3 INVENTORY OF EXISTING FACILITIES IN/ON YANGON CIRCULAR RAILWAY

3.1 General Condition of Existing Track and Civil Engineering Facilities

3.1.1 Track

1) Geometric Condition

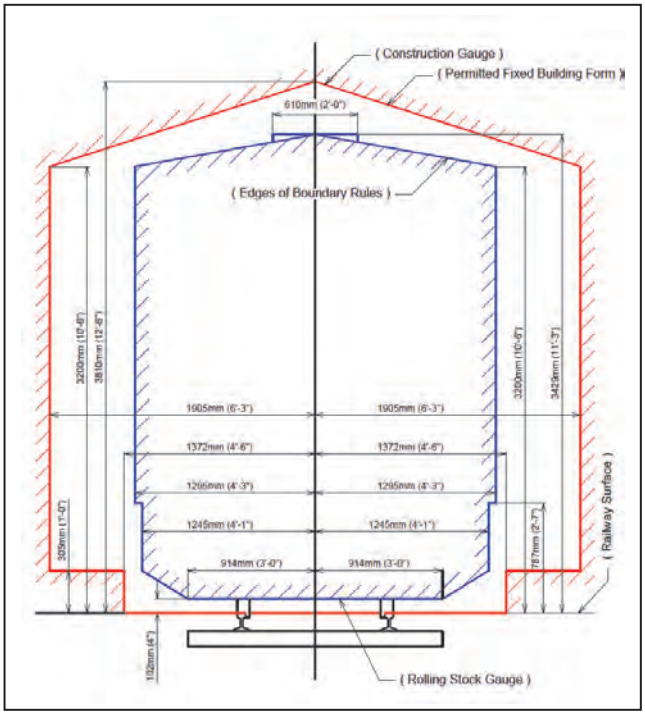
The basic geometric condition of Yangon Circular Railway is listed in the table below.

Table 3.1.1.1 Geometric Condition of Yangon Circular Railway

Item	Applied Condition	Remarks
Gauge	Meter Gauge	
Axle Load	12 ton	
Track Number	Double Track	
Minimum Radius	291 m	Whole MR: 103 m
Maximum Vertical Gradient	10‰	
Line interval	Main line to main line: 4.4 m Sidings: 3.8 m	
Total length	46.12 km	Reference: Google earth

Source: SUDP, YUTRA Project Team (2014)

The construction gauge and car gauge are shown in the figure below. The figure shows the both heights are quite low in comparison with other countries including Japan. The low height gauge is an obstacle not only for electrification but also for introducing container freight transport using rolling stock imported from other countries.



Source: MR

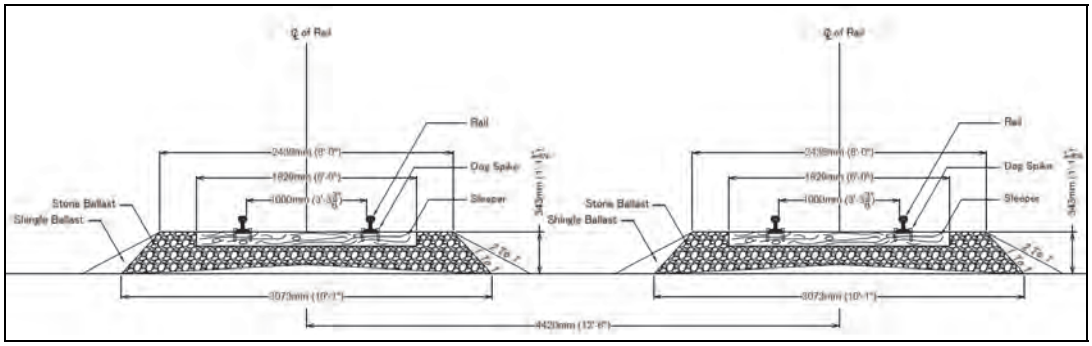
Figure 3.1.1.1 Construction Gauge and Car Gauge

3.81 m is applied for construction gauge and 3.2 m is applied for car gauge.

2) Track condition

(1) Overview of Track Condition

Typical track cross section of Yangon Circular Railway is shown in the figure below. Meter gauge and rail interval 4.42 m can be seen in the figure.



Source: MR

Figure 3.1.1.2 Typical Track Cross Section in Yangon Circular Railway

A 37 kg/m rail with 12 m length, which is quite light and generally only suitable for low grade lines, is used in Yangon Circular Line. Most of the railheads are worn-out due to prolonged use. It is recommended to replace them immediately to assure safety operation and prevent more damage. The ratio of good sleepers is being increased because MR is proceeding with the replacement of timber sleepers to PC sleepers which are produced by a PC sleeper plant in Bago. However, in spite of their efforts, the track condition is relatively poor because there is no proper ballast spreading, no proper embankment, no proper roadbed quality control and poor drainage system. This causes many derailments and extreme speed restrictions. The issues of the current track are summarized in the table below.

