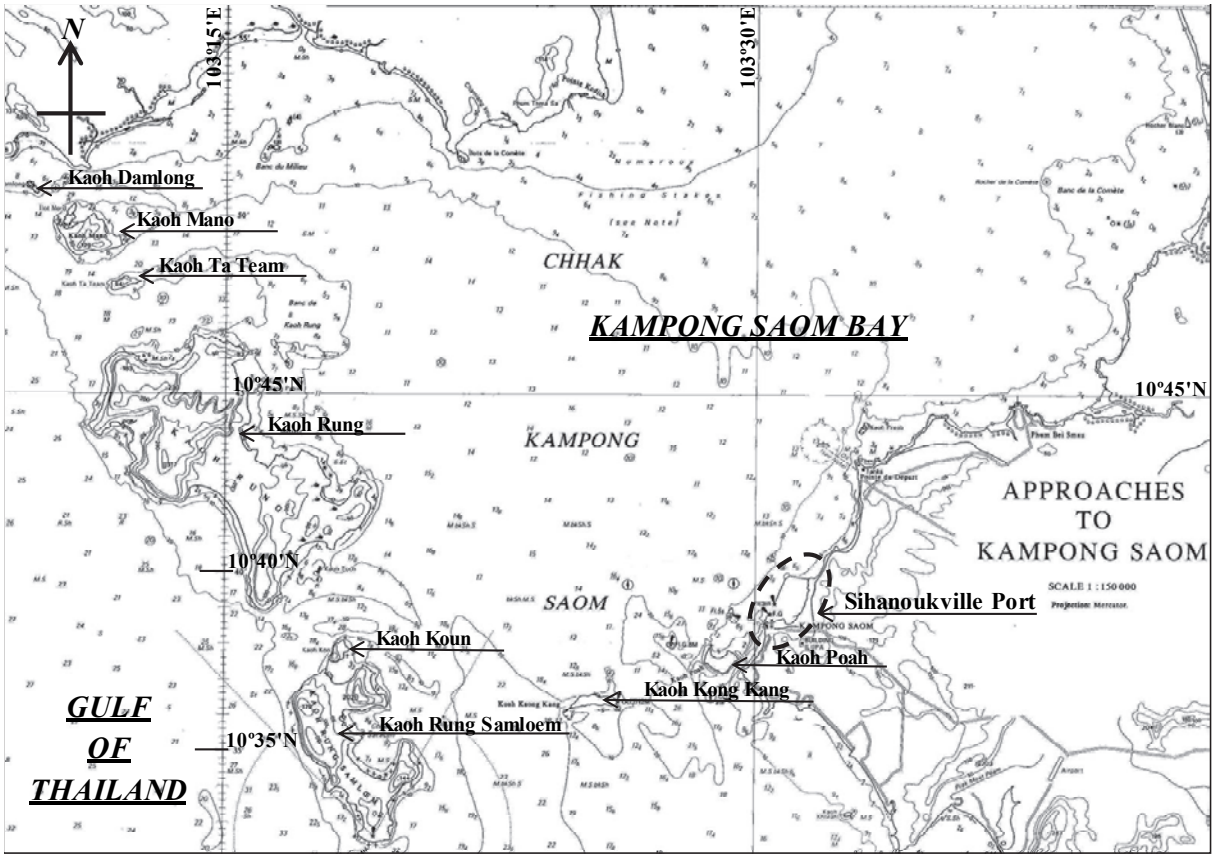
5.5. Natural Conditions

5.5.1 Topography

Sihanoukville Port faces the Kompong Saom bay in the Gulf of Thailand, lies at 103º 30'E longitude and 10º 39'N latitude, and has a seawater depth of 5 to 10 m. Damlong Is., Mano Is., Ta Team Is., Rong Is., Rong Samloen Is. and Poah Is. are located in mouth of the bay. (Figure 5.5-1) These islands function as natural breakwaters, especially against west and southwest waves from the Gulf of Thailand. The port area is enclosed with low rolling hills.



Source: British Admiralty Charts

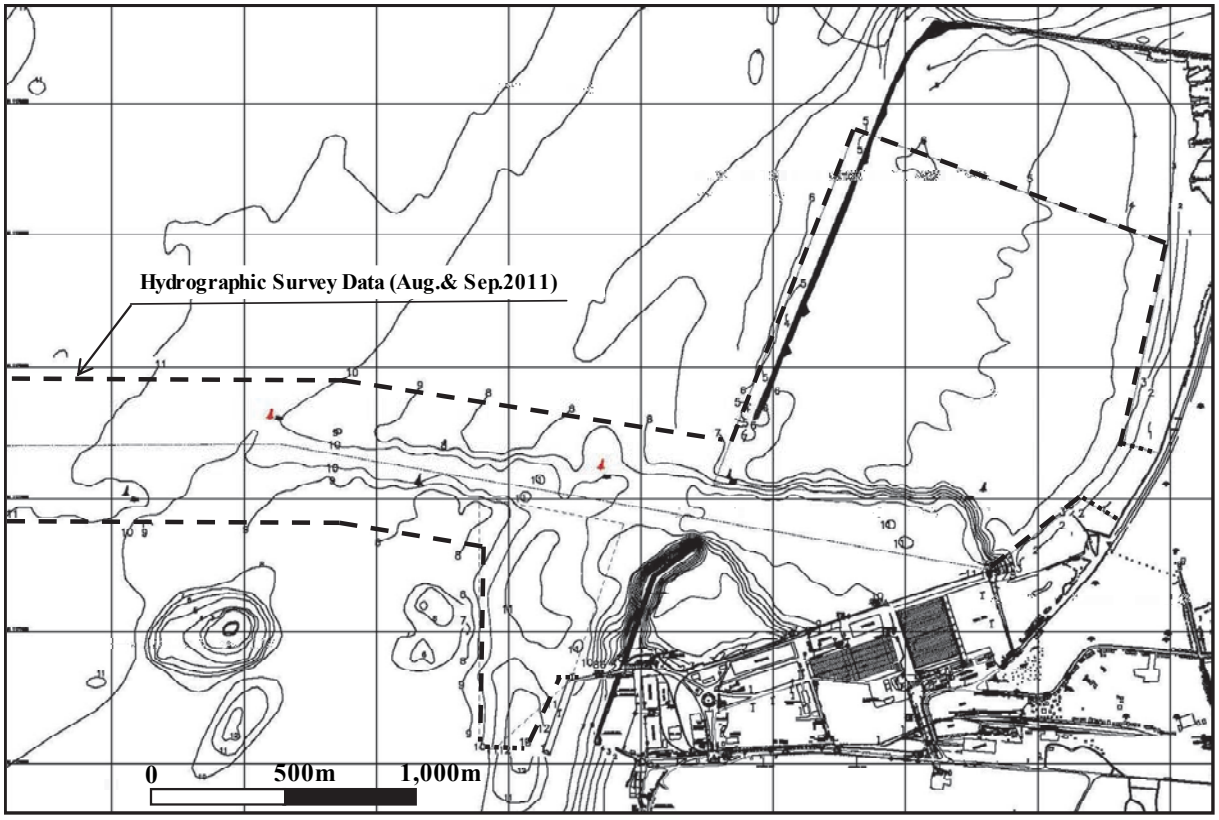
Figure 5.5-1 Topography around Sihanoukville Port

5.5.2 Bathymetry and sedimentation

In Aug. and Sep. 2011, hydrographic surveys were conducted by the JICA Project Team and E/S for the Sihanoukville Port Multi-Purpose Terminal Development Project Team (Multi-Purpose Terminal Project Team). Figure 5.5-2 shows the seabed counter lines based on the results of the hydrographic surveys.

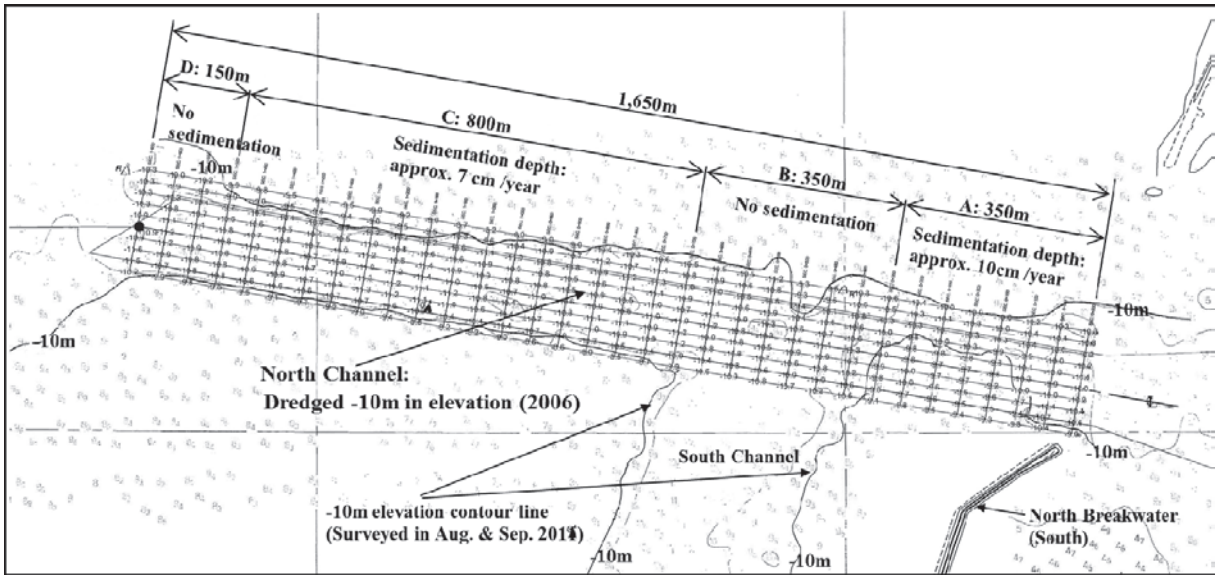
Based on a comparison with the hydrographic survey data and the as-built drawing of the dredging channel and basin with -10 m in design depth in 2006, soil sedimentation volume was analyzed by the Multi-Purpose Terminal Project Team.

The soil sedimentation area in the basin was limited and a small amount of sedimentation was found in the joint part between the dredging area and the existing seabed area. However, the soil sedimentation in the channel was more voluminous in area A (mouth area of the port) and area C (the middle part of channel). Areas B and D have no soil sedimentation, due to the fact that the soil moves to areas with lower elevation. From area B the soil moves to the south channel and from area D it moves offshore to the southwest. (See Figure 5.5-3)



Source: E/S for Sihanoukville Port Multi-purpose Terminal Development Project (2011) and Project Team

Figure 5.5-2 Hydrographic survey data (Aug. & Sep. 2011)



Source: E/S for Sihanoukville Port Multi-purpose Terminal Development Project (2011)

Figure 5.5-3 Sedimentation of channel

5.5.3 Meteorology

Meteorology data (Jan. 2000 to Aug. 2011) were collected by the Sihanoukville meteorological station located 1.1 km south of the No. 3 gate of Sihanoukville Port.

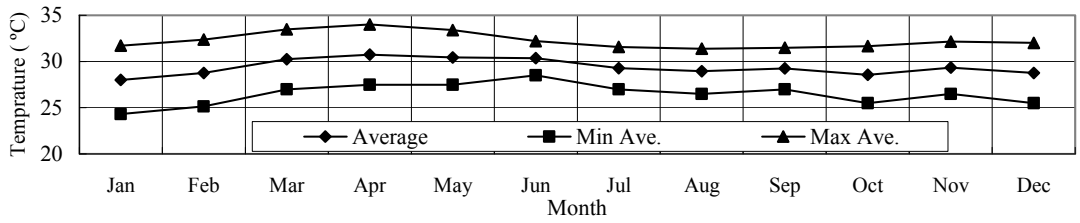
(1) Temperature

Table 5.5-1 shows the monthly average of maximum and minimum temperatures from 2000 to 2010. According to the temperature data, the average temperature from 2000 to 2011 was 29.4 ºC. The coolest month is January with a monthly average temperature of 24.3 ºC and the hottest month is April with a monthly average temperature of 34.0 ºC.

Table 5.5-1 Monthly average of maximum and minimum temperature (2000 to 2010)

Unit: ºC

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Average	28.0	28.8	30.2	30.8	30.5	30.4	29.3	28.9	29.2	28.6	29.3	28.8	29.4
Min Ave.	24.3	25.1	27.0	27.5	27.5	28.5	27.0	26.5	27.0	25.5	26.5	25.5	26.5
Max Ave.	31.7	32.4	33.5	34.0	33.4	32.2	31.6	31.4	31.5	31.7	32.2	32.0	32.3



Source: Meteorological Station of Sihanoukville, Ministry of Water Resources and Meteorology

(2) Wind

Table 5.5-2 shows the monthly maximum wind speeds from the year 2000 to 2011. Through the year, the strong wind blows mostly during the South-West Monsoon season in the west, southwest, and exceptionally northwest directions. The strongest winds on record during this period were 22 m/s in a southwest direction.

Table 5.5-2 Monthly maximum wind speeds (2000 to 2011)

Years	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd
2000	NE	8	E	12	SE	8	E	8	W	10	NW	13	NW	20	NW	18	NW	10	N	10	NE	6	NE	8
2001	N	8	N	6	E	9	N	12	NW	10	NW	17	NW	14	W	8 - 9	NW	5	NE	4	N	5	NE	7
2002	NE	6	S	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	SE	5	S	4	SE	4	NE	6	W	7	E	5	W	8 - 10	NW	6 - 7	W	5	NW	4	N	5	NE	4
2004	E	4	SE	3	S	4	E	4	NW	7	N	19 -20	W	4	S	6	W	4	NE	3	S	3	NE	4
2005	N	5	SE	4	SE	4	S	4	S	3	W	7	W	8 -10	NW	5	NW	9	NE	3	NE	7	NNE	8
2006	NE	6	S	5	E	4	N	4	NW	6	NW	15	NW	17	NW	16	NW	10	NW	16	S	14	NNE	8
2007	NE	10	S	10	S	8	NE	12	SE	15	N	15	N	10	W	8	W	7	W	6	NE	3	NE	4
2008	NNE	9	SSE	5	E	6	SE	4	W	5	W	5	NW	10	SW	12	W	10	SW	11.5	-	-	-	-
2009	N	10	NE	5	E	6	NW	7	W	7	SW	13	NW	17	NW	9	NW	18	NW	14	NE	10	NE	9
2010	N	9	SE	7	SE	6	E	5	S	8	W	7	NW	16	W	17	W	8	SW	22	NE	8	NE	7
2011	NE	5	SE	7	NE	5	SE	5	N	5	NW	7	NW	10										

Note: : More than 10 m/s : More than 20 m/s

Source: Meteorological Station of Sihanoukville, Ministry of Water Resources and Meteorology

Based on the wind direction frequency throughout year, Sihanoukville has 3 kinds of seasonal wind directions. Table 5.5-3 and Figure 5.5-4 show the wind direction frequency and the wind rose above 3 kinds of seasonal wind direction from 2000 to 2011.

