MJTD

Thilawa Special Economic Zone (Class A) Development

Environmental Monitoring Report (Construction Phase)

Myanmar Japan Thilawa Development Limited.

JUNE 2014

CONTENTS

Appendix

1. Executive Summary

The environmental inspection and compliance monitoring program will be implemented under the direction of Ministry of Environmental Conservation and Forestry with oversight by Thilawa SEZ Management Committee.

The monitoring record according to the Environment Monitoring Plan is submitted in conformity with the provision of Chapter 9.1, Table 9.1-2 and 9.2, Table 9.2-2 Content of the EIA Report of Thilawa SEZ Development Project (Class A).

2. Summary of Monitoring Activities

a) **Documentation of compliance with all Conditions;**

Attached herewith is confirmation of Environmental Impact Assessment in Thilawa Special Economic Zone from Thilawa SEZ Management Committee.

b) **Progress made to date on the implementation of the EMP against the submitted implementation schedule;**

EMP for Pre-construction Phase was submitted on March 2014. The First implementation report during Construction Period is submitted this day. Subsequent reports will be submitted on a quarterly base.

c) **Difficulties encountered in implementing of the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties;**

None

d) **Number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation;**

None

e) **Accidents or incidents relating to the occupational and community health and safety, and the environment:**

Neither accidents nor incidents happen during this monitoring period.

f) **Monitoring data on environmental parameters and conditions as committed in the EMP or otherwise required.**

Please refer to the attached Environmental Monitoring Form

3. Construction Progress

Thilawa SEZ Class A Development Project, Phase 1 construction activities is submitted enclosed with monthly progress reports from contractor in Appendix A to C.

- Monthly Progress Report for March, 2014
- Monthly Progress Report for April, 2014
- Monthly Progress Report for May, 2014

4. Monitoring Result

Environmental Monitoring plan report for Construction Phase implemented according to the following table, reference on Table 4.2-2, Chapter 4, EIA report.

Monitoring Plan (Construction Phase)

Category	Item	Location	Frequency	Remark
Air Quality	No2, So2, Co, TSP, PM10	Construction site (1point)	Once/ 3month	March 2014, Monitoring Report May 2014, Monitoring Report
Water Quality	Water temperature, PH, SS, DO, BOD, COD, coliform count, oil and grease, chromium	Construction site (1point) Well in the Monastery (1 point)	Once/2 month	March 2014, Monitoring Report May 2014, Monitoring Report
Waste	Amount of solid waste Management of solid waste of construction	Construction site	Once/3month	
Noise and Vibration	Noise and vibration level of construction	Preservation area such as residence around the proposed construction site (2 points)	Once/3moth (peak period)	Noise and Vibration monitoring report 2014
		Preservaition site such as residence along the route for on-site vehicles (2points)	Once(peak period)	
Ground Subsidence	Ground elevation Consumption of ground water amount	Representative (1 point)	Every week	Monthly progress report (April and May)
Hydrology				
Risk for infectious disease such as AIDS/HIV	Status of measures of infectious disease	Construction site	Once/month	Monthly progress report (March, April and May)
Working conditions (including occupational safety)	Prehension of condition of occupational safety and health Prehension of infectious disease	Construction site	Once/ month	
Accident	Existence of accident	Construction site	As occasion arise	

Thilawa Special Economic Zone CLASS A
Development Project –Phase 1

5. Environment Monitoring Form

Environment Monitoring Form

The latest results of the below monitoring items shall be submitted to Authorities on once at Pre-construction phase and on quarterly basis at Construction Phase, and on bi-annually base at Operation Phase. The items, standards to be applied, measurement points, and frequency for each monitoring parameter are established based on the EIA Report for Thilawa Special Economic Zone Development Project (Class A). Should there be any changes to the original plan, such change shall be reviewed and evaluated by environmental expert.

(1) General

1) Phase of the Project

- Please mark the current phase.

□ Pre-Construction Phase ☑ Construction Phase □ Operation Phase

2) Obtainment of Environmental Permits

Name of permits	Expected issuance date	Actual issuance date	Concerned authority	Remarks (Conditions, etc.)
Attached approval letter:				

3) Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period	Duration of Report Period	Frequency
Number and contents of formal comments made by the public		Same timing of submission of Monitoring Report	Upon receipt of comments/complaints
Number and contents of responses from Government agencies			

No comments.

(2) Monitoring Results

1) (a) Ambient Air Quality -February

NO_2, SO_2, CO, TSP, PM10

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standard	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
Construction area Near Gate 2	NO_2	ppm	0.0285	0.0354	None			Once in three month	HAZSCANNER, EPAS	
	SO_2	ppm	0.0014	0.0215	None			Ditto	HAZSCANNER, EPAS	
	CO	ppm	0.29	0.41	None			Ditto	HAZSCANNER, EPAS	
	TSP	ppm	0.08	0.1	None			Ditto	HAZSCANNER, EPAS	
	PM10	ppm	0.08	0.09	None			Ditto	HAZSCANNER, EPAS	

(b) Ambient Air Quality- May

NO_2, SO_2, CO, TSP, PM10

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standard	Target value to be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
Construction area Near Gate 2	NO_2	ppm	0.0345	0.0351	None			Once in three month	HAZSCANNER, EPAS	
	SO_2	ppm	0.0015	0.0229	None			Ditto	HAZSCANNER, EPAS	
	CO	ppm	0.37	1.41	None			Ditto	HAZSCANNER, EPAS	
	TSP	ppm	0.05	0.1	None			Ditto	HAZSCANNER, EPAS	
	PM10	ppm	0.04	0.16	None			Ditto	HAZSCANNER, EPAS	

Complains from Residents

- Are there any complains from residents regarding air quality in this monitoring period? □Yes, ☑No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

Complains from Residents

- Are there any complains from residents regarding air quality in this monitoring period? □Yes, ☑No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

2) (a) Water Quality-March

Measurement Point: Effluent of Wastewater

- Are there any effluents to water body in this monitoring period? □Yes, ☑No

If yes, please attach "Analysis Record" and fill in the items not to comply with Refereed International Standard.

Location	Item	Unit	Measured Value	Country's Standard	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW2	pH SS	- mg/l	7.93 1291	None (Available	5.0-9.0 Max 30		Once in two month	pH meter, HI7609829-1 pH Sensor Gravimetric method	SS is higher than standard. Increasing of

Location	Item	Unit	Measured Value	Country's Standard	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
	DO	mg/l	4.25	Guideline	-			HI7609829-2, (D.O) sensor	insoluble particulate matter around upstream area.
	COD	mg/l	1.5	Value	Max 3			Dichromate method	
	BOD_5	mg/l	0.74	determined	Max 20			Direct inoculation method	
	Oil & Grease	mg/l	<1	by MOI)	Max 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	5×10^2		-			AOAC Petrifilm Method	
SW3	pH	mg/l	7.59					pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	1417					Gravimetric method	
	DO	mg/l	7.4					HI7609829-2, (D.O) sensor	
	COD	mg/l	2	Ditto	Ditto		Once in two month	Dichromate method	Ditto
	BOD_5	mg/l	0.37					Direct inoculation method	
	Oil & Grease	mg/l	<1					APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02					APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	5×10^2					AOAC Petrifilm Method	

Location	Item	Unit	Measured Value	Country's Standard	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW4	pH	-	7.54					pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	1474					Gravimetric method	
	DO	mg/l	7.4					HI7609829-2, (D.O) sensor	
	COD	mg/l	2	Ditto	Ditto		Once in two	Dichromate method	Ditto
	BOD_5	mg/l	1.47				month	Direct inoculation method	
	Oil & Grease	mg/l	<1					APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02					APHA-AWWA-WEF Method	
	Total coli forms	cfu/100ml	1×10^3					AOAC Petrifilm Method	
GW1	pH	-	7.66					pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	386					Gravimetric method	
	DO	mg/l	5.11					HI7609829-2, (D.O) sensor	
	COD	mg/l	1.5				Once in two	Dichromate method	Ditto
	BOD_5	mg/l	1.1				month	Direct inoculation method	
	Oil & Grease	mg/l	<1					APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02					AOAC Petrifilm Method	
	Total coliforms	cfu/100ml	0						

*Reference to the Monitoring Report, March 2014

(b) Water Quality- May

Measurement Point: Effluent of Wastewater

- Are there any effluents to water body in this monitoring period? □Yes, □No

If yes, please attach "Analysis Record" and fill in the items not to comply with Refereed International Standard.

Location	Item	Unit	Measured Value	Country's Standard	Target valueto be applied	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW2	pH	-l	7.66	None (Available Guideline Value determined by MOI)	5.0-9.0			Once in two month	pH meter, HI7609829-1 pH Sensor	SS is higher than standard.
	SS	mg/l	947		Max 30				Gravimetric method	
	DO	mg/l	3.52		-				HI7609829-2, (D.O) sensor	Increasing of insoluble particulate matter around upstream area.
	COD	mg/l	1.20		Max 60				Dichromate method	
	BOD_5	mg/l	1.5		Max 20				Direct inoculation method	
	Oil & Grease	mg/l	<1		Max 5				APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max 0.5				APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	0		-				AOAC Petrifilm Method	

Location	Item	Unit	Measured Value	Country's Standard	Target valueto be applied	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
SW3	pH	-	7.7						pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	1191						Gravimetric method	
	DO	mg/l	3.31						HI7609829-2, (D.O) sensor	
	COD	mg/l	1.32	Ditto	Ditto			Once in two month	Dichromate method	
	BOD_5	mg/l	1.5						Direct inoculation method	
	Oil & Grease	mg/l	<1						APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02						APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	0						AOAC Petrifilm Method	
SW4	pH	-	7.54						pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	1252						Gravimetric method	
	DO	mg/l	3.45						HI7609829-2, (D.O) sensor	
	COD	mg/l	1.15						Dichromate method	
	BOD_5	mg/l	1.5	Ditto	Ditto			Once in two month	Direct inoculation method	
	Oil & Grease	mg/l	1						APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02						APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	0						AOAC Petrifilm Method	

Location	Item	Unit	Measured Value	Country's Standard	Target valueto be applied	Target valueto be applied	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
GW1	pH	-	7.29					Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	282						Gravimetric method	
	DO	mg/l	3.65						HI7609829-2, (D.O) sensor	
	COD	mg/l	1.98						Dichromate method	
	BOD_5	mg/l	2.0						Direct inoculation method	
	Oil & Grease	mg/l	<1						APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02						APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	0						AOAC Petrifilm Method	

*Reference to the Monitoring Report, May 2014

3) Soil Contamination (only operation phase) Not Applicable at Construction Phase Report

Situations environmental report from tenants

- Are there any serious issues regarding soil contamination in this monitoring period? □ Yes, □ No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Issues on Soil Contamination	Countermeasures

4) Noise -April

Noise Level

Location	Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standard	Target value to be applied (Mean)	Referred International Standard	Frequency	Method	Note (Reason of excess of the standard)
TNV-1	Leq (day) 7am-7pm	dB(A	67		None	75		Once (Peak period)	Sound Level Meter	
	Leq (evening) 7pm-10pm	dB(A)	56			60				
	Leq (night)10pm-7am	dB(A)	50			55				
TNV-2	Leq (day) 7am-7pm	dB(A	56		Ditto	75		Once in 3 month	Sound Level Meter	
	Leq (evening) 7pm-10pm	dB(A)	57			60				
	Leq (night)10pm-7am	dB(A)	48			55				
TNV-3	Leq (day) 7am-7pm	dB(A	71		Ditto	75		Once in 3 month	Sound Level Meter	
	Leq (evening) 7pm-10pm	dB(A)	57			60				
	Leq (night)10pm-7am	dB(A)	44			55				

*Reference to the Noise and Vibration Report, March 2014

Complains from Residents

- Are there any complains from residents regarding noise in this monitoring period? □ Yes, ☑ No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

5) Solid Waste

Measurement Point: Construction Site (Construction Phase), Storage for Sludge (Operation Phase)

- Are there any wastes of sludge in this monitoring period? □ Yes, ☑ No

If yes, please report the amount of sludge and fill in the results of solid waste management Activities.

Item	Generated from	Unit	Value	Solid Waste Management Activities
Amount of Sludge				
Amount of Sludge				

6) Ground Subsidence and Hydrology- April

Duration (Week)	Water Consumption		Ground Level		Note
	Quantity	Unit	Quantity	Unit	
27 March 2014	25.0	m3/week	+6.999	m	
3 April 2014	24.0	m3/week	+6.998	m	
9 April 2014	16.0	m3/week	+6.998	m	
24 April 2014	26.0	m3/week	+7.000	m	

*Reference to the Monthly Progress Report April

Ground Subsidence and Hydrology- May

Duration (Week)	Water Consumption		Ground Level		Note
	Quantity	Unit	Quantity	Unit	
01 May 2014	43.0	m3/week	+7.000	m	
08 May 2014	26.0	m3/week	+7.000	m	
15 May 2014	37.0	m3/week	+7.000	m	
22 May 2014	31.0	m3/week	+7.000	m	
30 May 2014	31.0	m3/week	+7.000	m	

*Reference to the Monthly Progress Report May

7) Offensive Odor (only operation phase) Not Applicable at Construction Phase Report

Complains from Residents

- Are there any complains from residents regarding offensive odor in this monitoring period? □ Yes, □ No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Complains from Residents	Countermeasures

Situations environmental report from tenants Not Applicable at Construction Phase Report

- Are there any serious issues regarding offensive odor in this monitoring period? □ Yes, □ No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Issues on Soil Contamination	Countermeasures

8) Infectious disease, Working Environment, Accident

Information from contractor (construction phase) or tenants (operation phase)

- Are there any incidents regarding Infectious disease, Working Environment, Accident in this monitoring period? □ Yes, ☑ No

If yes, please describe the contents of complains and its countermeasures to fill in below the table.

Contents of Incidents	Countermeasures

Note: If emergency incidents are occurred, the information shall be reported to the relevant organizations and authorities immediately.

End of Document

Thilawa Special Economic Zone CLASS A Development Project –Phase 1

Appendix

Air, Water and Waste Water Monitoring Report

March

MJTD MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

Thilawa Special Economic Zone

Development Project (Class A)

Monitoring report

March 2014

DECLARATIONS

DECLARATION - EIA Experts

Resource & Environment Myanmar Ltd (REM); a local consultant firm of EIA Experts, submit the following Environmental Monitoring Report on behalf of –**Myanmar Japan Thilawa Development Ltd** for **Thilawa Special Economic Zone Development Project (Class A).**

We do state that the Environmental Monitoring Report has been carried out according to the Environmental Conservation Law (2012), Environmental Conservation Rules and Environmental Impact Assessment Procedure (Draft, 2013).

To our knowledge, all information contained in this report is accurate and a truthful representation of all findings as relating to the project.

Signed: (Zaw Naing Oo) _____ Date: 25 – 03-2014

For: **Resource & Environment Myanmar Ltd (REM)**

Resource & Environment Myanmar

Contents

RESULT OF AIR AND WATER QUALITY MONITORING

1. Introduction

This is the first report for Air and water quality monitoring at Thilawa Special Economic Zone (TSEZ). This report sets out the environmental monitoring required throughout the construction of the Thilawa Special Economic Zone. The terms of reference for monitoring are shown in Table 1. The location of air and water monitoring points are shown in Figure 1 and Table 1.

Terms of Reference for Monitoring

Table 1 Terms of reference for air and water quality monitoring at TSEZ.