Table 3.1.1.2 Issues and the Expected Causes of the Current Track in Yangon Circular Railway

Issues	Severe track irregularity 	Eroded slope shoulder 	Poor ballast arrangement 	Insufficient ballast tamping 
Expected causes	a) Weak roadbed b) Lack of resistance to side pressure due to insufficient side ballast c) Ballast does not play an enough role for distributing train load due to insufficient ballast thickness. d) Lack of resistance to rail bucking stress due to insufficient track tamping, especially between sleepers.	a) Insufficient embankment compaction b) Narrow designated bank crown width c) Leaving eroded slope shoulder without any repair work.	a) Few side ballast which acts as resistance to side pressure. b) Ballast spreading above sleepers which has no meaning in terms of physical aspect.	a) Lack of hand-tietamper. b) Importance of the appropriate ballast tamping is not recognized.
Issues	Insufficient bottom ballast thickness below sleepers 	Mixing ballast with mud/soil 	Irregular sleeper interval 	Severe joint depression 
Expected causes	a) Mixing ballast with muddy roadbed by many years using and lack of maintenance although there was required thickness at first. b) No additional bottom ballast spreading during sleeper replacement work.	a) Due to no working drainage system, track is covered with water and mixed with mud during rainy season. b) Ballast is penetrated to roadbed due to many years using and weak roadbed.	a) No sleeper interval control during sleeper replacement.	a) No sleeper under joints
Issues	Severe rail corrugation / burr 	Poor drainage system, submerged track during rainy season 	Poor track condition on and around level crossings 	Poor track condition at approach part around bridge 

Expected causes	a) Lack of rail surface maintenance.	a) Roadbed surface does not worked as drainage surface due to mixing ballast with roadbed. b) No drainage slope on roadbed surface. c) Lack of installation of drainage ditch between tracks d) Drainage system is clogged up with garbage. e) Outlet of the drainage ditch does not work.	a) There is difference of elevation between level crossing part and the approaches due to no settlement at level crossing and settlement at the approaches. b) Guardrail is not installed correctly.	a) There is difference of elevation between bridge and the approaches due to no settlement at bridge and settlement at the approaches.
Issues	Poor track condition at turnout 	Track covered by plants / grasses 		
Expected causes	a) Lack of and insufficient track maintenance on and around turnout due to high difficulty.	a) No weeding work during track maintenance.		

Source: SUDP

In addition, track irregularity tests were conducted by MR in 2012. Results of track irregularities testing are shown in Appendix 3-2.

(2) Track Conditions Survey

(i) Survey Methodology

Visual survey was conducted from train cabin by two engineers on 21st and 22nd February 2014 for inner and outer lines. Survey sheet of evaluation items are listed in the below table.

Table 3.1.1.3 Visual Survey Sheet for Track Conditions

No	Evaluation Item	A	B	C	Remarks
1	Filling up condition of track ballast	Ballast is well spreading (More than 80% is filling up)	Moderate (Approximately 50% is filling up)	Less ballast (Less than 20% is filling up)	Check the colour of ballast (white is best)
2	Installed condition of sleeper	Almost 100% PC sleeper is installed (Except difficult place to install)	PC sleeper is installed partially	PC sleeper is not installed	Check the regularity of sleeper interval
3	Ride comfort	Acceptable to stand	Enable to stand with handrail	Difficult to stand without handrail	
4	Irregularity of rail alignment	No track irregularity	Partially track irregularity	Track irregularity	Check the friction of wheel tread
5	Condition of rail joint	With sound	With sound + shock	With bound after shocking	
6	Track environment	Can see track condition	Partially can't see well	Can't see track due to weeds and rubbish	Check the maintenance condition
7	Installed condition of side drainage	Side drain is working well	Available by repairing	Not working well or nothing	Check the water surface (if any)
8	Condition of embankment/cut	Roadbed is kept without any slope shoulder broken	Partially slope shoulder is broken	Slope shoulder is broken	
9	Sureness of construction gauge	No problem	Although any obstacles hinder construction gauge, not touch with train	Touch with train	
	Evaluation	A : Sound Condition	B : Needs Repair	C : Serious Condition	

Source: YUTRA Project Team (2014)

The above nine items were evaluated in three stages on the track during running. The evaluation shows A in sound condition, B is in need of repair, and C is in serious condition. Evaluation was conducted on “between neighboring stations” basis.

