



Technical Data Report

Weather and Oceanographic Conditions at Sites in the CCAA and in Queen Charlotte Sound, Hecate Strait and Dixon Entrance

ENBRIDGE NORTHERN GATEWAY PROJECT

**ASL Environmental Sciences
Sidney, British Columbia**

**David Fissel, B.Sc., M.Sc.
Jianhua Jiang, M.Sc., Ph.D.
Sarah Chang**

2010

Table of Contents

1	Introduction	1-1
2	Methods	2-1
2.1	Data Sources	2-1
2.1.1	Summary Tables and Figures	2-1
2.1.2	Detailed Wave Summaries - Wave Heights versus Peak Periods	2-8
2.1.3	Detailed Wind Summaries - Wind Speeds versus Directions	2-9
2.1.4	Detailed Ocean Current Summaries - Current Speeds versus Directions	2-9
2.1.5	Visibility Measurements - Statistical Distributions by Month	2-32
3	Conclusions	3-1
4	References.....	4-1
4.1	Literature Cited	4-1
4.2	Internet Sites	4-1
Appendix A	Quantitive Comparisons of South Hecate Strait and Arazanzu Bank.....	A-1

List of Tables

Table 2-1	Summary Table for Available Wind/Wave Buoy Data.....	2-1
Table 2-2	Metocean Statistical Parameters at Buoy Locations.....	2-2
Table 2-5	Percentage and Duration of Wind Speed Historical Exceedance	2-3
Table 2-6	Seasonal Percentage and Duration of Wind Speed Historical Exceedance.....	2-3
Table 2-7	Percentage and Duration of Wave Height Historical Exceedance	2-5
Table 2-8	Seasonal Percentage and Duration of Wave Height Historical Exceedance.....	2-5
Table 2-9	Annual Statistical Parameters and Occurrence Frequency of Significant Wave Greater than 6.5 m for Met Buoy ID C46183 (North Hecate Strait).....	2-11
Table 2-10	Joint Frequency Distribution of Significant Wave Height versus Peak Period for Met Buoy C46145 (Dixon Entrance).....	2-12
Table 2-11	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46183 and Meds213 (North Hecate Strait).....	2-13
Table 2-12	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46207 (Queen Charlotte Sound).....	2-14
Table 2-13	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46185 (Nearest the Entrance to Caamaño Sound in South Hecate Strait).....	2-15

Table 2-14	Joint Frequency Distribution of Significant Wave Height versus Peak Period for Met Buoy C46181 (Nanakwa Shoal).....	2-16
Table 2-15	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46145 (Dixon Entrance, Fall and Winter)....	2-17
Table 2-16	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Buoy C46183 in Hecate Strait (for the Fall and Winter Period)	2-18
Table 2-17	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46207 (Queen Charlotte Sound, Fall and Winter)	2-19
Table 2-18	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46185 (South Hecate Strait, Fall and Winter)	2-20
Table 2-19	Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46181 (Nanakwa Shoal, Fall and Winter) ...	2-21
Table 2-20	Percentage Exceedance of Significant Wave Heights at Met Buoy for the Full Measurement Period	2-22
Table 2-21	Percentage Exceedance of Significant Wave Heights at Met Buoy for Fall-Winter (October 1 - March 31).....	2-23
Table 2-22	Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy 46145 (Dixon Entrance)	2-24
Table 2-23	Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy C46183 (North Hecate Strait).....	2-25
Table 2-24	Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy C46207 (Queen Charlotte Sound).....	2-26
Table 2-25	Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy 46185 (South Hecate Strait).....	2-27
Table 2-26	Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy C46181 (Nanakwa Shoal)	2-28
Table 2-27	Joint Frequency Distribution of Near-Surface Ocean Current Speed versus Direction for Met Buoy C46145 (Dixon Entrance)	2-29
Table 2-28	Joint Frequency Distribution of Near-Surface Ocean Current Speed versus Direction for Met Buoy C46183 (Hecate Strait).....	2-30
Table 2-29	Joint Frequency Distribution of Near-Surface Ocean Current Speed versus Direction for Met Buoy C46207 (Queen Charlotte Sound)	2-31
Table 2-30	Summary Table for Available Visibility Weather Station Data	2-33
Table 2-31	Averaged Hours Throughout the Year with Visibility for the Given Increments	2-34
Table 2-32	Percentage And Duration of Visibility Historical Exceedance	2-36
Table 2-33	Seasonal Percentage and Duration of Visibility Historical Exceedance	2-36

List of Figures

Figure 1-1	Locations of Metocean Monitoring for Coastal Northern British Columbia	1-2
Figure 2-3	Histogram of Mean Wind Speeds	2-4
Figure 2-4	Histogram of Mean Wind Speeds for Nanakwa Shoal	2-4
Figure 2-5	Histogram of Significant Wave Heights	2-7
Figure 2-6	Histogram of Significant Wave Heights for Nanakwa Shoal	2-7
Figure 2-7	Histogram of Near-Surface Ocean Current Speeds	2-8
Figure 2-8	Percent Exceedance of Significant Wave Heights	2-10
Figure 2-9	Comparison of Percent Occurrence of Visibilities less than 2 km at Three Sites in Hecate Strait and Prince Rupert	2-32
Figure A-1	Histogram of Hs and Tp Values	A-3
Figure A-2	Scatter Plots	A-4
Figure A-3	Linear Regression Plots	A-5
Figure A-4	Cumulative Distribution for Hs Values	A-6

Glossary

mean winds	Wind data that is averaged over periods ranging from one minute to one hour.
metocean	A generic term used in industry to describe meteorological and oceanographic studies carried out in support of the design of project operations and major facilities.
significant wave height	The average of the one-third of the largest measured waves, usually computed over a period of one hour or less.
swell wave	Created by storms located at a considerable distance from the measurement location and characterized by longer period waves.
wind wave	Ocean waves which are generated by local winds associated with storms that have passed through the immediate area.

1 Introduction

This technical data report presents information on weather and ocean conditions (metocean conditions) at five locations (Figure 1-1):

- Queen Charlotte Sound, outside the CCAA at Shoal Patch (near Triangle Island)
- Dixon Entrance, outside the CCAA at Celestial Shoal
- Hecate Strait, outside the CCAA at North Danger Rocks
- South Hecate Strait, outside the CCAA at the entrance to Hecate Strait from Queen Charlotte Sound
- Nanakwa Shoal, in the CCAA at the southwest extent of Kitimat Arm

The locations of Environment Canada wind/wave measurement buoys and coastal weather stations are also shown in Figure 1-1, as are the locations of ocean current moorings used in this TDR. These data are intended for use in developing oil spill countermeasures to respond to a potential oil spill.

Data on waves and visibility were also collected and analyzed for use in assessing conditions for meeting/boarding large tankers near the entrances to the CCAA.

Overviews of the marine environment in the areas are available in the Marine Physical Environment TDR (ASL 2009).

In this TDR, statistics in tables and graphs (showing magnitude, frequency, direction, and exceedance where appropriate) are provided for the following parameters:

- winds (mean wind speeds)
- wind wave
- swell wave
- combined wind wave/swell
- visibility and occurrence of fog
- sea surface currents

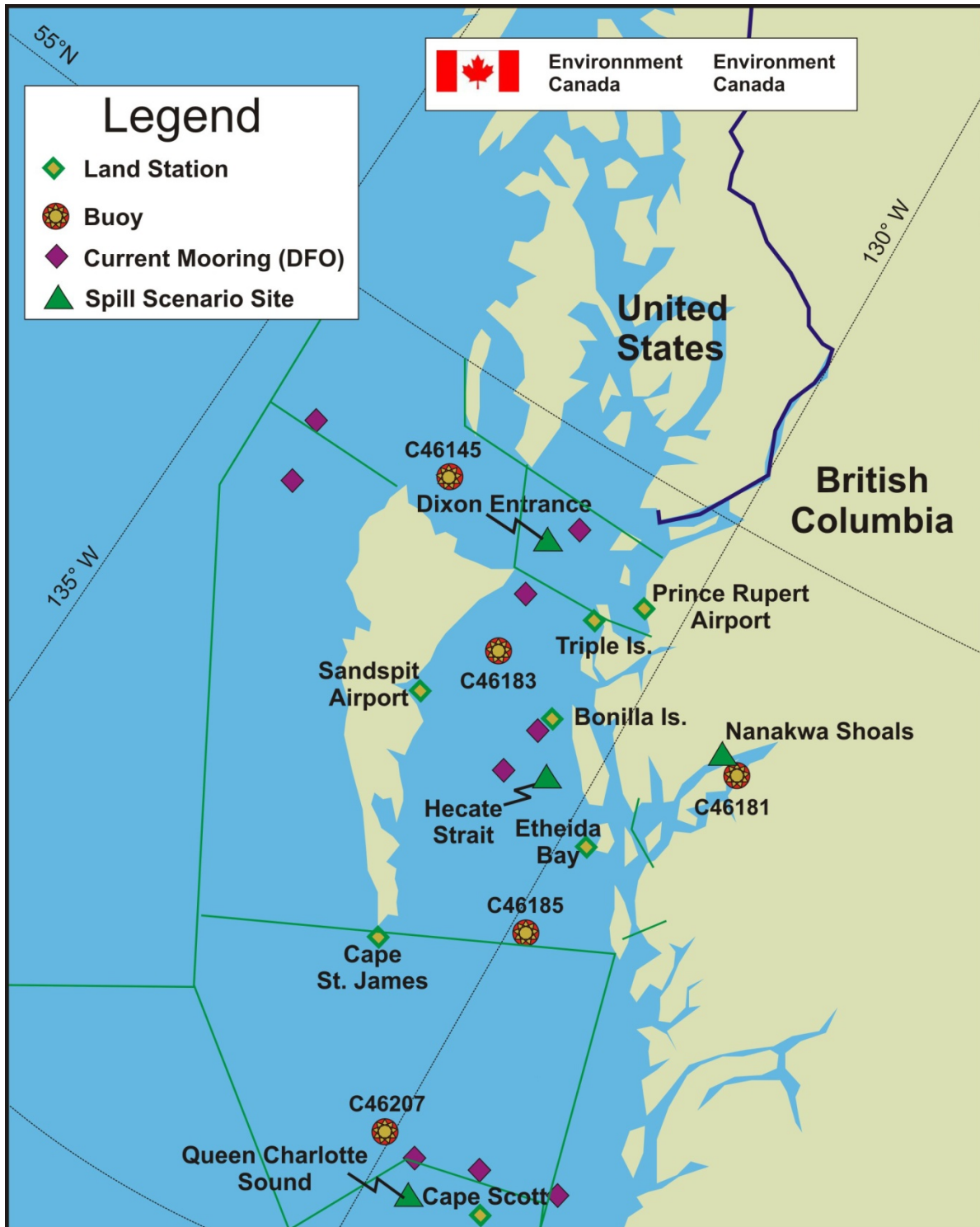


Figure 1-1 Locations of Metocean Monitoring for Coastal Northern British Columbia

2 Methods

2.1 Data Sources

The source data for the information presented in this report were obtained from publicly available Environment Canada data sets (Environment Canada 2009, Internet site) for meteorological and wave data and from the Department of Fisheries and Oceans Canada (Fisheries and Oceans Canada 2009, Internet site) for ocean current data. Corresponding data for each location ID are provided in Table 2-1.

Table 2-1 Summary Table for Available Wind/Wave Buoy Data

Buoy Location	ID	Latitude (deg)	Longitude (deg)	Start Time	End Time
Queen Charlotte Sound	C46207	50.86	129.91	10/18/1989 10:08	11/24/2008 22:26
Dixon Entrance	C46145	54.37	132.42	04/16/1991 18:34	11/24/2008 22:31
Hecate Strait	C46183	53.57	131.14	05/15/1991 10:34	11/24/2008 22:31
South Hecate Strait	C46185	52.42	129.80	09/12/1991 01:52	11/24/2008 22:34
Nanakwa Shoal	C46181	53.82	128.84	11/22/1988 22:37	03/08/2009 22:33

2.1.1 Summary Tables and Figures

Results of the statistical analyses of wind speeds (mean values), significant wave heights¹ and near-surface ocean currents for each of the measurement sites are provided in Table 2-2.

The percentage and duration of mean wind speed historical exceedance at the five sites are presented in Table 2-5. These are expressed by season in Table 2-6. Figure 2-3 compares mean wind speeds for four of the measurement areas. Figure 2-4 presents a histogram of mean wind speeds at Nanakwa Shoal, also by percentage of occurrence.

The occurrence of high wind speeds exceeding 12 m/s (23.6 knots) is greatest in North Hecate Strait, slightly reduced in Queen Charlotte Sound and South Hecate Strait, and further reduced in Dixon Entrance, as can be seen by comparing the mean wind speed histograms (Figures 2-1 and 2-3).

The percentage and duration of wave height historical exceedance at the measurement sites are given in Table 2-7. These data are listed seasonally in Table 2-8. Figure 2-5 compares significant wave heights at four of the measurement areas, while Figure 2-6 provides supplemental data for significant wave heights at Nanakwa Shoal.

Larger waves greater than 4 m wave height occur most often in Queen Charlotte Sound, and progressively less often in South Hecate Strait, North Hecate Strait and Dixon Entrance (see Figure 2-5).

Because of its stronger tidal currents, near-surface ocean current speeds in Dixon Entrance are usually higher than those in Hecate Strait and Queen Charlotte Sound (see Figure 2-7).

¹ Significant wave height is the average of the one-third of the largest measured waves for each data set.

At Nanakwa Shoal, less than 5% of waves exceeded 0.5 m in height, and waves of 1 m or more were present less than 1% of the time. By comparison, the buoy at Queen Charlotte Sound recorded waves in excess of 4 m almost 18% of the time. Correspondingly, historical wind speeds in Nanakwa Shoal were rarely over 15 m/s and exceeded 5 m/s only 40% of the time.

