

Thilawa Special Economic  
Zone (Zone A) Development

## Environmental Monitoring Report Phase - 2 (Construction Phase)



Myanmar Japan Thilawa  
Development Limited.

March 2016

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## **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 from December 2015 to February 2016 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 (Zone A).

When we submitted EMP for Phase 2, Construction Phase, Report (No.1) at 10<sup>th</sup> March 2016, we did not include the Monthly Construction Progress report for November 2015 due to requirement of some information to revise by our main contractor, Penta-Suntac Partnership. Hence, we would like to submit in this EMP for Phase 2, Construction Stage Report (No.2).

## **2. Summary of Monitoring Activities**

- a) Progress made to date on the implementation of the EMP against the submitted implementation schedule;

We already submitted EMP for Phase 2, Construction Phase Report (No.1) and Report (No.2) is submitted this day attached with Construction Phase implementation schedule.

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

During water quality sampling at February 2016, COD<sub>cr</sub> value at all points higher than the standard even though MJTD has not been discharging to water body. We have been investigating the reason of exceeding. The possible reason is because of the flood tide from Yangon River current flowing upstream. Next time we will try to consider the tide schedule to not sample Yangon River water.

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

None

- d) Accidents or incidents relating to the occupational and community health and safety, and the environment:

An Accident was occurred on 8<sup>th</sup> February 2016 at Thilawa SEZ Zone A, Phase 2. The victim was our main contractor, Penta-Suntac Partnership and was seriously injured by a backing dump truck. According to the doctor, she will be hospitalized for three months. Please refer to the attached Monthly Progress Report, February 2016.

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

Please refer to the attached Environmental Monitoring Form.

- e) **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 Zone A Development Project construction activities is submitted enclosed with monthly progress reports from contractor in Appendix A to D.

- A. Monthly Progress Report for November, 2015
- B. Monthly Progress Report for December, 2015
- C. Monthly Progress Report for January, 2016
- D. Monthly Progress Report for February,2016

## 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	NO <sub>2</sub> , SO <sub>2</sub> , CO, TSP, PM <sub>10</sub>	Construction site (1point)	Once/ 3month	January 2016, Monitoring Report
Water Quality	Water temperature, pH, SS, DO, BOD, COD, coliform count, oil and grease, chromium	Construction site (6 points) Well in the Monastery (1 point)	Once/2 month	December 2015, February 2016, Monitoring Report
Waste	Amount of solid waste Management of solid waste of construction	Construction site	Once/3month	Monthly Progress Reports (November, December) 2015, (January, February) 2016
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 January 2016
		Preservation 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 Reports (Nov, Dec) 2015, (Jan, Feb) 2016
Hydrology				
Risk for infectious disease such as AIDS/HIV	Status of measures of infectious disease	Construction site	Once/month	Monthly Progress Reports (Nov, Dec) 2015, (Jan, Feb) 2016
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 (Zone A)  
Development Project –Phase 2

**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 (Zone 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 (TSEZ Zone A, Phase 2)

- Please mark the current phase.

☐ Pre-Construction Phase

☒ Construction Phase

☐ Operation Phase

##### 2) Obtainment of Environmental Permits (Not Applicable)

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 (Not Applicable)

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			

**(2) Monitoring Results**
**1) Ambient Air Quality - January 2016**
NO<sub>2</sub>, SO<sub>2</sub>, CO, TSP, PM10

Location	Item	Unit	Measured Value (Mean)	Measured Value (Min-Max.)	Country's Standard	Target value to be applied	Referred International Standard*	Frequency	Method	Note (Reason of excess of the standard)
Construction Area	NO <sub>2</sub>	ppm	0.04	0.03 - 0.05	N/A	N/A	0.06	Once in three months	HAZSCANNER, EPAS	
	SO <sub>2</sub>	ppm	0.01	0.01 - 0.02	N/A	N/A	0.04	Once in three months	HAZSCANNER, EPAS	
	CO	ppm	0.32	0.24 - 0.38	N/A	N/A	10	Once in three months	HAZSCANNER, EPAS	
	TSP	ppm	0.07	0.03 - 0.09	N/A	N/A	0.33	Once in three months	HAZSCANNER, EPAS	
	PM10	ppm	0.01	0.01 - 0.03	N/A	N/A	0.12	Once in three months	HAZSCANNER, EPAS	

\*Remark: Referred to the Japan and Thailand Standard (EIA Report, Table 6.4-1).

**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 - December 2015**
**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 Referred International Standard.

\*MJTD is not discharging to water body at the time of monitoring. Below information is the result of scheduled monitoring at outside of water body upstream and downstream from the MJTD discharge point.

Location *2	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard*1	Frequency	Method	Note (Reason of excess of the standard)
SW-2	pH	mg/l	7.97	None (Available Guideline Value determined by MOI)	5.0-9.0	≥4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS **	mg/l	320.67		Max. 30			Gravimetric method	
	DO	mg/l	8.35		-			HI7609829-2, (D.O) sensor	
	COD <sub>M</sub>	mg/l	67		Max. 70 <sup>mg</sup>			Dichromate method	
	BOD <sub>5</sub>	mg/l	15		Max. 20			Direct inoculation method	
	Oil and Grease	mg/l	3.3		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	49		Max. 400			AOAC Petrifilm Method	
SW-3	pH	mg/l	7.92	None (Available Guideline Value determined by MOI)	5.0-9.0	≥4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS **	mg/l	718.33		Max. 30			Gravimetric method	
	DO	mg/l	7.96		-			HI7609829-2, (D.O) sensor	
	COD <sub>M</sub>	mg/l	76		Max. 70 <sup>mg</sup>			Dichromate method	
	BOD <sub>5</sub>	mg/l	23		Max. 20			Direct inoculation method	

Location #2	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard <sup>#1</sup>	Frequency	Method	Note (Reason of excess of the standard)
	Oil and Grease <sup>2</sup>	mg/l	9.9		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	130		Max 400	7.5×10 <sup>3</sup>		AOAC Petrifilm Method	
SW-4	pH	mg/l	7.4		5.0-9.0			pH meter, HI7609829-1 pH Sensor	
	SS <sup>2</sup>	mg/l	463	None	Max.30			Gravimetric method	
	DO	mg/l	6.10	(Available	-	>=4		HI7609829-2,(D.O)sensor	
	COD <sub>Cr</sub>	mg/l	62	Guideline	Max. 70 <sup>3</sup>		Once in two month	Dichromate method	
	BOD	mg/l	10	Value	Max. 20			Direct inoculation method	
	Oil and Grease	mg/l	2.2	determined by MOI	Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	240		Max 400			AOAC Petrifilm Method	
GW-1	pH	mg/l	7.75			5.5-9.0		pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	16		None	50		Gravimetric method	
	DO	mg/l	6.99	(Available		>=4		HI7609829-2,(D.O)sensor	
	COD <sub>Cr</sub>	mg/l	57	Guideline		60	Once in two month	Dichromate method	
	BOD <sup>2</sup>	mg/l	17	Value		15		Direct inoculation method	
	Oil and Grease	mg/l	<0.2 <sup>3</sup>	determine		0.1		APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02	d by MOI		0.04		APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	23			7.5×10 <sup>3</sup>		AOAC Petrifilm Method	

\*1Remark: Referred to the Vietnam Standard (EIA report), Reference to the Monitoring Report, October 2015.

\*2Remark: Same location with Phase (1) Operations Phase, Water Quality monitoring because Thilawa SEZ Zone A has only one main discharging gate which contain treated water discharge from the STP.

\*3Remark: Suspended solid content in all sampling points except GW-1 are higher than the standard from the submission of EIA (September 2013). The possible reasons is the increasing of insoluble particulate matter during run off or discharging that can be generated from some construction activities and direct discharge of waste water disposal from the upstream area or the natural soil conditions around the area.

\*4Remark: Oil and grease level at only SW-3 is higher than the standard. As of December 2015, Thilawa SEZ is not any discharging to the water body including SW-3. As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with river water.

\*5Remark: According to the Letter Ref: No MJTD/O/15-01-105, we monitored COD by Dichromate values instead of COD by Permanganate. Therefore, we have adopted target level of COD by Dichromate for effluent water quality discharging to the water body is 70 mg/l which is equivalent to 35 mg/l COD by Permanganate from this EMP report.

\*6Remark: The lab minimum deduction limit is <0.02 as describe in the Lab report, Water quality report, December 2015.

\*7Remark: BOD level at GW-1 and SW-3 is slightly higher than the standard. It may be caused because either fluctuation condition (such as pollution condition, water fall rainfall, tide up from Rangun River, water flow rate) at that point during monitoring. But BOD at all points are lower than the standard at previous monitoring reports. Finally, BOD levels against with standard shall be evaluated as yearly average or 75 percentile among all of the data in a year. Thus assessment of water quality will be evaluated after 1 year's operation.

## 2)(b) Water Quality - February 2016

### 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 Refer5eed International Standard.

Location #2	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard*1	Frequency	Method	Note (Reason of excess of the standard)
SW-2	pH	mg/l	6.16	None (Available Guideline Value determined by MOI)	5.0-9.0	≥4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS**	mg/l	2,711		Max. 30			Gravimetric method	
	DO	mg/l	6.67		-			HI7609829-2, (D.O) sensor	
	COD <sub>Cr</sub> *	mg/l	1,290		Max. 70*			Dichromate method	
	BOD	mg/l	4		Max. 20			Direct inoculation method	
	Oil and Grease*	mg/l	5.1		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms**	cfu/100ml	35,000		Max 400			AOAC Petrifilm Method	
SW-3	pH	mg/l	6.28	None (Available Guideline Value determined by MOI)	5.0-9.0	≥4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS**	mg/l	2,003		Max 30			Gravimetric method	
	DO	mg/l	7.16		-			HI7609829-2, (D.O) sensor	
	COD <sub>Cr</sub> *	mg/l	1,230		Max. 70*			Dichromate method	
	BOD	mg/l	3		Max. 20			Direct inoculation method	
	Oil and Grease	mg/l	<5		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms**	cfu/100ml	3,300		Max 400			AOAC Petrifilm Method	



Location <sup>*2</sup>	Item	Unit	Measured Value	Country's Standard	Target value to be applied	Referred International Standard <sup>*1</sup>	Frequency	Method	Note (Reason of excess of the standard)
SW-4	pH	mg/l	6.55	None (Available Guideline Value determined by MOI)	5.0-9.0	>=4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS <sup>3</sup>	mg/l	2.052		Max.30			Gravimetric method	
	DO	mg/l	6.84		-			HI7609829-2,(D.O) sensor	
	COD <sub>Cr</sub> <sup>4</sup>	mg/l	1,360		Max. 70 <sup>2</sup>			Dichromate method	
	BOD	mg/l	3		Max. 20			Direct inoculation method	
	Oil and Grease	mg/l	<5		Max. 5			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		Max. 0.5			APHA-AWWA-WEF Method	
	Total coliforms <sup>2</sup>	cfu/100ml	2,200		Max 400			AOAC Petrifilm Method	
GW-1	pH	mg/l	6.74	N/A	5.5-9.0	>=4	Once in two month	pH meter, HI7609829-1 pH Sensor	
	SS	mg/l	48.7		None			Gravimetric method	
	DO	mg/l	6.99		(Available Guideline Value			HI7609829-2,(D.O) sensor	
	COD <sub>Cr</sub> <sup>4</sup>	mg/l	90		determine			Dichromate method	
	BOD	mg/l	5		0.1			Direct inoculation method	
	Oil and Grease	mg/l	<5		0.04			APHA-AWWA-WEF Method	
	Cr	mg/l	<0.02		7.5×10 <sup>6</sup>			APHA-AWWA-WEF Method	
	Total coliforms	cfu/100ml	<1.1					AOAC Petrifilm Method	

<sup>\*1</sup>Remark: Referred to the Vietnam Standard (EIA report), Reference to the Monitoring Report, October 2015.

<sup>\*2</sup>Remark: Same locations with Phase (1) Operations Phase Water Quality monitoring because our Thilawa SEZ Zone A has only one main discharging gate.