Another investigator handled GPS in order to obtain average speed. Average speed can be calculated by departure time and arrival time at each station. Outer line clockwise direction was investigated on the first day, and inner line Anti-clockwise direction was investigated on the second day.

(ii) Result

The result of GPS data collection for outer line is shown in the below table. GPS was used to determine departure and arrival time at each station.

Table 3.1.1.4 Collected GPS DATA at Each Station of Outer line

No	Station	Distance from Yangon Station	Distance between each station (km)	Arrival time	Departure time	Stoppage time(min)	Running time (min)	Speed (km/hr)
1	Yangon Central	0.0			8:24			
			0.90				3	18.00
2	Phaya Rd.	0.90		8:27	8:28	1		
			0.53				2	15.90
3	Lanmataw	1.43		8:30	8:31	1		
			0.62				3	12.40
4	Pyay Rd.	2.05		8:34	8:35	1		
			0.99				2	29.70
5	Shan Rd.	3.04		8:37	8:38	1		
			0.68				2	20.40
6	Ahlone Rd.	3.72		8:40	8:41	1		
			0.79				3	15.80
7	Panhlaing Rd.	4.51		8:44	8:45	1		
			1.04				4	15.60
8	Kyeemyindaing	5.55		8:49	8:51	2		
			1.09				5	13.08
9	Hanthawaddy	6.64		8:56	8:56	0		
			0.93				2	27.90
10	Hletan	7.57		8:58	8:58	0		
			1.83				6	18.30
11	Kamayut	9.40		9:04	9:05	1		
			1.02				4	15.30
12	Thiri Myine	10.42		9:09	9:09	0		
			0.70				2	21.00
13	Okakyin	11.12		9:11	9:13	2		
			0.67				2	20.10
14	Thamine	11.79		9:15	9:16	1		
			0.67				3	13.40
15	Thamine Myothit	12.46		9:19	9:20	1		
			0.86				2	25.80
16	Kyuntkon	13.32		9:22	9:23	1		
			1.22				4	18.30
17	Insein	14.54		9:27	9:30	3		
			1.70				5	20.40
18	Ywama	16.24		9:35	9:35	0		
			1.27				4	19.05
19	Phwakan	17.51		9:39	9:39	0		
			0.83				4	12.45
20	Aungsanmyo	18.34		9:43	9:43	0		
			1.95				7	16.71
21	Danyingone	20.29		9:50	9:53	3		
			1.62				4	24.30
22	Gauk Kwin	21.91		9:57	9:58	1		
			2.70				7	23.14
23	Kyaikkalel	24.61		10:05	10:06	1		
			1.44				4	21.60

No	Station	Distance from Yangon Station	Distance between each station (km)	Arrival time	Departure time	Stoppage time(min)	Running time (min)	Speed (km/hr)
24	Mingaladon Buzza	26.05		10:10	10:10	0		
			0.97				4	14.55
25	Mingaladon	27.02		10:14	10:14	0		
			1.48				5	17.76
26	Waibagi	28.50		10:19	10:19	0		
			1.73				6	17.30
27	Okkalapa	30.23		10:25	10:26	1		
			0.78				4	11.70
28	Paywetseikkon	31.01		10:30	10:30	0		
			1.20				4	18.00
29	Kyaukyetwin	32.21		10:34	10:34	0		
			1.28				4	19.20
30	Tadakalay	33.49		10:38	10:39	1		
			1.66				4	24.90
31	Yegu	35.15		10:43	10:43	0		
			1.53				5	18.36
32	Parame	36.68		10:48	10:48	0		
			0.99				3	19.80
33	Kanbe	37.67		10:51	10:51	0		
			1.70				4	25.50
34	Baukthaw	39.37		10:55	10:56	1		
			1.05				3	21.00
35	Tarmwe	40.42		10:59	10:59	0		
			1.00				3	20.00
36	Myittanyunt	41.42		11:02	11:03	1		
			1.08				3	21.60
37	Malwagone	42.50		11:06	11:07	1		
			2.00				7	17.14
38	Pazundaung	44.50		11:14	11:15	1		
			1.62				8	12.15
39	Yangon Central	46.12		11:23				
			46.1			28	151	18.33

Source: YUTRA Project Team (2014)

As mentioned before, distance from Yangon station was measured by tracing Google Earth and this distance is used for track survey. Collected and calculated data are summarized in the table below.

Table 3.1.1.5 Summary of the Collected and Calculated Data for Outer Line

Departure time from Yangon station	8:24
Arrival time at Yangon station	11:23
Total stoppage time	28 min
Total running time	2 h 59 min
Average speed	15.46 km/h

Source: YUTRA Project Team (2014)

This approximate time for the train was during operation from Yangon station to Yangon station in clockwise direction. Waiting time and running time were also calculated. Total running time divided by total length of Yangon Circular Railway gives average speed. Average speed, 15.46 km/h, is quite slow. The cause speed restriction is assumed to be inappropriate ballast spreading, no maintained embankment, no roadbed quality control and poor side drainage system.