Table 2-2 Metocean Statistical Parameters at Buoy Locations

Met Buoy ID	Measurement period	Metocean parameter	Maximum	Mean	Value at Probability Levels of:			Std
					10%	50%	90%	
C46207 (Queen Charlotte Sound)	1989 – 2008	Significant wave height (m)	14.54	2.72	1.15	2.38	4.77	1.50
	1989 – 2008	Wind speed (m/s)	25.30	7.16	2.70	6.80	12.10	3.73
	1981 – 1982, 1990 – 1991, 1995	Surface current speed (m/s)	0.93	0.20	0.07	0.17	0.35	0.12
C46145 (Dixon Entrance)	1991 – 2008	Significant wave height (m)	11.17	1.59	0.61	1.40	2.83	0.93
	1991 – 2008	Wind speed (m/s)	24.00	6.69	2.40	6.30	11.40	3.50
	1984 – 1985, 1991	Surface current speed (m/s)	1.16	0.32	0.13	0.31	0.52	0.15
C46183 (Hecate Strait)	1984 – 2008	Significant wave height (m)	10.19	1.30	0.35	0.96	2.70	1.11
	1991 – 2008	Wind speed (m/s)	25.10	7.08	2.20	6.70	12.40	3.97
	1997, 1983 – 1984	Surface current speed (m/s)	1.12	0.26	0.08	0.24	0.45	0.15
C46185 (South Hecate Strait)	1991 – 2008	Significant wave height (m)	14.28	1.80	0.61	1.40	3.51	1.33
	1991 – 2008	Wind speed (m/s)	28.05	6.58	2.15	6.05	11.70	3.75
C46181 (Nanakwa Shoal)	1989 – 2009	Significant wave height (m)	2.33	0.14	0.02	0.07	0.35	0.17
	1989 – 2009	Wind speed (m/s)	28.00	4.55	0.80	4.00	9.20	3.32

Table 2-3 Percentage and Duration of Wind Speed Historical Exceedance

Met Buoy ID	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
	≥ 5 m/s	≥ 10 m/s	≥ 15 m/s	≥ 20 m/s	≥ 5 m/s	≥ 10 m/s	≥ 15 m/s	≥ 20 m/s	≥ 5 m/s	≥ 10 m/s	≥ 15 m/s	≥ 20 m/s
C46207	70.51	20.74	3.47	0.23	347	80	33	11	16.3	7.0	4.8	2.6
C46145	65.90	17.15	2.07	0.06	262	83	26	6	13.1	6.1	3.8	1.9
C46183	67.16	21.85	4.03	0.29	213	90	38	14	16.0	7.5	5.0	2.6
C46185	67.03	20.89	3.68	0.21	405	90	44	18	15.8	7.2	4.9	2.4
C46181	41.02	7.40	0.31	0.00	488	127	16	1	730	4.7	2.5	1.0

Table 2-4 Seasonal Percentage and Duration of Wind Speed Historical Exceedance

Met Buoy ID	Season (month)	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
		≥ 5 m/s	≥ 10 m/s	≥ 15 m/s	≥ 20 m/s	≥ 5 m/s	≥ 10 m/s	≥ 15 m/s	≥ 20 m/s	≥ 5 m/s	≥ 10 m/s	≥ 15 m/s	≥ 20 m/s
C46207	Jan – Mar	76.88	30.33	5.67	0.42	338	71	32	11	19.3	7.7	5.2	2.8
	Apr – Jun	67.03	12.90	1.06	0.02	246	53	22	3	14.7	5.9	3.4	1.5
	Jul – Sep	59.91	6.87	0.41	0.01	216	61	25	2	12.6	4.8	4.2	2.0
	Oct – Dec	77.14	31.00	6.22	0.45	347	80	33	11	18.9	7.6	4.8	2.5
C46145	Jan – Mar	74.60	25.92	3.29	0.10	262	68	25	6	16.6	6.6	3.7	1.9
	Apr – Jun	60.91	10.89	0.67	0.00	254	83	15	1	11.2	5.5	4.0	1.0
	Jul – Sep	52.13	5.64	0.27	*	163	38	8	*	9.5	4.4	2.7	*
	Oct – Dec	77.13	27.10	4.17	0.15	195	81	26	6	16.8	6.5	3.9	2.0
C46183	Jan – Mar	74.83	31.05	6.22	0.42	260	86	38	13	19.0	8.0	4.9	2.8
	Apr – Jun	62.77	14.97	1.60	0.04	189	60	28	3	14.7	6.4	5.0	1.8
	Jul – Sep	55.39	10.24	0.76	0.00	166	48	17	1	12.1	5.6	3.3	1.0
	Oct – Dec	75.89	31.34	7.57	0.70	178	90	33	14	18.6	8.5	5.3	2.7
C46185	Jan – Mar	75.24	28.97	6.11	0.29	312	76	44	18	18.1	7.5	5.3	2.4
	Apr – Jun	59.08	12.72	1.10	0.03	195	78	23	3	12.8	6.1	3.7	1.8
	Jul – Sep	55.63	11.00	0.52	0.01	186	84	27	3	12.7	7.2	3.7	3.0
	Oct – Dec	77.72	30.42	6.83	0.50	405	90	42	11	19.9	7.3	4.9	2.4
C46181	Jan – Mar	47.82	15.03	0.69	*	488	108	15	*	10.0	5.7	2.5	*
	Apr – Jun	34.59	1.78	0.01	*	87	29	1	*	5.0	2.3	1.0	*
	Jul – Sep	36.91	0.85	*	*	83	7	*	*	5.5	1.7	*	*
	Oct – Dec	43.88	10.86	0.47	0.00	281	127	16	1	8.2	4.9	2.7	1.0

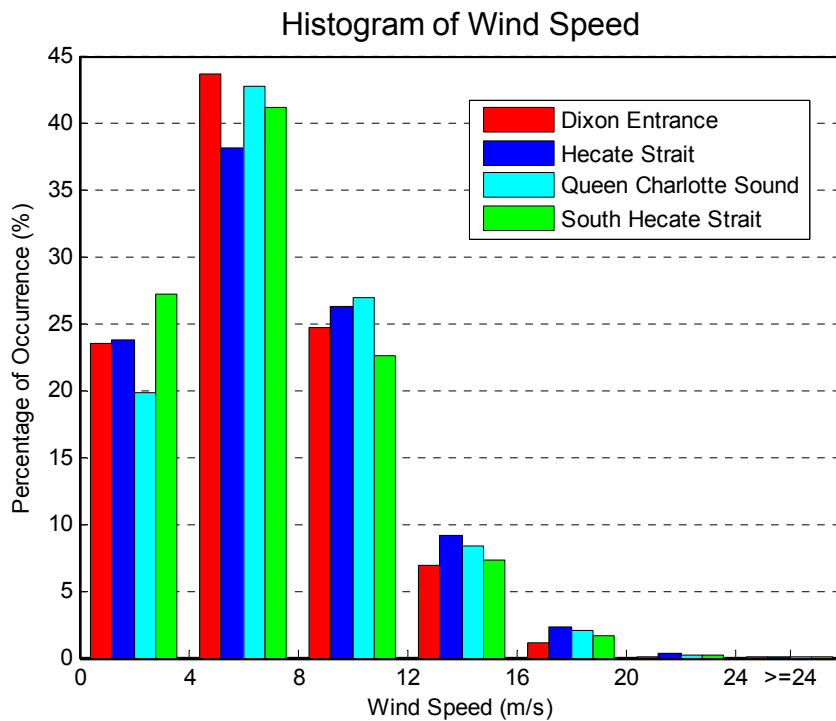


Figure 2-1 Histogram of Mean Wind Speeds

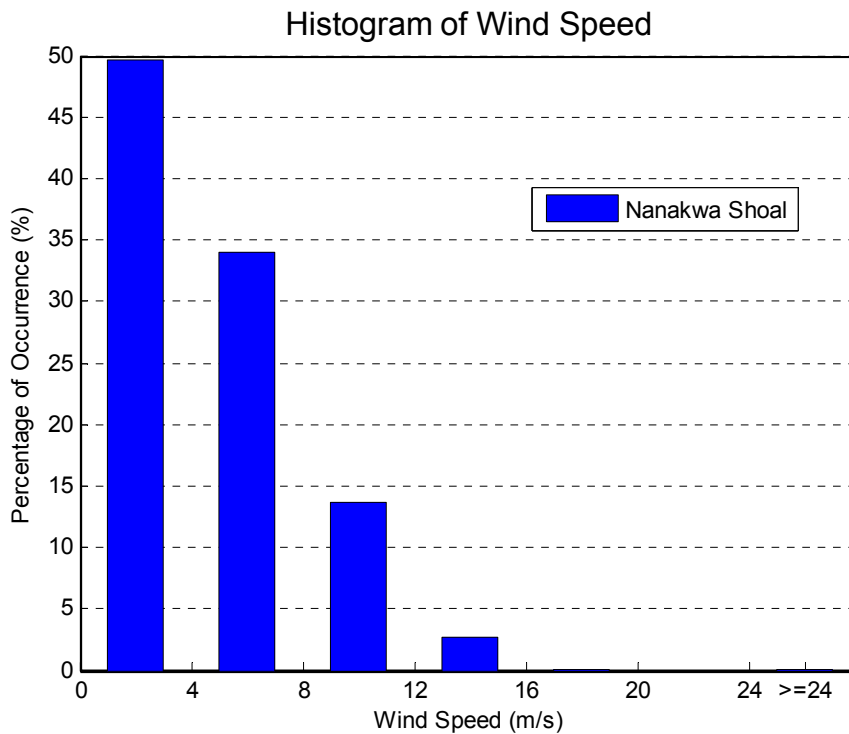


Figure 2-2 Histogram of Mean Wind Speeds for Nanakwa Shoal

Table 2-5 Percentage and Duration of Wave Height Historical Exceedance

Met Buoy ID	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m
C46207	61.04	17.66	3.68	0.61	1383	323	56	32	36.3	12.2	6.1	3.8
C46145	26.79	2.13	0.16	0.02	215	48	23	10	12.4	5.0	3.5	3.0
C46183	17.35	3.33	0.52	0.04	170	53.02	23	13	13.4	6.5	3.2	1.6
C46185	30.65	6.96	1.57	0.30	335	103	39	25	20.5	9.3	5.3	3.7
C46181	0.00	*	*	*	1	*	*	*	1	*	*	*
Met Buoy ID	≥ 0.5 m	≥ 1.0 m	≥ 1.5 m	≥ 2.0 m	≥ 0.5 m	≥ 1.0 m	≥ 1.5 m	≥ 2.0 m	≥ 0.5 m	≥ 1.0 m	≥ 1.5 m	≥ 2.0 m
C46207	99.96	94.33	78.22	61.04	31088	5422	2257	1383	6749.3	145.1	56.6	36.3
C46145	94.61	70.69	45.42	26.79	5212	1675	493	215	149.9	36.3	19.0	12.4
C46183	79.21	47.47	28.00	17.35	1300	471	315	170	47.4	22.3	16.4	13.4
C46185	95.99	68.11	45.88	30.65	5191	908	533	335	147.7	39.0	26.9	20.5
C46181	4.62	0.30	0.01	0.00	131	78	2	1	6.0	3.4	1.08	1.0

Table 2-6 Seasonal Percentage and Duration of Wave Height Historical Exceedance

Met Buoy ID	Season (month)	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
		≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m
C46207	Jan – Mar	84.67	29.6	6.07	0.91	1152	323	56	32	58.8	12.5	5.7	3.8
	Apr – Jun	45.02	4.74	0.36	0.01	318	62	10	1	20.6	8.0	2.9	1.0
	Jul – Sep	24.82	1.29	0.06	*	153	34	8	*	12.5	5.1	3.5	*
	Oct – Dec	85.41	32.29	7.55	1.37	1275	172	36	17	68.7	13.3	6.8	3.7
C46145	Jan – Mar	40.12	2.56	0.08	*	181	31	5	*	12.6	4.3	2.4	*
	Apr – Jun	11.36	0.45	0.00	*	105	27	1	*	7.7	4.6	1.0	*
	Jul – Sep	7.56	0.25	*	*	76	13	*	*	7.3	3.8	*	*
	Oct – Dec	49.38	5.34	0.57	0.07	215	48	23	10	16.1	5.5	3.8	3.0

Table 2-7 Seasonal Percentage and Duration of Wave Height Historical Exceedance (cont'd)

Met Buoy ID	Season (month)	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
		≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m	≥ 2 m	≥ 4 m	≥ 6 m	≥ 8 m
C46183	Jan – Mar	26.66	5.67	0.85	0.09	170	53.02	23	13	15.1	7.3	3.4	1.6
	Apr – Jun	10.18	1.25	0.14	0.00	69	26	8.33	0.33	11.1	4.5	1.6	0.3
	Jul – Sep	4.61	0.43	0.09	0.02	65	44	18	6	7.6	5.2	7.7	4.5
	Oct – Dec	27.71	5.88	0.97	0.06	100	37	18	5	14.5	6.4	3.3	1.4
C46185	Jan – Mar	45.78	11.94	2.84	0.51	335	103	39	25	25.2	9.8	5.8	4.1
	Apr – Jun	19.19	2.21	0.31	0.00	185	36	11	1	14.0	6.2	3.8	1.0
	Jul – Sep	8.96	0.67	0.12	0.00	85	45	27	1	10.3	5.8	4.9	1.0
	Oct – Dec	47.97	12.74	2.94	0.65	275	99	37	16	24.8	9.8	5.1	3.4
C46181	Jan – Mar	0.01	*	*	*	1	*	*	*	1.0	*	*	*
	Apr – Jun	0.00	*	*	*	1	*	*	*	1.0	*	*	*
	Jul – Sep	*	*	*	*	*	*	*	*	*	*	*	*
	Oct – Dec	*	*	*	*	*	*	*	*	*	*	*	*
Site ID	Season (month)	≥ 0.5 m	≥ 1.0 m	≥ 1.5 m	≥ 2.0 m	≥ 0.5 m	≥ 1.0 m	≥ 1.5 m	≥ 2.0 m	≥ 0.5 m	≥ 1.0 m	≥ 1.5 m	≥ 2.0 m
C46181	Jan – Mar	10.89	0.53	0.02	0.01	131	11	1	1	6.9	2.5	1.0	1.0
	Apr – Jun	0.49	0.01	0.00	0.00	14	1	1	1	2.2	1.0	1.0	1.0
	Jul – Sep	0.10	*	*	*	3	*	*	*	1.4	*	*	*
	Oct – Dec	6.30	0.61	0.02	*	115	78	2	*	5.6	5.0	1.2	*