- \*3Remark: Suspended solid content in all sampling points except GW-1 are higher than the standard from the submission of EIA (September 2013). 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 or the natural soil conditions around the area.
- \*4Remark: COD<sub>Cr</sub> level is high at (GW-1) point. COD<sub>Cr</sub> value can be increase when the presences of natural elements increase in the groundwater of that particular area. There was minimal wastewater discharge into the retention pond of the Thilawa SEZ, so the value of high COD is considered as not because of industrial wastewater sink into the aquifer.
- \*5Remark: According to the Letter Ref: No MJTD/O/15-01-105, we monitored COD by Dichromate values instead of COD by Permanganate. Therefore, we have adopted target level of COD by Dichromate for effluent water quality discharging to the water body is 70 mg/l which is equivalent to 35 mg/l COD by Permanganate. Also in our EMP report, we would like to use this COD by Dichromate target level.
- \*6Remark: As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with Yangon River water. Since Yangon River is a tidal river, the COD(Cr) result at SW-2, SW-3 and SW-4 have possibilities of containing a large amount of chloride ions. Therefore, these results might have positive interfered by chloride ion.
- \*7Remark: Total coliform has exceeded the reference standard in SW-2 and SW-4. In February 2016, Thilawa SEZ is not any discharging to the water body. Thus may be because contamination from human or animal waste near by the creek outside of Thilawa SEZ.
- \*8Remark: Oil and grease at SW-2 is slightly higher than the standard. As of February 2016, Thilawa SEZ is not any discharging to the water body including SW-2. As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with river water.

### 3) Soil Contamination (only operation phase)

#### 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
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#### 4) Noise –January 2016

##### Noise Level (Living Environment)

Location	Item	Unit	Measured Value (Mean)	Measured Value (Min~Max)	Country's Standard	Target value to be applied	Referred International Standard*1	Frequency	Method	Note (Reason of excess of the standard)
NV-1	Leq (day)	dB(A)	60.8	43.94-66.92	N/A	N/A	75	Once (peak period)	Sound Level Meter	
	Leq(eve)	dB(A)	49.1	40.52-49.55			65			
	Leq(night)	dB(A)	50.5	44.19-54.59			65			

\*Remark: Referred to the Japan Standard (EIA Report), Reference to the Noise and Vibration Report November 2015.

##### Noise Level (Along the Dagon-Thilawa Development Road)

Location	Item	Unit	Measured Value (Mean)	Measured Value (Min~Max)	Country's Standard	Target value to be applied	Referred International Standard*2	Frequency	Method	Note (Reason of excess of the standard)
NV-2	Leq (day)	dB(A)	69.6	55.91-76.12	N/A	75	Japanese traffic noise target level	Once in 3 months	Sound Level Meter	
	Leq(night)	dB(A)	47.7	40.04-52.61		70				

\*2Remark: Referred to the Japanese Traffic Noise Standard (Noise Regulation Law (Japan) Law No.98 of 1986, latest amendment by law No. 91 of 2000)

Reference to the Noise and Vibration Report January 2016.

### 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.

No.	Date	Description	No. of Loads	Remarks
1.	21-Nov-15	Waste Disposal(Normal Construction waste)	5	YCDC
2.	4-Dec-15	Waste Disposal(Sewage from Septic Tank at Temporary site office)	3	YCDC
3.	22-Feb-16	Waste Disposal(Normal Construction waste)	6	YCDC

\*Remark: Reference to the Monthly Progress Report November 2015, December 2015 and January 2016, February 2016.

### 6) (a) Ground Subsidence and Hydrology- November 2015

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
5-Nov-15	175	m <sup>3</sup> /week	-	m	Once a week	Heavy Raining Day
12-Nov-15	240	m <sup>3</sup> /week	+6.988	m		



19-Nov-15	188	m <sup>3</sup> /week	+6.966	m	
26-Nov-15	255	m <sup>3</sup> /week	-	m	

Public Holiday

\*Reference to the Monthly Progress Report November 2015.

**(b) Ground Subsidence and Hydrology- December 2015**

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
3-Dec-15	212	m <sup>3</sup> /week	+6.990	m	Once a week	
10-Dec-15	312	m <sup>3</sup> /week	+6.991	m		
17-Dec-15	276	m <sup>3</sup> /week	+6.992	m		
24-Dec-15	211	m <sup>3</sup> /week	+6.992	m		
31-Dec-15	191	m <sup>3</sup> /week	+6.994	m		

\*Reference to the Monthly Progress Report December 2015.

**(c) Ground Subsidence and Hydrology-January 2016**

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
7-Jan-16	211	m <sup>3</sup> /week	+6.989	m	Once a week	
14-Jan-16	221	m <sup>3</sup> /week	+6.990	m		
21-Jan-16	141	m <sup>3</sup> /week	+6.993	m		
28-Jan-16	207	m <sup>3</sup> /week	+6.996	m		

\*Reference to the Monthly Progress Report January 2016.

**(d) Ground Subsidence and Hydrology-February 2016**

Duration (Week)	Water Consumption		Ground Level		Frequency	Note
	Quantity	Unit	Quantity	Unit		
4-Feb-16	140	m <sup>3</sup> /week	+6,995	m	Once a week	
11-Feb-16	176	m <sup>3</sup> /week	+6,989	m		
18-Feb-16	252	m <sup>3</sup> /week	+6,989	m		
25-Feb-16	213	m <sup>3</sup> /week	+6,992	m		

\*Reference to the Monthly Progress Report February 2016.

**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
An Accident was occurred on 8 <sup>th</sup> February 2016. The victim was a Site Engineer from main contractor Penta Suntac Partnership and was seriously injured by a backing dump truck. According to the doctor, she will be hospitalized for three months.	Please refer to Attachment of Accident Report for detail.

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

End of Document



# Accident Report

Report No.: ST/AR01FEB2018

To MITI

Date of Incident	8-Feb-18	(Week)	Weather	Windy	Incident Response	SAFETY
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Info	Executive	Deputy Executive	Deputy Executive	Admin. GH	Integrating GH
Country Use Only	GH		GH		

Project ID	Type of Work	Project Location	Project Title	Project Period
MYSTRA-000000	Infrastructure	Thailand, Bangkok, Myanmar	Thailand B22 Phase 2	From : Feb 2018 To : July 2018
Client	Contact Person	Project	Contract Value	
PDITA-CCDW	NE	80%	Contribution of infrastructure for Thailand Special Economic Zone	
Status of JV				
No.	10	10		
STATUS:	100%	100%	100%	100%

Details of Accident	Name of Victim		ID Card/PP No.	Nationality	Gender (Age/DOB)	Occupation	Type of Injury	3 Risk and Special	
	May Thee Han		PP-2584	Myanmar	Female (DOB: 21/12/1982)	Engineer			
	Experience at Job (years)		Date of Entry to site		Victim's Company		Region of Injury	Also, Special and	
	1 year		21/12/2018		SAFETY		Term of Accident	Traffic Accident	
	Family Detail		Father, Mother, and Sister (Total 4)					Factor of Injury	Group work
	Address (Full Line)		Thailand Phayathai Road, Laha Kyi Road, Yangon Central Railway station					Number of Days Lost	30 Days

Project Manager	Location	Project Type	Project Type
	SEA	Storage	Level
	Application and Provision for Compensation		

National Review	Client	PDITA-CCDW Co., Ltd.
	Labour Department	ODD, B22 Committee Labour Department
	Police Department	
	Press relations	
	The police	10 police station

Comments of Head Office	Comments of Branch Office

Type of Worksite	Road Construction	Worksite detail or injury	Surveying for sub-grade level
Detail of Accident (Why? What? Where? When? How? With? From? Will be sent)			
The victim was a Site Engineer of B22 Phase 2 and at the time of accident (21 Feb 2018) she was working on the road. First truck coming in by road direction and stopped on the road. After that truck and park truck on road to give way for another truck. Second truck is coming to the back side without agreement along road (see sketch). Suddenly the truck direction change from side to middle of road. The victim was concentrated on driving truck and did not notice that the truck was approaching to her back. Truck driver did not aware that the victim was there as he didn't see her on the rear view mirror. There were workers nearby and they observed and warned the driver, but the driver did not hear them and keep backing up the truck. The victim was hit and then crashed by the truck across her legs, just before the parking.			
Sketch (Plan/ Cross Section / Dimensions are indicated)			



Background of Accident	Prevention for Recurrence	
	Detail	Action by Target date
Personal Factor	The victim was working on road without signpost.	Stop all machines and vehicles which operating without signpost.
	Inadequate knowledge of safety hazard.	Conduct accident investigation and counter measure meeting.
Facility Factor	The victim was surveying in the middle of road without any protection sign of hazard. She reaction.	Providing of signpost with vehicle for all heavy vehicles.
	No provision of signpost.	Providing of Control measures for all activities with warning line or barricade.
Work Factor	Failure to provide protection or warning by working area.	Provide signpost and additional for all activities.
	No alarm in vehicle for loading up.	Providing of warning line or barricade for working area.
Safety Factor	Working in congested area.	Discontinue all activities until all machines.
	Interference by strong wind.	Control working area by providing additional safety personnel.
Safety Management Factor	Noise made by machines.	Control working area by providing additional safety personnel.
	Lack of preparation for safety control measure.	Conduct daily safety meeting for safety control measure.
Safety Management Factor	Surveying in middle of road.	Control with warning line or barricade for all activities in congested area.
	Overlapping working.	Conduct safety orientation course and On job training.
Safety Management Factor	Not following established safety rules.	Instruction to follow established safety rules and procedures.
	Lack of monitoring for the compliance of safety rules.	Assign all work in charge person and safety personnel to monitor for the compliance of safety procedures by Project manager.
Safety Management Factor		Safety improvement by taking action.

Project Office	Thailand B22	Project Manager (SAFETY)
Project Office	Thailand B22	Project Manager (SAFETY)
Project Office	Thailand B22	Project Manager (SAFETY)

GH	GH

Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2

Appendix

Water and Waste Water Monitoring Report

December, 2015



**MJTD** MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED

---

## **WATER QUALITY MONITORING IN THILAWA SEZ (PHASE 1, OPERATION STAGE)**

**(Bi-Monthly Monitoring)**

**December 2015**



**Resource & Environment Myanmar Ltd.** 8-702/401 Delta Plaza Building, Shwegondaing Rd., Bahan, Yangon. MYANMAR

Tel: (959) 7301 3448; Fax: (951) 552901

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## 1. INTRODUCTION

The water quality sampling points are in the Thilawa SEZ area, which is located in the Thanlyin and Kyauktan townships, about 20 km southeast of Yangon city (Figure 1). Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

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



Figure 1. Location map of Thilawa SEZ area and water quality sampling locations

## 2. FIELD SURVEY

Water quality sampling for December 2015 was conducted in 4 locations (SW-2, SW-3, SW-4 and GW-1) among proposed 7 locations (GW-1, SW-1, SW-2, SW-3, SW-4, SW-5, SW-6).

### *Survey Item*

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards. There were four locations for water quality survey as SW-2, SW-3, W-4 and GW-1.

### *Summary of sampling points*

The detail of the locations of monitoring points are shown below.

Table 1. Locations of water quality sampling points

No.	Station	Type	Coordinate	Location
1.	SW-2	Surface Water	16° 40' 06.0" N	Upstream of Shwe Byauk Creek,

			96° 16' 43.1" E	Thilawa SEZ
2.	SW-3	Surface Water	16° 40' 05.5" N 96° 16' 41.6" E	Upstream of Shwe Byauk Creek, Thilawa SEZ
3.	SW-4	Surface Water	16° 39' 54.6" N 96° 16' 26.4" E	Downstream of Shwe Byauk Creek, Thilawa SEZ
4.	GW-1	Ground Water	16° 40' 25.1" N 96° 16' 31.7" E	In Moegyoe Swan Monastery, Thilawa SEZ



Figure 2. Location map of water quality sampling points

#### SW-2

SW-2 was collected at the upstream of Shwe Byauk Creek which is flowing generally from east to west and then entering into the Yangon River. This sampling point is also located at south of Class A area and Dagon-Thilawa car road. The surrounding area are Class A in the north, industrial compound in the east and paddy field in the south and west respectively.