Collected GPS data of inner line is summarized in the table below using the same method.

Table 3.1.1.6 Collected GPS DATA at Each Station of Inner line

No	Station	Distance from Yangon Station	Distance between each station (km)	Arrival time	Departure time	Stoppage time(min)	Running time (min)	Speed (km/hr)
1	Yangon Central	0.0		16:30				
			0.90				5	10.80
2	Phaya Rd.	0.90		16:25	16:25	0		
			0.53				4	7.95
3	Lanmataw	1.43		16:21	16:21	0		
			0.62				3	12.40
4	Pyay Rd.	2.05		16:18	16:18	0		
			0.99				3	19.80
5	Shan Rd.	3.04		16:15	16:15	0		
			0.68				3	13.60
6	Ahlone Rd.	3.72		16:12	16:12	0		
			0.79				3	15.80
7	Panhlaing Rd.	4.51		16:08	16:09	1		
			1.04				3	20.80
8	Kyeemyindaing	5.55		16:05	16:05	0		
			1.09				4	16.35
9	Hanthawaddy	6.64		16:00	16:01	1		
			0.93				4	13.95
10	Hletan	7.57		15:56	15:56	0		
			1.83				5	21.96
11	Kamayut	9.40		15:51	15:51	0		
			1.02				3	20.40
12	Thiri Myine	10.42		15:48	15:48	0		
			0.70				3	14.00
13	Okakyin	11.12		15:45	15:45	0		
			0.67				2	20.10
14	Thamine	11.79		15:43	15:43	0		
			0.67				3	13.40
15	Thamine Myothit	12.46		15:40	15:40	0		
			0.86				3	17.20
16	Kyuntkon	13.32		15:37	15:37	0		
			1.22				4	18.30
17	Insein	14.54		15:28	15:33	5		
			1.70				5	20.40
18	Ywama	16.24		15:23	15:23	0		

No	Station	Distance from Yangon Station	Distance between each station (km)	Arrival time	Departure time	Stoppage time(min)	Running time (min)	Speed (km/hr)
			1.27				6	12.70
19	Phwakan	17.51		15:17	15:17	0		
			0.83				2	24.90
20	Aungsanmyo	18.34		15:14	15:15	1		
			1.95				4	29.25
21	Danyingone	20.29		15:09	15:10	1		
			1.62				6	16.20
22	Gauk Kwin	21.91		15:03	15:03	0		
			2.70				6	27.00
23	Kyaikkalel	24.61		14:56	14:57	1		
			1.44				5	17.28
24	Mingaladon Buzza	26.05		14:51	14:51	0		
			0.97				5	11.64
25	Mingaladon	27.02		14:46	14:46	0		
			1.48				6	14.80
26	Waibagi	28.50		14:39	14:40	1		
			1.73				5	20.76
27	Okkalapa	30.23		14:34	14:34	0		
			0.78				3	15.60
28	Paywetseikkon	31.01		14:30	14:31	1		
			1.20				6	12.00
29	Kyaukyetwin	32.21		14:24	14:24	0		
			1.28				4	19.20
30	Tadakalay	33.49		14:19	14:20	1		
			1.66				4	24.90
31	Yegu	35.15		14:15	14:15	0		
			1.53				5	18.36
32	Parame	36.68		14:10	14:10	0		
			0.99				3	19.80
33	Kanbe	37.67		14:07	14:07	0		
			1.70				4	25.50
34	Baukthaw	39.37		14:03	14:03	0		
			1.05				3	21.00
35	Tarmwe	40.42		13:59	14:00	1		
			1.00				3	20.00
36	Myittanyunt	41.42		13:56	13:56	0		
			1.08				3	21.60
37	Malwagone	42.50		13:52	13:53	1		
			2.00				8	15.00
38	Pazundaung	44.50		13:44	13:44	0		
			1.62				6	16.20
39	Yangon Central	46.12			13:38			
			46.1			15	157	16.09

Source: YUTRA Project Team (2014)

Collected and calculated data are summarized in the table below.

Table 3.1.1.7 Summary of the Collected and Calculated Data for Inner Line

Item	Collected and calculated data
Departure time from Yangon station	13:38
Arrival time at Yangon station	16:30
Total stoppage time	15 min
Total running time	2 h 52 min
Average speed	18.33 km/h

Source: YUTRA Project Team (2014)

The visual survey result for outer line is summarized in the table below. This survey was conducted by two investigators and the average evaluation of the two evaluations was adopted. The differences found between two investigators was not large.