Description	items	Frequency	Location
Air Quality	TSP / PM10	1 time / 3months	At construction site (1point)
Waste water quality	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time / 2months	At the creek upstream and downstream which is crossed the car road (3points)
Underground water	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time /2months	Tube well, at inside of Moegyoswan Monastery (1 point)

Monitoring Instrument for Air and water

No.	Instrument	Brand & Model	Measurement/ Parameter	
1.	Environmental Perimeter Air Monitoring System	HAZ-SCANNER EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction	
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company® Indonesia		

So far, there is no environmental standard for ambient air quality in Republic of Myanmar, the survey result was evaluated by comparing with the standards in neighbouring country like Thailand, Vietnam, Japan and IFC (Table 2). The consultant will apply the air quality standard in Thailand, Vietnam, Japan and IFC as shown in Table 1.As for TSP and PM10, the standards in Thailand were applied and the others were compared with the standards in Japan.

Table 2 Survey Parameters for Air Quality

Item	Averagingp eriod	Japan	Thailand	Vietnam	IFC
SO_2	10 min	-	-	-	0.5mg/m³
	1hour	0.1ppm	0.3ppm	0.35mg/m³	0.125mg/m³(InterimTarget-1) 0.05mg/m³(InterimTarget-2) 0.02mg/m³(Guideline)
	24hours	0.04ppm	0.12ppm	0.125 mg/m³	-
	1 year	-		0.05mg/m³	-
NO_2	1hour	-	0.17ppm	-	0.2mg/m³
	24hours	0.04-0.06ppm	-	-	-
	1 year	-	0.03ppm	-	0.04mg/m³
NOx	1hour	-	-	0.2mg/m³	
	24hours	-	-	0.04mg/m³	
CO	1hour	-	30ppm	30mg/m³	-
	8hours	20ppm	-	10mg/m³	-
	24hours	10ppm	9ppm	-	-
TSP	1hour	-	-	0.3mg/m³	-
	24hours	-	0.33mg/m³	0.2mg/m³	-
	1 year		0.10mg/m³	0.14mg/m³	-
PM_{10}	24hours	-	0.12mg/m³	0.15mg/m³	0.15mg/m³(InterimTarget-1) 0.10mg/m³(InterimTarget-2) 0.07mg/m³(InterimTarget-3)
	1 year	-	0.05mg/m³	0.05mg/m³	0.07mg/m³(InterimTarget-1) 0.05mg/m³(InterimTarget-2) 0.03mg/m³(InterimTarget-3)
SPM	1hour	0.2mg/m³	-	-	-
	24hours	0.1mg/m³	-	-	-
$PM_{2.5}$	24hours	0.035mg/m³	0.05mg/m³	-	0.075mg/m³(InterimTarget-1) 0.05mg/m³(InterimTarget-2) 0.0375mg/m³(InterimTarget-3)
	1 year	0.015mg/m³	0.025mg/m³	-	0.035mg/m³(InterimTarget-1) 0.025mg/m³(InterimTarget-2) 0.015mg/m³(InterimTarget-3)
Ozone	1hour	-	0.10ppm	0.3mg/m³	-
	8hourdaily maximum	-	0.07ppm	0.2mg/m³	0.16mg/m³(InterimTarget-1) 0.1mg/m³(Guideline)
	1 year	-	0.04ppm	0.14mg/m³	-
Cl₂	1hour	0.06ppm	-	-	-
Pb	24hours	-	-	0.0015mg/m³	
	1 month	-	0.0015mg/m³	-	
	1 year	-	-	0.0005mg/m³	

Source: National Air Quality Standard in Japan (Circular No.25,1973, originally),Ministry of Environment, Japan
NotificationsofNationalEnvironmentalBoardNo.10, 24,28,33, and 36, Ministry of Natural Resources and Environment, Thailand
National Ambient Air Quality Standard (TCVN5973:2005), Ministry of Science and Technology in Vietnam
Environmental, Health, and Safety Guidelines, General EHS Guidelines, IFC, 2007

Figure 1 Location of air and water monitoring points

2. Description of the air quality monitoring station

Survey Period

Air quality survey was conducted once per 3 months as per specification provided by the client. The monitoring period was about 7 consecutive days. The sampling duration for each day is as shown in Table 3.

Table 3. Sampling Duration for Air Quality Survey in

Day	First Survey (February 15th – February 22nd)
Day 1	Feb. 15th - 16th
Day 2	Feb. 16th - 17th
Day 3	Feb. 17th - 18th
Day 4	Feb. 18th - 19th
Day 5	Feb. 19th - 20th
Day 6	Feb. 20th – 21st
Day 7	Feb. 21st – 22nd

Source: Source: Resource &Environment Myanmar Co., Ltd.

Survey Method

Sampling and analysis of ambient air pollutants was conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner Environmental Perimeter Air Station (EPAS) was used to collect Ambient Air Monitoring data. The characteristics of the instrument are:

- Portable direct reading
- Configure up to 14 simultaneous air measurements including U.S. EPA criteria air pollutants

The basic specification of the instrument are as follow.

Instrument	Brand	Model	Measurement/ Parameter
Environmental Perimeter Air Monitoring System	HAZ-SCANNER	EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction

Table 4. Sampling and Analysis Method for Air Quality

No.	Parameter	Analysis Method
1	Sulfur dioxide (SO2)	On site reading
2	Carbon monoxide (CO)	On site reading
3	Nitrogen dioxides (NO2)	On site reading
4	Total suspended particle (TSP)	On site reading
5	Particle matter 10 (PM10)	On site reading

Source: Resource &Environment Myanmar Co., Ltd

Target Ambient Air Quality Level

Parameters	Averaging Period	Value
TSP	24 hours	0.33 mg/m3
PM10	24 hours	0.12 mg/m3

Survey Result

Table 5 Total Suspended Particle (TSP) Level

Unit: mg/m3

Frequency		AQM-1	Thailand Standard	Vietnam Standard
1	First Day	0.1	0.33	0.2
2	Second Day	0.08	0.33	0.2
3	Third Day	0.07	0.33	0.2
4	Fourth Day	0.08	0.33	0.2
5	Fifth Day	0.1	0.33	0.2
6	Six Day	0.09	0.33	0.2
7	Seventh Day	0.08	0.33	0.2
Maximum		0.1		
Average		0.08		
Minimum		0.07		

Source: Resource & Environment Myanmar Co., Ltd

Table 6 Particulate matter 10 (PM10) Level

Unit: mg/m3

Frequency		AQM-1	Thailand	Vietnam
1	First Day	0.09	0.12	0.15
2	Second Day	0.08	0.12	0.15
3	Third Day	0.07	0.12	0.15
4	Fourth Day	0.08	0.12	0.15
5	Fifth Day	0.09	0.12	0.15
6	Six Day	0.06	0.12	0.15
7	Seventh Day	0.07	0.12	0.15
Maximum		0.09		
Average		0.08		
Minimum		0.06		

Source: Resource & Environment Myanmar Co., Ltd

The monitoring results of TSP and PM10 level are lower than the target ambient air quality level.

3. Water Quality Monitoring

Methodology

Sampling and preservation method

Water samples were taken by Alpha horizontal water sampler and collected in sterilized sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), were measured at each site concurrently with sample collection. All samples were kept in iced boxes and were transported to the laboratory and stored at 2-4 °C refrigerators.

Table 7 Field Equipment for Water Quality Survey

No.	Equipment	Manufacturer	Originate Country	Model
1	pH meter	HANNA	USA	HI7609829-1 pH Sensor
2	DO meter	HANNA	USA	HI7609829-2
3	Digital Water Velocity Meter	Global Water Flow Probe	USA	FP 211
4	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

Table 8 Container and Preservation Method for Water Samples

No	Parameter	Container	Preservation
1	Oil and Grease	1000 ml glass bottle	Sulfuric acid, Refrigerate
2	COD	500 ml plastic bottle	Sulfuric acid, Refrigerate
3	BOD_5	1,800 ml plastic bottle	Refrigerate
4	Heavy metals	500 ml plastic bottle	HNO_3 Refrigerate
5	Bacteria	200 ml glass bottle (Sterilize)	Refrigerate
6	Others	1,800 ml polyethylene bottle	Refrigerate

Test method

The following table provides the test method for water quality.

No	Item	Analysis method
1	pH	HI7609829-1 pH Sensor
2	Suspended Solids	Gravimetric method
3	Dissolved Oxygen (DO)	HI7609829-2 Galvanic dissolved oxygen (D.O) sensor
4	Chemical oxygen demand(COD)	Dichromate method
5	Biochemical oxygen demand(BOD_5)	Direct inoculation method
6	Oil & Grease	APHA-AWWA-WEF Method
7	Chromium (Cr) (mg/l)	APHA-AWWA-WEF Method
8	E. coliform, Fecal coliforms, total coliforms	AOAC Petrifilm Method

Monitoring Result

No	Item	GW-1	SW-2	SW-3	SW-4	Standard*	Unit
1	pH	7.66	7.93	7.59	7.54	5-9	
2	Suspended Solids	386	1291	1417	1474	Max. 30	mg/l
3	Dissolved Oxygen (DO)	5.11	4.25	7.4	7.4	-	mg/l
4	Chemical oxygen demand(COD)	1.5	1.5	2	2	Max. 60	mg/l
5	Biochemical oxygen demand(BOD_5)	1.1	0.74	0.37	1.47	Max. 20-60	mg/l
6	Oil & Grease	<1	<1	<1	<1	Max. 5	mg/l
7	Chromium (Cr) (mg/l)	<0.02	<0.02	<0.02	<0.02	Max. 0.5	mg/l
8	E. coliform	0	$1 X 10^2$	$1 X 10^3$	$4 X 10^2$	-	cfu/100ml
	Fecal coliforms	0	$4 X 10^2$	$4 X 10^2$	$6 X 10^3$	-	cfu/100ml
	Total coliforms	0	$5 X 10^2$	$5 X 10^2$	$1 X 10^3$	-	cfu/100ml

* Waste water quality standard, Ministry of Industry.

According to the waste water quality standard, Ministry of Industry, the suspended solids were high compared to the standard and the rest parameters were within the standard. According to the laboratory analysis, suspended solids concentration of three sample points (SW2, SW3, SW4) are higher than those of previous monthly monitoring. The possible reasons is the increasing of insoluble particulate matter during run off or discharging that can be generated from the some construction activities and direct discharge of waste water disposal from the upstream area.

Detailed of laboratory result and hourly air quality data are provided in appendix.

Laboratory Result

MINISTRY OF LIVESTOCK, FISHERIES AND RURAL DEVELOPMENT
DEPARTMENT OF FISHERIES
AQUACULTURE DIVISION
FRESHWATER AQUACULTURE RESEARCH
WATER AND SOIL EXAMINATION LABORATORY

RESULT ON CHEMICAL EXAMINATION OF WATER

Sender's reference : Resource & Environment Myanmar Co., Ltd
Collection Date : 14-2-2014

Location : Near Thanlyin & Thilawa
Project Name : Water Quality Monitoring in Thilawa SEZ
Arrival Date : 17-2-2014

Parameters	Unit	GW -1	SW-2	SW-3	SW-4
Biological Oxygen Demand (BOD5)	mg/l	1.1	0.74	0.37	1.47
Chemical Oxygen Demand (COD)	mg/l	1.5	1.5	2	2
Suspended Solids (SS)	mg/l	386	1291	1417	1474

Analyzed by – Htay Htay Kyi
San San Soe
Khaing Khaing Oo
Thuya Win

Approved by

(Aye Aye Thein)
Head of Freshwater Aquaculture Research

SGS

Report No. : 2014-00181 / 001 (Page 1 of 1) Issued date : March 3, 2014

CLIENT : RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.
CONTACT : Ms. Pwint Pwint
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Analysis Report

PROJECT NAME : Water Quality Monitoring in Thilawa SEZ
SAMPLE DESIGNATED AS : Water Quality SAMPLE RECIEVED DATE : February 14, 2013
SAMPLING LOCATION : Thilawa, Myanmar SAMPLING BY : Client

Stations	Results	
	Oil and Grease (mg/l)	Chromium Hexavalent (mg/l)
1. GW-1	< 1.0	< 0.02
2. SW-2	< 1.0	< 0.02
3. SW-3	< 1.0	< 0.02
4. SW-4	< 1.0	< 0.02
Detection Limit	1.0	0.02

Remark : - Analysis Methods followed to Standard Methods for the Examination of Water and Wastewater, recommended by APHA-AWWA-WEF.

Siripon I.
(Siripon Imwisaiwan)
License ID : 9-010-n-1793

SGS (THAILAND) LIMITED

Thepson Y.
(Thepson Yommana)
License ID : 9-010-n-333

TY/Client/VV/PI

Hourly Air Result

Within 15 to 16 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
15.2.2014	11:00-12:00	0.03	0.047
15.2.2014	12:00-13:00	0.07	0.083
15.2.2014	13:00-14:00	0.05	0.057
15.2.2014	14:00-15:00	0.03	0.037
15.2.2014	15:00-16:00	0.02	0.024
15.2.2014	16:00-17:00	0.03	0.035
15.2.2014	17:00-18:00	0.03	0.027
15.2.2014	18:00-19:00	0.04	0.04
15.2.2014	19:00-20:00	0.03	0.034
15.2.2014	20:00-21:00	0.05	0.053
15.2.2014	21:00-22:00	0.1	0.103
15.2.2014	22:00-23:00	0.1	0.086
15.2.2014	23:00-00:00	0.1	0.064
16.2.2014	00:00-01:00	0.05	0.051
16.2.2014	01:00-02:00	0.01	0.062
16.2.2014	02:00-03:00	0.11	0.11
16.2.2014	03:00-04:00	0.12	0.129
16.2.2014	04:00-05:00	0.2	0.164
16.2.2014	05:00-06:00	0.4	0.421
16.2.2014	06:00-07:00	0.3	0.342
16.2.2014	07:00-08:00	0.14	0.151
16.2.2014	08:00-09:00	0.12	0.14
16.2.2014	09:00-10:00	0.1	0.098
16.2.2014	10:00-11:00	0.03	0.041

Within 16 to 17 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
16.2.2014	11:00-12:00	0.1	0.074
16.2.2014	12:00-13:00	0.04	0.038
16.2.2014	13:00-14:00	0.04	0.042
16.2.2014	14:00-15:00	0.03	0.034
16.2.2014	15:00-16:00	0.05	0.055
16.2.2014	16:00-17:00	0.03	0.041
16.2.2014	17:00-18:00	0.04	0.04
16.2.2014	18:00-19:00	0.05	0.048
16.2.2014	19:00-20:00	0.03	0.035
16.2.2014	20:00-21:00	0.04	0.045
16.2.2014	21:00-22:00	0.1	0.059
16.2.2014	22:00-23:00	0.1	0.088
16.2.2014	23:00-00:00	0.03	0.031
17.2.2014	00:00-01:00	0.02	0.022
17.2.2014	01:00-02:00	0.03	0.031
17.2.2014	02:00-03:00	0.04	0.05
17.2.2014	03:00-04:00	0.1	0.103
17.2.2014	04:00-05:00	0.15	0.148
17.2.2014	05:00-06:00	0.2	0.163
17.2.2014	06:00-07:00	0.2	0.166
17.2.2014	07:00-08:00	0.2	0.184
17.2.2014	08:00-09:00	0.2	0.205
17.2.2014	09:00-10:00	0.14	0.169
17.2.2014	10:00-11:00	0.1	0.091