Figure 3. Surface water sampling at SW-2

#### SW-3

SW-3 was collected at the upstream of Shwe Byauk Creek which is flowing generally from east to west and then entering into the Yangon River. It is distanced about 60 m downstream of SW-2. This sampling point is also located at south of Class A area and Dagon-Thilawa car road. The surrounding area are Zone A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 4. Surface water sampling at SW-3

#### SW-4

SW-4 was collected at the downstream of Shwe Byauk Creek which is which is flowing generally from east to west and then entering into the Yangon River. It is distanced about 500 m downstream of SW-3. This sampling point is also located at south of Zone A area and Dagon-Thilawa car road. The surrounding area are Zone A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 5. Surface water sampling at SW-4

#### GW-1

W-6 was collected from tube well as ground water sample. It is located in the compound of Moegyoe Swan Monastery as well as in the Zone A area. The transparency of the ground water is high,



Figure 6. Ground water sampling at GW-1

#### *Survey Period*

Water quality survey was conducted on 22<sup>nd</sup> December, 2015.

#### *Survey 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 as pH, temperature, velocity, dissolved oxygen (DO), electrical conductivity (EC), and turbidity 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 2. Field Equipment for river flow measurement and water quality survey**

No.	Equipment	Manufacturer	Originate Country	Model
1	Multi-parameter (Temp., pH, EC, ORP, DO, TDS, Turbidity)	HANNA	USA	HI7609829 (with 3 sensors)
2	SmarTROLL multi-parameter	In-situ Inc.	USA	-
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

**Table 3. Container and preservation method of water samples for laboratory analysis**

No.	Parameter	Container	Preservation
1	BOD, COD	1000 ml glass bottle	Refrigerate
2	Suspended solid	1000 ml plastic bottle	Refrigerate
3	Coliform	1000 ml glass bottle	Refrigerate
4	Other	2000 ml plastic bottle	Refrigerate

The following table provides the test method for water quality.

**Table 4. Analytical method for water quality**

No.	Item	Analysis method	Sampling point
			W-2, W-3, W-5, W-6
1	Water Temperature	HI7609829-1 Sensor	✓
2	pH	HI7609829-1 Sensor	✓
3	Dissolved Oxygen (DO)	HI7609829-2 Sensor	✓
4	Suspended Solid	APHA-AWWA-WEF Method	✓
5	BOD	APHA-AWWA-WEF Method	✓
6	COD	APHA-AWWA-WEF Method	✓
7	Color	APHA-AWWA-WEF Method	✓
8	Odor	APHA-AWWA-WEF Method	✓
9	Total Nitrogen	APHA-AWWA-WEF Method	✓
10	Total Phosphorus	Photometric Method	✓
11	Total Coliform	APHA-AWWA-WEF Method	✓

### **Survey Result**

Water samples were sent to SGS Myanmar and SGS Thailand laboratories. Water quality results are shown in following table.

This table reveals that all of the monitoring results are under the limit (lower than the standard) except suspended solid content. Suspended Solid levels are higher than the standard as previous times in all sampling points except GW-1. COD levels at all points are higher than the standard. As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with river water. Thus, high COD values are judged to be caused by river water. Since October 2015, Operation Phase of Thilawa SEZ Zone A project, there is no discharge of industrial wastewater. This revealed that high COD level at GW-1 is judged not because of the industrial wastewater sink into the aquifer. High COD level may be caused by the presence of natural elements in that particular area, which can increase the COD in the groundwater. BOD level at GW-1 and SW-3 is slightly higher than the standard. It may be caused because either fluctuation condition (such as pollution condition, water fall rainfall, tide up from Rangun River, water flow rate) at that point during monitoring. But BOD at all points are lower than the standard at previous monitoring reports. Finally, BOD levels against with standard shall be evaluated as yearly average or 75 percentile among all of the data in a year. Thus assessment of water quality will be evaluated after 1 year's operation. Significantly, other heavy metals concentration at all monitoring points are lower than the standard. Certified analytical results from each laboratory are described in appendix.

Table 5. In-Situ Measurement and laboratory analysis of water quality (Phase 1, Operations Phase)

No	Parameter	SW-2	SW-3	SW-4	GW-1	Standard
1	Water Temperature (C)	29.31	29.29	29.52	33.94	40
2	pH	7.97	7.92	7.40	7.75	5 - 9
3	Suspended solid (mg/l)	320.67	718.33	463	16	30
4	DO (mg/l)	8.35	7.96	6.10	6.99	-
5	BOD (mg/l)	15	23	10	17	20
6	COD <sub>cr</sub> (mg/l)	67	76	62	57	70
7	Color (Pt.Co)	Not Objectable	Not Objectable	Not Objectable	Not Objectable	-
8	Odor	Natural	Natural	Natural	None	-
9	Total nitrogen (mg/l)	0.77	0.6	<0.6	1.47	-
10	Total phosphorus (mg/l)	<0.01	<0.01	<0.01	0.09	-
11	Total Coliform (MPN/100ml)	49	130	240	23	400



This table reveals that all of the monitoring results are under the limit (lower than the standard) except suspended solid content in all sampling points except GW-1 which are higher than the standard as previous times. Oil and grease level at only SW-3 is higher than the standard and also COD level at all points are higher than the standard. As of December 2015, Thilawa SEZ is not any discharging to the water body including SW-3. As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with river water. Moreover, some local boats frequently come along the Shwe Byauk Creek till to the bridge on the Thilawa Road in the downstream area of this creek. Thus, high COD and oil and grease values are judged to be caused by river water and running of the boats. Since October 2015, Operation Phase of Thilawa SEZ Zone A project, there is no discharge of industrial wastewater. This revealed that high COD level at GW-1 is judged not because of the industrial wastewater sink into the aquifer. High COD level may be caused by the presence of natural elements in that particular area, which can increase the COD in the groundwater. BOD level at GW-1 and SW-3 is slightly higher than the standard. It may be caused because either fluctuation condition (such as pollution condition, water fall rainfall, tide up from Rangoon River, water flow rate) at that point during monitoring. But BOD at all points are lower than the standard at previous monitoring reports. Finally, BOD levels against with standard shall be evaluated as yearly average or 75 percentile among all of the data in a year. Thus assessment of water quality will be evaluated after 1 year's operation. Significantly, other heavy metals concentration at all monitoring points are lower than the standard. Certified analytical results from each laboratory are described in appendix.

Table 6. In-Situ Measurement and laboratory analysis of water quality (Phase 2, Construction Phase)

No.	Parameter	SW-2	SW-3	SW-4	GW-1	Standard
1	Water Temperature (C)	29.31	29.29	29.52	33.94	40
2	pH	7.97	7.92	7.40	7.75	5 - 9
3	Suspended solid (mg/l)	320.67	718.33	463	16	30
4	DO (mg/l)	8.35	7.96	6.10	6.99	-
5	BOD (mg/l)	15	23	10	17	20
6	CODcr (mg/l)	67	76	62	57	70
7	Color (Pt.Co)	Not Objectable	Not Objectable	Not Objectable	Not Objectable	-
8	Odor	Natural	Natural	Natural	None	-
9	Total nitrogen (mg/l)	0.77	0.6	<0.6	1.47	-
10	Total phosphorus (mg/l)	<0.01	<0.01	<0.01	0.09	-
11	Total Coliform (MPN/100ml)	49	130	240	23	400
12	Chromium (mg/l)	<0.02	<0.02	<0.02	<0.02	0.5
13	Oil and grease (mg/l)	3.3	9.9	2.2	<0.2	5

## **APPENDIX**

### **LAB RESULTS**



**CLIENT** : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.**  
**CONTACT** : **Ms. Toe Toe Hlaing**  
**ADDRESS** : **B702 Delta Plaza, Shwegondaing Rd., Bahan, Yangon, Myanmar**  
**Tel. +959-73013448** **Fax. +951-552901**  
**E-mail : toetoehlainggeo@gmail.com**

**PROJECT NAME** : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
**SAMPLE DESIGNATED AS** : Surface Water Quality **SAMPLING DATE** : December 22, 2015  
**SAMPLING LOCATION** : Thilawa, Myanmar **SAMPLING BY** : Client

Parameters	Units	LOQ	Results		
			SW-2	SW-3	SW-4
Color	-	-	Not Objectable	Not Objectable	Not Objectable
Odor	-	-	Natural	Natural	Natural
Total Chromium (Cr)	mg/l	0.02	<0.02	<0.02	<0.02
Total Coliform Bacteria	MPN/100mL	-	48	130	240

Simpin I.  
(Simpin Imawilawan)  
Environmental Monitoring Manager

Therian Y.  
(Therian Yommana)  
Technical Manager

TY/Client(PPT/CI)

SGS (THAILAND) LIMITED



Report No. : 2015-01758 / 002 (Page 1 of 1)

Issued date : January 12, 2016

CLIENT : RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.  
CONTACT : Ms. Toe Toe Hlaing  
ADDRESS : B702 Delta Plaza, Shwegondaing Rd., Bahan, Yangon, Myanmar  
Tel. +959-73013448 Fax. +951-552901  
E-mail : toe.toehlainggeo@gmail.com

## Analysis Report

PROJECT NAME : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
SAMPLE DESIGNATED AS : Groundwater Quality  
SAMPLING DATE : December 22, 2015  
SAMPLING LOCATION : Thilawa, Myanmar  
SAMPLING BY : Client

Parameters	Units	LOQ	GW-1
Color	-	-	Not Objectable
Odor	-	-	None
Total Chromium (Cr)	mg/l	0.02	<0.02
Total Coliform Bacteria	MPN/100ml	-	23

Remarks : - Analysis Methods follow the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF) except the analytical method of Color is the visual method  
- LOQ = Limit of Quantitation

  
(Siriporn Imwilaiwan)

Environmental Monitoring Manager

  
(Thepsan Yommana)  
Technical Manager

SGS (THAILAND) LIMITED



TY/Client/PPT/CJ

110158



Job Ref: 6900/2015

Date : 31.12.2015

Page 1 of 2

Client Name : RESOURCE AND ENVIRONMENT MYANMAR CO., LTD  
B-702 Delta Plaza, Shwegondaing Rd, Bahan Township,  
Yangon, Myanmar

Project Name : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)

Sample Brought By : Client

Sample Location : Thilawa

Sample Received Date : 23.12.2015

Analysed Date : 24.12.2015

Results (mg/l)	Methods	Stations				Detection Limit
		SW-2 (22.12.15)	SW-3 (22.12.15)	SW-4 (22.12.15)	GW-1 (22.12.15)	
Lab Code	-	266/15	267/15	268/15	269/15	-
Commodity Name	-	Surface Water	Surface Water	Surface Water	Ground Water	-
BOD	In-house method based on Standard methods for the examination of water & waste water, APHA, AWWA & WEF, 22nd ed, 2012; 5210 D (Respirometric) and manual of BOD System Ox direct (Lovibond)	15	23	10	17	-
COD	In-house method based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 5220 D (Closed Reflux, Colorimetric) and manual of Photometer-system MD 100 and RD 125 Reactor (Lovibond)	67	76	62	57	-
Oil & Grease	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 5520 B	3.3	9.9	2.2	<0.2	0.2
Total Nitrogen (organic)	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 4500-N <sub>org</sub> C	0.77	0.6	<0.6	1.47	0.6



**WARNING:** The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) were said to be extracted. This document is issued by the Company under its General Conditions of Service printed overleaf or available on request and accessible at <http://www.sgs.com/termsandconditions>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute proof to a transaction from extending at their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample (s) tested and such sample (s) are retained for 7 days (in case of perishable items) and 30 days for all other samples. The samples from regulatory bodies are to be retained as specified. This document cannot be reproduced except in full, without prior written approval of the company.

