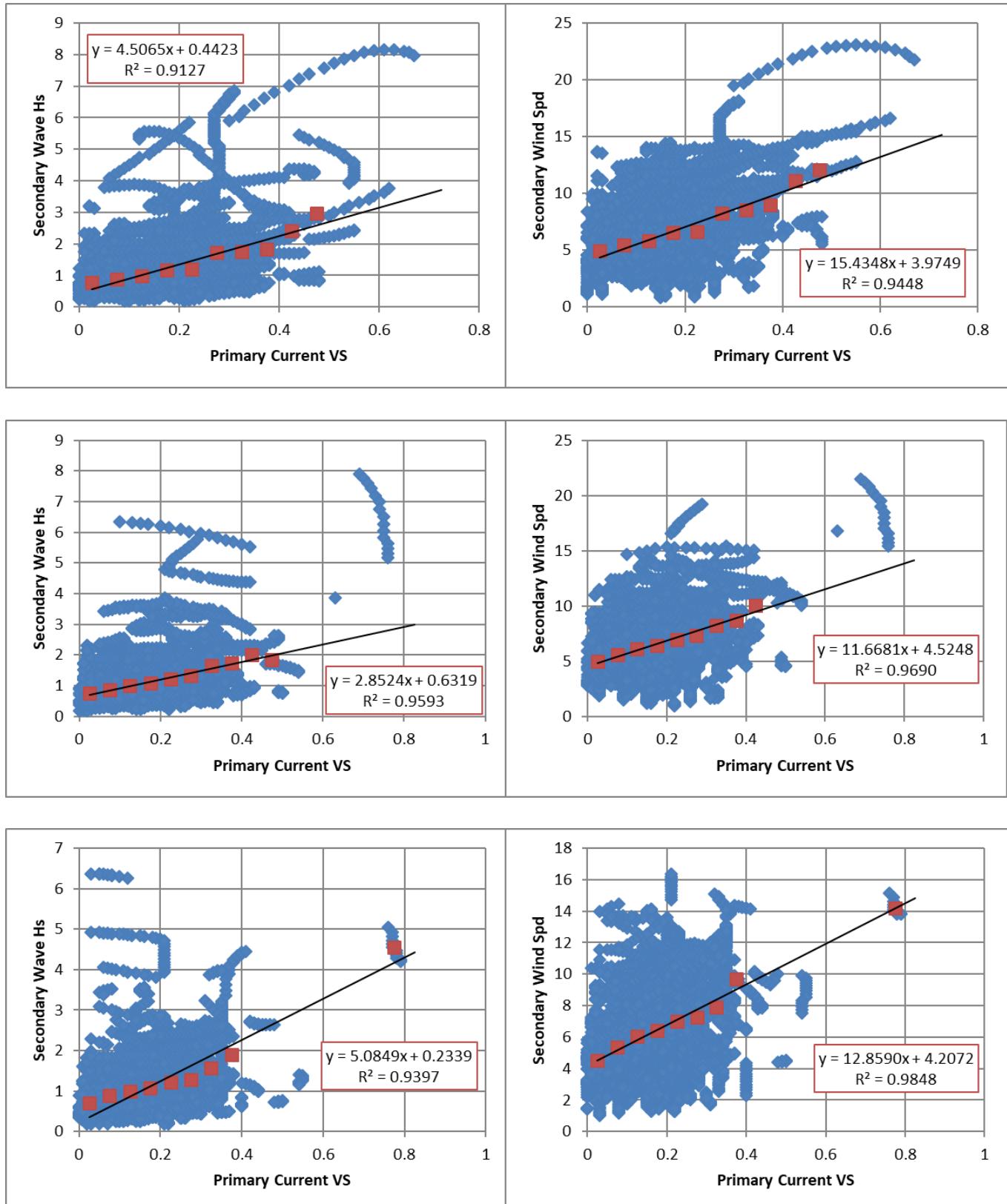


Figure 9.59 Off-Peak Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – SE, S and SW (from top to bottom).

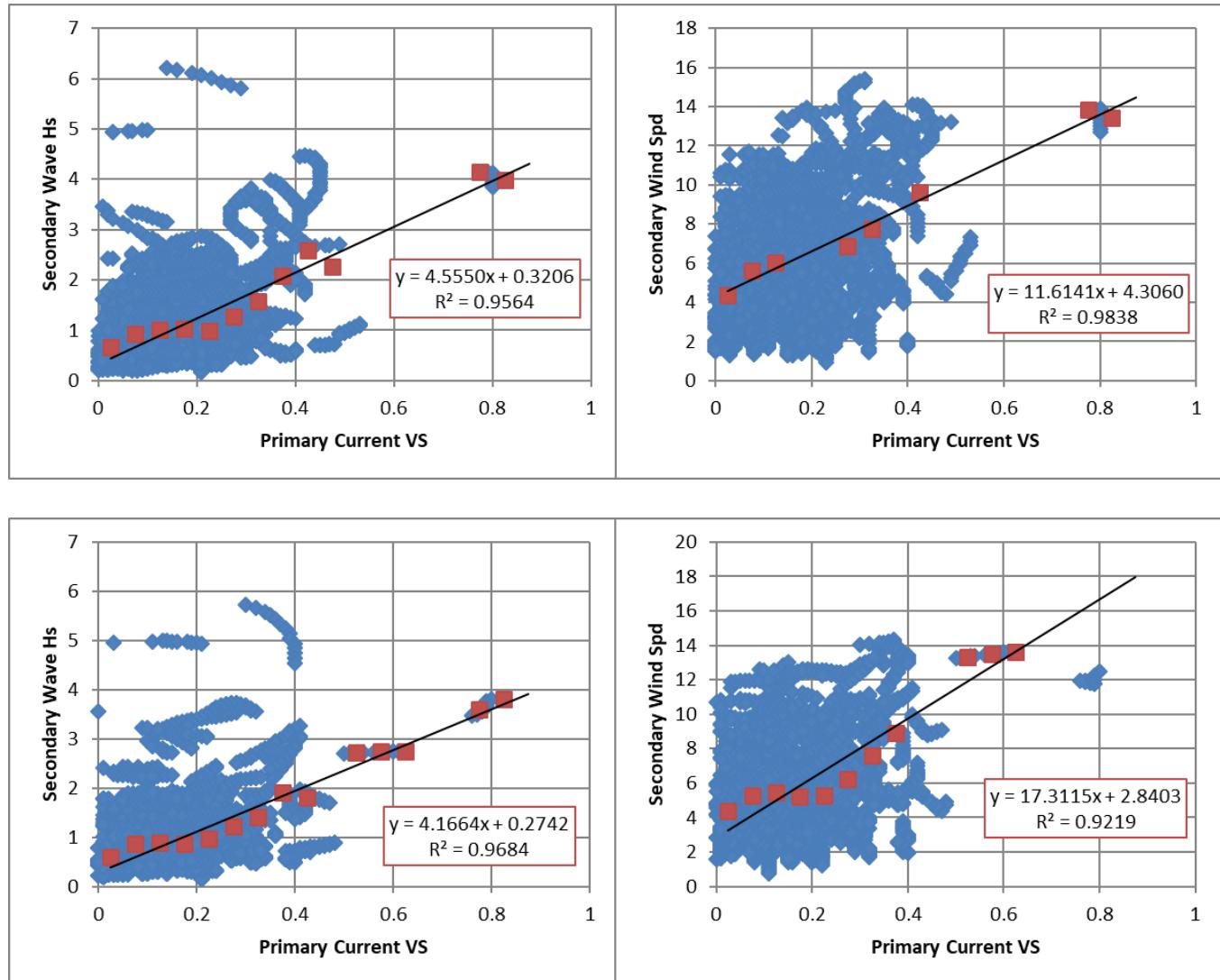


Figure 9.60 Off-Peak Hurricane Associated Significant Wave Height and Wind Speed for Primary Current – W and NW (from top to bottom).

9.5.4 Associated Tp

Off-peak hurricane associated Tp is derived using a relatively small sample population. The off-peak hurricane populations typically do not include larger values of Hs that are more commonly found with more severe storms occurring during the excluded months of this analysis within the Gulf of Mexico. This may lead to the potential for the overestimation of Tp values at higher return periods when extrapolation is needed.

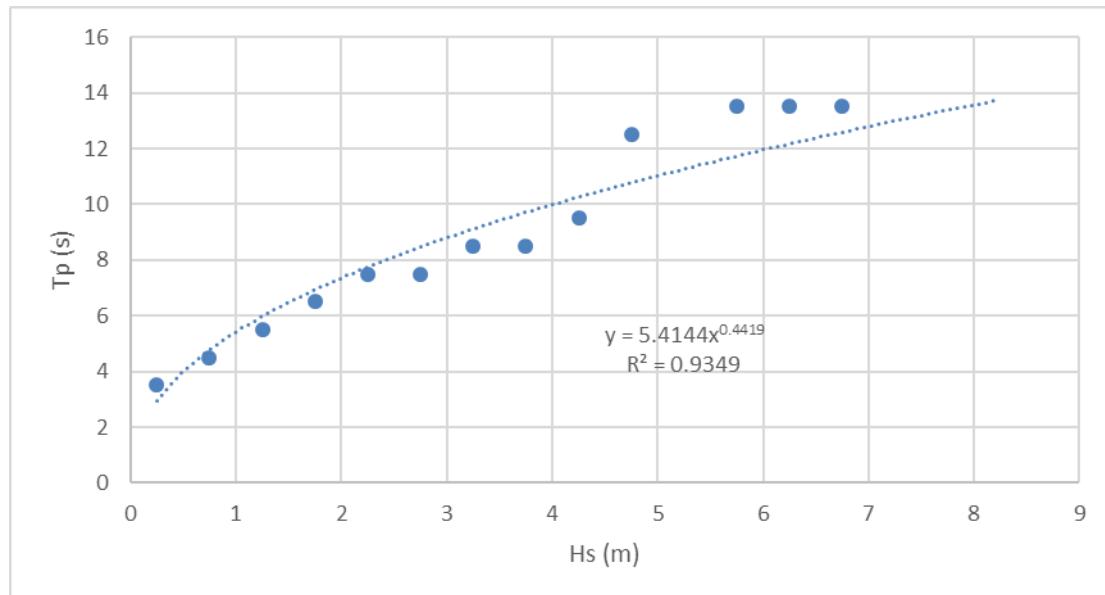


Figure 9.61 Off-Peak Hurricane Regression Analysis; Hs vs. Tp-mode.

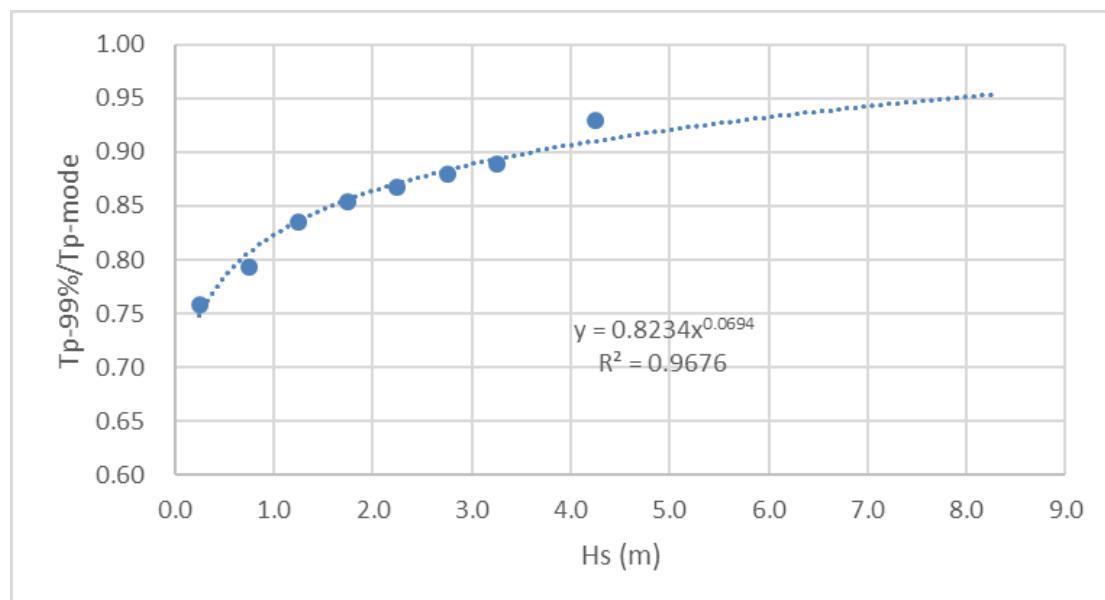


Figure 9.62 Off-Peak Hurricane Regression Analysis Tp low; Hs vs. Tp-99% exceedance/Tp-mode.

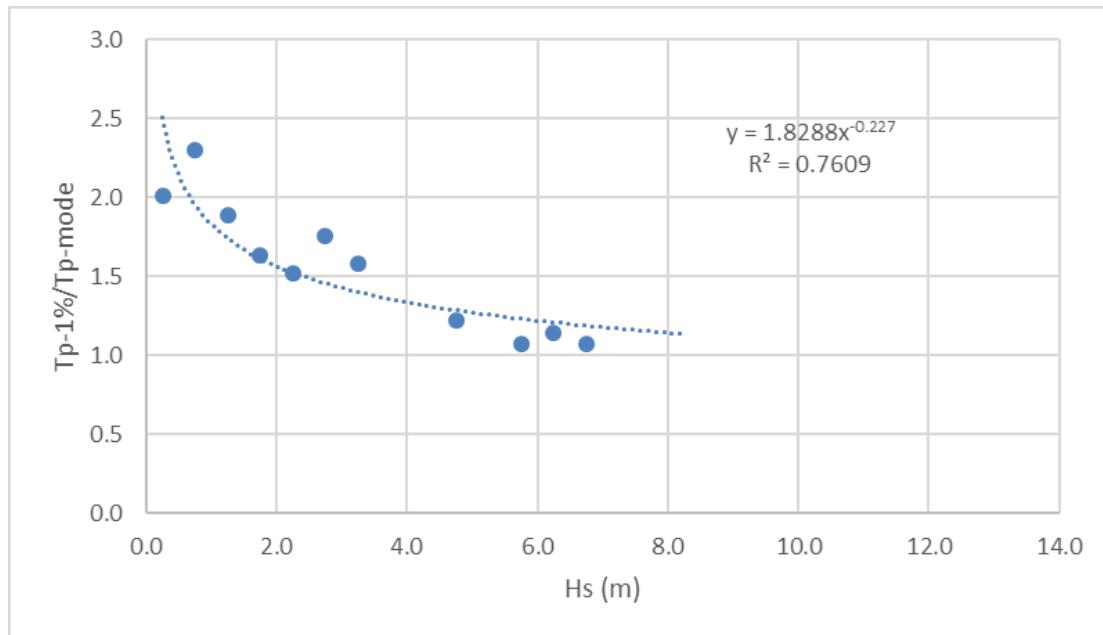


Figure 9.63 Off-Peak Hurricane Regression Analysis Tp high; Hs vs. Tp-1% exceedance/Tp-mode.

9.5.5 Associated Hc and Hmax

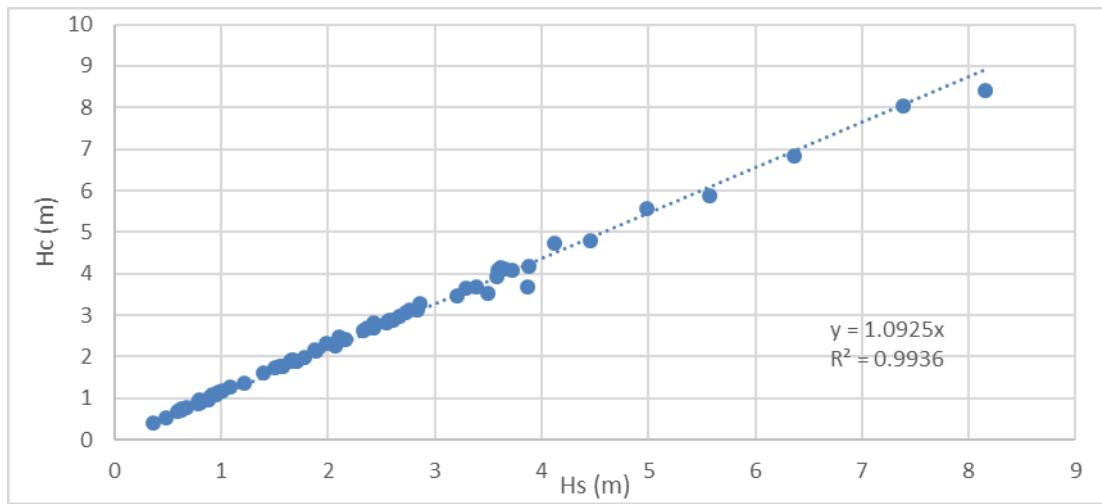


Figure 9.64 Off-Peak Hurricane Regression Analysis; H_s vs H_c .

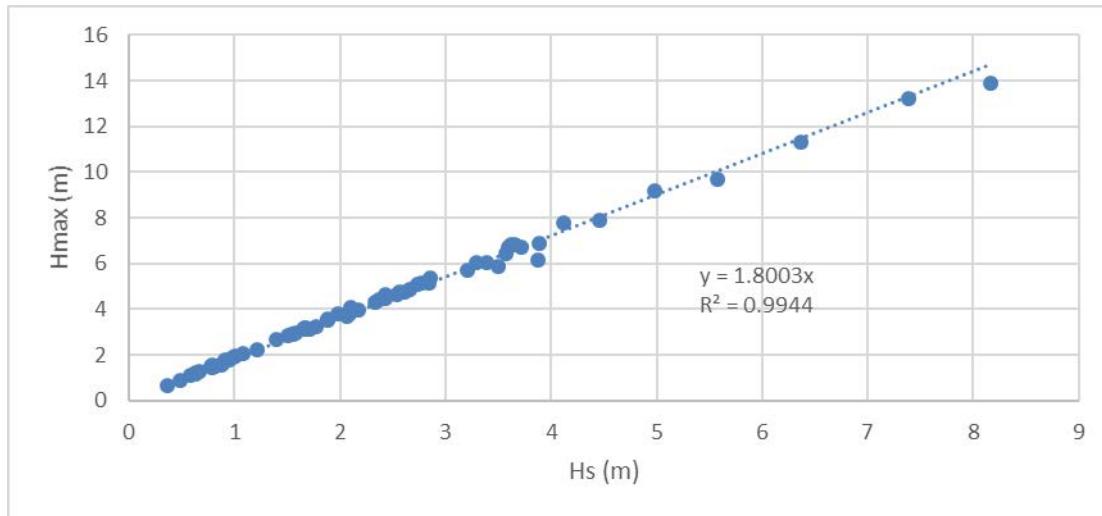


Figure 9.65 Off-Peak Hurricane Regression Analysis; H_s vs H_{max} .

9.5.6 Associated THmax

The associated THmax values presented in the Off-Peak Hurricane criteria tables have been derived based on a $0.9 \times T_p$ relationship.

9.5.7 Associated JONSWAP Peak Enhancement Factor

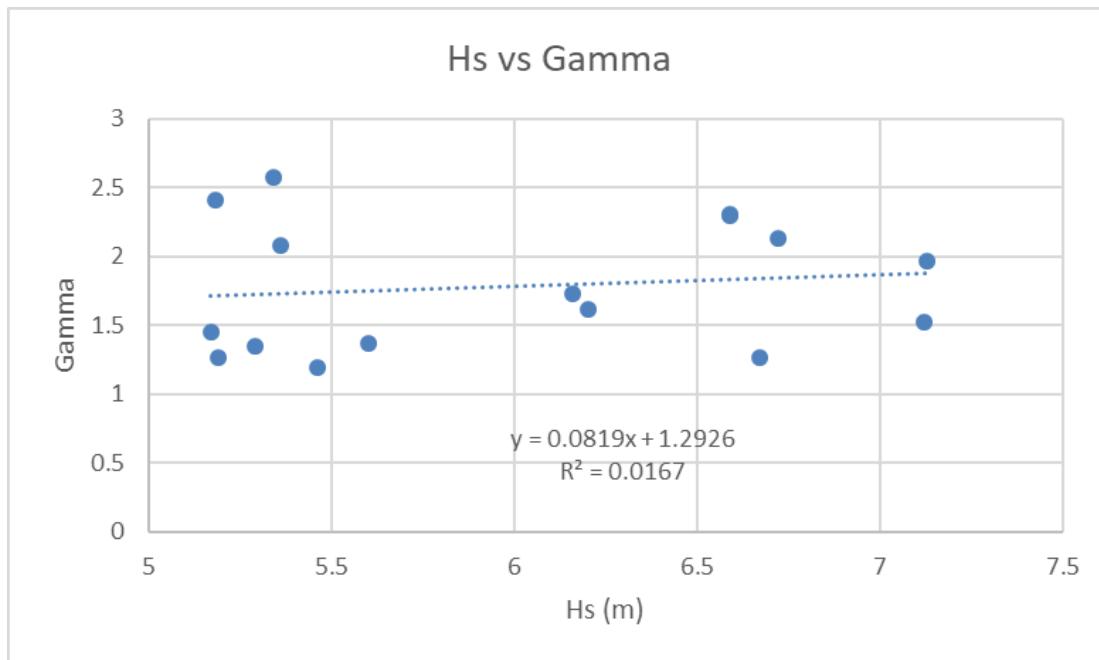


Figure 9.66 Off-Peak Hurricane Regression Analysis; Hs vs gamma.

9.5.8 Angular Difference

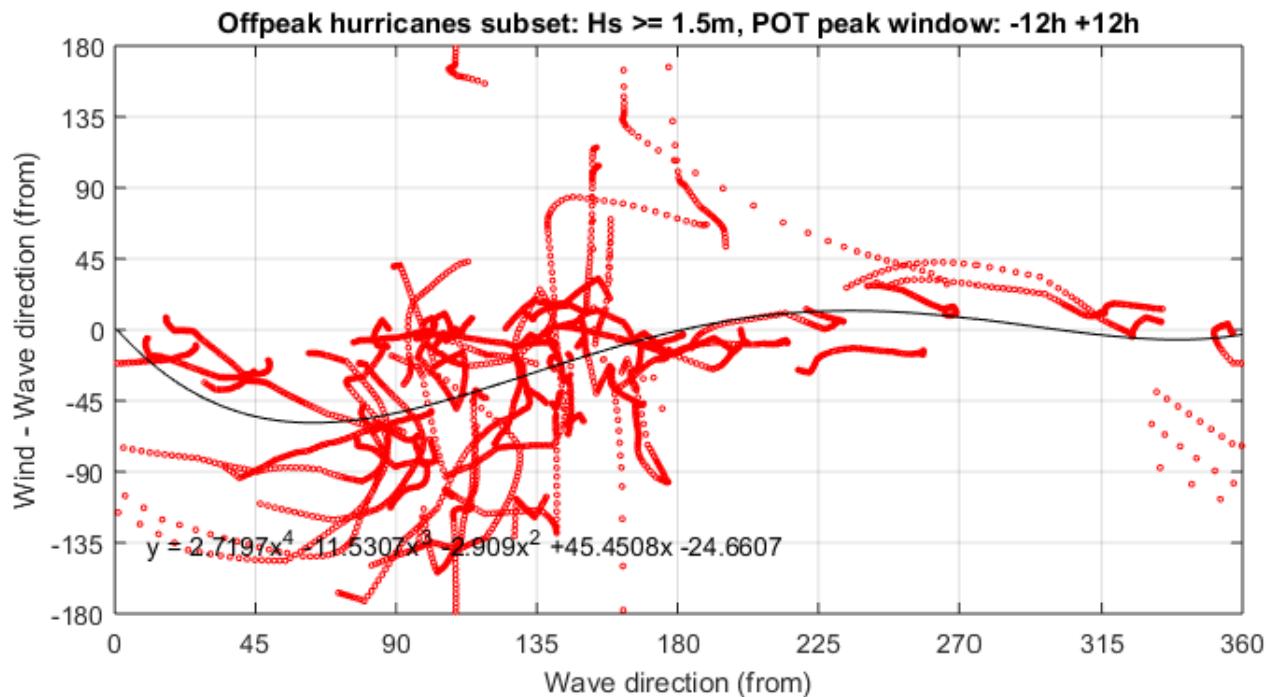


Figure 9.67 Regression Analysis: Wind and Wave Angular Difference, Off-Peak Hurricane Wave Primary.

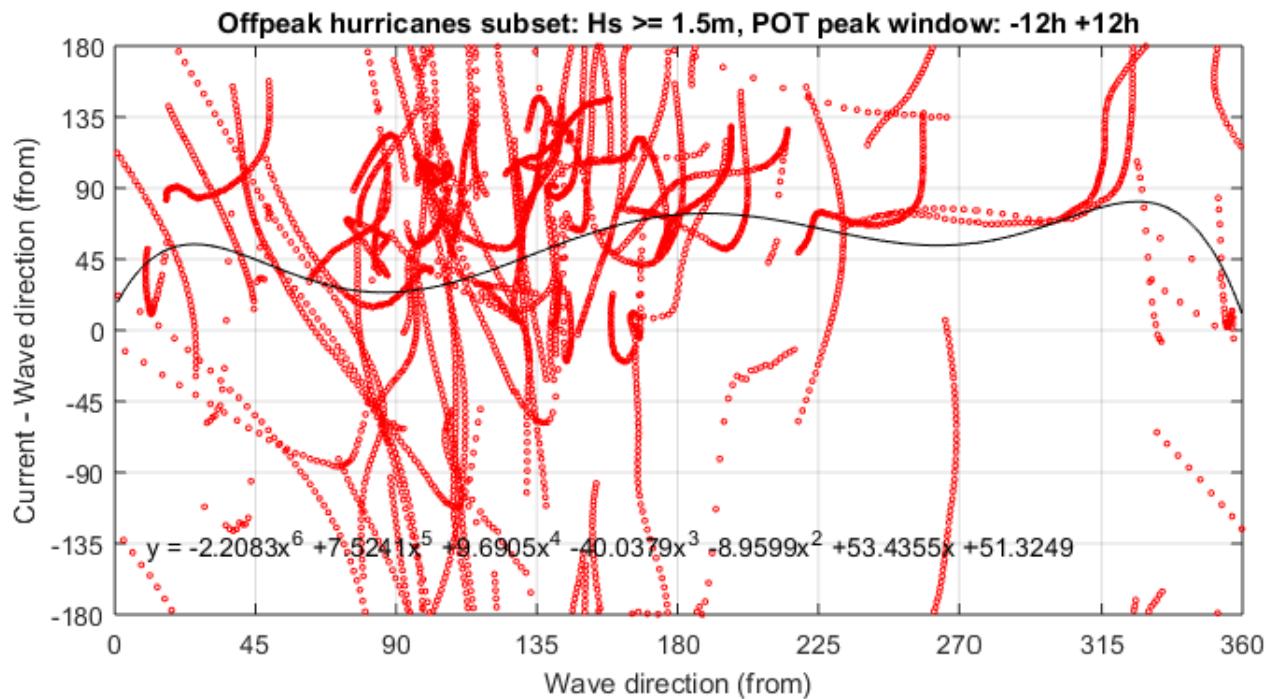


Figure 9.68 Regression Analysis; Current and Wave Angular Difference, Off-Peak Hurricane Wave Primary.

