Chapter 6

EXISTING ENVIRONMENT

6.1 Introduction

This chapter describes the existing environment within the proposed Project site zone of study. The existing physical, biological, chemical and socioeconomic characteristics of the proposed Project site and surroundings will be discussed. Among the objective is to establish the baseline based on the existing conditions prior to the commencement of the construction and operational phases. The zone of study for this EIA is 5 km radius from the proposed Project site and this is deemed as the area which is likely to experience some impact as a result of the Project implementation.

6.2 Physical Environment

6.2.1 Topography and Bathymetry

Topography and bathymetry surveys were conducted covering the proposed Project site (area to be reclaimed and to be dredged) between June and September 2016 and associated survey drawings are enclosed as **Appendix 6.1** and summarised as illustrated on **Figure 6.2.1**.

The Project site and surrounding areas was reported to be between +3m CD and -20m CD. Intertidal areas are largely sandy and deepest end of the proposed area to be reclaimed is about 4m deep. The proposed harbour basin and navigation channel currently measures from 1m to 14m.

A side scan sonar system was used to investigate the seabed features and profile. The survey maps are enclosed as **Appendix 6.2**. The side scan sonar records acquired within the surveyed area exhibit moderate to high sonar reflective seabed with seabed sediments interpreted to consist of gravel, sandy, silty clay with shell fragments. Other seabed features observed from the side scan sonar record are debris, mega ripples, moderate to high sonar reflective seabed, high sonar reflective seabed and seabed scars. No pipeline, cable or coral mass were observed from the side scan sonar record.

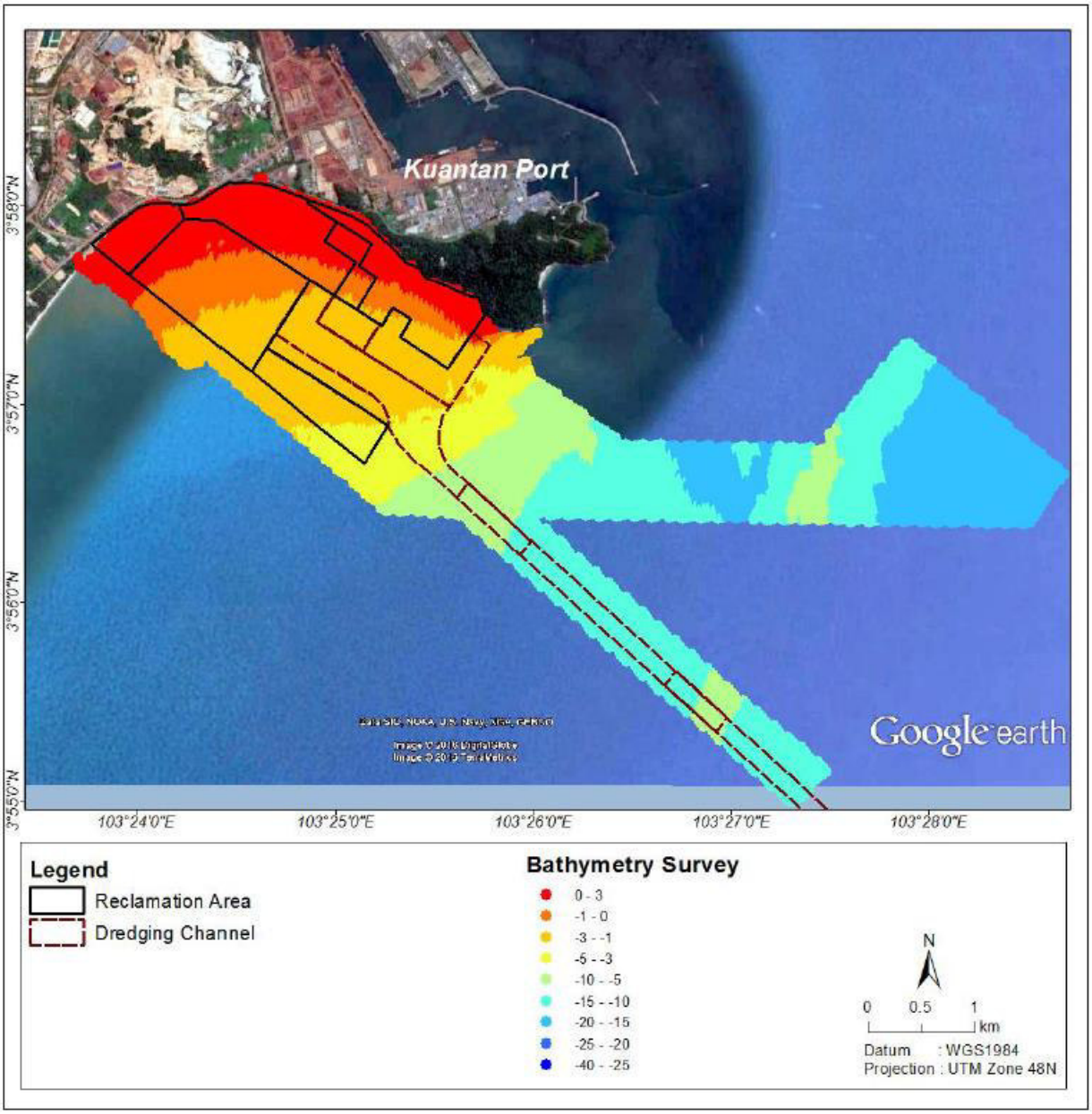

Figure 6.2.1: Topography and Bathymetry of the Proposed Project Site

The proposed Project site is situated immediately south of Tg. Gelang. A satellite image of the existing Tg. Gelang is presented in **Figure 6.2.2** which indicates that the proposed development is to be located on the southern side of the protruding headland; south of Kuantan Port. The reclamation will be sitting in the lee of Tg. Gelang where the coastline has a landward inset of more than 3.5km. The waters surrounding Tg. Gelang is known to feature a complex seabed (both sedimentologically and morphologically) and to be exposed to relatively strong northeast and southwest monsoon waves.

According to the National Coastal Erosion Study – Volume I. August 1985, erosion along the coastal stretches north and south of the development is generally classified as Category III (i.e. as acceptable erosion) while the coastal erosion over a short stretch just south of Sg. Balok's estuary has been classified as Category II (i.e. significant erosion). Tg. Gelang headland itself is rocky, and patches of

rocky outcrops are found fringing the waters just off the headland. In the coastal zone just south of the protruding headland, the water is shallow and seabed displays an abundance of fine sand accumulated in larger sand bars (**Figure 6.2.2**). Further south the coastline become more dynamic, and signs of coastal erosion can be observed. The trigger for the coastal erosion observed along the coastline further south of the headland is due to the changes in the littoral drift around Tg. Gelang, which have been disturbed and even blocked by the recent coastal developments; in particular the developments associated with the Kuantan Port. As the littoral drift is predominantly southward, the reduced sediment bypass around the headland manifest itself in coastal erosion to the south.

Figure 6.2.2: Location of Tg Gelang and accumulation of sediments down drift of Gelang headland and exposed rocky outcrops at the tip of the headland.

Plate 6.2.1: Tg. Gelang headland is rocky.

Plate 6.2.2: Sandy and rocky shoreline from the Tg. Gelang headland to the northern boundary of the proposed Project site.

Plate 6.2.3: Sandy beach with patches of rock outcrops along the shoreline from the north to southwest boundary of the proposed Project site.