- Feb, Mar and Apr : southeast and south

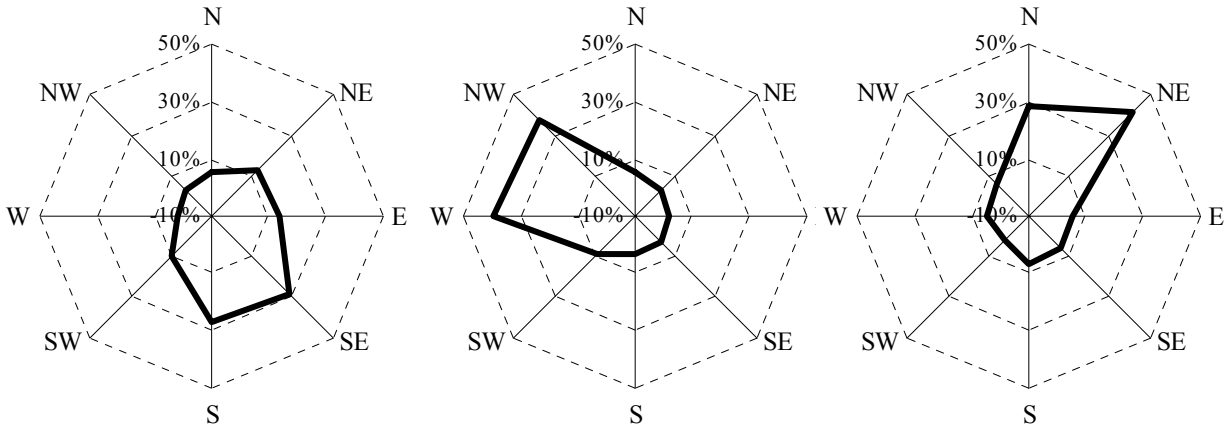
・ May, Jun, Aug and Sep : west and northwest
・ Jan, Oct, Nov, and Dec : north and northeast

Table 5.5-3 Wind direction frequency per month (daily max speed) in 2000-2010

(%)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Ave
N	8	3	4	5	4	10	4	3	**24**	**36**	**28**	**25**	13
NE	18	5	13	7	3	0	0	1	**22**	**47**	**58**	**36**	18
E	10	17	14	6	1	0	0	1	5	4	6	7	6
SE	**28**	**33**	**24**	11	0	0	1	0	2	1	1	16	10
S	**31**	**26**	**23**	7	6	1	1	1	4	9	2	10	10
SW	3	11	13	13	14	5	6	7	5	1	1	2	7
W	0	0	4	**30**	**34**	**32**	**46**	**54**	18	0	0	2	18
NW	1	3	4	**20**	**39**	**52**	**42**	**33**	20	1	2	2	18
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

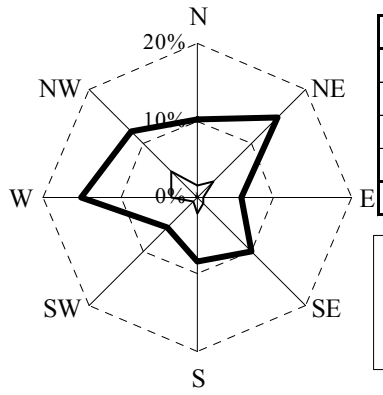
Source: Meteorological Station of Sihanoukville, Ministry of Water Resources and Meteorology



Source: Meteorological Station of Sihanoukville, Ministry of Water Resources and Meteorology

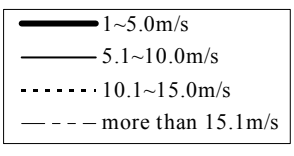
Figure 5.5-4 Wind rose of seasonal wind direction frequency (2000 – 2010)

Figure 5.5-5 shows the wind rose of wind direction frequency including wind velocity (2000-2010). High wind directions are west (18.4%), northwest (17.8%) and northeast (17.6%).



(%)

Speed (m/s)	N	NE	E	SE	S	SW	W	NW	Total
1~5.0m/s	10.3	14.7	5.8	9.8	8.3	5.4	15.0	11.9	81.2
5.1~10.0m/s	1.6	2.9	0.8	1.0	2.1	0.8	3.3	4.9	17.3
10.1~15.0m/s	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.6	1.0
more than 15.1m/s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
Total	12.0	**17.6**	6.6	10.9	10.4	6.3	**18.4**	**17.8**	100.0



Source: Meteorological Station of Sihanoukville, Ministry of Water Resources and Meteorology

Figure 5.5-5 Wind rose of wind direction frequency including wind velocity (2000 – 2010)

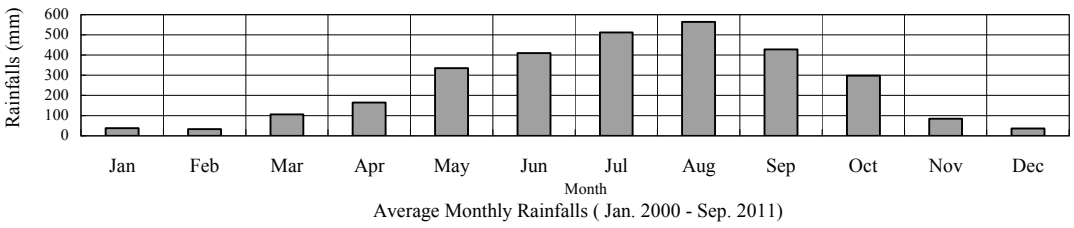
(3) Rainfall

Table 5.5-4 shows rainfall records from Jan. 2000 to Aug. 2011. The average annual mean rainfall is 3,081 mm and the average number of rainy days was 194 days from 2000 to 2010 excluding 2008.

Table 5.5-4 Rainfall in Sihanoukville (Jan. 2000-Aug. 2011)

(mm)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2000	Total	70.8	82.3	66.6	289.6	298.5	538.3	434.0	957.7	111.4	506.2	57.7	25.5	3,438.6
	Max/day	21.5	26.6	34.0	82.1	29.0	105.7	97.2	173.8	34.4	65.4	16.2	14.4	173.8
	Rainy Days	*9*	*14*	*11*	*14*	*22*	*24*	*24*	*26*	*20*	*27*	*10*	*9*	*210*
2001	Total	115.6	62.2	165.9	156.1	432.0	589.1	294.1	847.0	308.1	370.2	32.5	26.0	3,398.8
	Max/day	41.3	24.0	47.4	58.8	86.8	54.8	45.0	101.3	38.3	75.4	22.8	13.8	101.3
	Rainy Days	*12*	*8*	*19*	*11*	*22*	*24*	*19*	*30*	*24*	*26*	*7*	*7*	*209*
2002	Total	7.4	31.2	84.9	183.2	403.9	431.0	256.2	930.9	518.4	70.5	190.3	89.6	3,197.5
	Max/day	6.0	2.2	54.2	53.4	124.4	51.8	54.2	194.2	102.0	18.0	62.2	37.0	194.2
	Rainy Days	*4*	*4*	*6*	*13*	*21*	*26*	*24*	*28*	*26*	*18*	*15*	*8*	*193*
2003	Total	0.0	4.4	244.7	71.1	327.9	432.4	472.9	477.1	390.2	383.5	23.6	3.8	2,831.6
	Max/day	0.0	2.0	49.0	20.0	39.9	84.4	103.1	85.2	40.8	45.4	14.0	3.6	101.3
	Rainy Days	*1*	*3*	*16*	*10*	*28*	*21*	*25*	*22*	*29*	*25*	*8*	*1*	*189*
2004	Total	35.0	25.4	53.0	192.4	424.5	546.5	848.9	733.2	282.5	143.1	71.5	0.0	3,356.0
	Max/day	17.7	18.0	34.0	40.0	86.8	86.4	143.0	165.0	48.6	34.0	25.4	0.0	165.0
	Rainy Days	*4*	*4*	*3*	*14*	*22*	*25*	*26*	*26*	*23*	*12*	*10*	*1*	*170*
2005	Total	45.5	0.9	48.4	170.6	322.5	379.2	705.1	366.3	383.2	63.0	68.9	69.6	2,623.2
	Max/day	35.6	0.2	36.2	96.8	55.8	74.2	113.4	57.0	55.8	63.0	22.5	26.0	113.4
	Rainy Days	*2*	*2*	*4*	*13*	*20*	*25*	*29*	*23*	*20*	*24*	*15*	*8*	*185*
2006	Total	121.6	127.6	79.9	197.0	447.0	562.4	927.3	602.9	519.3	349.8	92.0	29.5	4,056.3
	Max/day	59.5	31.4	24.8	58.2	93.8	50.2	159.4	103.4	127.0	82.5	31.0	26.5	159.4
	Rainy Days	*11*	*15*	*9*	*13*	*21*	*28*	*27*	*26*	*25*	*21*	*9*	*3*	*208*
2007	Total	2.5	3.9	134.7	227.1	270.4	289.1	695.2	449.3	820.1	316.6	125.6	30.2	3,364.7
	Max/day	2.4	2.5	59.0	42.0	42.0	68.0	116.4	74.5	118.0	97.5	39.0	14.6	118.0
	Rainy Days	*2*	*3*	*12*	*16*	*20*	*21*	*29*	*30*	*24*	*18*	*10*	*4*	*189*
2008	Total	0.0	33.2	145.2	189.4	396.2	482.2	335.3	435.4	484.6	370.7	87.8	N.A.	2,960.0
	Max/day	0.0	14.4	54.6	62.5	95.0	143.0	42.5	69.0	55.8	68.4	24.4	N.A.	143.0
	Rainy Days	*3.0*	*5.0*	*13.0*	*16.0*	*27.0*	*21.0*	*24.0*	*24.0*	*29.0*	*20.0*	*12*	*N.A.*	*194*
2009	Total	2.4	6.8	113.3	127.4	353.2	141.5	379.1	220.8	715.1	215.7	14.4	63.3	2,353.0
	Max/day	2.4	4.0	33.5	34.0	56.4	18.6	72.4	37.8	76.8	51.6	10.6	36.8	76.8
	Rainy Days	*1*	*9*	*15*	*16*	*23*	*25*	*26*	*24*	*26*	*22*	*8*	*6*	*201*
2010	Total	46.2	0.6	2.6	56.0	244.0	239.6	438.8	308.0	176.6	482.4	164.4	30.2	2,189.4
	Max/day	33.4	0.6	1.0	19.4	43.4	37.6	69.4	45.3	42.8	62.4	36.8	14.6	69.4
	Rainy Days	*7*	*1*	*4*	*11*	*19*	*26*	*27*	*25*	*20*	*29*	*16*	*5*	*190*
2011	Total	1.2	12.8	129.6	110.8	97.0	277.0	355.0	442.8					1,426.2
	Max/day	1.0	10.8	61.6	39.6	31.8	39.0	51.6	96.0					331.4
	Rainy Days	*2*	*7*	*18*	*12*	*19*	*25*	*25*	*28*					136



Average Monthly Rainfalls (Jan. 2000 - Sep. 2011)

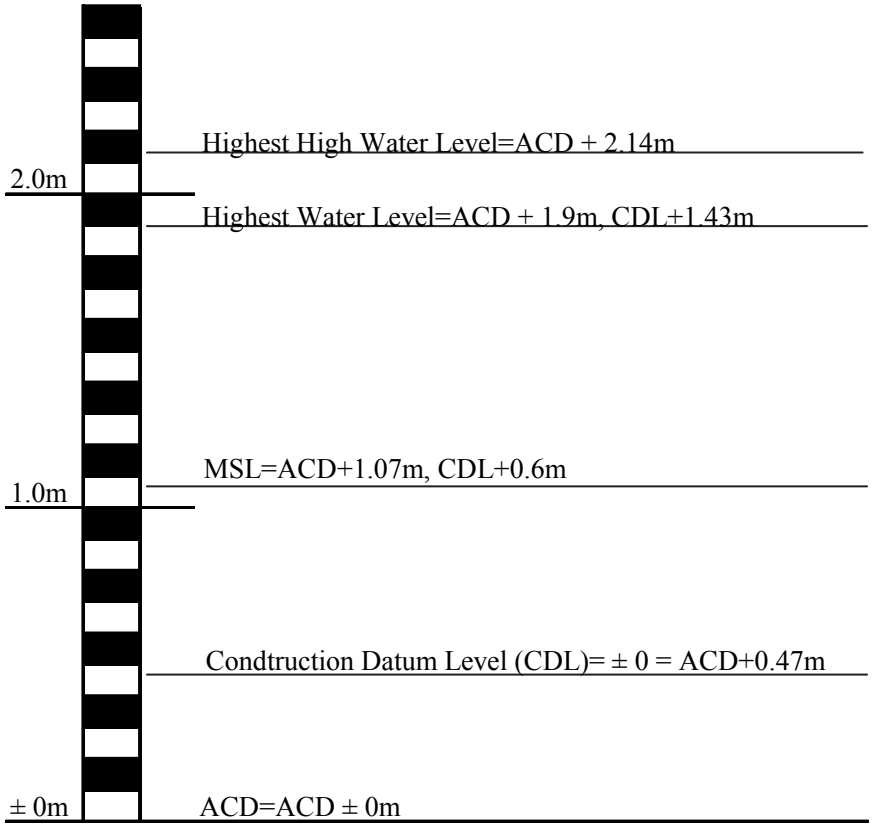
Note: : More than 200mm : More than 800mm

Source: Meteorological Station of Sihanoukville, Ministry of Water Resources and Meteorology

5.5.4 Oceanography

(1) Tide conditions

Based on the ACD (Admiralty Chart Datum) tide system, MSL (Mean Sea Level) is ACD+1.07 m and the Highest High Water Level is ACD+2.14 m. Tide observation was conducted by the JICA M/P and F/S in 1997 and then the Construction Datum Level (CDM) was determined based on the Japanese Standard. Consequently, ACD was lower than CDL by 0.47 m. (Figure 5.5-6)



Source: E/S for Sihanoukville Port Multi-purpose Terminal Development Project (2011)

Figure 5.5-6 Tides at Sihanoukville Port

According to observation tidal data analysis by the Multi-Purpose Terminal Project Team, only 2.8% of observed tide levels were lower than CDL. Therefore, it seems insignificant for the construction works and ship maneuvering.