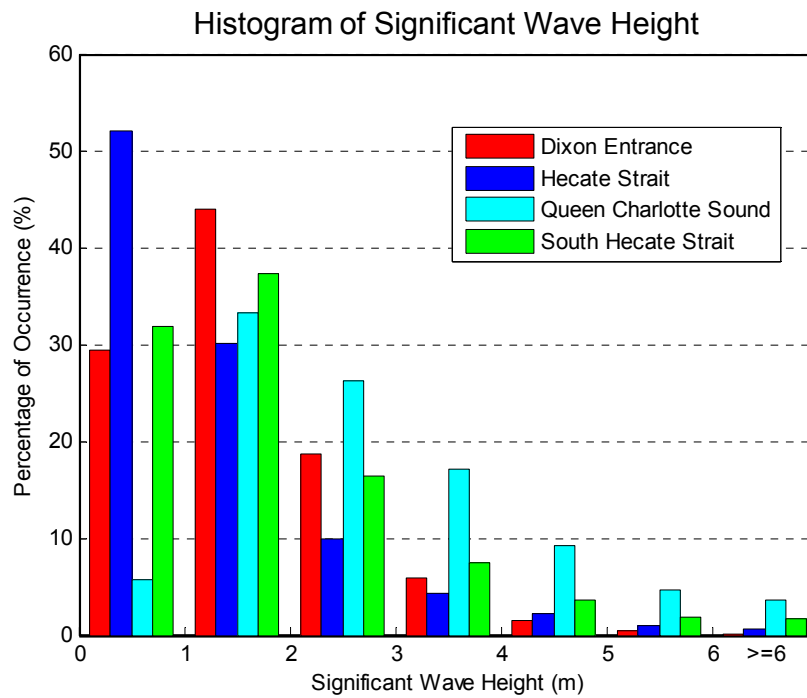


Figure 2-3 Histogram of Significant Wave Heights

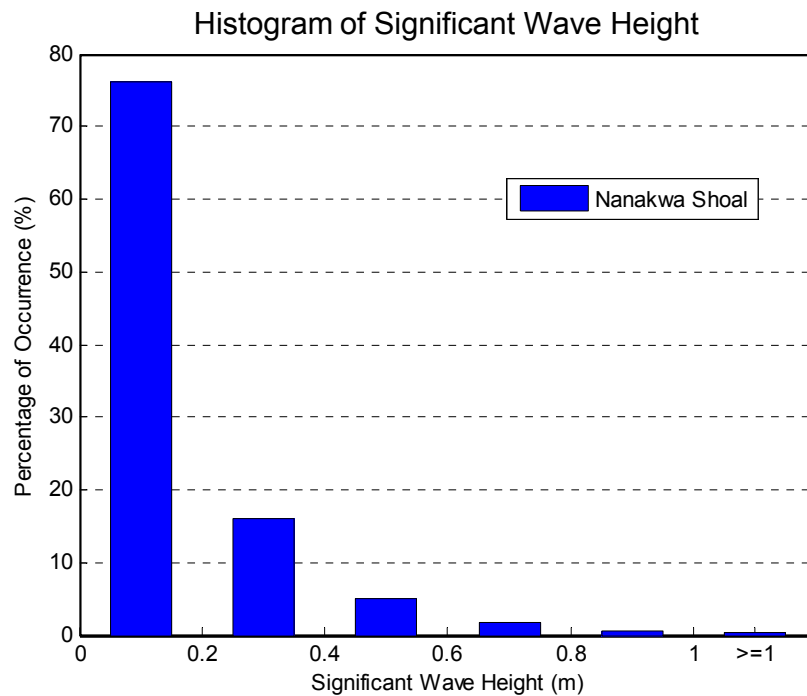


Figure 2-4 Histogram of Significant Wave Heights for Nanakwa Shoal

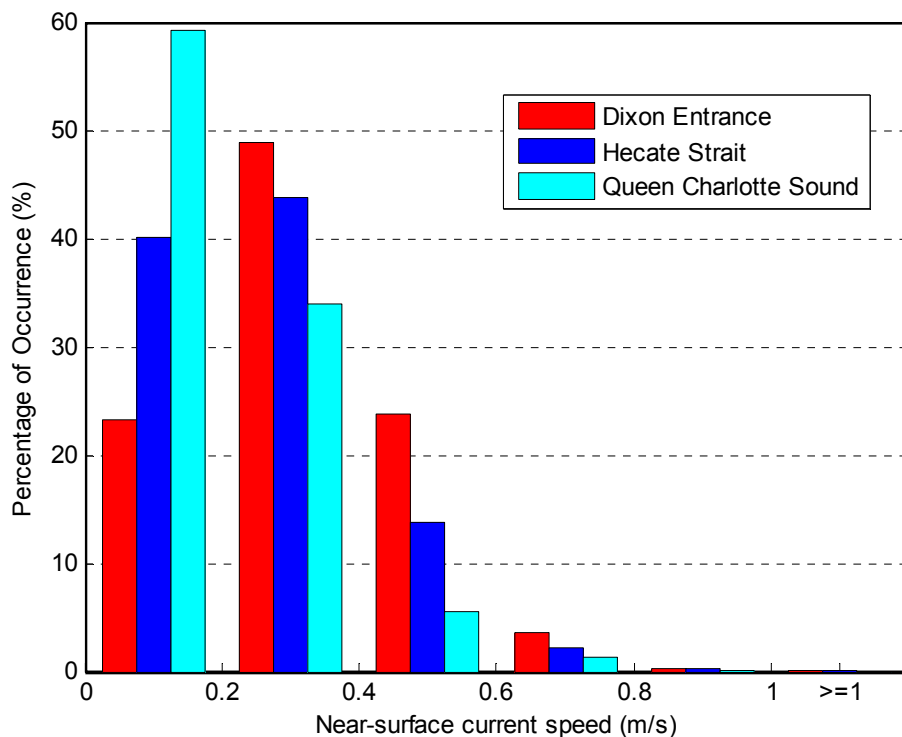


Figure 2-5 Histogram of Near-Surface Ocean Current Speeds

2.1.2 Detailed Wave Summaries – Wave Heights versus Peak Periods

A summary of significant wave height occurrences greater than 6.5 m, along with mean and maximum observed wave heights, is presented for the met buoy ID C46183 in Table 2-9. The range of wave spectrum peak periods for waves higher than 6.5 m is also included.

For ocean waves, the joint frequency distribution of wave heights with wave periods is presented for met buoy IDs C46145 (Dixon Entrance) in Table 2-10; C46183 (North Hecate Strait) in Table 2-11; C46207 (Queen Charlotte Sound) in Table 2-12; C46185 (South Hecate Strait) in Table 2-13; and C46181 (Nanakwa Shoal) in Table 2-14.

Joint frequency distributions of wave heights and periods for the fall and winter season (October 1 to March 31) are provided for met buoy IDs at C46145 (Dixon Entrance, Table 2-15), C46183 (Hecate Strait, Table 2-16), C46207 (Queen Charlotte Sound, Table 2-17), C46185 (South Hecate Strait, Table 2-18) and C46181 (Nanakwa Shoal, Table 2-19).

The cumulative frequency occurrence of significant wave heights for the five wave buoy data sets are given for the full measurement period in Table 2-20, and for the fall-winter period in Table 2-21, and are both shown in Figure 2-8. Larger waves with heights of 4 m or more are twice as likely to occur in the fall-winter period as compared with the full year statistics. In fall and winter, extremely large waves with significant height values of 8 m or more occur over 1% of the time in Queen Charlotte Sound and 0.6% of

the time in Southern Hecate Strait. They occur much less frequently in North Hecate Strait (0.1%), Dixon Entrance (0.04%) and Nanakwa Shoal (0.01%).

Relevant to this report is a comparison of wave conditions at the entrance to Caamaño Sound with those at Environment Canada wave buoy C46185 in South Hecate Strait. The comparison uses data collected specifically for this Project between September 2005 and January 2006, see Appendix A.

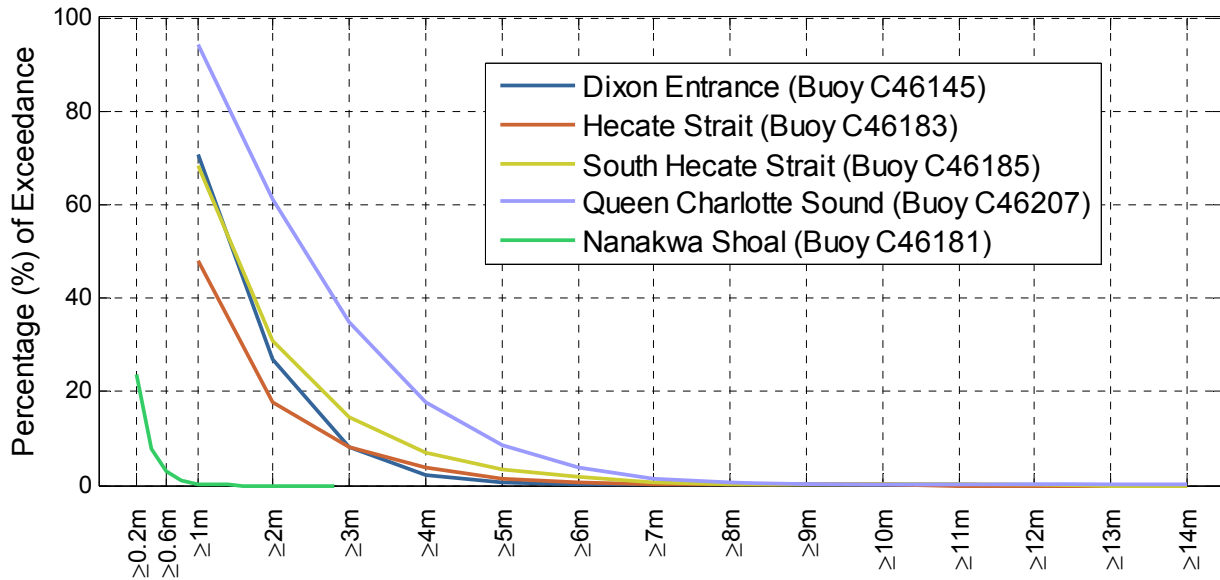
2.1.3 Detailed Wind Summaries – Wind Speeds versus Directions

The directional distributions of the winds are presented for the met buoy IDs in Tables 2-22 to 2-26.

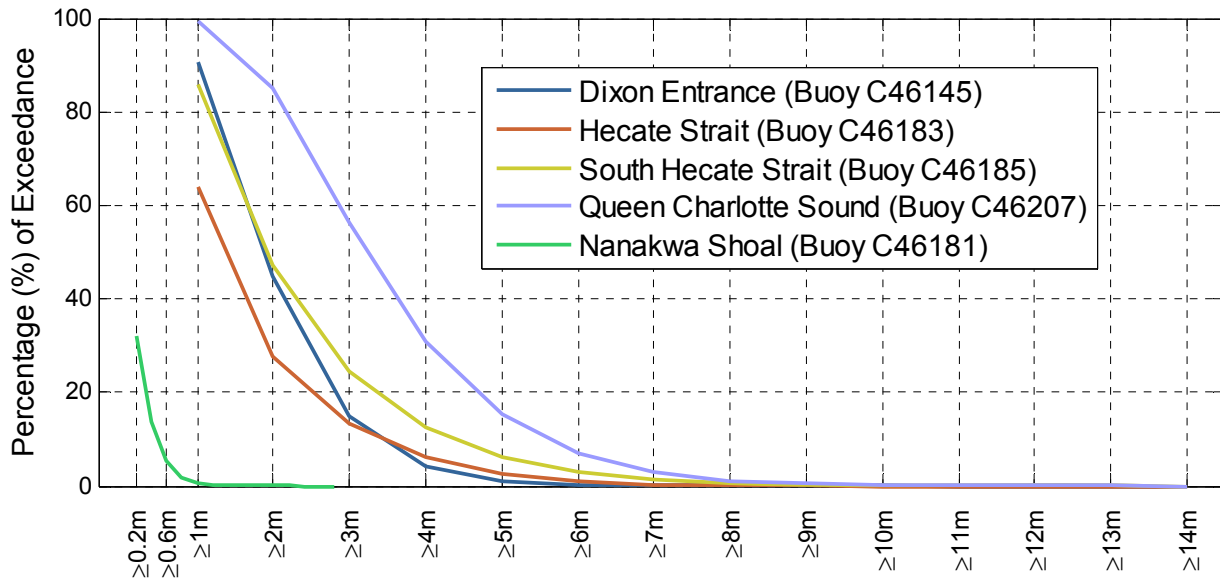
2.1.4 Detailed Ocean Current Summaries – Current Speeds versus Directions

The directional distributions of the near-surface ocean currents are presented for Dixon Entrance in Table 2-27, Hecate Strait in Table 2-28, and Queen Charlotte Sound in Table 2-29.

Percent Exceedance of Significant Wave Heights - All Data



Percent Exceedance of Significant Wave Heights - Fall/Winter Data



SOURCE: Environment Canada wave buoy data set sites

Figure 2-6 Percent Exceedance of Significant Wave Heights

Table 2-8 Annual Statistical Parameters and Occurrence Frequency of Significant Wave Greater than 6.5 m for Met Buoy ID C46183 (North Hecate Strait)

Year	Number of days of available data	Maximum significant wave height (hour)	Mean significant wave height (m)	Occurrence frequency of significant wave height $\geq 6.5\text{m}$ (%)	Range of wave spectrum peak periods (s) for significant wave height $\geq 6.5\text{ m}$
1984	11.5	4.98	1.44	n/a	n/a
1985	118.0	8.94	1.58	1.20	9 – 14
1986	140.0	9.84	1.86	2.41	9 – 14
1987	80.3	9.19	2.30	3.17	9 – 13
1988	323.1	9.29	1.39	0.59	10 – 13
1989	365.0	9.20	1.26	0.36	10 – 15
1990	173.3	8.12	1.71	1.03	10 – 14
1991	227.1	9.07	1.25	0.62	10 – 15
1992	317.0	9.54	1.35	0.49	8 – 13
1993	332.6	8.13	1.16	0.21	10 – 15
1994	168.2	7.35	1.24	0.20	9 – 12
1995	322.2	6.97	1.22	0.03	11 – 13
1996	347.9	8.14	1.23	0.14	10 – 14
1997	350.3	7.63	1.29	0.27	10 – 13
1998	357.8	9.54	1.27	0.23	9 – 14
1999	274.2	10.19	1.32	0.49	9 – 16
2000	360.0	7.96	1.27	0.28	9 – 15
2001	330.7	6.98	1.38	0.05	10 – 13
2002	265.1	8.05	1.20	0.22	10 – 13
2003	346.1	8.87	1.22	0.24	10 – 15
2004	352.5	7.32	1.08	0.07	7 – 12
2005	362.8	6.81	1.28	0.05	10 – 12
2006	330.9	7.74	1.24	0.28	9 – 14
2007	339.0	7.87	1.23	0.12	9 – 14
2008	323.3	8.60	1.27	0.31	9 – 14
Total (1984 – 2008)	6918.9	10.19	1.30	0.37	7 – 16

Table 2-9 Joint Frequency Distribution of Significant Wave Height versus Peak Period for Met Buoy C46145 (Dixon Entrance)

Tp (s)		Hs (m)														Row Total (%)		
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14		14 to 15	
0	2																0.00	
2	4	0.94	0.02	0.00													0.97	
4	6	2.94	5.91	0.77	0.01	0.00											9.63	
6	8	6.87	4.08	3.14	1.03	0.13	0.01										15.27	
8	10	8.56	9.50	1.49	0.26	0.07	0.02	0.00									19.91	
10	12	5.21	11.43	4.51	0.91	0.18	0.03	0.01	0.00								22.28	
12	14	2.71	7.52	4.70	1.92	0.49	0.11	0.02	0.00								17.49	
14	16	1.13	3.09	2.35	1.00	0.39	0.15	0.03	0.01	0.00	0.00						8.16	
16	18	0.61	1.53	1.20	0.61	0.21	0.07	0.04	0.02	0.01	0.00	0.00	0.00				4.29	
18	20	0.25	0.67	0.47	0.19	0.07	0.02	0.01	0.00	0.00	0.00	0.00	0.00				1.68	
20	22	0.05	0.11	0.04	0.01	0.00	0.00	0.00									0.22	
22	24	0.05	0.03	0.01	0.00												0.10	
24	26																0.00	
26	28																0.00	
28	30																0.00	
Column Total (%)		29.31	43.90	18.70	5.96	1.55	0.42	0.11	0.03	0.01	0.00	0.00	0.00	0.00	0.0000	0.0000	0.0000	