It was observed rubble mound protection has been implemented in an attempt to arrest the shoreline retreat and protect the hinterland infrastructure as shown on **Plate 6.2.4**. Meanwhile significant

shoreline erosion was also recently reported at location indicated on **Figure 6.2.3** and shown on **Plate 6.2.5**. Repair work was observed to be on-going during a site inspection later in July 2017 as shown on **Plate 6.2.6**.

Plate 6.2.4: Protected beach south of Gelang headland

Figure 6.2.3: Location of reported shoreline erosion.

Plate 6.2.5: Eroded shoreline along Jalan Kuantan, Source: Sinaran Harian on 4 July 2017

Plate 6.2.6: Repair work was on-going along the eroded shoreline.

6.2.2 Hydrology and Drainage

A small stream knowns as Sg Pengorak which flows from east to west, currently discharges to the proposed Project site. Some thin mangroves patches are seen along the riverbanks of Sg. Pengorak near its estuary. Beside Sg Pengorak, there are two other existing storm water drainage discharge points which flows directly into the Project site. These natural and designed drainage systems serve the catchment of the Kuantan Port and land uses along the Jalan Tanjung Gelang areas including storm water conveyed from road side drain. The main drainage discharge from Kuantan Port catchment seem to cater for industrial wastewater discharges too, based on site observation and discharge water quality presented in Section 6.2.4.1.

Other nearby river discharge is Sg Balok which is about 3.3km southwest of the proposed Project site.

Plate 6.2.7: Sg. Pengorak

Plate 6.2.8: Storm water Drainage Discharge

Plate 6.2.9: Storm water Drainage Discharge with Industrial Effluent Discharge

6.2.3 Meteorology

The meteorology of an area can be described by the wind pattern, rainfall amount, surface temperature and relatively humidity measured at the area. Meteorological data of the Project site was acquired from the nearest Malaysian Meteorological Service (MMS) station at the Sultan Ahmad Shah (SAS) Airport in Kuantan, which is approximately 30 km awayfrom the Project site. The meteorological station is located at 3°47' N, 103°13' E. In general, the climate of Malaysia is equatorial characterized by uniform temperatures, high humidity and copious rainfall throughout the year with little seasonal variation.

6.2.3.1 Surface Wind

Wind flow pattern in terms of direction and speed is important to understand the role of wind in transporting and dispersing air pollutants. The wind pattern was recorded from 1968 to 2014. Annual wind record and profile are as shown in **Table 6.2.1**. Based on the wind profile, it is noted that the most prevailing wind flow is from the north (approximately 26.6% of the time) and southwest (approximately 11.5% of the time). Wind speeds are generally low occurring below 3.3 m/s for 61.1% of the time and rarely exceeding 5.4 m/s (1.9%). Higher wind speeds are typically associated with winds from the north, northeast, east and southwest. Calm weather occurs about 19.7% annually.

Table 6.2.1: Percentage Frequency of Various Wind Direction and Speed

Wind speed range [%]								
Direction	**0.3-1.5**	**1.6-3.3**	**3.4-5.4**	**5.5-7.9**	**8.0-10.7**	**>10.7**	**Total**	**Mean Speed**
Calm							**19.7**	
Variable	0	0	0	0	0	0	**0**	
N	11.4	11.5	3.5	0.2	0	0	**26.6**	2
NE	2.4	3.2	3	0.6	0	0	**9.3**	2.9
E	1.5	3	3.9	0.4	0	0	**8.8**	3.2
SE	1.5	1.5	0.6	0	0	0	**3.7**	2.1
S	3.7	4.3	1.4	0.1	0	0	**9.6**	2.1
SW	3.6	4.3	3.1	0.4	0	0	**11.5**	2.6
W	2.4	1	0.5	0.1	0	0	**4**	1.8
NW	3.5	2.3	0.7	0.1	0	0	**6.5**	1.8