Table 3.1.1.8 Visual Survey Result of Outer Line

No	Station	(1)Filling up condition of track ballast	(2)Installed condition of sleeper	(3)Ride comfort	(4)Irregularity of rail alignment	(5)Condition of rail joint	(6)Track environment	(7)Installed condition of side drainage	(8)Condition of embankment /cut	(9)Sureness of construction gauge	Evaluation
1	Yangon Central										
		B	A	B	A-B	A-B	A	B	B	A	B
2	Phaya Rd.										
		B	A	A	A-B	A	A	B-C	B	A	B
3	Lanmataw										
		A-B	A	A	A	A	A	A-B	B	B	B
4	Pyay Rd.										
		B	A	A-B	A-B	B	B	A-B	B-C	A	B
5	Shan Rd.										
		B	A	A-B	A	A-B	A-B	B	C	A	B
6	Ahlone Rd.										
		B	A	A-B	B	A-B	A-B	B	B-C	A	B
7	Panhlaing Rd.										
		B	A	A-B	A-B	A-B	A	B-C	B	A	B
8	Kyeemyindaing										
		B	A	A-B	A-B	B	B	C	B	A	B
9	Hanthawaddy										
		B-C	A	B	A-B	B	B	B	B-C	A	B
10	Hletan										
		B	A	B	A	B-C	A-B	B-C	B	A-B	B
11	Kamayut										
		B	A	A	A	A-B	A-B	B-C	B	A-B	B
12	Thiri Myine										
		A-B	A	A	A	B	A	C	B-C	A	B
13	Okakyin										
		A-B	A	A	A	A-B	A-B	C	B	A	B
14	Thamine										
		B	A	A	A	A-B	A-B	C	B-C	A	B
15	Thamine Myothit										
		B	A	A	A-B	B	A-B	C	B-C	A-B	B
16	Kyuntkon										

No	Station	(1)Filling up condition of track ballast	(2)Installed condition of sleeper	(3)Ride comfort	(4)Irregularity of rail alignment	(5)Condition of rail joint	(6)Track environment	(7)Installed condition of side drainage	(8)Condition of embankment /cut	(9)Sureness of construction gauge	Evaluation
		B	A	A	A-B	B	A	C	B-C	A	B
17	Insein										
		B-C	A	A-B	B	B-C	B	C	B-C	A-B	B
18	Ywama										
		B	A	A-B	B	B	B	C	B-C	A-B	B
19	Phwakan										
		B	A	A-B	A-B	B	B	C	B-C	A-B	B
20	Aungsanmyo										
		B	A	B	A-B	B-C	A-B	C	B-C	A-B	B
21	Danyingone										
		B	A	A-B	A-B	A-B	A-B	C	B-C	A	B
22	Gauk Kwin										
		A	A	A-B	B	A-B	A-B	C	B	A-B	A-B
23	Kyaikkalel										
		B	A	A-B	A-B	B	A	C	B-C	A	B
24	Mingaladon Buzza										
		B	A	B	B-C	B-C	B	C	B-C	A	B
25	Mingaladon										
		B	A	A-B	B-C	B	A-B	C	B-C	A	B
26	Waibagi										
		B-C	A	B	B-C	B-C	B	C	B-C	A-B	B
27	Okkalapa										
		B	A	A-B	A-B	B	A-B	C	B	A	B
28	Paywetseikkon										
		B	A	A-B	B	B-C	B-C	C	B-C	A	B
29	Kyaukyetwin										
		B	A	A-B	B	B	B	C	B-C	A-B	B
30	Tadakalay										
		B-C	A	B	B-C	B-C	A	C	B	A	B-C
31	Yegu										
		B-C	A	B	B-C	B	A-B	C	B	A	B
32	Parame										
		B-C	A	A-B	B	B-C	A-B	C	B	A	B
33	Kanbe										
		C	A	B	B-C	B	B	C	C	A-B	B
34	Baukthaw										
		B-C	A	B	B	B-C	B-C	C	B-C	A	B
35	Tarmwe										
		B	A	B	B-C	B-C	B	C	B-C	A-B	B
36	Myittanyunt										
		B	A	B	B	B-C	A-B	C	B	A	B
37	Malwagone										
		B	A	B	B	B	A-B	C	B	A	B
38	Pazundaung										
		B	A	A-B	A-B	B-C	A-B	B	B	A	A-B
39	Yangon Central										

Source: YUTRA Project Team (2014)

From Gouk Kwin station to Kyaikkalel station and from Pazundaung station to Yangon Central station were evaluated as A-B (sound condition, but in places

in need of repair). Other sections were evaluated to need repair and also to be in serious condition for continual operation. Condition of Ballast and embankment are mainly in serious condition. Condition of side drainage is evaluated to be in need of repair at embankment and flat section. Evaluation of most embankment sections is in serious condition. Evaluation of rail alignment and rail joint has trend to be worn at eastern half area. Installed condition of sleeper is totally good in all sections; however interval of each sleeper is irregular.