Results (mg/l)	Methods	Stations				Detection Limit
		SW-2 (22.12.15)	SW-3 (22.12.15)	SW-4 (22.12.15)	GW-1 (22.12.15)	
Lab Code	-	266/15	267/15	268/15	269/15	-
Commodity Name	-	Surface Water	Surface Water	Surface Water	Ground Water	-
Total Suspended Solid	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 2540 D	320.67	718.33	463	16	2
Phosphorus	Laboratory Manual For the Physico-Chemical Analysis of Soil, Water and Plant ; Photometric (Ascorbic) Method	<0.01	<0.01	<0.01	0.09	0.01

\*\*\*\*\*End of report\*\*\*\*\*

SGS (Myanmar) Limited

(Nu Nu Yi)  
Manager

**WARNING:** The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) herein said to be extracted. This document is issued by the Company under its General Conditions of Service printed overleaf or available on request and accessible at <http://www.sgs.com/termsandconditions.htm>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute parties to a transaction from waiving all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample (s) tested and such sample (s) are retained for 7 days (in case of perishable items) and 30 days for all other samples. The samples from regulatory bodies are to be retained as specified. This document cannot be reproduced except in full, without prior written approval of the company.

**Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2**

**Appendix**

**Water and Waste Water Monitoring Report**

**February, 2016**



**MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED**

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**WATER QUALITY MONITORING IN THILAWA SEZ**  
**(PHASE 1, OPERATION STAGE)**  
**(PHASE 2, CONSTRUCTION STAGE)**

**(Bi-Monthly Monitoring)**

**February 2016**



Resource & Environment Myanmar Ltd. B-702/401 Delta Plaza Building, Shwegondaing Rd., Bahan, Yangon, MYANMAR

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[www.enviromyanmar.net](http://www.enviromyanmar.net)



## 1. INTRODUCTION

The water quality sampling points are in the Thilawa SEZ area, which is located in the Thanlyin and Kyauktan townships, about 20 km southeast of Yangon city (Figure 1). Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

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

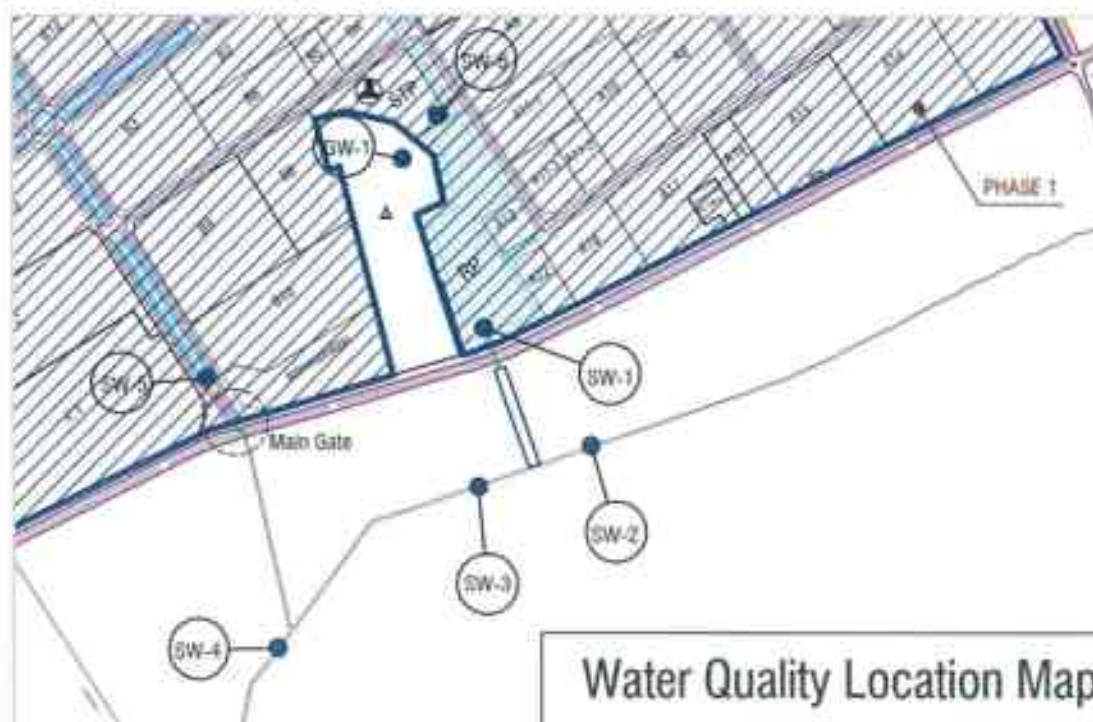


Figure 1. Location map of Thilawa SEZ area and water quality sampling locations

## 2. FIELD SURVEY

Water quality sampling for February 2016 was conducted in 4 locations (SW-2, SW-3, SW-4 and GW-1) among proposed 7 locations (GW-1, SW-1, SW-2, SW-3, SW-4, SW-5, SW-6).

### *Survey Item*

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards. There were four locations for water quality survey as SW-2, SW-3, W-4 and GW-1.

### *Summary of sampling points*

The detail of the locations of monitoring points are shown below.

Table 1. Locations of water quality sampling points

No.	Station	Type	Coordinate	Location
1.	SW-2	Surface Water	16° 40' 06.0" N 96° 16' 43.1" E	Upstream of Shwe Byauk Creek, Thilawa SEZ
2.	SW-3	Surface Water	16° 40' 05.5" N 96° 16' 41.6" E	Upstream of Shwe Byauk Creek, Thilawa SEZ
3.	SW-4	Surface Water	16° 39' 54.6" N 96° 16' 26.4" E	Downstream of Shwe Byauk Creek, Thilawa SEZ
4.	GW-1	Ground Water	16° 40' 25.1" N 96° 16' 31.7" E	In Moegyoe Swan Monastery, Thilawa SEZ



Figure 2. Location map of water quality sampling points

#### SW-2

SW-2 was collected at the upstream of Shwe Byauk Creek which is flowing generally from east to west and then entering into the Yangon River. This sampling point is also located at south of Class A area and Dagon-Thilawa car road. The surrounding area are Class A in the north, industrial compound in the east and paddy field in the south and west respectively.





Figure 3. Surface water sampling at SW-2

#### SW-3

SW-3 was collected at the upstream of Shwe Byauk Creek which is flowing generally from east to west and then entering into the Yangon River. It is distanced about 60 m downstream of SW-2. This sampling point is also located at south of Class A area and Dagon-Thilawa car road. The surrounding area are Zone A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 4. Surface water sampling at SW-3

#### SW-4

SW-4 was collected at the downstream of Shwe Byauk Creek, which is flowing generally from east to west and then entering into the Yangon River. It is distanced about 500 m downstream of SW-3. This sampling point is also located at south of Zone A area and Dagon-Thilawa car road. The surrounding area are Zone A in the north, industrial compound in the east and paddy field in the south and west respectively.



Figure 5. Surface water sampling at SW-4

#### GW-1

W-6 was collected from tube well as ground water sample. It is located in the compound of Moegyoe Swan Monastery as well as in the Zone A area. The transparency of the ground water is high.



Figure 6. Ground water sampling at GW-1

#### Survey Period

Water quality survey was conducted on 10 February, 2016.

Sample Point	SW-2	SW-3	SW-4	GW-1
Sampling Time	8:35 AM	9:00 AM	9:25 AM	10:15 AM

#### Survey 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 as pH, temperature, velocity, dissolved oxygen (DO), electrical conductivity (EC), and turbidity 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 2. Field Equipment for river flow measurement and water quality survey**

No.	Equipment	Manufacturer	Originate Country	Model
1	Multi-parameter (Temp., pH, EC, ORP, DO, TDS, Turbidity)	HANNA	USA	HI7609829 (with 3 sensors)
2	SmarTROLL multi-parameter	In-situ Inc.	USA	-
3	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

**Table 3. Container and preservation method of water samples for laboratory analysis**

No.	Parameter	Container	Preservation
1	BOD, COD	1000 ml glass bottle	Refrigerate
2	Suspended solid	1000 ml plastic bottle	Refrigerate
3	Coliform	1000 ml glass bottle	Refrigerate
4	Other	2000 ml plastic bottle	Refrigerate

The following table provides the test method for water quality.

**Table 4. Analytical method for water quality**

No.	Item	Analysis method	Sampling point
			SW-2, SW-3, SW-4, GW-1
1	Water Temperature	HI7609829-1 Sensor	✓
2	pH	HI7609829-1 Sensor	✓
3	Dissolved Oxygen (DO)	HI7609829-2 Sensor	✓
4	Suspended Solid	APHA-AWWA-WEF Method	✓
5	BOD	APHA-AWWA-WEF Method	✓
6	COD (Cr)	APHA 5220 D (Closed Reflux Colorimetric Method)	✓
7	Color	APHA-AWWA-WEF Method	✓
8	Odor	APHA-AWWA-WEF Method	✓
9	Total Nitrogen	APHA-AWWA-WEF Method	✓
10	Total Phosphorus	Photometric Method	✓
11	Total Coliform	APHA-AWWA-WEF Method	✓

APHA – American Public Health Association; AWWA – American Water Work Association;  
 WEF – Water Environment Federation; Odor is based on ISO 8588-1987

### **Survey Result**

Water samples were sent to SGS Myanmar and SGS Thailand laboratories. Water quality results are shown in following table.

This table reveals that all of the monitoring results. Suspended Solid and COD levels are higher than the standard as previous times in all sampling points. Oil and grease level at only SW-2 is slighter higher than the standard and also COD level at all points are higher than the standard. As of February 2016, Thilawa SEZ is not any discharging to the water body including SW-2. As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with river water. With respect to COD, it is known that chlorine in brackish water is affected to COD analysis value if pretreatment is carried out. Thus one of the probable reasons of high value of COD analysis might be affected by Yangon River. Identification of the reason of this phenomenon shall be monitored continuously. With respect to oil and grease, some local boats frequently come along the Shwe Byauk Creek till to the bridge on the Thilawa Road in the downstream area of this creek. Thus, high oil and grease values might be caused by Yangon River water and running of the boats. Since October 2015, Operation Phase of Thilawa SEZ Zone A project, there is no discharge of industrial wastewater. This revealed that high COD level at GW-1 is judged not because of the industrial wastewater sink into the aquifer. High COD level may be caused by the presence of natural elements in that particular area, which can increase the COD in the groundwater. Significantly, other heavy metals concentration at all monitoring points are lower than the standard. Certified analytical results from each laboratory are described in appendix.

Table 6. In-Situ Measurement and laboratory analysis of water quality (Phase 2, Construction Phase)

No	Parameter	SW-2	SW-3	SW-4	GW-1	Standard
1	Water Temperature (C)	21.73	22.26	22.17	33.07	40
2	pH	6.16	6.28	6.55	6.74	5 - 9
3	Suspended solid (mg/l)	2711	2003	2052	48.7	30
4	DO (mg/l)	6.67	7.16	6.84	6.99	-
5	EC ( $\mu$ s/cm)	10031.1	9760.7	9831.7	3500.2	-
6	Salinity (psu)	6.2	5.9	5.9	1.6	-
7	BOD (mg/l)	4	5	3	5	20
8	CODcr (mg/l)	1290	1230	1360	90	70
9	Color (Pt.Co)	Natural	Natural	Natural	<1	-
10	Odor	Natural	Natural	Natural	None	-
11	Total nitrogen (mg/l)	1.96	1.4	1.26	<1	-
12	Total phosphorus (mg/l)	0.019	0.02	0.038	0.019	-
13	Total Coliform (MPN/100ml)	35,000	3,300	2,200	<1.1	400
14	Chromium (mg/l)	<0.02	<0.02	<0.02	<0.02	0.5
15	Oil and grease (mg/l)	5.1	<5	<5	<5	5

This table reveals that all of the monitoring results. Suspended Solid and COD(Cr) levels are higher than the standard as previous times in all sampling points. As the sampling was carried out during the flood tide, the upstream of surface water sampling points is totally influent and contaminated with Yangon River water. Since Yangon River is a tidal river, the COD(Cr) result at SW-2, SW-3 and SW-4 have possibilities of containing a large amount of chloride ions. Therefore, these results might have positive interfered by chloride ion. Since October 2015, Operation Phase of Thilawa SEZ Zone A project, there is no discharge of industrial wastewater. This revealed that high COD(Cr) level at GW-1 is judged not because of the industrial wastewater sink into the aquifer. High COD(Cr) level may be caused by the presence of natural elements in that particular area, which can increase the COD(Cr) in the groundwater. Certified analytical results from each laboratory are described in appendix.