Within 17 to 18 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
17.2.2014	11:00-12:00	0.05	0.069
17.2.2014	12:00-13:00	0.1	0.11
17.2.2014	13:00-14:00	0.05	0.06
17.2.2014	14:00-15:00	0.04	0.041
17.2.2014	15:00-16:00	0.03	0.028
17.2.2014	16:00-17:00	0.04	0.041
17.2.2014	17:00-18:00	0.03	0.025
17.2.2014	18:00-19:00	0.03	0.027
17.2.2014	19:00-20:00	0.03	0.025
17.2.2014	20:00-21:00	0.1	0.078
17.2.2014	21:00-22:00	0.1	0.063
17.2.2014	22:00-23:00	0.04	0.045
17.2.2014	23:00-00:00	0.04	0.043
18.2.2014	00:00-01:00	0.05	0.052
18.2.2014	01:00-02:00	0.1	0.072
18.2.2014	02:00-03:00	0.1	0.097
18.2.2014	03:00-04:00	0.1	0.094
18.2.2014	04:00-05:00	0.1	0.089
18.2.2014	05:00-06:00	0.1	0.102
18.2.2014	06:00-07:00	0.2	0.182
18.2.2014	07:00-08:00	0.14	0.162
18.2.2014	08:00-09:00	0.04	0.061
18.2.2014	09:00-10:00	0.1	0.074
18.2.2014	10:00-11:00	0.1	0.081

Within 18 to 19 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
18.2.2014	11:00-12:00	0.1	0.099
18.2.2014	12:00-13:00	0.1	0.106
18.2.2014	13:00-14:00	0.1	0.086
18.2.2014	14:00-15:00	0.04	0.051
18.2.2014	15:00-16:00	0.02	0.02
18.2.2014	16:00-17:00	0.001	0.007
18.2.2014	17:00-18:00	0.05	0.056
18.2.2014	18:00-19:00	0.05	0.051
18.2.2014	19:00-20:00	0.05	0.056
18.2.2014	20:00-21:00	0.04	0.045
18.2.2014	21:00-22:00	0.04	0.04
18.2.2014	22:00-23:00	0.04	0.043
18.2.2014	23:00-00:00	0.03	0.03
19.2.2014	00:00-01:00	0.03	0.033
19.2.2014	01:00-02:00	0.04	0.037
19.2.2014	02:00-03:00	0.2	0.201
19.2.2014	03:00-04:00	0.1	0.084
19.2.2014	04:00-05:00	0.11	0.118
19.2.2014	05:00-06:00	0.2	0.162
19.2.2014	06:00-07:00	0.2	0.166
19.2.2014	07:00-08:00	0.12	0.134
19.2.2014	08:00-09:00	0.1	0.118
19.2.2014	09:00-10:00	0.12	0.139
19.2.2014	10:00-11:00	0.12	0.138

Within 19 to 20 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
19.2.2014	11:00-12:00	0.1	0.11
19.2.2014	12:00-13:00	0.1	0.114
19.2.2014	13:00-14:00	0.1	0.102
19.2.2014	14:00-15:00	0.02	0.03
19.2.2014	15:00-16:00	0.03	0.028
19.2.2014	16:00-17:00	0.05	0.05
19.2.2014	17:00-18:00	0.03	0.028
19.2.2014	18:00-19:00	0.03	0.033
19.2.2014	19:00-20:00	0.05	0.052
19.2.2014	20:00-21:00	0.1	0.101
19.2.2014	21:00-22:00	0.1	0.09
19.2.2014	22:00-23:00	0.1	0.088
19.2.2014	23:00-00:00	0.1	0.083
20.2.2014	00:00-01:00	0.1	0.089
20.2.2014	01:00-02:00	0.1	0.069
20.2.2014	02:00-03:00	0.1	0.092
20.2.2014	03:00-04:00	0.1	0.094
20.2.2014	04:00-05:00	0.1	0.094
20.2.2014	05:00-06:00	0.13	0.133
20.2.2014	06:00-07:00	0.22	0.222
20.2.2014	07:00-08:00	0.2	0.207
20.2.2014	08:00-09:00	0.14	0.164
20.2.2014	09:00-10:00	0.12	0.139
20.2.2014	10:00-11:00	0.1	0.116

Within 20 to 21 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
20.2.2014	11:00-12:00	0.05	0.069
20.2.2014	12:00-13:00	0.1	0.091
20.2.2014	13:00-14:00	0.1	0.09
20.2.2014	14:00-15:00	0.01	0.009
20.2.2014	15:00-16:00	0.03	0.037
20.2.2014	16:00-17:00	0.04	0.038
20.2.2014	17:00-18:00	0.03	0.033
20.2.2014	18:00-19:00	0.02	0.026
20.2.2014	19:00-20:00	0.05	0.051
20.2.2014	20:00-21:00	0.1	0.106
20.2.2014	21:00-22:00	0.05	0.053
20.2.2014	22:00-23:00	0.04	0.045
20.2.2014	23:00-00:00	0.02	0.023
21.2.2014	00:00-01:00	0.02	0.022
21.2.2014	01:00-02:00	0.04	0.462
21.2.2014	02:00-03:00	0.1	0.061
21.2.2014	03:00-04:00	0.1	0.063
21.2.2014	04:00-05:00	0.1	0.072
21.2.2014	05:00-06:00	0.1	0.092
21.2.2014	06:00-07:00	0.2	0.182
21.2.2014	07:00-08:00	0.2	0.182
21.2.2014	08:00-09:00	0.1	0.12
21.2.2014	09:00-10:00	0.05	0.057
21.2.2014	10:00-11:00	0.05	0.058

Within 21 to 22 day average AQM values table hour by hour

Date	Time	PM10	TSP
D.M.Y	H.M.S	mg/m3	mg/m3
21.2.2014	11:00-12:00	0.04	0.055
21.2.2014	12:00-13:00	0.1	0.081
21.2.2014	13:00-14:00	0.03	0.04
21.2.2014	14:00-15:00	0.04	0.051
21.2.2014	15:00-16:00	0.02	0.02
21.2.2014	16:00-17:00	0.04	0.05
21.2.2014	17:00-18:00	0.04	0.041
21.2.2014	18:00-19:00	0.01	0.008
21.2.2014	19:00-20:00	0.03	0.026
21.2.2014	20:00-21:00	0.1	0.067
21.2.2014	21:00-22:00	0.05	0.059
21.2.2014	22:00-23:00	0.05	0.052
21.2.2014	23:00-00:00	0.04	0.044
22.2.2014	00:00-01:00	0.04	0.043
22.2.2014	01:00-02:00	0.1	0.076
22.2.2014	02:00-03:00	0.1	0.083
22.2.2014	03:00-04:00	0.1	0.09
22.2.2014	04:00-05:00	0.1	0.082
22.2.2014	05:00-06:00	0.13	0.129
22.2.2014	06:00-07:00	0.2	0.169
22.2.2014	07:00-08:00	0.14	0.152
22.2.2014	08:00-09:00	0.2	0.187
22.2.2014	09:00-10:00	0.14	0.169
22.2.2014	10:00-11:00	0.1	0.091

Hourly Air Quality Monitoring Data(February)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
15/2/2014	11:00-12:00	0.43	25.32	0.00
15/2/2014	12:00-13:00	0.34	27.22	0.00
15/2/2014	13:00-14:00	0.00	26.54	0.00
15/2/2014	14:00-15:00	0.11	27.00	0.00
15/2/2014	15:00-16:00	0.12	27.00	0.00
15/2/2014	16:00-17:00	0.25	27.00	0.00
15/2/2014	17:00-18:00	0.38	26.00	0.00
15/2/2014	18:00-19:00	0.32	28.00	0.00
15/2/2014	19:00-20:00	0.10	26.00	0.00
15/2/2014	20:00-21:00	0.10	24.00	0.00
15/2/2014	21:00-22:00	0.42	27.00	11.22
15/2/2014	22:00-23:00	0.39	27.00	0.00
15/2/2014	23:00-00:00	0.24	34.00	0.00
16/2/2014	00:00-01:00	0.21	26.00	0.00
16/2/2014	01:00-02:00	0.37	27.00	0.00
16/2/2014	02:00-03:00	0.15	32.00	0.00
16/2/2014	03:00-04:00	0.37	21.00	0.00
16/2/2014	04:00-05:00	0.46	22.00	0.00
16/2/2014	05:00-06:00	0.32	32.00	0.00
16/2/2014	06:00-07:00	0.21	34.21	5.21
16/2/2014	07:00-08:00	0.22	35.00	2.31
16/2/2014	08:00-09:00	0.42	35.12	2.22
16/2/2014	09:00-10:00	0.43	35.00	0.00
16/2/2014	10:00-11:00	0.41	34.00	0.00
	[illegible]	0.28	28.56	0.87
	[illegible]	0.46	35.12	11.22
	[illegible]	0.00	21.00	0.00

Hourly Air Quality Monitoring Data(February)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
16/2/2014	11:00-12:00	0.10	26.51	2.22
16/2/2014	12:00-13:00	0.00	26.44	0.00
16/2/2014	13:00-14:00	0.12	28.11	1.28
16/2/2014	14:00-15:00	0.32	27.00	12.31
16/2/2014	15:00-16:00	0.24	29.00	2.55
16/2/2014	16:00-17:00	0.26	29.00	0.36
16/2/2014	17:00-18:00	0.28	24.00	1.22
16/2/2014	18:00-19:00	0.27	27.00	0.02
16/2/2014	19:00-20:00	0.23	26.00	0.00
16/2/2014	20:00-21:00	0.36	28.00	0.00
16/2/2014	21:00-22:00	0.33	28.00	0.00
16/2/2014	22:00-23:00	0.32	29.00	0.00
16/2/2014	23:00-00:00	0.24	28.00	0.00
17/2/2014	00:00-01:00	0.38	29.00	0.00
17/2/2014	01:00-02:00	0.37	29.00	0.00
17/2/2014	02:00-03:00	0.18	29.00	0.00
17/2/2014	03:00-04:00	0.28	28.00	0.00
17/2/2014	04:00-05:00	0.39	31.22	0.00
17/2/2014	05:00-06:00	0.41	29.15	0.00
17/2/2014	06:00-07:00	0.42	31.26	0.00
17/2/2014	07:00-08:00	0.36	35.32	0.00
17/2/2014	08:00-09:00	0.40	32.00	0.00
17/2/2014	09:00-10:00	0.38	32.00	0.00
17/2/2014	10:00-11:00	0.00	31.00	2.77
	Average	0.28	28.88	0.95
	Max	0.42	35.32	12.31
	Min	0.00	24.00	0.00

Hourly Air Quality Monitoring Data(February)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
17/2/2014	11:00-12:00	0.21	31.21	3.88
17/2/2014	12:00-13:00	0.25	29.00	0.98
17/2/2014	13:00-14:00	0.22	29.00	3.45
17/2/2014	14:00-15:00	0.43	31.00	2.10
17/2/2014	15:00-16:00	0.41	31.00	0.00
17/2/2014	16:00-17:00	0.39	29.00	0.00
17/2/2014	17:00-18:00	0.27	29.33	0.00
17/2/2014	18:00-19:00	0.35	28.21	0.00
17/2/2014	19:00-20:00	0.42	29.00	0.00
17/2/2014	20:00-21:00	0.14	28.00	0.00
17/2/2014	21:00-22:00	0.42	29.00	0.00
17/2/2014	22:00-23:00	0.41	28.32	0.00
17/2/2014	23:00-00:00	0.25	27.32	0.00
18/2/2014	00:00-01:00	0.34	28.14	0.00
18/2/2014	01:00-02:00	0.00	27.00	0.00
18/2/2014	02:00-03:00	0.18	26.00	0.00
18/2/2014	03:00-04:00	0.35	26.00	0.00
18/2/2014	04:00-05:00	0.12	25.00	0.00
18/2/2014	05:00-06:00	0.14	26.00	11.60
18/2/2014	06:00-07:00	0.34	26.00	0.00
18/2/2014	07:00-08:00	0.45	25.00	1.50
18/2/2014	08:00-09:00	0.43	36.00	0.00
18/2/2014	09:00-10:00	0.02	26.00	2.68
18/2/2014	10:00-11:00	0.00	24.11	27.86
	Average	0.27	28.11	2.25
	Max	0.45	36.00	27.86
	Min	0.00	24.11	0.00

Hourly Air Quality Monitoring Data(February)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
18/2/2014	11:00-12:00	0.34	29.00	0.00
18/2/2014	12:00-13:00	0.34	27.00	22.57
18/2/2014	13:00-14:00	0.33	29.21	0.00
18/2/2014	14:00-15:00	0.32	28.00	0.00
18/2/2014	15:00-16:00	0.34	11.00	3.80
18/2/2014	16:00-17:00	0.32	26.32	0.00
18/2/2014	17:00-18:00	0.34	28.14	0.00
18/2/2014	18:00-19:00	0.29	27.65	0.00
18/2/2014	19:00-20:00	0.28	30.00	0.00
18/2/2014	20:00-21:00	0.28	31.00	0.00
18/2/2014	21:00-22:00	0.29	32.00	0.00
18/2/2014	22:00-23:00	0.33	32.00	0.00
18/2/2014	23:00-00:00	0.32	30.00	0.00
19/2/2014	00:00-01:00	0.31	29.00	0.00
19/2/2014	01:00-02:00	0.33	29.00	0.00
19/2/2014	02:00-03:00	0.34	28.00	0.00
19/2/2014	03:00-04:00	0.34	28.00	0.00
19/2/2014	04:00-05:00	0.31	27.00	0.00
19/2/2014	05:00-06:00	0.34	26.00	0.00
19/2/2014	06:00-07:00	0.29	28.00	0.00
19/2/2014	07:00-08:00	0.28	35.22	0.00
19/2/2014	08:00-09:00	0.34	31.00	0.00
19/2/2014	09:00-10:00	0.34	31.00	2.00
19/2/2014	10:00-11:00	0.32	31.00	6.55
	Average	0.32	28.52	1.46
	Max	0.34	35.22	22.57
	Min	0.28	11.00	0.00

Hourly Air Quality Monitoring Data(February)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
19/2/2014	11:00-12:00	0.39	32.00	0.50
19/2/2014	12:00-13:00	0.38	31.66	0.30
19/2/2014	13:00-14:00	0.27	22.00	18.00
19/2/2014	14:00-15:00	0.43	22.00	53.10
19/2/2014	15:00-16:00	0.43	26.00	0.00
19/2/2014	16:00-17:00	0.43	25.00	0.00
19/2/2014	17:00-18:00	0.35	25.00	0.00
19/2/2014	18:00-19:00	0.32	26.00	0.00
19/2/2014	19:00-20:00	0.29	25.00	0.00
19/2/2014	20:00-21:00	0.12	27.00	0.00
19/2/2014	21:00-22:00	0.36	27.00	0.48
19/2/2014	22:00-23:00	0.02	34.92	4.00
19/2/2014	23:00-00:00	0.01	28.00	0.00
20/2/2014	00:00-01:00	0.39	29.00	0.00
20/2/2014	01:00-02:00	0.27	29.00	0.00
20/2/2014	02:00-03:00	0.15	35.00	0.12
20/2/2014	03:00-04:00	0.34	34.65	0.00
20/2/2014	04:00-05:00	0.41	29.00	0.00
20/2/2014	05:00-06:00	0.43	29.00	0.00
20/2/2014	06:00-07:00	0.29	32.00	0.09
20/2/2014	07:00-08:00	0.38	32.00	0.00
20/2/2014	08:00-09:00	0.42	35.33	0.00
20/2/2014	09:00-10:00	0.37	31.00	0.00
20/2/2014	10:00-11:00	0.28	31.00	0.70
	Average	0.31	29.11	3.22
	Max	0.43	35.33	53.10
	Min	0.01	22.00	0.00

Hourly Air Quality Monitoring Data(February)