(2) Wave Conditions

Based on the wave condition analysis of the JICA M/P and F/S in 1997, offshore waves with a height not exceeding 0.5 meters accounted for 92.3% and those exceeding 0.75 meters in height were estimated to be only 0.8%. Dominant wave directions are ordinarily north and west. The majority (97.8%) of the wave period was less than 3.00 seconds. (Table 5.5-5 and Table 5.5-6)

Table 5.5-5 Occurrence frequency of wave height by direction

year 1983-1996

Frequency / Wave height (m)		N	NNE	SW	WSW	W	WNW	NW	NNW	Total
0.00-0.24	n	696	23	391	8	721	3	347	3	2,192
	%	22.3%	0.7%	12.5%	0.3%	23.0%	0.1%	11.1%	0.1%	70.1%
0.25-0.49	n	203	8	26	1	334	9	104	8	693
	%	6.5%	0.3%	0.8%	0.0%	10.7%	0.3%	3.3%	0.3%	22.2%
0.50-0.74	n	69	6	10	-	75	2	53	3	218
	%	2.2%	0.2%	0.3%	-	2.4%	0.1%	1.7%	0.1%	7.0%
0.75-0.99	n	4	-	3	-	7	-	3	-	17
	%	0.1%	-	0.1%	-	0.2%	-	0.1%	-	0.5%
1.00-1.24	n	-	-	-	-	6	-	2	-	8
	%	-	-	-	-	0.2%	-	0.1%	-	0.3%
Total	n	972	37	430	9	1,143	14	509	14	3,128
	%	31%	1%	14%	0%	37%	0%	16%	0%	100%

Note: Hindcasted by Bretshneider method, n: number of occurrence

Source: JICA M/P and F/S in 1997

Table 5.5-6 Occurrence frequency of wave period by direction

year 1983-1996

Frequency / Wave period (m)		N	NNE	SW	WSW	W	WNW	NW	NNW	Total
0.00-0.99	n	215	1	74	2	125	4	53	1	475
	%	6.9%	0.0%	2.4%	0.1%	4.0%	0.1%	1.7%	0.0%	15.2%
1.00-1.99	n	502	28	348	4	394	10	331	10	1,627
	%	16.0%	0.9%	11.1%	0.1%	12.6%	0.3%	10.6%	0.3%	52.0%
2.00-2.99	n	249	7	8	3	572	-	114	3.00	956
	%	8.0%	0.2%	0.3%	-	18.3%	0.0%	3.6%	0.1%	30.5%
3.00-3.99	n	6	1	-	-	50	-	11	-	68
	%	0.2%	0.0%	-	-	1.6%	-	0.4%	-	2.2%
4.00-4.99	n	-	-	-	-	2	-	-	-	2
	%	-	-	-	-	0.1%	-	-	-	0.1%
Total	n	972	37	430	9	1,143	14	509	14	3,128
	%	31%	1%	14%	0%	37%	0%	16%	0%	100%

Note: Hindcasted by Bretshneider method, n: number of occurrence
Source: JICA M/P and F/S in 1997

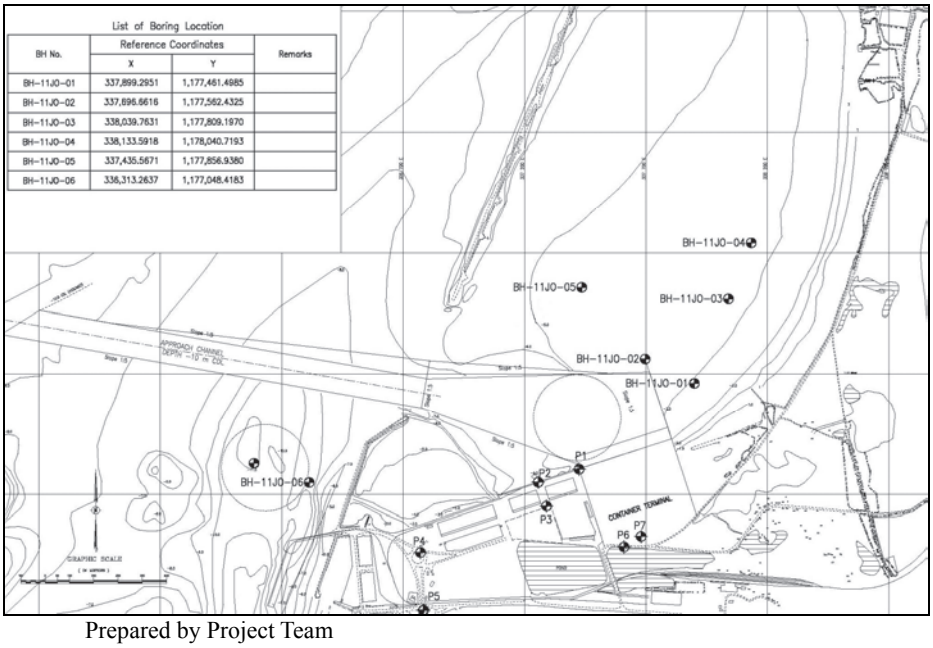
(3) Current Conditions

According to the Final Report of JICA M/P and F/S in 1997, a current survey was carried out from April to May 1996 at locations in the south channel, north channel and a disposal offshore area around Dek Koul Island. The maximum velocity and frequent direction of the current in the south channel is approximately 50 cm/sec from northwest to north. In the north channel, the maximum velocity is also 50 cm/sec and flows from south to southwest. The trend of currents around Dek Koul Island flow from the northeast with a maximum velocity of 80 cm/sec.

5.5.5 Geotechnical Conditions

(1) Geotechnical Investigation

A geotechnical investigation was conducted to determine the actual offshore subsoil conditions in the Sihanoukville Port area in order to evaluate the development potential of the space. Borehole locations were identified to collect data on the subsurface conditions considering the existing borehole locations. Six boreholes were drilled offshore as shown in the following Figure 5.5-7.



Prepared by Project Team

Figure 5.5-7 Borehole location map

A summary of boring results is shown in Table 5.5-7. A soft soil layer with an N-value of less

than 5 was found in 5 boreholes inside the breakwater distributed approximately 5 – 8 m in depth from the seabed. Based on the laboratory test of particle size distribution, the soft sail layer is mostly sandy soil.

A rock layer fluctuates from -11 m to -28 m of elevation in all 6 boreholes. Drilling logs, soil profiles and summary of the laboratory tests for the 6 boreholes (BH-1 to 6) are shown in Appendix -8.

Table 5.5-7 Summary of boring results (Sep. 2011)

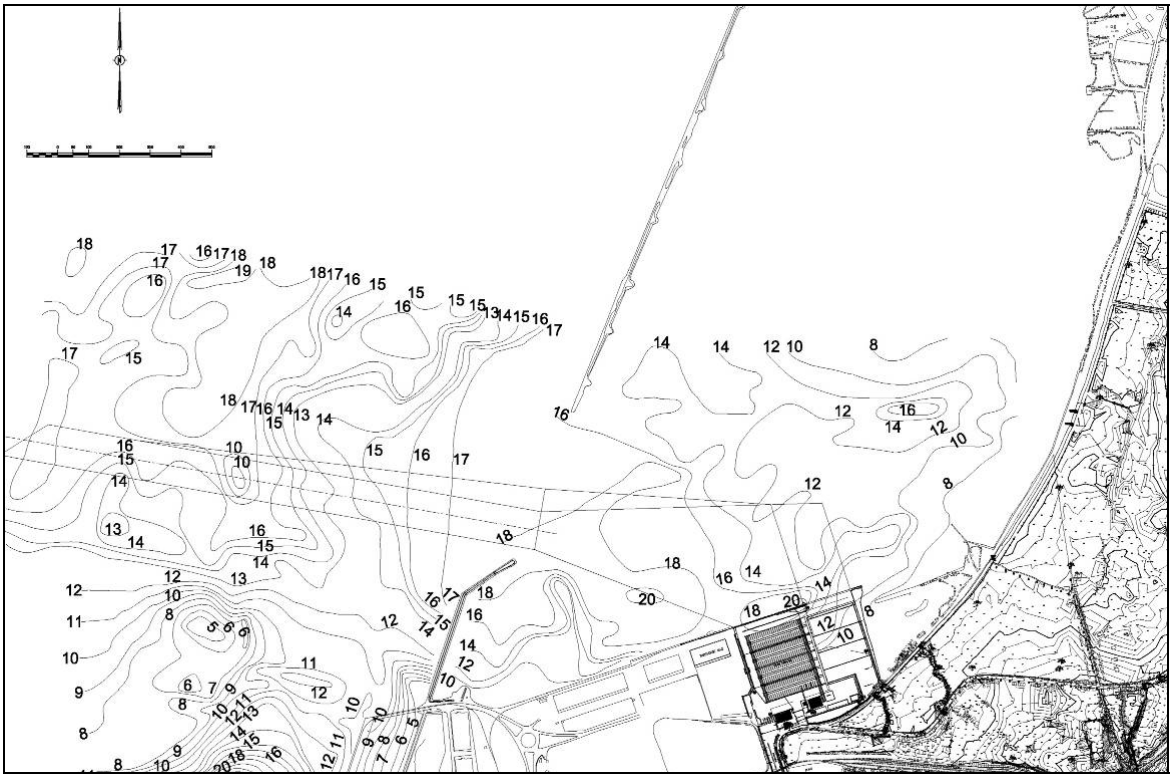
Boring No.	Elevation	N-Value	Description of Strata
BH-11JO-01	Seabed -4.4m to -9.9m	N<5	Very soft/soft sandy clay
	-9.9m to -20m	5<N<50	Clayey sand and sandy clay with gravels
	-20m to -23.4m	N>50	Sandstone and siltstone
BH-11JO-02	Seabed -4.8m to -13.0m	N<5	Very soft/soft sandy clay with fragment of shells
	-13.0m to -21.6m	5<N<50	Clayey sand and sandy clay
	-21.6m to -25.3m	N>50	Dense sand
	-25.3m to -28.4m	N=30	Very stiff clay/sandy clay
	-28.4m to 30.3m	N>50	Sandstone and siltstone
BH-11JO-03	Seabed -4.7m to -12.0m	N<10	Very soft or soft sandy clay
	-12.0m to -15.2m	10<N<50	Sandy clay, sand
	-15.2m to -17.7m	N>50	Sandstone, siltstone and sandy clay in fractures
	-17.7m to -19.8m	N=12	Clay with sandstone and siltstone
	-19.8m to -21.1m	N>50	Sandstone and siltstone
BH-11JO-04	Seabed -4.5m to -12.6m	N<5	Very soft or soft sandy clay
	-11.5m to -15.3m	N>50	Sandstone and Siltstone
BH-11JO-05	Seabed -5.2m to -9.9m	N<5	Very soft/soft sandy clay with fragment of shells
	-9.9m to -19.6m	5<N<50	Sandy clay with fragment shells, sand, clayey sand
	-19.6m to -23.2m	N>50	Sand
	-23.2m to -31.1m	N>50	Weathered sandstone/siltstone
	-31.1m to -34.4m	N>50	Moderately sandstone
BH-11JO-06	Seabed -10.5m to -10.8m	N<5	Very soft or soft silty clay
	-10.8m to -13m	N>50	Weathered sandstone/claystone/siltstone
	-13m to -16.9m	N>50	Moderately sandstone/siltstone

Prepared by Project Team

(2) Rock layer investigation

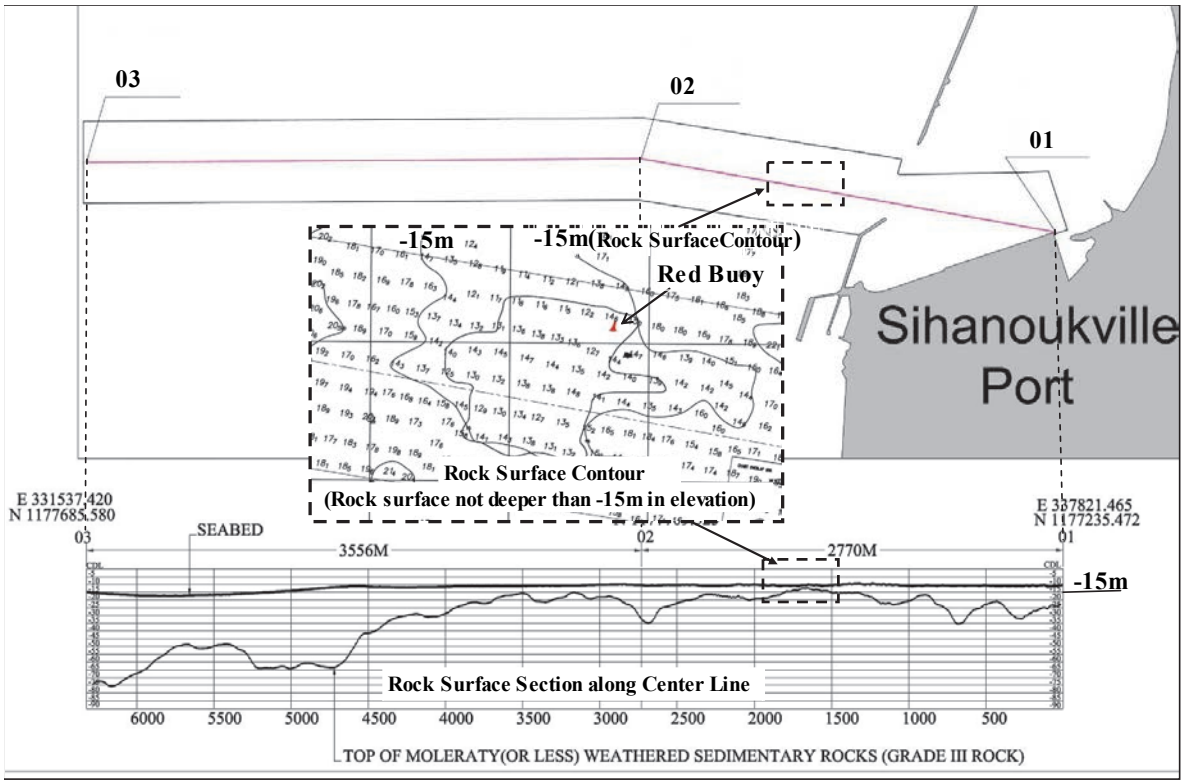
A sounding survey was conducted to identify the rock layer elevation in the inner and outer Sihanoukville Port in the JICA M/P and F/S in 1997. (Figure 5.5-8) Moreover, a detailed sounding survey was conducted for detail design by E/S for Sihanoukville Port Multi-purpose Terminal Development Project (2011).

