SURVEY DATA OF WATER, AIR AND NOISE QUALITY AT THILAWA SEZ AREA
ANNEX - E

Water Quality

The assessment of both surface and ground water quality in the field investigation period was carried out by measuring certain physical and chemical parameters. The water samples were collected and sent for analysis of some selected parameters at relevant laboratories in Yangon.

Surface Water Samples of Yangon River

Surface water samples were collected within the top 5 cm to 100 cm of water (Water Quality Surveys, UNESCO WHO Page 315).

Bottom Water Samples of Yangon River

Bottom water samples were collected at least 30 m below the surface and assessed for bed load. Bottom sediment samples represent the upper most 1 cm to 5 cm of bottom layer. This zone is commonly oxidized and brown in colour (Water Quality Surveys UNESCO WHO page 315).

Rivers often have a higher salt content during the low flow in dry season than during the flood season, while salt contents may also vary along the course of a river.

Selected analysis of surface water are shown in the following table:

Table E.1: Selected Analyses of Surface Water at Yangon River and Streams (Direct impact area)

Sr. No.	Pollutant or Parameter	Unit	Limit	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
1	pH		6 - 9	7.2	7.2	6.9	7.3	7.1	7.1	7.2
2	Turbidity	NTU		681	999	249	999	999	999	999
3	EC	µmhos/cm		11,000	14,600	16,000	15,700	13,800	12,300	12,300
4	BOD	mg/l	50	3	6.1	6.9	4	6	6	6.1
5	COD	mg/l	250	149.2	118	329.2	351	350.8	582.6	620
6	TSS	mg/l	50	1.52	1.96	2.44	2.4	5.72	2	5.28
7	Arsenic	mg/l	0.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
8	Iron	mg/l	3.5	2	4.8	5.5	4.8	30	5	50
9	Lead	mg/l	0.1	0	0	0.006	0.008	0	0	0
10	Mercury	mg/l	0.01	0.019	0.015	0.095	0.028	0.08	0.067	0.413
11	Temperature	C		25.8	25.9	26.1	26.1	28.2	28.4	27.4
12	Oil and Grease	mg/l	10	-	-	-	3.6	-	28	-

Limits for process wastewater, domestic seage and contaminated storm water discharged to surface waters, for general application (Pollution, prevention and abatement handbook 1998, The **World Bank Group, Washington, D.C, April, 1999).**

Sample No 1. Surface water of Shwebyauk Chaung

Sample No 2. Surface water of Pa Lan Chaung

Sample No 3. Surface water of Natsin Chaung , south of Dagon Thuriya Energy deport

Sample No 4. Surface water of Yangon River at Mya Myitta Mon Port

Sample No 5. Bottom water of Yangon River at Mya Myitta Mon Port

Sample No 6. Surface water of Yangon River at Padauk Shwe Wa Petrol Co., Ltd.

Sample No 7. Bottom water of Yangon River at Padauk Shwe Wa Petrol Co., Ltd.

Electrical Conductivity (EC)

The Electrical Conductivityy of the surface water was observed between 11,000 to 16,000 micro mhos/cm. All the water samples in the study area very saline water which is unpotable.

Turbidity

The results of turbidity in surface water at all sampled sites show high turbidity. It might be the presence of suspended matter as clay and divided organic and inorganic matters.

According to research on the subject of water bone diseases it has stressed very strongly the need to reduce the turbiditty as much as possible. It is, therfore important that safe and wholesome drinking waters have a very low turbidity to qualify as soft water for domestic supply.

Oil and Grease (O & G)

These are also important items for water quality. They include hydro carbon, fatty acid, soap, fats, wax, oil and other materials.

Oil and Grease are particularly resistant to anaerobic digestion, and when present in sludge because of excessive accumulation in digestor, and clog the pores of filter and deter the use of the suldge as fertilizer.

A knowledge of the quantity of oil grease present in a waste water is helpful in overcoming difficulties in plant operation.

Finding of Oil and Grease (O & G) at Yangon River

Oil and Grease concentration of Yangon River, near the bank of Padauk Shwe Wa Petrol Co., Ltd. was observed **28.0 mg/l which is higher than WB Standard limit of 10 mg/l** at the time of survey (Dry season, Feb 2013)

Domestic water supply resources in SEZ in Thilawa area

Safe drinking water supply and adequate sanitation facilities are essential elements in protection of the environment , and improvement of in health conditions and living standards.