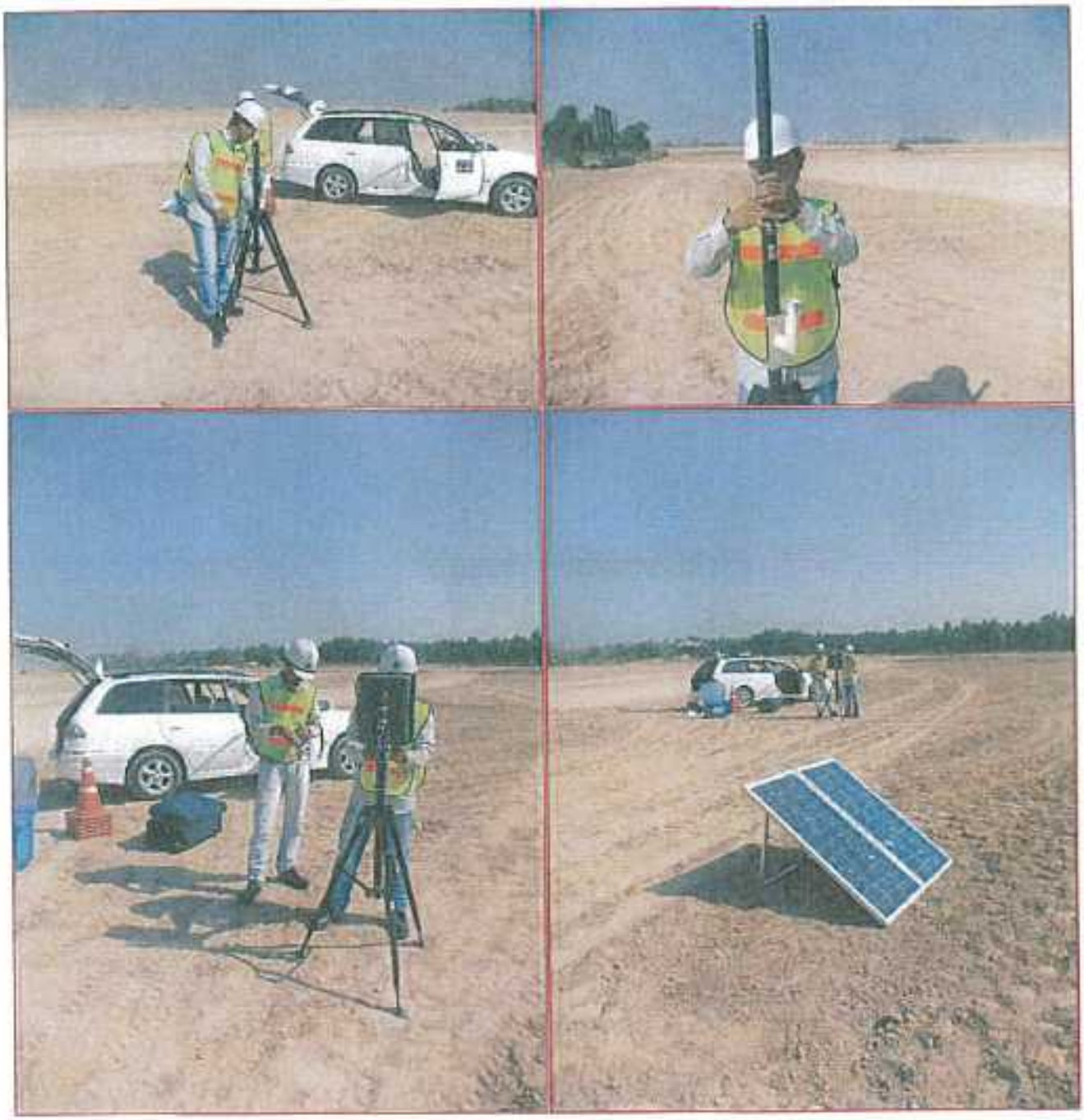
Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
20/2/2014	11:00-12:00	0.34	26.00	17.63
20/2/2014	12:00-13:00	0.38	27.00	0.00
20/2/2014	13:00-14:00	0.00	24.00	4.00
20/2/2014	14:00-15:00	0.15	23.00	0.00
20/2/2014	15:00-16:00	0.00	25.00	0.11
20/2/2014	16:00-17:00	0.15	25.00	0.08
20/2/2014	17:00-18:00	0.42	26.00	0.00
20/2/2014	18:00-19:00	0.34	22.00	0.00
20/2/2014	19:00-20:00	0.44	26.00	0.00
20/2/2014	20:00-21:00	0.41	28.00	0.00
20/2/2014	21:00-22:00	0.35	29.00	0.00
20/2/2014	22:00-23:00	0.28	29.00	0.00
20/2/2014	23:00-00:00	0.44	31.00	0.00
21/2/2014	00:00-01:00	0.35	32.00	0.00
21/2/2014	01:00-02:00	0.48	32.00	0.00
21/2/2014	02:00-03:00	0.34	31.00	0.00
21/2/2014	03:00-04:00	0.45	29.00	0.00
21/2/2014	04:00-05:00	0.48	29.22	0.00
21/2/2014	05:00-06:00	0.32	31.00	0.00
21/2/2014	06:00-07:00	0.31	32.00	0.00
21/2/2014	07:00-08:00	0.37	30.00	0.00
21/2/2014	08:00-09:00	0.42	29.00	0.02
21/2/2014	09:00-10:00	0.39	35.65	0.00
21/2/2014	10:00-11:00	0.45	31.00	0.00
	Average	0.34	28.45	0.91
	Max	0.48	35.65	17.63
	Min	0.00	22.00	0.00

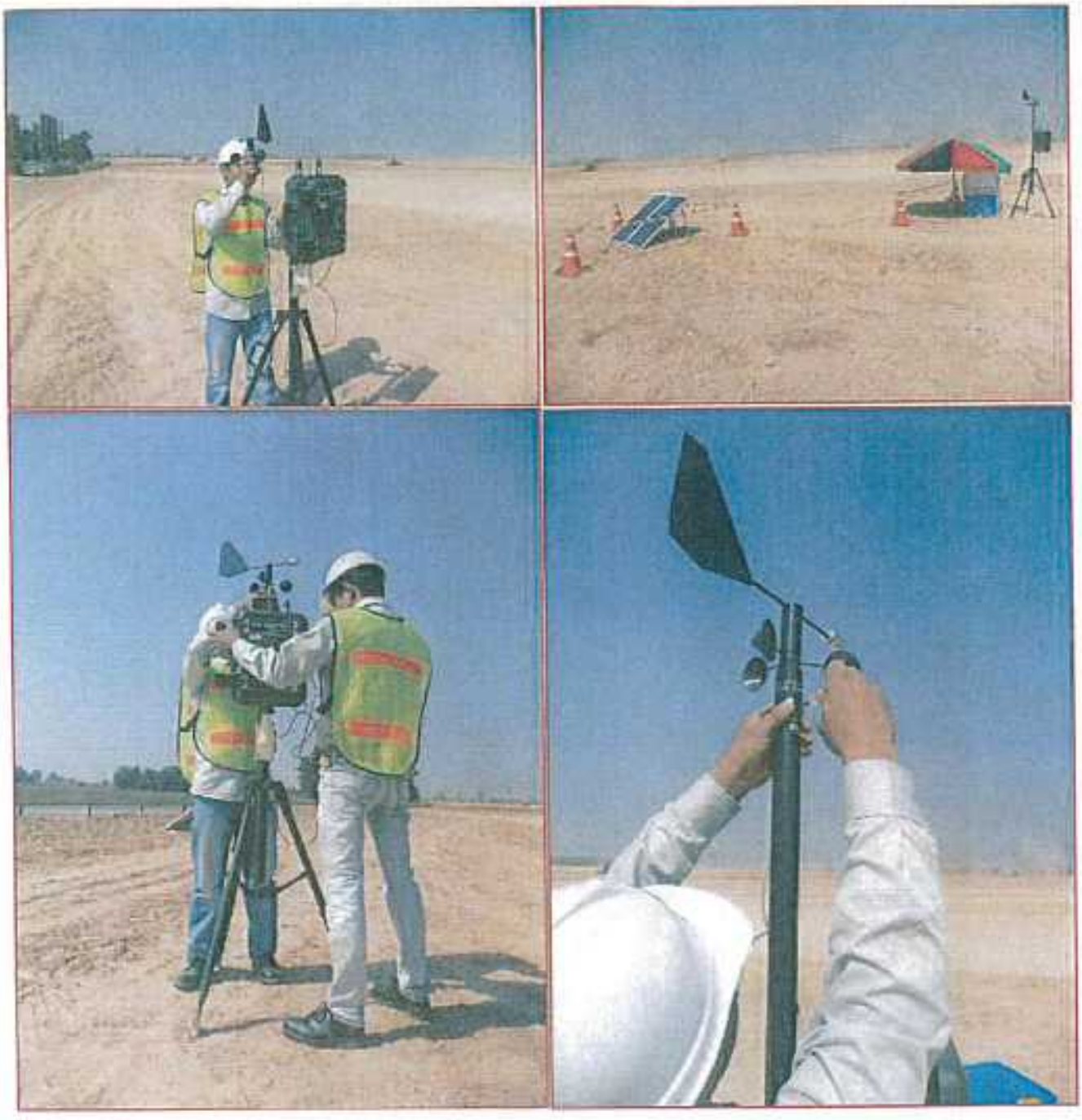
Hourly Air Quality Monitoring Data(February)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
21/2/2014	11:00-12:00	0.31	29.00	0.00
21/2/2014	12:00-13:00	0.30	28.22	0.00
21/2/2014	13:00-14:00	0.30	27.31	0.00
21/2/2014	14:00-15:00	0.29	26.00	0.00
21/2/2014	15:00-16:00	0.29	31.00	0.00
21/2/2014	16:00-17:00	0.28	25.24	0.95
21/2/2014	17:00-18:00	0.28	29.00	0.00
21/2/2014	18:00-19:00	0.27	28.00	0.00
21/2/2014	19:00-20:00	0.05	27.00	0.00
21/2/2014	20:00-21:00	0.03	28.00	0.73
21/2/2014	21:00-22:00	0.00	28.00	0.33
21/2/2014	22:00-23:00	0.03	28.00	1.71
21/2/2014	23:00-00:00	0.29	27.00	5.98
22/2/2014	00:00-01:00	0.28	26.00	0.93
22/2/2014	01:00-02:00	0.30	26.00	0.00
22/2/2014	02:00-03:00	0.28	24.00	0.00
22/2/2014	03:00-04:00	0.30	28.00	0.00
22/2/2014	04:00-05:00	0.24	24.00	0.00
22/2/2014	05:00-06:00	0.25	28.00	0.00
22/2/2014	06:00-07:00	0.28	35.62	0.00
22/2/2014	07:00-08:00	0.24	29.00	0.00
22/2/2014	08:00-09:00	0.26	29.00	0.00
22/2/2014	09:00-10:00	0.24	29.00	0.00
22/2/2014	10:00-11:00	0.29	35.00	0.36
	Average	0.24	28.14	0.46
	Max	0.31	35.62	5.98
	Min	0.00	24.00	0.00

Field Activities Photo

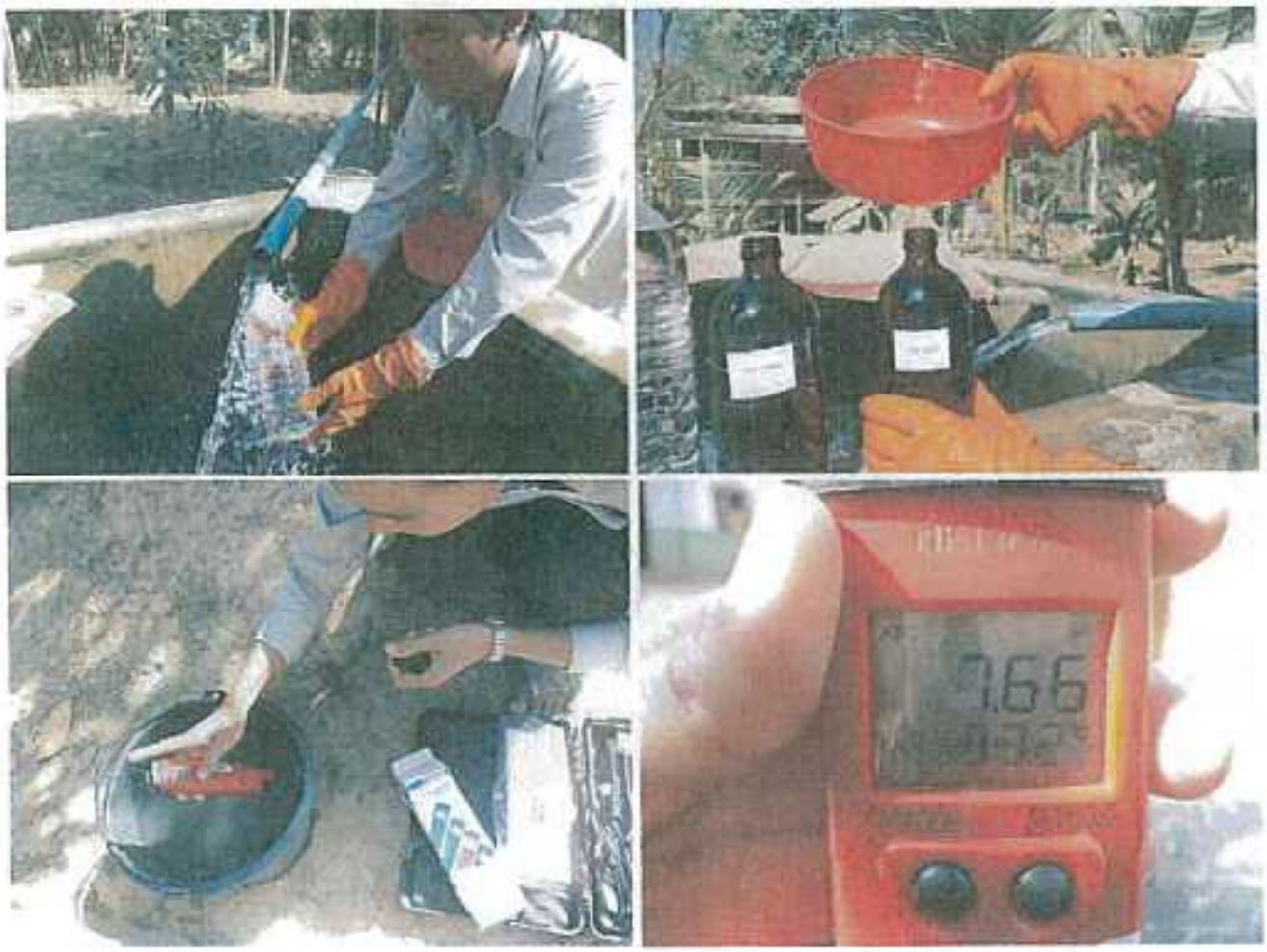
Thilawar SEZ Air Quality Monitoring . to setting up and activities photos






THILAWA SEZ
CLASS A
DEVELOPMENT
PENTA-OCEAN CONSTRUCTION

GW-1 water sampling and Measuring in situ parameters photo are as shown as follow



SW-2 water sampling and Measuring in situ parameters photo are as shown as follow

SW-3 water sampling and Measuring in situ parameters photo are as shown as follow

SW-4 water sampling and Measuring in situ parameters photo are as shown as follow

Thilawa Special Economic Zone CLASS A Development Project –Phase 1

Appendix

Air, Water and Waste Water Monitoring Report

May

MJTD MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

MONITORING REPORT
FOR
CLASS A THILAWA SPECIAL ECONOMIC ZONE

(MAY 2014)

Resource & Environment Myanmar Ltd.
B-702/401 Delta Plaza Building, Shwegondaing Rd., Bahan, Yangon. MYANMAR
Tel: (959) 7301 3448; Fax: (951) 552901

www.enviromyanmar.net

Contents

RESULT OF AIR AND WATER QUALITY MONITORING

1. Introduction

This is the second report for Air and water quality monitoring at Thilawa Special Economic Zone (TSEZ). This report sets out the environmental monitoring required throughout the construction of the Thilawa Special Economic Zone. The terms of reference for monitoring are shown in Table 1. The location of air and water monitoring points are shown in Figure 1 and Table 1.