NOTES:

Period of record: 1991/04/16 18:34:00 to 2008/11/24 22:30:48

Filename: c46145.dat

Max Hs: 11.17 m

Mean Hs: 1.59 m

non-flagged records: 139,923

flagged records: 0

Numerical values are rounded from four decimal places to two

Table 2-10 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46183 and Meds213 (North Hecate Strait)

Tp (s)		Hs (m)														Row Total (%)	
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14		14 to 15
0	2																0.00
2	4	6.77	0.10	0.01													6.88
4	6	13.04	13.23	0.61	0.01	0.00	0.00										26.92
6	8	5.36	7.41	4.19	1.03	0.09	0.01	0.00									18.09
8	10	4.60	5.56	2.98	1.73	1.00	0.28	0.04	0.00		0.00						16.19
10	12	4.43	2.41	1.73	1.29	0.88	0.54	0.28	0.08	0.02	0.00						11.65
12	14	7.04	0.72	0.30	0.21	0.17	0.12	0.11	0.05	0.03	0.00						8.76
14	16	9.18	0.57	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00					9.80
16	18	0.96	0.05														1.01
18	20	0.35	0.02														0.37
20	22	0.15	0.00														0.15
22	24	0.02	0.01	0.00													0.02
24	26	0.00															0.00
26	28	0.09	0.03	0.00				0.00									0.12
28	30	0.02	0.01	0.00	0.00												0.03
Column Total (%)		52.00	30.15	9.85	4.28	2.14	0.96	0.44	0.13	0.06	0.00	0.00	0.00	0.00	0.00	0.00	

NOTES:

Period of record: 1984/11/27 21:00:00 to 2008/11/24 22:30:40

Filename: c46183_meds213.dat

Max Hs: 10.19 m

Mean Hs: 1.30 m

non-flagged records: 173,603

flagged records: 0

Numerical values are rounded from four decimal places to two

Table 2-11 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46207 (Queen Charlotte Sound)

Tp (s)		Hs (m)														Row Total (%)	
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14		14 to 15
0	2			0.00													0.00
2	4	0.01	0.00	0.01	0.00	0.00	0.00										0.03
4	6	0.16	2.00	0.35	0.09	0.04	0.02	0.01	0.00	0.00	0.00	0.00					2.68
6	8	1.19	6.99	3.95	1.40	0.32	0.02	0.00	0.00								13.87
8	10	0.82	10.32	6.27	3.45	1.85	0.88	0.28	0.05	0.00							23.94
10	12	0.47	5.79	8.49	5.04	2.57	1.28	0.62	0.31	0.10	0.03	0.01	0.00				24.71
12	14	0.86	2.89	4.41	4.56	2.54	1.26	0.57	0.24	0.11	0.07	0.03	0.01	0.00			17.55
14	16	1.24	2.34	1.53	1.62	1.18	0.81	0.43	0.18	0.06	0.02	0.01	0.01	0.01	0.00	0.00	9.45
16	18	0.72	2.24	0.78	0.71	0.56	0.35	0.20	0.12	0.07	0.03	0.01	0.00	0.00	0.00		5.80
18	20	0.18	0.66	0.39	0.24	0.14	0.10	0.05	0.02	0.01	0.01	0.00	0.00	0.00			1.80
20	22	0.02	0.04	0.04	0.03	0.02	0.00	0.00									0.15
22	24	0.00	0.00	0.01	0.00	0.00	0.00										0.02
24	26			0.00		0.00											0.00
26	28																0.00
28	30	0.00	0.00	0.01	0.00	0.00	0.00										0.01
Column Total (%)		5.67	33.29	26.24	17.14	9.24	4.74	2.16	0.92	0.35	0.16	0.06	0.02	0.01	0.00	0.00	

NOTES:

Period of record: 1989/10/18 10:08:00 to 2008/11/24 22:26:08

Filename: c46207.dat

Max Hs: 14.54 m

Mean Hs: 2.72 m

non-flagged records: 141,787

flagged records: 0

Numerical values are rounded from four decimal places to two

**Table 2-12 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46185
(Nearest the Entrance to Caamaño Sound in South Hecate Strait)**

Tp (s)		Hs (m)														
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14	14 to 15
0	2	0.00														
2	4	0.53	0.04	0.00		0.00	0.00			0.00						
4	6	3.16	8.21	0.67	0.01	0.00	0.00									
6	8	1.87	6.84	5.51	1.41	0.18	0.02	0.00								
8	10	2.97	7.27	4.11	2.87	1.58	0.69	0.20	0.05	0.01						
10	12	2.06	5.88	3.73	1.88	1.03	0.75	0.47	0.25	0.08	0.03	0.00	0.00	0.00		
12	14	4.77	2.94	1.73	0.96	0.53	0.26	0.14	0.08	0.06	0.03	0.02	0.01	0.00	0.00	0.00
14	16	8.51	2.58	0.46	0.22	0.17	0.10	0.04	0.03	0.02	0.01	0.01	0.00	0.00		0.00
16	18	5.95	2.47	0.18	0.07	0.07	0.03	0.02	0.01	0.01	0.01	0.00	0.00			
18	20	1.70	0.90	0.06	0.00	0.01	0.00		0.00							
20	22	0.16	0.08	0.01		0.00										
22	24	0.02	0.01			0.00										
24	26	0.07	0.03	0.00			0.00									
26	28	0.01	0.00	0.00	0.00											
28	30	0.03	0.00	0.00	0.00	0.00	0.00									
Column Total (%)		31.81	37.27	16.47	7.42	3.58	1.85	0.87	0.42	0.18	0.08	0.04	0.02	0.01	0.00	0.00

NOTES:

Period of record: 1991/09/12 01:52:00 to 2008/11/24 22:33:36

Filename: c46185.dat

Max Hs: 14.27 m

Mean Hs: 1.80 m

non-flagged records: 132,595

flagged records: 0

Table 2-13 Joint Frequency Distribution of Significant Wave Height versus Peak Period for Met Buoy C46181 (Nanakwa Shoal)

Tp (s)		Hs (m)												Row Total (%)	
		0.0 to 0.2	0.2 to 0.4	0.4 to 0.6	0.6 to 0.8	0.8 to 1.0	1.0 to 1.2	1.2 to 1.4	1.4 to 1.6	1.6 to 1.8	1.8 to 2.0	2.0 to 2.2	2.2 to 2.4		2.4 to 2.6
0	2														0.00
2	4	53.44	15.94	4.87	1.78	0.57	0.09	0.01	0.00				0.00		76.71
4	6	6.14	0.05	0.02	0.02	0.11	0.12	0.04	0.01						6.51
6	8	11.36	0.03	0.00	0.00	0.00						0.00			11.39
8	10	4.75	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00		0.00			4.82
10	12	0.49		0.00			0.00								0.49
12	14														0.00
14	16	0.00													0.00
16	18	0.00													0.00
18	20	0.00													0.00
20	22	0.00													0.00
22	24	0.00	0.00	0.00											0.01
24	26	0.01	0.00	0.00	0.00								0.00		0.01
26	28														0.00
28	30	0.05	0.01	0.01	0.00	0.00	0.00	0.00		0.00			0.00		0.07
Column Total (%)		76.24	16.05	4.91	1.80	0.70	0.22	0.06	0.01	0.00	0.00	0.00	0.00	0.00	

NOTES:

Period of record: 1988/11/22 22:37:00 to 2009/03/10 22:32:44

Filename: c46181.dat

Max VCAR: 2.33 m

Mean VCAR: 0.14 m

non-flagged records: 133,911

flagged records: 0

Table 2-14 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46145 (Dixon Entrance, Fall and Winter)

Tp (s)		Hs (m)														
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14	14 to 15
0	2															
2	4	0.19	0.02	0.00												
4	6	0.68	5.63	1.26	0.01	0.00										
6	8	0.84	2.56	4.84	1.91	0.25	0.02									
8	10	1.75	6.39	1.94	0.50	0.13	0.03	0.00								
10	12	2.42	11.39	6.65	1.63	0.33	0.06	0.02	0.00							
12	14	1.86	10.94	7.91	3.47	0.91	0.20	0.04	0.01							
14	16	0.75	4.98	4.16	1.82	0.73	0.27	0.07	0.02	0.00	0.00					
16	18	0.43	2.53	2.24	1.16	0.38	0.14	0.08	0.03	0.01	0.00	0.00	0.00			
18	20	0.31	1.15	0.90	0.34	0.13	0.04	0.02	0.01	0.00	0.00	0.00	0.00			
20	22	0.05	0.21	0.08	0.02	0.01	0.00	0.00								
22	24	0.02	0.06	0.02	0.00											
24	26															
26	28															
28	30															
Column Total (%)		9.30	45.84	30.01	10.87	2.88	0.77	0.23	0.07	0.02	0.01	0.01	0.00	0.00	0.00	0.00

NOTES:

Period of record: 1989/03/18 08:20:40 to 2006/05/15 17:00:40

Filename: c46145(winter).dat

Max Hs: 11.20 m

Mean Hs: 2.05 m

non-flagged records: 68,703

flagged records: 0

Table 2-15 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Buoy C46183 in Hecate Strait (for the Fall and Winter Period)

Tp (s)		Hs (m)														Row Total (%)	
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14		14 to 15
0	2																0.00
2	4	3.49	0.14	0.01													3.64
4	6	7.59	12.86	0.85	0.01	0.00	0.00										21.32
6	8	3.94	8.42	5.82	1.62	0.13	0.01	0.00									19.94
8	10	5.43	8.30	4.33	2.62	1.63	0.47	0.06	0.00		0.00						22.85
10	12	4.82	4.26	3.02	2.20	1.53	0.92	0.47	0.13	0.03	0.00						17.38
12	14	5.50	1.24	0.57	0.40	0.31	0.23	0.20	0.09	0.05	0.01						8.58
14	16	4.83	0.69	0.04	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00					5.63
16	18	0.31	0.05														0.36
18	20	0.09	0.02														0.10
20	22	0.04	0.00														0.04
22	24	0.02															0.02
24	26																0.00
26	28	0.11	0.01														0.13
28	30	0.00	0.00	0.00													0.00
Column Total (%)		36.18	36.00	14.63	6.86	3.61	1.64	0.75	0.22	0.09	0.01	0.00	0.00	0.00	0.00	0.00	

NOTES:

Period of record: 1984/11/27 21:00:00 to 2008/11/24 22:31:00

Filename: c46183(winter).dat

Max Hs: 10.20 m

Mean Hs: 1.66 m

non-flagged records: 88,849

flagged records: 0

Table 2-16 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46207 (Queen Charlotte Sound, Fall and Winter)

Tp (s)		Hs (m)														
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14	14 to 15
0	2															
2	4	0.00		0.01	0.01	0.00										
4	6	0.01	0.61	0.35	0.10	0.06	0.04	0.01	0.01	0.00	0.00	0.00	0.00			
6	8	0.10	1.44	2.93	1.80	0.51	0.04	0.00	0.00							
8	10	0.13	3.43	5.44	4.47	2.98	1.54	0.51	0.09	0.01						
10	12	0.20	3.60	9.62	7.73	4.47	2.25	1.13	0.58	0.19	0.06	0.01	0.00			
12	14	0.14	2.68	6.05	7.08	4.39	2.30	1.07	0.45	0.21	0.13	0.05	0.02	0.00		
14	16	0.13	1.24	2.27	2.60	2.07	1.42	0.78	0.34	0.12	0.05	0.01	0.02	0.01	0.00	0.00
16	18	0.08	0.72	1.19	1.22	0.97	0.64	0.37	0.23	0.13	0.05	0.02	0.00	0.00	0.00	
18	20	0.02	0.37	0.63	0.41	0.24	0.17	0.08	0.03	0.02	0.02	0.01	0.00	0.00		
20	22		0.04	0.08	0.05	0.04	0.01	0.00								
22	24		0.00	0.01	0.00	0.00	0.00									
24	26			0.00		0.00										
26	28															
28	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00								
Column Total (%)		0.81	14.14	28.58	25.48	15.74	8.42	3.95	1.74	0.67	0.31	0.10	0.05	0.02	0.01	0.00

NOTES:

Period of record: 1989/10/18 10:08:00 to 2008/11/26 14:08:00

Filename: c46207(winter).dat

Max Hs: 14.50 m

Mean Hs: 3.48 m

non-flagged records: 74,324

flagged records: 0

Table 2-17 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46185 (South Hecate Strait, Fall and Winter)

Tp (s)		Hs (m)														
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	10 to 11	11 to 12	12 to 13	13 to 14	14 to 15
0	2	0.00														
2	4	0.32	0.07	0.00		0.00										
4	6	1.90	7.35	0.92	0.01	0.01	0.00									
6	8	0.75	5.44	6.04	2.13	0.31	0.03	0.00								
8	10	2.17	8.33	5.5	4.34	2.68	1.21	0.37	0.08	0.02						
10	12	1.96	8.22	6.11	3.21	1.77	1.34	0.82	0.46	0.15	0.06	0.01	0.01	0.00		
12	14	2.16	4.22	2.98	1.75	0.98	0.48	0.27	0.14	0.11	0.06	0.04	0.02	0.01	0.01	0.00
14	16	2.30	2.45	0.79	0.40	0.32	0.18	0.09	0.06	0.04	0.01	0.01	0.00	0.01		
16	18	1.69	1.65	0.30	0.13	0.12	0.06	0.03	0.02	0.02	0.02	0.01	0.00			
18	20	0.69	0.76	0.07	0.01	0.01	0.00		0.00							
20	22	0.06	0.10	0.00		0.00										
22	24	0.01	0.02			0.00										
24	26	0.06	0.03	0.00			0.00									
26	28	0.01	0.00	0.00	0.00											
28	30	0.06	0.01		0.00	0.00	0.00									
Column Total (%)		14.15	38.65	22.72	11.98	6.22	3.31	1.58	0.76	0.34	0.15					

NOTES:

Period of record: 1991/10/19 23:52:00 to 2008/12/13 21:33:36

Filename: c46185(winter).dat

Max Hs: 14.27 m

Mean Hs: 2.32 m

non-flagged records: 67,211

flagged records: 0

Table 2-18 Joint Frequency Distribution of Significant Wave Height versus Peak Period at Met Buoy C46181 (Nanakwa Shoal, Fall and Winter)