Survey method of Inner line was also applied to the outer line. Result is summarized in the table below.

Table 3.1.1.9 Visual Survey Result of Inner Line

No	Station	(1)Filling up condition of track ballast	(2)Installed condition of sleeper	(3)Ride comfort	(4)Irregularity of rail alignment	(5)Condition of rail joint	(6)Track environment	(7)Installed condition of side drainage	(8)Condition of embankment/cut	(9)Sureness of construction gauge	Evaluation
1	Yangon Central										
		B	A	A	A-B	B	A	B-C		A	B
2	Phaya Rd.										
		A-B	A	A	A	A	A	C	B	A-B	B
3	Lanmataw										
		B	A	A	A	A	A-B	B	B-C	A-B	B
4	Pyay Rd.										
		B	A	A	A	A	B	B	B-C	A	B
5	Shan Rd.										
		B	A	A	A	A	B	B	B-C	A	B
6	Ahlone Rd.										
		A-B	A	A-B	A	A-B	A-B	B-C	B	A	B
7	Panhlaing Rd.										
		A-B	A	A-B	A-B	B	B-C	C	B	B	B
8	Kyeemyindaing										
		B	A	A	A-B	A-B	B	C	B	A	B
9	Hanthawaddy										
		A-C	A	A-B	A-B	B	B	B	B	A	B
10	Hletan										
		A-C	A	A-B	A-B	A-B	B	C	A-B	A	B
11	Kamayut										
		A-B	A	A	A	A-B	A-B	C	A-B	A	B
12	Thiri Myine										
		A-B	A	A	A	B	A-B	C	A-B	A	B
13	Okakyin										
		A-B	A	A	A-B	A-B	A-B	C	A-B	A	B
14	Thamine										
		A-B	A	A	A-B	A-B	A-B	C	A-B	A	B
15	Thamine Myothit										
		A-B	A	A-B	A-B	B	B	C	A	A	A-B
16	Kyuntkon										
		A-B	A	A	A	A-B	B	C	A-B	A	A-B
17	Insein										
		B-C	A	A-B	A-B	B-C	A-B	C	A-B	A	B
18	Ywama										

No	Station	(1)Filling up condition of track ballast	(2)Installed condition of sleeper	(3)Ride comfort	(4)Irregularity of rail alignment	(5)Condition of rail joint	(6)Track environment	(7)Installed condition of side drainage	(8)Condition of embankment/cut	(9)Sureness of construction gauge	Evaluation
		A-B	A	A-B	B	B	B	C	A	A	B
19	Phwakan										
		A-B	A	A-B	B	A-B	A-B	C	A-B	A	A-B
20	Aungsanmyo										
		B	A	A-B	A-B	B	A-B	C	A-B	A	B
21	Danyingone										
		B	A	A-B	B	B	B	C	B-C	A	B
22	Gauk Kwin										
		A-B	A	B	B-C	B	B	C	B-C	A	B
23	Kyaikkalel										
		A-B	A	B	B-C	B	B	C	B	A	B
24	Mingaladon Buzza										
		A-B	A	A-B	A-B	A	A-B	C	B	A	B
25	Mingaladon										
		A-B	A	A-B	B	B	A-B	C	B-C	A	B
26	Waibagi										
		B	A	B	B-C	B	B	C	B-C	A	B-C
27	Okkalapa										
		B-C	A	B	B-C	A-B	A	C	B	A	B
28	Paywetseikkon										
		B	A	B	B	B	B	B-C	B-C	A	B
29	Kyaukyetwin										
		B	A	B	B	A-B	B	B-C	B	A	B
30	Tadakalay										
		B	A	A-B	A-B	A-B	A-B	C	B	A	B
31	Yegu										
		B	A	A-B	A-B	A-B	A-B	C	A-B	A	B
32	Parame										
		A-B	A	B	A	A-B	A-B	C	B	A	B
33	Kanbe										
		A-B	A	B	B	B	B	C	B	A	B
34	Baukthaw										
		B	A	A-B	A-B	A-B	A-B	B	B	A	B
35	Tarmwe										
		B	A	A-B	A-B	A-B	A	C	B	A	B
36	Myittanyunt										
		B	A	B	A-B	A-B	A	C	B	A	B
37	Malwagone										
		B	A	A	B	B	B	C	B	A-B	B
38	Pazundaung										
		A-B	A	A	B	A-B	A	B-C	B-C	A-B	B
39	Yangon Central										

Source: YUTRA Project Team (2014)

Inner line has similar pattern of conditions as outer line. Three sections were evaluated as A-B (between sound condition and in need of repair) as total evaluation. Other sections were evaluated B (in need of repair), except for one section. Most sections require some repair.