Table 5. In-Situ Measurement and laboratory analysis of water quality (Phase 1, Operations Phase)

No.	Parameter	SW-2	SW-3	SW-4	GW-1	Standard
1	Water Temperature (C)	21.73	22.26	22.17	33.07	40
2	pH	6.16	6.28	6.55	6.74	5 - 9
3	Suspended solid (mg/l)	2711	2003	2052	48.7	30
4	DO (mg/l)	6.67	7.16	6.84	6.99	-
5	EC ( $\mu$ s/cm)	10031.1	9760.7	9831.7	3500.2	-
6	Salinity (psu)	6.2	5.9	5.9	1.6	-
7	BOD (mg/l)	4	5	3	5	20
8	COD Cr(mg/l)*	1290	1230	1360	90	70
9	Color (Pt.Co)	Natural	Natural	Natural	<1	-
10	Odor	Natural	Natural	Natural	None	-
11	Total nitrogen (mg/l)	1.96	1.4	1.26	<1	-
12	Total phosphorus (mg/l)	0.019	0.02	0.038	0.019	-
13	Total Coliform (MPN/100ml)	35,000	3,300	2,200	<1.1	400

\*Note: According to this analysis method, the samples containing more than 2000 mg Cl-/L is not applicable for this method.

## **APPENDIX**

### **LAB RESULTS**

**Report No. : 2016-00181 / 001 (Page 1 of 1)**

Issued date : March 1, 2016

**CLIENT** : RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.  
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E-mail : toetoehlainggeo@gmail.com

## Analysis Report

**PROJECT NAME** : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
**SAMPLE DESIGNATED AS** : Surface Water Quality **SAMPLING DATE** : February 10, 2011  
**SAMPLING LOCATION** : Thilawa, Myanmar **SAMPLING BY** : Client

Parameters	Units	LOQ	Results		
			SW-2	SW-3	SW-4
Color	-	-	Natural	Natural	Natural
Odor	-	-	Natural	Natural	Natural
Total Chromium (Cr)	mg/l	0.02	<0.02	<0.02	<0.02
Total Coliform Bacteria	MPN/100mL	1.8	35,000	3,300	2,200

**Remarks :** - Analysis Methods follow the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF) except parameters as follows :  
• Odor is base on ISO 8588-1987.  
• Color follows the visual method.  
- LOQ = Limit of Quantitation

(Siriporn Imwilaiwan)  
Environmental Monitoring Manager

(Thepson Yommana)  
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/JC/Cj

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**Report No. : 2016-00181 / 002 (Page 1 of 1)**

Issued date : March 1, 2016

**CLIENT** : RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.  
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**Analysis Report**

**PROJECT NAME** : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
**SAMPLE DESIGNATED AS** : Groundwater Quality **SAMPLING DATE** : February 10, 2016  
**SAMPLING LOCATION** : Thilawa, Myanmar **SAMPLING BY** : Client

Parameters	Units	LOQ	GW-1
Color	Pt.Co	-	<1
Odor	-	-	None
Total Chromium (Cr)	mg/l	0.02	<0.02
Total Coliform Bacteria	MPN/100mL	1.1	<1.1

**Remarks :** - Analysis Methods follow the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF) except the analytical method of Color is the visual method.  
- LOQ = Limit of Quantitation

---

(Siripom Imwilaiwan)

Environmental Monitoring Manager

---

(Thapson Yommana)

Technical Manager

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## ANALYSIS REPORT

Job Ref: 0627/2016

Date : 25.02.2016

Page 1 of 2

Client Name : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD**  
**B-702 Delta Plaza, Shwegondaing Rd, Bahan Township,**  
**Yangon, Myanmar**

Project Name : **Environmental Monitoring in Thilaw SEZ, Zone A (Phase I)**

Sample Brought By : **Client**

Sample Location : **Thilawa**

Sample Received Date : **11.02.2016**

Analysed Date : **11.02.2016**

Results (mg/l)	Methods	Stations				Detection Limit
		GW-1 (10.2.16)	SW-2 (10.2.16)	SW-3 (10.2.16)	SW-4 (10.2.16)	
Lab Code	-	018/16	019/16	020/16	021/16	-
Commodity Name	-	Ground Water	Surface Water	Surface Water	Surface Water	-
Total Suspended Solid	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 2540 D	48.7	2711	2003	2052	20
Oil & Grease	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 5520 B	<5	5.1	<5	<5	5
Total Nitrogen (organic)	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 4500-N <sub>org</sub> C	<1	1.96	1.4	1.26	1
Total Phosphorus	Laboratory Manual For the Physico-Chemical Analysis of Soil, Water and Plant; Photometric (Ascorbic) Method	0.019	0.019	0.02	0.038	0.01



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Results (mg/l)	Methods	Stations				Detection Limit
		GW-1 (10.2.16)	SW-2 (10.2.16)	SW-3 (10.2.16)	SW-4 (10.2.16)	
Lab Code	-	018/16	019/16	020/16	021/16	-
Commodity Name	-	Ground Water	Surface Water	Surface Water	Surface Water	-
BOD	In-house method based on Standard methods for the examination of water & waste water, APHA, AWWA & WEF, 22nd ed, 2012; 5210 D (Respirometric) and manual of BOD System Ox direct (Lovibond)	5	4	5	3	2
COD	In-house method based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 5220 D (Closed Reflux, Colorimetric) and manual of Photometer-system MD 100 and RD 125 Reactor (Lovibond)	90	1290	1230	1360	10

\*\*\*\*\* End of report \*\*\*\*\*

SGS (Myanmar) Limited

(Nu Nu Yi)  
Manager

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**Report No. : 2016-00192 / 001 (Page 1 of 1)**

Issued date : March 8, 2016

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**Analysis Report**

**PROJECT NAME** : Environmental Monitoring in Thilawa SEZ, Zone A (Phase I)  
**SAMPLE DESIGNATED AS** : Wastewater Quality **SAMPLING DATE** : February 2, 2016  
**SAMPLING LOCATION** : Thilawa, Myanmar **SAMPLING BY** : Client

Parameters	Units	LOQ	WW-2
Color*	-	-	Not Objectable
Odor*	-	-	Not Objectable
Phenol	mg/l	0.001	<0.001
Formaldehyde	mg/l	0.01	<0.01
Free Chlorine (Cl <sub>2</sub> )	mg/l	0.01	0.04
Cyanide (CN)	mg/l	0.05	<0.05
Arsenic (As)	mg/l	0.01	<0.01
Barium (Ba)	mg/l	0.1	<0.1
Total Chromium (Cr)*	mg/l	0.02	<0.02
Cadmium (Cd)	mg/l	0.01	<0.01
Lead (Pb)	mg/l	0.05	<0.05
Nickel (Ni)	mg/l	0.06	<0.06
Mercury (Hg)	mg/l	0.0005	<0.0005
Selenium (Se)	mg/l	0.01	<0.01
Total Coliform Bacteria*	MPN/100mL	-	920,000

**Remarks :** - Analysis Methods follow the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF) except parameters as follows :

- Color follows the visual method.
- Odor is base on ISO 8588-1987.
- Formaldehyde follows Water and Wastewater Analysis endorsed by Environmental Engineering Association of Thailand (EEAT).
- Mercury (Hg) follows U.S. EPA method 245.1.

- LOQ = Limit of Quantitation  
\* Analysis(s) is/are not included in scope of Accreditation by Department of Industrial Works of Thailand.

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Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2

Appendix

Air Quality Monitoring Report

January, 2016





**MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED**

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## **AIR QUALITY MONITORING IN THILAWA SEZ, ZONE A (PHASE 2)**

**January 2016**



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### Survey Item

Parameters for air quality survey were determined by referring environmental quality standard for air in Thailand and Japan as shown in following table.

As there is no environmental standard for ambient air quality in Republic of Myanmar, the survey result was evaluated by comparing with Japan and Thailand standards.

Table-1. Survey parameters and target levels for air quality

Parameters	Averaging Period	Value
SO <sub>2</sub>	24 hours	0.12 ppm <sup>1</sup>
CO	24 hours	9 ppm <sup>1</sup>
NO <sub>2</sub>	24 hours	0.04 – 0.06 ppm <sup>2</sup>
TSP	24 hours	0.33 mg/m <sup>3</sup> <sup>1</sup>
PM10	24 hours	0.12 g/m <sup>3</sup> <sup>1</sup>

### Summary of sampling points

The detail of the location of air quality monitoring point is shown below.

Table-2. Location of air quality monitoring station.

Sampling Point	Coordinates	Description of Sampling Point
AQ-1	16°41'13.4"N, 96°15'51.9"E	In the Zone A area, Thilawa SEZ

Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
25.1.2016	10:00-11:00	209.2667	12.6833	26.1167	100.0333	5.7000
25.1.2016	11:00-12:00	202.7667	30.8667	10.2833	56.5667	2.1667
25.1.2016	12:00-13:00	266.8000	32.6333	23.3667	26.2333	1.0000
25.1.2016	13:00-14:00	239.0500	48.0667	2.9667	31.0833	1.0000
25.1.2016	14:00-15:00	273.0167	38.7500	5.9667	165.7167	1.0000
25.1.2016	15:00-16:00	407.1833	20.1667	2.0667	28.6833	1.1000
25.1.2016	16:00-17:00	372.5500	9.0333	7.1333	15.1833	5.7167
25.1.2016	17:00-18:00	323.8833	20.7000	9.1667	18.0000	2.7167
25.1.2016	18:00-19:00	311.0000	20.2000	5.4333	21.2667	1.0333
25.1.2016	19:00-20:00	325.6667	15.4167	4.4333	25.7667	1.0000
25.1.2016	20:00-21:00	295.0833	21.5667	4.6000	22.7333	1.0000
25.1.2016	21:00-22:00	276.4500	22.4000	4.5333	22.9333	1.0000
25.1.2016	22:00-23:00	263.4000	61.0500	8.2500	29.2000	1.0000
25.1.2016	23:00-00:00	232.0833	78.2500	5.2500	29.9500	1.0000
26.1.2016	00:00-01:00	208.5000	77.0333	5.7667	35.2667	1.0000
26.1.2016	01:00-02:00	190.5000	83.5500	7.8333	26.2167	1.0000
26.1.2016	02:00-03:00	177.5500	82.3167	12.0333	24.5000	1.0000
26.1.2016	03:00-04:00	167.9500	84.2333	8.8333	26.7333	1.1500
26.1.2016	04:00-05:00	164.7500	85.7333	10.3667	20.7500	1.0000
26.1.2016	05:00-06:00	159.4833	58.5500	9.8000	16.9500	1.0000
26.1.2016	06:00-07:00	157.1667	66.5667	6.6333	17.9333	1.1000
26.1.2016	07:00-08:00	188.9333	35.3333	3.3833	26.0167	1.5667
26.1.2016	08:00-09:00	198.5833	33.5667	4.3500	24.4667	1.0667
26.1.2016	09:00-10:00	192.9000	24.2167	25.2167	16.1333	1.0000
MAX	24hours	407.1833	85.7333	26.1167	165.7167	5.7167
MIN	24hours	157.1667	9.0333	2.0667	15.1833	1.0000
Average	24hours	241.8549	44.2868	8.9076	34.5132	1.5549

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.407	0.086	0.026	0.166	0.006
MIN	24hours	0.157	0.009	0.002	0.015	0.001
Average	24hours	0.242	0.044	0.009	0.035	0.002

Thilawa Special Economic Zone (Zone A)  
Development Project –Phase 2

Appendix

Noise and Vibration Monitoring Report

January, 2016



**MYANMAR JAPAN THILAWA DEVELOPMENT LIMITED**

---

## **NOISE AND VIBRATION MONITORING IN THILAWA SEZ (PHASE 2, CONSTRUCTION STAGE)**

**January 2016**



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## 1. INTRODUCTION

The monitoring points are sited in the Thilawa SEZ area, which is located in the Thanlyin and Kyauktan townships, about 20 km southeast of Yangon city (Figure 1). Thilawa SEZ is surrounded by ring road and accompanied with the container ports along the Yangon River.