According to the detailed sounding survey, a rock layer with approximately -11 to -13 m elevation was found around the red buoy (about 450 m from entrance of the Port) in the north channel. (Figure 5.5-9)



Source: JICA M/P and F/S in 1997

Figure 5.5-8 Rock layer surface by sounding survey (1996)



Source: E/S for Sihanoukville Port Multi-purpose Terminal Development Project (2011)

Figure 5.5-9 Results of detailed sounding survey in the North Channel

5.6. Baseline condition of natural environment

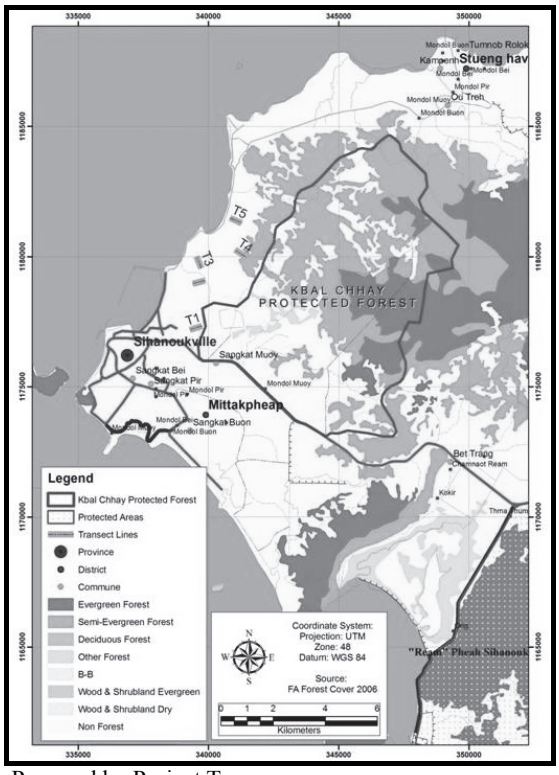
5.6.1 General description of the coastal area

The coastal area around Sihanoukville Port is mainly comprised of sandy beaches, rocky coasts and headlands. Mangroves are distributed along small inlets and in Ream National Park, which is located approximately 20 km south-east from the Port. Coral reefs are mainly distributed in the offshore islands.

5.6.2 Ecosystem

(1) Terrestrial ecosystem

Vegetation in the hinterland of Sihanoukville Port is mainly comprised of grassland, shrubland, swamp, plantation and small patches of secondary forest. Approximately 2-3 km east of Sihanoukville Port lies the boundary of Kbal Chhay Protected Forest, which is managed by Ministry of Agriculture, Forestry and Fishery (MAFF). Figure 5.6-1 shows the main vegetation type around Sihanoukville and the boundary of Kbal Chhay Protected Forest.



Prepared by Project Team

Figure 5.6-1 The main vegetation type around Sihanoukville and the boundary of Kbal Chhay Protected Forest

1) Terrestrial flora/fauna survey

Terrestrial flora/fauna survey was conducted in the hinterland area of Sihanoukville Port in November 2011, by subcontracting a local consultant (Key Consultants). The aim of the survey was to understand the terrestrial flora/fauna characteristics in the area of the potential route of the new access road. The road is expected to be routed somewhere in between the Hun Sen beach road and west of Kbal Chhay Protected Forest. Terrestrial flora was surveyed through line-transect method. Terrestrial fauna was surveyed through interviewing local people that live or work in the survey area.

a) Methodology

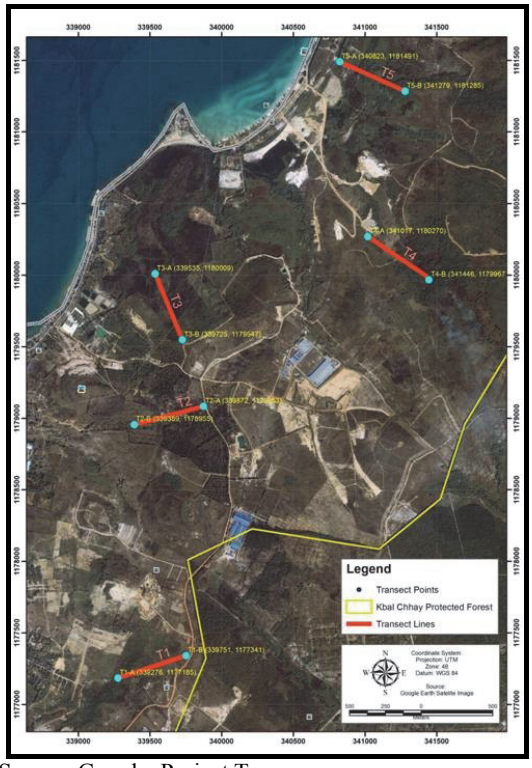
Line-transect survey was conducted at five sites, with each transect comprising of 500 m x 20 m

(i.e. area of 1 ha). Figure 5.6-2 shows the location of the surveyed transects. The following information was recorded in the process:

- Species name of trees identified along the transect
- Number of trees that were above 1.5 m in height

Local tree experts (experienced loggers) were recruited for identification of tree species. Unclear tress species were photographed and identified later by experts in Phnom Penh.

Interview survey was selected as the preferred methodology for terrestrial fauna, as spotting and identification of wildlife species were considered difficult in the field, especially as many animals are nocturnal and secretive. Field guides were used during the interview to avoid misidentification.



Source: Google, Project Team

Figure 5.6-2 Transects of the terrestrial flora survey

b) Results of flora survey

A total of 85 tree species were identified through the survey. The most dominant tree species were *Acacia* spp. and *Eucalyptus* spp. Two identified tree species *Dipterocarpus costatus* and *Xylopia pierrei* are classified as threatened under the IUCN Red List. *Dipterocarpus costatus* is classified as Endangered (EN) and was found at transect T1. *Xylopia pierrei* is classified as Vulnerable (VU) and was found at transects T1 and T3. Both species are common in Cambodia and do not require any special conservation yet. Nevertheless, clearing of these threatened species should be avoided by careful route selection (e.g. avoidance of forest area). Figure 5.6-3 shows the photograph of these threatened species taken during the survey.

Dipterocarpus costatus

Xylopia pierrei

Prepared by Project Team

Figure 5.6-3 Threatened tree species identified during the survey

Table 5.6-1 shows the number of tree species and tree density recorded at each transect. Note that tree density is based on the number of trees that were above 1.5 m in height. The number of tree species ranged between 21-51 species. Tree density ranged between 5-143 trees per hectare. The results show that there is wide variation in tree density within the surveyed area.

Table 5.6-1 Number of tree species and tree density at each transect

Transect	No. of tree species	No. of trees (H>1.5 m)	Tree density per ha
T1	47	110	110
T2	21	5	5
T3	51	143	143
T4	23	52	52
T5	31	41	41

Prepared by Project Team

c) Results of fauna survey

According to the interview survey, a total of 83 species were identified to exist around the survey area, consisting of mammals (16 species), birds (39 species), reptiles (18 species) and amphibians (10 species). Within the identified species, two mammal and three reptile species are classified as threatened under the IUCN Red List. Table 5.6-2 shows the identified threatened species and their classification under IUCN Red List. Since the habitat range of these threatened species are uncertain, a detailed field survey should be conducted in the EIA to confirm whether the route of the access road does not overlap with their habitats. If impacts are predicted, the route should be altered or appropriate conservation measures considered.

Table 5.6-2 Identified threatened fauna species and their classification under IUCN Red List

	Common name	Species name	IUCN category
Mammals	Sunda Pangolin	*Manis javanica*	Endangered (EN)
	Lyle's Flying Fox	*Pteropus lylei*	Vulnerable (VU)
Reptiles	Indochinese box turtle*	*Cuora galbinifrons*	Critically Endangered (CR)
	Snail-eating turtle	*Malayemys subtrijuga*	Vulnerable (VU)
	King cobra	*Ophiophagus hannah*	Vulnerable (VU)

*: According to IUCN Red List information on Indochinese box turtle, its presence in Cambodia is uncertain and its main habitat is high altitude woodlands. Therefore, there is a possibility of misidentification with other similar looking species.

Prepared by Project Team

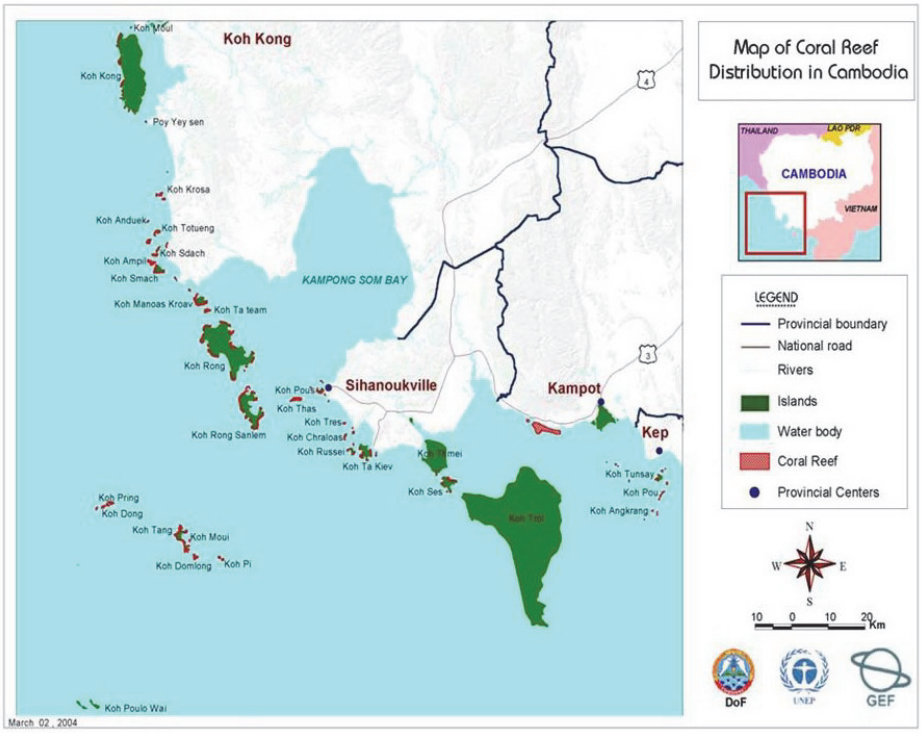
(2) Marine ecosystem

1) Important marine habitats

Cambodian waters support important marine habitats such as coral reefs, seagrass beds and mangrove forests. While seagrass beds are limited or non-existent in waters adjacent to the Port, small patches of seagrass beds are found in Koh Rong and Koh Rong Samloem islands (UNEP, 2007[1]), which are located approximately 20 km west from Sihanoukville Port. While extensive seagrass beds are distributed along the coast of Kampot Province, these areas will not be affected from Port development as they are more than 30-40 km east from the Port.

Along the coast of Sihanoukville, mangroves are mostly distributed along small inlets and in Ream National Park, which is located approximately 20 km east from the Port. These mangroves are unlikely to be affected from Port development primarily due to their distant locations. No mangroves are found near the Port.

Coral reefs in Cambodia are mostly distributed along parts of the mainland and around islands. Figure 5.6-4 shows the distribution of coral reefs in Cambodia. In Sihanoukville, coral reefs are found in the nearshore and offshore islands, which may be affected by port development such as dredging activities. Hence a baseline coral reef survey was conducted in November 2011, targeting Koh Rong, Koh Rong Samloem and Koh Thas islands. These islands are located 10-20 km west of the Port. The nearshore coral reefs were not surveyed due to limited water visibility. The survey was conducted by subcontracting a local consultant (Key Consultants). Details of the survey are described below.



Source: UNEP 2007, National Report on Coral Reefs in the Coastal Waters of the South China Sea

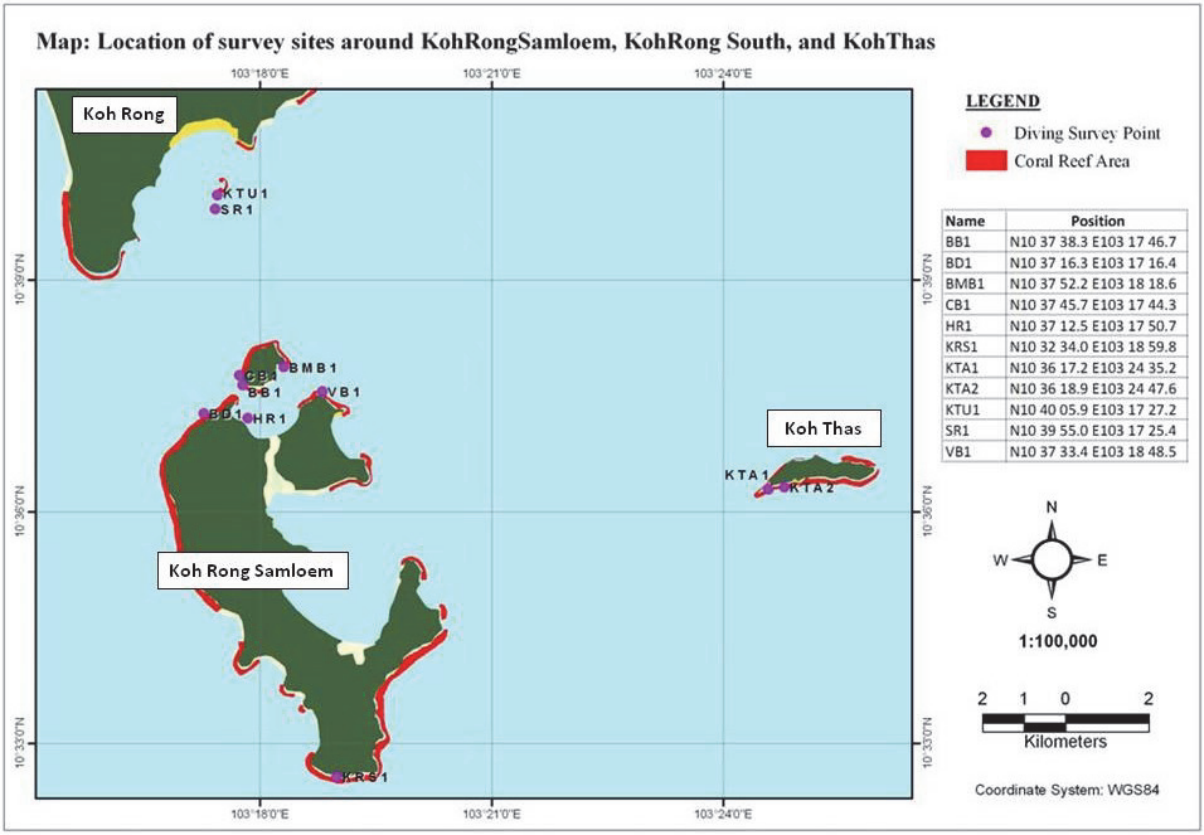
Figure 5.6-4 Distribution of coral reefs in Cambodia

a) Methodology

Coral reefs of Koh Rong, Koh Rong Samloem and Koh Thas islands were surveyed by following the Reef Check method. The Reef Check method is an internationally recognized method for assessing the health of coral reefs, which is conducted by recording substrate coverage and other health indicators (e.g. coral bleaching, coral disease, fish and invertebrates) along a set length of

[1] UNEP 2007, National Report on Seagrass in the South China Sea

transect. Survey was conducted by qualified Reef Check divers along a 100 m transect. A total of 11 sites were surveyed (Koh Rong: 2 sites; Koh Rong Samloem: 7 sites; Koh Thas: 2 sites). Figure 5.6-5 shows the location of the surveyed sites.



Prepared by Project Team

Figure 5.6-5 Location of the coral reef survey sites

b) Results

i) Hard coral

Average hard coral coverage at Koh Rong, Koh Rong Samloem and Koh Thas were 36%, 34% and 20% respectively. Hard coral coverage at Koh Thas was lower partly due to the higher proportion of sandy substrate in the area.