At present domestic water and some industrial water in study area and adjoining areas are available from Thilawa reservoir , Zarmani reservoir and some tube wells.

Existing water Supply System

Water Resource	Distribution	Remark
Thilawa Reservoir	National Housing Board distributes to POL Storage sites and adjacent areas	
Zamani Reservoir	Distribution to the Regional Regiment and future SEZ area	

The surface water quality of Thilawa Reservoir is shown in the following table.

Table E.2: Analysis of surface water of Thilawa Reservoir

Sample No 1.- Surface water of Thilawa Reservoir (8.3.2013)

Characteristics	World Health Organization (WHO)		Sample No. 1: water quality result
	Highest desirable	Maximum permissible	
Phsico -chemical	Level	Level	
Turbidity (J.T.U)	5	25.0	108 NTU
Colour (Pt - scale)	5	50.0	
Taste and odour	nothing	disagreeable	
pH	7- 8.5	6.5 - 9.2	7.06
Total solids	500	1500	
Total hardness	100	500	
Chlorides	200	600	12.41
Sulphates (as So_4)	200	400	ND
Fluorides (as F)	1	1.5	
Nitrates (as No3)	45	45	
Calcium (as Ca)	75	200	11.22
Magnesium	30	150	0.98
Iron (as Fe)	0.1	1	0.50
Manganese (as Mn)	0.05	0.5	
Copper	0.05	1	
Zinc	5	15	
Phenlic compounds	0.001	0.002	
Detergents, anionic	0.2	1	
Mineral oil	0.01	0.30	
Arsenic	0.05	0.05	
Chromium (as Cr^{+6})	-	0.01	
Cyanide	-	0.05	
Lead	-	0.1	
Selenium	-	0.01	
Cadmium	-	0.01	
Mercury	-	0.001	
PCBS (µ g / L)	-	0.2	
Gross alfa acitivity (Pci / L)		3	
Gross beta acitivity (Pci / L)		30	
EC			46.3 µmhos/cm

(Source: P.K. Goel , water pollution , Causes, effects and controls)

Note : all the values are in mg/ L expect pH , otherwise stated.
NTU is a measure of light scattered by a formazin polymer.
Approximately, 1 NTU is equal to 1 JTU.
ND - Not detected

Finding - At present the result data shows that the surface water of Thilawa Reservoir is of chemically potable. It is necessary to analysis the ecoli activity occasionally.

Location of Surface Water Sampling Sites

Sr No	Sample No	Location	GPS Value
1	Sample No 1	Shwebauk Chaung	(16˚ 39' 41.60" N,96˚15'49.86"E)
2	Sample No 2	Pa Lan Chaung	(16˚ 38' 20.13" N,96˚16'22.31"E)
3	Sample No 3	Natsin Chaung	(16˚ 37' 45" N,96˚16'18"E)
4	Sample No 4	Yangon River at Myat Myitta Mon (surface)	(16˚ 40' 18" N,96˚14'34"E)
5	Sample No 5	Yangon River at Myat Myitta Mon (Bottom Depth 12.5 metre)	(16˚ 40' 18" N,96˚14'34"E)
6	Sample No 6	Yangon River at P.S.W (surface)	16˚38'59.85"N,96˚16'4.3"E
7	Sample No 7	Yangon River at Padauk Shwe War Co.(Bottom Depth - 10 metre)	16˚38'59.85"N,96˚16'4.3"E

The selected water samples were analysed at the respective laboratories. Out of nine parameters, seven parameter were observed below the limits, three parameters were significantly polluted and concentrated at present. These are COD, iron and mercury. These parameters are briefly described as follows :

Chemical Oxygen Demand (COD)

COD is a measure of the oxygen required to oxide all compounds in water, both organic and inorganic.

COD is the measure of oxygen equivalent of most organic materials in water. This is widely used as a means on measuring pollution strength of industrial effluents. The COD test is very useful for analysis of industrial waste. Within short-time results are obtained COD which gives an idea of toxic conditions.