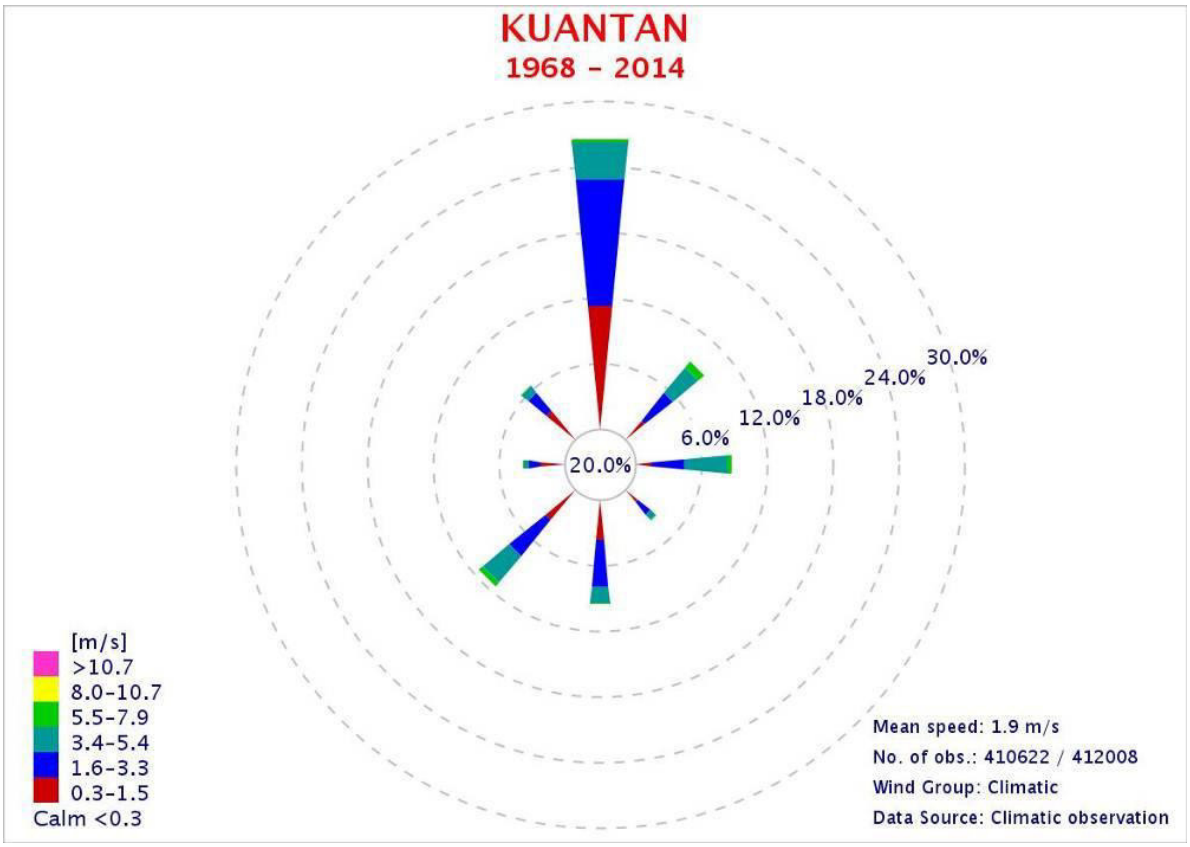

Figure 6.2.4: Annual Wind Rose Summary 1968-2014

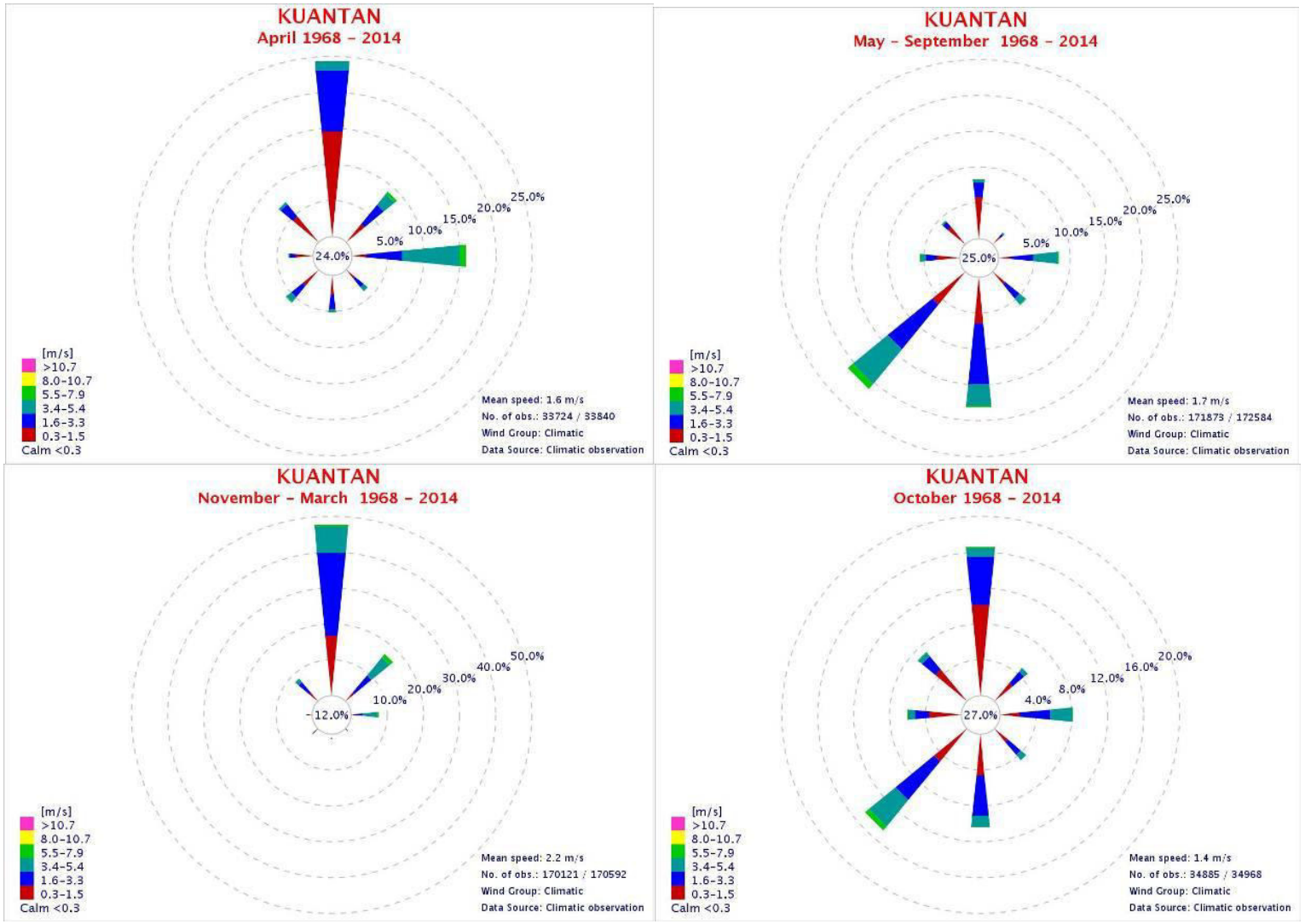

Figure 6.2.5: Seasonal Wind Rose Summary

6.2.3.2 Temperature

Figure 6.2.6 shows the daily mean temperature for each month of the year averaged over the period from 1968 to 2014. The graph shows that mean temperature varied from 25.1°C to 27.4°C. The slightly lower 24-hr mean temperatures observed in the November-February each year can be attributed to the high precipitation and high cloud cover during the wet northeast monsoon period. The highest 24-hr mean temperatures were observed in May. The mean annual temperature is averaged at 26.4°C.

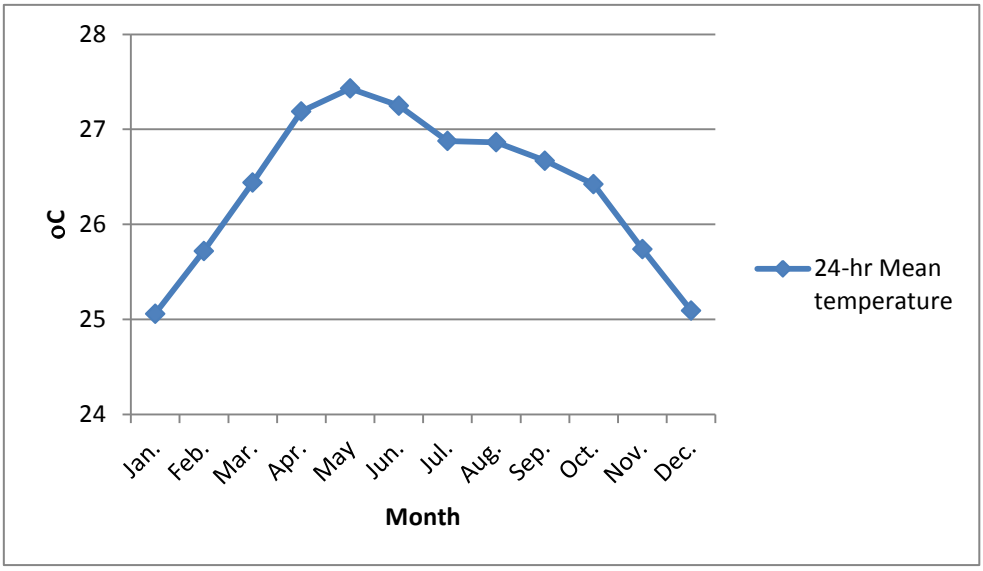

Figure 6.2.6: Monthly Mean Temperature (1968-2014)

6.2.3.3 Rainfall and Rain days

The average annual rainfall recorded at Kuantan Airport over the period 1968 to 2014 is approximately 2,986mm with an average of 185 rainy days per year. The highest annual rainfall was recorded at 4,185mm. Although rainfall is heavy throughout the year, variations are evident (see **Figure 6.2.7**). The wettest months are November, December and January during the northeast monsoon, and driest in February and July. The average monthly rainfall ranges between 133mm and 690mm. The lowest rain days is recorded in February with 10 rain days. **Table 6.2.2** shows the monthly mean number of rain days in Kuantan.