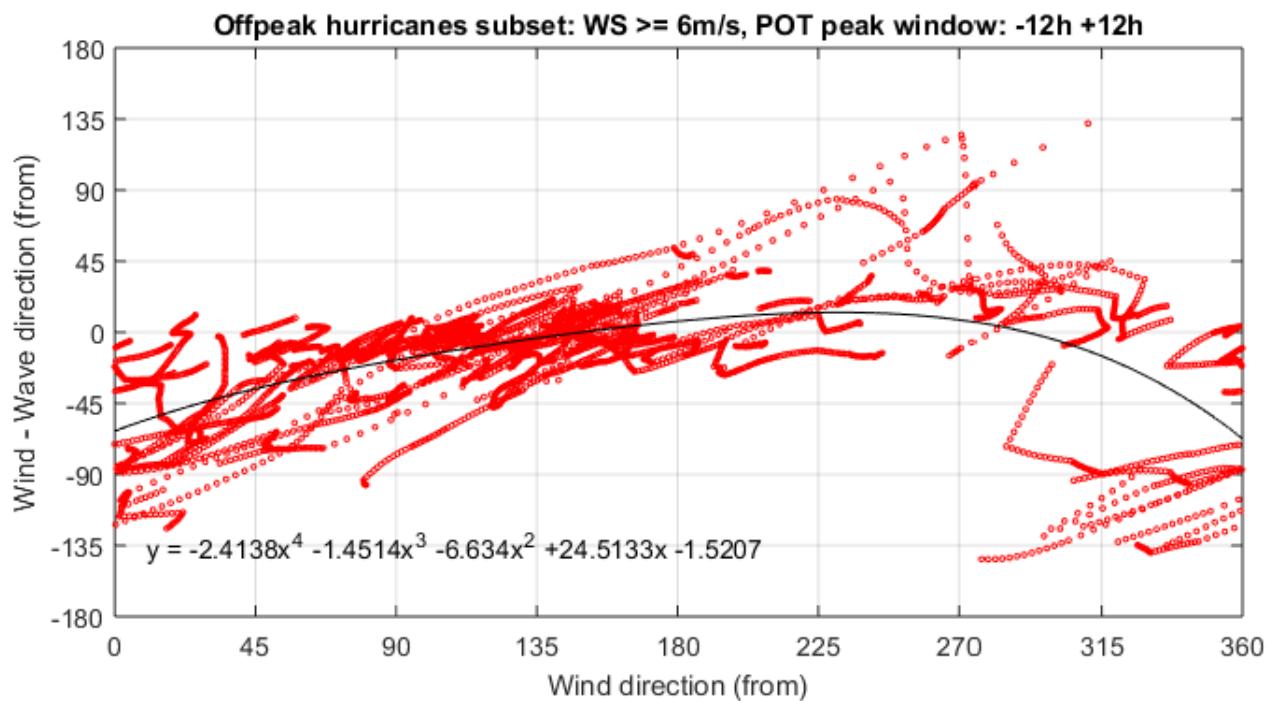


Figure 9.69 Regression Analysis: Wind and Wave Angular Difference, Off-Peak Hurricane Wind Primary.

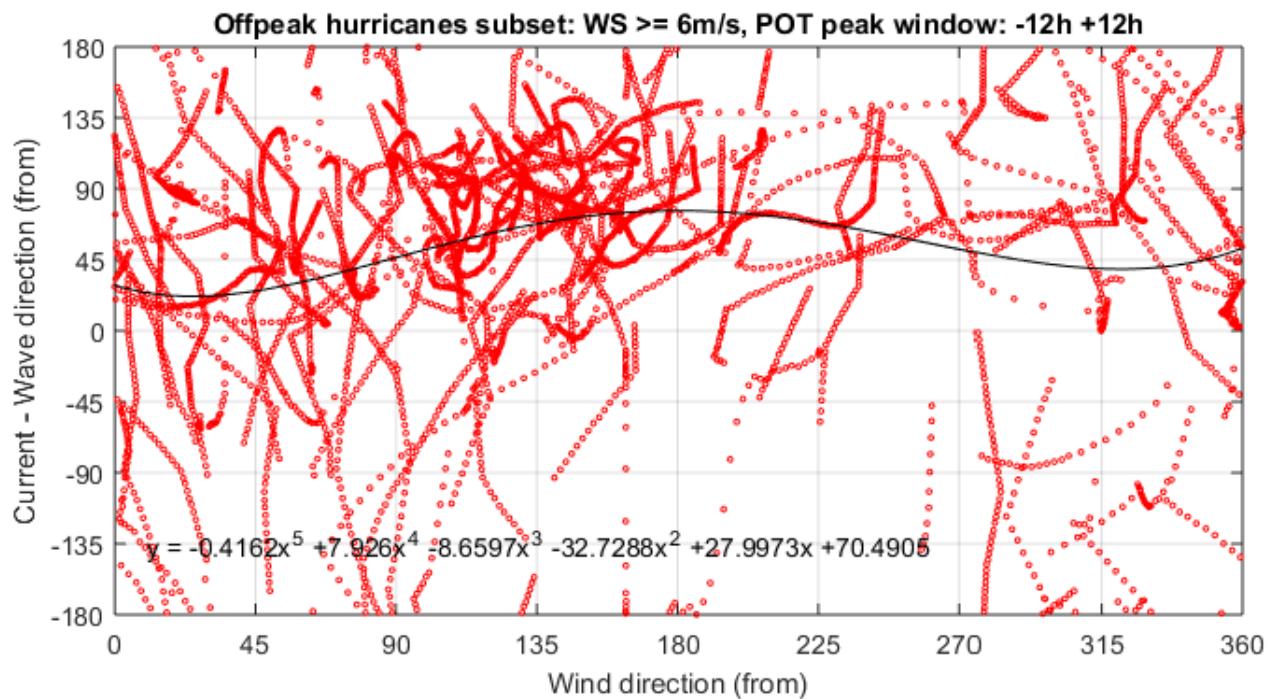


Figure 9.70 Regression Analysis; Current and Wave Angular Difference, Off-Peak Hurricane Wind Primary.

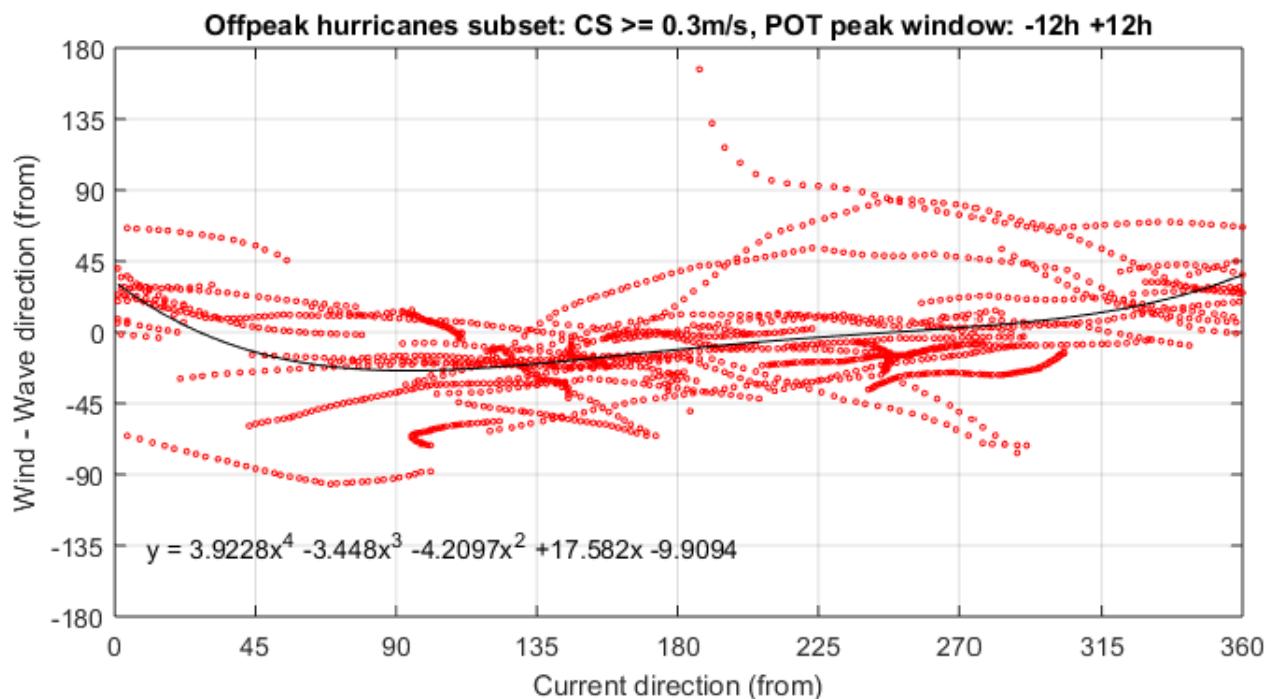


Figure 9.71 Regression Analysis: Wind and Wave Angular Difference, Off-Peak Hurricane Current Primary.

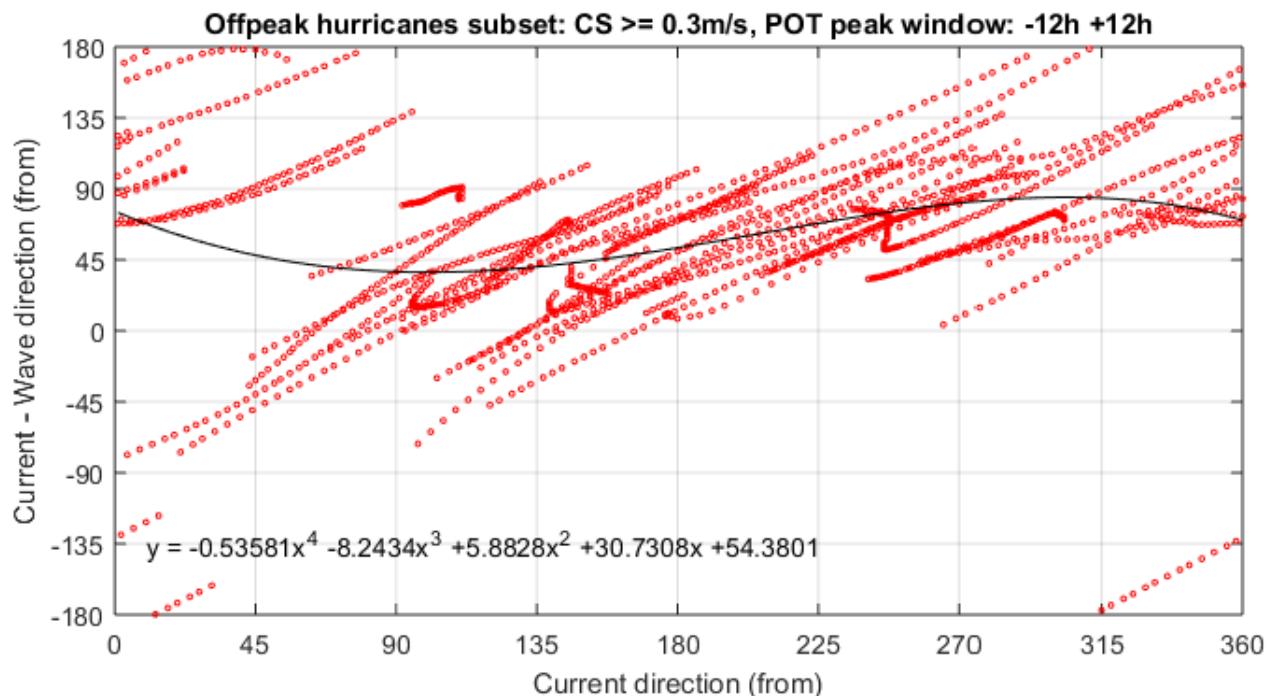


Figure 9.72 Regression Analysis; Current and Wave Angular Difference, Off-Peak Hurricane Current Primary.

9.5.9 Wind Profile

Wind profile for Off-Peak Hurricanes is calculated similarly to the methodology for hurricanes (Section 9.3.12).

9.5.10 Current Profile

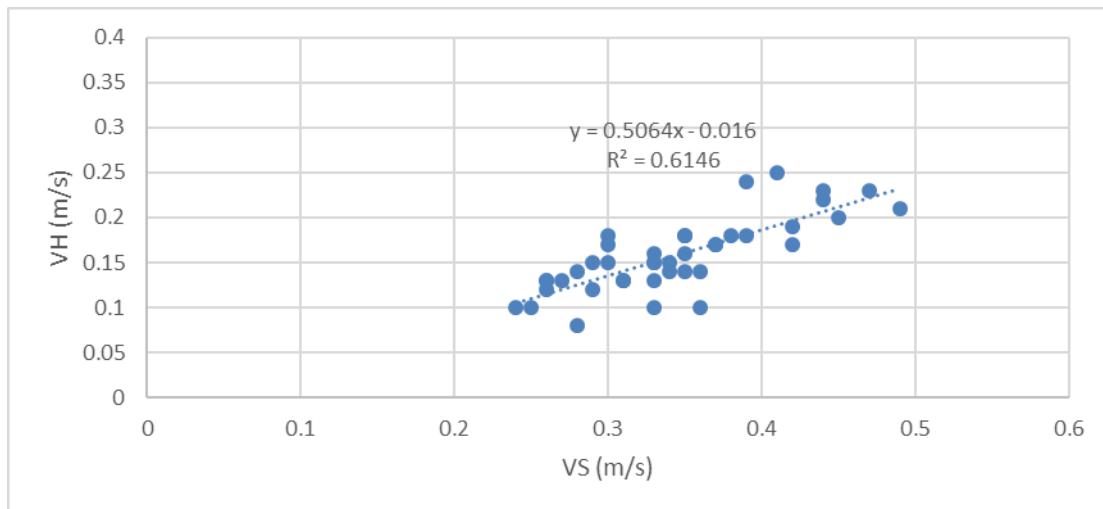


Figure 9.73 Regression Analysis; Hurricane Surface current speed vs mid depth current speed.

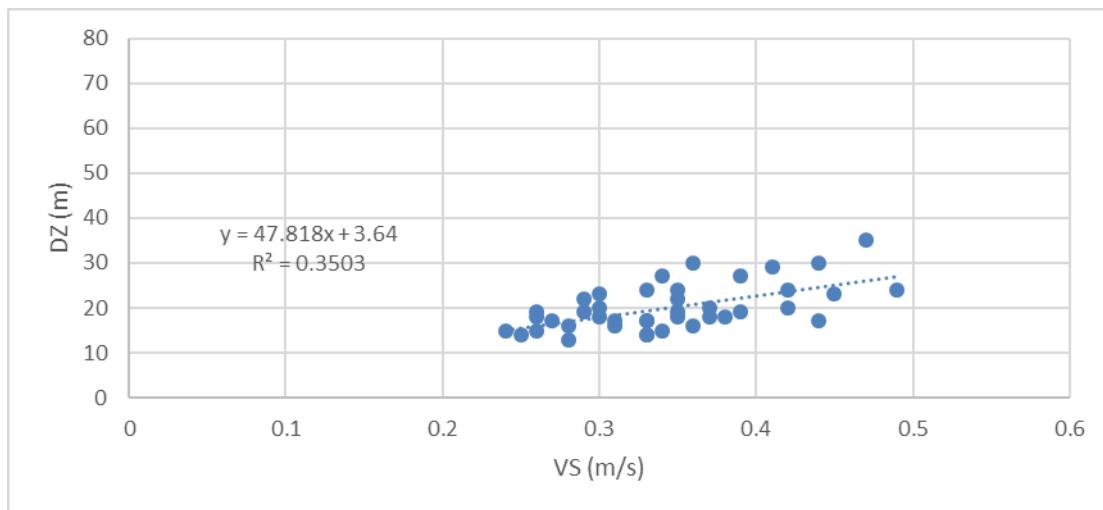


Figure 9.74 Regression Analysis; Hurricane Surface current speed vs depth of zero speed.

10. WINTER STORM CRITERIA METHODOLOGY

10.1 Winter Storm Criteria Derivation

The 1-, 10- and 100-year Winter Storm criteria were derived from the GOMOS2014 dataset using the methodology described in the following sections.

10.2 Omni-directional Independent Criteria

The independent omni-directional Winter Storm wind, wave and current cases were based on analysis of hindcast data from one GOMOS2014 point near the site of interest. Extreme value analysis was carried out on a subset of peak winter storm wind speeds and wave heights from the GOMOS2014 data. The analysis considered 110 storm events from 1950 to 2014.

The Peaks Over Threshold (POT) method consisted of declustering the data by selecting peak events to produce a set of independent and identically distributed observations. This method was then employed to derive the 1-, 10- and 100-year criteria. The number of peaks exceeding a given level, divided by the number of years of record, gave the rate of exceedance which could then be used to find the expected number of occurrences in a specified period of time.

The Exponential (EXP), Fisher-Tippett 1 (FT1), Generalized Pareto (GP), and Weibull 3 (W3) distributions were tested for goodness-of-fit to the GOMOS2014 data using the method of least squares (LS), maximum likelihood (MLE) or the method of moments (MoM). The best fits for 1-, 10-, and 100-year wave height and wind speed are summarized in Table 10.1.

Table 10.1 Winter Storm Extreme Omni-directional Winds and Waves.

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values		
					1-year	10-year	100-year
Total Hs (m)	W3	LS	2.96	90	3.53	5.50	6.94
Ws 1-hr (m/s)	W3	LS	14.19	90	15.30	20.46	24.72

To complete the omni-directional hurricane cases, associated parameters were derived. These included peak period (T_p), maximum wave height (H_{max}), crest height (H_c) and additional current variables.

10.3 Directional Independent Criteria

Directional criteria are given in Table 10.2 and a detailed description of the computations is presented below.

Winter Storm hindcast data from the selected GOMOS2014 grid point were separately partitioned into eight equal directional sectors for each month on the basis of wave and wind direction. The maxima of the grid point from each directional sector for each month were selected and used to estimate a single set of maximum directional relative magnitudes for each month. The highest of the relative magnitudes for each directional sector, regardless of the month of occurrence, was then selected as the all year relative magnitude for that directional sector.

In order to derive the directional extreme significant wave heights and wind speed the 1-, 10-, and 100-year return periods, the relative magnitudes were then applied to the n-year extreme criteria.

Table 10.2 Relative Magnitude of GOMOS2014 Winter Storm Significant Wave Height and Wind Speed by Direction.

GRID POINT / parameter	N	NE	E	SE	S	SW	W	NW
E4037419 / Significant Wave Height	0.55	0.81	1.00	0.88	0.63	0.66	0.66	0.96
E4037419 / Wind Speed	0.70	0.75	0.85	0.66	0.62	0.61	0.67	1.00

10.4 Associated Tp and Tz

Data from GOMOS2014 grid point E4037419 were used to create an omni-directional joint frequency distribution of Tp conditional on Hs and of Tz conditional on Hs. The mode of each conditional distribution was then estimated for each primary parameter class interval. The Winter Storm regression analysis of Tp-mode against Hs and of Tz-mode against Hs are shown in Figure 10.1 and Figure 10.2, respectively.

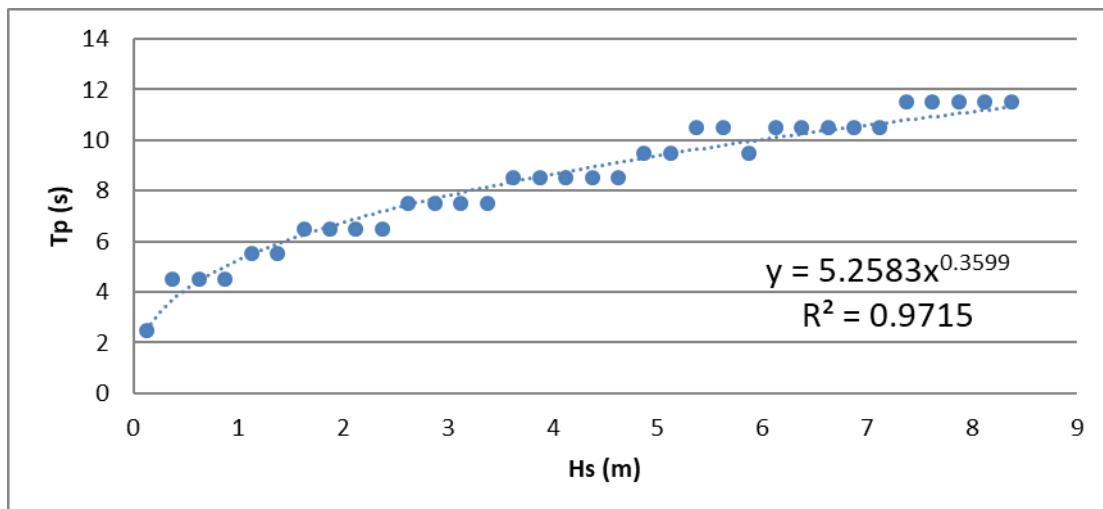


Figure 10.1 Winter Storm Regression Analysis; Hs vs. Tp-mode.

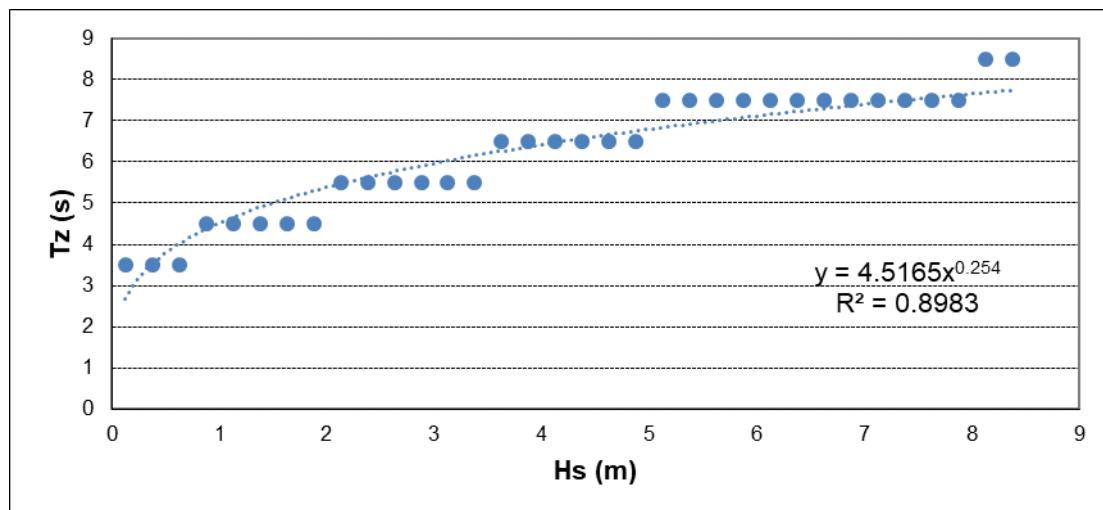


Figure 10.2 Winter Storm Regression Analysis; Hs vs. Tz-mode.

10.5 Associated H_{max} and H_c

Time series data from GOMOS2014 dataset grid point E4037419 were processed using the EXWAN program to produce a representative crest height for each individual storm. The ratio of crest heights to the highest H_s recorded in each storm was then calculated. A regression equation was then developed and used to derive the respective crest heights. Figure 10.3 shows the Winter Storm regression analysis of H_s vs H_c.

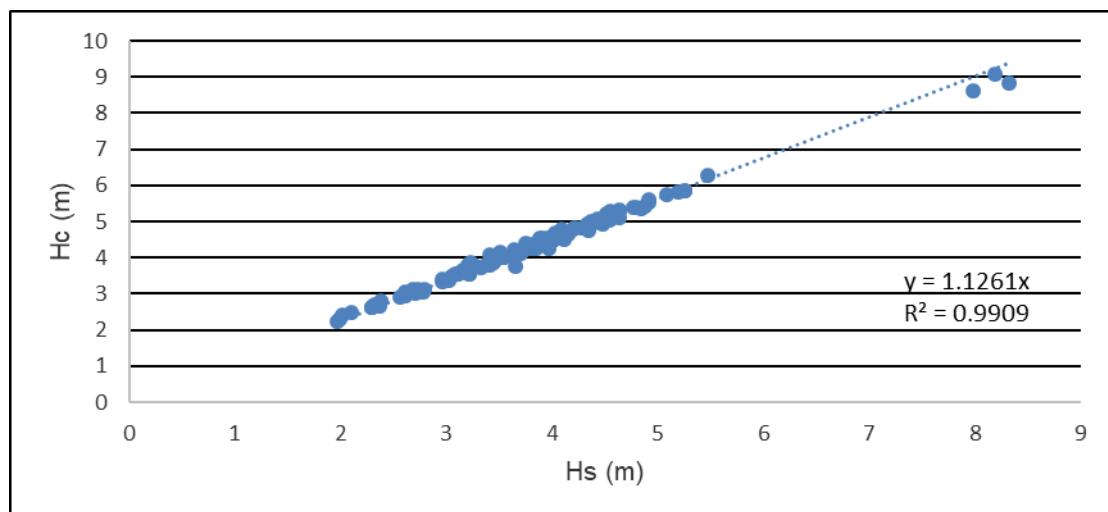


Figure 10.3 Winter Storm Regression Analysis; H_s vs H_c.

The maximum wave height was calculated using EXWAN and the 2-parameter Weibull distribution proposed by Forristall. The values used for A and B were the Forristall default values for A and B, 2.13 and 8.42 respectively. As with the crest heights, the ratio of maximum heights to the highest H_s recorded in each storm was then calculated. A regression equation was then developed and used to derive the respective maximum wave heights for each significant wave height. Figure 10.4 shows the Winter Storm regression analysis of H_{max} vs H_s.