3.1.2 Earthwork & Drainage

1) Place of Earthwork

Earthwork section is roughly divided three sections: embankment, cut and flat. Approximate distance and place are mentioned below.

- Embankment section : from Thamine Myothit st. to Aungsanmyo st., 7.92 km
  : from Kyaikkalel st. to Parame st. 6.27 km
- Cut section : from Yangon Central st. to Thamine Myothit st, 10.42 km
- Flat section : from Aungsanmyo st. to Kyaikkalel st. 12.07 km
  : from Parame st. to Yangon Central st. 9.44 km

Typical condition of embankment, cut and flat section are shown below.

Embankment	Cut	Flat
		

Source: YUTRA Project Team (2014)

Figure 3.1.2.1 Typical Condition of Embankment, Cut and Flat Section

2) Evaluation of Earthwork

In the above mentioned visual survey result (Tables 3.1.1.8 and 3.1.1.9), there is an evaluation item called “(8) Condition of embankment/cut”, and according to the result, it is clear that many place need to be repaired due to breaks in roadbed and slope shoulder. According to the interview to MR, all earthworks haven’t been maintained in a long time. As mentioned earlier, this causes derailments and speed restrictions.

3) Side Drainage

(1) Overview of Side Drainage

Side drainage plays an important role in maintaining the proper roadbed condition. Although side drainage which is across the track is not managed by MR, new side drainage between tracks has been constructed as shown in the figure below. Maintained section is from Lanmataw station to Ahlone Rd. Station. Under construction section of side drainage can be seen from Yangon Central station to Lanmataw station as shown below.

New side drainage	Under construction side drainage
	

Source: YUTRA Project Team (2014)

Figure 3.1.2.2 Current Condition of New Side Drainage and Under Construction Side Drainage

In the above mentioned visual survey result (Tables 3.1.1.8 and 3.1.1.9), there is an evaluation item called "(7) Installed condition of side drainage", and according to the result, almost all places need repair or have nothing existing. This evaluation is discussed for the places located between tracks or on side of track.

(2) Side Drainage Conditions Survey

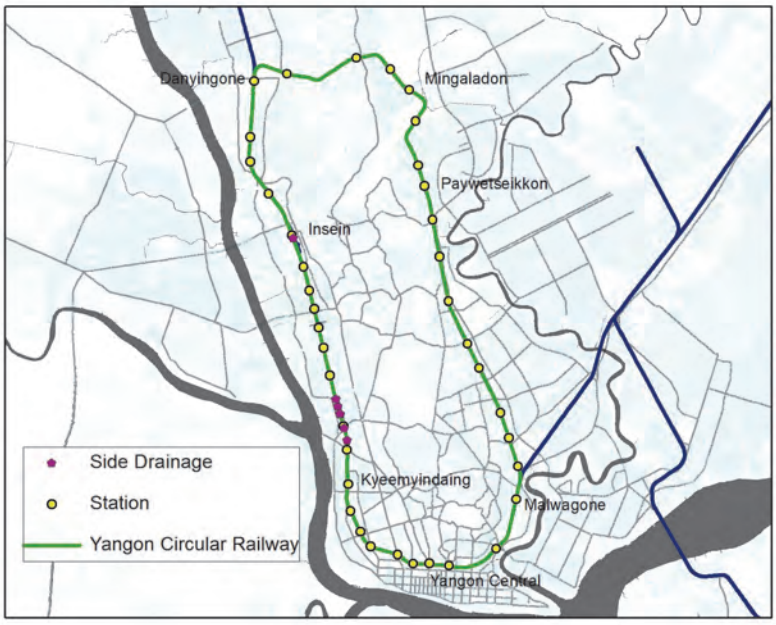
Another side drainage conditions survey was conducted focusing on areas across the track by two separate teams in two days. The list of side drainage couldn't be gotten from MR because side drainage isn't touched by them at all. Hence, the investigator tried to walk on the track with MR staff as much as possible to find it. GPS was handled with investigator to collect data at an accurate place. The first team started from Yangon station in clockwise direction, and the second team start from Yangon station to anti-clockwise direction. The items listed below were surveyed.