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

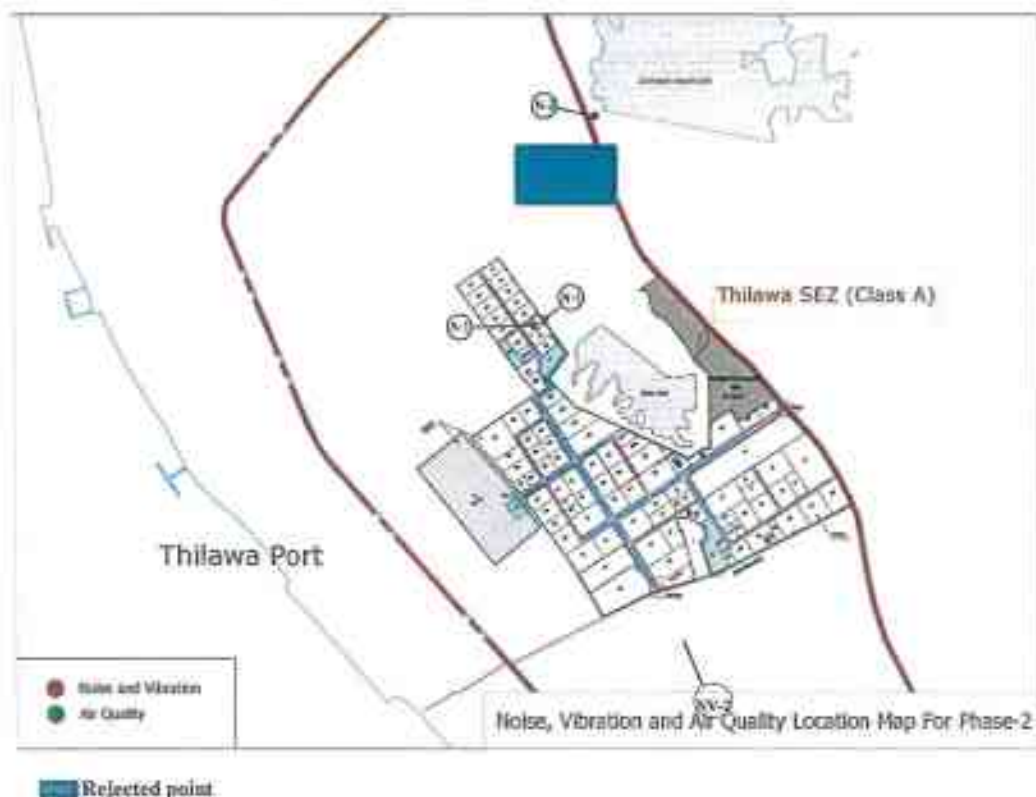


Figure 1. Location map of Thilawa SEZ area and monitoring locations

## 2. ENVIRONMENTAL STANDARD

### (A) Noise

#### *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 Finance 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").
- Noise level from traffic is different characteristic from ambient noise, and higher. Though the noise level for living area is set, there is no target level specified for traffic noise along the road. Therefore, tentative target levels for traffic noise along the road are set in accordance with the Japanese traffic noise target level.

This target noise level is shown in Table 1 and 2, 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. Target traffic noise level in construction phase

Category	Day time (Leq) (6am-10pm)	Night Time (Leq) (10pm-6am)
Along the Four Lane road	75 dB	70 dB

Note: Applied "proximity to major arterial roads"

Source: Noise Regulation Law (Japan) (Law No.98 of 1986, latest Amendment by Law No.91 of 2000)

Table 3. Noise standard at construction stage in various countries

Items		Day time (Leq)	Night time (Leq)
Japan	Using heavy equipment 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)	-

Items		Day time (Leq)	Night time (Leq)
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

### 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.

- Ambient noise standard for sensitive areas of Japan and International Organization, relatively high in comparison with the results of baseline survey especially during night time.
- 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 4 and the target noise level is not so much difference comparing with ambient noise standard as shown in Table 5.

Table 4. Target 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 5. Noise standard at operation stage in South-East Asia 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: Noise Standard in Indonesia (KEP-48/MENLH/11/1996)

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

## (B) Vibration

As there is no vibration standard to receptors in Myanmar, the target vibration level at construction phase shall be set based on the standards in some foreign countries. Accordingly the target level of vibration 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.

## 3. FIELD SURVEY

The survey included noise and vibration monitoring for three locations in Thilawa SEZ area.

### *Survey Item*

#### (A) Noise

Parameter for noise level survey was determined by referring the environmental quality standards in Japan and other countries for operation stage as shown in Table 6.

Table 6. Survey parameters for noise level

No.	Parameter	Category	Day Time (Leq) (7am-7pm)	Evening Time (Leq) (7pm-10pm)	Night Time (Leq) (10pm-7am)
1	A-weighted loudness equivalent (LAeq)	Residential houses and monastery located more than 150m from the construction site, office, commercial facilities, and factories	75 dB	65 dB	65 dB
2		Along the four lane road which was 15m distance from the Admin Compound	Day time (Leq) (6am-10pm)  75 dB	Night Time (Leq) (10pm-6am)  70 dB	

#### (B)



### (C) 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 millimeters 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

### *Summary of sampling points*

The details of the locations of monitoring points are shown below.

Table 7. Locations of noise and vibration monitoring stations

Sampling Point	Coordinates	Description of Sampling Point
NV-1	16° 41' 12.43" N 96° 15' 54.11" E	Inside of the Thilawa class A expansion compound.
NV-2	16° 40' 10.86" N 96° 16' 31.36" E	In front of Administrative Building, Thilawa SEZ Class A.



Figure 2. Location map of noise and vibration monitoring locations

#### NV-1

NV-1 was an open area located within the Class A expansion area, north of Class A. It is surrounded by Thilawa dam in the south, residential area in the northeast and garment factory in the west respectively. There is an access road situated north of NV-1 and which is paved with moderately traffic volume. Dominant source of noise was vehicular traffic activity nearby the site. Noise and vibration monitoring at NV-1 is shown in figure 3.



Figure 3. Noise and vibration monitoring at NV-1.

#### NV-2

NV-2 was sited in front of Administrative Building in Thilawa SEZ Class A. It is an opened area and close to Dagon-Thilawa road, distanced about 15m away. The road was paved with moderate to highly traffic volume during not only the day time but also the night time, by passing of dump truck, loader vehicles and others construction machines. Dominant sources of noise were vehicle traffic during the day time. Noise and vibration monitoring at NV-2 is shown in figure 4.



Figure 4. Noise and vibration monitoring at NV-2.

#### Survey Period

Sampling and monitoring of surrounding sound and vibration level at NV-1 and NV-2 were conducted during 20<sup>th</sup> - 22<sup>th</sup> January 2016.

Sampling Point	Survey Period
NV-1	20 <sup>th</sup> - 21 <sup>st</sup> January, 2016 (24 hours)
NV-2	21 <sup>st</sup> - 22 <sup>nd</sup> January, 2016 (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

#### Survey Result

##### (A) Noise

Noise levels ( $L_{Aeq}$ ) of the monitoring points were presented in Table 7. 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  $L_{Aeq}$ .

$$10^{\text{LOG10}\{\text{AVERGAE}(10^{((\text{RANGE})/10))}\}}$$

By means of the calculated results, all noise levels found lower than the environmental standard (1-day) of the target value. Previously, the target noise level for NV-1 result is within the ambient noise level standard which was located within the Class A expansion area, north of Class A. Previously, the target noise level for NV-2 was targeted the ambient noise level at the Phase 2, Construction Phase Report (No.1). However, since the location of NV-2 is located in Admin building compound which is close to the public main road distance 15m, the target noise level should be changed to the Traffic Noise level

standard. Therefore, from this report the new target noise level (Traffic Noise Level) is used. Noise level ( $L_{Aeq}$ ) in present monitoring period was presented in Table 8 to 11.

Table 8. Hourly  $L_{Aeq}$  value at NV-1 (Ambient noise)

Unit: dBA

Time	NV-1
	20-21 January
7:00-8:00	50.83
8:00-9:00	66.92
9:00-10:00	65.10
10:00-11:00	65.15
11:00-12:00	49.33
12:00-13:00	43.94
13:00-14:00	56.08
14:00-15:00	61.43
15:00-16:00	57.54
16:00-17:00	52.06
17:00-18:00	48.98
18:00-19:00	47.24
Day $L_{Aeq}$	60.77
19:00-20:00	49.55
20:00-21:00	48.52
21:00-22:00	49.17
Evening $L_{Aeq}$	49.10
22:00-23:00	48.80
23:00-24:00	47.36
24:00-1:00	50.86
1:00-2:00	52.96
2:00-3:00	45.28
3:00-4:00	47.45
4:00-5:00	52.81
5:00-6:00	54.59
6:00-7:00	44.19
Night $L_{Aeq}$	50.65

**Table 9. Hourly  $L_{Aeq}$  value at NV-2 (Traffic noise)**  
Unit: dBA

Time	NV-2
	21 <sup>st</sup> - 22 <sup>nd</sup> January
6:00-7:00	69.79
7:00-8:00	67.63
8:00-9:00	64.65
9:00-10:00	72.03
10:00-11:00	66.92
11:00-12:00	72.23
12:00-13:00	64.20
13:00-14:00	55.91
14:00-15:00	59.82
15:00-16:00	59.90
16:00-17:00	66.49
17:00-18:00	68.81
18:00-19:00	73.37
19:00-20:00	64.84
20:00-21:00	76.12
21:00-22:00	68.35
Day $L_{Aeq}$	69.58
22:00-23:00	48.08
23:00-24:00	52.61
24:00-1:00	49.00
1:00-2:00	44.14
2:00-3:00	45.29
3:00-4:00	40.04
4:00-5:00	42.54
5:00-6:00	47.32
Night $L_{Aeq}$	47.67



Table 10. A-weighted Loudness Equivalent ( $L_{Aeq}$ ) Level of NV-1  
Unit: dB(A)

Date	21th - 22th January 2016		
	NV-1 (Ambient Noise)		
	Day Time	Evening Time	Night Time
Average Result	60.8	49.1	50.1
Target Noise Level	75	65	65

Table 11. A-weighted Loudness Equivalent ( $L_{Aeq}$ ) Level of NV-2  
Unit: dB(A)

Date	21th - 22th January 2016	
	NV-2 (Traffic Noise)	
	Day Time	Night Time
Average Result	69.6	47.7
Target Noise Level from Traffic	75	70

#### (B) Vibration

Vibration results were presented in Figure 5 and 6. Table of observed vibration level is presented in Appendix.

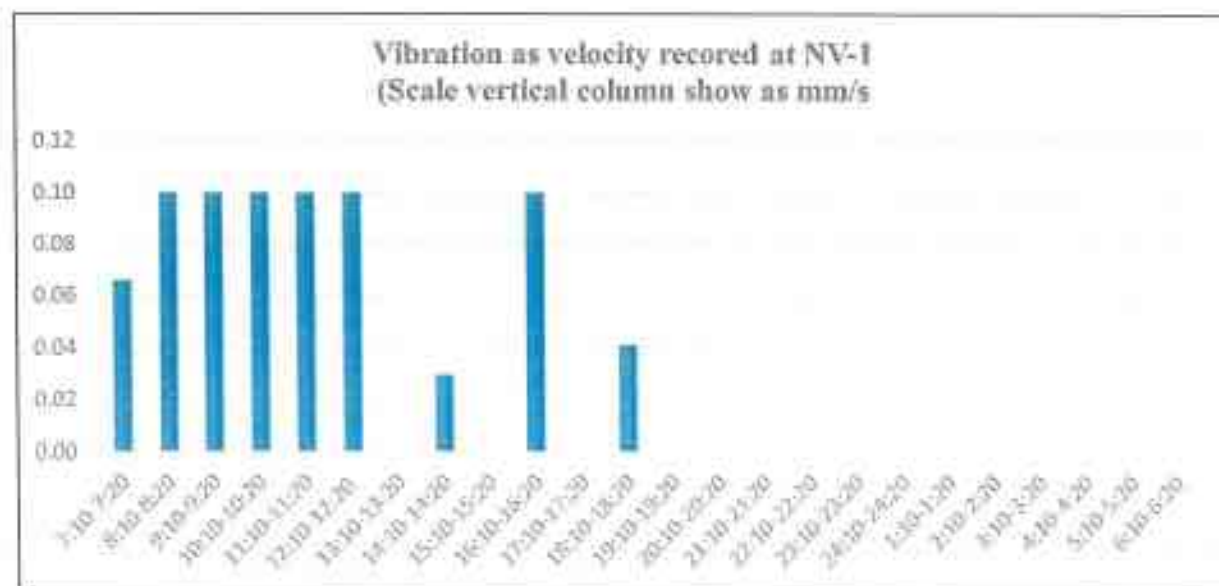


Figure 5. Vibration result of NV-1.