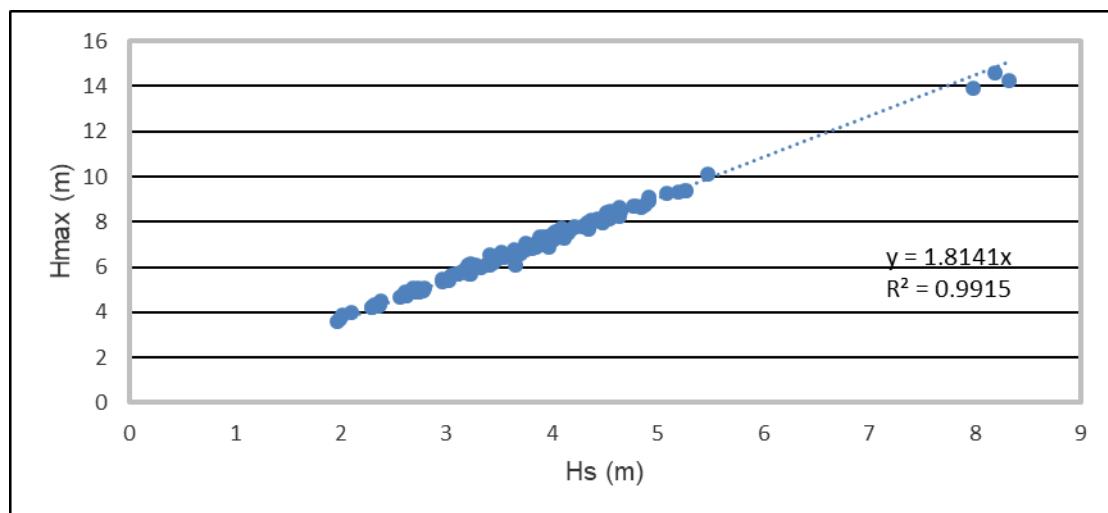


Figure 10.4 Winter Storm Regression Analysis; H_s vs H_{max}.

10.6 Associated THmax

The associated THmax values presented in the Winter Storm criteria tables have been derived based on a $0.9 \times T_p$ relationship.

10.7 Associated Wind Speed

The data from GOMOS2014 grid point E4037419 were used to create an omni-directional joint frequency distribution of WS conditional on Hs. The mode of each conditional distribution was then estimated for each primary parameter class interval. A scatter plot was generated and a trend-line fitted in order to define the relationship between the two parameters over a given range of wave heights. Figure 10.5 shows that relationship.

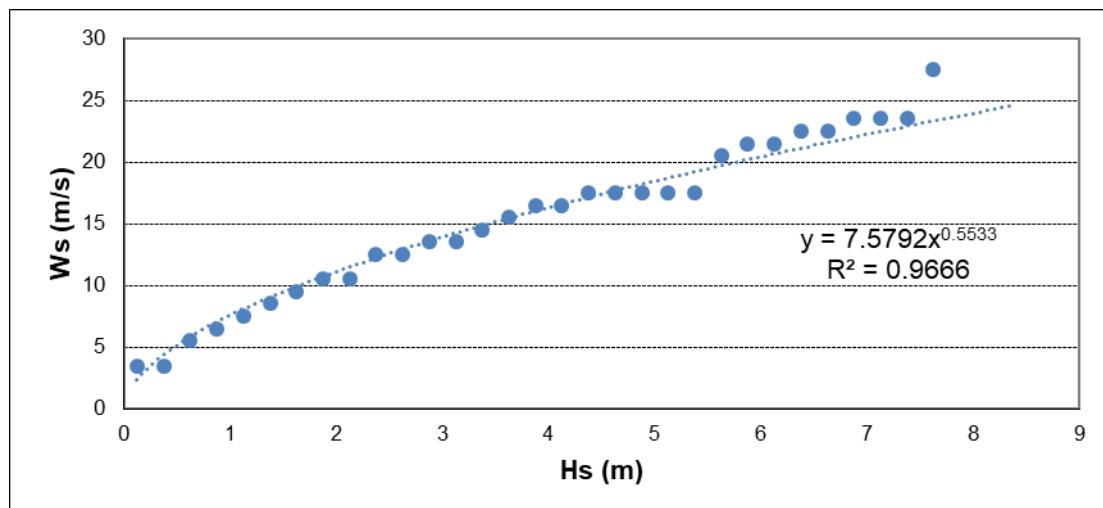


Figure 10.5 Winter Storm Regression Analysis; Hs vs Wind Speed.

10.8 Associated Surface Current

For the non-directional case, the recommended surface current speed has been taken as 1.5% of the wind speed as per Det Norske Veritas guidelines (DNV 2007).

Please note that all surface current statistics represent the storm-driven current component only. They do not include any background current component. A background current of 0.2 knots may be added as per API guidelines.

10.9 Associated Current Profiles

Associated current profiles can be derived following two options, linear decay and slab, recommended by API and DNV guidelines. Both the linear decay and slab profiles would start with the associated surface current speed calculated using the methodology described in the previous section and extend down to a depth of 50 m for which wind driven currents are representative.

10.9.1 Linear Decay Profile

A linear decay profile can be attained using the associated surface current speed and linear decay down to a depth of 50 m. The mid-depth current speed of this layer is equal to half of the associated surface current speed and found at 25 m water depth.

10.9.2 Slab Profile

A slab profile assumes a layer of constant current speed equal to the associated surface current speed down to a depth of 50 m. The current speed below this level is assumed to be zero.

10.10 Extreme Winter Storm Event Duration and History

Winter Storm histories for the 20 most severe events at GOMOS2014 grid point E4037419 were considered in the analysis. Time series of wave height and wind speed for individual storms were organized such that the maximum Hs or Ws for each event represented effective time zero. This allowed the build-up and decrease to be normalized for all identified storm events. Figure 10.6 and Figure 10.7 display the wave and wind magnitudes of the events examined.

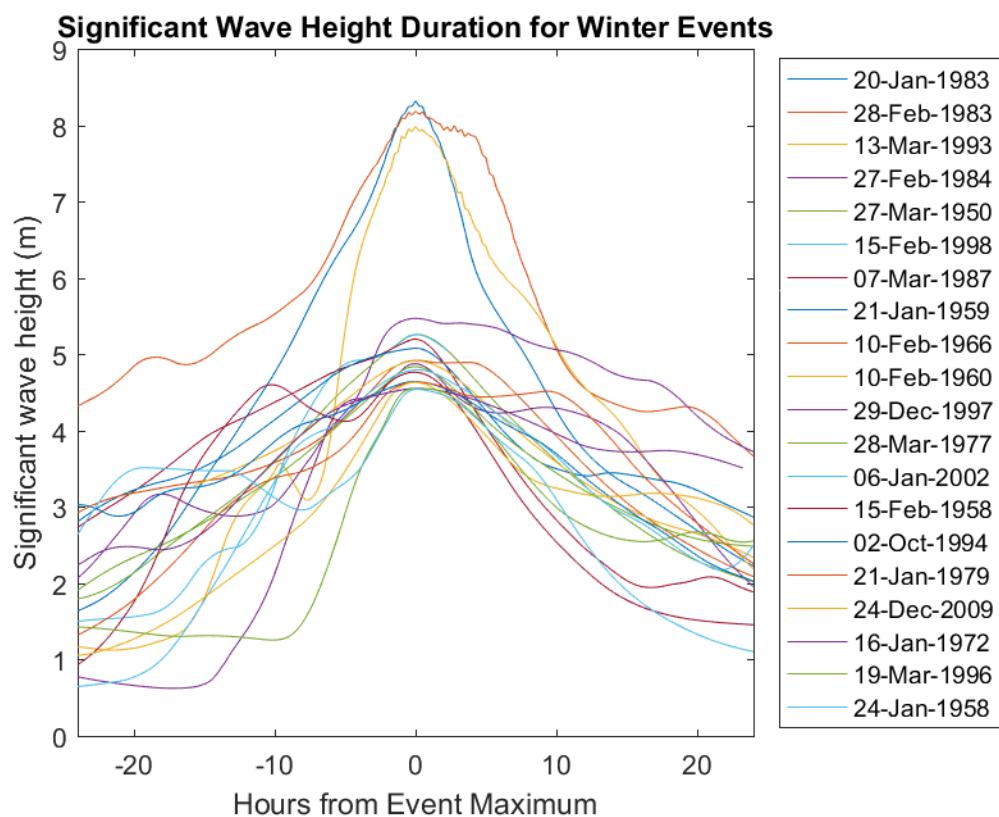


Figure 10.6 GOMOS2014 E4037419 Winter Storm Events Considered for Hs Duration Analysis.

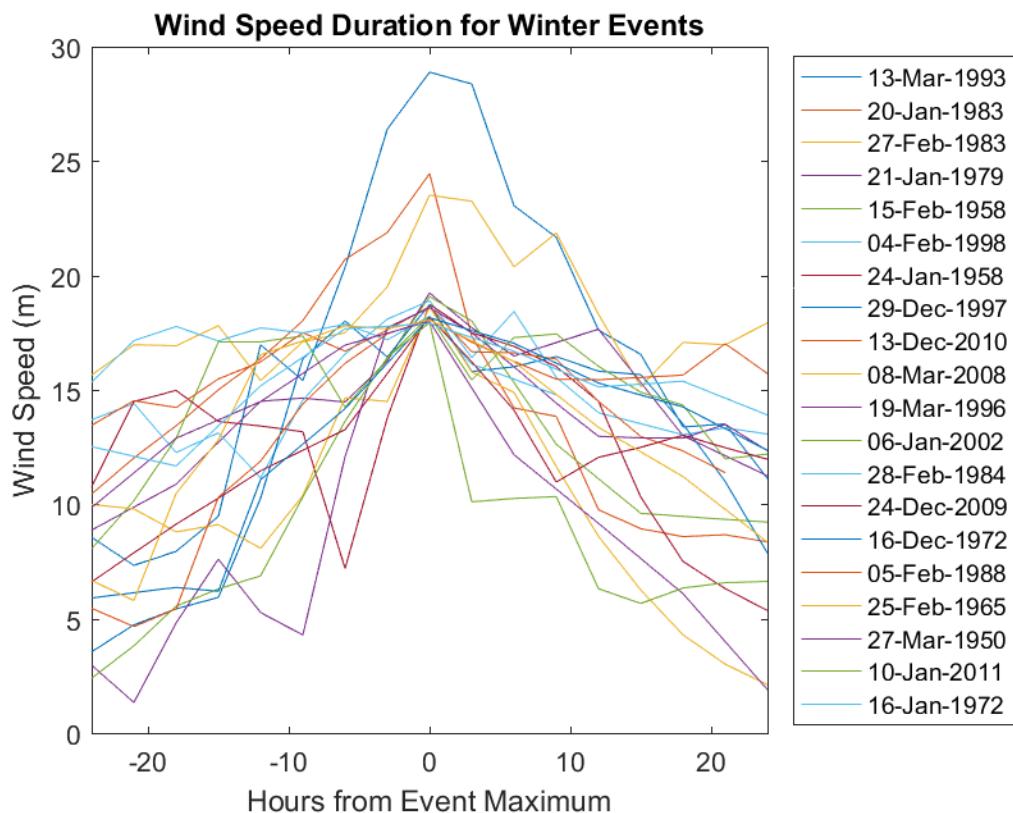


Figure 10.7 GOMOS2014 E4037419 Winter Storm Events Considered for Ws Duration Analysis.

11. LOOP CURRENT CRITERIA METHODOLOGY

The 1-, 10-, 25-, 50- and 100-year Loop Current Eddy (LCE) criteria were derived from the GEM42 dataset using the methodology described in the following sections.

11.1 GEM42 Simulations

The GEM42 model was run for the site of interest and for three additional locations located 30km to the west, south and east of the site, respectively. Results from GEM42 are based on simulations of 91 Loop Current / Loop Current Eddy (LC/LCE) events observed from 1985 to 2016. Table 11.1 below shows a complete list of the LC/LCE events that were simulated, along with the period for which they were modelled.

Table 11.1 GEM42 Eddy List.

Eddy	Start Date	End Date	Eddy	Start Date	End Date
Fast-m	6-Feb-85	30-May-86	quick-m	7-Mar-02	3-Apr-03
HotCore-h	6-Sep-85	6-Dec-85	Rebel-h	28-Mar-02	16-May-02
X8585M-e	11-Jan-85	8-Apr-85	Sargassum-h	6-Feb-03	31-Dec-03
X8586M-e	6-Feb-85	8-Mar-86	Titanic-h	25-Sep-03	14-Oct-04
X8687M-e	23-Jun-86	29-Apr-87	Ulysses-h	6-May-04	8-Sep-05
LittleJupiter-h	30-Apr-87	14-Aug-87	Vortex-h	17-Feb-05	2-Feb-06
Unnamed-h	20-Feb-87	15-May-87	Walker-h	22-Sep-05	18-May-06
L-h	8-Apr-88	1-Jul-88	Xtreme-h	2-Mar-06	7-Sep-06
XMURPH-e	16-Mar-88	7-Apr-89	Yankee-h	13-Jul-06	29-Nov-07
Nelson-hx	1-Jan-89	25-May-90	Albert-h	6-Sep-07	16-Jan-08
Oggie-h	23-Jun-89	28-Jul-89	Zorro-h	12-Mar-07	5-Sep-07
Phantom-h	10-Nov-89	22-Dec-89	Albert-north-h	17-Jan-08	3-Mar-08
Rogue-h	24-Aug-90	21-Nov-90	Albert-south-h	16-Jan-08	27-Mar-08
Steady-h	16-Nov-90	29-Mar-91	Brazos-h	17-Jan-08	25-Sep-08
XQUIET-e	8-Jan-90	23-Nov-90	Cameron-h	5-May-08	24-Mar-09
Triton-hx	15-Feb-91	31-Mar-92	Darwin-h	1-Oct-08	6-Nov-09
Unchained-h	4-Sep-92	28-May-93	Ekman-h	2-Jul-09	4-Mar-11
Vasquez-wg	4-Sep-92	29-Jun-93	Loop_DtoE-h	1-Mar-09	1-Jul-09
Whopper-hx	9-Apr-93	20-May-94	Loop_EtoF-h	7-Aug-09	18-May-10
xtra-m	17-Sep-93	6-May-94	Franklin-h	19-May-10	18-Oct-11
XWHOP-m	8-Jun-93	20-May-94	Loop_FtoG-h	23-May-10	21-Apr-11
Yucatan-hx	15-Jul-94	27-Jan-95	Galileo-h	21-Apr-11	6-Jan-12
Aggie-hx	18-Aug-95	26-Jul-96	G-h	21-Apr-11	19-Jun-11
biloxi-m	22-Dec-95	13-Dec-96	Hadal-h	17-Jul-11	29-Feb-12
Unnamed-h	22-Dec-95	1-Mar-96	Icarus-h	8-Nov-11	11-Feb-13
XZAPP-e	16-Feb-95	8-Aug-95	Loop_GtoH-h	20-Jun-11	17-Jul-11
Creole-hx	7-Jun-96	30-May-97	Loop_HtoL-h	28-Jul-11	7-Nov-11
Devian-h	13-Dec-96	15-Aug-97	Jumbo_Jr-h	8-Sep-12	29-Nov-12
02-wg	22-Aug-97	13-Feb-98	Jumbo-h	14-Jun-12	26-Feb-13
Fourchon-h	12-Dec-97	1-Aug-98	Loop_ItoJ-h	13-Feb-12	13-Jun-12
eldora-m	23-May-97	7-Nov-98	Loop_ItoJ-h_north	13-Feb-12	13-Jun-12
gyre-m	8-May-98	26-Feb-99	Kraken-f	4-Apr-13	8-Apr-14

Haskell-h	2-Jul-99	12-Aug-99	Loop_JtoK-h	8-Jan-13	12-Mar-13
Jugger-m	26-Aug-99	9-Nov-00	Loop_JtoK-h_north	8-Jan-13	12-Mar-13
Unnamed-h	11-Jan-99	23-Jul-99	Loop_KtoL-f	9-Dec-13	2-Jul-14
indigo-m	16-Jul-99	9-Dec-99	Loop_LtoM-f	14-Nov-14	4-Mar-15
02-wg	30-Mar-00	4-Jan-01	Loop_MtoN-f	5-Mar-15	4-May-15
Kinetic-m	27-Apr-00	1-Feb-01	Loop_N2toO-f	20-Jun-15	16-Aug-15
Lazy-h	22-Jun-00	14-Sep-00	Loop_NtoN2-f	5-May-15	19-Jun-15
03-wg	19-Apr-01	24-May-01	Loop_OtoP-f	21-Oct-15	4-May-16
Millen-m	2-Feb-01	21-Nov-01	Lazarus-f	4-Jul-14	18-Jan-15
Nansen-h	19-Apr-01	14-Nov-01	Michael-f	5-Mar-15	17-May-15
Odessa-h	9-Aug-01	17-Jan-02	Nautilus2-f	20-Jun-15	26-Nov-15
pelagic-m	29-Nov-01	9-May-02	Nautilus-f	4-May-15	22-Oct-15
QE-2-h	2-May-02	17-Oct-02	Olympus-f	17-Aug-15	10-May-16
			Poseidon-f	5-May-16	16-Dec-16

At each of the selected sites, GEM42 produced discontinuous time series of daily averaged current profiles over the period of analysis (1985 to 2016). Each period represents a LC/LCE event that impacted the site. To account for diurnal variability, a separate program (GEM42-SIMPROFILE) was run to construct hourly time series of current profiles. Additionally, the simulation at each site were repeated ten times with different random numbers to account for possible changes in the LC and LCE shape. The final product was a group of 10 hourly simulations per site. Based on additional statistical analyses, the best simulation at each site was selected.

11.2 Omni-directional Criteria

Omni-directional extremes for LC/LCE surface currents were based on the selected simulations for each site. Extreme value analysis was carried out on a subset of peak LC/LCE surface currents. Peaks were selected based on a reset duration of 7 days and on a minimum threshold of 0.75 m/s (~1.5 knots). The peaks from each site were pooled together into a synthetic time series suitable for extreme value analysis. A series of distributions including exponential (EXP), Fisher-Tippet 1 (FT1), Generalized Pareto (GP) and Weibull 3 (W3) were tested for goodness-of-fit using the method of least squares (LS), maximum likelihood (MLE) and the method of moments (MoM). The best fit for 1-, 10-, 25-, 50- and 100-year surface current speed was selected and is presented in Table 11.2.

Table 11.2 LCE Extreme Omni-Directional Currents (All-Data).

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values				
					1-year	10-year	25-year	50-year	100-year
CS surface all-data (m/s)	EXP	LS	0.92	50	*	1.24	1.46	1.62	1.78

For the client location, the extreme value analysis did not result in reliable estimates of a 1-year extreme return period. That is due to the fact the client site is in a region where LC/LCE impact does not happen every year. Therefore, a 1-year return period is not provided.

The omni-directional criteria defined in this section includes all types of LC/LCE shear profiles, therefore it is referred to as a “all-data” condition. Criteria were also derived individually for three different shear profile cases: low-shear, medium-shear and high-shear. The shear profile analyses and respective extremes are described in the next section.

11.3 Definition of Shear Profile Cases and Omni-directional Extremes

LC/LCE surface currents may be characterized by vertical profiles that are variable in terms of vertical shear. Three shear profile cases may be defined: a low-shear case, a medium-shear case and a high-shear case. Each case is defined based on the ratio of current speed at 984 ft (300 m) depth to that at the surface. High shear profiles were those where $\text{Curr300m/Curr0m} > 0.52$, low-shear profiles were those where $\text{Curr300m/Curr0m} < 0.12$, and medium-shear profiles were those in between.

The GEM42 surface current results were sorted out according to the shear cases above. Individual extreme value analyses were conducted for each shear case similarly to the all-data criteria. Peak LC/LCE surface currents from each site were pooled together into a synthetic time series suitable for extreme value analysis. A series of distributions were tested for goodness-of-fit and the best fit for 1-, 10-, 25-, 50- and 100-year surface current speed was selected. Table 11.3 presents the selected fits and resulting return periods of extreme surface currents for each shear case.

Table 11.3 LCE Extreme Omni-Directional Currents (Shear Cases)

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values				
					1-year	10-year	25-year	50-year	100-year
CS surface low shear (m/s)	EXP	LS	0.30	100	*	0.62	0.76	0.86	0.97
CS surface medium shear (m/s)	W3	LS	0.45	150	*	1.29	1.55	1.73	1.92
CS surface high shear (m/s)	W3	LS	0.20	126	*	1.86	0.98	1.06	1.14

For the client location, the extreme value analyses did not result in reliable estimates of 1-year extreme return periods for each shear case. That is due to the fact the client site is in a region where LC/LCE impact does not happen every year. Therefore, extreme values for a 1-year return period are not provided.

11.4 Directional Criteria

GEM42 surface current results for all conditions (all-data and each shear case) were separately partitioned into eight equal directional sectors based on surface current direction. The maximum value from each directional sector was used to estimate maximum directional relative magnitudes. The sector with the highest maximum value receives a factor of 1 and all other sectors are scaled down accordingly.

To derive the directional extreme surface currents for 1-, 10-, 25-, 50- and 100-year return periods, the relative magnitudes for each sector were applied to the n-year extreme. Table 11.4 presents the relative magnitude factors for all-data and each shear case.

Table 11.4 Relative Magnitude of GEM42 Surface Currents by Direction (All-Data and Shear Cases).

Case	N	NE	E	SE	S	SW	W	NW
All-data	0.350	0.022	0.262	0.180	0.520	0.690	1.000	0.823
Low-shear	0.503	0.045	0.539	0.372	0.876	0.870	1.000	0.937
Medium-shear	0.350	0.000	0.023	0.060	0.520	0.690	1.000	0.823
High-shear	0.300	0.000	0.000	0.000	0.766	1.000	0.988	0.860

11.5 Extreme Current Profiles

GEM42 results for all conditions (all-data and each shear case) were analysed to develop representative current profiles for extreme surface currents. For each condition, an average profile was calculated based on all profiles that exceeded a selected threshold at the surface. The threshold selected here was 0.75m/s. The average profile was then normalized to the surface value. The normalized average profiles were employed to develop the 1-, 10-, 25-, 50-, and 100-year profiles associated to omni-directional and directional surface extremes. Figure 11.1 shows the normalized current profiles for all-data and for each shear case.

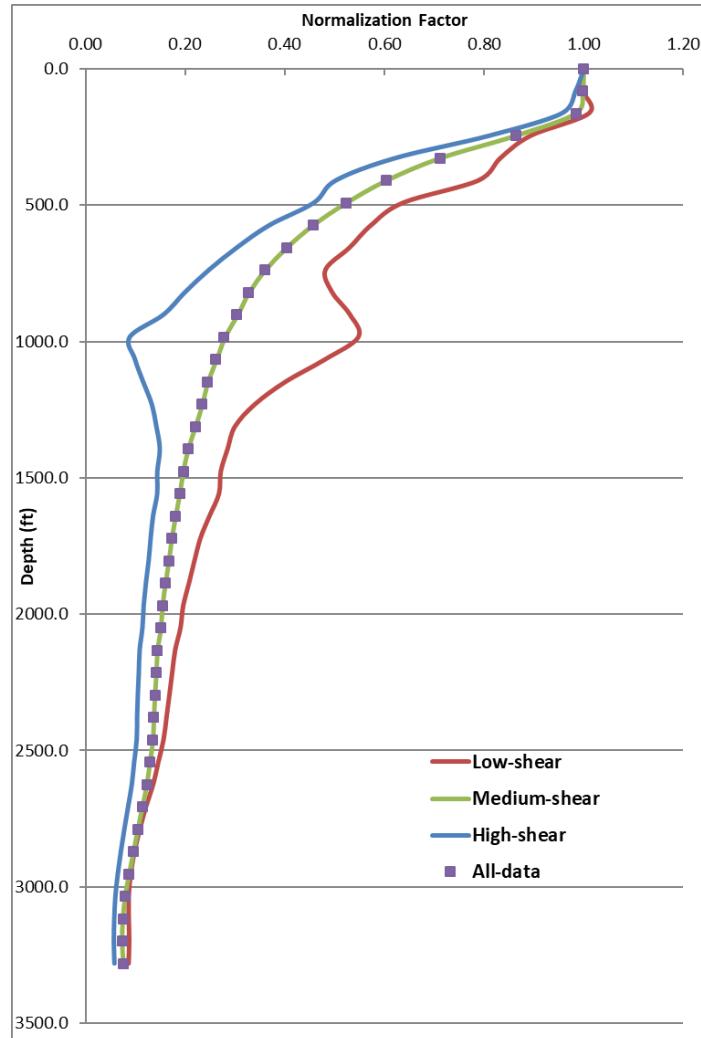


Figure 11.1 LC/LCE Normalized Profiles (All-Data and Shear Cases).

11.6 LCE Events Duration

The most relevant LC/LCE events that affected the client site and the daily average current speed time histories of these were plotted out in descending order of peak current speed (Figure 11.2). Those events were normalized so that the peak speed from each was taken as 1.0 and all other speeds during each event were taken as fractional values. An analysis was then carried out to determine how long the current speed from this subset of events exceeded a range of fractional values. No trend was detected in terms of the amount of time a fractional threshold was exceeded versus the absolute magnitude of the peak speed. Therefore, an average relationship was derived.

Figure 11.3 shows the relationship between the duration of exceedance of normalized thresholds for the most relevant LC/LCE events. These lines indicate that there is a considerable spread in periods of exceedances but that the average curve is fairly smooth and linear (indicated by the heavy blue line). This line was selected as representative of extreme LC/LCE events but it should be stressed that this line represents an average case for an extreme event rather than a worst-case scenario.

As illustrated in Figure 11.4, a linear least squares fit was made to the average duration-threshold line. That functional relationship was then used to construct representative time histories of daily average current speeds corresponding to the extreme 1-, 10-, 25-, 50-, and 100-year LCE surface currents.