The hard corals found in the surveyed area belonged to the families: Poritidae, Acroporidae, Agariciidae, Dendrophyllidae, Faviidae, Fungiidae, Mussidae and Siderastreidae. The most common corals were Poritidae and Faviidae species, which are generally slow-growing but more tolerant to sedimentation.

Rate of bleaching was low at all the sites (around 3%). Some hard corals were infected by pink-spotted disease, which is caused by a parasitic flatworm.

ii) Fish and invertebrates

Fish abundance was highest at site SR1 in Koh Rong (around 130 individuals/100 m^2). Fish abundance at Koh Rong Samloem ranged between around 5-30 individuals/100 m^2. Fish abundance was lowest at Koh Thas, and was less than 5 individuals/100 m^2. The most commonly observed fish were snappers, sweetlips and butterfly fish. One Bumphead parrotfish (*Bolbometopon muricatum*) individual was observed at Koh Rong Samloem (site BB1), which is classified as Vulnerable (VU) under the IUCN Red List.

Invertebrate abundance was generally low throughout the three islands. The main observed

species were urchins. One Crown of Thorn starfish was observed at site BB1 in Koh Rong Samloem.

c) Conclusion

Although hard coral coverage at the surveyed islands are relatively low (20-30%), the health of these corals appears to be in relatively good state as indicated by the low rate of bleaching. As these coral reefs play an important role in the regional ecosystem, impacts from construction activities should be prevented by implementing appropriate mitigation measures and monitoring.

2) Marine mammals

According to the survey conducted by Beasley et al. (2007)[2], ten marine mammal species have been confirmed in Cambodian waters. Nine are Cetaceans and one dugong. In the Sihanoukville area, Irrawaddy dolphins are known to inhabit the adjacent waters of Ream National Park. Oceanic species are commonly observed around Koh Rong and Koh Rong Samloem. Dugongs were formerly abundant in waters around Kep and Kampot Provinces but the present status is unknown. Dugongs have also been reported around Koh Rong and Koh Rong Samloem, but probably persist occasionally and in very low numbers.

5.6.3 Air quality

Currently, air quality data around the Sihanoukville Port area is limited to the air quality survey conducted as part of the EIA of Sihanoukville Port Urgent Development for Oil Supply Base and Multipurpose Terminal (2008). The survey was conducted at one site along the Hun Sen beach road (approximately 200 m from the main gate of SEZ) for a 24-hour period on September 7th, 2007 (Friday). The surveyed parameters were total suspended particulates (TSP), carbon monoxide (CO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). Table 5.6-3 shows the results of the survey.

Table 5.6-3 Results of air quality survey (24-hour average value)

	24-hour average value (mg/m^3)	National standard 8-hour average value (mg/m^3)
TSP	0.02	0.33
CO	< 10	20
NO_2	0.012	0.1
SO_2	0.004	0.3

Source: EIA of Sihanoukville Port Urgent Development for Oil Supply Base and Multipurpose Terminal (2008)

According to the survey results, values of all parameters were significantly below national ambient air quality standard. Based on these results, in general, the air quality around the port area may be considered to be in relatively good condition, which is understandable as port and industrial activities in the area are at the moment relatively limited. However, under certain conditions, port activities may contribute to local-scale air pollution. Following are some examples:

- Air quality along Phe Street (Road no.4) could deteriorate due to outgoing and incoming cargo trucks, which will be most significant during peak cargo loading/unloading hours. Heavy traffic jams commonly occur during these hours, which will further enhance air pollution. Traffic jams are most common on Saturdays due to concentration of cargo loading/unloading activities. The usage of relatively old cargo trucks are also of concern as they have higher emission rates of air pollutants compared to modern trucks.
- Fugitive dust emissions from coal and wood chip stockyard could deteriorate the air quality in and around the port area, which will be most significant during windy and dry conditions.

[2] Beasley et al (2007), Conservation Status of Marine Mammals in Cambodian Waters, Including Seven New Cetacean Records of Occurrence, Aquatic Mammals 2007, 33(3), 368-379

5.6.4 Water quality

Water quality survey was conducted in October 2011 to acquire baseline water quality data in and around the Port area. The survey was subcontracted to a local consultant (Key Consultants).

(1) Methodology

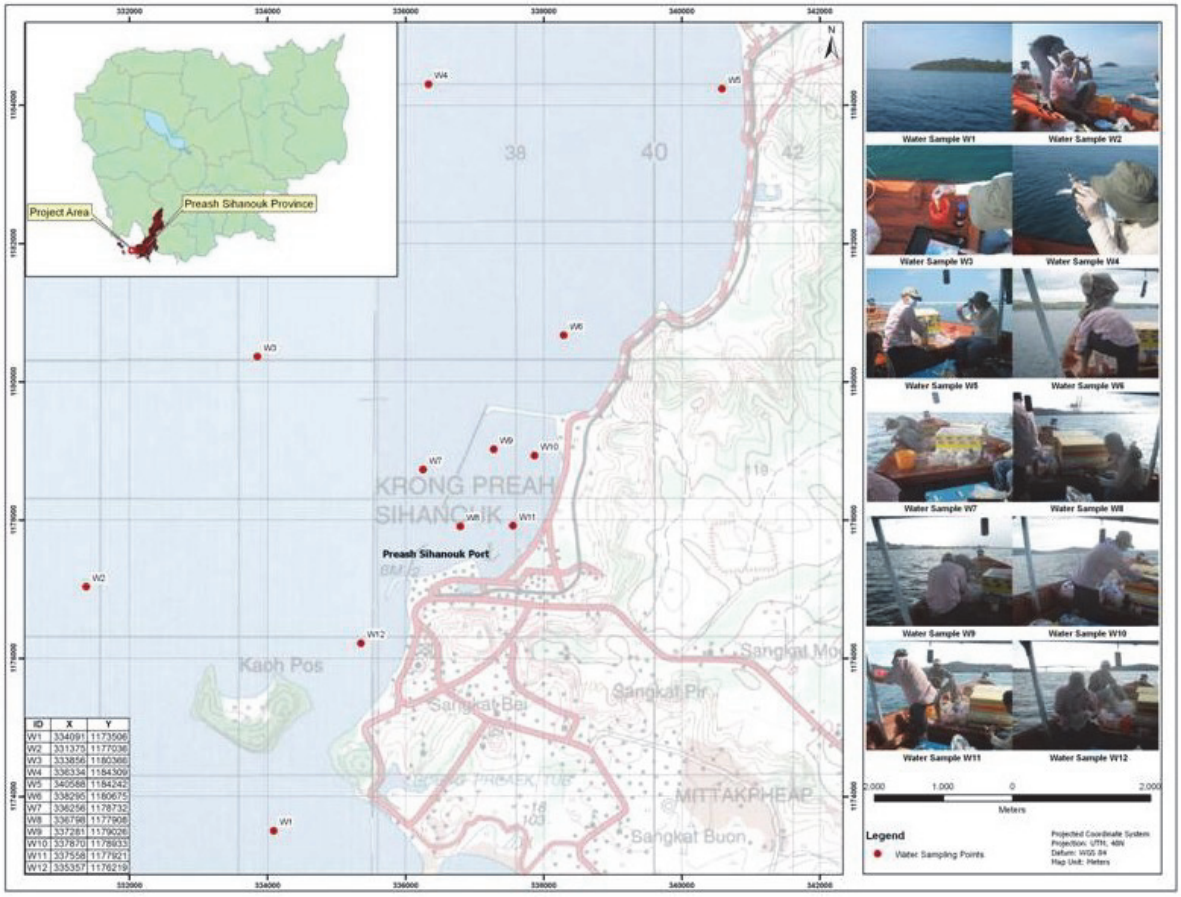
Table 5.6-4 shows the surveyed water quality parameters and employed methodologies. Water temperature, pH, salinity and dissolved oxygen (DO) were measured *in situ*. The other parameters were analyzed at Ministry of Environment (MOE) laboratory. Water samples were collected on October 24th, 2011 between 7 am and 4 pm. The weather was mostly sunny but was interrupted with occasional squalls.

Table 5.6-4 Surveyed water quality parameters and employed methodologies

Parameter	Unit	Methodology	Remarks
Water temperature	℃	Digital thermometer AZ 363	*In situ*
pH	-	Digital pH meter (phScan)	*In situ*
Salinity	PSU	Refractometer	*In situ*
Dissolved Oxygen (DO)	mg/l	DO meter	*In situ*
Turbidity	NTU	Turbidity meter	MOE lab.
Total Suspended Solids (TSS)	mg/l	2540 D	MOE lab.
Chemical Oxygen Demand (COD)		JIS K0102	MOE lab.
Total Nitrogen (T-N)	mg/l	JIS K0102	MOE lab.
Total Phosphorus (T-P)	mg/l	JIS K0102	MOE lab.
Oil content (n-hexane extracts)	mg/l	5520 D	MOE lab.
Coliform bacteria	MPN/100 ml	NFT 90-413	MOE lab.

Prepared by Project Team

A total of 12 sites were surveyed, covering surface, middle and bottom layers. Figure 5.6-6 shows the location of the surveyed sites.



Prepared by Project Team

Figure 5.6-6 Location of the water quality survey sites

(2) Results

Table 5.6-5 shows the results of the water quality survey. Following are the main findings:

- Water temperature and salinity were more or less uniform throughout the water column of the surveyed area (around 30 ˚C and 3 %).
- DO concentration was generally within acceptable levels at most sites and layers, ranging between 6-8 mg/l. An exception was at sites W9 and W10, which had bottom layer DO concentration of 2.3 and 3.56 mg/l respectively. This is probably due to the fact that the area has limited water exchange and receives untreated wastewater from the nearby communities.
- Concentration of COD, T-N and T-P were generally within acceptable levels at most sites and layers. An exception was at sites W2 and W3, which had a bottom layer T-N concentration of 1.08 and 1.50 mg/l respectively, exceeding the upper limit of the national water quality standard (1 mg/l). The cause of these high T-N levels is uncertain.
- Oil was detected at all the surveyed sites. Possible sources are untreated wastewater from the nearby communities and ship bilge water.
- High levels of Coliform bacteria were detected at sites W1, W9, W11 and W12. Since these sites are all located either inside the breakwater or in the nearshore area, the likely source is untreated wastewater from the nearby communities.

Table 5.6-5 Results of water quality survey

		Temp.	pH	DO	Salinity	Turbidity	TSS*2	COD	T-N	T-P	Oil content	Coliform bacteria
Unit		°C	-	mg/l	%	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	MPN/100ml
Standard*1		-	7.0-8.3	>2.0-7.5	-	-	-	<2-8	<0.2-1.0	<0.02-0.09	0.00	<1000
W1	S	30.0	8.4	7.51	2.90	0.00	276.00	1.09	0.47	0.02	27.60	0
	M	30.0	8.5	7.45	2.85	0.00	258.00	1.51	0.43	0.02	11.80	$2.4x10^3$
	B	30.1	8.5	8.58	3.00	10.00	324.00	1.43	0.49	0.03	0.50	< 30
W2	S	30.2	8.4	7.72	2.30	0.00	272.00	1.68	0.32	0.01	31.20	0
	M	30.0	8.4	8.71	2.60	0.00	268.00	0.84	0.83	0.04	7.80	0
	B	30.2	8.4	9.88	2.65	2.00	292.00	1.18	1.50	0.03	2.10	0
W3	S	30.5	8.5	7.17	2.65	0.00	284.00	1.76	0.63	0.01	19.80	0
	M	29.9	8.5	7.23	3.00	0.00	298.00	2.18	0.79	0.01	0.40	0
	B	29.9	8.4	10.10	2.50	8.00	298.00	3.11	1.08	0.03	0.00	0
W4	S	30.3	8.5	7.04	2.80	0.00	318.00	1.60	0.45	0.03	19.00	0
	M	30.0	8.5	6.83	3.00	0.00	98.00	2.02	0.58	0.05	5.40	0
	B	29.9	8.4	7.30	3.20	1.00	296.00	1.09	0.56	0.03	0.18	0
W5	S	30.1	8.5	6.49	3.00	0.00	290.00	1.68	0.45	0.03	2.80	0
	M	30.1	8.4	6.72	2.90	0.00	258.00	3.19	0.48	0.03	0.20	0
	B	30.1	8.4	4.89	2.90	5.00	270.00	3.53	0.48	0.01	0.00	0
W6	S	30.2	8.5	7.00	2.80	0.00	274.00	1.93	0.41	0.02	37.40	< 30
	M	30.1	8.4	6.81	2.40	0.00	276.00	2.69	0.46	0.02	5.60	0
	B	30.1	8.5	6.79	2.75	3.00	252.00	3.61	0.46	0.02	0.60	0
W7	S	30.2	8.6	6.84	2.90	0.00	286.00	3.02	0.63	0.03	9.20	< 30
	M	30.1	8.6	6.52	3.10	0.00	302.00	2.02	0.38	0.04	0.00	< 30
	B	30.1	8.6	6.39	3.00	2.00	270.00	2.52	0.39	0.03	0.00	0
W8	S	30.4	8.6	7.17	3.10	0.00	310.00	2.52	0.46	0.02	4.00	0
	M	30.3	8.6	7.22	2.90	0.00	298.00	1.68	0.45	0.04	0.00	< 30
	B	30.2	8.6	7.14	3.20	1.00	282.00	2.69	0.51	0.04	0.00	0
W9	S	30.5	8.8	8.37	3.00	0.00	318.00	1.85	0.44	0.04	18.60	$9.2x10^2$
	M	30.6	8.8	7.62	3.10	0.00	324.00	1.85	0.64	0.04	1.60	< 30
	B	30.3	8.6	2.30	3.20	4.00	356.00	0.92	0.53	0.03	0.22	0
W10	S	30.6	8.7	7.66	3.00	0.00	340.00	1.09	0.48	0.02	4.80	< 30
	M	30.6	8.7	7.56	3.00	0.00	292.00	0.84	0.62	0.04	0.00	36
	B	30.7	8.7	3.56	3.10	7.00	284.00	0.34	0.62	0.04	0.00	0
W11	S	30.3	8.6	7.11	3.10	0.00	302.00	0.17	0.32	0.04	1.80	$9.3x10^3$
	M	30.3	8.7	7.17	3.00	0.00	302.00	1.18	0.61	0.05	0.06	$2.3x10^2$
	B	30.2	8.7	6.68	3.20	6.00	274.00	0.59	0.40	0.03	0.00	0
W12	S	30.2	8.6	6.70	3.00	0.00	306.00	0.92	0.36	0.04	4.20	$2.3x10^2$
	M	30.2	8.6	6.78	3.10	0.00	276.00	0.17	0.54	0.03	0.40	$9.2x10^2$
	B	30.2	8.6	5.71	3.15	3.00	292.00	0.34	0.63	0.02	0.00	0

S: surface layer, M: middle layer, B: bottom layer

*1: Water quality standard in public water areas for bio-diversity conservation (for Coastal Water) in annex 4 of the Sub-decree on Water Pollution Control, April 06 1999.