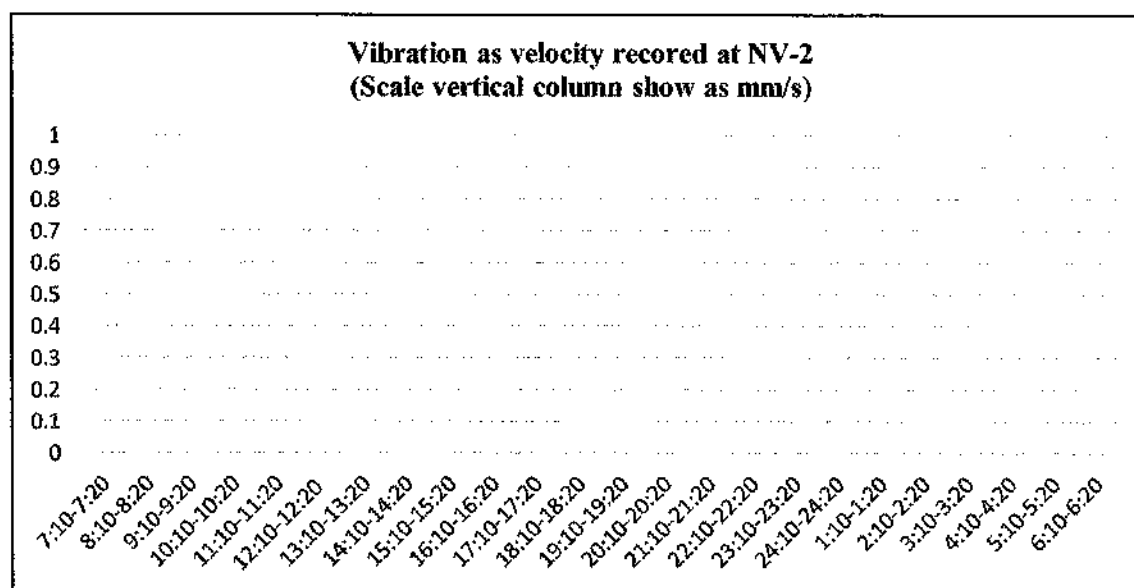


Figure 6. Vibration result of NV-2.

#### 4. CONCLUSION

The noise level monitoring results are compared with target noise level proposed in this report (See Table 3). One noise receptor was designated in construction phase based on the baseline noise data.

All the noise level monitoring points are lower than the target noise level (See Table 8 to 11).

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 millimeters 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.

The observed noise and vibration in all monitoring points are lower than the target level.

During the same time monitoring condition, NV-1 & NV-2 were same ambient activities.

## APPENDIX

Observed vibration level in 2 monitoring stations

Vibration as Velocity (mm/s)

Time	NV-1 (20-21 January)	NV-2 (21-22 January)
7:10-7:20	0.07	0
8:10-8:20	0.10	0
9:10-9:20	0.10	0
10:10-10:20	0.10	0
11:10-11:20	0.10	0
12:10-12:20	0.10	0
13:10-13:20	0.00	0
14:10-14:20	0.03	0
15:10-15:20	0.00	0
16:10-16:20	0.10	0
17:10-17:20	0.00	0
18:10-18:20	0.04	0
19:10-19:20	0.00	0
20:10-20:20	0.00	0
21:10-21:20	0.00	0
22:10-22:20	0.00	0
23:10-23:20	0.00	0
24:10-24:20	0.00	0
1:10-1:20	0.00	0
2:10-2:20	0.00	0
3:10-3:20	0.00	0
4:10-4:20	0.00	0
5:10-5:20	0.00	0
6:10-6:20	0.00	0



Figure-1. Location map of air quality monitoring point

#### AQ-1

This station was installed in the flat area, in the northern part of Thilawa SEZ Zone A. AQ-1 is bounded by Thilawa dam in southeast, agricultural land and residential houses of Alwan sok village in north and garment factory in the west respectively. Possible emission source is from daily human activities in Alwan sok village far about 400 m from this monitoring location.



Figure-2. Air quality monitoring at AQ-1

### **Survey Period**

Air quality monitoring was conducted seven consecutive days during January 2016. The measurement duration is shown in the following table.

Table-3. Sampling duration for air quality survey

Sampling Point	Period
AQ-1	19 <sup>th</sup> - 26 <sup>th</sup> January, 2016

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
- Standard configuration measures PM2.5, PM10 or TSP particulates, CO, NO, NO<sub>2</sub>, SO<sub>2</sub>, temperature, and relative humidity
- Wind parameters are also measured by Haz-scanner EPAS and the required data are analyzed by using the WRPLOT View of AERMOD View (ver. 7.0) in which calm wind is defined below 0.5 m/s.

Table-4. Sampling and analysis method for air quality

No.	Parameter	Analysis Method
1	Sulfur dioxide (SO <sub>2</sub> )	On site reading
2	Carbon monoxide (CO)	On site reading
3	Nitrogen dioxides (NO <sub>2</sub> )	On site reading
4	Total Particle matter (TSP)	On site reading
5	Particle matter 10 (PM10)	On site reading

Source: Resource & Environment Myanmar Co., Ltd.

### **Survey Result**

Daily average of ambient gases levels at AQ-1 for 7 consecutive are presented in following tables. All ambient gases levels and particulate matters in each day are lower than the environmental standard (1-day) referred. Generally, it indicated the area had few emission sources and it was certainly to say the measured data were baseline level in the area.

Table-5. Ambient air quality at AQ-1

	Date	Time	Co	NO2	TSP	PM (10)	SO2
	D.M.Y	Hours	ppm	ppm	mg/m3	mg/m3	ppm
1	19-20 January, 2016	24	0.31	0.05	0.08	0.03	0.01
2	20-21 January, 2016	24	0.36	0.03	0.09	0.02	0.02
3	21-22 January, 2016	24	0.38	0.04	0.07	0.01	0.01
4	22-23 January, 2016	24	0.37	0.04	0.07	0.01	0.01
5	23-24 January, 2016	24	0.27	0.04	0.06	0.01	0.01
6	24-25 January, 2016	24	0.29	0.04	0.06	0.01	0.00
7	25-26 January, 2016	24	0.24	0.04	0.03	0.01	0.00
Maximum		24	0.38	0.05	0.09	0.03	0.02
Average		24	0.32	0.04	0.07	0.01	0.01
Minimum		24	0.24	0.03	0.03	0.01	<0.01
Target value		24	1.0	<0.06	<0.33	<0.12	<0.04

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

Sometime, during the monitoring of air quality, some values for first 2 or 3 hours after starting the EPAS (Environmental Perimeter Air Monitoring System) in each survey point may not be consistent or deviated from the actual environmental condition. Because of the sensors in EPAS may not be proper calibration itself for a few hours after starting and it may need the time to calibrate the gaseous concentration in recent point/environment with the logged value of previous point.



**Appendix**

**Hourly Air Results**

Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
19.1.2016	10:00-11:00	0.0000	345.7750	200.2500	86.9750	1.0000
19.1.2016	11:00-12:00	22.4681	129.0213	91.8511	62.4468	6.5532
19.1.2016	12:00-13:00	22.4681	129.0213	91.8511	62.4468	6.5532
19.1.2016	13:00-14:00	45.3167	7.7000	17.6000	31.6500	30.4000
19.1.2016	14:00-15:00	136.4167	3.0167	28.0500	28.4333	3.6000
19.1.2016	15:00-16:00	264.8000	11.8167	25.8167	39.5000	25.4000
19.1.2016	16:00-17:00	343.4333	44.7500	5.8833	37.3167	9.6167
19.1.2016	17:00-18:00	532.4500	65.9333	2.0833	104.5000	4.8333
19.1.2016	18:00-19:00	389.7500	2.0000	2.9000	91.4167	1.0000
19.1.2016	19:00-20:00	395.9714	2.0000	2.5429	71.6286	1.0000
19.1.2016	20:00-21:00	1064.4231	101.5385	6.6154	109.1538	1.9423
19.1.2016	21:00-22:00	822.5500	66.8333	4.5833	114.2000	2.1333
19.1.2016	22:00-23:00	368.4500	69.7333	5.4333	117.0500	1.2500
19.1.2016	23:00-00:00	422.1190	49.0952	9.0714	117.4762	1.0476
20.1.2016	00:00-01:00	445.5833	44.0167	5.3833	149.1167	2.1333
20.1.2016	01:00-02:00	311.4500	37.4167	5.5000	127.3833	3.3333
20.1.2016	02:00-03:00	250.0167	29.5500	6.6667	104.3333	7.4667
20.1.2016	03:00-04:00	214.0667	18.3667	10.9000	56.2667	8.2167
20.1.2016	04:00-05:00	273.1000	29.4667	8.8167	66.2500	24.1167
20.1.2016	05:00-06:00	100.4833	41.2167	6.9167	71.9167	1.5667
20.1.2016	06:00-07:00	217.9500	42.7333	10.0333	86.5667	6.3667
20.1.2016	07:00-08:00	325.6500	19.6833	57.2500	99.8833	4.5333
20.1.2016	08:00-09:00	184.3167	11.4000	35.7667	57.1333	10.5333
20.1.2016	09:00-10:00	299.9667	2.3333	42.1167	64.4167	20.7833
<b>MAX</b>	<b>24hours</b>	1064.4231	345.7750	200.2500	149.1167	30.4000
<b>MIN</b>	<b>24hours</b>	0.0000	2.0000	2.0833	28.4333	1.0000
<b>Average</b>	<b>24hours</b>	310.5500	54.3507	28.4951	81.5609	7.7242

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	1.064	0.346	0.200	0.149	0.030

MIN	24hours	0.000	0.002	0.002	0.028	0.001
Average	24hours	0.311	0.054	0.028	0.082	0.008

Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
20.1.2016	10:00-11:00	185.9000	2.2667	36.6500	46.7000	33.1500
20.1.2016	11:00-12:00	177.2500	2.2833	34.7167	36.2500	27.1000
20.1.2016	12:00-13:00	166.0333	2.0167	29.2167	33.2500	38.7333
20.1.2016	13:00-14:00	116.3833	2.9167	17.1833	28.2000	54.6667
20.1.2016	14:00-15:00	183.0167	17.2500	7.1833	91.0500	52.5333
20.1.2016	15:00-16:00	211.8500	4.3500	5.0500	14.6333	27.5667
20.1.2016	16:00-17:00	272.5167	23.6000	5.8167	123.1500	3.5000
20.1.2016	17:00-18:00	465.5000	51.1667	2.1667	116.0000	7.3667
20.1.2016	18:00-19:00	402.8500	61.7833	2.1667	53.1500	1.0000
20.1.2016	19:00-20:00	772.0333	57.8000	2.5833	92.3667	37.5000
20.1.2016	20:00-21:00	624.1000	56.7667	2.9333	106.6833	1.5833
20.1.2016	21:00-22:00	534.9833	45.9667	4.0000	77.5833	2.7167
20.1.2016	22:00-23:00	454.7667	45.4833	4.2167	73.8833	9.6667
20.1.2016	23:00-00:00	416.5333	47.4500	7.9667	101.8333	11.8333
21.1.2016	00:00-01:00	489.4500	43.5167	8.6667	146.0000	26.6667
21.1.2016	01:00-02:00	348.1333	44.7667	7.8833	126.2167	2.6167
21.1.2016	02:00-03:00	307.4667	43.1667	5.2333	121.3167	6.7667
21.1.2016	03:00-04:00	197.7167	40.3500	14.5167	91.3667	1.0000
21.1.2016	04:00-05:00	332.4667	33.9833	9.6333	104.8167	13.5833
21.1.2016	05:00-06:00	602.5833	41.1500	27.6500	103.3833	17.0500
21.1.2016	06:00-07:00	480.6833	39.0500	20.2167	126.5667	68.8500
21.1.2016	07:00-08:00	405.4833	20.7833	26.7333	103.1667	12.2000
21.1.2016	08:00-09:00	292.3167	2.7167	40.3000	72.4000	19.0500
21.1.2016	09:00-10:00	245.8833	2.1500	41.2500	54.3333	49.9500
MAX	24hours	772.0333	61.7833	41.2500	146.0000	68.8500
MIN	24hours	116.3833	2.0167	2.1667	14.6333	1.0000
Average	24hours	361.9125	30.5306	15.1639	85.1792	21.9438