Terms of Reference for Monitoring

Table 1 Terms of reference for air and water quality monitoring at TSEZ.

Description	Items	Frequency	Location
Air Quality	TSP / PM10	1 time / 3months	At construction site (1point)
Waste water quality	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time / 2months	At the creek upstream and downstream which is crossed the car road (3points)
Underground water	pH, SS, DO, BOD, COD, Coliform count, oil and grease, chromium	1time /2months	Tube well, at insids of Moegyoswan Monastery (1 point)

Monitoring Instrument for Air and water

No.	Instrument	Brand & Model	Measurement/ Parameter	
1.	Environmental Perimeter Air Monitoring System	HAZ-SCANNER EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction	
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company® Indonesia		

So far, there is no environmental standard for ambient air quality in Republic of Myanmar, the survey result was evaluated by comparing with the standards in neighbouring country like Thailand, Vietnam, Japan and IFC (Table 2). The consultant will apply the air quality standard in Thailand, Vietnam, Japan and IFC as shown in Table 1.As for TSP and PM10, the standards in Thailand were applied and the others were compared with the standards in Japan.

Table 2 Survey Parameters for Air Quality

Item	Averagingperiod	Japan	Thailand	Vietnam	IFC
SO_2	10 min	-	-	-	0.5mg/m³
	1hour	0.1ppm	0.3ppm	0.35mg/m³	0.125mg/m³(InterimTarget-1) 0.05mg/m³(InterimTarget-2) 0.02mg/m³(Guideline)
	24hours	0.04ppm	0.12ppm	0.125 mg/m³	-
	1 year	-		0.05mg/m³	-
NO_2	1hour	-	0.17ppm	-	0.2mg/m³
	24hours	0.04-0.06ppm	-	-	-
	1 year	-	0.03ppm	-	0.04mg/m³
NOx	1hour	-	-	0.2mg/m³	
	24hours	-	-	0.04mg/m³	
CO	1hour	-	30ppm	30mg/m³	-
	8hours	20ppm	-	10mg/m³	-
	24hours	10ppm	9ppm	-	-
TSP	1hour	-	-	0.3mg/m³	-
	24hours	-	0.33mg/m³	0.2mg/m³	-
	1 year		0.10mg/m³	0.14mg/m³	-
PM_{10}	24hours	-	0.12mg/m³	0.15mg/m³	0.15mg/m³(InterimTarget-1) 0.10mg/m³(InterimTarget-2) 0.07mg/m³(InterimTarget-3)
	1 year	-	0.05mg/m³	0.05mg/m³	0.07mg/m³(InterimTarget-1) 0.05mg/m³(InterimTarget-2) 0.03mg/m³(InterimTarget-3)
SPM	1hour	0.2mg/m³	-	-	-
	24hours	0.1mg/m³	-	-	-
$PM_{2.5}$	24hours	0.035mg/m³	0.05mg/m³	-	0.075mg/m³(InterimTarget-1) 0.05mg/m³(InterimTarget-2) 0.0375mg/m³(InterimTarget-3)
	1 year	0.015mg/m³	0.025mg/m³	-	0.035mg/m³(InterimTarget-1) 0.025mg/m³(InterimTarget-2) 0.015mg/m³(InterimTarget-3)
Ozone	1hour	-	0.10ppm	0.3mg/m³	-
	8hourdaily maximum	-	0.07ppm	0.2mg/m³	0.16mg/m³(InterimTarget-1) 0.1mg/m³(Guideline)
	1 year	-	0.04ppm	0.14mg/m³	-
Ox	1hour	0.06ppm	-	-	-
Pb	24hours	-	-	0.0015mg/m³	
	1 month	-	0.0015mg/m³	-	
	1 year	-	-	0.0005mg/m³	

Source: National Air Quality Standard in Japan (CircularNo.25,1973, originally),Ministry of Environment, Japan
NotificationsofNationalEnvironmentalBoardNo.10, 24,28,33, and 36, Ministry of Natural Resources and Environment, Thailand
National Ambient Air Quality Standard (TCVN5973:2005), Ministry of Science and Technology in Vietnam
Environmental, Health, and Safety Guidelines, General EHS Guidelines, IFC, 2007

Figure 1 Location of air and water monitoring points

2. Description of the air quality monitoring station

Survey Period

Air quality survey was conducted once per 3 months as per specification provided by the client. The monitoring period was about 7 consecutive days. The sampling duration for each day is as shown in Table 3.

Table 3. Sampling Duration for Air Quality Survey in

Day	Second Survey (May 16th – May 23rd)
Day 1	May. 16th - 17th
Day 2	May. 17th - 18th
Day 3	May. 18th - 19th
Day 4	May. 19th - 20th
Day 5	May. 20th – 21st
Day 6	May. 21st – 22nd
Day 7	May. 22nd – 23rd

Source: Source: Resource &Environment Myanmar Co., Ltd.

Survey Method

Sampling and analysis of ambient air pollutants was conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner Environmental Perimeter Air Station (EPAS) was used to collect Ambient Air Monitoring data. The characteristics of the instrument are:

- Portable direct reading
- Configure up to 14 simultaneous air measurements including U.S. EPA criteria air pollutants

The basic specification of the instrument are as follow.

Instrument	Brand	Model	Measurement/ Parameter
Environmental Perimeter Air Monitoring System	HAZ-SCANNER	EPAS	CO, NO_2, NO, SO_2, PM (2.5), PM (10), VOCS, Relative Humidity, Temperature, Wind Speed, Wind Direction

Table 4. Sampling and Analysis Method for Air Quality

No.	Parameter	Analysis Method
1	Sulfur dioxide (SO2)	On site reading
2	Carbon monoxide (CO)	On site reading
3	Nitrogen dioxides (NO2)	On site reading
4	Total suspended particle (TSP)	On site reading
5	Particle matter 10 (PM10)	On site reading

Source: Resource & Environment Myanmar Co., Ltd.

Target Ambient Air Quality Level

Parameters	Averaging Period	Value
TSP	24 hours	0.33 mg/m3
PM10	24 hours	0.12 mg/m3

Survey Result

Table 5 Total Suspended Particle (TSP) Level

Unit: mg/m3

Frequency		AQM-1	Thailand Standard	Vietnam Standard
1	First Day	0.1	0.33	0.2
2	Second Day	0.05	0.33	0.2
3	Third Day	0.02	0.33	0.2
4	Fourth Day	0.04	0.33	0.2
5	Fifth Day	0.1	0.33	0.2
6	Six Day	0.03	0.33	0.2
7	Seventh Day	0.03	0.33	0.2
Maximum		0.1		
Average		0.05		
Minimum		0.02		

Source: Resource & Environment Myanmar Co., Ltd

Table 6 Particulate matter 10 (PM10) Level

Unit: mg/m3

Frequency		AQM-1	Thailand	Vietnam
1	First Day	0.05	0.12	0.15
2	Second Day	0.04	0.12	0.15
3	Third Day	0.16	0.12	0.15
4	Fourth Day	0.02	0.12	0.15
5	Fifth Day	0.03	0.12	0.15
6	Six Day	0.01	0.12	0.15
7	Seventh Day	0.01	0.12	0.15
Maximum		0.16		
Average		0.04		
Minimum		0.01		

Source: Resource & Environment Myanmar Co., Ltd
Shaded area shows higher than Standard.

Except of third day monitoring result, the monitoring results of TSP and PM10 level are lower than the target ambient air quality level. PM 10 level of third day result is slightly higher than the environmental standard.

3. Water Quality Monitoring

Methodology

Sampling and preservation method

Water samples were taken by Alpha horizontal water sampler and collected in sterilized sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), were measured at each site concurrently with sample collection. All samples were kept in iced boxes and were transported to the laboratory and stored at 2-4 °C refrigerators.

Table 7 Field Equipment for Water Quality Survey

No.	Equipment	Manufacturer	Originate Country	Model
1	pH meter	HANNA	USA	HI7609829-1 pH Sensor
2	DO meter	HANNA	USA	HI7609829-2
3	Digital Water Velocity Meter	Global Water Flow Probe	USA	FP 211
4	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

Table 8 Container and Preservation Method for Water Samples

No	Parameter	Container	Preservation
1	Oil and Grease	1000 ml glass bottle	Sulfuric acid, Refrigerate
2	COD	500 ml plastic bottle	Sulfuric acid, Refrigerate
3	BOD_5	1,800 ml plastic bottle	Refrigerate
4	Heavy metals	500 ml plastic bottle	HNO_3 Refrigerate
5	Bacteria	200 ml glass bottle (Sterilize)	Refrigerate
6	Others	1,800 ml polyethylene bottle	Refrigerate

Test method

The following table provides the test method for water quality.

No	Item	Analysis method
1	pH	HI7609829-1 pH Sensor
2	Suspended Solids	Gravimetric method
3	Dissolved Oxygen (DO)	HI7609829-2 Galvanic dissolved oxygen (D.O) sensor
4	Chemical oxygen demand(COD)	Dichromate method
5	Biochemical oxygen demand(BOD_5)	Direct inoculation method
6	Oil & Grease	APHA-AWWA-WEF Method
7	Chromium (Cr) (mg/l)	APHA-AWWA-WEF Method
8	E. coliform, Fecal coliforms, total coliforms	AOAC Petrifilm Method

Monitoring Result

No	Item	GW-1	SW-2	SW-3	SW-4	Standard*	Unit
1	pH	7.29	7.66	7.7	7.54	5-9	
2	Suspended Solids	282	947	1191	1252	Max. 30	mg/l
3	Dissolved Oxygen (DO)	3.65	3.52	3.31	3.45	-	mg/l
4	Chemical oxygen demand(COD)	1.98	1.20	1.32	1.15	Max. 60	mg/l
5	Biochemical oxygen demand(BOD_5)	2.0	1.5	1.5	1.5	Max. 20-60	mg/l
6	Oil & Grease	<1	<1	<1	1	Max. 5	mg/l
7	Chromium (Cr) (mg/l)	<0.02	<0.02	<0.02	<0.02	Max. 0.5	mg/l
8	E. coliform	0	0	0	0	-	cfu/100ml
	Fecal coliforms	0	0	0	0	-	cfu/100ml
	Total coliforms	0	0	0	0	-	cfu/100ml

* Waste water quality standard, Ministry of Industry.

Shaded area shows higher than Standard.

According to the waste water quality standard, Ministry of Industry, the suspended solids were high compared to the standard and the rest parameters were within the standard. According to the laboratory analysis, suspended solids concentration of three sample points (SW2, SW3, SW4) are higher than those of previous mouthly monitoring. The possible reasons is the increasing of insoluble particulate matter during run off or discharging that can be generated from the some construction activities and direct discharge of waste water disposal from the upstream area.

Detailed of laboratory result and hourly air quality data are provided in appendix.

Laboratory Result

DEPARTMENT OF FISHERIES
AQUACULTURE DIVISION
FRESHWATER AQUACULTURE RESEARCH
WATER AND SOIL EXAMINATION LABORATORY

RESULT ON CHEMICAL EXAMINATION OF WATER

Sender's reference: Resource & Environment Myanmar Co.ltd Collection Date : 13.5.2014

Location : Near Thanlyin & Thilawa Arrival Date & Time :15.5.2014

Project name : **Water Qualitity Monitoring in Thilawa SEZ**

Parameter	Unit	GW-1	SW-2	SW-3	SW-4
Biological Oxygen Demand	mg/l	2.0	1.5	1.5	1.5
Chemical Oxygen Demand	mg/l	1.98	1.20	1.32	1.15
Suspended solid	mg/l	282	947	1191	1252

Analyzed by - San San Soe

- Khaing Khaing Oo
- Thin Thin Aye

Approved

(Aye Aye Thein)

Head of Freshwater Aquaculture Research

Analytical Laboratory Section
Reg: No.
Date
Department of Fisheries

THE REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF LIVESTOCK , FISHERIES AND RURAL DEVELOPMENT
DEPARTMENT OF FISHERIES
FISH INSPECTION AND QUALITY CONTROL DIVISION
YANGON, MYANMAR
ANALYTICAL LABORATORY SECTION

ORIGINAL

Test Report for Microbiological Analysis

Name of Project : Water Quality Monitoring in Thilawa SEZ.

Name of Company : Resource and Environment Myanmar Co., Ltd.

Date of Received : 21.5.2014

Date of Analysis : 21.5.2014

Test Method : AOAC Petrifilm Method

No	Date of Analysis	Detail of Samples (Water)	Total Coliforms cfu/100ml	Fecal Coliforms cfu/100ml	E.coli cfu/100ml	Remarks
1	21.5.14	GW 1	0	0	0	
2	21.5.14	SW 2	0	0	0	
3	21.5.14	SW 3	0	0	0	
4	21.5.14	SW 4	0	0	0	

Reference : The International Commission on Microbiological Specification for foods (ICMSF,1986), 98/93 EC, Guidelines for drinking water quality WHO 1997 (2nd Edition).

Analyzed by :

Than Than Myint
Micro Lab

Evaluated by:

Dr.Su Myo Thwe
Ph.D Japan
TM, Head of Micro Lab

Approved by :

Thet Naing (QMR)
B.Sc (Chemistry)
Assistant Director
Analytical Laboratory Section
Department of Fisheries

Remarks: This result is responsible for the sample in the lab.

Report No. : 2014-00533 / 001-1 (Page 1 of 1) Issued date : June 2, 2014

CLIENT : RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.
CONTACT : Ms. Pwint Pwint
ADDRESS : B702 Delta Plaza, Shwegondaing Rd., Bahan, Yangon, Myanmar
Tel. +959-73013448 Fax. +951-552901
E-mail : pwint@enviromyanmar.net

Analysis Report

PROJECT NAME : Water Quality Monitoring Thilawa SEZ (April)
SAMPLE DESIGNATED AS : Water Quality SAMPLING DATE : April 14, 2014
SAMPLING LOCATION : Thilawa, Myanmar SAMPLING BY : Client

Stations	Results	
	Oil and Grease (mg/l)	Chromium Hexavalent (mg/l)
1. GW-1	< 1.0	< 0.02
2. SW-2	< 1.0	< 0.02
3. SW-3	< 1.0	< 0.02
4. SW-4	1.0	< 0.02
Detection Limit	1.0	0.02

Remark : - Analysis Methods followed to Standard Methods for the Examination of Water and Wastewater, recommended by APHA-AWWA-WEF.