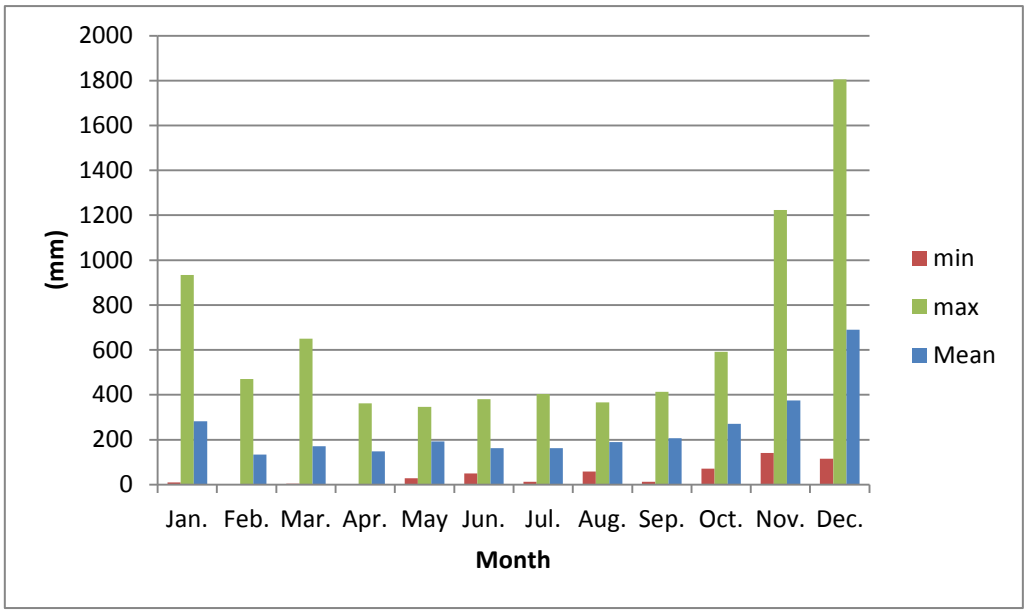

Figure 6.2.7: Monthly Rainfall in Kuantan (1968-2014)

Table 6.2.2: Number of Rain Days in Kuantan (1968-2014)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	16	10	12	13	15	13	13	14	16	20	22	22	185
Max	25	22	27	22	22	20	20	23	24	25	29	28	222
Min	3	1	2	1	9	6	7	7	6	12	15	13	140

6.2.3.4 Relative Humidity

Figure 6.2.8 shows the 24-hour mean monthly humidity averaged over 1968 to 2014. Throughout the year, the mean monthly relative humidity remains high ranging between 83.6% and 89.0%. The lowest relative humidity occurs in the month of August and the highest humidity occurs in December. The average annual 24-hour relative humidity is 85.1%.

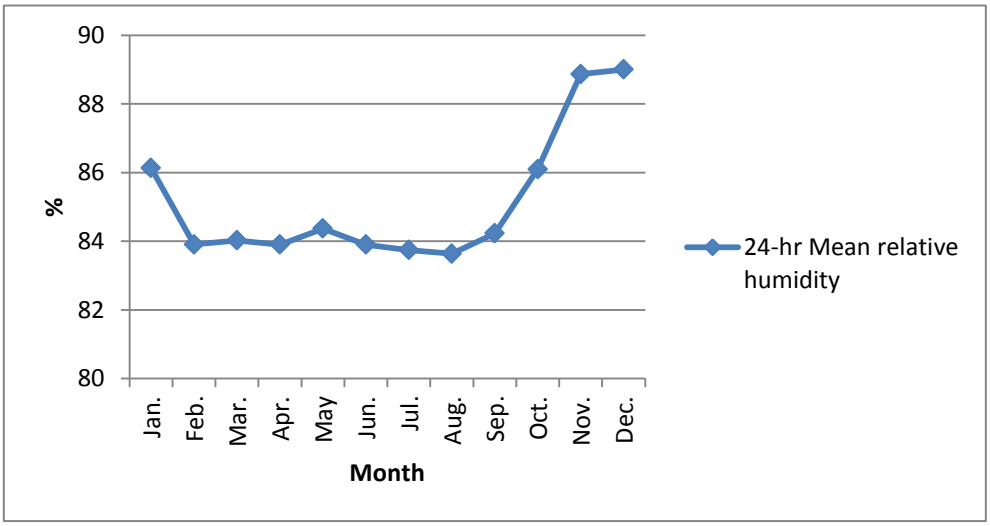

Figure 6.2.8: Monthly Mean Humidity at Kuantan (1968-2014)

6.2.4 Environmental Baseline Sampling

6.2.4.1 Water Quality

Baseline monitoring on water quality was undertaken to ascertain and characterize the existing water quality within the vicinity of the Project area and as inputs into the impact assessment as well as for future monitoring reference during the construction and operational stages.

Water monitoring was conducted during flood and ebb tides over both neap and spring tides, on 16 October 2016 / 16 November 2016 for the first sampling (neap tide) and 21 March 2017 for the second sampling (spring tide). Water sampling at deeper waters namely W1 to W5 and W10 were conducted at three depths (surface, middle and bottom) while one surface sampling was conducted at shallower areas (W6 to W9). Descriptions on the water monitoring stations are stated in **Table 6.2.3** and further illustrated in **Figure 6.2.9.**

.

Table 6.2.3: Description of the Water Monitoring Stations

Station	Approximate Location	Description
W1	3° 56' 2.24"N 103° 23' 5.62"E	Representing existing water quality near estuary where Sg Balok connects with the sea
W2	3° 57' 25.83"N 103° 26' 42.26"E	Representing existing water quality between Kuantan Port and Proposed Project site.
W3	3° 55' 25.57"N 103° 26' 54.95"E	Representing existing water quality at Proposed navigation channel further from Proposed Port
W4	3° 56' 28.09"N 103° 25 45.34"E	Representing existing water quality at Proposed navigation channel near to Proposed Port
W5	3° 57' 35.79"N 103° 24' 45.79"E	Representing existing water quality at Proposed Port's berth
W6	3° 57' 25.46"N 103° 25' 42.11"E	Representing existing water quality at east boundary of Proposed Project site.
W7	3° 57' 57.09"N 103° 25' 6.68"E	Representing existing water quality at the culvert discharge from Kuantan Port drainage system.
W8	3° 58' 8.01"N 103° 24' 36.69"E	Representing existing water quality at the estuary of Sg Pengorak
W9	3° 57' 40.27"N 103° 24' 2.07"E	Representing existing water quality at west boundary of Proposed Project site.
W10	3° 56' 32.93"N 103° 23' 51.32"E	Representing existing water quality between Proposed Project site and Sg Balok estuary

Water quality test results are summarized in **Table 6.2.4 to 6.2.11** and the test reports appended as **Appendix 6.3.** The test results are compared to the Class 3 of Malaysia Marine Water Quality Criteria and Standard.

CHEMSAIN KONSULTANT SDN. BHD.

LEGEND:

- PROJECT SITE
- AIR AND NOISE MONITORING (A1/N1 - A3/N3)
- MARINE WATER (W1 - W10)
- MARINE SEDIMENT (S1 - S6)
- MARINE ECOLOGY (ME1 - ME5)
- F — FISHERIES (F1 & F2)

BASELINE MONITORING LOCATIONS

FIGURE: 6.2.9

D:\ACAD\DRAWINGS\EV703\7021\FIG-629.DWG

Table 6.2.4a: Baseline Water Quality during Ebb of Neap Tide

Location(Depth)	**Guideline Limit**	**W1(S)**	**W1(M)**	**W1(B)**	**W2(S)**	**W2(M)**	**W2(B)**	**W3(S)**	**W3(M)**	**W3(B)**	**W4(S)**	**W4(M)**	**W4(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1845**	**1855**	**1910**	**1535**	**1540**	**1600**	**1615**	**1620**	**1640**	**1650**	**1700**	**1715**
Temperature (in-situ), ^{o}C	≤2 ^{o}C increase over max ambient	30.4	30.3	30.2	30.5	30.4	30.4	30.5	30.4	30.3	30.7	30.6	60.5
pH Value (in-situ)	-	8.1	8.1	8.1	8.3	8.2	8.2	8.4	8.4	8.4	8.3	8.3	8.3
Dissolved Oxygen (in-situ), mg/l	>3	7.4	7.3	7.4	7.3	7.3	7.3	7.3	7.3	7.3	7.5	7.7	7.6
Salinity, ppt	-	30	30	31	31	32	32	32	32	32	30	32	32
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	<5.0	<5.0	<5.0	50	**123**	<5.0	5.0	45.0	34.0	<5.0	5.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	451	343	716	608	359	269	345	445	448	531	598	424
Oil and Grease, mg/l	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead, µg/l	50	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc, µg/l	100	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Location(Depth)	**Guideline Limit**	**W1(S)**	**W1(M)**	**W1(B)**	**W2(S)**	**W2(M)**	**W2(B)**	**W3(S)**	**W3(M)**	**W3(B)**	**W4(S)**	**W4(M)**	**W4(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1845**	**1855**	**1910**	**1535**	**1540**	**1600**	**1615**	**1620**	**1640**	**1650**	**1700**	**1715**
Arsenic, µg/l	50	2	2	2	2	2	2	2	2	2	2	2	2
Mercury, µg/l	50	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cyanide, µg/l	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	**490**	**330**	<1.1	<1.1	<1.1