Tp (s)		Hs (m)												Row Total (%)	
		0.0 to 0.2	0.2 to 0.4	0.4 to 0.6	0.6 to 0.8	0.8 to 1.0	1.0 to 1.2	1.2 to 1.4	1.4 to 1.6	1.6 to 1.8	1.8 to 2.0	2.0 to 2.2	2.2 to 2.4		2.4 to 2.6
0	2														0.00
2	4	43.93	18.31	8.36	3.32	1.08	0.17	0.02	0.00				0.00		75.20
4	6	7.58	0.05	0.02	0.03	0.21	0.22	0.08	0.02						8.22
6	8	10.43	0.04	0.00	0.00	0.00									10.47
8	10	5.31	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.00		0.00			5.42
10	12	0.52		0.00											0.53
12	14														0.00
14	16	0.00													0.00
16	18	0.00													0.00
18	20	0.00													0.00
20	22	0.00													0.00
22	24	0.01	0.00	0.00											0.01
24	26	0.01	0.01	0.00	0.00								0.00		0.02
26	28												0.00		0.00
28	30	0.09	0.01	0.01	0.00	0.00	0.00	0.00		0.00					0.13
Column Total (%)		67.89	18.44	8.41	3.37	1.32	0.41	0.12	0.03	0.00	0.00	0.00	0.01	0.00	

NOTES:

Period of record: 1988/11/22 22:37:00 to 2009/03/10 22:32:44

Filename: c46181_fallwinter.dat

Max VCAR: 2.33 m

Mean VCAR: 0.18 m

non-flagged records: 70,475

flagged records: 63,436

Table 2-19 Percentage Exceedance of Significant Wave Heights at Met Buoy for the Full Measurement Period

Met Buoy ID	≥1 m	≥2 m	≥3 m	≥4 m	≥5 m	≥6 m	≥7 m	≥8 m	≥9 m	≥10 m	≥11 m	≥12 m	≥13 m	≥14 m
C46207 (Queen Charlotte Sound)	94.33	61.04	34.80	17.66	8.42	3.68	1.53	0.61	0.25	0.09	0.03	0.01	0.003	0.001
C46145 (Dixon Entrance)	70.69	26.79	8.10	2.13	0.58	0.16	0.05	0.02	0.01	0.004	0.001			
C46183 (Hecate Strait)	47.99	17.85	8.01	3.73	1.59	0.63	0.19	0.06	0.01	0.001				
C46185 (South Hecate Strait)	68.21	30.94	14.47	7.05	3.47	1.62	0.75	0.33	0.15	0.07	0.03	0.01		
Met Buoy ID	≥0.2 m	≥0.4 m	≥0.6 m	≥0.8 m	≥1.0 m	≥1.2 m	≥1.4 m	≥1.6 m	≥1.8 m	≥2.0 m	≥2.2 m	≥2.4 m	≥2.6 m	≥2.8 m
C46181 (Nanakwa Shoal)	23.76	7.71	2.80	1.00	0.30	0.09	0.02	0.01	0.005	0.005	0.003			

**Table 2-20 Percentage Exceedance of Significant Wave Heights at Met Buoy for Fall-Winter
(October 1 - March 31)**

Met Buoy ID	≥ 1 m	≥ 2 m	≥ 3 m	≥ 4 m	≥ 5 m	≥ 6 m	≥ 7 m	≥ 8 m	≥ 9 m	≥ 10 m	≥ 11 m	≥ 12 m	≥ 13 m	≥ 14 m
C46207 (Queen Charlotte Sound)	99.21	85.07	56.49	31.01	15.27	6.85	2.9	1.16	0.49	0.18	0.08	0.03	0.01	
C46145 (Dixon Entrance)	90.71	44.87	14.86	3.99	1.11	0.34	0.11	0.04	0.02	0.01				
C46183 (Hecate Strait)	63.81	27.81	13.18	6.32	2.71	1.07	0.32	0.1	0.01					
C46185 (South Hecate Strait)	85.84	47.19	24.47	12.49	6.27	2.96	1.38	0.62	0.28	0.13	0.06	0.03	0.01	
Met Buoy ID	≥ 0.2 m	≥ 0.4 m	≥ 0.6 m	≥ 0.8 m	≥ 1.0 m	≥ 1.2 m	≥ 1.4 m	≥ 1.6 m	≥ 1.8 m	≥ 2.0 m	≥ 2.2 m	≥ 2.4 m	≥ 2.6 m	≥ 2.8 m
C46181 (Nanakwa Shoal)	32.11	13.67	5.26	1.90	0.58	0.17	0.04	0.01	0.01	0.01	0.01			

Table 2-21 Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy 46145 (Dixon Entrance)

WDIR (deg from)			WSPD (m/s)												Row Total (%)	
			0.00 to 2.00	2.00 to 4.00	4.00 to 6.00	6.00 to 8.00	8.00 to 10.00	10.00 to 12.00	12.00 to 14.00	14.00 to 16.00	16.00 to 18.00	18.00 to 20.00	20.00 to 22.00	22.00 to 24.00		24.00 to 26.00
11.25	33.75	NNE	0.41	0.67	0.44	0.28	0.18	0.12	0.04	0.01	0.00	0.01				2.16
33.75	56.25	NE	0.39	0.60	0.41	0.41	0.36	0.28	0.18	0.09	0.02	0.00	0.00			2.75
56.25	78.75	ENE	0.44	0.78	0.84	0.85	0.75	0.60	0.40	0.12	0.07	0.02				4.96
78.75	101.25	E	0.51	1.21	1.60	1.46	1.14	0.82	0.56	0.26	0.08	0.02	0.00			7.66
101.25	123.75	ESE	0.47	1.22	2.00	2.04	1.66	1.21	0.80	0.48	0.21	0.05	0.01	0.00	0.00	10.15
123.75	146.25	SE	0.47	1.32	2.18	2.78	2.74	2.13	1.39	0.80	0.39	0.14	0.04	0.00		14.38
146.25	168.75	SSE	0.36	1.14	1.84	2.17	1.72	0.95	0.38	0.14	0.05	0.01				8.75
168.75	191.25	S	0.45	1.07	1.45	1.29	0.64	0.16	0.02	0.01		0.00				5.08
191.25	213.75	SSW	0.36	0.89	1.08	0.79	0.31	0.10	0.02	0.01	0.00					3.56
213.75	236.25	SW	0.39	0.94	0.97	0.74	0.46	0.21	0.07	0.03	0.02	0.00				3.83
236.25	258.75	WSW	0.44	1.06	1.29	1.05	0.57	0.28	0.10	0.04	0.01	0.00	0.00			4.84
258.75	281.25	W	0.54	1.64	2.73	2.79	1.51	0.62	0.12	0.06	0.01	0.00				10.10
281.25	303.75	WNW	0.50	1.44	2.56	2.97	2.23	1.01	0.33	0.08	0.02	0.00	0.00			11.13
303.75	326.25	NW	0.48	1.03	1.22	1.25	0.98	0.46	0.12	0.03	0.01	0.00				5.57
326.25	348.75	NNW	0.43	0.68	0.61	0.44	0.23	0.08	0.02	0.01	0.00	0.00				2.50
348.75	11.25	N	0.42	0.78	0.69	0.44	0.16	0.05	0.01		0.00					2.56
Column Total (%)			7.07	14.48	21.90	21.75	15.65	9.06	4.65	2.24	0.89	0.25	0.06	0.00	0.00	

NOTES:

Period of record: 1991/04/16 18:34:00 to 2008/11/24 22:30:48

Filename: c46145.dat

Max WSPD: 24.00 m/s

Mean WSPD: 6.69 m/s

Vector-averaged WSPD: 1.55 m/s at 149.20 deg

non-flagged records: 139,923

flagged records: 0

Numerical values are rounded from four decimal places to two

Table 2-22 Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy C46183 (North Hecate Strait)

WDIR (deg from)			WSPD (m/s)												Row Total (%)	
			0.00 to 2.00	2.00 to 4.00	4.00 to 6.00	6.00 to 8.00	8.00 to 10.00	10.00 to 12.00	12.00 to 14.00	14.00 to 16.00	16.00 to 18.00	18.00 to 20.00	20.00 to 22.00	22.00 to 24.00		24.00 to 26.00
11.25	33.75	NNE	0.51	0.86	0.62	0.43	0.26	0.18	0.05	0.02	0.01	0.00				2.93
33.75	56.25	NE	0.46	0.69	0.45	0.25	0.14	0.07	0.36	0.01	0.00					2.12
56.25	78.75	ENE	0.44	0.68	0.48	0.33	0.12	0.07	0.03	0.01						2.23
78.75	101.25	E	0.48	0.83	0.64	0.58	0.47	0.26	0.15	0.06	0.02	0.00	0.00	0.00		3.50
101.25	123.75	ESE	0.54	0.90	1.03	1.21	1.37	1.34	1.05	0.67	0.29	0.12	0.02	0.00		8.55
123.75	146.25	SE	0.62	1.33	2.02	2.62	3.10	2.73	2.02	1.41	0.77	0.39	0.13	0.04	0.01	17.18
146.25	168.75	SSE	0.61	1.39	1.93	2.23	2.58	2.16	1.34	0.77	0.38	0.17	0.06	0.01	0.00	13.69
168.75	191.25	S	0.61	1.16	1.400	1.48	1.41	0.77	0.38	0.12	0.05	0.02	0.01	0.00		7.41
191.25	213.75	SSW	0.45	0.85	0.97	1.01	0.57	0.22	0.06	0.02	0.00	0.00	0.00			4.14
213.75	236.25	SW	0.39	0.75	0.96	0.78	0.400	0.14	0.04	0.01	0.00					3.47
236.25	258.75	WSW	0.37	0.64	0.80	0.68	0.23	0.08	0.03	0.01	0.01		0.00			2.92
258.75	281.25	W	0.42	0.65	0.70	0.64	0.39	0.16	0.06	0.03	0.01	0.00				3.07
281.25	303.75	WNW	0.41	0.78	0.99	1.12	0.89	0.43	0.14	0.03	0.01	0.00				4.79
303.75	326.25	NW	0.49	1.12	1.75	2.35	2.13	0.85	0.20	0.05	0.01	0.00				8.96
326.25	348.75	NNW	0.55	1.42	2.37	2.46	1.38	0.39	0.11	0.05	0.02	0.02	0.00			8.79
348.75	11.25	N	1.03	1.38	1.69	1.12	0.61	0.26	0.11	0.05	0.01	0.01	0.00			6.27
Column Total (%)			8.38	15.43	18.80	19.35	16.19	10.09	5.82	3.30	1.60	0.74	0.23	0.06	0.01	

NOTES:

Period of record: 1991/05/15 10:34:00 to 2008/11/24 22:30:48

Filename: c46183.dat

Max WSPD: 25.10 m/s

Mean WSPD: 7.08 m/s

Vector-averaged WSPD: 2.23 m/s at 145.40 deg

non-flagged records: 136,980

flagged records: 0

Numerical values are rounded from four decimal places to two

Table 2-23 Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy C46207 (Queen Charlotte Sound)

WDIR (deg from)			WSPD (m/s)												Row Total (%)	
			0.00 to 2.00	2.00 to 4.00	4.00 to 6.00	6.00 to 8.00	8.00 to 10.00	10.00 to 12.00	12.00 to 14.00	14.00 to 16.00	16.00 to 18.00	18.00 to 20.00	20.00 to 22.00	22.00 to 24.00		24.00 to 26.00
11.25	33.75	NNE	0.28	0.52	0.66	0.69	0.47	0.24	0.12	0.05	0.02	0.00				3.06
33.75	56.25	NE	0.28	0.49	0.53	0.46	0.26	0.18	0.09	0.05	0.01	0.00				2.34
56.25	78.75	ENE	0.24	0.40	0.47	0.37	0.21	0.13	0.07	0.02	0.01	0.00				1.92
78.75	101.25	E	0.27	0.50	0.53	0.44	0.32	0.21	0.14	0.07	0.03	0.00				2.50
101.25	123.75	ESE	0.29	0.50	0.64	0.55	0.44	0.37	0.27	0.17	0.09	0.04	0.01	0.00	0.00	3.37
123.75	146.25	SE	0.35	0.71	1.06	1.12	1.07	1.07	0.97	0.73	0.52	0.25	0.09	0.03	0.00	7.99
146.25	168.75	SSE	0.37	0.88	1.34	1.67	1.74	1.59	1.19	0.92	0.49	0.19	0.05	0.01		10.46
168.75	191.25	S	0.73	1.07	1.75	2.09	1.76	1.14	0.67	0.32	0.09	0.02	0.01			9.65
191.25	213.75	SSW	0.38	1.07	1.61	1.65	1.22	0.77	0.34	0.11	0.03	0.02	0.00	0.00		7.21
213.75	236.25	SW	0.40	1.19	1.65	1.40	0.93	0.56	0.23	0.07	0.02	0.00	0.00			6.46
236.25	258.75	WSW	0.38	1.08	1.59	1.24	0.75	0.45	0.22	0.05	0.02	0.01	0.00	0.00		5.80
258.75	281.25	W	0.40	1.26	1.78	1.40	0.94	0.54	0.22	0.07	0.02	0.01	0.00	0.00		6.62
281.25	303.75	WNW	0.38	1.28	2.15	2.10	1.28	0.60	0.22	0.07	0.03	0.01	0.00	0.00		8.14
303.75	326.25	NW	0.33	1.17	2.22	3.47	2.87	0.97	0.24	0.07	0.02	0.00	0.00			11.37
326.25	348.75	NNW	0.31	0.82	1.62	2.10	1.57	0.74	0.26	0.08	0.02	0.00				7.52
348.75	11.25	N	0.82	0.66	1.05	1.21	0.98	0.53	0.23	0.06	0.02	0.01				5.57
Column Total (%)			6.21	13.60	20.69	21.96	16.81	10.10	5.49	2.91	1.44	0.57	0.18	0.05	0.00	

NOTES:

Period of record: 1989/10/18 10:08:00 to 2008/11/24 22:26:08

Filename: c46207.dat

Max WSPD: 25.30 m/s

Mean WSPD: 7.16 m/s

Vector-averaged WSPD: 1.51 m/s at 216.47 deg

non-flagged records: 141,787

flagged records: 0

Numerical values are rounded from four decimal places to two

Table 2-24 Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy 46185 (South Hecate Strait)