Finding

COD in surface water of Natcin Chaung and Yangon River is found to be higher than the limit of 250 mg/l of COD.

Mercury (Hg)

(Mercury is a toxic heavy metal found in mercuric sulphide and other ores compounds consisting or zinc, tin and copper).

Mercury can be traced in all environmental media. Typical concentration of mercury in water bodies range from 0.001 to 0.003 micro gram per litre, mercury enters into the environment through disposal of certain produces.

The main human hazard of mercury is associated with exposure to highly toxic organic methy mercury, primarily through the ingestion or aquatic organisms. Mercury is also highly toxic to animals.

Finding

According to guideline for process waste water, domestic sewage and contaminated storm water discharged to surface water for general application, limit of Mercury is 0.01 mg/l in the surface water.

The results of analysis of Mercury in all water samples were found slightly higher than the limit.

Iron

In natural water, iron may be present as ferrous bicarbonate (Fe $(HCO_3)_2$), ferrous hydroxide, ferrous sulphate ($FeSO_4$) and organic iron. Groundwater containing iron in soluble form (Ferrous) are usually clear and colorless when first drawn. Upon contact with air, they slowly cloud and finally deposit a yellowish to reddish brown precipitate of ferric hydroxide.

Iron is an essential element, with a suggested daily intake of 14 mg. Most of the people ingest around 20 mg per day. The deficiency of iron may result in decreased hemesynthesis and anemia. The drinking water contributes only a small fraction of daily iron needs.

Iron containing water stain porcelain fixture and laundry. In iron-bearing waters, the growth of iron bacteria may cause pipe clogging.

Findings

Iron concentration in surface water was found as follows :

Sample No. 1 Surface water of Shwebyauk Chaung	2 mg/l
Sample No. 2 Surface water of Pa Lan Chaung	4.8 mg/l
Sample No. 3 Surface water of Natsin Chaung , south of Dagon Thuriya Energy deport	5.5 mg/l
Sample No. 4 Surface water of Yangon River at Mya Myitta Mon Port	4.8 mg/l
Sample No. 5 Bottom water of Yangon River at Mya Myitta Mon Port	30.0 mg/l
Sample No. 6 Surface water of Yangon River at Padauk Shwe Wa Petrol Co., Ltd.	5.0 mg/l
Sample No.7 Bottom water of Yangon River at Padauk Shwe Wa Petrol Co., Ltd.	50.0 mg/l

The above data show that iron concentration in bottom water of Yangon River was observed very high.

Agro-chemical Pollution

A high nutrient level is essential for productive agriculture. The major common chemical fertilizer, generally used for crop production are as follows.

1. Urea
2. Triple Super Phosphate and
3. Muriate of Potash

The use of both natural and chemical fertilizers may result in an excess of nutrients. These can cause problems in water bodies and to heath.

Nitrate are highly soluble and therefore may quickly reach water body. Sources of Nitrogen in aquatic systems include animal wastes, particularly chemical fertilizers and waste water discharges. Nitrate poisoning in infant animals, including humans can cause serious problem and even lead to death.

Phosphorus is an essential chemical food element that can contribute to the eutrophication of lakes and other water bodies. Increase phosphorus levels result from discharge of phosphorus containing materials into surface waters. Phosphorus appears exclusively as phosphate (PO4) in aquatic environments. They may be constituents of plant or animal tissues. Runoff of the agricultural area is a major contributor to phosphate in surface water. Phosphate are not toxic and do not represent a direct heath threat to human and other organism. They do represent a serious indirect threat to water analysis. Phosphate can also interfere with water treatment processes.

Nitrate and phosphorus fertilizers and detergents can contaminate surface waters where they promote the growth of oxygen consuming algae which reduce the Dissolved Oxygen of water. It can cause killing fish and other aquatic organism.

Pesticide Pollution

The water samples were collected from Yangon River and small chaungs which intermittent flow to Yangon River, these were sent to analysis the pesticide residue.

Pesticides

The farmers are using pesticides. The world wide use of pesticide is increasing by 2.3% every year. The effective pest management is essential for crop production. Six types of pesticides are as follows.