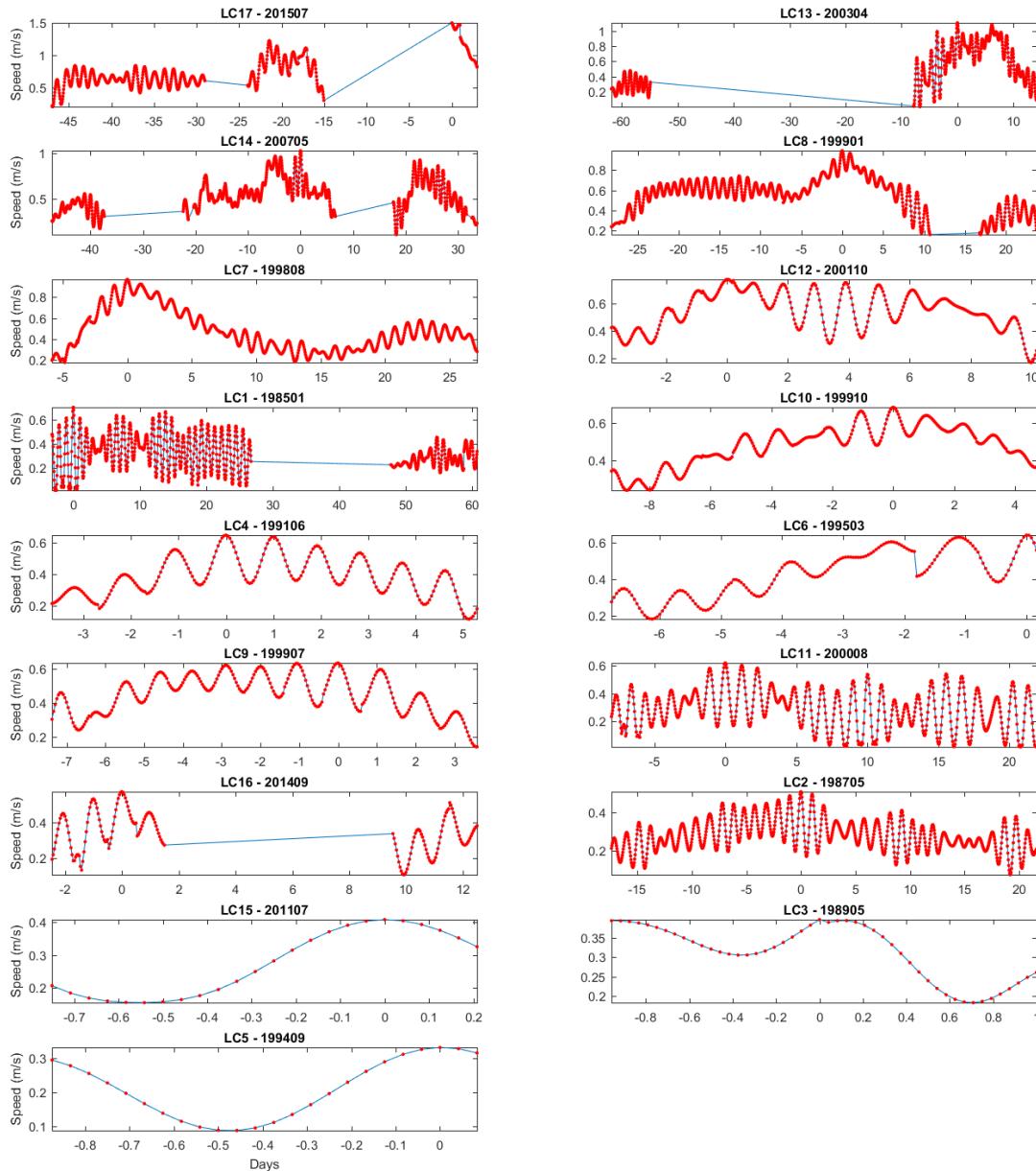


Figure 11.2 Time Histories of Most Relevant LC/LCE events.

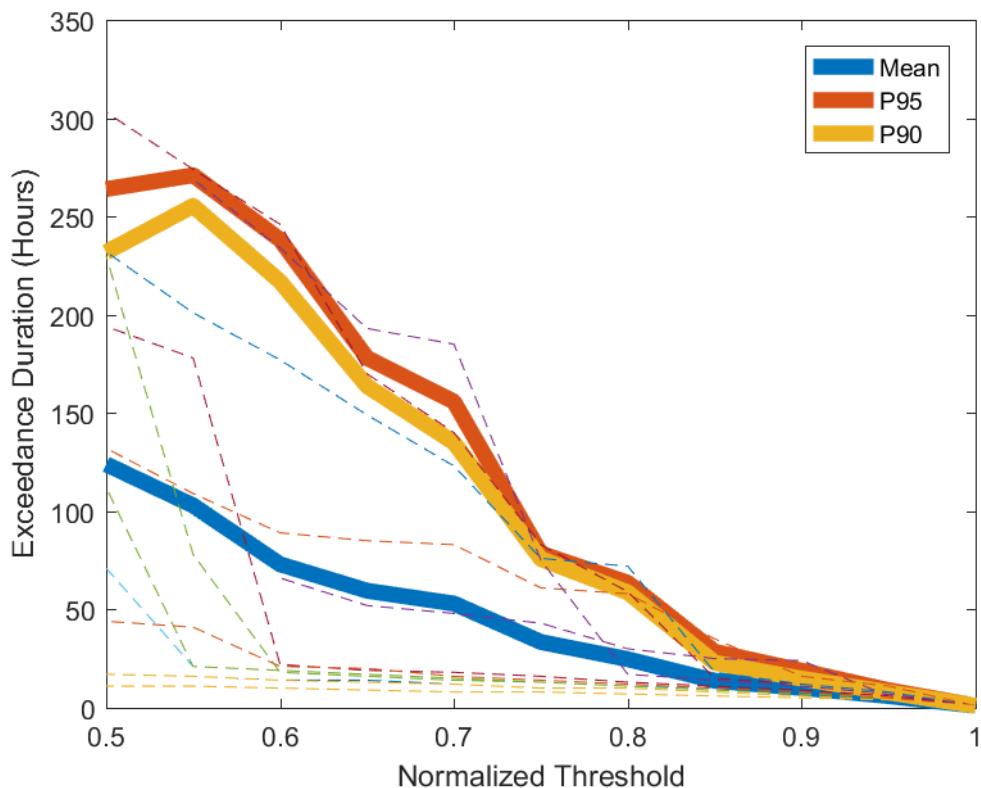


Figure 11.3 Duration of Exceedances of Normalized Thresholds for Significant LC/LCE events.

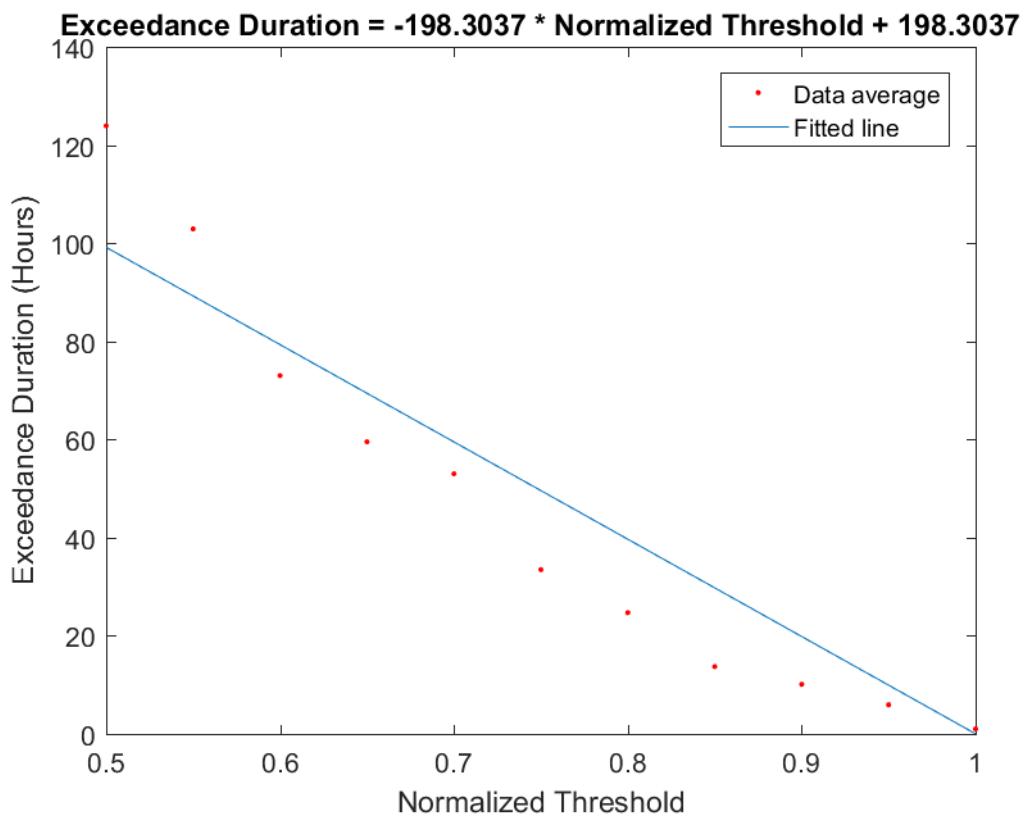


Figure 11.4 Line of Best Fit to Average Durations-Threshold Relationship.

12. NEAR BED CURRENT CRITERIA METHODOLOGY

The 1-, 10-, 25-, 50- and 100-year near bed current criteria were based on the near bed measured currents from the NTL Station 42374, years 2006 to 2009, at 1588m (5210ft) below the surface. The methodology is described in the following sections.

12.1 Omni-directional Criteria

Omni-directional extremes for near bed currents were based on a subset of peak near bed currents. The Peaks Over Threshold method (POT) was used to separate those peaks. The method consisted of declustering the data by selecting peak events to produce a set of independent and identically distributed observations. A reset duration of 48h was used. This method was then employed to derive the n-year criteria. The number of peaks exceeding a given level, divided by the number of years of record, gave the rate of exceedance which could then be used to find the expected number of occurrences in a specified period of time.

The Exponential (EXP), Fisher-Tippett 1 (FT1), Generalized Pareto (GP), and Weibull 3 (W3) distributions were tested for goodness-of-fit to the GOMOS2014 data using the method of least squares (LS), maximum likelihood (MLE) or the method of moments (MoM). The best fit for 1-, 10-, 25-, 50- and 100-year near bed currents are summarized in Table 12.1.

Table 12.1 Extreme Omni-directional Near Bed Currents.

Parameter	Distribution	Fit	Threshold	# Peaks	Extreme Values				
					1-year	10-year	25-year	50-year	100-year
CS near bed (m/s)	EXP	LS	0.11	151	0.23	0.30	0.32	0.34	0.36

12.2 Directional Criteria

Near bed currents were partitioned into eight equal directional sectors based on current direction at 1588m. The maximum value from each directional sector was used to estimate maximum directional relative magnitudes. The sector with the highest maximum value receives a factor of 1 and all other sectors are scaled down accordingly.

To derive the directional extreme near bed currents for 1-, 10-, 25-, 50- and 100-year return periods, the relative magnitudes for each sector were applied to the n-year extreme. Table 12.2 presents the relative magnitude factors for each direction.

Table 12.2 Relative Magnitude of Near Bed Currents by Direction.

Parameter	N	NE	E	SE	S	SW	W	NW
CS near bed (m/s)	1.000	0.984	0.698	0.774	0.714	0.758	0.762	0.710

12.3 Extreme Current Profile

Near bed current data were analysed to develop a representative current profile for extreme near bed currents. An average profile was calculated based on all profiles that exceeded a selected threshold at

the selected reference level (1588m). The threshold selected here was 0.20m/s. Each profile that exceeded the threshold was normalized to the value at the reference level. A final normalized profile was calculated based on the average of all individual normalized profiles. The final profile was employed to develop the 1-, 10-, 25-, 50-, and 100-year profiles associated to omni-directional and directional near bed extremes. Figure 12.1 shows the normalized current profile that was used.

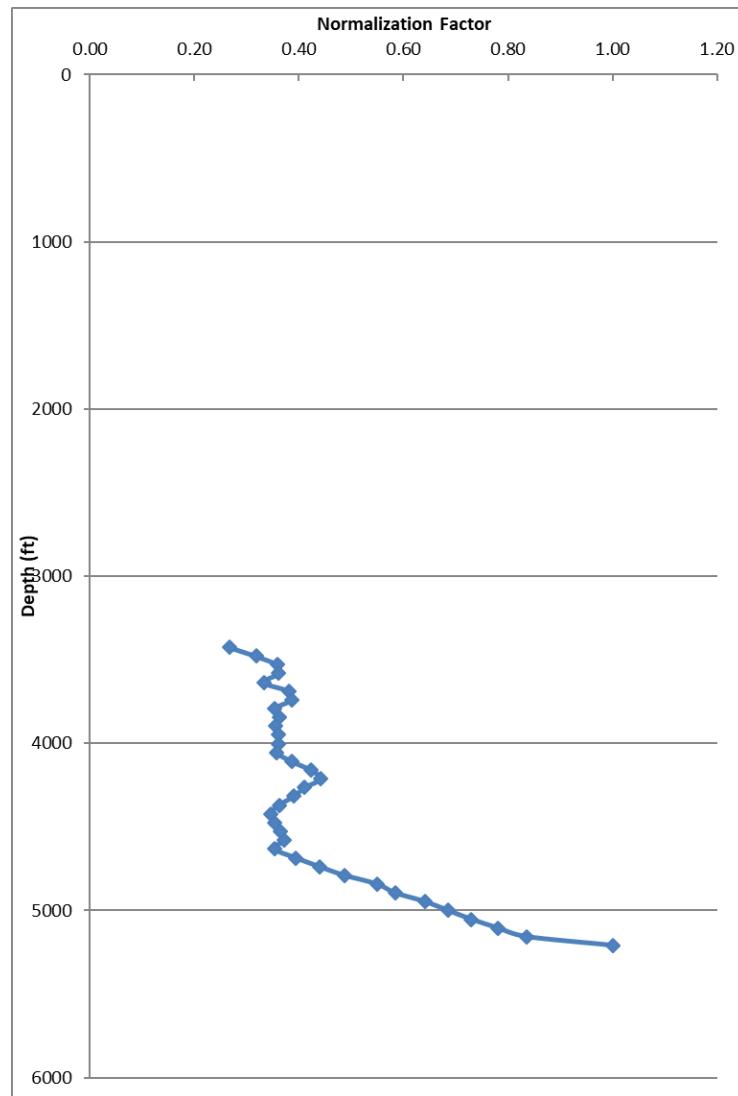


Figure 12.1 Near Bed Current Normalized Profile.

13. MEASURED DATA QC FOR NEAR BED CURRENT CRITERIA AND CPC ANALYSIS

Measured current data representative for the Horn Mountain platform, available through the NOAA National Data Buoy Center (NDBC – www.ndbc.noaa.gov), were employed in the Near Bed Current criteria and Current Profile Characterization.

Data from the NTL Station 42374 (Horn Mountain Spar) from 2005 to 2018 for the upper water column (40m to 550m) were downloaded and quality controlled. The data were measured from a 75kHz ADCP, setup using all 4 beams. Periods where the data suffered interference from the spar were error flagged.

Data from the NTL station 42374 (Horn Mountain Spar) from 2006 to 2009 for the lower water column (1044m to 1620m) were downloaded and quality controlled. On the whole, the quality of these 75kHz ADCP near bed measurements was good, and we were able to utilize much of the available data.

The selected in-situ datasets were transferred to the Fugro server for quality control, processing, and analysis. The quality control was conducted using Fugro's in-house oceanographic software designed to analyze raw data, compare datasets and perform quality control steps. The routine data quality control procedures typically include:

- Screening analysis through time series plots top identify erroneous or anomalous data.
- Application of amended start and end times to remove invalid data.
- Application of magnetic declination to convert all directional data from magnetic to True North.
- Removal of all zeros.
- Threshold limits for error (where available) and vertical velocity, percent good pings, echo intensity and beam correlation values for the ADCP instruments were undertaken as applicable.
- Final inspection of data quality by an experienced oceanographer to identify and remove any remaining anomalous values outside of the physical limits of the region.

For the near bed current extreme analysis, data from the lowest available, good quality bin were utilized. The extreme analysis was undertaken using the same methodology as described in Section 9.

For the current profile characterization, current data are required throughout the water column. As such, the following procedures were adopted:

- Temporal gaps in the data of less than 24 hours were interpolated.
- Vertical gaps in the data of less than 3 bins were interpolated.
- From the uppermost measurement bin to the surface, data were extrapolated using the relationship between the same measurement depth and the surface from HYCOM data.
- Where more than 3 bins were missing, data were infilled with HYCOM data.

A series of 544 characteristic current speed profiles are presented in the order of decreasing frequency of occurrence. A profile identification number and the percentage frequency of occurrence are indicated above each individual profile plot. The range of possible speed values at each depth is indicated by a set of horizontal lines. A solid line joins the mean current speed at each measurement level. The profiles are presented in Appendix C. These criteria are also provided digitally in the separate file C118910_0130_R3_CPC.xls for efficient input to riser design software. The profiles have been derived

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with a bin size or resolution of 0.22 m/s (0.72 ft/s). This bin size represents the greatest possible difference between the maximum and minimum values at each depth. Please note that current speeds are given in metres per second.

14. TECHNICAL REFERENCES

14.1 Extreme Value Analysis

Extreme omni-directional wind, wave and current speeds were derived using the Peaks-Over-Threshold (POT) Method. The POT values were derived by fitting the Weibull, Fisher-Tippett 1, Generalised Pareto, and Exponential functions to the rate of exceedance using the method of least squares, Maximum Likelihood and Method of Moments. Extreme directional wind speeds were derived by scaling the omni-directional extreme values using relative severity factors derived from the relative magnitude of the maximum 1-hour mean wind speed in each direction sector.

14.1.1 Probability Distributions

The functions used in this study (Carter & Challenor, 1981; Carter D. J., Challenor, Ewing, Pitt, Srokosz, & Tucker, 1986; Johnson, Kotz, & Balakrishnan, 1994) for the estimation of extreme values are the:

- Fisher-Tippett distribution, Type 1.
- Weibull 3-parameter
- Exponential
- Generalised Pareto

The FT1 and Exponential functions are two parameter distributions. The Weibull function may be described by two or three parameters: α is the location parameter and the limiting value of the distribution, β is the scale parameter and defines the spread of the distribution, and γ is the shape parameter and describes the asymmetry of the distribution. The Generalised Pareto is also a three-parameter distribution: a location parameter, x_l , a scale parameter, β , and a shape parameter, γ . The following paragraphs describe the distributions and present expressions for the moments estimators and for plotting on probability paper.

Fisher-Tippett Type 1 Distribution

This function is also known as a Gumbel, double exponential, Jenkinson Type 2, extreme value and extremal type 1 distribution.

$$P(x) = \exp \{-\exp [-(x - \alpha)/\beta]\} \quad \beta > 0$$

where $P(x)$ is the cumulative probability that $X \leq x$ and α is the mode of the distribution.

The function may be re-arranged to give

$$x = \alpha - \beta [\ln(-\ln P(x))]$$

It can be seen that plotting $-\ln(-\ln P(x))$ against x will give a straight line.

The mean and variance of the F-T 1 distribution are as follows:

$$\text{Mean} = \alpha + \gamma\beta$$

$$\text{variance} = \beta^2 \pi^2 / 6$$

where γ = Euler's constant = 0.5772.

The moments estimators are therefore given by

$$\alpha = \text{mean} - \gamma\beta$$

$$\beta = \sqrt{\text{variance}} \sqrt{6/\pi}$$

Weibull Distribution

$$P(x) = 1 - \exp \{ -[(x - \alpha)/\beta]^\gamma \} \quad x > \alpha; \beta, \gamma > 0$$

$$P(x) = 0 \quad x < \alpha$$

where α is the lower limiting value of the distribution.

Re-arranging gives

$$x = \alpha + \beta [-\ln(1 - P(x))]^{1/\gamma}$$

$$\ln[-\ln(1 - P(x))] = \gamma \ln(x - \alpha) - \gamma \ln \beta$$

so a plot of $\ln[-\ln(1 - P(x))]$ against $\ln(x - \alpha)$ is a straight line.

For a three parameter Weibull distribution the mean, variance and skewness are given by

$$\text{Mean} = \beta \Gamma(1 + 1/\gamma) + \alpha$$

$$\text{variance} = \beta^2 [\Gamma(1 + 2/\gamma) - \Gamma^2(1 + 1/\gamma)]$$

$$\text{skewness} = \beta^3 [\Gamma(1 + 3/\gamma) - 3\Gamma(1 + 2/\gamma) * \Gamma(1 + 1/\gamma) + 2\Gamma^3(1 + 1/\gamma)]$$

where Γ is the gamma function and the moments estimators are obtained by:

$$\alpha = \text{mean} - [\beta \Gamma((1 + 1/\gamma))]$$

$$\beta = \{\text{variance}/[\Gamma(1 + 2/\gamma) - \Gamma^2(1 + 1/\gamma)]\}^{0.5}$$

$$\text{Skewness} = [\Gamma(1 + 3/\gamma) - 3\Gamma(1 + 2/\gamma) * \Gamma(1 + 1/\gamma) + 2\Gamma^3(1 + 1/\gamma)] / [\Gamma(1 + 2/\gamma) - \Gamma^2(1 + 1/\gamma)]^{3/2}$$

which is solved iteratively for γ

Note that skewness = coefficient of skewness * variance^{3/2}.

For a two parameter Weibull distribution, $\alpha = 0$ and the mean and variance are given by

$$\text{mean} = \beta \Gamma(1 + 1/\gamma)$$

$$\text{variance} = \beta^2 [\Gamma(1 + 2/\gamma) - \Gamma^2(1 + 1/\gamma)]$$

and the moments estimators are obtained by

$$\beta = \text{mean}/\Gamma(1 + 1/\gamma)$$

$$\text{variance}/\text{mean}^2 = [\Gamma(1 + 2/\gamma) - \Gamma^2(1 + 1/\gamma)] / [\Gamma(1 + 1/\gamma)]^2$$

which is solved iteratively for γ

Exponential Distribution

$$P(x) = 1 - \exp [-(x - \alpha)/\beta]$$

The mean and variance are given by

$$\text{Mean} = \alpha + \beta$$

$$\text{variance} = \beta^2$$

The moments estimators are therefore

$$\alpha = \text{mean} - \beta$$

$$\beta = \sqrt{\text{variance}}$$

Generalised Pareto Distribution

$$P(x) = 1 - [1 + (\gamma x/\beta)]^{-1/\gamma} \text{ for } 0 < x < \infty \text{ if } \gamma > 0 \text{ and } 0 < x < -\beta/\gamma \text{ if } \gamma < 0.$$

14.1.2 Peaks Over Threshold Analysis

The peak over threshold technique (Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station, 1986; Davison & Smith, 1990) consists of declustering the data by selecting storm peak events that exceeded a predetermined threshold within a forty-eight hour moving window. The observations are assumed to be independent and identically distributed. The number of peaks exceeding a given level, divided by the number of years of record, gives the rate of exceedance which can then be used to find the expected number of occurrences in a period of specified length of time. The probability distribution of the peak values which depends on the threshold over which the peaks are counted is then combined with the rate of occurrence of peaks to give the unconditional distribution of peak values from which extreme values corresponding to given return periods can be calculated, i.e.

$$P(x.y) = P(x/y) P(y)$$

where $P(x.y)$ = the unconditional probability distribution of peak values with time.

$P(x/y)$ = the conditional probability distribution of peak values.

$P(y)$ = the probability distribution of storms with time.

The return periods of extreme values are calculated as follows:

$$RP = 1 / \{ \lambda [1 - P(x/y)] \}$$

where λ is the Poisson parameter and $P(x/y)$ the conditional probability distribution of peak values::

The number of storms occurring per unit time is assumed to be a random variable that may be represented by the Poisson distribution. The Poisson distribution is characterised by a mean value, λ , which is the average number of storms per year. The value of λ is calculated as the number of storms divided by the period of record in years. The probability density of the Poisson distribution is given by the following formula:

$$p(i) = (\lambda^i \exp^{-\lambda}) / i!$$

where $i = 0, 1, 2, \dots n$.

14.1.3 Cumulative Frequency Distribution

Cumulative frequency extrapolation involves grouping all the parameter values in the data set using specified class intervals and then forming a cumulative frequency distribution (cfd) by summing the number of observations greater than or equal to the lower bound of the class interval. The Fisher-Tippett distributions, Types 1 and 3 and the Weibull and Exponential distributions are then fitted to the data, using the method of least squares, in order to extrapolate to the required probability of non-exceedence. The advantage of this method is that it can be used with as little as one year of data. However, the probability levels calculated for the cumulative frequency method assume that the measurements used to form the distribution are independent. Therefore, by ignoring the correlation between consecutive values of the metocean parameter, this method may result in underestimation of extreme values. Note that in some cases the Fisher-Tippett 3 function has values of the location parameter (the upper limiting value of the distribution) which are very high. As the value of this parameter becomes larger the distribution tends more towards the F-T1, therefore, the function fitted to the cfd's represents a Fisher-Tippett Type 1 rather than a Fisher-Tippett Type 3.

The relationship between probability of non-exceedence and return period is as follows:

$$P(x) = 1 - 1/(365.25mRP)$$

where $P(x)$ = the probability of non-exceedence.

m = the number of observations in a day.

RP = the return period (years).

14.2 Wave Parameters Hmax, and Hc from EXWAN

The EXWAN program is an extension of the SWAP wave analysis program, developed in the NOCDAP project by the Norwegian Continental Shelf Institute, to analyze the probability distribution of storm wave parameters. The EXWAN report (Machado, 2004) describes the theory behind the program, giving a list of references, which can be consulted for further details about each model.

EXWAN takes into account the possibility that the highest maximum wave height (H_{max}) or crest height (H_c) in N -years may come from other than the most severe storm, unlike the structure variable method, which assumes that the extreme N -year H_{max} or H_c occurs during the most severe 3-hour period in N -years. EXWAN takes this into account by identifying each individual storm and treating it as a single event. EXWAN then generates a probability distribution of H_{max} or H_c for each storm. Crest height is estimated from the wave time series data using the Forristall 3D model.

The probability distributions of maximum wave or crest height for a storm are given by:

$$P(H_{max} < h) = \exp \left\{ \int_0^T \log \{F_{Hs(t)}(h)\} dt / T_{m02}(t) \right\}$$

where:

$P(H_{max} < h)$ is the non-exceedance probability of the maximum wave or crest height in a storm;

$F_{Hs(t)}(h)$ is the short-term non-exceedance probability of wave or crest height, h , for a significant wave height, H_s , at time, t ;

$T_{m02}(t)$ is the spectral estimate of the mean zero up-crossing wave period at time, t ;

T is the duration of the storm.

This approach was developed by Borgman (1973) and has been adopted by the EXWAN software as a means of determining the maximum wave and crest height from each storm. The GOMOS2014 data contained an estimate of T_p and this parameter is used to derive T_{m02} by multiplying by 0.71.

In order to calculate $F_{Hs(t)}(h)$ for each time step within each storm the Forristall 3-D approach was used for crest height. This formulation is based on the 2-parameter Weibull distribution:

$$F_{Hs}(h) = 1 - \exp\left\{-\frac{(4h/H_s)^A}{B}\right\}$$

where, A and B are parameters that were empirically fitted.

Forristall (2000) derived estimates of extreme crest heights for given sea states in given water depths by using simulations of JONSWAP spectra and empirically fitted the following for A and B :

$$A = 2 - 1.7912S - 0.5302U_r + 0.2824U_r^2$$

$$B = \{4(0.3536 + 0.2568S + 0.0800U_r)\}^A$$

where:

$$U_r = \frac{H_s}{k_l^2 d^3}; \text{ is the Ursell number, and}$$

$$S = \frac{2\pi H_s}{g T_{m01}^2}; \text{ is the wave steepness,}$$

$T_{m01} = m_0/m_1$, the ratio of the zeroth to the first moments of the wave spectrum;

k_l is the deep water wave number corresponding to T_{m01} ;

d is the water depth.

Time series data from GOMOS2014 grid point T4037419 was processed using the EXWAN program to produce a representative crest height for each individual storm. The extreme value analysis was applied to the crest height time series in a similar way described in Section 9.3.1.

The maximum wave height was calculated using EXWAN and the 2-parameter Weibull distribution proposed by Forristall. The values used for A and B are 2.13 and 8.42, respectively. The extreme value analysis was applied to the maximum wave height time series in a similar way described in Section 9.3.1.