Table 6.2.4b: Baseline Water Quality during Ebb of Neap Tide

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1735**	**1745**	**1755**	**1810**	**1820**	**1835**
Temperature (in-situ), ^{o}C	≤2 ^{o}C increase over max ambient	30.4	30.3	30.3	30.5	30.4	30.4
pH Value (in-situ)	-	8.3	8.3	8.3		8.3	8.3
Dissolved Oxygen (in-situ), mg/l	>3	7.2	7.2	7.2	7.4	7.4	7.3
Salinity, ppt	-	32	32	32	30	30	30
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	<5.0	6.0	<5.0	<5.0	6.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	60	84	<50	<50	<50
Nitrate (NO_3), µg/l	1000	381	352	476	444	431	338
Oil and Grease, mg/l	5	<1	<1	<1	<1	<1	<1
Lead, µg/l	50	<1	<1	<1	<1	<1	<1
Copper, µg/l	10	<1	<1	<1	<1	<1	<1
Zinc, µg/l	100	<5	<5	<5	<5	<5	<5
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5
Arsenic, µg/l	50	2	2	2	2	2	2
Mercury, µg/l	50	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	<10	<10	<10
Cyanide, µg/l	20	<10	<10	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	<1.1	<1.1	<1.1	6.9	<1.1	<1.1

Table 6.2.5a: Baseline Water Quality Results during Flood Neap Tide

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1320**	**1335**	**1350**	**0930**	**0945**	**1000**	**1015**	**1030**	**1040**	**1100**	**1115**	**1130**
Temperature (in-situ), ^{o}C	≤2 ^{o}C increase over max ambient	31.6	31.4	31.4	30.2	30.1	30.0	30.3	30.1	30.1	30.4	30.3	30.2
pH Value (in-situ)	-	8.2	8.2	8.2	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Dissolved Oxygen (in-situ), mg/l	>3	7.3	7.3	7.3	7.2	7.6	7.6	7.2	7.6	7.7	6.8	6.9	7.2
Salinity, ppt	-	29	31	21	32	32	32	32	32	32	32	32	32
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	15.0	7.0	14.0	<5.0	<5.0	18.0	<5.0	<5.0	24.0	<5.0	<5.0	<5.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	690	<50	<50	79	<50	<50	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	435	307	**1040**	264	314	392	334	360	355	229	444	349
Oil and Grease, mg/l	5	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Lead, µg/l	50	1	1	<1	<1	<1	3	<1	<1	<1	<1	<1	<1
Copper, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc, µg/l	100	18	38	6	<5	<5	9	<5	<5	<5	<5	<5	<5
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic, µg/l	50	2	2	2	2	2	4	2	2	2	2	2	2

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1320**	**1335**	**1350**	**0930**	**0945**	**1000**	**1015**	**1030**	**1040**	**1100**	**1115**	**1130**
Mercury, µg/l	50	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cyanide, µg/l	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	**330**	**3500**	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1

Table 6.2.5b: Baseline Water Quality Results during Flood Neap Tide

Location(Depth)	Guideline Limit	W5(S)	W5(M)	W5(B)	W6(S)	W7(S)	W8(S)	W9(S)	W10(S)	W10(M)	W10(B)
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/11/16**	**16/11/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1140**	**1145**	**1155**	**1211**	**1445**	**1405**	**1235**	**1245**	**1255**	**1310**
Temperature (in-situ), ^{o}C	≤2 ^{o}C increase over max ambient	30.5	30.4	30.3	31.2	29.0	27.5	31.3	31.5	31.4	31.3
pH Value (in-situ)	-	8.3	8.3	8.3	8.2	7.4	7.4	8.2	8.3	8.3	8.3
Dissolved Oxygen (in-situ), mg/l	>3	7.2	7.4	7.4	6.6	**2.8**	4.8	7.2	7.3	7.3	7.3
Salinity, ppt	-	31	31	31	31	<1	<1	30	30	31	30
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	<5.0	<5.0	<5.0	68.5	35.0	<5.0	<5.0	<5.0	12.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	40	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	<50	<50	<50	351	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	251	<100	443	132	<100	**4848**	407	421	428	478

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W6(S)**	**W7(S)**	**W8(S)**	**W9(S)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/11/16**	**16/11/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1140**	**1145**	**1155**	**1211**	**1445**	**1405**	**1235**	**1245**	**1255**	**1310**
Oil and Grease, mg/l	5	<1.0	<1.0	<1.0	<1.0	8.6	<1.0	<1.0	<1.0	<1.0	<1.0
Lead, µg/l	50	<1	<1	<1	<1	7	3	<1	2	<1	<1
Copper, µg/l	10	<1	<1	<1	<1	15	6	<1	<1	<1	<1
Zinc, µg/l	100	<5	<5	<5	<5	**176**	66	<5	<5	<5	<5
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic, µg/l	50	2	2	2	2	3	3	2	2	2	2
Mercury, µg/l	50	<0.1	0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	<10	90	17	<10	<10	<10	<10
Cyanide, µg/l	20	<10	<10	<10	<10	**230**	<10	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	<1.1	<1.1	<1.1	170	**>1.6x10^4**	**9200**	<1.1	<1.1	<1.1	<1.1
BOD, mg/l	-	NA	NA	NA	NA	29.6	2.1	NA	NA	NA	NA
COD, mg/l	-	NA	NA	NA	NA	139	<10	NA	NA	NA	NA

Table 6.2.6a: Baseline Water Quality Results on Phosphorus and PAH Ebb Neap Tide

Location (Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1845**	**1855**	**1910**	**1535**	**1540**	**1600**	**1615**	**1620**	**1640**	**1650**	**1700**	**1715**
Phosphorus (PO_4), mg/l	0.67	0.18	0.24	0.16	0.25	0.20	0.18	0.16	0.24	0.21	0.23	0.19	0.20
PAH													
Naphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorence, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 6.2.6b: Baseline Water Quality Results on Phosphorus and PAH Ebb Neap Tide

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1735**	**1745**	**1755**	**1810**	**1820**	**1835**
Phosphorus (PO_4), mg/l	0.67	0.27	0.24	0.24	0.13	0.20	0.18
PAH							
Naphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10
Acenaphthylene, ng/g	1000	<10	<10	<10	<10	<10	<10
Acenaphthalene, mg/l	1000	<10	<10	<10	<10	<10	<10
Fluorence, ng/g	1000	<10	<10	<10	<10	<10	<10
Phenanthrene, ng/g	1000	<10	<10	<10	<10	<10	<10
Anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10
Fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10
Pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10
Chrysene, ng/g	1000	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, ng/g	1000	<10	<10	<10	<10	<10	<10

Table 6.2.7a: Baseline Water Quality Results on Phosphorus and PAH Flood Neap Tide