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.772	0.062	0.041	0.146	0.069
MIN	24hours	0.116	0.002	0.002	0.015	0.001
Average	24hours	0.362	0.031	0.015	0.085	0.022

Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
21.1.2016	10:00-11:00	188.2833	2.1167	36.3000	39.4167	33.3333
21.1.2016	11:00-12:00	214.1833	15.3667	25.1167	39.3167	29.1000
21.1.2016	12:00-13:00	180.0167	4.8167	34.8500	33.4000	16.2167
21.1.2016	13:00-14:00	253.5667	31.5167	19.5333	52.4333	17.3167
21.1.2016	14:00-15:00	405.0333	55.7333	2.5000	89.8833	1.0000
21.1.2016	15:00-16:00	480.6000	58.0000	4.1000	163.3167	1.0000
21.1.2016	16:00-17:00	379.5424	40.7119	2.8136	73.7288	1.0169
21.1.2016	17:00-18:00	353.8033	30.6557	3.3770	146.6393	3.9180
21.1.2016	18:00-19:00	494.2167	66.6500	2.6833	58.4667	5.3167
21.1.2016	19:00-20:00	415.6500	54.7167	4.4333	43.0167	1.0000
21.1.2016	20:00-21:00	568.8500	50.8667	4.1500	60.3833	18.1167
21.1.2016	21:00-22:00	743.2333	47.9333	3.8000	59.4833	46.7167
21.1.2016	22:00-23:00	550.1667	62.0167	3.1000	60.2667	14.0333
21.1.2016	23:00-00:00	384.7167	45.5833	5.3667	58.2500	1.5833
22.1.2016	00:00-01:00	375.3667	55.8833	4.6833	59.1667	1.4833
22.1.2016	01:00-02:00	331.6667	46.9333	7.5500	50.9333	1.0000
22.1.2016	02:00-03:00	265.0000	46.3167	6.0167	43.2833	1.1833
22.1.2016	03:00-04:00	247.4333	46.1167	9.8167	38.2667	2.0500
22.1.2016	04:00-05:00	255.3833	44.6667	9.7500	47.8833	2.8167
22.1.2016	05:00-06:00	316.1667	51.4333	12.4167	67.7500	11.1833
22.1.2016	06:00-07:00	288.6500	51.6167	6.5833	36.5167	1.0000
22.1.2016	07:00-08:00	544.4333	48.4167	20.9833	90.6000	3.4167
22.1.2016	08:00-09:00	487.7333	19.9833	43.0500	92.1833	19.6833
22.1.2016	09:00-10:00	309.9000	11.2000	37.4167	95.2667	28.1833
MAX	24hours	743.2333	66.6500	43.0500	163.3167	46.7167
MIN	24hours	180.0167	2.1167	2.5000	33.4000	1.0000
Average	24hours	376.3998	41.2188	12.9329	66.6605	10.9028

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.743	0.067	0.043	0.163	0.047
MIN	24hours	0.180	0.002	0.003	0.033	0.001
Average	24hours	0.376	0.041	0.013	0.067	0.011

Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
22.1.2016	10:00-11:00	284.3667	4.8500	35.2667	46.8667	15.0167
22.1.2016	11:00-12:00	208.4000	7.2167	30.1167	42.0500	17.9667
22.1.2016	12:00-13:00	182.9000	22.0667	21.3000	27.8667	31.8833
22.1.2016	13:00-14:00	356.3833	44.9833	15.4500	54.1500	1.2500
22.1.2016	14:00-15:00	351.5833	46.8833	7.5667	116.7333	2.0500
22.1.2016	15:00-16:00	446.9500	40.9000	2.6833	101.6667	1.0000
22.1.2016	16:00-17:00	464.7667	48.4667	6.3333	67.7833	1.0000
22.1.2016	17:00-18:00	557.2667	53.1333	10.6167	66.4833	1.5833
22.1.2016	18:00-19:00	567.0833	68.0333	3.1833	79.0500	1.7667
22.1.2016	19:00-20:00	690.2833	60.5333	3.0167	90.6333	7.2667
22.1.2016	20:00-21:00	889.6667	62.4667	4.0000	109.2500	71.9333
22.1.2016	21:00-22:00	360.6167	58.6667	3.6667	81.8333	4.1667
22.1.2016	22:00-23:00	609.7000	50.6833	3.6500	96.7667	5.7500
23.1.2016	23:00-00:00	428.5333	64.8833	6.1333	81.7167	6.8000
23.1.2016	00:00-01:00	314.4167	40.4667	12.0333	60.0667	2.3333
23.1.2016	01:00-02:00	241.8000	33.4667	8.4333	43.7000	1.0333
23.1.2016	02:00-03:00	201.3167	35.6167	8.6500	30.5500	1.0000
23.1.2016	03:00-04:00	218.9167	40.1000	5.9500	41.8000	2.7833
23.1.2016	04:00-05:00	167.0333	51.0000	6.5167	34.2667	1.0000
23.1.2016	05:00-06:00	242.8667	45.0000	10.3667	50.2167	3.5500
23.1.2016	06:00-07:00	365.9500	63.5833	2.0167	84.3000	9.6000
23.1.2016	07:00-08:00	329.1500	46.7667	33.4833	83.8000	12.9000
23.1.2016	08:00-09:00	240.5833	23.2333	45.2667	87.0500	2.1333
23.1.2016	09:00-10:00	181.3833	3.4333	43.7333	44.3167	27.4500
MAX	24hours	889.6667	68.0333	45.2667	116.7333	71.9333
MIN	24hours	167.0333	3.4333	2.0167	27.8667	1.0000
Average	24hours	370.9132	42.3514	13.7264	67.6215	9.7174

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.890	0.068	0.045	0.117	0.072
MIN	24hours	0.167	0.003	0.002	0.028	0.001
Average	24hours	0.371	0.042	0.014	0.068	0.010

Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
23.1.2016	10:00-11:00	105.3171	2.0000	32.4878	27.4878	12.9268
23.1.2016	11:00-12:00	62.4833	3.3833	10.1500	37.6167	57.2500
23.1.2016	12:00-13:00	85.3000	7.0000	10.0500	24.0000	43.1500
23.1.2016	13:00-14:00	169.0667	19.2833	3.8500	52.5167	19.2500
23.1.2016	14:00-15:00	251.6833	22.0000	2.0833	95.6167	1.0000
23.1.2016	15:00-16:00	264.8833	30.2500	2.9667	73.4667	2.3667
23.1.2016	16:00-17:00	349.4000	42.8333	3.0000	126.0000	1.0667
23.1.2016	17:00-18:00	319.8167	38.8167	2.5000	79.7167	1.0000
23.1.2016	18:00-19:00	426.9333	43.8667	3.4500	67.8000	2.5333
23.1.2016	19:00-20:00	535.3167	45.2667	3.4167	48.1833	4.5500
23.1.2016	20:00-21:00	487.6000	57.1167	3.8333	69.3167	1.0000
23.1.2016	21:00-22:00	497.3500	59.6500	2.8167	101.9667	28.4000
23.1.2016	22:00-23:00	376.2456	46.0000	3.4035	61.4211	1.5439
23.1.2016	23:00-00:00	242.6364	64.2500	10.9318	41.0227	1.0000
24.1.2016	00:00-01:00	228.6333	67.7000	3.7500	40.2333	1.0000
24.1.2016	01:00-02:00	225.2667	53.4833	4.7500	52.9167	1.0000
24.1.2016	02:00-03:00	232.5000	61.3333	6.8833	53.8833	1.3333
24.1.2016	03:00-04:00	222.6667	54.6667	19.5333	58.8167	1.0000
24.1.2016	04:00-05:00	224.6000	58.9500	13.3833	58.8833	1.0000
24.1.2016	05:00-06:00	206.2000	54.8500	12.7500	56.3167	1.0333
24.1.2016	06:00-07:00	259.0167	50.9667	13.8333	62.0500	5.0333
24.1.2016	07:00-08:00	233.3167	51.4667	22.6833	101.8667	6.5667
24.1.2016	08:00-09:00	246.1167	24.6333	39.8167	66.7667	1.0000
24.1.2016	09:00-10:00	163.8333	3.2000	42.2500	53.0500	1.1833
MAX	24hours	535.3167	67.7000	42.2500	126.0000	57.2500
MIN	24hours	62.4833	2.0000	2.0833	24.0000	1.0000
Average	24hours	267.3409	40.1236	11.4405	62.9548	8.2161

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.535	0.068	0.042	0.126	0.057
MIN	24hours	0.062	0.002	0.002	0.024	0.001
Average	24hours	0.267	0.040	0.011	0.063	0.008



Date	Time	CO	NO2	PM10	TSP	SO2
D.M.Y	H.M.S	ppb	ppb	µg/m3	µg/m3	ppb
24.1.2016	10:00-11:00	119.0833	2.4167	18.7500	42.6333	3.3000
24.1.2016	11:00-12:00	72.4167	9.1500	12.1500	40.6000	1.0000
24.1.2016	12:00-13:00	131.8333	18.7333	22.7500	30.4500	2.1667
24.1.2016	13:00-14:00	104.8333	29.2667	19.3833	27.4000	1.2500
24.1.2016	14:00-15:00	264.1833	38.5833	2.5333	36.3000	1.0000
24.1.2016	15:00-16:00	344.9833	32.1667	3.8833	40.1667	1.0000
24.1.2016	16:00-17:00	321.0500	48.1167	5.2667	40.0333	1.0000
24.1.2016	17:00-18:00	395.3833	57.6167	2.3833	56.3667	3.2333
24.1.2016	18:00-19:00	469.3667	60.0000	2.6500	53.8333	1.0000
24.1.2016	19:00-20:00	384.0167	66.1833	2.8000	118.8167	1.0000
24.1.2016	20:00-21:00	411.3333	61.3667	5.7667	104.6000	1.0500
24.1.2016	21:00-22:00	489.7167	68.1500	9.1667	136.1833	1.5333
24.1.2016	22:00-23:00	501.9167	72.6667	5.7500	109.7167	1.0000
24.1.2016	23:00-00:00	344.1333	54.1167	5.4000	86.6333	1.1167
25.1.2016	00:00-01:00	298.8667	51.1000	5.2333	73.1167	1.5500
25.1.2016	01:00-02:00	251.2333	38.3833	10.2167	48.6833	3.7500
25.1.2016	02:00-03:00	246.0167	47.9000	8.3167	46.7000	1.0000
25.1.2016	03:00-04:00	265.0000	51.7167	6.9000	60.3333	1.0000
25.1.2016	04:00-05:00	275.1500	44.1333	7.8000	73.7833	8.1333
25.1.2016	05:00-06:00	314.4500	46.8500	7.1167	73.4167	15.2833
25.1.2016	06:00-07:00	249.3167	48.3667	13.8667	36.6333	7.9667
25.1.2016	07:00-08:00	208.9167	37.7167	21.7833	25.4167	3.7667
25.1.2016	08:00-09:00	194.6833	22.7000	29.4667	42.7167	1.0000
25.1.2016	09:00-10:00	183.9833	21.4667	37.5000	56.3167	1.5000
<b>MAX</b>	<b>24hours</b>	501.9167	72.6667	37.5000	136.1833	15.2833
<b>MIN</b>	<b>24hours</b>	72.4167	2.4167	2.3833	25.4167	1.0000
<b>Average</b>	<b>24hours</b>	285.0778	42.8694	11.1181	60.8688	2.7333

		ppm	ppm	mg/m3	mg/m3	ppm
MAX	24hours	0.502	0.073	0.038	0.136	0.015
MIN	24hours	0.072	0.002	0.002	0.025	0.001
Average	24hours	0.285	0.043	0.011	0.061	0.003