WDIR (deg from)			WSPD (m/s)														Row Total (%)	
			0.00 to 2.00	2.00 to 4.00	4.00 to 6.00	6.00 to 8.00	8.00 to 10.00	10.00 to 12.00	12.00 to 14.00	14.00 to 16.00	16.00 to 18.00	18.00 to 20.00	20.00 to 22.00	22.00 to 24.00	24.00 to 26.00	26.00 to 28.00		28.00 to 30.00
11.25	33.75	NNE	0.37	0.64	0.53	0.41	0.29	0.16	0.05	0.01								2.46
33.75	56.25	NE	0.39	0.549	0.48	0.40	0.28	0.13	0.03	0.01								2.31
56.25	78.75	ENE	0.37	0.53	0.47	0.27	0.18	0.09	0.02	0.00	0.00							1.94
78.75	101.25	E	0.45	0.70	0.67	0.52	0.29	0.19	0.08	0.03	0.01	0.00						2.95
101.25	123.75	ESE	0.45	0.96	1.14	1.006	0.76	0.48	0.32	0.19	0.10	0.03	0.00	0.00				5.49
123.75	146.25	SE	0.58	1.37	1.83	2.02	1.77	1.32	1.03	0.69	0.47	0.27	0.06	0.01				11.43
146.25	168.75	SSE	0.51	1.55	2.10	2.30	1.99	1.48	1.20	0.84	0.40	0.20	0.05	0.00	0.00	0.00	0.00	12.61
168.75	191.25	S	0.75	1.95	2.51	2.32	1.77	1.15	0.60	0.24	0.09	0.02	0.01	0.00				11.41
191.25	213.75	SSW	0.52	1.40	1.73	1.38	0.89	0.52	0.25	0.07	0.01	0.00	0.00					6.78
213.75	236.25	SW	0.53	1.28	1.43	1.17	0.65	0.35	0.16	0.03	0.00	0.00						5.61
236.25	258.75	WSW	0.54	1.06	0.92	0.69	0.43	0.17	0.06	0.01	0.00	0.00	0.00					3.88
258.75	281.25	W	0.52	1.20	0.94	0.59	0.35	0.11	0.03	0.01	0.00		0.00					3.77
281.25	303.75	WNW	0.50	1.30	1.42	0.73	0.29	0.12	0.05	0.02	0.00	0.00	0.00					4.42
303.75	326.25	NW	0.48	1.35	2.12	2.20	1.63	1.02	0.37	0.07	0.01							9.26
326.25	348.75	NNW	0.43	1.12	1.69	1.77	1.60	0.95	0.44	0.07	0.01							8.08
348.75	11.25	N	1.19	1.66	1.86	1.39	0.78	0.38	0.20	0.09	0.04	0.03	0.01					7.61
Column Total (%)			8.57	18.66	21.86	19.26	13.94	8.62	4.88	2.37	1.14	0.55	0.13	0.02				

NOTES:

Period of record; 1991/09/12 01:52:00 to 2008/11/24 22:33:36

Filename: c46185.dat

Max WSPD: 28.05 m/s

Mean WSPD: 6.58 m/s

Vector-averaged WSPD: 1.59 m/s at 172.15 deg

non-flagged records: 132,595

flagged records: 0

Table 2-25 Joint Frequency Distribution of Wind Speed versus Direction for Met Buoy C46181 (Nanakwa Shoal)

WDIR (deg from)			WSPD (m/s)														Row Total (%)	
			0.00 to 2.00	2.00 to 4.00	4.00 to 6.00	6.00 to 8.00	8.00 to 10.00	10.00 to 12.00	12.00 to 14.00	14.00 to 16.00	16.00 to 18.00	18.00 to 20.00	20.00 to 22.00	22.00 to 24.00	24.00 to 26.00	26.00 to 28.00		28.00 to 30.00
11.25	33.75	NNE	2.24	2.75	2.39	2.32	2.17	1.59	0.69	0.22	0.02							14.40
33.75	56.25	NE	1.83	2.68	2.98	2.84	2.73	1.89	1.11	0.44	0.07	0.01						16.57
56.25	78.75	ENE	0.90	0.41	0.21	0.12	0.06	0.04	0.01	0.01								1.76
78.75	101.25	E	0.56	0.09	0.04	0.03	0.02	0.02	0.02	0.00								0.77
101.25	123.75	ESE	0.50	0.06	0.02	0.01	0.01	0.02	0.00									0.63
123.75	146.25	SE	0.61	0.11	0.04	0.03	0.02	0.01	0.00									0.82
146.25	168.75	SSE	0.94	0.48	0.33	0.17	0.07	0.03	0.01									2.03
168.75	191.25	S	1.84	2.03	2.54	1.68	0.59	0.13	0.01	0.00								8.82
191.25	213.75	SSW	1.98	3.76	4.88	3.75	1.31	0.28	0.04	0.01								16.02
213.75	236.25	SW	2.19	3.29	4.18	3.84	1.74	0.34	0.05	0.01	0.00							15.64
236.25	258.75	WSW	2.42	1.69	0.55	0.27	0.08	0.02	0.00	0.00								5.03
258.75	281.25	W	3.12	1.6	0.10	0.03	0.00											4.85
281.25	303.75	WNW	2.15	0.60	0.05	0.01	0.00											2.81
303.75	326.25	NW	1.75	0.48	0.03	0.01	0.00	0.00		0.00							0.00	2.28
326.25	348.75	NNW	2.15	0.40	0.05	0.01	0.00	0.01										2.63
348.75	11.25	N	2.97	0.98	0.28	0.21	0.23	0.19	0.08	0.03								4.97
Column Total (%)			28.17	21.42	18.65	15.33	9.04	4.56	2.03	0.70	0.09	0.01	0.00	0.00	0.00	0.00	0.00	

NOTES:

Period of record; 1988/11/22 22:37:00 to 2009/08/10 22:32:44

Filename: c46181.dat

Max WSPD: 28.00 m/s

Mean WSPD: 4.55 m/s

Vector-averaged WSPD: 0.09 m/s at 64.82 deg

non-flagged records: 133,911

flagged records: 0

Table 2-26 Joint Frequency Distribution of Near-Surface Ocean Current Speed versus Direction for Met Buoy C46145 (Dixon Entrance)

VDIR (deg to)			VSPD (m/s)											Row Total (%)	
			0.00 to 0.10	0.10 to 0.20	0.20 to 0.30	0.30 to 0.40	0.40 to 0.50	0.50 to 0.60	0.60 to 0.70	0.70 to 0.80	0.80 to 0.90	0.90 to 1.00	1.00 to 1.10		1.10 to 1.20
11.25	33.75	NNE	0.59	1.83	3.15	3.21	1.76	0.76	0.17	0.06					11.53
33.75	56.25	NE	0.47	1.71	2.94	2.59	1.41	0.57	0.22	0.06					9.98
56.25	78.75	ENE	0.38	1.17	1.43	1.19	0.49	0.15	0.00						4.82
78.75	101.25	E	0.41	0.65	0.56	0.26	0.06								1.94
101.25	123.75	ESE	0.30	0.52	0.17	0.04	0.00								1.04
123.75	146.25	SE	0.30	0.43	0.16	0.04									0.93
146.25	168.75	SSE	0.25	0.43	0.33	0.10	0.02								1.13
168.75	191.25	S	0.27	0.33	0.52	0.52	0.35	0.09	0.00						2.08
191.25	213.75	SSW	0.31	0.46	0.62	0.68	0.45	0.16	0.02	0.00					2.73
213.75	236.25	SW	0.34	0.77	1.02	0.73	0.33	0.15	0.02	0.00					3.37
236.25	258.75	WSW	0.34	0.96	1.51	1.24	0.73	0.42	0.14	0.02					5.36
258.75	281.25	W	0.33	1.06	0.99	2.32	1.74	0.98	0.30	0.13	0.02				8.87
281.25	303.75	WNW	0.41	1.54	2.71	2.96	2.14	1.60	0.78	0.19	0.05	0.03	0.04	0.01	12.48
303.75	326.25	NW	0.43	1.73	2.71	2.54	2.04	1.62	0.58	0.21	0.11	0.06	0.03	0.02	12.09
326.25	348.75	NNW	0.48	1.58	2.45	2.41	1.65	0.92	0.27	0.12	0.03				9.90
348.75	11.25	N	0.71	1.82	2.74	3.05	2.04	1.05	0.30	0.04	0.01				11.75
Column Total (%)			6.33	17.00	25.00	23.88	15.21	8.50	2.81	0.84	0.23	0.09	0.07	0.03	

NOTES:

Period of record; 1984/04/16 14:30:00 to 1991/08/18 14:59:52

Filename: dixonentrance.dat

Max VSPD: 1.16 m/s

Mean VSPD: 0.32 m/s

Vector-averaged VSPD: 0.17 m/s at 329.15 deg

non-flagged records: 23,673

flagged records: 0

Numerical values are rounded from three decimal places to two

Table 2-27 Joint Frequency Distribution of Near-Surface Ocean Current Speed versus Direction for Met Buoy C46183 (Hecate Strait)

VDIR (deg to)			VSPD (m/s)											Row Total (%)	
			0.00 to 0.10	0.10 to 0.20	0.20 to 0.30	0.30 to 0.40	0.40 to 0.50	0.50 to 0.60	0.60 to 0.70	0.70 to 0.80	0.80 to 0.90	0.90 to 1.00	1.00 to 1.10		1.10 to 1.20
11.25	33.75	NNE	0.68	1.42	0.98	0.40	0.09	0.00							3.57
33.75	56.25	NE	0.89	1.03	0.69	0.18	0.02	0.00							2.81
56.25	78.75	ENE	0.87	1.18	0.66	0.32	0.09	0.01							3.12
78.75	101.25	E	0.87	1.35	0.88	0.41	0.15	0.03							3.69
101.25	123.75	ESE	0.88	1.89	1.86	1.02	0.36	0.08	0.02						6.11
123.75	146.25	SE	0.86	2.35	3.49	3.16	1.53	0.39	0.06	0.03					11.87
146.25	168.75	SSE	0.99	2.53	2.67	1.91	1.06	0.40	0.21	0.07	0.00				9.86
168.75	191.25	S	0.95	1.52	1.04	0.72	0.44	0.38	0.20	0.17	0.04	0.01			5.48
191.25	213.75	SSW	0.78	0.95	0.44	0.30	0.10	0.03	0.01	0.01	0.01				2.64
213.75	236.25	SW	0.75	1.00	0.36	0.10	0.06	0.01							2.28
236.25	258.75	WSW	0.78	0.95	0.40	0.11	0.02	0.00							2.27
258.75	281.25	W	0.81	1.28	0.70	0.27	0.05	0.00							3.11
281.25	303.75	WNW	0.82	1.66	1.83	1.28	0.59	0.20	0.06	0.03	0.02				6.50
303.75	326.25	NW	1.01	3.02	4.18	3.91	2.65	1.39	0.52	0.31	0.09	0.03	0.01	0.01	17.12
326.25	348.75	NNW	0.87	2.55	3.34	3.22	2.00	0.97	0.35	0.13	0.01				13.45
348.75	11.25	N	0.84	1.67	1.77	1.10	0.51	0.15	0.05	0.00					6.10
Column Total (%)			13.65	26.37	25.28	18.44	9.72	4.05	1.50	0.77	0.17	0.04	0.01	0.01	

NOTES:

Period of record: 1977/07/18 20:22:30 to 1984/04/12 00:52:22

Filename: hecatestrait.dat

Max VSPD: 1.12 m/s

Mean VSPD: 0.26 m/s

Vector-averaged VSPD: 0.04 m/s at 331.23 deg

non-flagged records: 38,275

flagged records: 0

Numerical values are rounded from three decimal places to two

Table 2-28 Joint Frequency Distribution of Near-Surface Ocean Current Speed versus Direction for Met Buoy C46207 (Queen Charlotte Sound)

VDIR (deg to)			VSPD (m/s)										Row Total (%)		
			0.00 to 0.10	0.10 to 0.20	0.20 to 0.30	0.30 to 0.40	0.40 to 0.50	0.50 to 0.60	0.60 to 0.70	0.70 to 0.80	0.80 to 0.90	0.90 to 1.00		1.00 to 1.10	1.10 to 1.20
11.25	33.75	NNE	1.35	2.61	2.22	1.13	0.43	0.21	0.23	0.06	0.07	0.01			8.31
33.75	56.25	NE	1.25	2.75	1.94	0.79	0.30	0.06	0.07	0.03	0.01				7.21
56.25	78.75	ENE	1.22	2.80	1.66	0.53	0.14	0.06	0.02	0.00					6.44
78.75	101.25	E	1.39	3.52	2.32	0.59	0.17	0.06	0.02						8.08
101.25	123.75	ESE	1.35	2.30	1.24	0.29	0.08	0.02	0.01						5.29
123.75	146.25	SE	1.32	1.96	0.84	0.23	0.07	0.02	0.00						4.44
146.25	168.75	SSE	1.31	2.20	0.95	0.31	0.05	0.02	0.01						4.86
168.75	191.25	S	1.28	2.38	1.15	0.46	0.23	0.04	0.01	0.00					5.55
191.25	213.75	SSW	1.26	1.86	1.10	0.44	0.21	0.07	0.01	0.00					4.96
213.75	236.25	SW	1.24	2.27	1.72	0.50	0.12	0.04	0.01	0.00					5.89
236.25	258.75	WSW	1.13	2.38	1.55	0.50	0.14	0.05	0.01						5.76
258.75	281.25	W	1.21	2.38	1.47	0.56	0.14	0.04	0.02	0.01					5.83
281.25	303.75	WNW	1.11	2.33	1.45	0.71	0.19	0.07	0.10	0.01					5.97
303.75	326.25	NW	1.22	2.56	1.61	0.70	0.33	0.18	0.10	0.02					6.72
326.25	348.75	NNW	1.20	2.36	1.40	0.83	0.48	0.28	0.15	0.03					6.73
348.75	11.25	N	1.32	2.46	1.65	10.15	0.72	0.44	0.26	0.06	0.01	0.01			7.95
Column Total (%)			20.16	39.12	24.29	9.58	3.80	1.66	1.04	0.23	0.09	0.02	0.000	0.000	

NOTES:

Period of record: 1981/09/03 18:30:00 to 1995/08/10 17:30:16

Filename: queencharlottesound.dat

Max VSPD: 0.93 m/s

Mean VSPD: 0.20 m/s

Vector-averaged VSPD: 0.04 m/s at 1.44 deg

non-flagged records: 35,876

flagged records: 0

Numerical values are rounded from three decimal places to two

2.1.5 Visibility Measurements – Statistical Distributions by Month

A summary table for available visibility weather station data is presented in Table 2-30. Included are the latitudes and longitudes, as well as data collection starting and ending dates for the stations at Cape St. James, Cape Scott, Prince Rupert (eastern Dixon Entrance), Triple Island, Bonilla Island, Ethelda Bay, Sandspit (western Hecate Strait), and Kitimat. Long-term measurements of visibility were obtained and summarized for the stations at Prince Rupert, Sandspit, Cape St. James and Cape Scott. Visibility data at Environment Canada sites in eastern Hecate Strait were also obtained and summarized for Ethelda Bay Lighthouse, Bonilla Island and Triple Island. Monthly distributions of visibility are provided in Table 2-31.

The percentage and duration of historical visibility exceedance at the five measurement sites are presented in Table 2-32 for all observations. In Table 2-33, the data are presented by season for the seven weather stations.

A comparison of the percent occurrence of visibilities less than 2 km for the measurement locations in eastern Hecate Strait and Prince Rupert is provided in Figure 2-9. Reduced visibilities exhibit a seasonal pattern, with the poorest visibility in August and September and improved visibility conditions in the spring. Eastern Dixon Entrance and western Hecate Strait have the most favourable visibility conditions, with visibility more often reduced in eastern Hecate Strait and most reduced in Queen Charlotte Sound at the Cape Scott and Cape St. James weather stations.