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APPENDICES

A. OPERATIONAL WIND CRITERIA

A.1 INCLUDING HURRICANES

Table 15.1 Monthly and All-Year Operational Wind Statistics Including Hurricanes

COMBINED PERIOD (1980 to 2014)	STATISTICS											
	1hr Wind Speed at 32.8084ft [ft/s]				EXCEEDENCE PERCENTILE FOR 1hr Wind Speed at 32.8084ft [ft/s]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	1.44	24.60	80.51	9.91	6.10	7.19	9.32	11.96	23.98	38.09	42.29	48.50
February	1.35	23.93	77.17	10.00	5.28	6.50	8.76	11.29	23.36	37.11	41.46	49.35
March	1.41	22.61	94.95	9.83	5.41	6.59	8.37	10.43	21.52	36.06	40.32	47.24
April	0.52	21.29	56.20	8.46	5.58	6.63	8.50	10.63	20.67	32.58	35.81	43.13
May	1.21	17.85	53.41	7.16	4.76	5.61	7.19	8.89	17.45	27.13	29.86	37.80
June	1.74	15.95	48.92	6.65	4.49	5.31	6.63	8.04	15.16	24.64	28.12	35.27
July	1.38	15.13	51.18	5.91	4.63	5.48	6.92	8.32	14.40	22.44	25.30	33.66
August	1.28	15.23	106.73	7.57	4.10	4.86	6.23	7.64	13.98	24.08	28.17	38.22
September	1.48	18.79	137.47	9.48	4.69	5.58	7.09	8.76	17.19	30.74	34.88	49.15
October	1.84	22.08	85.83	9.18	5.54	6.69	8.66	10.93	21.29	33.89	38.16	47.34
November	1.94	24.12	74.44	9.42	6.14	7.32	9.55	11.94	23.56	36.65	40.68	46.65
December	1.08	24.56	61.15	9.82	5.58	6.82	9.48	12.27	23.79	37.76	41.73	49.51
All Year	0.52	20.49	137.47	9.42	4.99	5.94	7.64	9.48	19.16	33.37	37.73	46.13

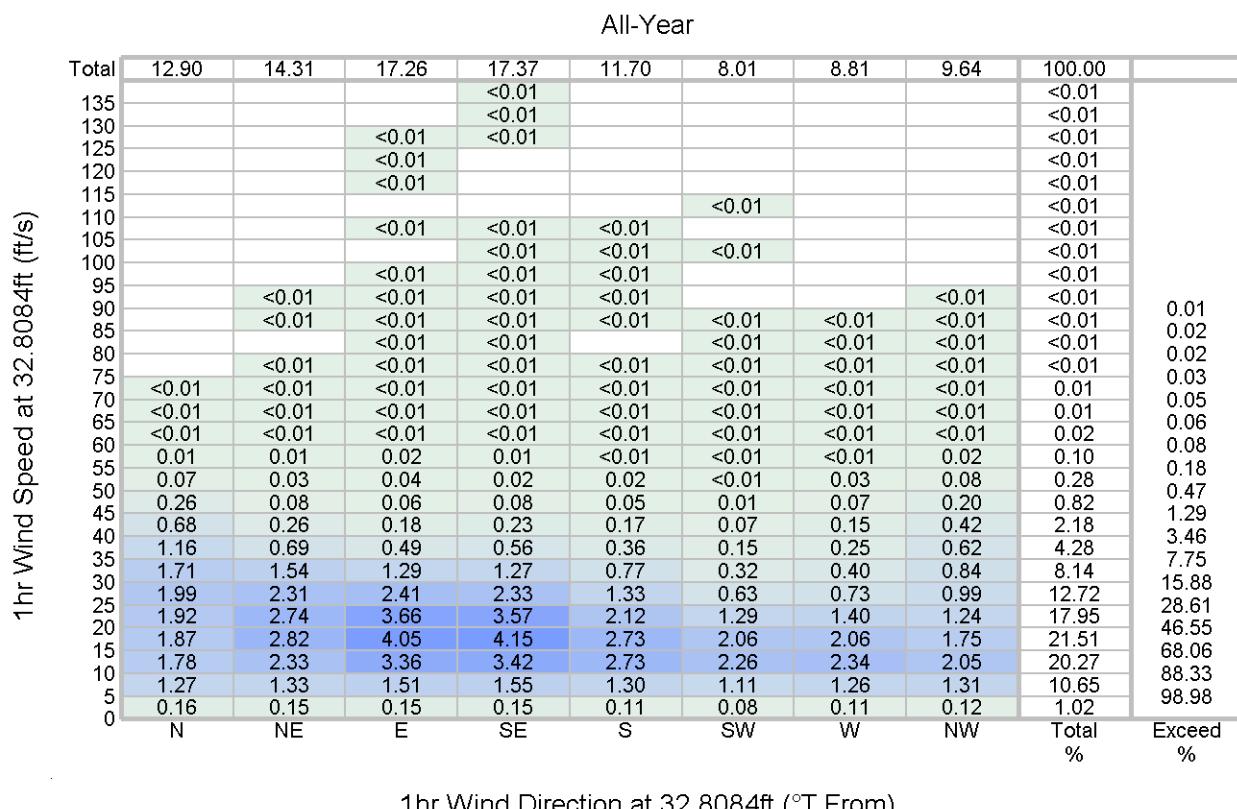
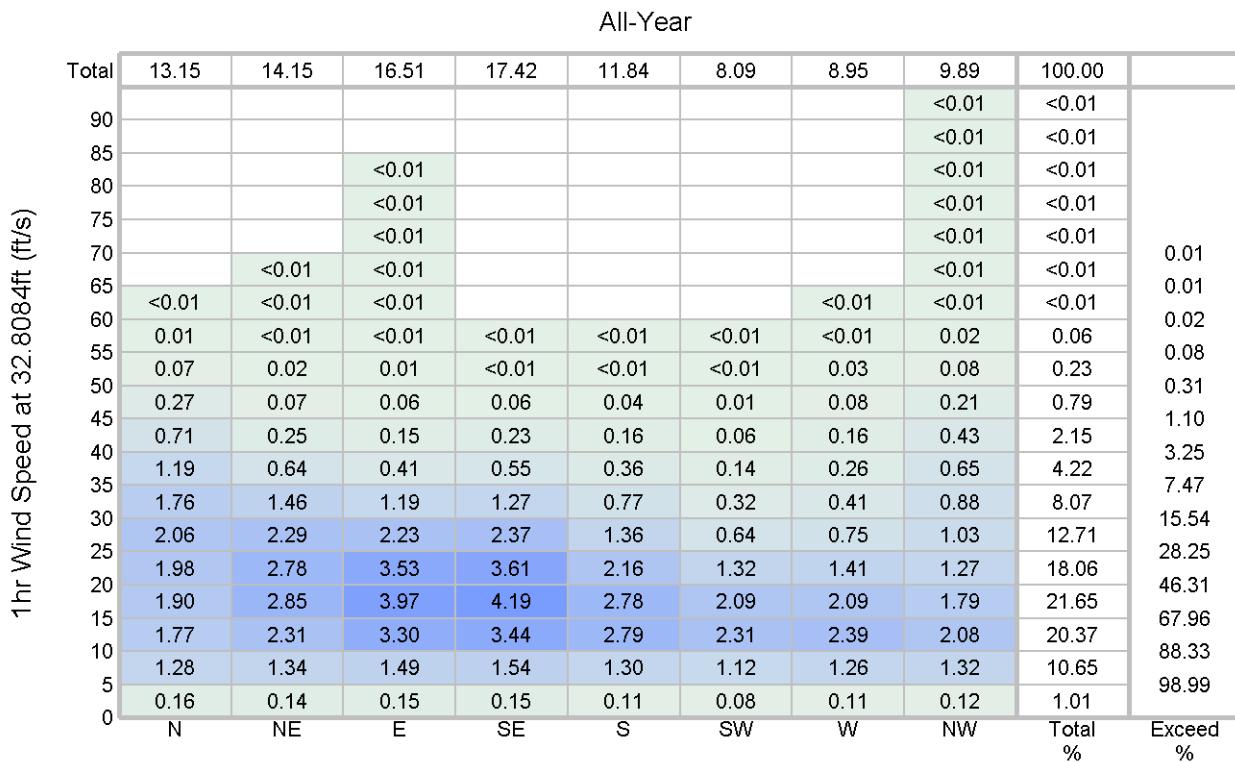


Figure A.1 Joint Frequency Distribution of Wind Speed by Direction – All Year, Including Hurricanes

A.2 EXCLUDING HURRICANES

Table 15.2 Monthly and All-Year Operational Wind Statistics Excluding Hurricanes

COMBINED PERIOD (1980 to 2014)	STATISTICS											
	1hr Wind Speed at 32.8084ft [ft/s]				EXCEEDENCE PERCENTILE FOR 1hr Wind Speed at 32.8084ft [ft/s]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	1.44	24.60	80.51	9.91	6.10	7.19	9.32	11.96	23.98	38.09	42.29	48.50
February	1.35	23.93	77.17	10.00	5.28	6.50	8.76	11.29	23.36	37.11	41.46	49.35
March	1.41	22.61	94.95	9.83	5.41	6.59	8.37	10.43	21.52	36.06	40.32	47.24
April	0.52	21.29	56.20	8.46	5.58	6.63	8.50	10.63	20.67	32.58	35.81	43.13
May	1.21	17.83	53.41	7.16	4.76	5.61	7.19	8.89	17.42	27.13	29.86	37.83
June	1.74	15.63	42.03	6.36	4.43	5.25	6.53	7.91	14.96	24.05	27.10	33.35
July	1.38	14.91	43.01	5.50	4.66	5.51	6.92	8.33	14.37	22.08	24.57	30.31
August	1.28	13.94	45.01	5.50	4.07	4.79	6.07	7.41	13.29	21.39	23.98	29.04
September	1.48	17.21	47.80	7.34	4.66	5.44	6.96	8.50	16.14	27.76	31.40	35.93
October	1.84	21.42	57.22	8.58	5.48	6.59	8.53	10.74	20.73	32.81	36.86	44.16
November	1.94	23.99	54.33	9.28	6.10	7.25	9.52	11.94	23.46	36.42	40.22	46.37
December	1.08	24.56	61.15	9.82	5.58	6.82	9.48	12.27	23.82	37.73	41.70	49.57
All Year	0.52	20.38	94.95	9.21	4.99	5.94	7.64	9.48	19.09	33.14	37.43	45.37



1hr Wind Direction at 32.8084ft ($^{\circ}$ T From)

Figure A.2 Joint Frequency Distribution of Wind Speed by Direction – All Year, Excluding Hurricanes

B. OPERATIONAL WAVE CRITERIA

B.1 INCLUDING HURRICANES

Table 15.3 Monthly and All-Year Operational Wave Statistics Including Hurricanes

COMBINED PERIOD (1980 to 2014)	STATISTICS											
	Significant Wave Height [ft]				EXCEEDENCE PERCENTILE FOR Significant Wave Height [ft]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	0.49	4.10	27.37	2.33	0.91	1.09	1.35	1.67	3.58	7.50	8.82	11.12
February	0.45	4.06	27.28	2.37	0.81	1.00	1.35	1.67	3.54	7.16	8.53	11.54
March	0.39	3.87	29.04	2.34	0.84	1.01	1.25	1.52	3.25	7.02	8.44	11.17
April	0.20	3.43	13.02	1.82	0.77	0.96	1.26	1.50	3.03	5.87	6.85	9.31
May	0.17	2.66	13.51	1.43	0.72	0.83	1.03	1.25	2.36	4.33	5.25	8.17
June	0.42	2.32	18.87	1.30	0.79	0.86	1.00	1.16	2.03	3.66	4.78	7.11
July	0.36	2.03	21.29	1.08	0.83	0.90	1.03	1.18	1.79	2.97	3.75	6.14
August	0.16	2.13	42.11	2.04	0.68	0.76	0.89	1.04	1.67	3.31	4.55	8.98
September	0.38	2.92	52.87	2.82	0.65	0.74	0.92	1.09	2.17	5.33	6.75	14.74
October	0.14	3.49	41.27	2.40	0.70	0.85	1.14	1.40	2.91	6.26	7.74	12.61
November	0.18	3.97	26.36	2.30	0.82	0.96	1.23	1.61	3.46	7.04	8.41	10.86
December	0.37	4.08	16.16	2.30	0.88	1.07	1.39	1.71	3.49	7.29	8.78	11.47
All Year	0.14	3.25	52.87	2.24	0.76	0.87	1.08	1.29	2.60	6.05	7.49	10.66

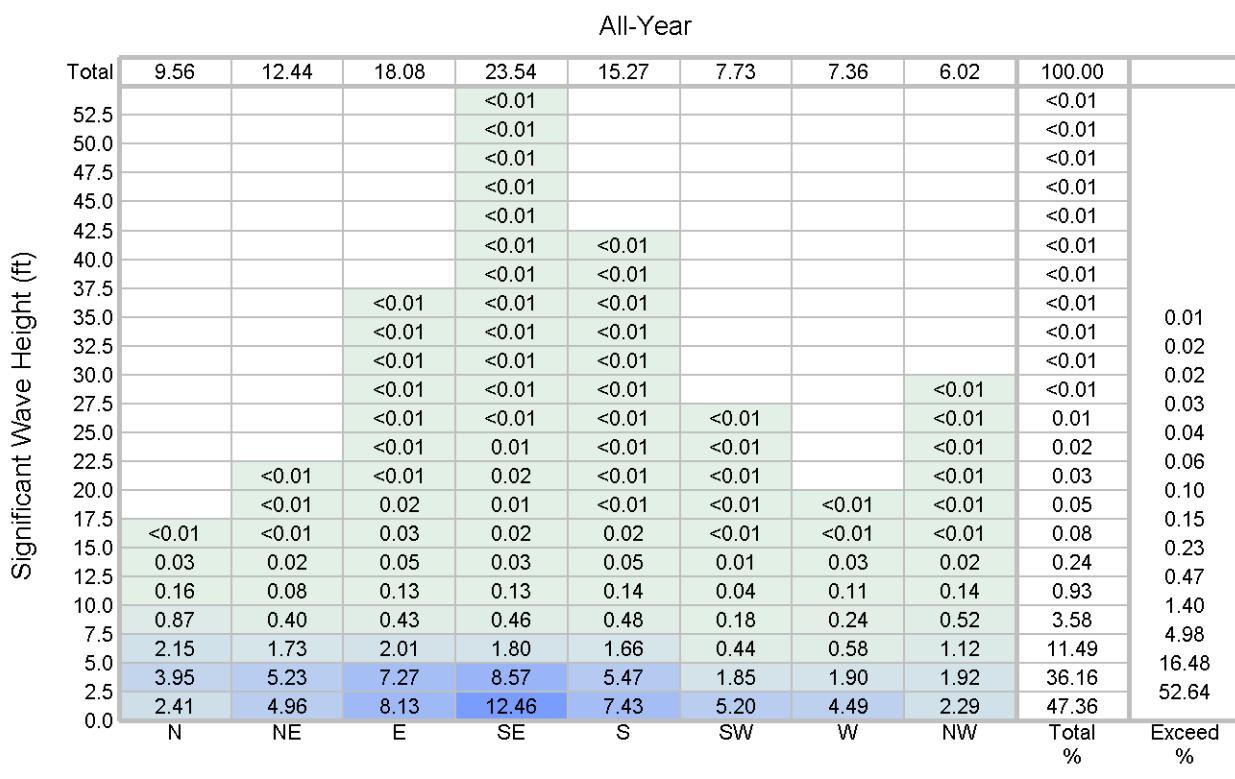


Figure B.1 Joint Frequency Distribution of Significant Wave Height by Direction – All Year, Including Hurricanes

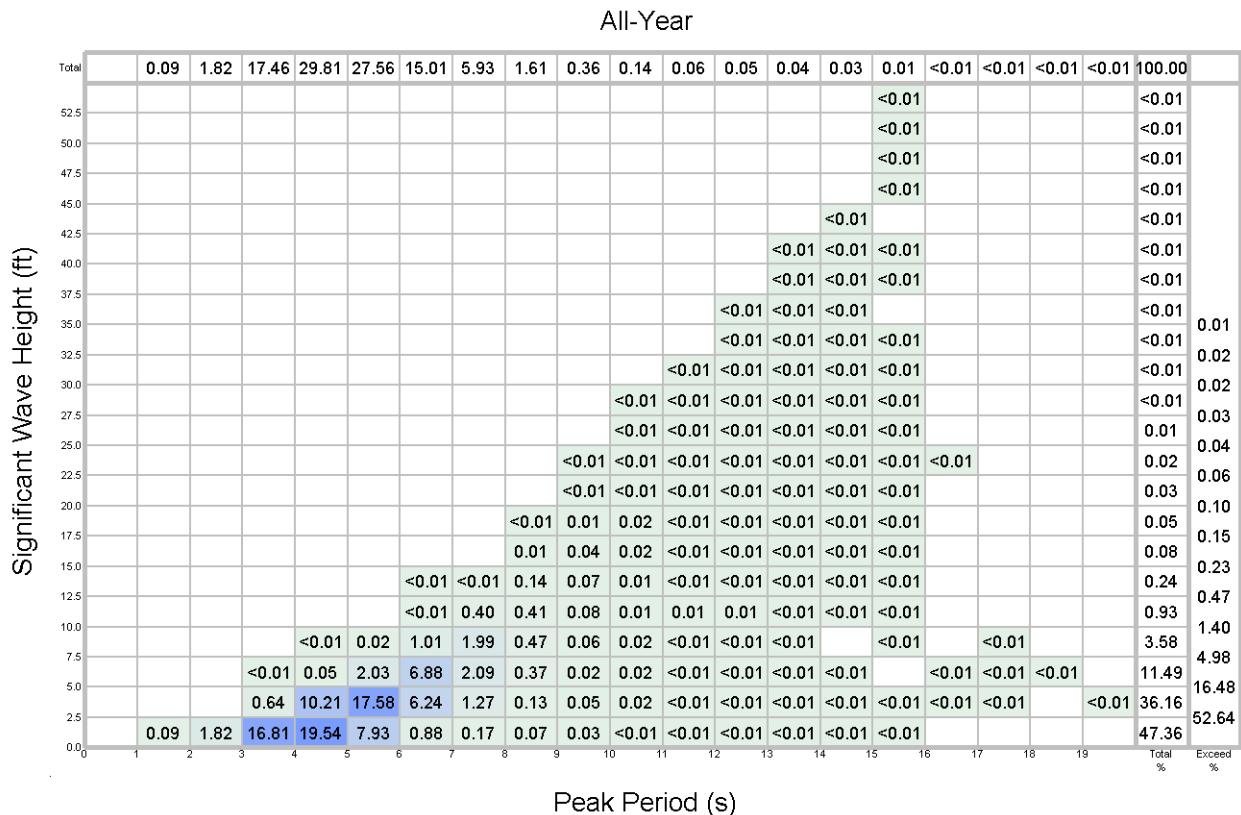


Figure B.2 Joint Frequency Distribution of Significant Wave Height by Peak Wave Period – All Year, Including Hurricanes

B.2 EXCLUDING HURRICANES

Table 15.4 Monthly and All-Year Operational Wave Statistics Excluding Hurricanes

COMBINED PERIOD (1980 to 2014)	STATISTICS											
	Significant Wave Height [ft]				EXCEEDENCE PERCENTILE FOR Significant Wave Height [ft]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	0.49	4.10	27.37	2.33	0.91	1.09	1.35	1.67	3.58	7.50	8.82	11.12
February	0.45	4.06	27.28	2.37	0.81	1.00	1.35	1.67	3.54	7.16	8.53	11.54
March	0.39	3.87	29.04	2.34	0.84	1.01	1.25	1.52	3.25	7.02	8.44	11.17
April	0.20	3.43	13.02	1.82	0.77	0.96	1.26	1.50	3.03	5.87	6.85	9.31
May	0.17	2.65	13.51	1.43	0.72	0.83	1.03	1.25	2.36	4.33	5.25	8.19
June	0.42	2.20	8.56	1.05	0.78	0.85	0.99	1.14	1.98	3.42	4.16	6.12
July	0.36	1.93	7.98	0.79	0.83	0.90	1.03	1.17	1.77	2.81	3.34	4.90
August	0.16	1.74	8.44	0.75	0.66	0.74	0.87	1.01	1.58	2.67	3.08	4.43
September	0.38	2.35	9.05	1.38	0.65	0.73	0.89	1.04	1.94	4.34	5.37	6.79
October	0.14	3.25	15.40	1.97	0.68	0.83	1.11	1.36	2.75	5.83	7.14	10.00
November	0.18	3.90	13.45	2.15	0.80	0.96	1.23	1.62	3.44	6.92	8.19	10.42
December	0.37	4.08	16.16	2.30	0.88	1.07	1.39	1.70	3.49	7.28	8.78	11.48
All Year	0.14	3.18	29.04	2.04	0.75	0.87	1.07	1.28	2.58	5.95	7.32	10.09

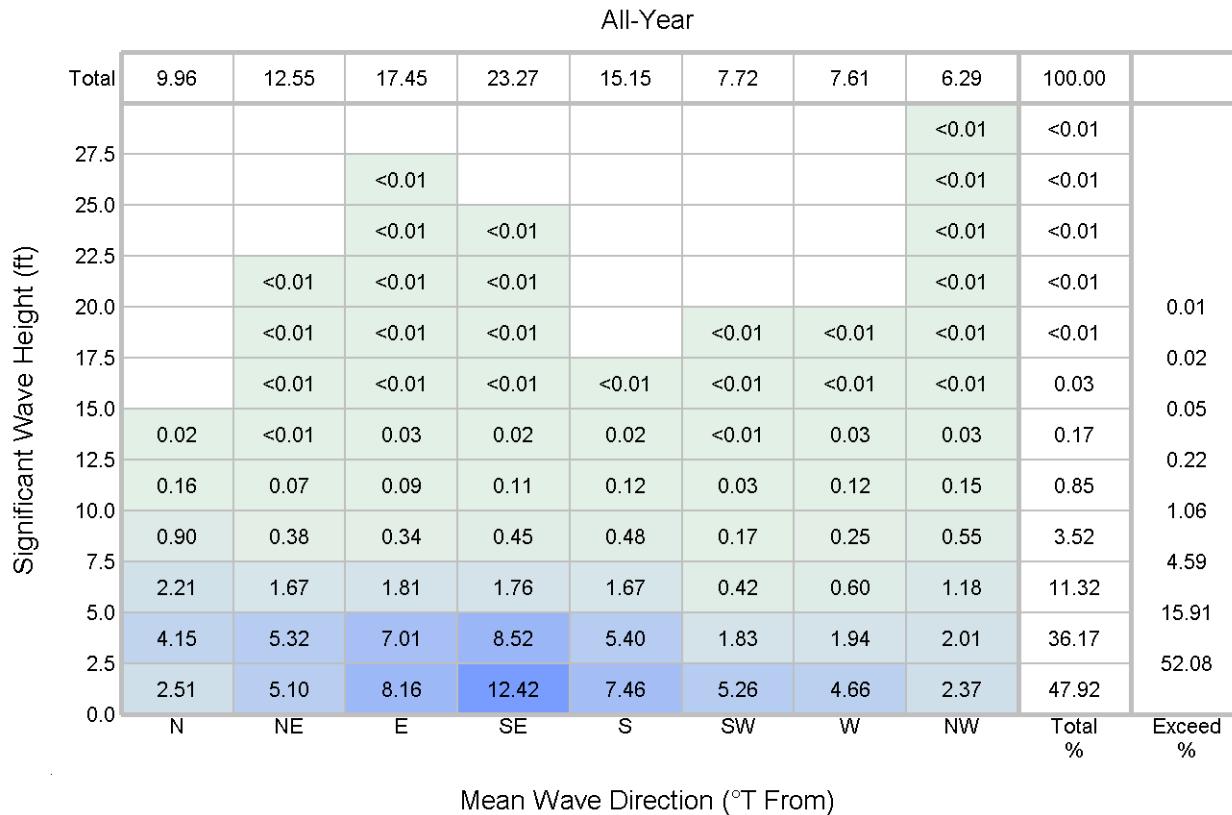


Figure B.3 Joint Frequency Distribution of Significant Wave Height by Direction – All Year, Excluding Hurricanes

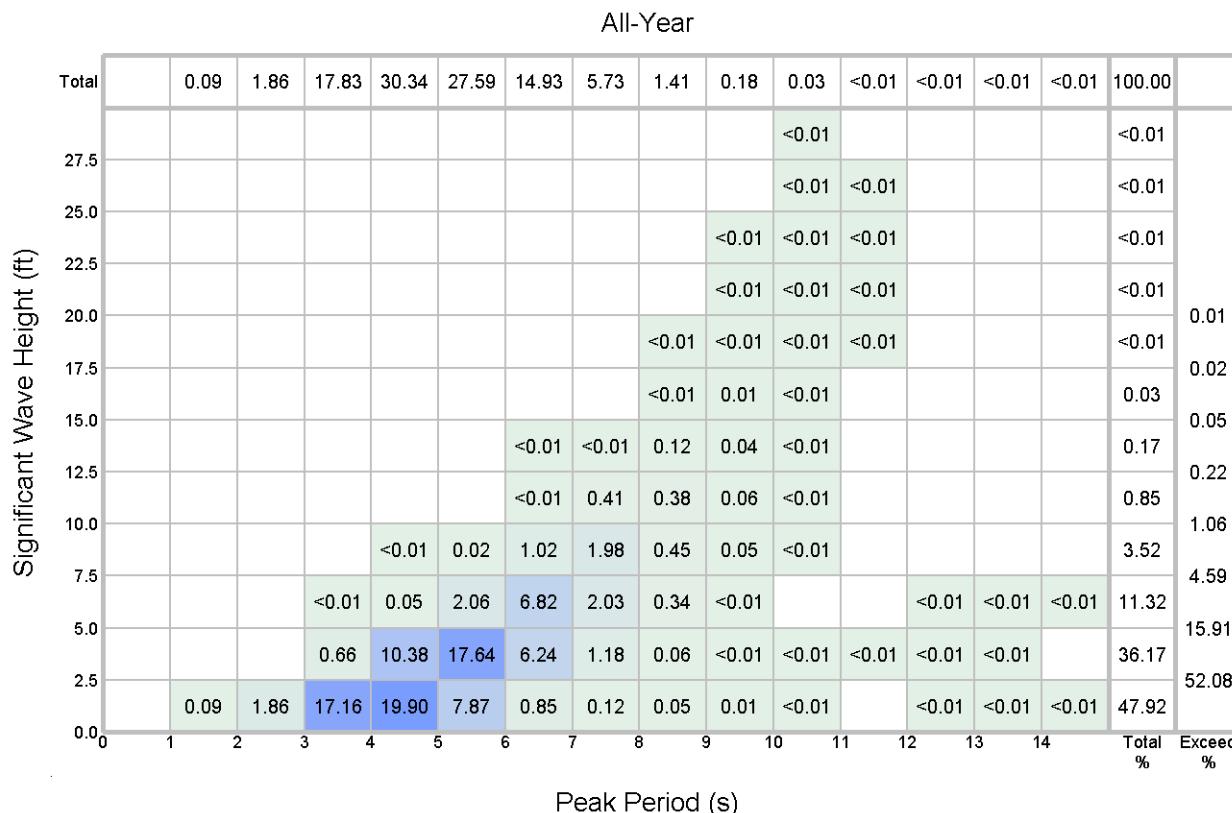


Figure B.4 Joint Frequency Distribution of Significant Wave Height by Peak Wave Period – All Year, Excluding Hurricanes