*2: The values of TSS may not be correct as the values are excessively high. Possible error in the laboratory analysis process.

Note: Gray cell indicate that the values exceed Cambodian water quality standard.

Prepared by Project Team

(3) Conclusion

Although the waters in and around the port area was polluted by oil and coliform bacteria, apart from these parameters, the water quality appears to be in relatively acceptable levels. However, due to the enclosed nature, the area inside the port breakwater will be susceptible to future water pollution, especially with the port expansion, SEZ operation and continuing wastewater discharge from the local community. Therefore, discharge of any untreated wastewater should be prevented or gradually phased out to minimize the risk of further water pollution.

5.6.5 Waste

(1) Non-hazardous waste

The main non-hazardous wastes generated from Sihanoukville Port are plastics, wood chips, bottles, tins, and papers. These wastes are collected by a private company (CINTRY Co., Ltd.) and are disposed at the city's waste disposal area.

(2) Hazardous waste

Oily wastes are the main hazardous wastes generated from Sihanoukville Port. Oil-water separator is used to treat oily waste.

5.6.6 Noise/vibration

Currently, noise data around the port area is limited to the noise survey conducted as part of the EIA of Sihanoukville Port Urgent Development for Oil Supply Base and Multipurpose Terminal (2008). The survey was conducted at one site along the Hun Sen beach road (approximately 200 m from the main gate of SEZ) for a 24-hour period from September 7th, 2007 (6 AM Friday).

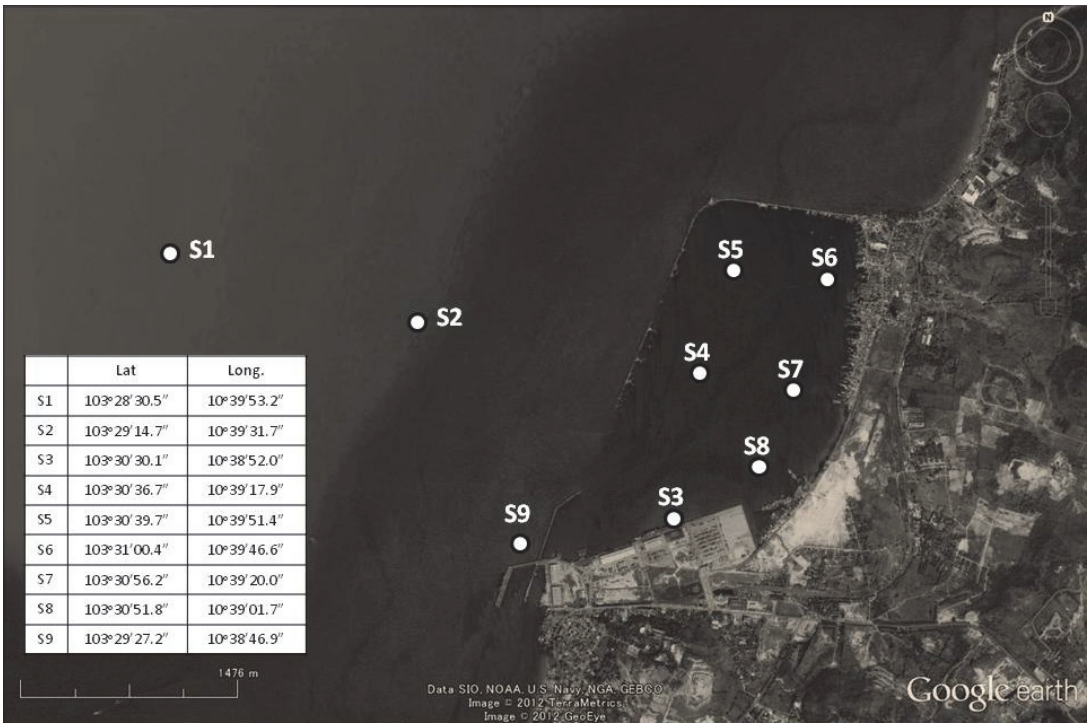
According to the survey results, hourly-averaged noise levels were within national noise standards for commercial and services areas during all hours. Although maximum noise levels occasionally exceeded the national standard, in general, noise around the port area can be considered to be under acceptable levels. However, noise levels along Phe Street (Road no.4) may become unacceptably high during hours of heavy cargo-truck movement.

5.6.7 Sediment quality

Sediment quality survey was conducted on October 27th, 2011 to acquire baseline sediment quality data in and around the Sihanoukville Port area. The survey was subcontracted to a Vietnamese consultant (HYMETEC).

(1) Methodology

Sediment quality survey was conducted at 9 sites. The locations are shown in Figure 5.6-7. Table 5.6-6 shows the surveyed sediment quality parameters and employed methodologies. Sediment samples were collected with a grab sampler. Several samples were collected at each site, which were mixed and then preserved in a cooler box.



	Lat	Long.
S1	103°28′30.5″	10°39′53.2″
S2	103°29′14.7″	10°39′31.7″
S3	103°30′30.1″	10°38′52.0″
S4	103°30′36.7″	10°39′17.9″
S5	103°30′39.7″	10°39′51.4″
S6	103°31′00.4″	10°39′46.6″
S7	103°30′56.2″	10°39′20.0″
S8	103°30′51.8″	10°39′01.7″
S9	103°29′27.2″	10°38′46.9″

Source: Google, Project Team

Figure 5.6-7 Location of the sediment quality survey sites

Table 5.6-6 Surveyed sediment quality parameters and employed methodologies

No.	Items	Analysis equipment	Analysis method
1	Specific gravity	Weight analysis Sartorius	TCVN 4195:1995
2	Water content	Oven Memmet	TCVN 6648:2000
3	Particle size distribution	Weight analysis Sartorius	TCVN 6862:2001
4	Total organic carbon (TOC)	TOC analyzer	EPA 9060:1996
5	Oil (total petroleum hydrocarbon)	Weight analysis Sartorius	TCVN 5070 – 1995
6	Detergent (methylene blue active substances)	UV-VIS	SMEWW 5540C:2005
7	Phenol	UV-VIS	EPA 9071A – 1996
8	Nitrate	Ion chromatography	TCVN 6643:2000
9	Chlorine	-	TCVN 6225- 3:1996
10	Sulfate	Ion chromatography	TCVN 6656 : 2000
11	Phosphate	Ion chromatography	TCVN 6499:1999 (ISO 11263:1994)
12	Total nitrogen (T-N)	UV-VIS	TCVN 6498:1999 (ISO 11261:1995)
13	Total phosphorus (T-P)		TCVN 4052-85
14	Total sulphur (T-S)	IR spectrum	TCVN 7371:2004
15	Cyanide (CN)	UV-VIS	TCVN 6181:1996 (ISO 6703:1984)
16	Barium (Ba)	Atomic absorption spectroscopy (AAS)	TCVN 6649:2000& SMEWW 3125:2005
17	Arsenic (As)		TCVN 6649:2000& TCVN 6626:2000
18	Tin (Sn)		TCVN 6649:2000& SMEWW 3125:2005
19	Iron (Fe)	UV-VIS	TCVN 6649:2000& TCVN 6177:1996
20	Manganese (Mn)	Atomic absorption spectroscopy (AAS)	TCVN 6649:2000& TCVN 6496:1999
21	Cadmium (Cd)		TCVN 6649:2000& TCVN 6496:1999
22	Chromium $(Cr)^{+6}$		TCVN 6649:2000& TCVN 6496:1999
23	Lead (Pb)		TCVN 6649:2000& TCVN 6496:1999
24	Mercury (Hg)		TCVN 6649:2000& TCVN 7877:2008
25	Copper (Cu)		TCVN 6649:2000& TCVN 6496:1999
26	Nickel (Ni)		TCVN 6649:2000& TCVN 6496:1999
27	Zinc (Zn)		TCVN 6649:2000& TCVN 6496:1999
28	Total PCBs	Gas chromatography	EPA 617 – 1996
29	Total DDT		TCVN 7876 – 2008 TCVN 6124:1996
30	Dioxins	Gas chromatography with mass spectrometry	TCQS 01:2010/NĐVN
31	Tributyltin (TBT)	Gas chromatography with mass spectrometry	EPA 282.3

Prepared by Project Team

(2) Results

Table 5.6-7 shows the results of the survey. Following are the main findings:

Nutrients

- T-N and T-P concentration were relatively high in front of the Port (site S3) and in the inner

part of the breakwater area (sites S5 and S6). Strong hydrogen sulfide smell was detected from samples collected at these sites. This is an indication that the seafloor inside the breakwater area is under anaerobic condition, which is probably caused by the limited water exchange and receiving of untreated wastewater from the nearby communities.

Heavy metals

- Cadmium concentration at sites S5 (0.785 mg/l) and S6 (0.717 mg/l) slightly exceeded the Canadian ISQG value (0.7 mg/l), but were below the Australian SL value (1.5 mg/l).
- Mercury concentration at sites S1 (0.171 mg/l), S2 (0.227 mg/l) and S7 (0.193 mg/l) slightly exceeded both the Canadian ISQG value (0.13 mg/l) and Australian SL value (0.15 mg/l).
- Copper concentration at sites S3 (24.35 mg/l), S5 (40.90 mg/l), S6 (76.80 mg/l) and S7 (51.10 mg/l) exceeded the Canadian ISQG value (18.7 mg/l). Site S6 also exceeded the Australian SL value (65 mg/l).
- Nickel concentration at sites S3 (25.65 mg/l), S5 (26.65 mg/l), S6 (23.70 mg/l), S7 (21.55 mg/l) and S9 (25.90 mg/l) slightly exceeded the Australian SL value (21 mg/l).
- While the concentration of cadmium, mercury, copper and nickel at some sites were slightly or moderately above the Canadian ISQG or Australian SL values, they were well below the upper threshold of the Canadian or Australian guideline values (i.e. PEL and SQG-high). Overall, for the above reasons, the status of heavy metal pollution in the surveyed area may be considered to be at a minor to moderate level.

Persistent Organic Pollutants

- PCBs, DDT and TBT concentration were below Canadian ISQG or Australian SL values at all sites.
- Dioxin concentration at sites S6 (1.0294 ng/kg) and S7 (1.7152 ng/kg) slightly exceeded the Canadian ISQG (0.85 ng/kg).

(3) Conclusion

Sediments around the port area were slightly contaminated by heavy metals and dioxins. However, due to the lack of any obvious pollution sources in the vicinity, the sources of these contaminants are uncertain and will require further investigation. However, the port SEZ may become a future source of heavy metal contamination; hence the wastewater should be strictly monitored. Nutrient levels were also relatively high, which is mostly likely due to the discharge of untreated wastewater from the nearby communities. Therefore, discharge of any untreated wastewater should be gradually phased out to minimize the risk of further sediment pollution.

Table 5.6-7 Results of sediment quality survey

No	Parameter	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9	Canada[*1]		Australia[*2]	
												ISQG	PEL	SL	SQG-high
1	Specific Gravity	-	2.700	2.761	2.501	2.650	2.715	2.670	2.650	2.559	2.625	-	-	-	-
2	Water Content	%	38.23	35.42	56.13	31.46	56.27	52.68	36.02	29.34	32.76	-	-	-	-
3	Particle Size Distribution >0,85mm	%	17.15	2.30	24.31	2.86	40.03	36.86	46.06	9.01	54.87	-	-	-	-
	0,85mm ÷ 0,355mm	%	29.88	28.51	39.63	10.64	42.73	35.50	30.47	61.32	31.39	-	-	-	-
	0,355mm ÷ 0,25mm	%	0.16	0.33	0.65	0.11	0.19	0.24	1.99	0.46	0.09	-	-	-	-
	0,25mm ÷ 0,18mm	%	20.83	18.41	7.80	12.22	5.74	6.70	4.60	12.80	2.81	-	-	-	-
	0,18mm÷ 0,15mm	%	20.55	27.98	7.04	23.78	3.67	6.89	4.37	7.82	3.02	-	-	-	-
	0,15mm ÷ 0,125mm	%	5.84	7.95	3.41	15.12	1.78	2.35	1.99	2.29	1.45	-	-	-	-
	0,125mm ÷ 0,106mm	%	1.66	2.70	0.94	5.03	0.47	1.54	1.01	1.11	0.60	-	-	-	-
	0,106mm ÷ 0,095mm	%	0.31	0.71	0.38	1.53	0.25	0.32	0.17	0.44	0.09	-	-	-	-
	0,095mm ÷ 0,085mm	%	1.09	3.60	0.88	0.53	0.10	0.10	0.16	0.67	0.09	-	-	-	-
	0,085mm ÷ 0,075mm	%	0.58	1.66	2.18	7.22	1.46	1.94	1.57	0.75	1.37	-	-	-	-
	< 0,075mm	%	1.95	5.85	12.77	20.96	3.57	7.56	7.62	3.34	4.22	-	-	-	-
4	Total Organic Carbon (TOC)	mg/kg	4,700	7,600	22,100	2,700	20,400	23,600	13,100	6,000	35,100	-	-	-	-
5	Oil (Total Petroleum Hydrocarbon)	mg/kg	< 10	< 10	< 10	20	20	< 10	30	10	< 10	-	-	550	-
6	Detergent (Methylene Blue Active Substances)	mg/kg	0.598	0.678	1.202	1.460	0.540	1.543	1.613	0.638	1.440	-	-	-	-
7	Phenol	mg/kg	0.195	0.137	0.202	0.101	0.492	0.238	0.310	0.123	0.119	-	-	-	-
8	Nitrate	mg/kg	2.01	100.4	28.15	32.50	121.2	2.001	45.05	386.4	15.90	-	-	-	-
9	Chlorine	mg/kg	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	-	-	-	-
10	Sulfate	mg/kg	1,033	1,750	2,776	846.6	2,050	2,484	5,513	1,933	4,872	-	-	-	-
11	Phosphate	mg/kg	<0.65	<0.65	<0.65	2.75	<0.65	<0.65	<0.65	<0.65	<0.65	-	-	-	-
12	Total Nitrogen (TN)	mg/kg	1,270	530	1,880	430	1,850	2,360	1,260	680	1,090	-	-	-	-
13	Total Phosphorus (TP)	mg/kg	561.1	342.7	360.2	240.1	366.8	366.8	279.4	80.8	318.7	-	-	-	-
14	Total Sulphur (TS)	mg/kg	1.13	2.63	23.14	9.34	12.13	4.21	2.57	3.12	1.09	-	-	-	-
15	Cyanide (CN)	mg/kg	0.037	0.022	0.03	0.027	0.025	0.028	0.027	0.024	0.032	-	-	-	-
16	Barium (Ba)	mg/kg	478.1	140.7	267.5	310.3	499.1	381.8	315.6	215.6	109.3	-	-	-	-
17	Arsenic (As)	mg/kg	2.087	2.274	3.065	1.818	2.383	2.573	3.378	2.221	1.376	7.24	41.6	20	-
18	Tin (Sn)	mg/kg	1.085	0.790	1.341	0.333	1.324	0.945	1.003	0.258	2.149	-	-	-	-
19	Iron (Fe)	mg/kg	4,421	4,961	11,008	3,271	11,736	9,082	7,877	2,134	9,343	-	-	-	-
20	Manganese (Mn)	mg/kg	547.9	648.5	1,437.4	269.5	1,245.9	764.3	927.2	100.7	1,288.8	-	-	-	-
21	Cadmium (Cd)	mg/kg	0.111	0.238	0.524	0.140	0.785	0.717	0.509	0.056	0.462	0.7	4.2	1.5	10
22	Chromium $(Cr)^{+6}$	mg/kg	0.31	0.61	0.93	0.82	0.90	1.10	0.80	0.55	1.27	-	-	-	-