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16
Time		1320	1335	1350	0930	0945	1000	1015	1030	1040	1100	1115	1130
Phosphorus (PO_4), mg/l	0.67	0.15	0.21	0.28	0.20	0.27	0.22	0.23	0.28	0.13	0.18	0.24	0.29
PAH													
Naphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorence, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 6.2.7b: Baseline Water Quality Results on Phosphorus and PAH Flood Neap Tide

Location(Depth)	**Standard**	**W5(S)**	**W5(M)**	**W5(B)**	**W6(S)**	**W7(S)**	**W8(S)**	**W9(S)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/11/16**	**16/11/16**	**16/11/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1140**	**1145**	**1155**	**1211**	**1445**	**1405**	**1235**	**1245**	**1255**	**1300**
Phosphorus (PO_4), mg/l	0.67	0.15	0.20	0.27	0.18	0.29	0.39	0.19	0.17	0.19	0.17
PAH											
Naphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorence, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 6.2.8a: Baseline Water Quality Results, Ebb Spring Tide

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		**21/3/17**	**21/3/17**	**21/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**
Time		**0947**	**1000**	**1017**	**0947**	**0955**	**1005**	**0840**	**0845**	**0850**	**0915**	**0925**	**0935**
Temperature (in-situ), ^{o}C	≤2 ^{o}C increase over max ambient	30.2	30.1	30.1	30.3	30.2	30.2	29.8	29.7	29.7	30.1	30.0	30.0
pH Value (in-situ)	-	7.9	7.9	7.9	8.1	8.1	8.1	8.2	8.2	8.2	8.2	8.2	8.2
Dissolved Oxygen (in-situ), mg/l	>3	7.3	7.4	7.5	7.4	7.5	7.5	7.7	7.8	7.7	7.4	7.5	7.4
Salinity, ppt	-	28	29	29	29	29	29	29	29	29	29	29	29
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	6.8	10.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	<100	<100	<100	<100	<100	<100	262	<100	<100	<100	<100	<100
Oil and Grease, mg/l	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead, µg/l	50	<1	<1	<1	5	<1	<1	<1	<1	<1	<1	<1	<1
Copper, µg/l	10	<1	<1	<1	2	<1	<1	2	2	1	<1	<1	<1
Zinc, µg/l	100	<5	8	8	7	5	<5	**299**	<5	34	<5	<5	9
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic, µg/l	50	2	2	3	2	3	2	2	3	2	2	3	3
Mercury, µg/l	50	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.5	1.9	<0.1	4.7	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10
Cyanide, µg/l	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		21/3/17	21/3/17	21/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17
Time		0947	1000	1017	0947	0955	1005	0840	0845	0850	0915	0925	0935
Faecal Coliform Count, MPN/100ml	200	<1.1	<1.1	12	<1.1	<1.1	3.6	<1.1	<1.1	<1.1	1.1	<1.1	<1.1

Table 6.2.8b: Baseline Water Quality Results, Ebb Spring Tide

Location(Depth)	Guideline Limit	W5(S)	W5(M)	W5(B)	W10(S)	W10(M)	W10(B)
Date		21/3/17	21/3/17	21/3/17	21/3/17	21/3/17	21/3/17
Time		1125	1137	1145	1040	1045	1055
Temperature (in-situ), °C	≤2 °C increase over max ambient	30.8	30.7	30.7	30.4	30.3	30.3
pH Value (in-situ)	-	8.0	8.0	8.0	8.0	7.9	7.9
Dissolved Oxygen (in-situ), mg/l	>3	7.7	7.6	7.5	7.6	7.4	7.7
Salinity, ppt	-	29	29	29	29	29	29
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	<5.0	<5.0	<5.0	<5.0	12.2
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	<100	<100	<100	<100	<100	<100
Oil and Grease, mg/l	5	<1	<1	<1	<1	<1	<1
Lead, µg/l	50	<1	<1	<1	<1	<1	<1
Copper, µg/l	10	<1	<1	<1	<1	<1	<1
Zinc, µg/l	100	<5	5	<5	<5	7	<5
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**21/3/17**	**21/3/17**	**21/3/17**	**21/3/17**	**21/3/17**	**21/3/17**
Time		**1125**	**1137**	**1145**	**1040**	**1045**	**1055**
Arsenic, µg/l	50	2	2	2	3	2	3
Mercury, µg/l	50	<0.1	0.2	0.3	<0.1	<0.1	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	13	12	10
Cyanide, µg/l	20	<10	<10	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1

Table 6.2.9a: Baseline Water Quality Results, Flood Spring Tide

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		22/3/17	22/3/17	22/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17	23/3/17
Time		1430	1440	1447	1625	1635	1640	1415	1420	1435	1550	1555	1610
Temperature (in-situ), °C	≤2 °C increase over max ambient	30.6	30.5	30.4	30.5	30.4	30.4	30.5	30.4	30.3	30.8	30.7	30.6
pH Value (in-situ)	-	7.9	7.9	7.9	8.1	8.1	8.2	8.2	8.1	8.2	8.2	8.2	8.2
Dissolved Oxygen (in-situ), mg/l	>3	7.6	7.8	7.5	7.8	7.9	7.5	7.4	7.2	7.5	7.3	7.5	7.7
Salinity, ppt	-	29	29	29	29	29	29	29	29	29	29	29	29
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	<100	<100	<100	<100	<100	108	262	<100	<100	<100	<100	<100
Oil and Grease, mg/l	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead, µg/l	50	2	2	<1	5	<1	<1	<1	<1	<1	<1	<1	<1
Copper, µg/l	10	2	<1	<1	<1	<1	3	2	<1	<1	<1	<1	<1
Zinc, µg/l	100	<5	<5	<5	<5	<5	41	<5	<5	<5	<5	<5	<5
Cadmium, µg/l	10	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic, µg/l	50	4	3	2	2	2	4	2	3	2	3	3	2
Mercury, µg/l	50	0.1	1.9	<0.1	3.4	<0.1	0.2	2.0	0.7	0.3	2.7	0.4	<0.1
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	13

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		**22/3/17**	**22/3/17**	**22/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**23/3/17**
Time		**1430**	**1440**	**1447**	**1625**	**1635**	**1640**	**1415**	**1420**	**1435**	**1550**	**1555**	**1610**
Cyanide, µg/l	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	<1.1	1.1	<1.1	<1.1	1.1	<1.1	<1.1	2.2	<1.1	<1.1	1.1	<1.1

Table 6.2.9b: Baseline Water Quality Results, Flood Spring Tide

Location(Depth)	Guideline Limit	W5(S)	W5(M)	W5(B)	W6(S)	W7(S)	W8(S)	W9(S)	W10(S)	W10(M)	W10(B)
Date		**22/3/17**	**22/3/17**	**22/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**21/3/17**	**22/3/17**	**22/3/17**	**22/3/17**
Time		**1547**	**1557**	**1610**	**1018**	**1700**	**1715**	**1112**	**1500**	**1510**	**1515**
Temperature (in-situ), ^{o}C	≤2 ^{o}C increase over max ambient	30.7	30.6	30.5	30.6	31.2	32.1	30.7	30.5	30.4	30.3
pH Value (in-situ)	-	8.1	8.1	8.1	8.2	7.5	7.4	7.8	8.0	8.0	8.0
Dissolved Oxygen (in-situ), mg/l	>3	7.8	7.7	7.6	7.2	5.8	5.9	7.4	7.6	7.5	7.6
Salinity, ppt	-	29	29	29	29	<1	10	29	29	29	29
Total Suspended Solids (TSS), mg/l	100 or ≤ 10% increase in seasonal avg, whichever lower	<5.0	<5.0	<5.0	<5.0	30.0	17.3	6.0	<5.0	<5.0	<5.0
Unionized Ammonia, µg/l	320	<30	<30	<30	<30	<30	87	<30	<30	<30	<30
Nitrite (NO_2), µg/l	1000	<50	<50	<50	<50	<50	110	<50	<50	<50	<50
Nitrate (NO_3), µg/l	1000	<100	<100	<100	<100	276	**1250**	<100	230	<100	100
Oil and Grease, mg/l	5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead, µg/l	50	<1	<1	<1	<1	7	3	<1	2	<1	<1
Copper, µg/l	10	<1	<1	<1	<1	17	6	<1	<1	<1	<1