C. CURRENT PROFILE CHARACTERIZATION

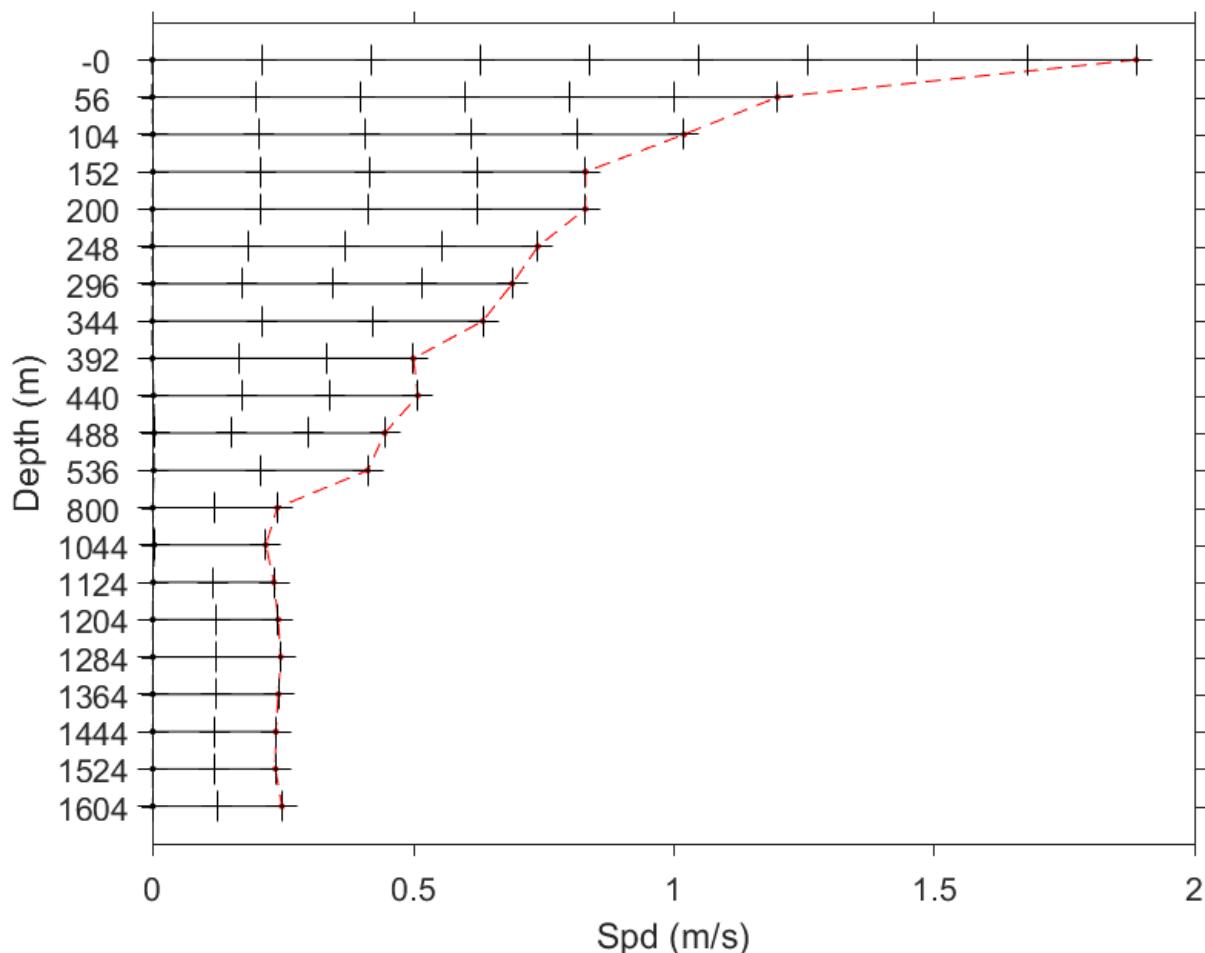


Figure C.1 Possible current states at each depth. The vertical lines represent the resolution used for the separation of each state (0.22 m/s).