(Siriporn Imwilaiwan)
License ID : 0-010-n-1793

(Thepson Yommana)
License ID : 0-010-n-333

SGS (THAILAND) LIMITED

TY/Client/VV/Ws

Hourly Air Result

Within 16 to 17 day average AQM values table hour by hour

Date	Time	PM2.5	PM10	TSP
D.M.Y	H.M.S	UG/m3	UG/m3	UG/m3
16.5.2014	14:00-15:00	139.05	48.05	187.09
16.5.2014	15:00-16:00	19.67	54.80	74.47
16.5.2014	16:00-17:00	1.02	45.10	46.12
16.5.2014	17:00-18:00	1.00	45.78	46.78
16.5.2014	18:00-19:00	19.49	47.61	67.10
16.5.2014	19:00-20:00	1.00	78.23	79.23
16.5.2014	20:00-21:00	54.78	55.73	110.52
16.5.2014	21:00-22:00	1.55	44.03	45.58
16.5.2014	22:00-23:00	1	61.52381	62.52
16.5.2014	23:00-00:00	63.20	48.00	111.20
17.5.2014	00:00-01:00	11.93	64.33	76.27
17.5.2014	01:00-02:00	15.75	64.23	79.98
17.5.2014	02:00-03:00	6.78	56.20	62.98
17.5.2014	03:00-04:00	3.27	49.75	53.02
17.5.2014	04:00-05:00	8.10	46.50	54.60
17.5.2014	05:00-06:00	25.27	52.15	77.42
17.5.2014	06:00-07:00	54.02	64.97	118.98
17.5.2014	07:00-08:00	48.23	50.92	99.15
17.5.2014	08:00-09:00	52.06	49.31	101.38
17.5.2014	09:00-10:00	98.80	42.50	141.30
17.5.2014	10:00-11:00	85.37	24.45	109.82
17.5.2014	11:00-12:00	7.23	30.72	37.95
17.5.2014	12:00-13:00	2.30	28.77	31.07
17.5.2014	13:00-14:00	1.00	27.67	**28.67**

Within 17th to 18th day average AQM values table hour by hour

Date	Time	PM2.5	PM10	TSP
D.M.Y	H.M.S	UG/m3	UG/m3	UG/m3
17.5.2014	14:00-15:00	1.44	40.76	42.20
17.5.2014	15:00-16:00	1.00	18.32	19.32
17.5.2014	16:00-17:00	1.00	24.20	25.20
17.5.2014	17:00-18:00	1.00	43.10	44.10
17.5.2014	18:00-19:00	1.00	26.27	27.27
17.5.2014	19:00-20:00	1.93	32.53	34.47
17.5.2014	20:00-21:00	1.37	33.55	34.92
17.5.2014	21:00-22:00	9.45	39.68	49.14
17.5.2014	22:00-23:00	1.15	39.65	40.80
17.5.2014	23:00-00:00	4.33	35.17	39.50
18.5.2014	00:00-01:00	2.23	24.62	26.85
18.5.2014	01:00-02:00	1.88	23.27	25.15
18.5.2014	02:00-03:00	13.97	29.05	43.02
18.5.2014	03:00-04:00	1.75	33.58	35.33
18.5.2014	04:00-05:00	7.35	68.17	75.52
18.5.2014	05:00-06:00	4.00	44.42	48.42
18.5.2014	06:00-07:00	10.77	43.92	54.68
18.5.2014	07:00-08:00	19.77	47.67	67.43
18.5.2014	08:00-09:00	28.47	38.91	67.37
18.5.2014	09:00-10:00	96.08	65.00	161.08
18.5.2014	10:00-11:00	32.17	54.60	86.77
18.5.2014	11:00-12:00	66.85	35.80	102.65
18.5.2014	12:00-13:00	60.21	33.72	93.93
18.5.2014	13:00-14:00	3.87	52.69	56.56

Within 18th to 19th day average AQM values table hour by hour

Date	Time	PM2.5	PM10	TSP
D.M.Y	H.M.S	UG/m3	UG/m3	UG/m3
18.5.2014	14:00-15:00	2.94	10.05	12.99
18.5.2014	15:00-16:00	18.63	11.30	29.93
18.5.2014	16:00-17:00	1.00	24.50	25.50
18.5.2014	17:00-18:00	1.00	23.10	24.10
18.5.2014	18:00-19:00	33.70	27.09	60.79
18.5.2014	19:00-20:00	1.00	17.50	18.50
18.5.2014	20:00-21:00	1.00	20.20	21.20
18.5.2014	21:00-22:00	1.00	25.40	26.40
18.5.2014	22:00-23:00	1.00	12.50	13.50
18.5.2014	23:00-00:00	1.00	18.90	19.90
19.5.2014	00:00-01:00	1.00	15.60	16.60
19.5.2014	01:00-02:00	1.00	16.70	17.70
19.5.2014	02:00-03:00	1.00	15.42	16.42
19.5.2014	03:00-04:00	1.00	18.30	19.30
19.5.2014	04:00-05:00	1.00	11.40	12.40
19.5.2014	05:00-06:00	1.00	14.80	15.80
19.5.2014	06:00-07:00	1.00	2.00	3.00
19.5.2014	07:00-08:00	54.02	16.70	70.72
19.5.2014	08:00-09:00	8.02	2.00	10.02
19.5.2014	09:00-10:00	1.00	13.45	14.45
19.5.2014	10:00-11:00	1.00	15.17	16.17
19.5.2014	11:00-12:00	1.00	17.68	18.68
19.5.2014	12:00-13:00	1.00	16.10	17.10
19.5.2014	13:00-14:00	1.00	27.67	28.67

Within 19th to 20th day average AQM values table hour by hour

Date	Time	PM2.5	PM10	TSP
D.M.Y	H.M.S	UG/m3	UG/m3	UG/m3
19.5.2014	14:00-15:00	1.00	19.53	20.53
19.5.2014	15:00-16:00	1.00	8.95	9.95
19.5.2014	16:00-17:00	3.50	16.15	19.65
19.5.2014	17:00-18:00	1.00	7.15	8.15
19.5.2014	18:00-19:00	2.97	27.80	30.77
19.5.2014	19:00-20:00	1.00	6.72	7.72
19.5.2014	20:00-21:00	6.15	2.00	8.15
19.5.2014	21:00-22:00	29.88	2.00	31.88
19.5.2014	22:00-23:00	1.55	44.03	45.58
19.5.2014	23:00-00:00	4.33	35.17	39.50
20.5.2014	00:00-01:00	31.17	3.70	34.87
20.5.2014	01:00-02:00	27.64	4.92	32.56
20.5.2014	02:00-03:00	1.00	3.57	4.57
20.5.2014	03:00-04:00	26.12	8.08	34.20
20.5.2014	04:00-05:00	4.92	3.42	8.33
20.5.2014	05:00-06:00	26.28	2.00	28.28
20.5.2014	06:00-07:00	1.00	2.00	3.00
20.5.2014	07:00-08:00	2.37	96.30	98.67
20.5.2014	08:00-09:00	44.85	53.02	97.87
20.5.2014	09:00-10:00	85.32	92.90	178.22
20.5.2014	10:00-11:00	30.00	15.87	45.87
20.5.2014	11:00-12:00	18.52	4.07	22.58
20.5.2014	12:00-13:00	62.62	2.00	64.62
20.5.2014	13:00-14:00	31.75	8.84	40.59

Within 20th to 21th day average AQM values table hour by hour

Date	Time	PM2.5	PM10	TSP
D.M.Y	H.M.S	UG/m3	UG/m3	UG/m3
20.5.2014	14:00-15:00	5.37	3.35	8.72
20.5.2014	15:00-16:00	24.30	25.47	49.77
20.5.2014	16:00-17:00	21.05	25.00	46.05
20.5.2014	17:00-18:00	1.00	40.05	41.05
20.5.2014	18:00-19:00	64.65	2.00	66.65
20.5.2014	19:00-20:00	59.83	2.00	61.83
20.5.2014	20:00-21:00	49.35	2.00	51.35
20.5.2014	21:00-22:00	39.02	2.00	41.02
20.5.2014	22:00-23:00	23.72	2.00	25.72
20.5.2014	23:00-00:00	19.73	2.00	21.73
21.5.2014	00:00-01:00	85.83	9.55	95.38
21.5.2014	01:00-02:00	28.98	23.40	52.38
21.5.2014	02:00-03:00	1.00	3.57	4.57
21.5.2014	03:00-04:00	8.80	92.58	101.38
21.5.2014	04:00-05:00	95.93	97.05	192.98
21.5.2014	05:00-06:00	27.45	2.00	29.45
21.5.2014	06:00-07:00	58.15	80.98	139.13
21.5.2014	07:00-08:00	2.37	96.30	98.67
21.5.2014	08:00-09:00	1.00	8.68	9.68
21.5.2014	09:00-10:00	7.18	2.03	9.22
21.5.2014	10:00-11:00	49.58	2.23	51.82
21.5.2014	11:00-12:00	61.42	24.83	86.25
21.5.2014	12:00-13:00	61.00	44.30	105.30
21.5.2014	13:00-14:00	50.02	10.63	60.65

Within 21th to 22th day average AQM values table hour by hour

Date	Time	PM2.5	PM10	TSP
D.M.Y	H.M.S	UG/m3	UG/m3	UG/m3
21.5.2014	14:00-15:00	12.35	2.00	14.35
21.5.2014	15:00-16:00	36.30	2.33	38.63
21.5.2014	16:00-17:00	44.63	65.74	110.37
21.5.2014	17:00-18:00	21.97	95.92	117.88
21.5.2014	18:00-19:00	40.18	92.11	132.29
21.5.2014	19:00-20:00	15.23	2.00	17.23
21.5.2014	20:00-21:00	6.28	12.93	19.22
21.5.2014	21:00-22:00	1.00	2.00	3.00
21.5.2014	22:00-23:00	6.03	2.00	8.03
21.5.2014	23:00-00:00	1.75	2.00	3.75
22.5.2014	00:00-01:00	1.00	2.00	3.00
22.5.2014	01:00-02:00	1.00	2.00	3.00
22.5.2014	02:00-03:00	1	3.56	4.56
22.5.2014	03:00-04:00	26.11	8.08	34.19
22.5.2014	04:00-05:00	18.84	2.00	20.84
22.5.2014	05:00-06:00	26.28	2.00	28.28
22.5.2014	06:00-07:00	1.00	2.00	3.00
22.5.2014	07:00-08:00	1.00	2.00	3.00
22.5.2014	08:00-09:00	8.02	2.00	10.02
22.5.2014	09:00-10:00	99.70	2.00	101.70
22.5.2014	10:00-11:00	42.75	6.27	49.02
22.5.2014	11:00-12:00	48.83	7.30	56.13
22.5.2014	12:00-13:00	2.18	3.58	5.77
22.5.2014	13:00-14:00	1.26	5.23	6.49

Hourly Air Quality Monitoring Data (May)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
16/5/2014	14:00-15:00	1.20	34.20	0.00
16/5/2014	15:00-16:00	0.51	34.95	0.00
16/5/2014	16:00-17:00	0.00	35.00	0.00
16/5/2014	17:00-18:00	0.00	35.00	0.00
16/5/2014	18:00-19:00	0.00	35.00	0.00
16/5/2014	19:00-20:00	0.10	35.00	0.00
16/5/2014	20:00-21:00	0.78	32.50	0.00
16/5/2014	21:00-22:00	0.81	34.80	0.02
16/5/2014	22:00-23:00	0.10	34.92	0.00
16/5/2014	23:00-00:00	0.10	35.00	0.00
17/5/2014	00:00-01:00	0.85	32.67	10.13
17/5/2014	01:00-02:00	0.97	34.62	0.00
17/5/2014	02:00-03:00	0.24	34.92	0.00
17/5/2014	03:00-04:00	0.08	35.00	0.00
17/5/2014	04:00-05:00	0.05	34.97	0.00
17/5/2014	05:00-06:00	0.15	35.00	0.00
17/5/2014	06:00-07:00	0.37	35.00	0.00
17/5/2014	07:00-08:00	1.02	34.97	0.00
17/5/2014	08:00-09:00	0.63	35.00	0.00
17/5/2014	09:00-10:00	0.85	35.00	10.56
17/5/2014	10:00-11:00	0.98	35.00	0.02
17/5/2014	11:00-12:00	1.34	35.07	0.08
17/5/2014	12:00-13:00	0.25	35.00	0.00
17/5/2014	13:00-14:00	0.00	34.98	0.00
	Average	0.47	34.73	0.87
	Max	1.34	35.07	10.56
	Min	0.00	32.50	0.00

Hourly Air Quality Monitoring Data (May)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
17/5/2014	14:00-15:00	0.00	34.95	2.55
17/5/2014	15:00-16:00	0.00	35.00	0.00
17/5/2014	16:00-17:00	0.00	34.80	1.28
17/5/2014	17:00-18:00	0.00	34.42	8.58
17/5/2014	18:00-19:00	0.00	34.90	3.56
17/5/2014	19:00-20:00	0.00	35.00	0.26
17/5/2014	20:00-21:00	0.00	35.00	3.85
17/5/2014	21:00-22:00	0.04	34.11	0.02
17/5/2014	22:00-23:00	0.08	34.98	0.00
17/5/2014	23:00-00:00	0.15	35.00	0.00
18/5/2014	00:00-01:00	0.02	35.00	0.00
18/5/2014	01:00-02:00	0.03	34.98	0.00
18/5/2014	02:00-03:00	0.24	34.98	0.00
18/5/2014	03:00-04:00	0.01	35.00	0.00
18/5/2014	04:00-05:00	0.67	35.00	0.00
18/5/2014	05:00-06:00	0.18	35.00	0.00
18/5/2014	06:00-07:00	0.28	35.00	0.00
18/5/2014	07:00-08:00	0.49	35.00	0.00
18/5/2014	08:00-09:00	0.66	34.19	0.00
18/5/2014	09:00-10:00	1.11	34.97	0.00
18/5/2014	10:00-11:00	0.73	35.00	0.00
18/5/2014	11:00-12:00	1.10	35.00	0.00
18/5/2014	12:00-13:00	1.03	35.00	0.00
18/5/2014	13:00-14:00	0.00	35.00	2.77
	Average	0.28	34.89	0.95
	Max	1.11	35.00	8.58
	Min	0.00	34.11	0.00

Hourly Air Quality Monitoring Data (May)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
18/5/2014	14:00-15:00	0.00	35.00	3.37
18/5/2014	15:00-16:00	0.00	35.00	0.48
18/5/2014	16:00-17:00	0.00	35.00	3.45
18/5/2014	17:00-18:00	0.00	35.00	2.10
18/5/2014	18:00-19:00	0.94	34.38	0.00
18/5/2014	19:00-20:00	0.21	34.95	0.00
18/5/2014	20:00-21:00	0.27	35.00	0.00
18/5/2014	21:00-22:00	0.05	35.00	0.00
18/5/2014	22:00-23:00	0.09	35.00	0.00
18/5/2014	23:00-00:00	0.14	35.00	0.00
19/5/2014	00:00-01:00	0.14	35.00	0.00
19/5/2014	01:00-02:00	0.04	35.00	0.00
19/5/2014	02:00-03:00	0.03	34.95	0.00
19/5/2014	03:00-04:00	0.26	34.52	0.00
19/5/2014	04:00-05:00	0.11	35.00	0.00
19/5/2014	05:00-06:00	0.18	35.00	0.00
19/5/2014	06:00-07:00	0.35	35.00	0.00
19/5/2014	07:00-08:00	0.12	35.00	0.00
19/5/2014	08:00-09:00	0.14	36.00	12.00
19/5/2014	09:00-10:00	1.68	35.21	0.00
19/5/2014	10:00-11:00	0.48	34.93	1.17
19/5/2014	11:00-12:00	1.14	35.00	0.00
19/5/2014	12:00-13:00	0.02	34.88	1.65
19/5/2014	13:00-14:00	0.00	35.00	29.75
	Average	0.27	34.99	2.25
	Max	1.68	36.00	29.75
	Min	0.00	34.38	0.00

Hourly Air Quality Monitoring Data (May)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
19/5/2014	14:00-15:00	0.24	35.00	22.57
19/5/2014	15:00-16:00	0.77	35.00	0.00
19/5/2014	16:00-17:00	0.03	34.97	0.00
19/5/2014	17:00-18:00	0.12	35.00	0.00
19/5/2014	18:00-19:00	0.04	34.47	3.80
19/5/2014	19:00-20:00	0.03	35.02	0.00
19/5/2014	20:00-21:00	0.43	35.00	0.00
19/5/2014	21:00-22:00	0.20	35.00	0.00
19/5/2014	22:00-23:00	0.12	35.00	0.00
19/5/2014	23:00-00:00	0.22	35.00	0.00
20/5/2014	00:00-01:00	0.08	35.00	0.00
20/5/2014	01:00-02:00	0.07	35.00	0.00
20/5/2014	02:00-03:00	0.35	34.95	0.00
20/5/2014	03:00-04:00	0.08	34.52	0.00
20/5/2014	04:00-05:00	0.02	35.00	0.00
20/5/2014	05:00-06:00	0.00	35.00	0.00
20/5/2014	06:00-07:00	0.35	35.00	0.00
20/5/2014	07:00-08:00	0.12	35.00	0.00
20/5/2014	08:00-09:00	1.43	30.63	0.00
20/5/2014	09:00-10:00	0.78	35.00	0.00
20/5/2014	10:00-11:00	0.77	35.00	0.00
20/5/2014	11:00-12:00	1.39	34.82	0.00
20/5/2014	12:00-13:00	1.11	34.80	0.00
20/5/2014	13:00-14:00	0.00	34.98	8.57
	Average	0.36	34.76	1.46
	Max	1.43	35.02	22.57
	Min	0.00	30.63	0.00