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W6(S)**	**W7(S)**	**W8(S)**	**W9(S)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**22/3/17**	**22/3/17**	**22/3/17**	**23/3/17**	**23/3/17**	**23/3/17**	**21/3/17**	**22/3/17**	**22/3/17**	**22/3/17**
Time		**1547**	**1557**	**1610**	**1018**	**1700**	**1715**	**1112**	**1500**	**1510**	**1515**
Zinc, µg/l	100	<5	<5	<5	8	96	39	<5	<5	<5	<5
Cadmium, µg/l	10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium Hexavalent, µg/l	48	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic, µg/l	50	2	2	3	2	3	3	2	3	3	2
Mercury, µg/l	50	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.5
Tributyltin, µg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol, µg/l	100	<10	<10	<10	<10	<10	<10	<10	12	<10	<10
Cyanide, µg/l	20	<10	<10	<10	<10	<10	15	<10	<10	<10	<10
Faecal Coliform Count, MPN/100ml	200	<1.1	<1.1	<1.1	<1.1	**>1.6x10^4**	**1.6x10^4**	<1.1	<1.1	1.1	<1.1
BOD, mg/l	-	NA	NA	NA	NA	14.9	<2.0	NA	NA	NA	NA
COD, mg/l	-	NA	NA	NA	NA	61	29	NA	NA	NA	NA

Table 6.2.10a: Baseline Water Quality Results on Phosphorus and PAH, Ebb Spring Tide

Location(Depth)	Guideline Limit	W1(S)	W1(M)	W1(B)	W2(S)	W2(M)	W2(B)	W3(S)	W3(M)	W3(B)	W4(S)	W4(M)	W4(B)
Date		16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16	16/10/16
Time		1845	1855	1910	1535	1540	1600	1615	1620	1640	1650	1700	1715
Phosphorus (PO_4), mg/l	0.67	0.18	0.24	0.16	0.25	0.20	0.18	0.16	0.24	0.21	0.23	0.19	0.20
PAH													
Naphthalene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthalene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorence, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, mg/l	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 6.2.10b: Baseline Water Quality Results on Phosphorus and PAH, Ebb Spring Tide

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1735**	**1745**	**1755**	**1810**	**1820**	**1835**
Phosphorus (PO_4), mg/l	0.67	0.27	0.24	0.24	0.13	0.20	0.18
PAH							
Naphthalene, mg/l	1000	<10	<10	<10	<10	<10	<10
Acenaphthylene, mg/l	1000	<10	<10	<10	<10	<10	<10
Acenaphthalene, mg/l	1000	<10	<10	<10	<10	<10	<10
Fluorence, mg/l	1000	<10	<10	<10	<10	<10	<10
Phenanthrene, mg/l	1000	<10	<10	<10	<10	<10	<10
Anthracene, mg/l	1000	<10	<10	<10	<10	<10	<10
Fluoranthene, mg/l	1000	<10	<10	<10	<10	<10	<10
Pyrene, mg/l	1000	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, mg/l	1000	<10	<10	<10	<10	<10	<10
Chrysene, mg/l	1000	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, mg/l	1000	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, mg/l	1000	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, mg/l	1000	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, mg/l	1000	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, mg/l	1000	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, mg/l	1000	<10	<10	<10	<10	<10	<10

Table 6.2.11a: Baseline Water Quality Results on Phosphorus and PAH, Flood Spring Tide

Location(Depth)	**Standard**	**W1(S)**	**W1(M)**	**W1(B)**	**W2(S)**	**W2(M)**	**W2(B)**	**W3(S)**	**W3(M)**	**W3(B)**	**W4(S)**	**W4(M)**	**W4(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1845**	**1855**	**1910**	**1535**	**1540**	**1600**	**1615**	**1620**	**1640**	**1650**	**1700**	**1715**
Phosphorus (PO_4), mg/l	0.67	0.18	0.24	0.16	0.25	0.20	0.18	0.16	0.24	0.21	0.23	0.19	0.20
PAH													
Naphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorence, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table 6.2.11b: Baseline Water Quality Results on Phosphorus and PAH, Flood Spring Tide

Location(Depth)	**Guideline Limit**	**W5(S)**	**W5(M)**	**W5(B)**	**W6(S)**	**W7(S)**	**W8(S)**	**W9(S)**	**W10(S)**	**W10(M)**	**W10(B)**
Date		**16/10/16**	**16/10/16**	**16/10/16**	**16/10/16**	**16/11/16**	**16/11/16**	**16/11/16**	**16/10/16**	**16/10/16**	**16/10/16**
Time		**1140**	**1145**	**1155**	**1211**	**1445**	**1405**	**1235**	**1245**	**1255**	**1300**
Phosphorus (PO_4), mg/l	0.67	0.15	0.20	0.27	0.18	0.29	0.39	0.19	0.17	0.19	0.17
PAH											
Naphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Acenaphthalene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluorence, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenanthrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chrysene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Indeno(1,2,3-cd)pyrene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Dibenz(a,h)anthracene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene, ng/g	1000	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Based on the test results, most of the water parameters analyzed were well below the stipulated guideline limits for Class 3 of the Malaysia Marine Water Quality Criteria and Standard during both neap and spring tides.

Discharge water quality at monitoring stations W7 and W8 represents storm water discharges from Kuantan Port and Sg. Pengorak respectively. Water sample during the neap tide monitoring was collected after a rain event and the discharges from the culvert was fast flowing. At the time, the water quality at W7 (from Kuantan Port) was reported with high suspended solid (68.5 mg/l), zinc (176 µg/l), phenol (90 µg/l) and cyanide (230 µg/l). Among these, zinc and cyanide levels in the discharge water exceeded the stipulated limits in Class 3 of the Malaysia Marine Water Quality Criteria and Standard. Meanwhile discharge water quality at W7 during spring tide monitoring reported higher zinc (96 µg/l) and faecal coliform (>1.6x10^4 MPN/100ml). The observed water quality is likely to be associated with discharges from industries within the Kuantan Port area as well as the storm water of the area.

Monitoring station W8 is located at the estuary of Sg. Pengorak. Water quality at this point exhibited high nitrate and faecal coliform. High nitrate levels were reported to be 4848 µg/l during neap tide and 1250 µg/l during spring tide while high faecal coliform were reported at 9.2x10^3 MPN/100ml during neap tide and 1.6x10^4 MPN/100ml during spring tide. These associated parameters could be contributed by sewage discharges upstream of Sg. Pengorak and the surrounding areas.

6.2.4.2 Marine Sediment

Existing marine sediment quality was determined to establish to understand the criteria pollutants in the composition of the marine sediment at the proposed work areas. Disturbance of marine sediment during development stage may release these potential pollutants and affect the marine environment. Sediment sampling was conducted at 6 locations as described in **Table 6.2.12** and further illustrated on **Figure 6.2.9**.