1. Insecticides for control of insects
2. Fungicides for control of Fungi
3. Weedicides or herbicides for control of weeds
4. Rodenticides for control of rodents
5. Molluscicide for control of molluses
6. Nematicides for control of nematodes

Toxicities

Organochlorines - DDT, aldrin, dieldrin, endrin and heplachlor are hazardous because of their persistent nature. They are highly stable and break down very slowly. These are cumulative toxicing and cause severe problems at the higher end of the food chain. Most of these pesticides are mutagenic and carcinogenic. They can stop cell division. DDT is know to cause the polocarcinoma, leukemia and anemia etc. Malathion can cause schizonpheenia and depression, dieldrin can cause insomnia. Parathion and malathion cause muscular weakness and delayed paralysis. Benzene Heixachloride affects central nervous systems. Methoxyclor causes liver and kidney damage.

The indiscriminate use of pesticides to prevent damage of crops by insects has lead to wide spread contamination of ground and surface water, food and food products. Women are more susceptible to pesticides poisoning and the poison can travel from mother to the foetus.

The effluent standard pertain to the quality of waste water originating from community, agricultural operations and industry. In general, these standards restrict the quality of pollutants that set the designated degree of treat sent, some important standards are given in the table below.

Table E.3: General Standards for Discharges of Effluent

Source: Central Pollution Control Board (CPCB 1995)

Parameter	Standards			Water Samples						
	Inland surface water	Public sewers	Land for irrigation	No.1	No.2	No.3	No.4	No.5	No.6	No.7
Dissolved solids mg/l max.	2100	2100	2100	7040	9344	10240	10048	8832	7872	7872
pH value	5.5~9.0	5.5~9.0	5.5~9.0	7.2	7.2	6.9	7.3	7.1	7.1	7.2
Ammoniacal Nitrogen (asn)mg/l max.	50	50	-	2.10	2.80	2.10	0.7	0.7	1.4	0.7
Dissolved phosphate(asn) mg/l max.	510	0.116	-	0.116	0.104	0.116	0.04	0.12	0.12	0.076
Pesticicle Compound SumofBHC isomers	Absent	Absent	Absent	ND	ND	ND	ND	ND	ND	ND

Sum of DDT isomers	Absent	Absent	Absent	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Dieldrin	Absent	Absent	Absent	ND	ND	ND	ND	ND	ND	ND
Aldrin	Absent	Absent	Absent	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Endrin	Absent	Absent	Absent	ND	ND	ND	ND	ND	ND	ND
DDE	Absent	Absent	Absent	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD
Parathion Methyl	Absent	Absent	Absent	ND	ND	ND	ND	ND	ND	ND
Malathion	Absent	Absent	Absent	ND	ND	ND	ND	ND	ND	ND

(Water pollution, Causes, Effects and Control, P.K.GOE)

Sample No 1. Surface water of Shwebyauk Chaung

Sample No 2. Surface water of Pa Lan Chaung

Sample No 3. Surface water of Natsin Chaung , south of Dagon Thuriya Energy deport

Sample No 4. Surface water of Yangon River at Mya Myitta Mon Port

Sample No 5. Bottom water of Yangon River at Mya Myitta Mon Port

Sample No 6. Surface water of Yangon River at Padauk Shwe Wa Petrol Co., Ltd.

Sample No7. Bottom water of Yangon River at Padauk Shwe Wa Petrol Co., Ltd.

CPCB - Central Pollution Control Board

N.D - Not detected at limit of detection

LOD - Limit of Detection

Mg/l - Milli gram per litre or parts per million

Compound	Residue (mg/kg)
Sum of BHC isomers	ND
Sum of DDT isomers	<LOD (0.004 mg/kg)
Dieldrin	ND
Aldrin	<LOD (0.01 mg/kg)
Endrin	ND
DDE	<LOD (0.008 mg/kg)
Parathion Methyl	ND
Malathion	ND

The general conclusion is that the pesticide residue contant of the sampled water does not exceed the above value.

Ground Water

Two selected samples were taken the study these area and sent for analysis to evaluate the drinking water quality purpose. The standards are referred according to World Health Organization (WHO) drinking water limits.