Hourly Air Quality Monitoring Data (May)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
20/5/2014	14:00-15:00	0.00	35.00	1.50
20/5/2014	15:00-16:00	0.01	35.00	0.30
20/5/2014	16:00-17:00	0.27	23.33	22.81
20/5/2014	17:00-18:00	0.76	0.00	66.89
20/5/2014	18:00-19:00	0.85	33.95	0.00
20/5/2014	19:00-20:00	0.64	34.92	0.00
20/5/2014	20:00-21:00	0.07	35.00	0.00
20/5/2014	21:00-22:00	0.03	35.00	0.00
20/5/2014	22:00-23:00	0.03	35.00	0.00
20/5/2014	23:00-00:00	0.04	35.00	0.00
21/5/2014	00:00-01:00	0.36	34.62	0.48
21/5/2014	01:00-02:00	0.02	34.92	4.30
21/5/2014	02:00-03:00	0.01	35.00	0.00
21/5/2014	03:00-04:00	0.44	35.00	0.00
21/5/2014	04:00-05:00	0.27	35.00	0.00
21/5/2014	05:00-06:00	0.15	35.00	0.12
21/5/2014	06:00-07:00	0.00	34.65	0.00
21/5/2014	07:00-08:00	0.79	35.00	0.00
21/5/2014	08:00-09:00	1.80	35.00	0.00
21/5/2014	09:00-10:00	0.52	35.00	0.09
21/5/2014	10:00-11:00	0.63	35.00	0.00
21/5/2014	11:00-12:00	1.09	35.00	0.00
21/5/2014	12:00-13:00	0.96	34.85	0.00
21/5/2014	13:00-14:00	0.46	34.75	0.75
	Average	0.42	32.96	4.05
	Max	1.80	35.00	66.89
	Min	0.00	0.00	0.00

Hourly Air Quality Monitoring Data (May)

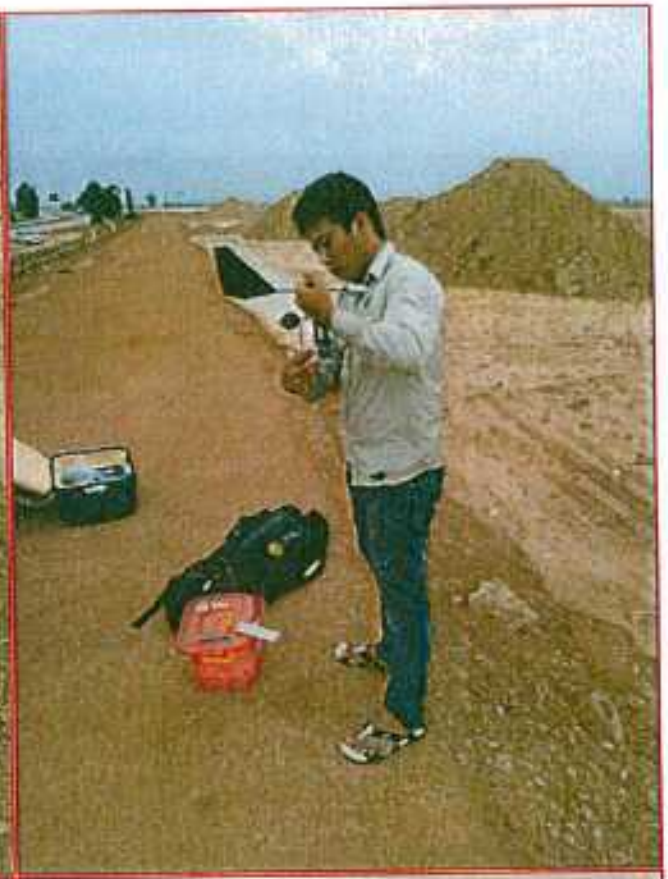
Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
21/5/2014	14:00-15:00	0.09	35.00	0.00
21/5/2014	15:00-16:00	0.07	35.00	17.63
21/5/2014	16:00-17:00	0.00	34.08	4.00
21/5/2014	17:00-18:00	0.15	34.82	0.00
21/5/2014	18:00-19:00	0.00	34.25	0.11
21/5/2014	19:00-20:00	0.15	35.00	0.08
21/5/2014	20:00-21:00	0.77	35.00	0.00
21/5/2014	21:00-22:00	0.99	35.00	0.00
21/5/2014	22:00-23:00	0.44	34.74	0.00
21/5/2014	23:00-00:00	0.41	34.77	0.00
22/5/2014	00:00-01:00	0.35	35.00	0.00
22/5/2014	01:00-02:00	0.28	34.85	0.00
22/5/2014	02:00-03:00	0.44	34.90	0.00
22/5/2014	03:00-04:00	0.35	35.00	0.00
22/5/2014	04:00-05:00	1.07	35.00	0.00
22/5/2014	05:00-06:00	0.26	34.93	0.00
22/5/2014	06:00-07:00	0.45	35.00	0.00
22/5/2014	07:00-08:00	1.07	35.00	0.00
22/5/2014	08:00-09:00	0.57	34.73	0.00
22/5/2014	09:00-10:00	0.64	34.98	0.00
22/5/2014	10:00-11:00	0.37	35.00	0.00
22/5/2014	11:00-12:00	0.54	35.00	0.02
22/5/2014	12:00-13:00	0.26	35.00	0.00
22/5/2014	13:00-14:00	0.06	35.00	0.00
	Average	0.41	34.88	0.91
	Max	1.07	35.00	17.63
	Min	0.00	34.08	0.00

Hourly Air Quality Monitoring Data (May)

Date	Time	CO	NO2	SO2
		ppm	ppb	ppb
22/5/2014	14:00-15:00	0.52	33.74	0.00
22/5/2014	15:00-16:00	0.12	34.62	0.00
22/5/2014	16:00-17:00	1.01	34.98	0.00
22/5/2014	17:00-18:00	0.09	35.00	0.00
22/5/2014	18:00-19:00	0.00	35.00	0.00
22/5/2014	19:00-20:00	0.01	34.98	0.95
22/5/2014	20:00-21:00	0.05	35.00	0.00
22/5/2014	21:00-22:00	0.04	35.00	0.00
22/5/2014	22:00-23:00	0.05	35.00	0.00
22/5/2014	23:00-00:00	0.03	35.00	0.73
23/5/2014	00:00-01:00	0.00	34.98	0.33
23/5/2014	01:00-02:00	0.03	34.71	1.71
23/5/2014	02:00-03:00	1.09	34.85	4.95
23/5/2014	03:00-04:00	0.67	34.93	1.93
23/5/2014	04:00-05:00	0.30	35.00	0.00
23/5/2014	05:00-06:00	0.01	34.86	0.00
23/5/2014	06:00-07:00	0.08	35.00	0.00
23/5/2014	07:00-08:00	1.23	31.82	0.00
23/5/2014	08:00-09:00	1.45	34.82	0.00
23/5/2014	09:00-10:00	0.79	35.00	0.00
23/5/2014	10:00-11:00	0.89	35.00	0.00
23/5/2014	11:00-12:00	0.16	35.00	0.00
23/5/2014	12:00-13:00	0.12	35.00	0.00
23/5/2014	13:00-14:00	0.14	35.00	0.36
	Average	0.37	34.76	0.46
	Max	1.45	35.00	4.95
	Min	0.00	31.82	0.00

Field Activities Photo

Field Photo of Air Quality Monitoring






Appendix -1 Field Photo Album

- **Thilawar SEZ class A Development Water quality sampling and in-situ parameters testing activities on May 13, 2014.**

SW-2 (up-stream, 10 m east from main drain)

SW-3(up - stream, 10 m west from main drain)

SW-4 (down-stream, 10 m west from drain)

GW-1(Moe Gyoe Swan Monastery)

Thilawa Special Economic Zone CLASS A Development Project –Phase 1

Appendix

Noise and Vibration Monitoring Report

March, 2014

NOISE AND VIBRTION MONITORING

IN

THILAWA SEZ CLASS A DEVELOPMENT

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Noise and Vibration Monitoring Report

1. Introduction

The monitoring points are located in the Thilawa SEZ class A area. The site location is shown in Figure 1. Thilawa SEZ is located beside the Thanlyin and Kyauktan towns, about 20 km southeast side of Yangon city as shown in Figure 3.1-1. Project area with 400ha is center of Thilawa SEZ with an area of about 2,400 ha. Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

There are 2 ways to access to Thilawa SEZ from Yangon city, which are the route passing through Thanlyin Bridge and the route passing through Dagon Bridge.

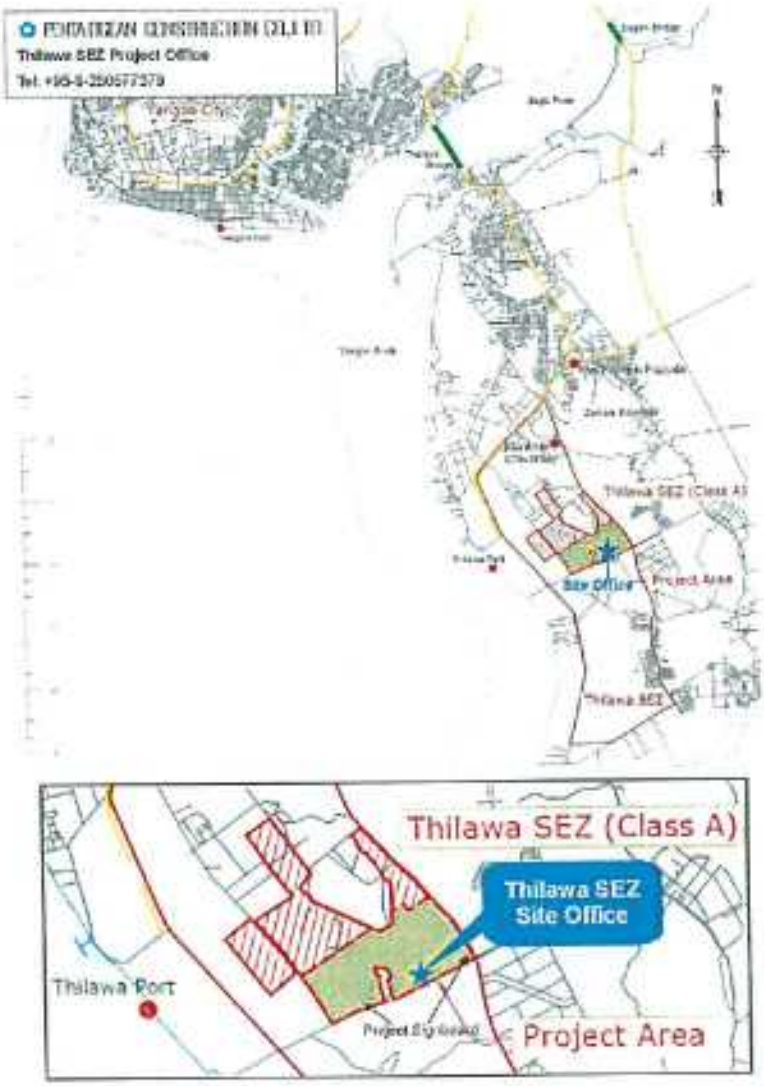

Figure 1 Location map of the Thilawa Special Economic Zone.

2. Environmental Standard

2.1 Noise

(1) Construction Phase

There is no noise standard of construction activities to receptors in Myanmar and International Organization's standards such as WHO and Environmental, Health, and Safety (EHS) Guidelines prepared by International Fiancé Cooperation (IFC) in a group member of World Bank, therefore the target noise level at construction stage is set based on the standard in the other foreign countries.

In the south-east Asia countries, only Singapore has the noise standard of construction activities to receptors categorized area to be quiet, residential area, and the other areas. On the basis of the above information, target noise level is set as following concept.

- Residential houses and monastery located less than 150m from the construction site comply with the middle range of the Singapore standard (categorized as "Residential buildings located less than 150m"), or
- Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories shall comply with the moderate range of standard Singapore standard (categorized as "Other buildings") or

This target noise level is shown in Table 1 and is not so much difference comparing with noise standard at construction stage in the other countries as shown in Table 2.

Table 1 Target Noise Level in Construction Phase

Category	Day time (Leq) (7am-7pm)	Evening Time (Leq) (7pm-10pm)	Night time (Leq) (10pm-7am)
Residential houses and monastery located less than 150m	75 dB	60 dB	55 dB
Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories	75 dB	65 dB	65 dB

Note) Evaluation point is at boundary of building

Table 2 Noise Standard at Construction Stage in the Various Countries

Items		Day time (Leq)	Night time (Leq)
Japan	Using heavy equipments with high noise level (piling, excavating etc.)	85 dB (Maximum)	-
Singapore	Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	60 dB (7am – 7pm, 12hrs)	50 dB (7pm – 7am, 12hrs)
	Residential buildings located less than 150m from the construction site where the noise is being emitted	75 dB (7am – 7pm, 12hrs)	60 dB (7pm – 10pm, 3hr) 55 dB (10pm – 7am, 9hr)
	Other Buildings	75 dB (7am – 7pm, 12hrs)	65 dB (7pm – 7am, 12hrs)
UK	In rural, suburban and urban areas away from main road traffic and industrial noise.	70 dB (8:00-18:00)	-
	Urban areas near main roads	72 dB (8:00-18:00)	-
USA	Residential	80 dB (8hrs)	70 dB (8hrs)
	Commercial	85 dB (8hrs)	85 dB (8hrs)
	Urban Area with high ambient noise level (>65 dB)	Ambient Noise Level +10dB	

Source: Noise Regulation Act, Japan (Law No.98, 1968, Amended No.33, 2006)
Environmental Protection and Management Act in Singapore (Chap.94A, Section 77, revised in 2008)
British Standard 5228: 1997 "Noise and vibration control on open and construction sites"
Transit Noise and Vibration Impact Assessment, U.S. Department of Transportation in USA, 1995

(2) Operation Phase

There is no ambient noise standard to receptors in Myanmar. However, most of the countries in south-east Asia have the ambient noise standard to receptors categorized land use or requirement of quiet as well as in Japan. International standard is also available in the EHS Guidelines prepared by IFC. On the

basis of the above information, target noise level is set as following concept and target ambient noise level.

- According to baseline survey in the Project, ambient noise levels in the monastery in Thilawa SEZ (Class A) are 53-60 dB in the daytime (6:00-22:00) and 44-58 dB in the nighttime (22:00-6:00).
- Ambient noise standard for sensitive areas of Japan and International Organization, relatively high in comparison with the results of baseline survey especially during nighttime.
- Thus, the target ambient noise level for sensitive and residential area is set in accordance with the noise standard in Singapore which is similar to the ambient noise level of the baseline survey.

The target noise level is shown in Table 3 and the target noise level is not so much difference comparing with ambient noise standard as shown in Table 4.