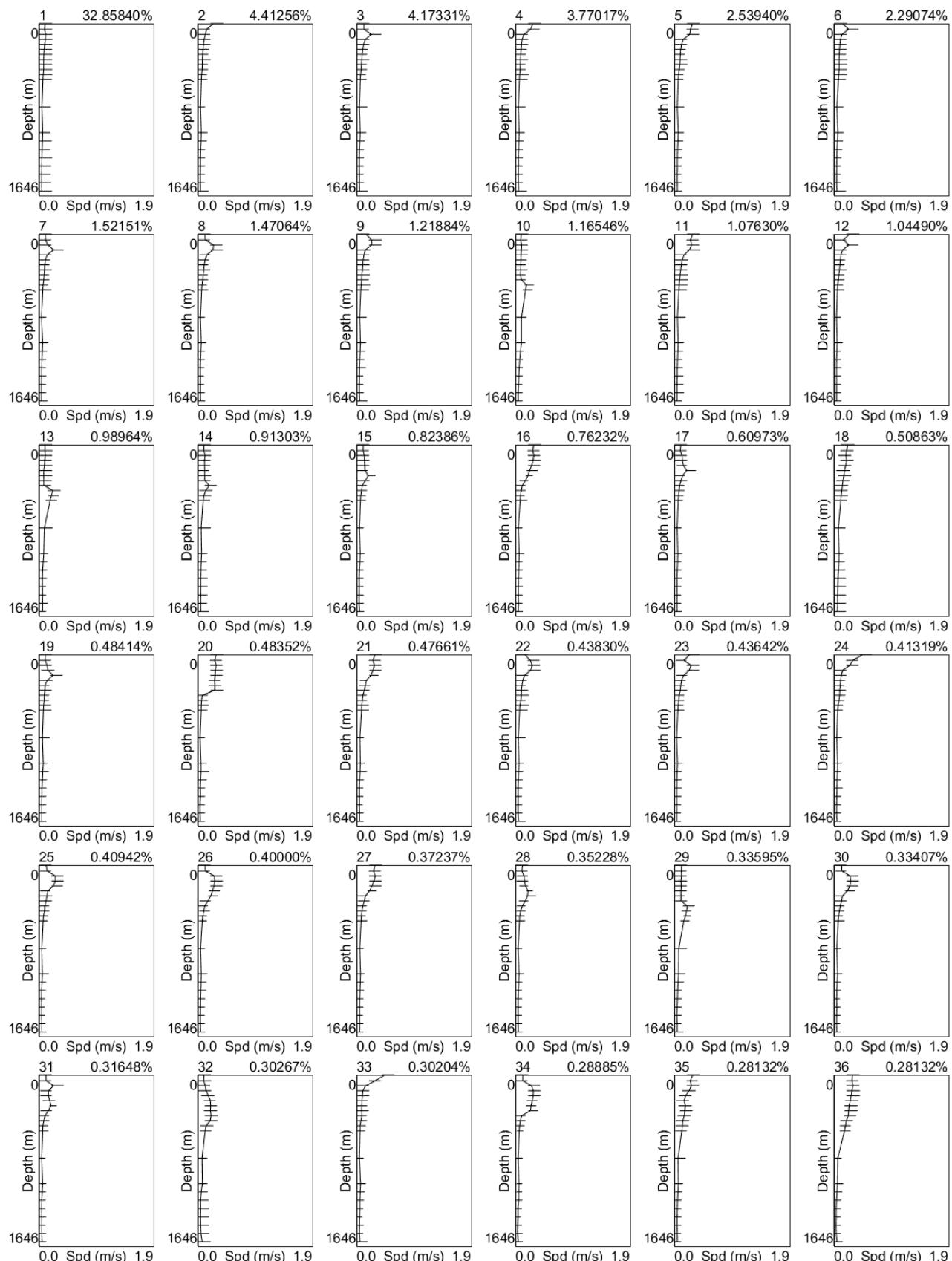


Figure C.2 Current Profile Characterization Profiles 1-36



Figure C.3 Current Profile Characterization Profiles 37 – 72

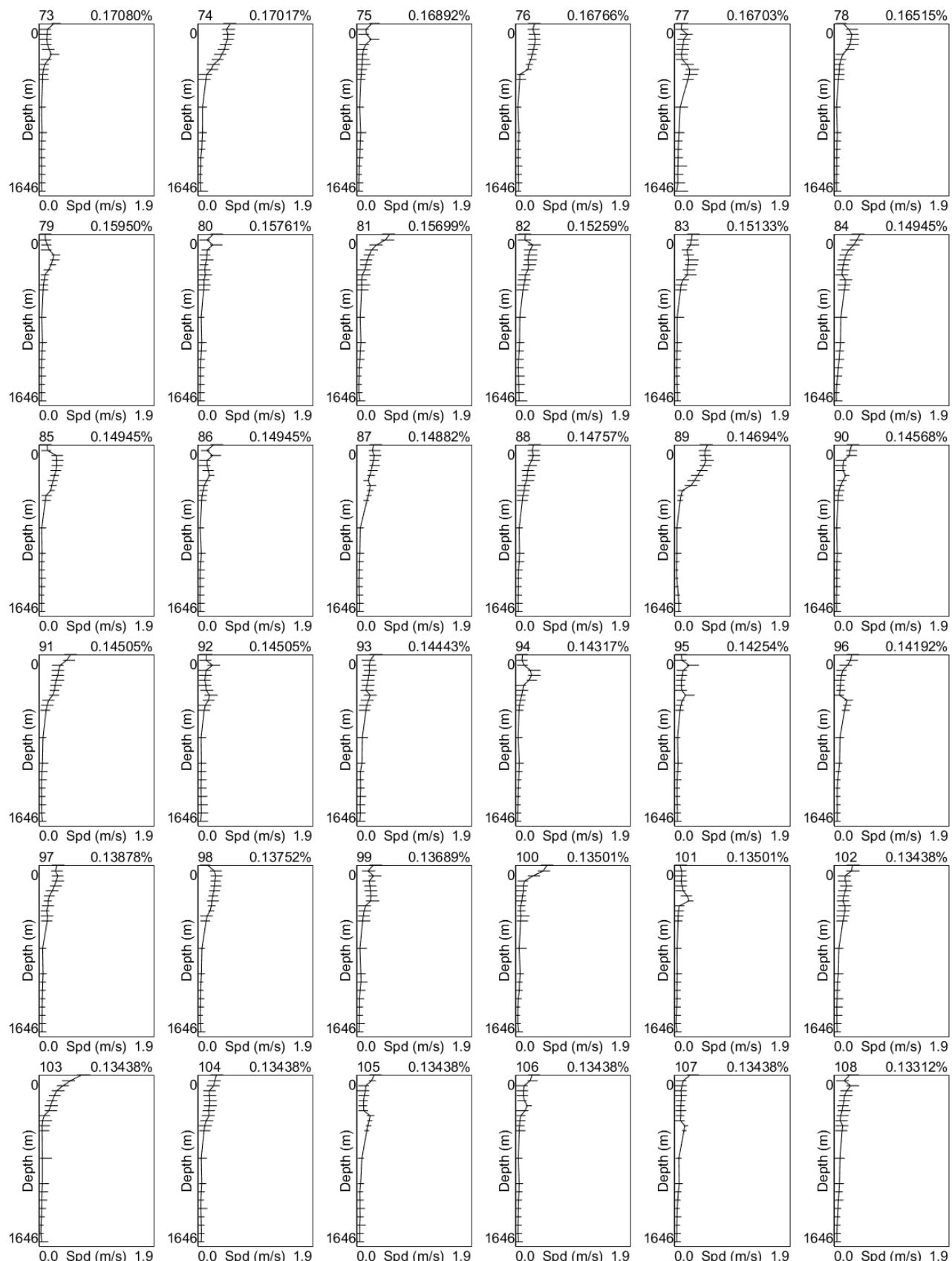


Figure C.4 Current Profile Characterization Profiles 73 – 108

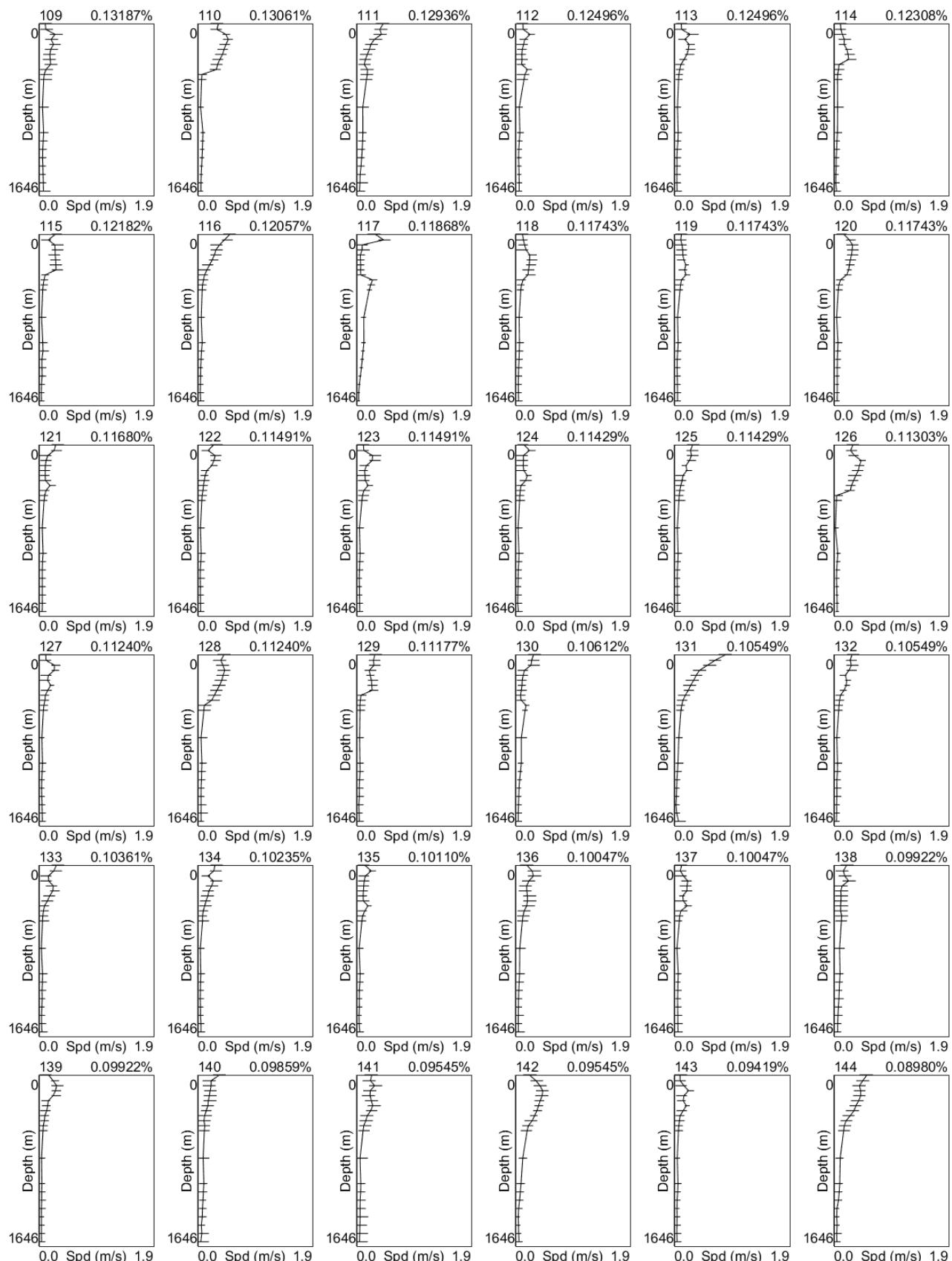


Figure C.5 Current Profile Characterization Profiles 109 – 144



Figure C.6 Current Profile Characterization Profiles 145 – 180

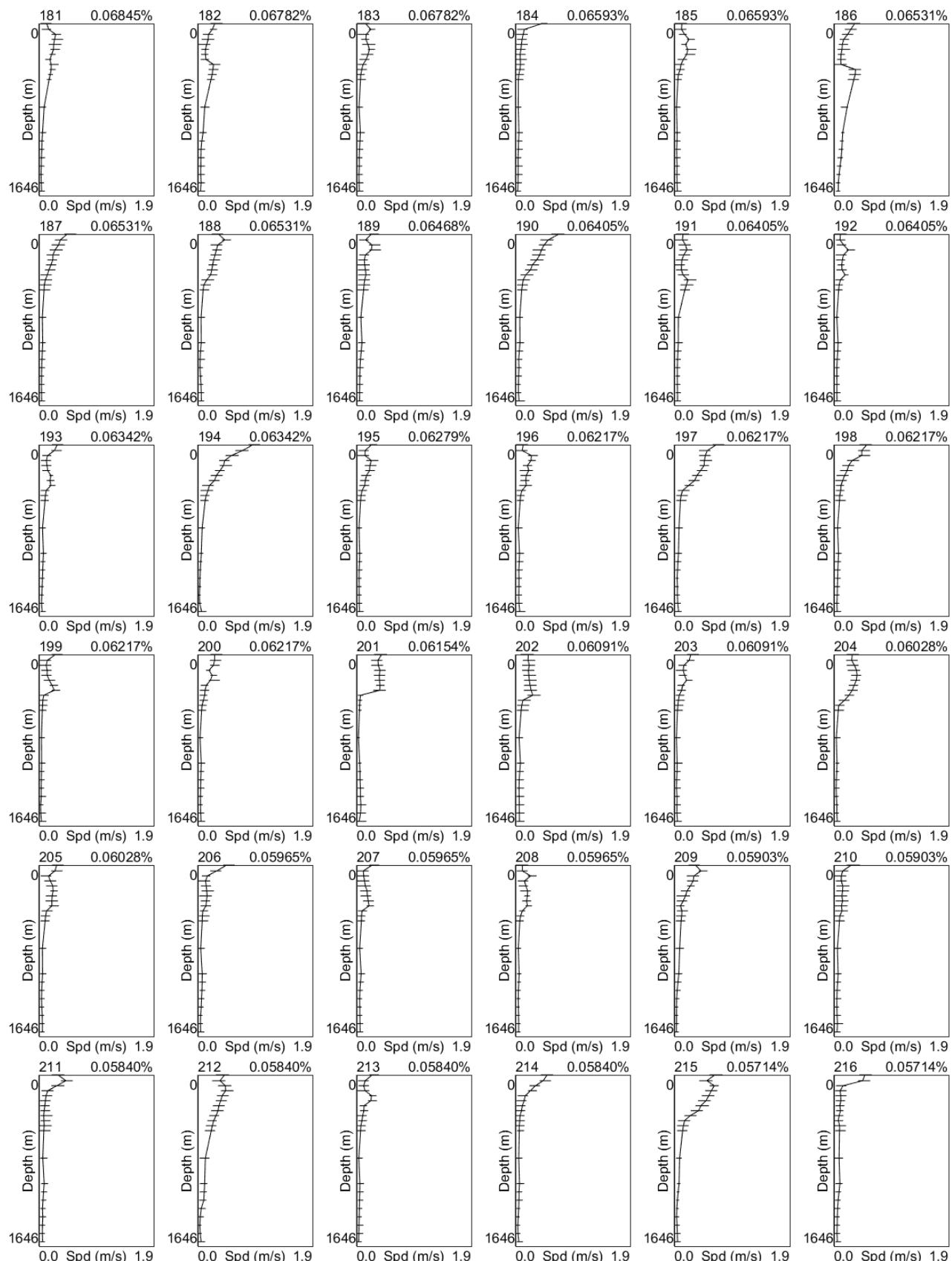


Figure C.7 Current Profile Characterization Profiles 181 – 216

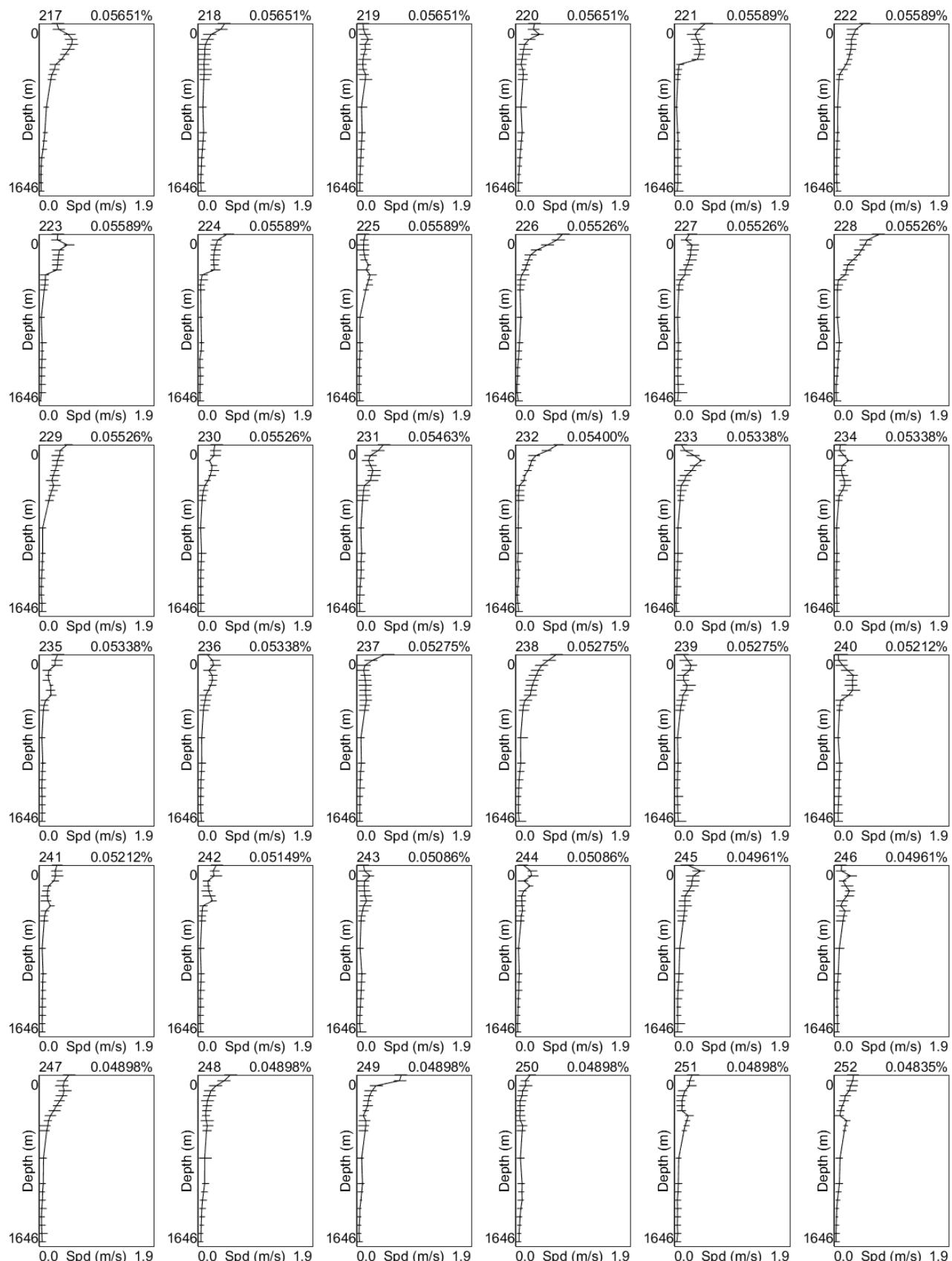


Figure C.8 Current Profile Characterization Profiles 217 – 252

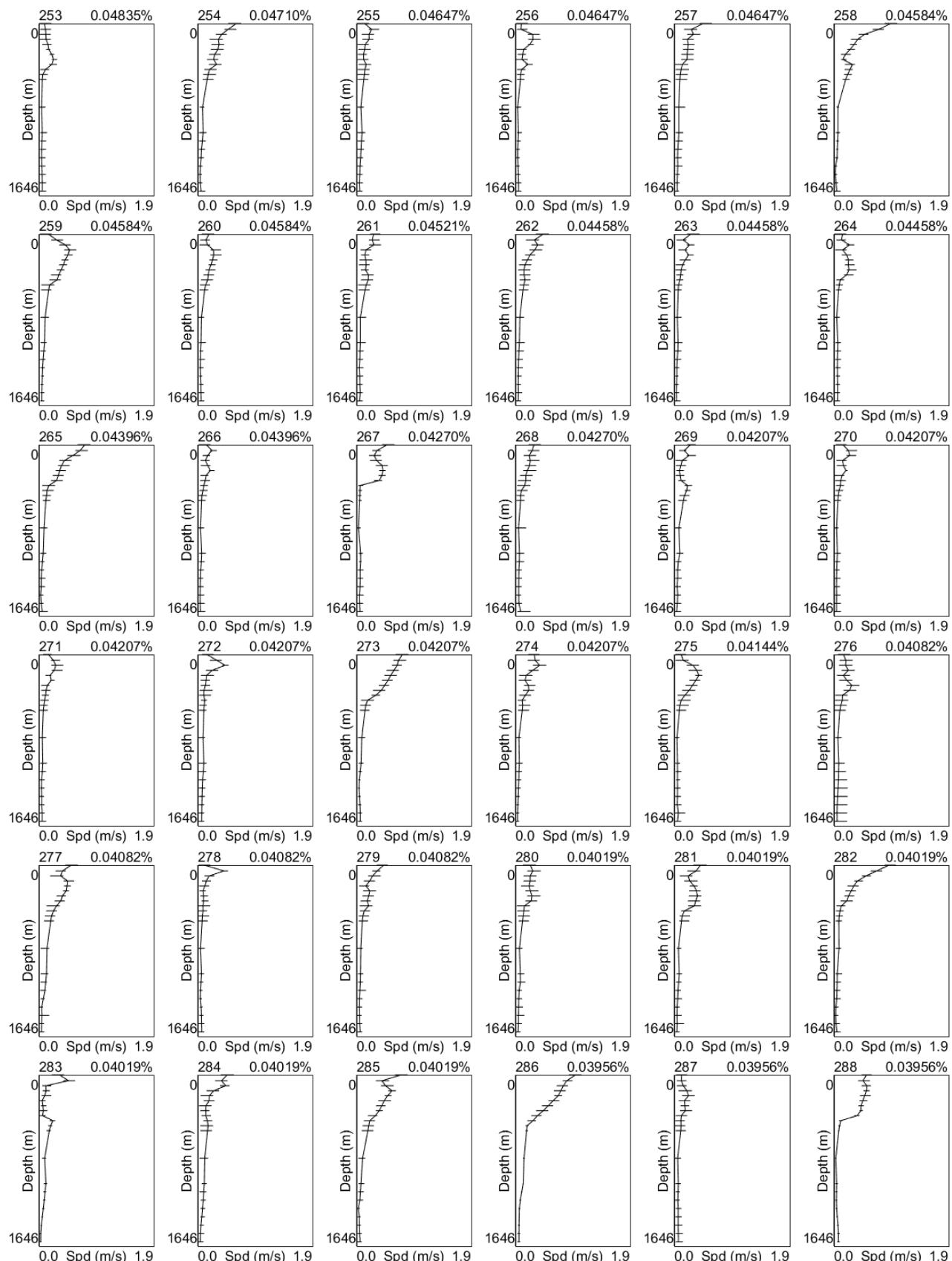


Figure C.9 Current Profile Characterization Profiles 253 – 288

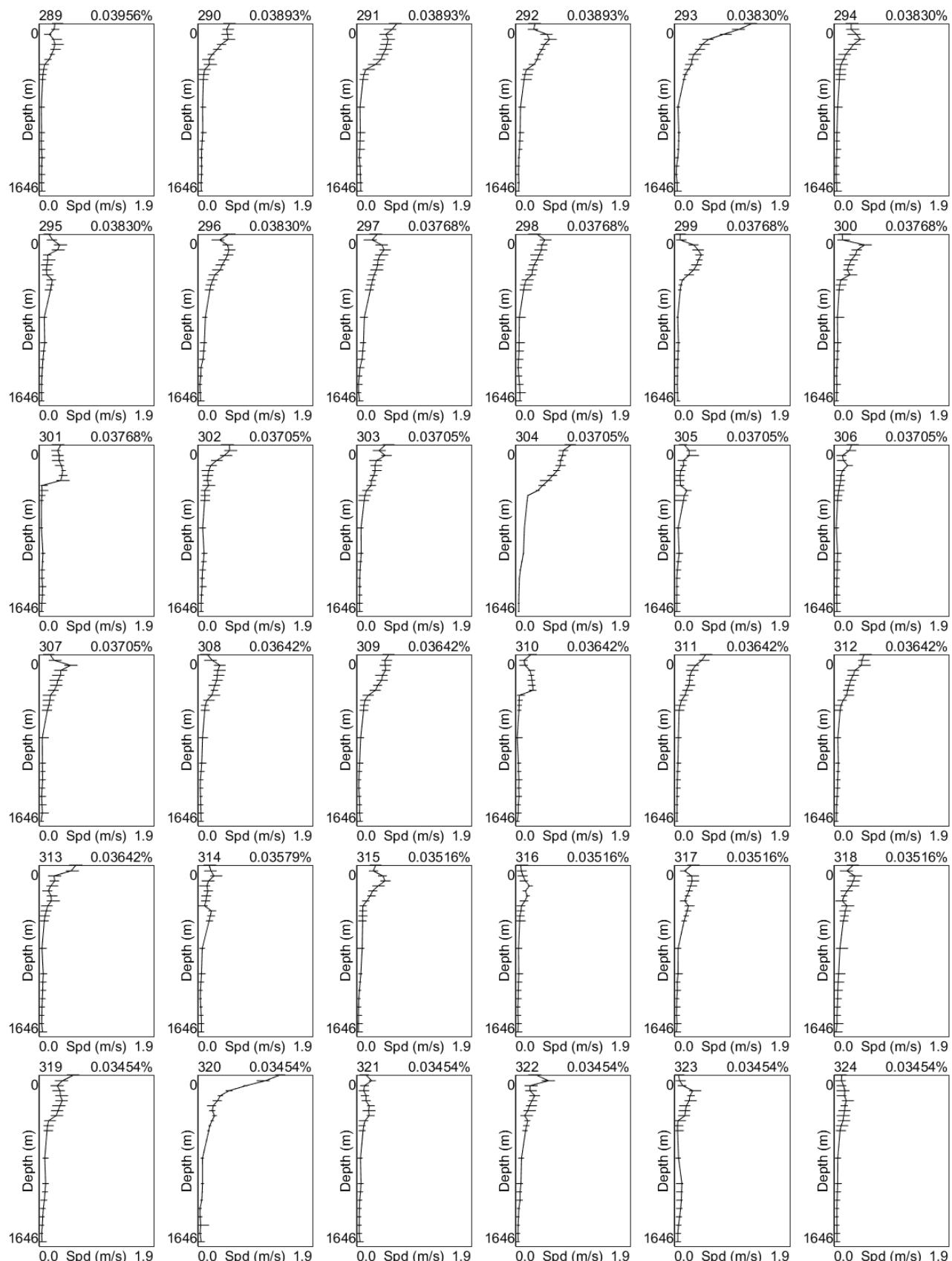


Figure C.10 Current Profile Characterization Profiles 289 – 324



Figure C.11 Current Profile Characterization Profiles 325 – 360

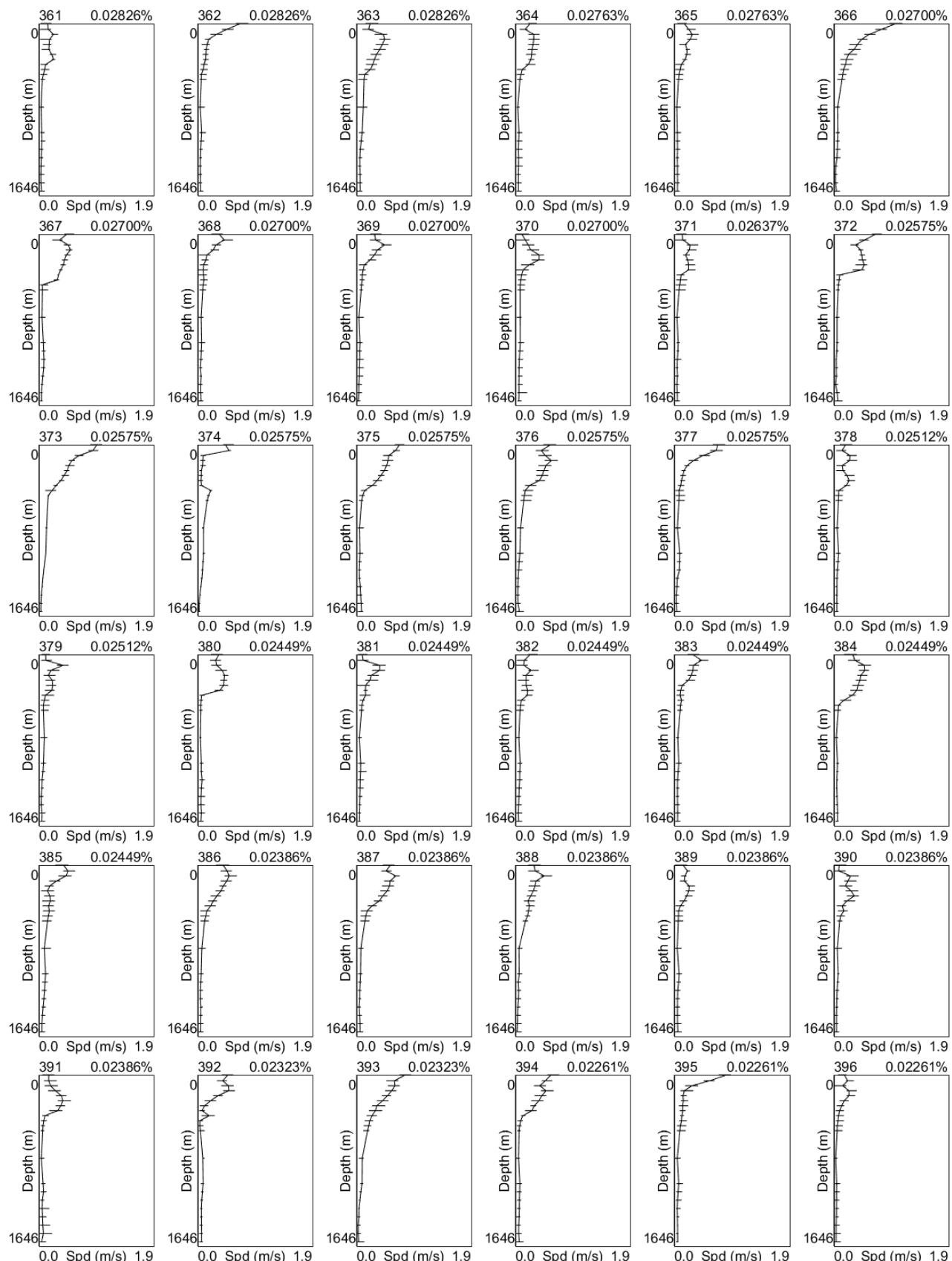


Figure C.12 Current Profile Characterization Profiles 361 – 396

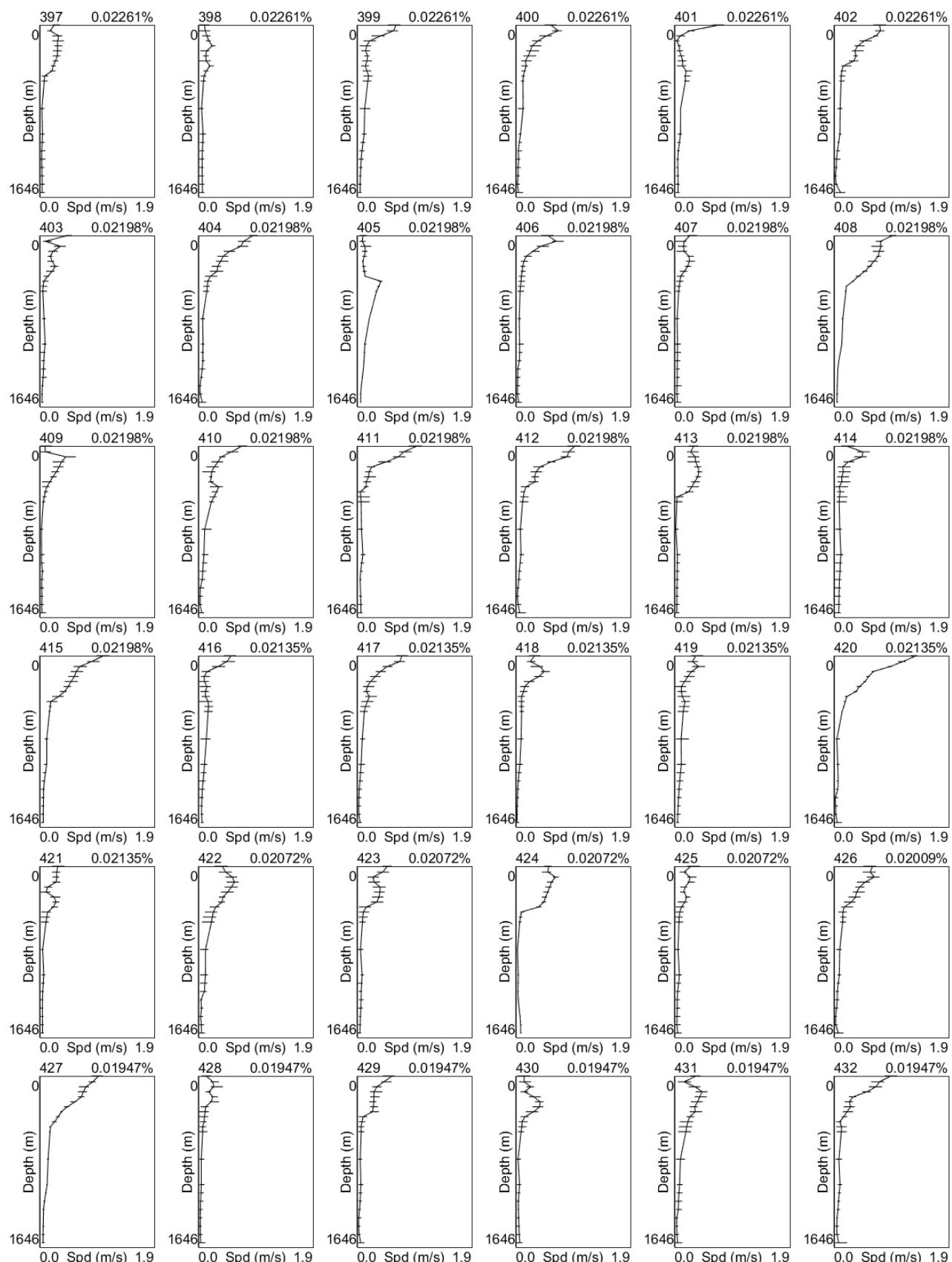


Figure C.13 Current Profile Characterization Profiles 397 – 432

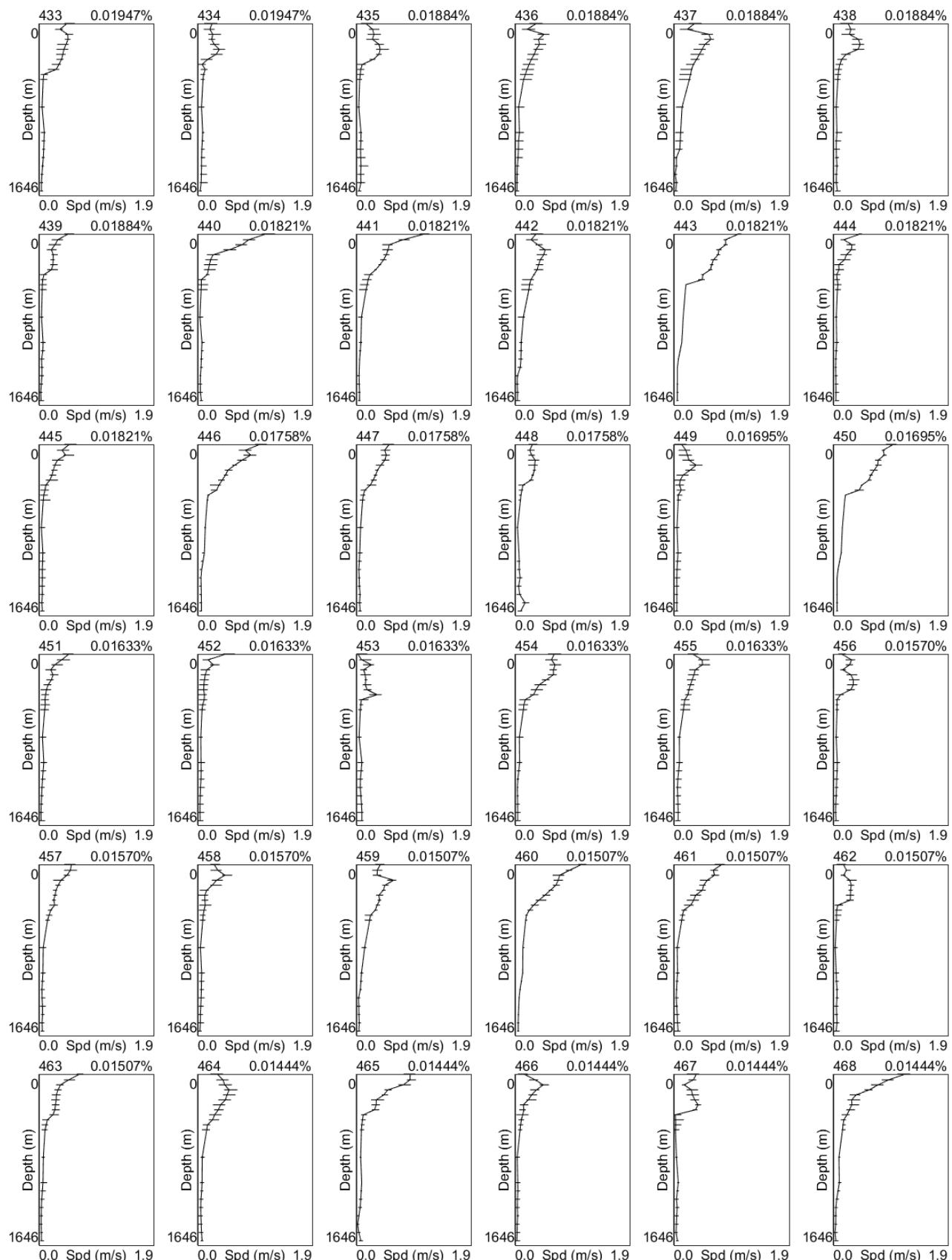


Figure C.14 Current Profile Characterization Profiles 433 – 468

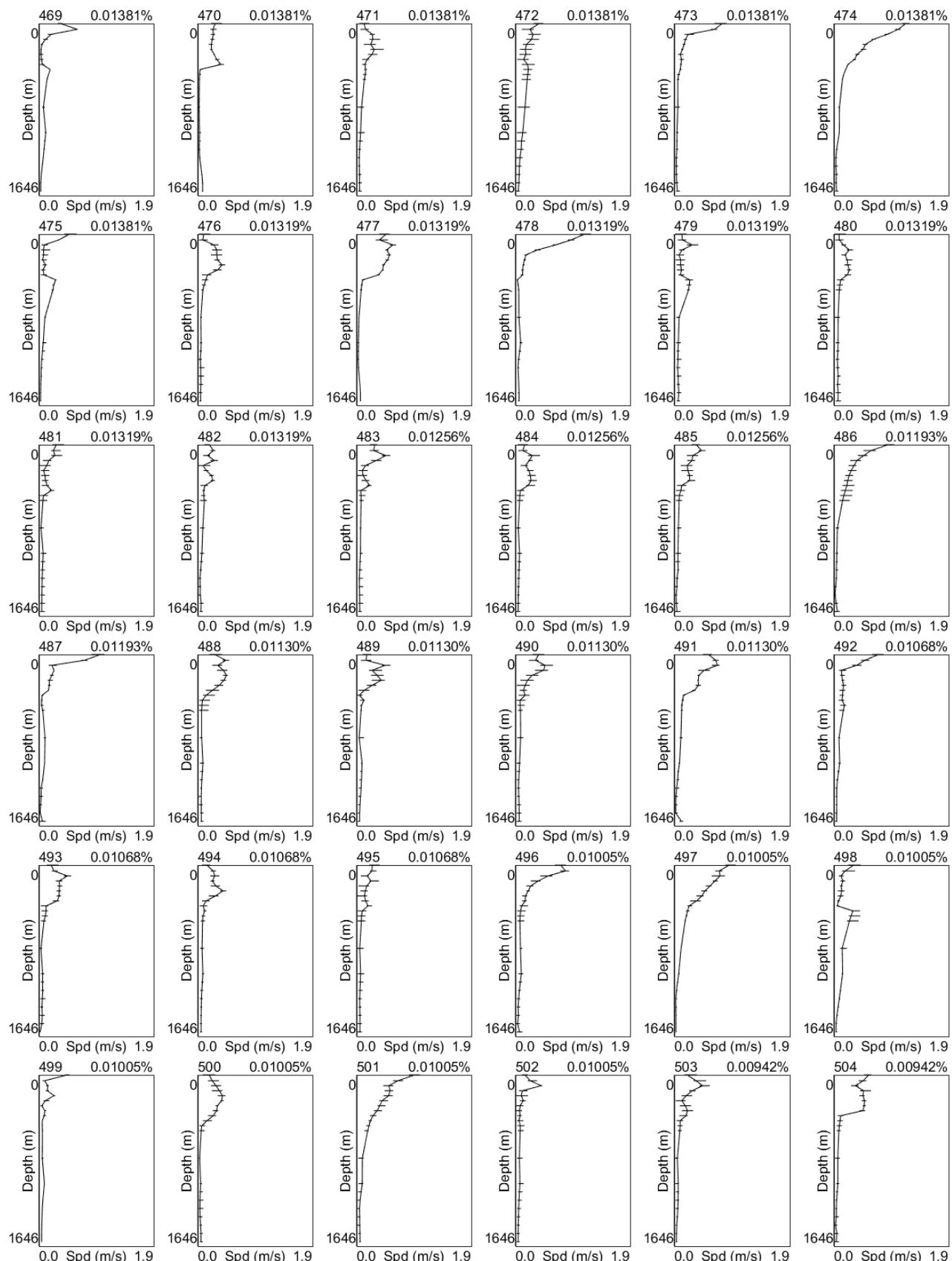


Figure C.15 Current Profile Characterization Profiles 469 – 504

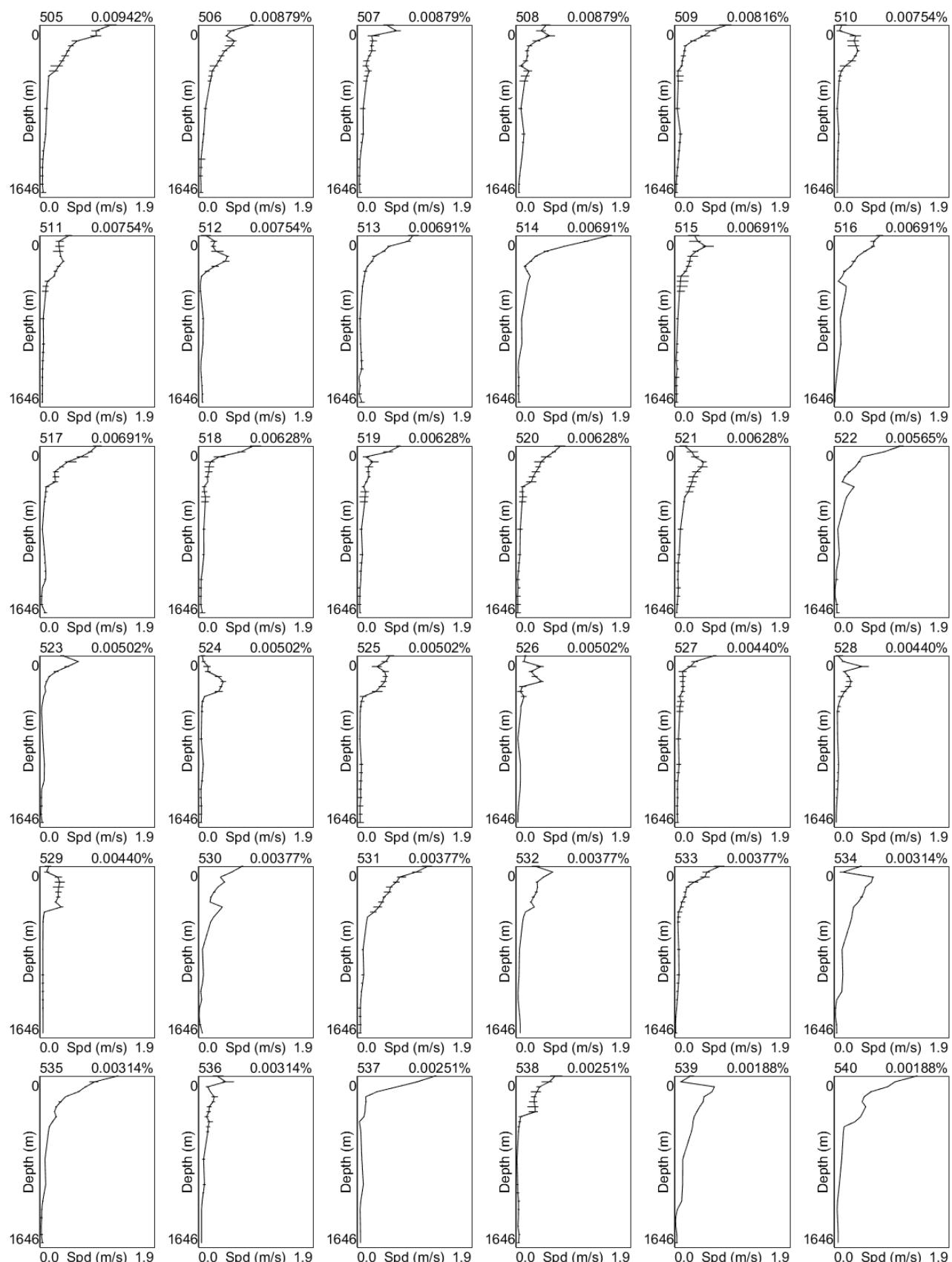


Figure C.16 Current Profile Characterization Profiles 505 – 540

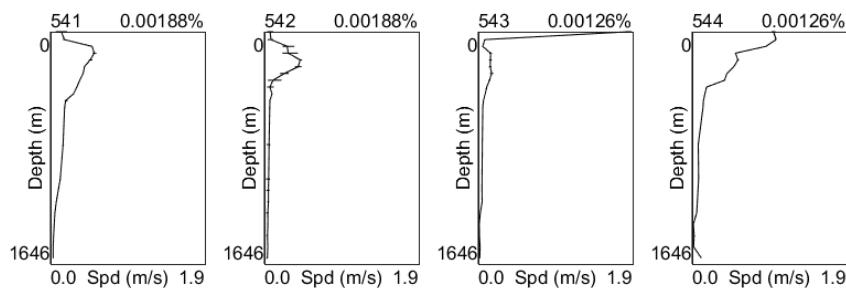


Figure C.17 Current Profile Characterization Profiles 541 – 544

D. SEAWATER PROPERTIES

Table 15.5 Monthly and All-Year Operational Seawater Temperature Statistics at 0ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Temperature at 0ft [°F]				EXCEEDENCE PERCENTILE FOR Seawater Temperature at 0ft [°F]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	63.06	70.37	75.94	2.05	64.83	65.54	66.99	67.90	70.46	72.71	73.54	75.20
February	63.54	69.44	75.93	2.36	63.94	64.18	65.20	66.59	69.55	72.35	73.17	74.81
March	62.02	70.39	77.39	2.54	64.85	65.20	65.98	67.00	70.45	73.55	74.55	76.29
April	65.54	73.10	80.19	2.36	67.61	68.05	69.09	70.15	73.09	75.98	76.80	78.86
May	70.89	78.04	84.74	2.62	71.98	72.53	73.45	74.75	78.02	81.50	82.21	83.32
June	76.69	83.48	90.66	2.17	78.08	78.88	79.93	80.90	83.36	86.36	87.23	88.33
July	81.69	85.90	90.76	1.47	82.76	83.03	83.59	84.08	85.85	87.88	88.45	89.61
August	81.85	86.25	90.80	1.53	82.71	83.10	83.72	84.24	86.27	88.20	88.68	90.05
September	78.53	84.28	88.45	1.60	79.89	80.69	81.35	82.08	84.40	86.22	86.75	87.50
October	76.65	80.54	85.00	1.66	77.12	77.37	77.95	78.40	80.44	82.92	83.38	84.01
November	72.91	76.81	82.84	1.60	73.35	73.63	74.09	74.75	76.87	78.77	79.18	80.80
December	68.35	73.36	77.88	1.74	69.31	69.68	70.30	70.88	73.42	75.53	76.21	77.09
All Year	62.02	77.70	90.80	6.38	65.75	66.77	68.08	69.43	77.41	86.12	87.04	88.54