Table E.4: Analyses of Ground Water

Characteristics	World Health Organization (WHO)		Sample 1
	Highest desirable level	Maximum permissible level	
Physico - chemical			
Turbidity (J.T.U)	5.0	25.0	48 NTU
Colour (Pt - scale)	5.0	50.0	
Taste and Odour	nothing	disagreeable	
pH	7.0 - 8.5	6.5 - 9.2	6.90
Total solids	500	1500	
Total hardness	100	500	
Chlorides	200	600	1276.56
Sulphates (as SO_4)	200	400	N.D
Fluorides (as F)	1	1.5	
Nitrates (as NO_3)	45.0	45	
Calcium (as Ca)	75	200	272.54
Magnesium	30	150	191.30
Iron (as Fe)	0.1	1	1.0
Manganese (as Mn)	0.05	0.5	
Copper	0.05	1.0	
Zinc	5	15.0	
Phenoic compounds	0.001	0.0	
Detergents, anionic	0.2	1	
Mineral Oil	0.01	0.30	
Arsenic	0.05	0.05	
Chromium (as Cr^{+6})	-	0.01	
Cyanide	-	0.05	
Lead	-	0.1	
Selenium	-	0.01	
Cadmium	-	0.01	
Mercury	-	0.001	
PCBs (ug/L)	-	0.2	
Gross alfa - activity (PCi/L)	-	3	
Gross beta - activity (PCi/L)	-	30.0	
EC	-	30.0	3400 (hos/cm)

P.k Goel, Water Pollution, Canses, Effects and Controls
Sample No. 1 = Tube Well, East of Thuriya Energy Deport Management Co., Ltd.
WT 60 ft (4.2.2013)
Note : all the values are in mg/l except pH, otherwise stated.
NTU is measure of light scattered by a formazin polymer.
Approximately, 1 NTU is equal to 1 JTU.
N.D - Not detected

Ground Water Quality

pH - pH in ground water is 6.9 which is maximum permissible level of 6.5 to 9.2 (WHO standard).

Chloride - Chloride concentration in ground water was observed to be 1276.5 mg/l at present. Chloride is an essential element, drinking water contribute to only a small fraction of daily intake. In drinking, Chloride concentration exceeding 250 mg/l cause salty taste. According to WHO drinking water standards, maximum permissible level of Chloride concentration is 600 mg/l.

Calcium - Concentration of Calcium in natural water may range between 10 and 100 mg/l. Water with a Calcium level between 40 and 100 mg/l are generally considered hard to very hard. Suggested daily intake of Calcium is 800 mg for human. The deficiency may cause osteoporosis and toxicity may include kidney stones.

Calcium concentration in ground water was found slightly higher than maximum permissible limit of 200 mg/l.

Iron - Iron concentration in ground water was found to be 1.0 mg/l which is maximum permissible level of WHO drinking water standard. Iron is essential element, with a suggested daily intake of 14 Mg. Most of people ingest around 20 mg per day. The deficit of iron may result in decreased anemia.

EC - EC value in ground water was observed 3400 micro mhos/cm. These are very saline water which is unpotable at present.

Table E. 5: Location of Ground Water Sampling Site

Sr No	**Sample No**	**Location**	**GPS Value**
1	GW 1	Dagon Thuri Ya Energy	16˙37' 55.0"N, 96˙16' 20.68"E
2	GW 3	Myat Myitta Mon Co.	16˙40' 38.05"N, 96˙14' 56.51'E

Ground Water Table

There was no ground water table found at about 4 ½ feet below the natural ground surface by boring with auger at the sampling sites near Thuriya Co. ltd, Shwetaung Co. ltd., and Padauk Shwe war Co. ltd.