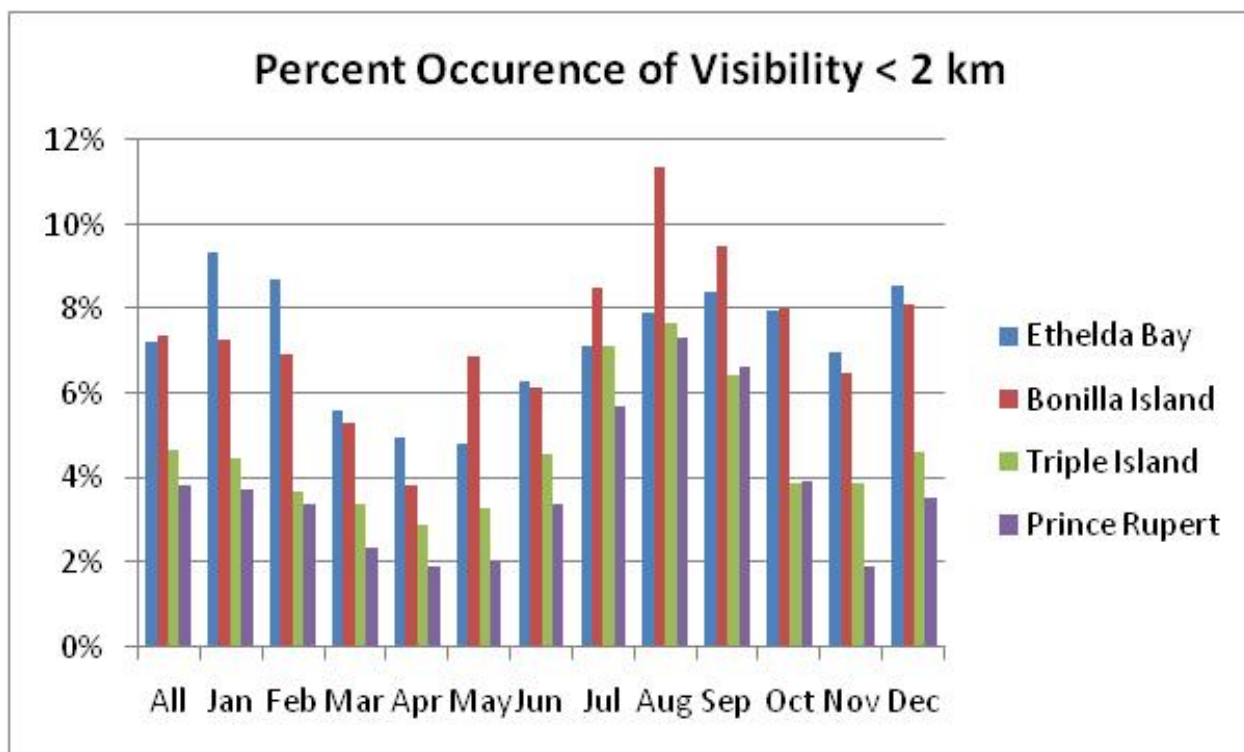


Figure 2-7 Comparison of Percent Occurrence of Visibilities less than 2 km at Three Sites in Hecate Strait and Prince Rupert

Table 2-29 Summary Table for Available Visibility Weather Station Data

Weather Station	Latitude (deg)	Longitude (deg)	Start Time	End Time
Cape St. James	51.93	131.02	1953	1994
Cape Scott	50.78	128.43	1966	2001
Prince Rupert	54.26	130.44	1961	2005
Triple Island	54.29	130.88	1953	2001
Bonilla Island	53.49	130.64	1994	2002
Ethelda Bay	53.05	129.68	1957	1994
Sandspit	53.25	131.81	1953	2005
Kitimat	54.05	128.68	Feb. 1994	Jun. 1994

Table 2-30 Averaged Hours Throughout the Year with Visibility for the Given Increments

Measurement Area	Weather station	Measurement Period	Visibility (km)	Averaged Hours over the Measurement Period											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Queen Charlotte Sound	Cape St. James (51°55.8'N 131°1.2'W)	1953-1994	≤ 0.5	32.2	27.5	23.3	21.0	36.9	52.8	72.4	74.4	65.3	60.2	27.6	30.7
			0.5-1	18.6	16.7	15.5	12.0	14.7	17.5	21.5	21.4	16.8	18.2	15.5	17.9
			1-2	27.1	23.1	19.5	11.8	12.7	14.5	15.2	15.3	14.3	23.4	15.6	24.8
			2-3	6.6	7.5	4.8	3.6	4.6	3.2	4.4	2.9	3.4	4.4	4.8	7.0
			3-4	29.1	27.8	19.4	14.6	12.5	13.6	11.0	10.8	14.1	19.7	20.9	25.9
			4-5	29.5	24.2	19.2	14.4	11.5	10.3	9.5	10.2	14.0	21.0	23.6	28.1
			5-9	48.8	42.2	34.4	31.1	25.4	19.3	18.4	19.5	22.9	34.1	37.6	46.5
			≥ 9	555.0	510.7	613.2	616.0	628.0	592.5	593.1	591.1	570.9	564.2	578.7	568.2
Queen Charlotte Sound	Cape Scott (50°46.8'N 128°25.8'W)	1966-2001	≤ 0.5	22.7	15.4	12.8	12.8	22.5	36.6	57.9	81.4	79.1	35.8	15.4	26.5
			0.5-1	19.9	13.0	11.8	10.8	11.7	17.4	20.1	28.8	23.0	18.0	14.1	13.3
			1-2	20.4	12.7	10.6	10.4	12.3	12.4	12.5	15.2	14.0	15.6	12.6	15.8
			2-3	8.0	6.5	7.6	4.8	5.6	5.3	5.6	5.1	3.7	5.6	9.4	6.7
			3-4	20.1	15.7	14.0	12.4	9.3	9.5	10.9	12.5	13.9	16.0	17.7	21.3
			4-5	15.1	14.8	14.7	10.9	11.6	11.4	11.6	12.1	15.3	18.0	15.1	20.0
			5-9	32.8	30.8	31.5	28.4	26.4	25.8	24.1	23.8	27.4	37.0	36.8	37.4
			≥ 9	627.4	588.2	660.2	647.9	662.6	618.5	611.0	573.8	558.7	609.3	623.4	623.2
Dixon Entrance	Prince Rupert (54°15.4'N 130°26.4'W)	1961-2005	≤ 0.5	5.7	7.1	4.9	5.4	6.1	10.0	15.7	23.8	24.3	12.4	4.6	8.4
			0.5-1	8.1	5.9	4.6	4.3	3.9	5.9	11.0	13.9	10.3	7.1	2.8	6.5
			1-2	14.3	10.2	8.2	4.4	5.6	8.6	16.1	16.9	13.4	10.0	6.5	11.8
			2-3	8.2	4.8	3.8	3.2	3.5	5.0	8.3	8.4	7.0	5.2	3.3	5.7
			3-4	13.6	9.9	8.6	5.7	6.9	9.1	15.5	17.2	16.6	14.3	10.7	14.9
			4-5	21.2	16.5	15.4	11.7	10.3	11.4	19.1	20.8	20.1	20.4	15.8	22.2
			5-9	43.1	35.0	32.7	32.4	23.0	26.4	33.1	30.7	31.1	36.5	36.6	46.3
			≥ 9	634.5	596.0	671.3	660.3	692.4	649.7	628.5	613.7	601.1	646.6	644.5	634.9

Table 2-31 Averaged Hours Throughout the Year with Visibility for the Given Increments (cont'd)

Measurement Area	Weather station	Measurement Period	Visibility (km)	Averaged Hours over the Measurement Period											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hecate Strait	Sandspit (53°15.0'N 131°48.6'W)	1953-2005	≤ 0.5	6.9	9.9	3.4	4.6	4.1	6.1	3.5	6.0	7.0	4.8	7.4	4.6
			0.5-1	9.5	6.5	5.0	3.4	4.8	2.9	4.7	4.0	6.0	5.1	4.1	6.6
			1-2	14.8	11.3	9.0	5.9	5.3	5.9	7.4	5.7	6.2	9.9	7.5	12.2
			2-3	5.1	4.2	3.4	2.6	2.2	2.9	2.6	2.2	3.5	4.5	3.9	4.8
			3-4	18.6	12.4	9.7	6.2	5.3	6.3	7.3	6.2	8.3	13.9	16.0	15.5
			4-5	18.7	15.4	13.1	8.9	8.6	8.1	6.4	6.0	9.4	16.3	17.3	19.9
			5-9	32.4	29.2	25.3	18.8	16.0	13.6	11.4	11.7	16.1	28.6	31.9	34.9
			≥ 9	643.3	598.6	682.9	678.9	707.9	683.8	710.9	711.2	673.7	667.9	641.7	653.2
Hecate Strait	Bonilla Island (53°29.4'N 130°38.4'W)	1994-2002	≤ 0.5	20.3	19.8	8.2	*	32.8	19.5	29.4	36.3	33.1	16.3	19.0	20.0
			0.5-1	14.5	14.9	11.1	16.7	*	12.6	8.5	20.5	15.1	19.2	8.3	22.3
			1-2	22.8	15.0	22.6	12.4	22.6	14.5	27.9	30.5	23.1	27.2	22.0	20.5
			2-3	16.4	8.3	11.0	8.3	*	8.3	14.3	13.1	12.3	10.0	11.6	17.3
			3-4	16.6	18.3	26.4	18.0	19.6	12.3	20.8	17.5	15.5	19.3	22.2	22.3
			4-5	13.2	10.7	16.6	17.8	25.2	14.2	19.4	13.1	12.3	18.6	18.4	15.5
			5-9	43.4	38.8	37.1	29.7	23.9	17.6	32.3	17.5	22.4	27.1	35.6	32.7
			≥ 9	646.7	589.2	653.0	653.4	679.4	656.7	620.5	618.8	617.9	642.3	623.9	623.9
Hecate Strait	Triple Island (54°17.4'N 130°52.8'W)	1953-2001	≤ 0.5	9.8	7.0	9.5	10.4	15.5	18.7	34.5	40.8	33.8	13.4	13.4	10.7
			0.5-1	11.2	11.4	8.4	4.8	4.9	7.2	12.7	8.6	7.1	7.3	7.4	9.9
			1-2	13.4	8.0	8.6	6.6	4.9	8.1	8.0	9.5	7.0	9.5	9.0	15.5
			2-3	4.9	5.5	4.8	4.9	*	4.8	9.4	7.8	6.1	5.0	5.4	9.5
			3-4	10.9	14.6	11.1	7.4	7.2	9.4	11.4	12.3	9.8	9.7	9.7	14.9
			4-5	18.2	16.8	14.0	11.6	11.2	12.1	13.0	11.2	17.9	12.4	22.5	25.6
			5-9	26.2	28.6	29.1	19.8	19.0	20.3	22.9	30.2	23.4	32.2	29.3	38.0
			≥ 9	677.5	621.2	700.3	689.7	708.4	666.6	660.2	648.6	640.3	692.7	667.7	660.1

NOTE:
*Indicates no records were available for the given criteria

Table 2-31 Percentage And Duration of Visibility Historical Exceedance

Weather station	Percent exceedance (%)				Max duration of exceedance (hour)				Average duration of exceedance (hour)			
	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km
Cape St. James	5.95	8.20	10.61	11.14	60	70	70	72	4.0	4.3	4.4	4.5
Cape Scott	4.13	6.10	7.73	8.08	23	36	36	36	2.2	2.4	2.4	2.4
Prince Rupert	1.14	1.95	3.29	3.92	29	34	43	43	3.0	3.0	3.1	3.0
Triple Island	1.60	2.07	2.61	2.72	10	10	10	12	1.7	1.7	1.7	1.7
Bonilla Island	1.71	2.77	4.87	5.47	6	8	8	8	1.5	1.5	1.6	1.6
Ethelda Bay	0.55	1.56	5.44	6.51	4	10	12	14	1.5	1.5	1.9	2.0
Sandspit	0.33	0.79	1.76	2.08	18	22	35	35	2.2	2.4	2.7	2.7

Table 2-32 Seasonal Percentage and Duration of Visibility Historical Exceedance

Weather station	Season (month)	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
		≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km
Cape St. James	Jan – Mar	3.76	6.05	9.19	9.91	60	60	60	72	3.4	3.8	3.8	3.9
	Apr – Jun	4.96	6.92	8.62	9.04	54	70	70	70	3.7	4.1	4.3	4.4
	Jul – Sep	9.79	12.40	14.38	14.72	45	62	62	63	4.3	4.7	4.9	4.9
	Oct – Dec	5.25	7.38	10.21	10.85	51	51	61	61	4.4	4.5	4.5	4.5
Cape Scott	Jan – Mar	1.46	2.99	4.76	5.20	13	15	15	15	1.9	2.0	2.1	2.1
	Apr – Jun	2.89	4.30	5.54	5.81	11	15	15	15	1.9	2.1	2.2	2.2
	Jul – Sep	9.44	12.65	14.43	14.69	23	36	36	36	2.4	2.7	2.7	2.7
	Oct – Dec	2.62	4.30	6.02	6.48	16	17	17	21	2.2	2.4	2.3	2.4

Table 2-33 Seasonal Percentage and Duration of Visibility Historical Exceedance (cont')

Weather station	Season (month)	Percent exceedance (%)				Maximum duration of exceedance (hour)				Average duration of exceedance (hour)			
		≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km	≤ 0.5 km	≤ 1.0 km	≤ 2.0 km	≤ 3.0 km
Prince Rupert	Jan – Mar	0.50	1.21	2.59	3.21	29	30	30	37	2.1	2.1	2.4	2.5
	Apr – Jun	0.58	1.00	1.72	2.10	14	15	21	21	2.8	3.0	2.9	2.9
	Jul – Sep	2.71	4.25	6.36	7.36	21	34	41	41	3.4	3.7	3.8	3.7
	Oct – Dec	0.74	1.29	2.44	2.92	25	25	43	43	2.7	2.6	2.6	2.6
Triple Island	Jan – Mar	0.49	1.03	1.75	1.86	4	4	5	7	1.2	1.2	1.4	1.5
	Apr – Jun	1.03	1.22	1.49	1.51	8	8	8	8	1.7	1.7	1.6	1.6
	Jul – Sep	4.37	5.18	5.76	5.97	10	10	10	12	1.8	1.9	1.9	1.9
	Oct – Dec	0.41	0.75	1.33	1.45	4	4	4	4	1.4	1.4	1.4	1.4
Bonilla Island	Jan – Mar	0.70	1.69	3.39	3.84	3	3	3	3	1.3	1.3	1.5	1.5
	Apr – Jun	1.23	1.47	2.47	2.70	4	4	4	4	1.4	1.5	1.3	1.3
	Jul – Sep	3.89	5.26	8.21	9.10	6	8	8	8	1.6	1.7	1.8	1.8
	Oct – Dec	0.92	2.56	5.31	6.13	3	3	7	8	1.3	1.2	1.5	1.5
Ethelda Bay	Jan – Mar	0.40	1.64	6.00	7.25	3	5	8	8	1.3	1.4	1.8	1.9
	Apr – Jun	0.26	0.79	3.12	3.91	4	4	7	8	1.4	1.4	1.8	1.8
	Jul – Sep	1.03	2.13	6.58	7.68	4	5	9	13	1.6	1.7	2.0	2.2
	Oct – Dec	0.51	1.66	6.06	7.18	4	10	12	14	1.5	1.6	2.0	2.1
Sandspit	Jan – Mar	0.47	1.23	2.73	3.16	17	20	35	35	2.2	2.3	2.6	2.7
	Apr – Jun	0.22	0.46	1.02	1.19	18	18	20	20	2.4	2.4	2.7	2.7
	Jul – Sep	0.31	0.67	1.34	1.56	14	21	23	23	2.3	2.6	2.9	2.8
	Oct – Dec	0.32	0.81	1.97	2.42	18	22	28	28	2.1	2.3	2.6	2.7

3 Conclusions

Ocean wave heights are small at Nanakwa Shoal and considerably larger at the other four sites. Significant wave heights exceeding 4 m occur nearly 18% of the time in Queen Charlotte Sound and much less frequently in South Hecate Strait (7.0%), North Hecate Strait (3.3 %) and Dixon Entrance (2.1%). At Nanakwa Shoal, the largest measured significant wave height is only 2.3 m.