No	Parameter	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9	Canada*1		Australia*2	
												ISQG	PEL	SL	SQG-high
23	Lead (Pb)	mg/kg	11.20	6.70	14.90	2.75	15.35	19.20	13.05	3.05	6.65	30.2	112	50	220
24	Mercury (Hg)	mg/kg	0.171	0.227	0.086	0.053	0.100	0.027	0.193	0.034	0.083	0.13	0.70	0.15	1
25	Copper (Cu)	mg/kg	4.75	4.003	24.35	5.452	40.90	76.80	51.10	7.051	8.452	18.7	108	65	270
26	Nickel (Ni)	mg/kg	19.20	17.05	25.65	15.70	26.65	23.70	21.55	15.65	25.90	-	-	21	52
27	Zinc (Zn)	mg/kg	19.40	14.95	48.30	14.45	66.15	72.30	59.45	15.70	32.25	124	271	200	410
28	Total PCBs	µg/kg	<5.4	<5.4	<5.4	<5.4	<5.4	<5.4	<5.4	<5.4	<5.4	21.5	189	25*3	-
29	Total DDT	µg/kg	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	1.19	4.77	1.6*3	46*3
30	Dioxins (PCDDs&PCDFs)	ng/kg	0.0027	0.0492	0	0.1690	0.4050	1.0294	1.7152	0.3031	0.1865	0.85	21.5	-	-
31	Tributyltin (TBT)	µg/kg	0.78	0.04	0.32	<0,02	0.29	0.13	<0,02	<0,02	0.16			9*3	-

*1: Canadian Sediment Quality Guidelines for the Protection of Aquatic Life
ISQG (Interim sediment quality guideline): Concentration below which adverse biological effects are expected to occur rarely
PEL (Probable effect level): Level above which adverse effects are expected to occur frequently
*2: National Assessment Guidelines for Dredging 2009
SL (Screening level): Level of a substance in the sediment below which toxic effects on organisms are not expected
SQG-high (Sediment quality high values): Very significant contamination
*3: Normalized to 1 per cent total organic carbon
Note: Gray cell indicate that the values exceed either ISQG or SL.
Prepared by Project Team

5.7. Baseline Information on Social Environment

5.7.1 Involuntary resettlement

(1) Outline of public awareness survey

The sub-decree in 2000 left PAS the issue regarding illegal residents in its territory as described in Section 5.4.1. The two areas of residential quarter existing in PAS jurisdiction include the area around SEZ and along the coast line (Figure 5.4-4). Their background and cause as to what brought them to live in PAS jurisdiction vary.

Most of the residents are generally poor and exposed to considerably difficult living conditions. However, the relationship between PAS and the residents in the port area has remained a vital issue for years with regard to the compensation of resettlement due to PAS project in the past. It has been a concern to prevent new residents from coming into the port area for the improper purpose of getting resettlement compensation.

In this context, the result of the public awareness survey for the residents conducted in 2009 entitled "Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanoukville for Sustainable Development (2009-2010)" is utilized to be the base for understanding the present situation of the settlement areas. The survey outputs shall be in consideration of formulating a basic direction in improving the living environment in the Project.

Public awareness survey was conducted to understand the current living, environmental and residential needs in the Sihanoukville Port areas. The original survey started in June and completed in August, 2009. Two types of samples were surveyed: one is the residents, and the other is the key informant. A key informant is a non-resident closely working with residents of the urban poor areas such as government officials or NGOs. The sample numbers are 125 for residents and 23 for non-residents. The reason as to why the survey on the awareness of non-residents is taken is for the Survey Team to get an objective view about the urban poor areas. The surveyed items include topics about 1) socio-economy, 2) background information, 3) housing, 4) basic infrastructure, 5) living environment, 6) merit and demerit, and 7) future plan.

In the Project, the target areas have been picked up from the result of the original survey. The target areas include the two villages in the port area, coast line in the port area of Commune No.1, and SEZ Area of Commune No.3, Mittakpheap KHAN[3] (Figure 5.4.4). The survey covered 50 households in two villages for the resident survey and interview, with 10 key informants for non- resident survey.

(2) Results

Overview of the result of the survey is shown in Table 5.7-1.

1) General

As compared to the other two deprived areas in Preah Sihanouk City in the original survey in 2009, results show that the living standard of residents in the port area is slightly higher than the other two areas. Residents around Sihanoukvilit Port have greater advantage in finding jobs and setting up micro-small businesses. However, infrastructure and living environment are not enough to improve the living standard. It seems that more than 70% of respondents are willing to continue living in the settlement areas; however at the same time, they hope for better quality of life and future. Some of the residents in SEZ area of Village No.3 started living in the port area to get compensation from the project. Some of them have their own house in the city or other place in the province, and they only set-up a cabin in the port area to get compensation in the future. On the other hand, for residents along the coast line in the port area of Village No.1, fishing is a crucial livelihood issue.

[3] Note: Inland Area of Village No.3, Commune No.1, Mittakpheap would locate area along railway, where it was not recognized by Ministry of Interior (squatter area). It would be not including inland area along National Road No 4.

2) Public services in the village

Health: The public health services were accessible in the village. The villagers could access the public referral hospital in Preah Sihanouk.

Education: With support and monitoring from NGOs and schools, children continue to go to school and only few of them have dropped out from schools in the last year (reported from the head of the village).

Infrastructure: There was no sewerage system in both ports and inland area of the village. The wastewater was going to the sea, which could possibly affect the local environment. Public electricity was accessible. Water supply was run by a private company and the price was slightly higher than local public water supply.

Living condition: The living environment was worse in the area along the railway, which affected the health of the people.

3) Advantage/disadvantage

Advantage: There were a lot of micro/small businesses and job opportunities in the village. There were jobs and business opportunities related to fishery, support in fishing industry, and food processing, transport service, cargo servicing and business marketing.

Disadvantage: There is no existing sewerage system in the village. This is similar to the squatter's area in Cambodia, where the poor living environment has posed health problems.

4) Future plan

People would not want to leave the area because they thought that there was no place better for them to stay. They realize that it is a squatter area; however, they alleged that if the government needed the areas for development, they should be provided with an appropriate location for them to live where they could get similar economic and social benefits.

Table 5.7-1 Summary of the survey results

Categories	Sub-Categories	Result *() is the total result of the original survey of 3 areas considered as poverty area in Preah Sihanoukv City.
Socio-economy	Demography	Average household size: 5.9 (5.69)
	Education	Rate of residents to ever attended formal schools - 80% (81%) for age ranging from 6 to 17 years olds - 86% (85%) for age ranging from 18 to 55 years old School attendance rate - 77% (71%) for age group from 6 to 17 years old Illiteracy Rate - 25% (28%) for more than 5 years old
	Health	Place for advice and treatment 1) Pharmacies: 49% (47%) 2) Private clinics: 21% (22%) 3) Public health facilities: 9% (8%)
	Employment	- 8.3% (9%) of children from 6 to 17 years olds are employed - 48.1% (40%) of working age population are employed
Background Information	Years of residency	1) Less than 10 years: 42% (50.4%) 2) From 11 to 20 years: 36% (32.8%) 3) More than 21 years: 22% (16.8%)
	Origin	1) Preah Sihanouk: 40% (44.8%) 2) Other coastal provinces: 30% (39.4%)

		3) Other provinces: 30% (15.8%)
	Reason for settlement	1) Easy to find job: 42% (37%) 2) Easy to set up business: 36% (34%) 3) Access to fishing: 30% (20.8%) 4) Land and house are affordable: 28% (22.4%)
	Period of absence from home *question asked to people who had been away and came back within a week before the survey	1) Less than one week: 50% (47%) 2) From 1 to 4 weeks : 28% (26%) 3) From 5 to 12 weeks : 16% (19%) 4) More than 12 weeks: 6% (7%)
Housing and Assets	Materials	1) Board/wood: 68% (62.4%) 2) Concrete: 6% (18.4%) 3) Galvanized iron or aluminum: 11% (15.2%)
	Ownership of land title	Yes: 52% (57.6%)[4]
Basic Infrastructure	Needs	1) Roads/bridges: 24% (43.2%) 2) Hospital/health centers: 28% (21.6%) 3) Schools: 22% (12.8%) 4) Sewerage system: 10% (11.2%)
Merits and Demerits, etc	Merits and Strength	1) Easy to find job: 60% (48%) 2) Easy to access to markets: 46% (52%) 3) Set up of micro-small businesses: 42% (50%) 4) Access to fishing: 38% (29%)
	Demerits and Weakness	1) Insufficient access to health facility and service: 46% (38%) 2) Micro/small business was not profitable: 40% (26.4%) 3) Poor infrastructure and poor living condition: 34% (50%) 2) Insufficient access to electricity grid: 24% (26.4%)
Future Plan	Willingness to continue residing in the future	- Yes: 72% (74%) - No: 28% (26%)
	Reason of continued residence	1) Could not afford land in other places: 33% (26%) 2) Easy to manage current business: 31% (39%) 4) Easy for fish and finding food: 17% (9%) 3) Land is personally owned: 3% (12%)
	Reason of willingness to leave the settlement area	1) Business was not profitable: 29% (22%) 2) No land and house ownership: 14% (19%) 3) No future/hope/opportunity: 14% (9%) 4) To find better living condition: 14% (6%)

* : Item which has differences of 5% and more to less than 10% from the result of the original survey in 2009 (3 areas total),
: Item which has differences of 10% and more from the result of the original survey in 2009 (3 areas total)

Source: JICA Project Team, Public Awareness Survey on Settlement Area for the Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanoukville for Sustainable Development (2009-2010)

[4] Land Title System has not been set up in Cambodia yet. The Project of Land Title System has been conducted under the GTZ from Battambang Province. PAS has issued an "Agreement" to residents of the inland area Village No.3, Commune No.1, which is a type of private contract for the permission to live in the jurisdictional land of PAS, which consists of basic information of family members, fingerprints, photo of face of family members, list of assets, and location maps of immovable assets. It is assumed that the residents of Port Area of Village No.3, Commune No.1 do not posses any land title also due to living on the water.

5.7.2 Local economy

According to the 2008 census, the total population in Preah Sihanouk Province was 221,396, of which 40.6% live in urban areas. Out of the total population in the province, 32.4% (71,699) was under 15 years of age. The working age population (ages between 15 and 64) was 145,862 or 65.9% of the population.

The economically active segment of the population (employed population + unemployed population) was 102,290, which accounted for 46.2% of the total population in the province. Population density of the province was 230 persons/km^2, which was considerably higher than the national average of 56 persons/km^2.

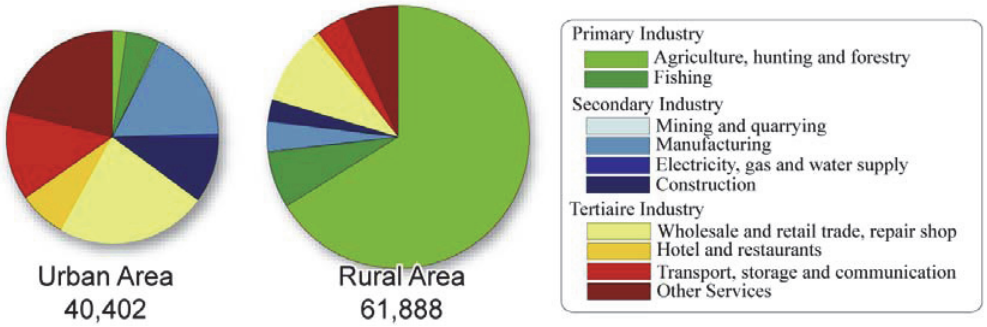
Population of Preah Sihanouk Province has increased by 2.6% per annum between 1998 and 2008. During the same period, the number of labor force in the Study area has increased more rapidly from 56,346 in 1998 to 101,739 in 2008, with an annual average increase rate of 6.1% (Table 5.7-2).

Table 5.7-2 Changes in population and labor force in the study area

	Population			Labor Force
	Urban	Rural	Total	
Census 1998	66,723	103,932	170,655	56,346 (age between 15 and 64)
Census 2008	89,846	131,550	221,396	145,862 (age between 15 and 64)
2011*	72.694	124,157	196,851	122,112 (over 18 years of age)
Annual Growth Rate (98-08)	3.0%	2.4%	2.6%	6.1%

*The Population Statistics in Preah Sihanouk Province (Ministry of Interior, 2012)
Source: CENSUS 1998 and 2008, NIS,

Such rapid increase in labor force was attributed to four main factors, namely; 1) an increase in the total population, 2) an increase in the percentage of working age population to total population (54.6% -> 65.9%), 3) an increase in the labor force participation rate (57.3% -> 69.3%), and 4) a decrease in the crude unemployment rate (8.2% -> 2.1%). Particularly the labor force participation rate of female population in Preah Sihanouk province was considerably lower than the other provinces in 1998 (Preah Sihanouk 40.5%; National Average 71.9%). Such tendency however, has improved during the past decade (from 40.5% in 1998 to 60.3% in 2008). Also, the high crude unemployment rate of females has decreased from 10.5% in 1998 to 2.7% in 2008. The participation of females in economic activities was one of the major contributors for the labor supply expansion.



Source: 2008 Population Census, NIS, The Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanoukville for Sustainable Development (2009-2010)

Figure 5.7-1 Labor force of urban and rural area of Preah Sihanouk Province, by industry in 2008

Figure 5.7-1 illustrates the labor force in both urban and rural areas of Preah Sihanouk Province by industry in 2008. The dependency on agricultural sector in absorbing labor force was relatively low. The labor force engaged in the agricultural sector accounted for 40.9% of the total labor force in the province (2.1% in urban and 66.2% in rural area), which was significantly lower than the national average (71.0%) as well as the coastal provinces average (70.6%).

Compared with other provinces, fishery plays an important role in Preah Sihanouk Province. About 5.2% and 6.9% of the labor force in the urban and rural areas, respectively, were engaged in the fisheries sector.

In Preah Sihanouk Province, the secondary sector plays an important role in the economy, absorbing 14.9% of labor force, which was much higher than the national average (8.6%) as well as the coastal provinces average (5.8%). Manufacturing sector absorbed 9,131 labor forces in the province. The sectors with the most labor force included clothes and apparels with 4,985, food products with 1,029, leather and related products with 777, furnitures with 444, fabricated metal products except machinery with 314, etc.