Soil types of the study area appears to be predominantly fine textured substrata such as silty clay and clay. It is recommended that the piezometers should be installed to monitor the fluctuation of water table both in dry and wet season of the year. The infiltration rate and permeability rates are not available at present. But it might be very slow rate of infiltration and permeability due to fine textured clay. General elevation of ground water table at the SEZ and adjacent areas are found as follows:

Table E.6: Elevation of Ground Water Table (G-W-T) at Thilawar Economic Zone

Sr No	Location	Lat			Long			Elevation of Ground Level (Meter)	Elevation of Ground water table (Meter)
		Deg	Min	Sec	Deg	Min	Sec		
1	Pa Da Gyi Village	16	39	11	96	19	10	17.60	15.78
2	Pa Da Gyi Village	16	39	22	96	19	8	20.25	15.08
3	Shwe Byauk Village	16	39	27	96	18	24	12.60	11.63
4	Aye Mya Thida Ward,Kyauktan	16	39	17	96	17	24	6.90	5.45
5	Thida Myine Ward,Kyauktan	16	37	53	96	18	14	5.13	3.50
6	Swepyi Tharyar Ward,Kyauktan	16	38	33	96	17	37	5.92	4.10
7	Phayar kone Village	16	43	0	96	17	16	13.60	10.55
8	Myoepya Kwet Thit Village	16	43	22	96	17	7	14.70	6.98
9	Urban (Kun Chan Kone) Village	16	43	12	96	17	0	12.70	10.27
10	Urban (Phayar Kone) Village	16	43	32	96	16	24	16.70	14.00
11	Kyeik Inn Village	16	42	60	96	17	26	22.65	18.08
12	Pyinhaung Kyaung Village	16	42	37	96	17	42	14.40	8.31
13	Htan Pin Ceit Village	16	42	29	96	17	45	20.10	9.70
14	Hta Ma Lone Village	16	42	20	96	17	53	16.20	9.36
15	A Lae Ywa Village	16	41	13	96	18	37	18.00	9.24
16	Lat Yat San Village	16	42	7	96	17	23	12.20	7.58

Investigation of Ambient Air Quality

Investigation is limited to some key pollutant such as suspended particulate matter (SPM). A good air quality management system usually reviews the potable emission sources and environmental receptors in the study area concerned and then selects the pollutants to be monitored. One such pollutant is particulate matter of less than 10 microns in aerodynamic diameter (PM10). Other pollutants normally investigated included Sulphur Dioxide (SO_2) and Nitrogen Oxide (NO_2).

The particulate matter (PM10), Sulphur Dioxide (SO_2) and Nitrogen Oxide (NO_2). Tests of were done in cool and dry period of February 2013. The samples were analyzed at the Occupational Health Laboratory, Department of Health in Nay Pyi Taw. The results are shown in the following Table E.8

Instruments : High Volume Sampler

Method : SO_2 in Air pollution (Modified West and Gaeke Method)

NO_2 in Air Pollution (Indian Standard with Sodium Arsenite Method)

Ambient air conditions at properly boundary for general application.

(micrograms per cubic meter)

Table E.7: Air Quality Guideline

Pollutant	**Unit**	**Concentration**	
		World Bank	**WHO**
Particulate matter			
Annual arithmetic mean	g/m^3	50	
Maximum 24 hour average	"	70	50
Nitrogen Oxide			
Maximum 24 hour average	"	150	
Annual Mean	"		40
One Hour Mean	"		200
Sulphur Dioxide			
Annual arithmetic mean	"	50	
Maximum 24 hour average	"	125	20

Table E.8: Investigation of Ambient Air

Sr. No.	Location	TSPM	PM10 (24 hr mean)	SO2 (24 hr mean)	NO2 (Annual mean)	NO2 (1 hr mean)
1	Myamyittamon Gate	77.03	29.72	0.02	7.60	42.35
2	Myamyittamon Bridge	129.95	32.54	0.02	0.51	61.17

Finding - At present air pollutants are not exceed WHO air quality guideline.

Control of air pollution

The following methods are most effective for dealing with the control of air pollution.

(a) Source of correction methods

(b) Pollution control equipment

(c) Diffusion of pollutant in air

(d) Vegetation

(e) Zoning

Ambient Air and Ambient Noise Observation Site

Sr No	Test No	Location	GPS Value
1	Ambient Air	Myat Myitta Mon Gate	16˙40' 41.29"N, 96˙14' 54.12"E
	Ambient Noise	Myat Myitta Mon Gate	16˙40' 24.43"N, 96˙14' 35.25"E
2	Ambient Air	Myat Myitta Mon Bridge	16˙40' 23.80"N, 96˙14' 36.69"E
	Ambient Noise	Myat Myitta Mon Bridge	16˙40' 23.80"N, 96˙14' 36.69"E