Table 15.6 Monthly and All-Year Operational Seawater Salinity Statistics at 0ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Salinity at 0ft [PSU]				EXCEEDENCE PERCENTILE FOR Seawater Salinity at 0ft [PSU]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	32.16	36.03	36.48	0.41	34.47	34.68	35.16	35.60	36.13	36.35	36.39	36.45
February	32.12	35.54	36.91	0.71	33.52	33.81	34.11	34.53	35.71	36.29	36.39	36.49
March	30.14	34.99	36.48	0.72	32.86	33.42	33.72	34.02	35.06	35.89	36.11	36.29
April	30.40	34.75	36.45	0.71	32.61	33.17	33.58	33.94	34.80	35.60	35.79	36.15
May	28.55	34.53	36.34	0.85	31.07	31.66	33.20	33.82	34.57	35.38	35.68	36.13
June	29.26	34.02	36.37	0.77	31.40	32.07	32.73	33.17	34.05	34.86	35.16	35.84
July	29.16	33.39	36.06	0.90	30.44	30.71	31.73	32.45	33.48	34.35	34.61	35.52
August	29.91	33.33	35.51	0.64	30.94	31.69	32.30	32.63	33.43	33.98	34.12	34.56
September	32.01	34.02	35.74	0.53	32.81	32.94	33.23	33.38	34.00	34.69	34.95	35.32
October	33.13	34.72	36.04	0.44	33.59	33.72	33.97	34.14	34.76	35.25	35.38	35.85
November	34.28	35.46	36.69	0.31	34.80	34.88	34.96	35.05	35.49	35.81	35.98	36.28
December	34.25	35.84	36.38	0.24	35.12	35.29	35.44	35.55	35.87	36.13	36.17	36.25
All Year	28.55	34.71	36.91	1.07	31.74	32.39	32.94	33.33	34.80	36.06	36.22	36.38

Table 15.7 Monthly and All-Year Operational Seawater Oxygen Statistics at 0ft

COMBINED PERIOD (2010)	STATISTICS											
	Seawater Oxygen at 0ft [ml/l]				EXCEEDENCE PERCENTILE FOR Seawater Oxygen at 0ft [ml/l]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January												
February												
March												
April												
May	0.10	4.48	6.57	0.86	0.89	1.73	2.95	3.65	4.66	5.06	5.47	6.47
June	1.89	4.38	6.25	0.69	2.30	2.48	3.08	3.36	4.53	5.02	5.20	6.15
July	0.47	4.27	5.89	0.76	1.20	2.55	3.09	3.26	4.41	4.96	5.09	5.63
August	1.85	4.20	6.65	0.77	1.96	2.08	2.71	3.22	4.31	4.99	5.46	6.48
September	2.17	4.04	5.44	0.56	2.22	2.64	3.00	3.33	4.15	4.64	4.94	5.43
October	4.44	4.58	4.83	0.18	4.44	4.44	4.44	4.44	4.48	4.83	4.83	4.83
November												
December												
All Year	0.10	4.31	6.65	0.75	1.87	2.28	3.05	3.34	4.41	4.97	5.21	6.27

Table 15.8 Monthly and All-Year Operational Seawater Temperature Statistics at 328ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Temperature at 328ft [°F]				EXCEEDENCE PERCENTILE FOR Seawater Temperature at 328ft [°F]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	62.95	67.66	72.39	1.64	64.14	64.51	65.04	65.46	67.77	69.80	70.34	71.23
February	61.40	66.79	71.18	1.84	62.02	63.18	63.86	64.52	66.63	69.25	69.95	70.84
March	61.54	66.01	71.23	1.85	62.52	62.83	63.37	63.82	65.75	68.73	69.58	70.28
April	59.52	65.59	70.11	1.76	61.64	61.99	62.63	63.22	65.51	67.93	68.46	69.38
May	59.63	66.08	70.55	1.69	62.11	62.36	62.80	63.50	66.40	67.93	68.24	68.74
June	61.88	66.85	71.28	1.55	62.93	63.66	64.28	64.90	66.84	68.78	69.55	70.97
July	59.58	66.42	71.53	1.93	60.81	61.84	63.30	64.05	66.45	69.04	69.59	70.62
August	57.48	66.56	71.23	2.31	60.18	61.01	62.35	63.28	66.84	69.35	69.81	70.61
September	56.73	66.19	71.44	1.89	60.67	61.68	62.76	63.90	66.45	68.34	69.04	69.91
October	60.34	66.38	72.54	1.79	62.15	62.89	63.69	64.31	66.30	68.49	69.38	72.10
November	59.57	66.08	74.72	2.10	61.43	61.78	62.44	63.51	66.08	68.33	69.02	72.97
December	58.33	66.16	72.94	2.18	60.81	61.39	62.45	63.59	66.23	68.50	69.27	72.13
All Year	56.73	66.40	74.72	1.96	61.54	62.19	63.10	63.95	66.46	68.82	69.55	70.96

Table 15.9 Monthly and All-Year Operational Seawater Salinity Statistics at 328ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Salinity at 328ft [PSU]				EXCEEDENCE PERCENTILE FOR Seawater Salinity at 328ft [PSU]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	35.67	36.30	36.48	0.12	35.85	35.92	36.04	36.12	36.34	36.40	36.42	36.45
February	35.77	36.26	36.60	0.14	35.85	35.89	35.97	36.05	36.31	36.39	36.43	36.50
March	35.48	36.29	36.53	0.09	35.99	36.05	36.11	36.20	36.30	36.38	36.41	36.47
April	35.83	36.30	36.48	0.07	36.00	36.09	36.21	36.24	36.31	36.37	36.39	36.45
May	36.10	36.32	36.52	0.04	36.22	36.23	36.25	36.27	36.32	36.35	36.37	36.45
June	36.22	36.33	36.49	0.03	36.24	36.26	36.28	36.29	36.33	36.36	36.38	36.43
July	36.02	36.33	36.61	0.06	36.13	36.20	36.26	36.29	36.33	36.36	36.41	36.53
August	35.80	36.34	36.51	0.06	36.10	36.17	36.23	36.28	36.35	36.39	36.42	36.46
September	35.85	36.36	36.53	0.05	36.14	36.24	36.28	36.31	36.37	36.40	36.41	36.47
October	36.15	36.38	36.60	0.04	36.26	36.28	36.32	36.34	36.39	36.42	36.44	36.47
November	36.04	36.40	36.60	0.05	36.17	36.25	36.32	36.36	36.41	36.45	36.48	36.54
December	35.90	36.36	36.64	0.07	36.06	36.13	36.24	36.30	36.37	36.43	36.44	36.49
All Year	35.48	36.33	36.64	0.09	35.99	36.06	36.19	36.25	36.34	36.41	36.43	36.49

Table 15.10 Monthly and All-Year Operational Seawater Oxygen Statistics at 328ft

COMBINED PERIOD (2010)	STATISTICS											
	Seawater Oxygen at 328ft [ml/l]				EXCEEDENCE PERCENTILE FOR Seawater Oxygen at 328ft [ml/l]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January												
February												
March												
April												
May	3.07	4.21	5.23	0.50	3.11	3.31	3.44	3.51	4.45	4.71	4.90	5.19
June	3.26	4.41	5.08	0.43	3.31	3.39	3.55	3.74	4.49	4.89	5.01	5.08
July	1.79	4.38	4.80	0.34	2.59	3.68	4.01	4.13	4.41	4.66	4.73	4.79
August	3.27	4.08	4.53	0.24	3.30	3.34	3.66	3.77	4.12	4.31	4.40	4.50
September	2.29	3.75	4.42	0.41	2.29	2.31	2.75	3.39	3.86	4.15	4.25	4.40
October	2.97	2.99	3.01	0.02	2.97	2.97	2.97	2.97	2.99	3.01	3.01	3.01
November												
December												
All Year	1.79	4.22	5.23	0.46	2.96	3.26	3.48	3.64	4.28	4.74	4.85	5.08

Table 15.11 Monthly and All-Year Operational Seawater Temperature Statistics at 1640ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Temperature at 1640ft [°F]				EXCEEDENCE PERCENTILE FOR Seawater Temperature at 1640ft [°F]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	43.76	46.85	49.56	0.84	44.44	44.92	45.45	45.80	46.93	47.81	48.11	48.88
February	44.34	46.73	49.16	0.87	44.65	44.90	45.14	45.51	46.80	47.72	48.08	48.70
March	44.18	46.60	49.33	0.94	44.55	44.70	44.98	45.31	46.56	47.84	48.14	48.84
April	43.01	45.83	48.35	1.00	43.67	43.83	44.17	44.52	45.79	47.23	47.54	47.87
May	43.09	45.70	47.99	1.00	43.62	43.90	44.13	44.40	45.78	47.01	47.23	47.57
June	43.11	45.84	50.27	1.05	43.78	43.98	44.33	44.67	45.71	47.21	47.71	49.24
July	42.99	45.62	49.37	1.10	43.58	43.75	44.02	44.28	45.52	47.26	47.84	48.47
August	43.45	46.09	49.78	1.26	43.72	43.84	44.16	44.47	46.09	47.70	48.36	49.45
September	42.61	46.00	49.81	1.02	43.75	44.06	44.38	44.71	46.08	47.28	47.71	48.53
October	44.20	46.25	49.13	0.96	44.49	44.57	44.78	45.04	46.15	47.63	48.08	48.68
November	42.87	45.88	49.83	1.06	43.25	43.57	44.08	44.63	45.94	47.11	47.51	48.46
December	42.61	46.04	49.52	1.27	43.24	43.48	43.96	44.26	46.13	47.67	48.05	48.87
All Year	42.61	46.12	50.27	1.11	43.70	43.95	44.31	44.66	46.15	47.54	47.92	48.76

Table 15.12 Monthly and All-Year Operational Seawater Salinity Statistics at 1640ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Salinity at 1640ft [PSU]				EXCEEDENCE PERCENTILE FOR Seawater Salinity at 1640ft [PSU]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	34.67	35.00	35.23	0.07	34.82	34.86	34.88	34.91	35.00	35.08	35.10	35.15
February	34.84	34.98	35.17	0.06	34.86	34.87	34.89	34.91	34.98	35.06	35.08	35.13
March	34.81	34.97	35.21	0.07	34.82	34.84	34.87	34.88	34.97	35.07	35.09	35.15
April	34.74	34.92	35.10	0.08	34.77	34.78	34.80	34.82	34.91	35.03	35.05	35.07
May	34.71	34.91	35.10	0.07	34.75	34.77	34.79	34.81	34.91	35.00	35.02	35.05
June	34.72	34.91	35.26	0.08	34.76	34.77	34.79	34.82	34.90	35.01	35.05	35.17
July	34.70	34.89	35.17	0.08	34.74	34.76	34.78	34.80	34.89	35.01	35.06	35.10
August	34.78	34.94	35.22	0.08	34.79	34.80	34.81	34.83	34.93	35.04	35.10	35.19
September	34.75	34.93	35.18	0.07	34.79	34.80	34.81	34.84	34.93	35.01	35.03	35.13
October	34.79	34.94	35.15	0.07	34.81	34.83	34.84	34.85	34.93	35.05	35.07	35.12
November	34.73	34.91	35.20	0.07	34.76	34.77	34.81	34.83	34.91	35.00	35.02	35.08
December	34.72	34.94	35.26	0.09	34.73	34.76	34.80	34.82	34.94	35.05	35.08	35.15
All Year	34.67	34.94	35.26	0.08	34.77	34.78	34.81	34.83	34.94	35.04	35.07	35.13

Table 15.13 Monthly and All-Year Operational Seawater Oxygen Statistics at 1640ft

COMBINED PERIOD (2010)	STATISTICS											
	Seawater Oxygen at 1640ft [ml/l]				EXCEEDENCE PERCENTILE FOR Seawater Oxygen at 1640ft [ml/l]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January												
February												
March												
April												
May	2.56	2.66	3.00	0.07	2.57	2.57	2.58	2.59	2.65	2.74	2.80	2.94
June	2.52	2.72	2.96	0.10	2.52	2.54	2.57	2.58	2.72	2.88	2.90	2.94
July	1.52	2.72	2.90	0.14	1.98	2.52	2.55	2.67	2.73	2.80	2.83	2.89
August	2.51	2.64	2.79	0.07	2.51	2.52	2.53	2.55	2.62	2.73	2.74	2.79
September	1.85	2.63	2.93	0.18	1.85	1.86	2.49	2.51	2.64	2.78	2.79	2.93
October												
November												
December												
All Year	1.52	2.68	3.00	0.12	2.51	2.52	2.54	2.57	2.70	2.79	2.86	2.93

Table 15.14 Monthly and All-Year Operational Seawater Temperature Statistics at 4921ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Temperature at 4921ft [°F]				EXCEEDENCE PERCENTILE FOR Seawater Temperature at 4921ft [°F]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	39.46	39.73	39.95	0.08	39.46	39.49	39.57	39.65	39.74	39.81	39.83	39.86
February	39.49	39.71	39.82	0.06	39.50	39.51	39.60	39.65	39.72	39.78	39.79	39.80
March	39.49	39.72	39.89	0.06	39.54	39.57	39.59	39.65	39.72	39.78	39.81	39.85
April	39.52	39.72	39.88	0.06	39.54	39.58	39.60	39.64	39.73	39.78	39.82	39.86
May	39.53	39.72	39.83	0.05	39.54	39.54	39.61	39.64	39.74	39.78	39.79	39.81
June	39.53	39.71	39.78	0.05	39.55	39.58	39.61	39.64	39.73	39.76	39.77	39.78
July	39.55	39.71	39.81	0.04	39.58	39.58	39.61	39.64	39.72	39.75	39.76	39.78
August	39.58	39.71	39.80	0.04	39.59	39.59	39.61	39.65	39.72	39.74	39.75	39.75
September	39.59	39.71	39.85	0.04	39.59	39.59	39.61	39.65	39.72	39.75	39.76	39.78
October	39.58	39.71	39.85	0.04	39.60	39.60	39.62	39.65	39.72	39.76	39.78	39.81
November	39.59	39.73	39.87	0.05	39.61	39.61	39.62	39.65	39.73	39.79	39.80	39.82
December	39.59	39.74	39.88	0.06	39.61	39.62	39.64	39.66	39.74	39.82	39.83	39.85
All Year	39.46	39.72	39.95	0.05	39.53	39.58	39.61	39.65	39.73	39.78	39.80	39.84

Table 15.15 Monthly and All-Year Operational Seawater Salinity Statistics at 4921ft

COMBINED PERIOD (1993 to 2012)	STATISTICS											
	Seawater Salinity at 4921ft [PSU]				EXCEEDENCE PERCENTILE FOR Seawater Salinity at 4921ft [PSU]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	34.95	34.97	35.00	0.01	34.95	34.95	34.96	34.96	34.98	34.98	34.99	34.99
February	34.95	34.97	34.99	0.01	34.95	34.95	34.96	34.97	34.97	34.98	34.98	34.99
March	34.96	34.97	35.00	0.01	34.96	34.96	34.96	34.97	34.97	34.98	34.98	34.99
April	34.96	34.97	34.99	0.01	34.96	34.96	34.96	34.97	34.97	34.98	34.98	34.99
May	34.96	34.97	34.98	0.01	34.96	34.96	34.96	34.96	34.97	34.98	34.98	34.98
June	34.96	34.97	34.98	0.01	34.96	34.96	34.96	34.96	34.97	34.98	34.98	34.98
July	34.95	34.97	35.01	0.01	34.96	34.96	34.96	34.96	34.97	34.98	34.98	34.98
August	34.95	34.97	34.98	0.01	34.96	34.96	34.96	34.96	34.97	34.97	34.98	34.98
September	34.94	34.97	34.99	0.01	34.95	34.95	34.96	34.96	34.97	34.97	34.98	34.98
October	34.94	34.97	34.99	0.01	34.95	34.95	34.95	34.96	34.97	34.98	34.98	34.98
November	34.95	34.97	34.99	0.01	34.95	34.95	34.96	34.96	34.97	34.98	34.98	34.98
December	34.95	34.97	35.00	0.01	34.96	34.96	34.96	34.96	34.98	34.98	34.99	34.99
All Year	34.94	34.97	35.01	0.01	34.95	34.96	34.96	34.96	34.97	34.98	34.98	34.99

Table 15.16 Monthly and All-Year Operational Seawater Oxygen Statistics at 4921ft

COMBINED PERIOD (2010)	STATISTICS											
	Seawater Oxygen at 4921ft [ml/l]				EXCEEDENCE PERCENTILE FOR Seawater Oxygen at 4921ft [ml/l]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January												
February												
March												
April												
May	4.37	4.64	4.90	0.15	4.37	4.38	4.39	4.41	4.65	4.79	4.88	4.90
June	4.46	4.72	4.89	0.12	4.46	4.47	4.48	4.49	4.76	4.81	4.86	4.89
July	4.39	4.75	4.91	0.10	4.39	4.41	4.54	4.62	4.76	4.85	4.89	4.91
August	4.38	4.55	4.72	0.09	4.38	4.39	4.43	4.44	4.53	4.69	4.70	4.72
September	3.30	4.57	5.06	0.34	3.30	3.30	3.73	4.42	4.58	4.79	4.95	5.06
October												
November												
December												
All Year	3.30	4.65	5.06	0.17	4.38	4.39	4.43	4.46	4.71	4.81	4.86	4.90

E. AIR TEMPERATURE

Table 15.17 Monthly and All-Year Operational Near Surface Air Temperature Statistics

COMBINED PERIOD (2005 to 2015)	STATISTICS											
	Near Surface Air Temperature [°F]				EXCEEDENCE PERCENTILE FOR Near Surface Air Temperature [°F]							
	MIN	MEAN	MAX	STD DEV.	99	98	95	90	50	10	5	1
January	27.77	58.59	75.11	8.99	34.33	36.87	42.30	46.29	59.27	69.53	70.84	72.95
February	35.15	59.15	74.21	8.20	39.79	42.04	44.60	47.21	60.17	69.35	70.79	72.95
March	40.55	63.61	75.29	7.05	44.54	46.95	50.40	53.33	65.03	71.69	72.77	74.03
April	45.77	69.07	79.07	4.96	52.38	55.11	59.54	62.51	69.89	74.21	75.29	76.78
May	57.29	74.12	83.03	3.56	61.97	64.49	67.19	69.33	74.75	77.81	78.71	80.33
June	72.59	79.66	85.19	1.95	74.39	75.09	76.55	77.27	79.61	82.13	83.03	84.29
July	72.77	80.96	86.45	1.49	77.27	77.81	78.53	79.07	80.96	82.85	83.39	84.11
August	74.39	81.97	88.07	1.88	77.09	77.45	78.71	79.59	82.13	84.11	84.83	86.45
September	70.25	79.72	85.01	2.29	72.54	73.31	75.29	76.73	80.15	82.13	82.49	83.39
October	51.35	73.39	83.21	5.57	56.60	58.51	61.79	65.21	74.39	79.63	80.51	81.77
November	41.27	65.72	79.07	6.96	47.17	49.55	52.79	55.76	67.01	73.49	74.75	77.27
December	37.67	62.22	76.55	8.21	41.68	44.65	48.11	50.63	63.23	72.05	73.49	75.47
All Year	27.77	70.74	88.07	10.14	43.43	46.49	51.35	55.85	72.59	81.77	82.67	84.11

F. MARINE GROWTH

The marine growth in the Gulf of Mexico may be taken as the following Table (based on Table C.21 in API RP 2MET¹), unless site-specific studies are conducted to determine more appropriate values. Soft marine growth of varying thickness has been observed in depths as deep as 2000 m.

Table 15.18 Hard Shell Marine Growth.

Depth	Thickness (mm)
MHHW	38
-10 m from MLLW	38
-50 m from MLLW	10
-100 m from MLLW	10
-140 m from MLLW	0

The marine growth specific gravity is the ratio of the density of the growth to the reference density (e.g., sea water). In the Gulf of Mexico, a value of 1.2 may be used (Table C.21 in API RP 2MET).

The marine growth density may also be set to 1325 kg/m³ based on DNV 2007². The density of seawater is approximately 1025 kg/m³. This would give a value of specific gravity approximately at 1.3 (1325/1025~=1.3). This is slightly larger than the API recommendation.

In the Norsok standard³, it is mentioned that the weight of marine growth is classified as a variable functional action. Unless more accurate data are available, the specific weight of the marine growth in air may be set equal to 13 kN/m³. The specific weight is the weight per unit volume of a material. The equivalent marine growth density could be estimated as the weight divided by the acceleration due to gravity (~9.8 m/s²), which is equal to ~1327 kg/m³ (13000/9.8). This is consistent with the DNV standard.

The above density is for hard shell marine growth. The density for the soft marine growth may be considered as equivalent to that of sea water, i.e., specific gravity is equal to 1.0.

¹ API RP 2MET, First Edition, November, 2014: Derivation of Metocean Design and Operating Conditions.

² Det Norske Veritas, 2007: Environmental Conditions and Environmental Loads. Recommended Practice DNV-RP-C205.

³ Norsok Standard N-003, 2007: Actions and action effects.

G. CONDENSED DIRECTIONAL WAVE SCATTER DIAGRAM

Table 15.19 Condensed Directional Wave Scatter Diagram.

Bin	Sea State					Probability									Wind	Current
						omni	N	Wind	E	SE	S	SW	W	NW		
#	Hs Low	Hs High	Hs Mid	Tp	Tz	p	p	p	p	p	p	p	p	p	Vw	Surface Current
1	0.0	1.6	0.8	3.0	2.5	21.189899	0.963118	1.996310	3.398454	5.355001	3.423550	2.783753	2.214356	1.055356	17.71	0.27
2	1.6	3.3	2.5	4.7	3.6	42.480184	2.778212	5.171829	8.040650	11.360229	6.445883	3.449625	3.288616	1.945140	21.10	0.32
3	3.3	4.9	4.1	5.7	4.3	19.234655	2.512581	2.939873	3.849213	4.201541	2.939873	0.783857	0.852302	1.155416	24.49	0.37
4	4.9	6.6	5.7	6.5	4.8	9.287977	1.633552	1.459181	1.687005	1.497314	1.358143	0.364388	0.443914	0.844480	27.89	0.42
5	6.6	8.2	7.4	7.1	5.3	4.217511	0.967355	0.520833	0.612745	0.596449	0.563204	0.178935	0.251617	0.526374	31.28	0.47
6	8.2	9.8	9.0	7.7	5.7	2.067363	0.500626	0.227824	0.234016	0.267913	0.284861	0.100060	0.148297	0.303765	34.67	0.52
7	9.8	11.5	10.7	8.2	6.0	0.837310	0.146342	0.076267	0.107882	0.115705	0.127112	0.033571	0.099734	0.130697	38.07	0.57
8	11.5	13.1	12.3	8.7	6.3	0.312565	0.049541	0.027378	0.043023	0.045630	0.053452	0.017274	0.036504	0.039763	41.46	0.62
9	13.1	14.8	13.9	9.2	6.6	0.133957	0.009778	0.010104	0.032267	0.016296	0.027704	0.008474	0.015645	0.013689	44.85	0.67
10	14.8	16.4	15.6	9.6	6.8	0.067141	0.002607	0.002607	0.022489	0.009778	0.018578	0.003911	0.003911	0.003259	48.25	0.72
11	16.4	18.0	17.2	9.9	7.1	0.036504	-	0.001304	0.010756	0.011082	0.005541	0.002281	0.004563	0.000978	51.64	0.77
12	18.0	19.7	18.9	10.3	7.3	0.034548	-	0.001956	0.014667	0.010104	0.005215	0.001956	-	0.000652	55.04	0.83
13	19.7	21.3	20.5	10.6	7.5	0.024771	-	0.002281	0.006844	0.010430	0.003259	0.001304	-	0.000652	58.43	0.88
14	21.3	23.0	22.1	11.0	7.7	0.015319	-	0.000326	0.003585	0.009126	0.001956	-	-	0.000326	61.82	0.93
15	23.0	24.6	23.8	11.3	7.9	0.013037	-	-	0.003911	0.006519	0.001630	0.000326	-	0.000652	65.22	0.98
16	24.6	26.2	25.4	11.6	8.1	0.011082	-	-	0.002281	0.007170	0.000652	0.000326	-	0.000652	68.61	1.03
17	26.2	27.9	27.1	11.9	8.3	0.007170	-	-	0.003259	0.001956	0.001304	-	-	0.000652	72.00	1.08
18	27.9	29.5	28.7	12.1	8.5	0.005867	-	-	0.000978	0.003585	0.000326	-	-	0.000978	75.40	1.13
19	29.5	31.2	30.3	12.4	8.6	0.002933	-	-	0.000978	0.001956	-	-	-	-	78.79	1.18
20	31.2	32.8	32.0	12.7	8.8	0.004237	-	-	0.000978	0.002607	0.000652	-	-	-	82.19	1.23
21	32.8	34.4	33.6	12.9	8.9	0.003259	-	-	0.000326	0.002933	-	-	-	-	85.58	1.28
22	34.4	36.1	35.3	13.1	9.1	0.002933	-	-	0.000326	0.002281	0.000326	-	-	-	88.97	1.33
23	36.1	37.7	36.9	13.4	9.2	0.001956	-	-	0.000978	0.000978	-	-	-	-	92.37	1.39
24	37.7	39.4	38.5	13.6	9.4	0.001304	-	-	-	0.000978	0.000326	-	-	-	95.76	1.44
25	39.4	41.0	40.2	13.8	9.5	0.001956	-	-	-	0.000978	0.000978	-	-	-	99.15	1.49
26	41.0	42.7	41.8	14.1	9.6	0.002281	-	-	-	0.001630	0.000652	-	-	-	102.55	1.54

ANADARKO PETROLEUM CORPORATION
METOCEAN CRITERIA STUDY, HORN MOUNTAIN, GULF OF MEXICO



	Sea State					Probability									Wind	Current
						omni	N	Wind	E	SE	S	SW	W	NW		
Bin	Hs Low	Hs High	Hs Mid	Tp	Tz	p	p	p	p	p	p	p	p	p	Vw	Surface Current
#	(ft)	(ft)	(ft)	(s)	(s)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(ft/s)	(ft/s)
27	42.7	44.3	43.5	14.3	9.8	0.000326	-	-	-	0.000326	-	-	-	-	105.94	1.59
28	44.3	45.9	45.1	14.5	9.9	0.000326	-	-	-	0.000326	-	-	-	-	109.34	1.64
29	45.9	47.6	46.8	14.7	10.0	-	-	-	-	-	-	-	-	-	112.73	1.69
30	47.6	49.2	48.4	14.9	10.1	-	-	-	-	-	-	-	-	-	116.12	1.74
31	49.2	50.9	50.0	15.1	10.3	0.000652	-	-	-	0.000652	-	-	-	-	119.52	1.79
32	50.9	52.5	51.7	15.3	10.4	0.000326	-	-	-	0.000326	-	-	-	-	122.91	1.84
33	52.5	54.1	53.3	15.4	10.5	0.000652	-	-	-	0.000652	-	-	-	-	126.30	1.89

* Please refer to Section 10.9 Associated Current Profiles to find options for deriving associated current profiles using the associated surface current speed in this table.