The tertiary sector absorbed about 38.0% of the labor force of the province (64.9% in urban area and 20.4% in rural area). In the urban area of Preah Sihanouk, transport industry and tourism related industries (hotel and restaurant) are well developed, occupying 13.6% and 7.3% of the total labor force, respectively.

5.7.3 Fishery

The fishing industry contributes very significantly to domestic food security. The industry provides over 81.5% of protein amount being consumed in the national diet and also forming a critical source of essential vitamins and micro-nutrients. Statistics on fish catch indicate an upward trend in the coastal area, due to the rapid growth of consumer demand as well as the improvement of transportation infrastructures. However, there is a concern about the depletion of marine resources along the coastal area because of intensive trawl fishing in the area. According to the investigation of marine fishery resources executed by the former Soviet Union during 1992-1993, the maximum sustainable yield in Cambodia was between 50,000 and 60,000 tons/year. Marine fish catch in 2008 of 66,000 tons already exceeded this level. In light of this, marine aquaculture is identified as a priority area. JICA is currently engaged in the construction of Marine Aquaculture Development Center (MADeC) in Preah Sihanouk, which will be used to conduct training in aquaculture and infectious disease control techniques.

Table 5.7-3 Fish catch in Cambodia

	2000	2002	2004	2006	2008
Fisheries:					
- Inland (tons)	245,600	360,300	250,000	422,000	365,000
- Marine (tons)	36,000	45,850	55,800	60,500	66,000
Aquaculture					
- Inland (tons)	14,410	14,547	18,585	34,160	39,025
- Marine (tons)	20	53	75	40	75
Trade and Export (tons)	43,600	52,500	45,850	30,000	25,000
Flooded forests:	FiA official data available 2005= 778,399.3650 ha				
Others (Fingerling)	7,508,000	13,420,000	15,793,000	21,335,000	37,193,000

*Metric tons
Source: General Population Census of Cambodia 2008: Provisional Population Totals, by National Institute of Statistics, August 2008, "The Strategic Planning Framework for Fisheries: 2010 – 2019" by Minister of Agriculture, Forestry and Fisheries

Many types of small-scale or artisanal, middle-scale, and large-scale fishing gears are used in Cambodia. According to a proclamation made by the Ministry of Agriculture, Forestry and Fisheries, small-scale or artisanal and middle-scale fishing gears are distinguished by the capacity of boat engine, fishing gear size and the size of its catch net. Marine capture fisheries in Cambodia are divided into two categories, namely middle-scale fisheries and small-scale or artisanal fisheries. Fishing boats in Sihanoukville Port are categorized as small-scale. Table 5.7-4 shows the number of fishing boats larger than 33 horse power (hp) in the province, which is in the port area (in Commune 1 and 3).

Table 5.7-4 Fishing boat in Preah Sihanouk Province in 2010

	Family Fishing in fish pond		Small-scale fishery		Total (excluding Rowboat)
	Rowboat	< 10 hp	< 33 hp	> 33 hp	Total
Total-SHV Province (A)	560	397	1,251	289	1,937
Total-SHV City	27	39	484	201	724
Commune 1&3 (B)	3	0	323	221	449
(B)/(A) (%)	-	-	25.8	76.5	23.2

Source: Marine Fisheries Administration Inspectorate. Kampong Som Fisheries Administration Cantonment, Minister of Agriculture, Forestry and Fisheries, JICA Project Team

Also, aquaculture fish farmers share the area in the port with fishermen. (Chapter 5, 5.4.1)

5.7.4 Infectious disease

HIV has been a main issue in terms of infectious diseases in Preah Sihanouk Province. The total number of people who carries HIV is 1,717 in 2011 according to the Department of Health (DH). Among them, 980 people receive support from NGOs and other organizations, while 1,200 people have not benefited from any support.

Two villages in the port area and inland area of Village No.3, Commune No.3, Mittakpheap KHAN have been among the crucial areas in the province in terms of people infected with HIV/AIDS. Among 107 families, at least one family member has HIV/AIDS, which is 3.67% of the total number of families in the area. This ratio is higher than in urban areas and other districts in the province. NGOs and other organizations are conducting programs to support and educate the residents regarding

HIV/AIDS disease.

Table 5.7-5 Family with member(s) infected with HIV/AIDS in commune No.1 (2008)

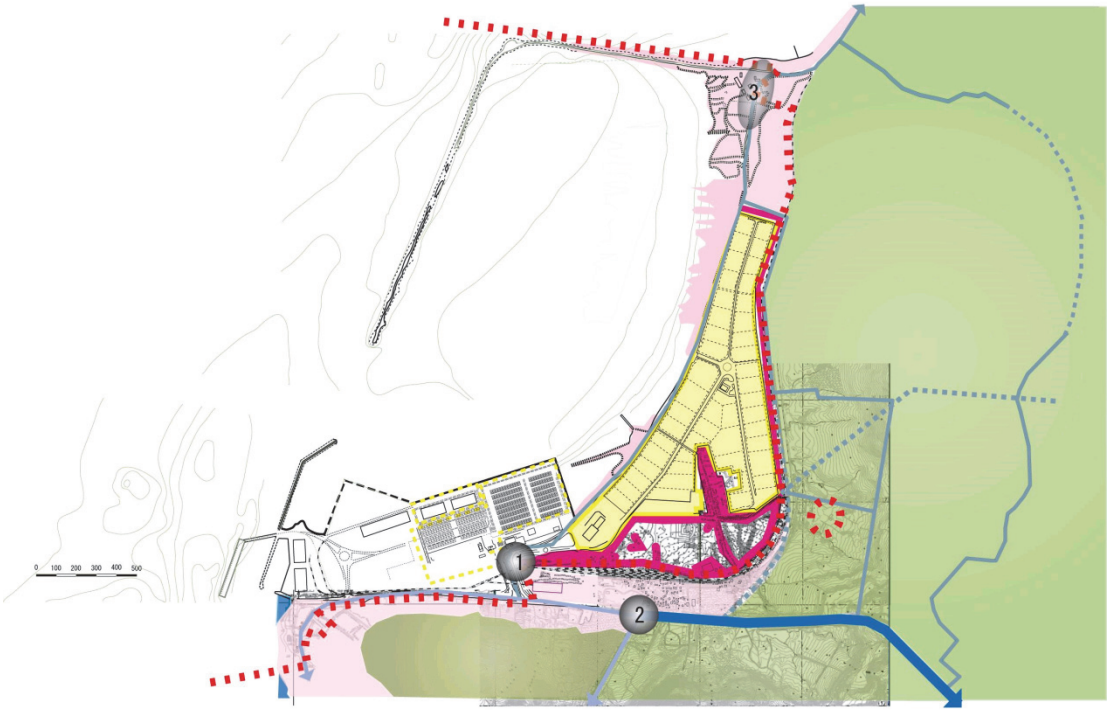
District	Population	Family (A)	Family with member(s) infected with HIV/AIDS (B)	(B) / (A) (%)
Urban Area	62,513	12,910	238	1.84
Village 1 and 3	29,107 (46.56% in Urban Area)	*6,013	175	2.91
Stuen Hav	15,117	3,062	32	1.04
Prey Nob	89,238	17,282	139	0.80

*estimated by the ratio of number. of family / population in Urban Area.
Source: DATA BOOK 2009, Preah Sihanouk Krong, Stueng Hav District, Prey Nob District, by National Committee for Sub-National Democratic Development (NCDD), JICA Project Team

5.7.5 Traffic accidents

Traffic accidents are one of the crucial issues in the area of Sohanoukville Port and National Road No.4, which connects Phnom Penh and Preah Sihanouk serving heavy land cargo transportation. The total number of car accidents recorded was 208 in 2011, including 12 by cargo trucks on National Road No.4 between Preah Sihanouk City and Pich Nil Pass[5].

In and around the Sihanoukville Port area, there is no statistic record of traffic accidents. However, from interviews conducted, there are certain traffic accident-prone spots as shown in Figure 5.7.2.



Source: PAS, Traffic Office, Police Commission of Sihanoukville, Cambodia National Police, Public Awareness Survey on Settlement Area for the Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanoukville for Sustainable Development (2009-2010), JICA Project Team

Figure 5.7-2 Traffic accident prone spots in and around the sihanoukville Port

[5] Traffic Office, Police Commission of Sihanoukville, Cambodia National Police

Table 5.7-6 Type of traffic accidents

Traffic Accident-Prone Spots (Figure 5.7-2)	Type of Area	Type of Accidents
1	Corner and junction of the main gate of PAS, Hun Sen Road and approaching SEZ. The junction itself is flat and vistaed. The side of the approach road to PAS from the provincial road often plays a role as parking area for cargo trucks. Most vehicles and trucks get their speed down in this spot.	Turnover accidents of motorbikes can be observed often in this spot. Most fender benders and minor accidents are caused by cars and large cargo trucks.
2	Junction of National Road. No.4 and road to City center The junction itself is vistaed. However, both roads are inclined with a certain pitch toward the junction.	Most accidents here are caused by large cargo trucks due to two main causes; failure to stop on time due to brake trouble of poorly maintained vehicle and failure to negotiate a curve. There were few accidents leading to injury and death.
3	Fishery town. This small area contains small shops and business, provincial port, ship dockyard, school, jetties for fishermen, and residents. Also, it has a gate for police office and a Cambodian navy facility on the large dyke. Due to mixed existence of these various kinds and types of facilities and residents, heavy use of various types and number of vehicles and people exist in this area.	Mostly fender benders and minor accidents occur in this spot. Few accidents are caused by over speeding due to congestion of vehicles and people.

Source: PAS, Traffic Office, Police Commission of Sihanoukville, Cambodia National Police, Public Awareness Survey on Settlement Area for the Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanoukville for Sustainable Development (2009-2010), JICA Project Team

5.7.6 Tourism and natural environment

The coastal area in Cambodia is composed of four provinces, including Sihanoukville Province, and is now attracting attention of tourists in and out of the country. A number of tourism plans and projects are under plan and in operation by public and private sectors. The coastal area was awarded "The Most Beautiful Bay in the World" by PEMSEA[6] at the 7th General Assembly of the Most Beautiful Bays in the World Club in Toubacouta, Republic of Senegal on 26 May 2011. It stimulated the establishment of the National Committee for Coastal Development and Management in February, 2012 (by government circulation), which had been planned and recommended by JICA Study in 2010[7]. Not only the coast and the sea, mountainous landscapes and nature life also attract tourists and

[6] Partnerships in Environmental Management for the Seas of East Asia

[7] The Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanoukville for Sustainable Development (2009-2010), Ministry of Land Management, Urban Planning and Cadastre

pursuers. (Figure 5.7-3)

Preah Sihanouk City is recently developing rapidly in terms of manufacturing and tourism. Growth of tourists is shown in Table 5.7-7. Both local and international tourists have been increasing and the growth after six years has approximately rose by 3.5 times. However, the number of facilities such as hotels and restaurants were insufficient to meet the number of tourists (Table 5.7-8). Among the major tourist companies, Yis Chea Tourism Development Co., Ltd. and Evergreen Success and Asia Resort Development Co., Ltd received final registration certificates for QIP on 12th November 2007 and 11th July 2008, respectively.

Table 5.7-7 Number of tourists in Preah Sihanouk Province (2002-2008)

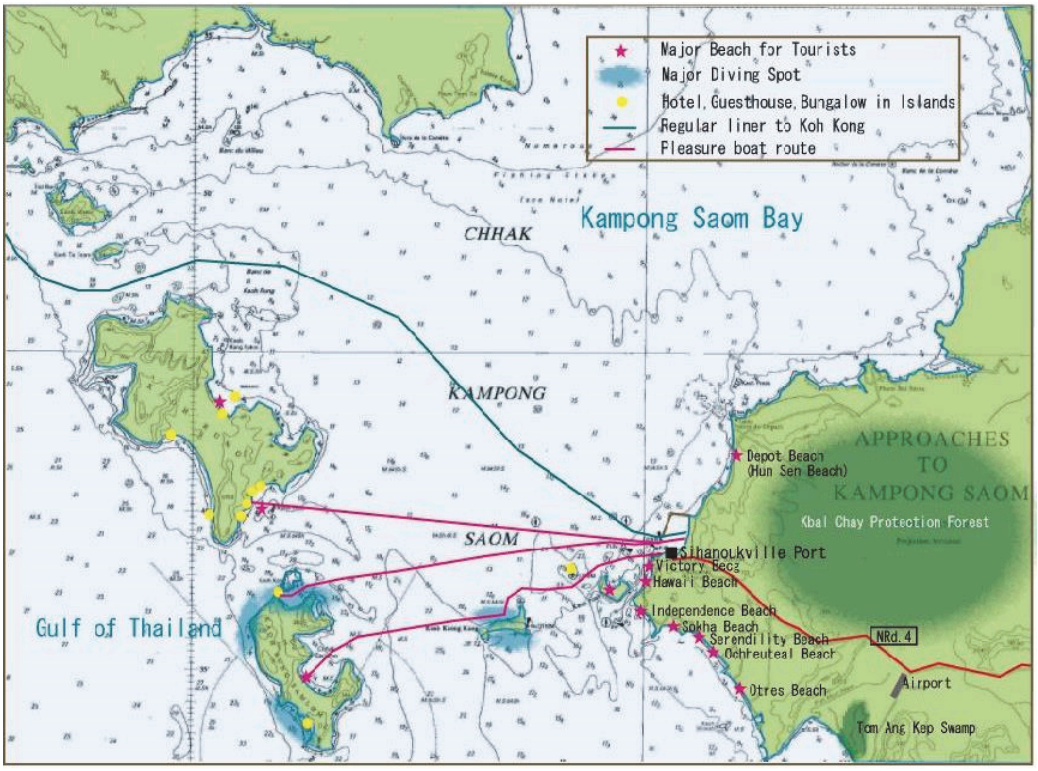
Year	Local Tourists (people)	International Tourists (people)	Total (people)
2003	83,888	33,604	117,492
2008	396,850	135,668	532,518
Growth Rate (%)	373.07	303.73	353.24

Source: Department of Tourism in Preah Sihanouk Province, 2009, JICA Project Team

Table 5.7-8 Number of hotels, guesthouses, and restaurants in Preah Sihanouk Province (2002-2008)

Year	Hotel (No./Rooms)	Guesthouse (No./Rooms)	Restaurant (No./Tables)
2003	40 / 1,312	78 / 750	49 / 626
2008	46 / 1,782	111 / 1,533	78 / 1,039
Growth Rate (%)	15.00 / 35.82	42.31 / 104.40	59.18 / 65.97

Source: Department of Tourism in Preah Sihanouk Province, 2009, JICA Project Team



Source: Department of Tourism in Preah Sihanouk Province, JICA Project Team

Figure 5.7-3 Major tourism resources in Preah Sihanouk City area