Table 3 Target Ambient Noise Level in Operation Phase

Category	Day time (Leq) (7am-7pm)	Evening Time (Leq) (7pm-10pm)	Night time (Leq) (10pm-7am)
Sensitive area such as Monastery	60 dB	55 dB	50 dB
Residential houses	65 dB	60 dB	55 dB
Commercial and Industrial Areas	70 dB	65 dB	60 dB

Note) Evaluation point is at boundary of building

Table 4 Ambient Noise Standard at Operation Stage in South-East Countries

Items		Day time (Leq)	Night time (Leq)
Indonesia	Noise standard for sensitive areas such as residences, hospitals, schools, places of religious worships	55 dB	
	Noise standard for office and commercial	65 dB	
	Noise standard for commercial and service	70 dB	
Malaysia	Sensitive Areas/ Low Density Residential Areas	55 dB (7am – 10pm, 15hrs)	50 dB (10pm – 7am, 9hrs)
	Sub Urban Residential	60 dB (7am – 10pm, 15hrs)	55 dB (10pm – 7am, 9hrs)
	Urban Residential	65 dB (7am – 10pm, 15hrs)	60 dB (10pm – 7am, 9hrs)
	Commercial and Business	70 dB (7am – 10pm, 15hrs)	60 dB (10pm – 7am, 9hrs)
Singapore	Sensitive Areas	60 dB (7am – 7pm, 12hrs)	55 dB (7pm – 10pm, 3hr) 50 dB (10pm – 7am, 9hr)
	Residential Areas	65 dB (7am – 7pm, 12hrs)	60 dB (7pm – 10pm, 3hr) 55 dB (10pm – 7am, 9hr)
	Commercial Areas	70 dB (7am – 7pm, 12hrs)	65 dB (7pm – 10pm, 3hr) 60 dB (10pm – 7am, 9hr)
Thailand	Noise standard	70 dB (24hrs)	
Japan	Sensitive Area (Class AA)	50 dB (6am – 10pm, 16hrs)	40 dB (10pm – 6pm, 8hrs)
	Residential Area (Class A and Class B)	55 dB (6am – 10pm, 16hrs)	45 dB (10pm – 6pm, 8hrs)
	Commercial and Industrial Area (Class C)	60 dB (6am – 10pm, 16hrs)	50 dB (10pm – 6pm, 8hrs)
IFC	Residential; institutional, educational	55 dB (7am – 10pm, 15hrs)	45 dB (10pm – 7am, 9hrs)
	Industrial; commercial	70 dB (7am – 10pm, 15hrs)	70 dB (10pm – 7am, 9hrs)

Source: Nose Standard in Indonesia (KEP-48/MENLH/II/1996)
Effect of Traffic Noise on Sleep: A Case Study in Serdang Raya, Selangor, Malaysia, Environment Asia, 2010
Environmental Protection and Management Act in Singapore (Chap.94A, Section 77, revised in 2008)
Notification of Environmental Board No. 15 B.E.2540(1997) under the Conservation and Enhancement of National Environmental Quality Act B.E.2535 (1992) dated March 12, B.E.2540 (1997) and Notification of Pollution Control Department ; Subject: Calculation of Noise Level Dated August 11, B.E. 2540 (1997) in Thailand

2.2 Vibration

(3) Construction Phase

There is no vibration standard of construction activity to receptors in Myanmar as well as south-east Asia and International Organizations such as WHO and IFC. Thus, the target vibration level at

construction phase shall be set based on the standards in some foreign countries. Accordingly the target level of vibration in construction phase is set based on the following policies.

- Monastery and residential house where are necessary to keep quiet and sleep shall comply with the Japanese standard for residential area,
- Office, commercial facilities, and factories areas shall comply with the Japanese standard for mixed areas including residential and commercial and industrial areas, and
- The category of times divided into three types in a manner consistency with target noise level for construction.

The target vibration level is shown in Table 5 and is not so much difference comparing with vibration standard at construction stage in the other countries as shown in Table 6.

3. Monitoring Result

Noise Level

Survey Item

Parameter for noise level survey was determined by referring the environmental quality standards in Japan as shown in Table 5.

As there are no environmental standards for noise level in Republic of Myanmar, the survey result was evaluated by comparing with the environmental standards and request limit for road noise in Japan.

Table 5 Survey Parameters for Noise Level

No.	Parameter	Unit		Environmental Standard	Request limit for road noise
				Japan	
				Living Environment	Along Road
1	A-weighted loudness equivalent (LAeq)	dB	Daytime (6:00-22:00)	55	75
			Nighttime (22:00-6:00)	45	70

Note) Environmental Quality Standard for Noise (Category B, Residential Area) in Japan

Survey Location

Dry season

Summary of sampling points

The locations of noise level points and vibration monitoring points are shown in Table 6. The detail of each sampling points are described below. Locations of noise monitoring points in dry season are shown in table below.

Table 6 Location of Noise and Vibration Monitoring Station

Sampling Point	Coordinates	Description of Sampling Point
TNV-1	16°42'15.8"N, 96°16'00.5"E	In front of Myanmar Maritime University; about 2 m east of car road
TNV-2	16°40'15.5"N, 96°16'34.0"E	In the Moekyoswan Monastery Compound; about 140 m away from main car road
TNV-3	16°40'20.2"N, 96°16'35.5"E	In the Moekyoswan Monastery Compound; about 250 m away from main car road

TNV-1

The TNV-1 location was an open area in front of Myanmar Maritime University with about 2m from car road. The road was paved with low traffic volume and moderate speed. The nearest house is 20 meter away and no obstruction from trees. Dominant source of noise was vehicular traffic nearby the

site. There was not any other noise source around the house. The location of TNV-1 is shown in Figure 2.

Figure 2 Location of TNV-1.

TNV-2

TNV-2 was sited at Moegyoswun Monastery Compound. The location was an open area beside monk houses with about 250m from the car road. The road was paved with low traffic. Dominant sources of noise were alarm song in the compound that ring thrice a day. There was not any other noise source around the monastery compound. The location of TNV-2 is shown in Figure 3.

Figure 3 Location of TNV-2.

TNV-3

TNV-3 was sited in front of Moegyoswun Monastery. The location was an open area beside the road with about 6 m from the car road. The road was paved with low traffic. Dominant sources of noise were

alarm song in the compound that ring thrice a day and vehicular traffic. The location of TNV-3 is shown in Figure 4.

Figure 4 Location of TNV-3.

Survey Period

Sampling and monitoring of surrounding sound and vibration level at TNV-1, TNV-2 and TNV-3 were conducted during 31st March to 3rd April, 2014.

Sampling Point	Survey Period
TNV-1	31st March - 1st April, 2014 (24 hours)
TNV-2	1st - 2nd April, 2014 (24 hours)
TNV-3	2nd - 3rd April, 2014 (24 hours)

Survey Method

Sampling and monitoring of surrounding sound and vibration level were conducted by using following instrument for 24 hours/1 day measurement.

Instrument	Brand	Model	Measurement unit
Sound Level Meter	Lutron	SL-0423SD	dB
Vibration Meter	Lutron	VB-8206SD	mm/s, cm/s

a) Noise Survey

Frequency

- One time (24 hours monitoring in weekday)

Total Sample

- Three samples

Record Interval

- One record for 10 minute interval

b) Vibration Survey

Frequency

- One time (24 hours monitoring in weekday)

Total Sample

- Three samples

Record Interval

- One record for 5 seconds interval for 10 minutes during an hour

Survey Result

Noise levels (L_{Aeq}) of the monitoring points were presented in TABLE. One day L_{Aeq} was calculated by using the following array formula in the excel sheet. This formula is firstly used for hourly L_{Aeq} and then for the 24 hours L_{Aeq}.

10*LOG10(AVERGAE(10^((RANGE)/10)))

By means of the calculated results, all of the noise levels found lower than the environmental standard (1-day) in Thailand. Noise level (LAeq) in present monitoring period was presented in Table 7 and Table 8.

Table 7 Hourly LAeq value in noise monitoring stations.

Unit: dBA

Time	TNV-1	TNV-2	TNV-3
7:00-8:00	66.58	57.07	63.72
8:00:9:00	69.11	55.76	61.96
9:00-10:00	57.96	56.79	70.33
10:00-11:00	58.73	50.92	79.03
11:00-12:00	73.02	49.08	66.62
12:00-13:00	71.87	50.89	54.77
13:00-14:00	63.56	47.96	79.22
14:00-15:00	64.64	48.97	80.81
15:00-16:00	74.85	74.29	79.31
16:00-17:00	74.92	56.95	81.37
17:00-18:00	66.10	58.54	75.47
18:00-19:00	62.20	61.21	59.08
Day L_{Aeq}	67	56	71
19:00-20:00	55.71	60.92	62.56
20:00-21:00	57.80	60.17	61.13
21:00-22:00	53.31	48.82	48.35
Evening L_{Aeq}	56	57	57
22:00-23:00	48.59	48.06	46.98
23:00-24:00	46.50	51.10	41.68
24:00-1:00	45.93	44.53	40.63
1:00-2:00	45.84	42.26	41.03
2:00-3:00	63.43	46.05	41.44
3:00-4:00	38.83	44.29	45.78
4:00-5:00	48.77	44.35	41.94
5:00-6:00	48.94	53.97	43.56
6:00-7:00	63.11	59.85	56.16
Night L_{Aeq}	50	48	44

Table 8 A-weighted Loudness Equivalent (LAeq) Level

Unit: dB(A)

Date	TNV-1 31 March -01 April 14			TNV-2 01-02 April 14			TNV-3 02-03 April 14		
	Day Time	Evening Time	Night Time	Day Time	Evening Time	Night Time	Day Time	Evening Time	Night Time
	67	56	50	56	57	48	71	57	44
Target Noise Level	75	65	65	75	60	55	75	60	55

Vibration

Vibration can be defined as regularly repeated movement of a physical object about a fixed point. The parameter normally used to assess the ground vibration is the peak particle velocity (ppv) expressed in millimetres per second (mm/s).

Vibration can cause varying degrees of damage in buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance or annoyance or, at higher levels, to affect a person's ability to work.

Typical levels measured during construction activities are shown below:

Construction Activity	Typical Ground Vibration Level
Vibratory roller	Up to 1.5mms @ 25m
Hydraulic rock breakers	4.5 mm/s @ 5m, 0.4 @ 20m, 0.1 @ 50m
Compactor	20mm/s @ 5m, <0.3mm/s @30m
Pile driving	1-3mm/s @ 50m depending on soil conditions and piling technique
Bulldozer	1-2mm/s @ 5m, 0.1 @ 50m
Truck traffic (smooth surface)	<0.2mm/s @ 20m
Truck traffic (rough surface)	<2mm/s @ 20m

Survey location

- Three points (same location as noise survey)

Frequency

- One time (24 hours)

Methodology

- Vibration level (dB), Frequency, Velocity, Measurement of vibration level is conducted by International standard method.

Result

Vibration results were presented in Figure 5 to 7.

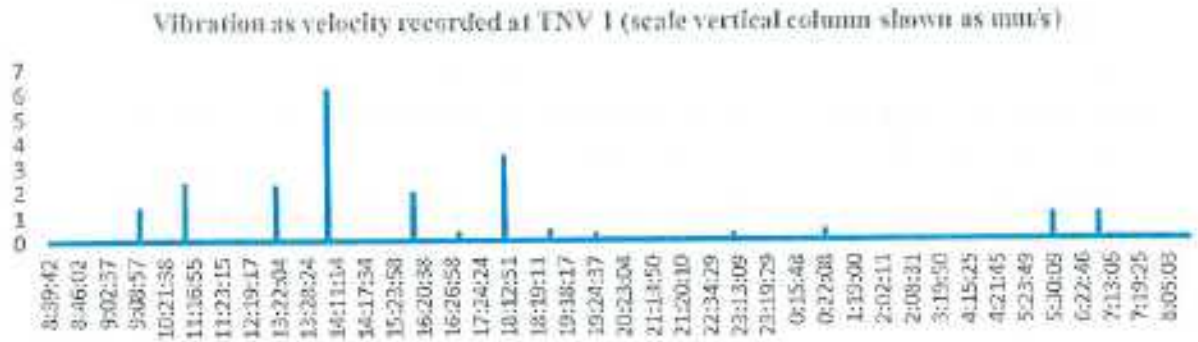

Figure 5 Vibration result of TNV 1.

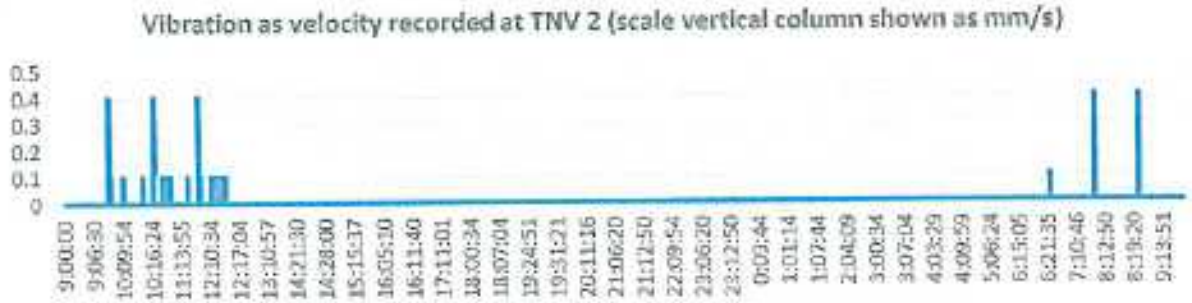

Figure 6 Vibration result of TNV 2.

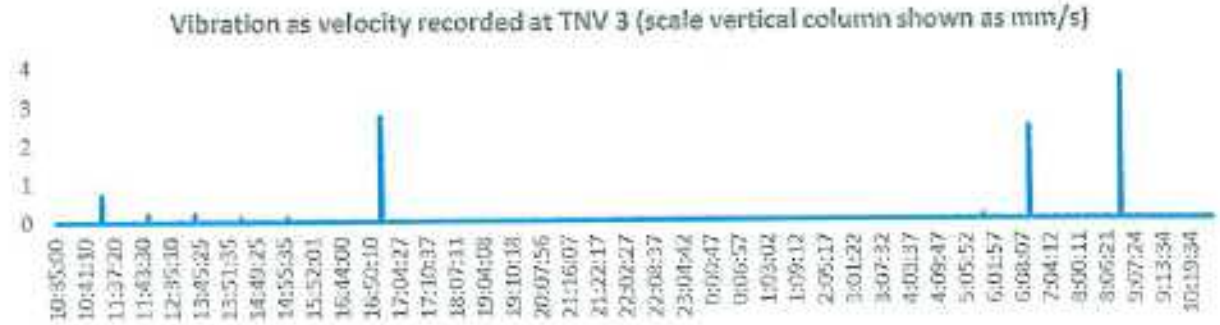

Figure 7 Vibration result of TVN 3.

4. Conclusion

The noise level along the road, all the noise levels found lower than the request limit of road noise in Japan. The noise level on living environment, in the project site are lower than the target noise level.

There is no standard relating to vibration during construction activities. Common practice in Myanmar has been to use guidance from internationally recognized standards. Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, the magnitude of vibration is expressed in terms of Peak Particle Velocity (PPV) in millimetres per second (mm/s).

In the case of nominally continuous sources of vibration such as traffic, vibration is perceptible at around 0.5mm/s and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration.

For example, compaction and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 20mm/s and 2.5mm/s respectively. This guidance is applicable to the day-time only; it is unreasonable to expect people to be tolerant of such activities during the night-time.

Guidance relevant to acceptable vibration at the foundation of buildings is contained within BS 7385 (1993): Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration. This states that that there should typically be no cosmetic damage if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines relate to relatively modern buildings.

Therefore, the guideline values should be reduced to 50% or less for more critical buildings. Critical buildings would include premises with machinery that is highly sensitive to vibration or historic buildings that may be in poor repair, including residential properties.