The largest wind speeds occur in Hecate Strait and Queen Charlotte Sound with somewhat smaller values in Dixon Entrance and even smaller in the marine terminal area. The largest near-surface ocean currents are found in Dixon Entrance. In Hecate Strait, they are smaller; in Queen Charlotte Sound, they are smaller than in Hecate Strait.

Reduced visibilities exhibit a seasonal pattern, with the poorest visibility in August and September and improved visibility conditions in the spring. Eastern Dixon Entrance and western Hecate Strait have the most favourable visibility conditions, with visibility more often reduced in eastern Hecate Strait and most reduced in Queen Charlotte Sound at the Cape Scott and Cape St. James weather stations.

4 References

4.1 Literature Cited

- ASL Environmental Sciences Inc. 2009. Marine Physical Environment. Prepared for Enbridge Northern Gateway Pipelines Inc. Calgary, Alberta. 25 p. + 10 Appendices
- S. L. Ross. 2009a. Properties and Fate of Hydrocarbons from Hypothetical Spills in the Confined Channel Assessment Area and at the Marine Terminal. Prepared for Enbridge Northern Gateway Pipelines Inc. Calgary, AB.
- S. L. Ross. 2009b. Properties and Fate of Hydrocarbons from Hypothetical Spills at Three Sites in Open Water. Prepared for Enbridge Northern Gateway Pipelines Inc. Calgary, AB.

4.2 Internet Sites

- Environment Canada. 2009. National Climate Data and Information Archive. Available at:
http://climate.weatheroffice.ec.gc.ca/climateData/canada_e.html
- Fisheries and Oceans Canada. 2009. Moorings Data Inventory, Pacific Region. Available at:
http://www.pac.dfo-mpo.gc.ca/sci/osap/data/SearchTools/SearchMoorings_e.asp

Appendix A Quantitative Comparisons of South Hecate Strait and Arazanzu Bank

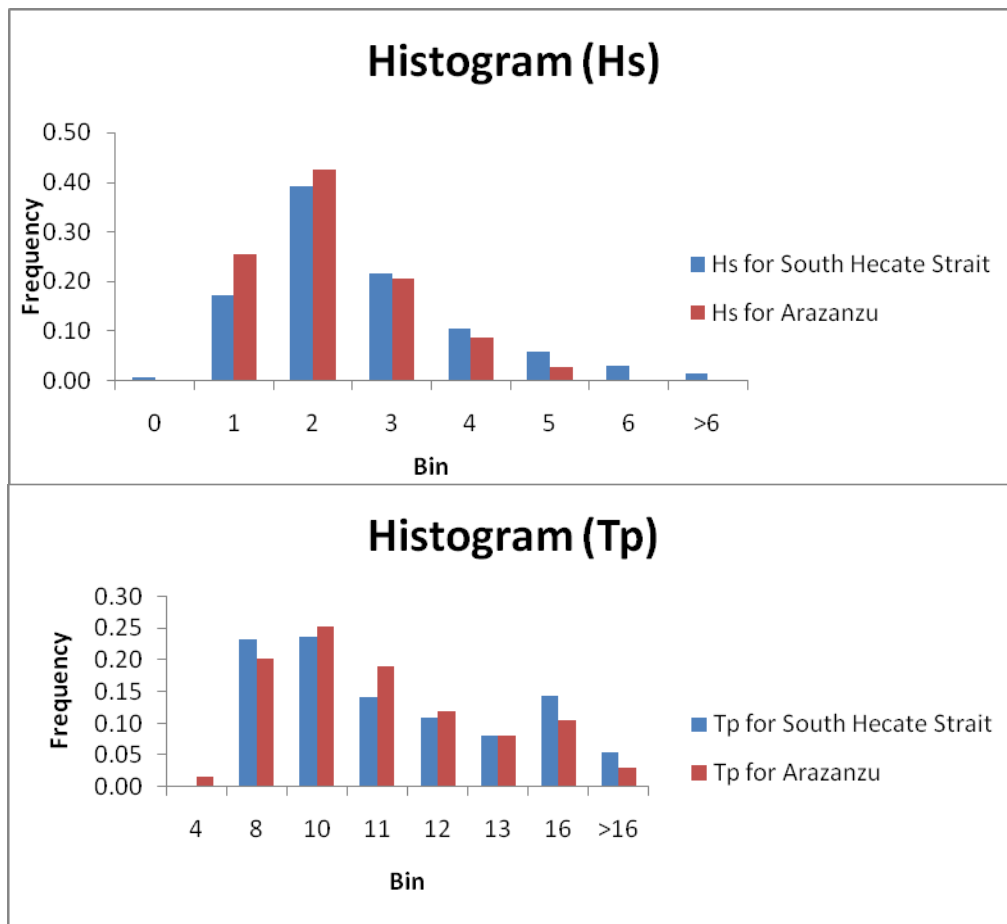


Figure A-1 Histogram of Hs and Tp Values

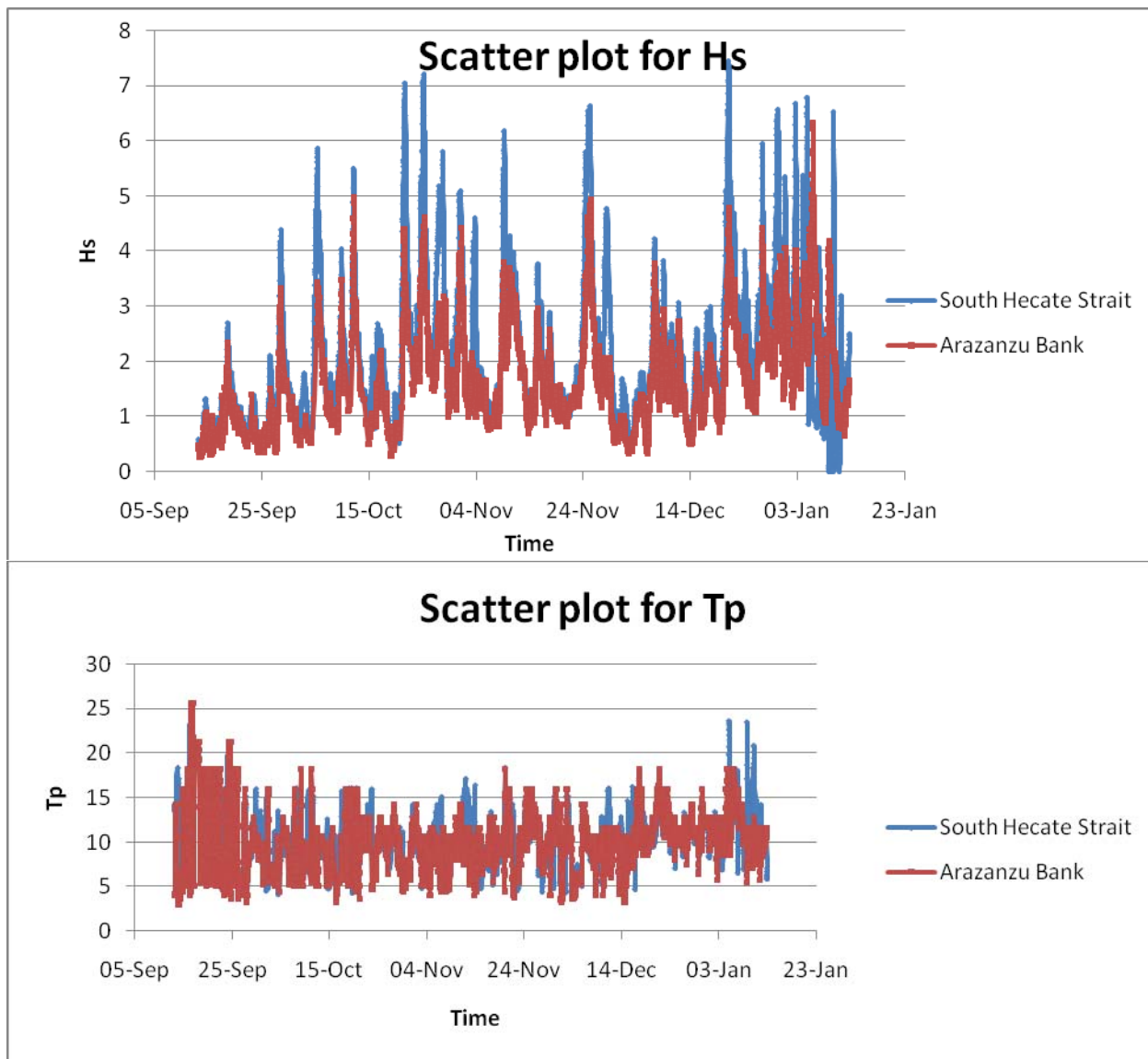


Figure A-2 Scatter Plots

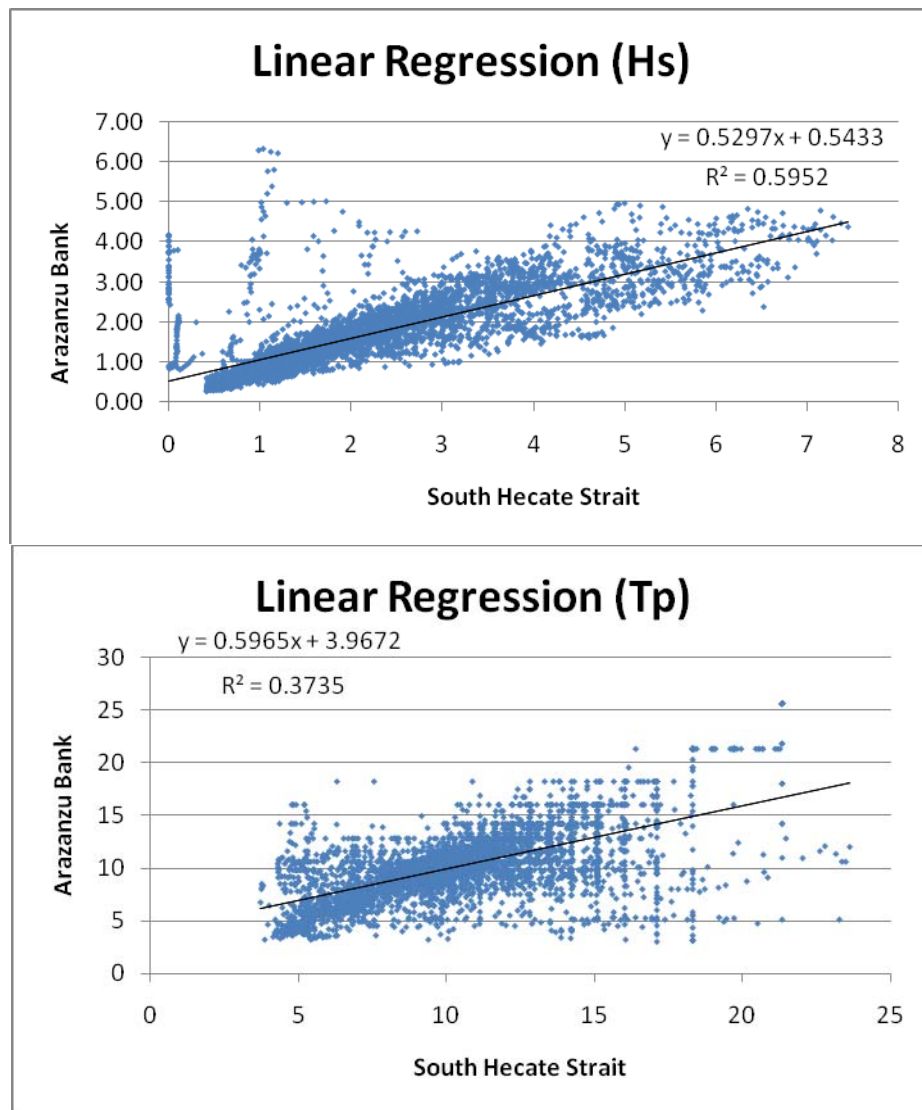


Figure A-3 Linear Regression Plots

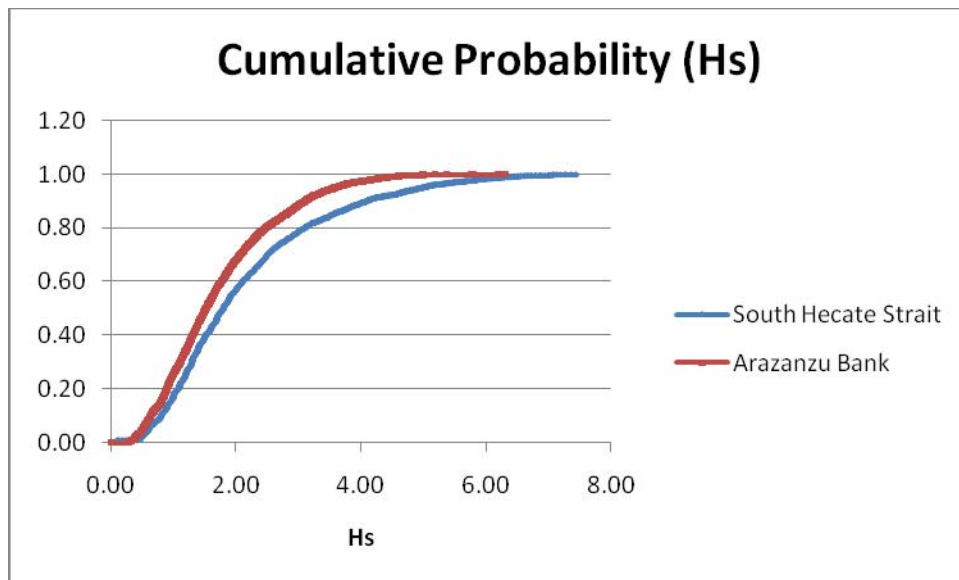


Figure A-4 Cumulative Distribution for Hs Values