Table 6.2.12: Proposed Baseline Marine Sediment Locations

Station	Approximate Coordinates	Description
S1	3° 56' 2.24"N 103° 23' 5.62"E	Representing existing sediment quality near estuary where Sg Balok connects with the sea
S2	3° 57' 25.83"N 103° 26' 42.26"E	Representing existing sediment quality between Kuantan Port and Proposed Project site.
S3	3° 55' 25.57"N 103° 26' 54.95"E	Representing existing sediment quality at Proposed navigation channel further from Proposed Berthing Area
S4	3° 56' 28.09"N 103° 25’ 45.34"E	Representing existing sediment quality at Proposed navigation channel near to Proposed Berthing Area
S5	3° 57' 35.79"N 103° 24' 45.79"E	Representing existing sediment quality at Proposed Berthing Area
S6	3° 57' 53.17" N 103° 24' 45.79"E	Representing existing sediment quality at Proposed Site

Test results of marine sediment sampled are summarized in **Table 6.2.13** and the test reports are included in **Appendix 6.3**. The results are evaluated against the Netherland Standards for Water Sediment.

Table 6.2.13: Baseline for Marine Sediment Quality (Dry Basis)

Location	**Guideline Limit**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Date		**18/10/16**	**17/10/16**	**17/10/16**	**17/10/16**	**18/10/16**	**18/10/16**
Time		**1020**	**0900**	**0930**	**1010**	**0915**	**0945**
Lead, mg/kg	85	10.7	17.6	17.9	6.1	2.3	7.9
Copper, mg/kg	35	2.2	7.0	7.9	1.7	<1.5	<1.5
Zinc, mg/kg	140	31.7	37.1	36.6	15.8	1.6	25.6
Nickel, mg/kg	35	2.1	4.2	4.8	<1.5	<1.5	<1.5
Cadmium, mg/kg	0.8	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Chromium, mg/kg	100	8.1	11.0	11.0	4.5	<1.5	5.9
Mercury, mg/kg	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic, mg/kg	29	5.4	9.5	7.4	4.9	3.6	6.0
Particle size Distribution							
Gravel, %		0.4	<0.1	<0.1	5.9	9.0	0.3
Sand, %	-	50.0	13.5	9.0	58.1	83.3	72.3
Silt, %		48.2	85.0	84.0	36.0	7.7	27.4
Clay, %		0.9	1.5	7.0	<0.1	<0.1	<0.1

The test result indicates that the marine sediment of around the Project site was relatively clean and the heavy metal content in the marine sediment samples were well below the stipulated guideline levels.

Meanwhile particle size distribution test shows that the surface marine sediment sampled were mainly sandy and silty, which agrees with the seabed scan exercise as reported in Section 6.2.1 and **Appendix 6.2**.

6.2.4.3 Ambient Air Quality

Baseline for ambient air was established at identified sensitive receptors around the proposed Project site. This ambient air monitoring was conducted once at monitoring locations as described in **Table 6.2.14** and illustrated on **Figure 6.2.9**.

Table 6.2.14: Proposed Ambient Air Monitoring Locations

Station	Approximate Coordinates	Description
A1	3°58'5.21"N 103°24'52.53"E	Representing existing ambient air quality at LPK Apartment
A2	3°58'7.16"N 103°24'22.86"E	Representing existing ambient air quality at surau of Kampung Selamat
A3	3°57'51.12"N 103°23'50.36" E	Representing existing ambient air quality at northwest corner of the Proposed Project location, nearby an existing reclaimed site

The selected ambient air parameters were based on potential fugitive emission associated with the usage and movements of machineries and vehicles during construction and operation stages of the proposed Project. Test report are appended in **Appendix 6.3** and the results are evaluated against the Malaysia Ambient Air Quality Standard (Year 2020) as presented in **Table 6.2.15**.

Table 6.2.15: Baseline for Ambient Air Quality

Parameter	Guideline Limit	A1	A2	A3
		19/10/16 - 20/10/16	**17/10/16 - 18/10/16**	**16/10/16 - 17/10/16**
PM_{10}, µg/m^3	100 @ 24 hours	35.6	42.5	23.8
$PM_{2.5}$, µg/m^3	35 @ 24 hours	32.8	**39.2**	17.3
SO_2, µg/m^3	80 @ 24 hours	<20	<20	<20
		20/3/17	**20/3/17**	**20/3/17**
NO_2, µg/m^3	280 @ 1 hour	<6.0 @ Morning	34.6 @ Morning	<6.0 @ Morning
		<6.0@ Afternoon	<6.0 @ Afternoon	<6.0 @ Afternoon
		<6.0 @ Evening	17.6 @ Evening	<6.0 @ Evening

The test results indicate that the existing ambient air quality at A2 (located at surau of Kampung Selamat) was dusty and reported with some measured NO_2 levels during morning and evening times. In fact, the reported $PM_{2.5}$ level at A2 was higher than the guideline limit of 35 µg/m^3 during the baseline monitoring exercise in October 2016. It was observed that A2 is located near a busy junction leading to some quarries at Bukit Pengorak and these associated activities could be the main contributors to the existing ambient air quality.

Meanwhile the measured ambient air parameters at A1 and A3 were reported to be within the respective guideline limits. Ambient air quality at A3 was comparatively better and this could be associated with better breeze in the area which could contribute to better air dispersion.

6.2.4.4 Noise Level

Background environmental noise were established at 3 monitoring stations similar to the ambient air monitoring as described in **Table 6.2.16** and further illustrated in **Figure 6.2.9**.

Table 6.2.16: Proposed Baseline Noise Measurement Locations

Station	Approximate Coordinates	Description
N1	3°58'5.21"N 103°24'52.53"E	Representing existing noise level at LPK Apartment
N2	3°58'7.16"N 103°24'22.86"E	Representing existing noise level at surau of Kampung Selamat
N3	3°57'51.12"N 103°23'50.36" E	Representing existing noise level at north west corner of the Proposed Project location, nearby an existing reclamation site

Noise measurements were conducted continuously over 24 hours period to represent 15 hours (7 am to 10 pm) day time and 9 hours (10 pm to 7 am) night time. Noise parameters which include L_{eq}, L_{max}, L_{10} and L_{90} were recorded and summarised in **Table 6.2.17**. Site records and guideline references are appended in **Appendix 6.3** and the measured noise level are evaluated against the recommended guideline levels for Urban Land Use Category of Schedule 1 of the Planning Guidelines for Environmental Noise Limits and Control.

Table 6.2.17: Baseline for Noise Levels

Monitoring Locations	Measured Noise Levels, dB(A)							
	Day time				Night time			
	L_{eq}	L_{10}	L_{90}	L_{max}	L_{eq}	L_{10}	L_{90}	L_{max}
N1	**63.9**	66.2	59.3	83.6	**55.4**	58.1	51.3	80.1
N2	56.8	66.5	49.8	97.2	**52.9**	55.6	48.8	74.3
N3	56.7	57.4	35.4	88.3	**50.5**	52.3	43.8	82.5
Guideline Limit (L_{eq})	**60**	-	-	-	**50**	-	-	-

Measured night time noise levels at all monitoring locations were above the recommended guideline limit of 50 dB(A) and noise level at N1 during day time was above the requirement of 60 dB(A). As these sensitive receptors are located within the industrial zone of Kuantan Port and Bukit Pengorak and near main access roads to these industrial areas, the contributing noise sources observed during monitoring exercises were vehicles movement and human activities around the area.