- Visit time
- Side drainage length (m)
- Detail of length
- Side drainage width (m)
- Current condition (A:OK, B:Need repair, C:Dangerous)
  - Superstructure
  - Abut/Pier
  - Shoe

In addition, a figure showing existing point of infrastructure which was made by MR was found. This figure is older than the list from MR; therefore some old information appears there, and does not correlate well with other information, even though the figure and list were provided from MR. Identification serial No. was settled in this figure from three directions, which are clockwise direction from Yangon Central station to Danyingone station, and Anti-clockwise direction from Nyittanyunt station to Danyingone station and Yangon-Mandalay line from Yangon Central station to Myittanyunt station.

(3) Location of Side Drainage

All side drainages are seen in the western area. There is some potential not to find all side drainage due to the difficulties to walk all tracks in Yangon Circular Railway and the lack of information by MR staff. Location of side drainage is shown in the map below.



Source: YUTRA Project Team (2014)

Figure 3.1.2.3 Location Map of Side Drainage

(4) Result

Survey data of side drainage is summarized in the table below.

Table 3.1.2.1 Survey Result Data of Side Drainage

Infrastructure No	MR's ID No	Station		Survey data km	Remarks
		From	to	Clock Wise	
SD01	C16DX	Hanthawaddy	Hletan	7.06	Not listed from MR
SD02	C16EX	Hanthawaddy	Hletan	7.50	Not listed from MR
SD03	C16FX	Hletan	Kamayut	8.02	Not listed from MR
SD04	C16GX	Hletan	Kamayut	8.04	Not listed from MR
SD05	C17AX	Hletan	Kamayut	8.30	Not listed from MR
SD06	C18CX	Hletan	Kamayut	8.57	Not listed from MR
SD07	C22BX	Kyuntkon	Insein	14.39	Not listed from MR

Source: YUTRA Project Team (2014)

Before discussing the result, the meaning of infrastructure No and MR ID No is explained with an example below.

• Infrastructure No (SD01)

- SD: Side Drainage
- 01: Serial Numbers counted from Yangon Central Station

• MR's ID No (C16DX)

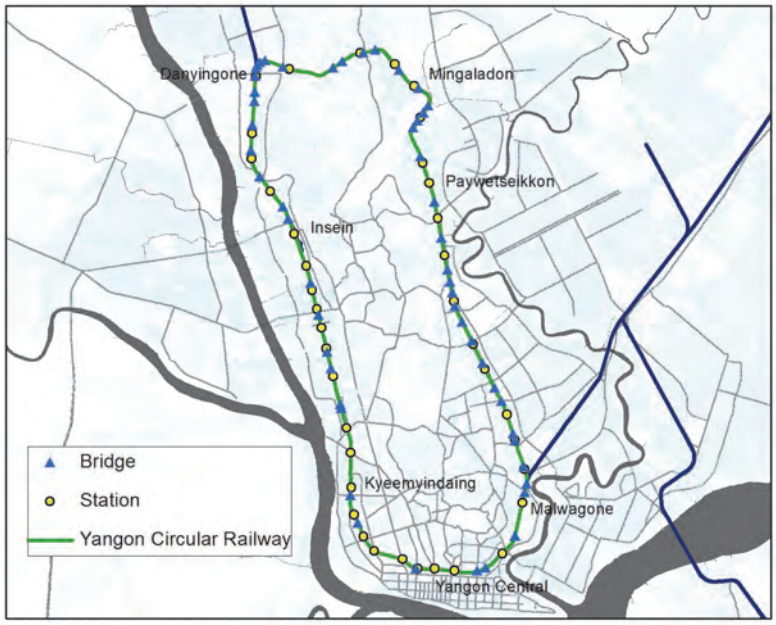
- C: Clockwise Direction of Yangon Circular Railway (A: Anti-Clockwise Direction, YM: Yangon-Mandalay Line)
- 16D: Serial Numbers counted from Yangon Central Station
- X: Extra infrastructure from MR's Figure (Not recognized as infrastructure or new infrastructure)

According to this survey, seven side drainages could be found in Yangon Circular Railway. Size of all side drainage is less than 1 m or difficult to measure. All side drainages don't work properly due being clogged with a lot of rubbish. Detail information of all side drainage are shown in Appendix 3-3

3.1.3 Bridges (Include Culverts)

1) Location of Bridges

46 bridges are listed by MR's organization; however, actually 53 bridges could be found by conditions survey. Please note that MR categorizes not only bridge but also culvert as "Bridge" for their inventory. The places that survey team found are shown in the map below.



Source: YUTRA Project Team (2014)

Figure 3.1.3.1 Location Map of Bridges

2) Overview of Bridge Types

Steel I girder is mainly used in Yangon Circular Railway. Pipe or Box culvert were categorized as bridge according to MR list, and these are all classified as less than 5 m length. RC type could be also seen in Yangon Circular Railway. Brick, wood and drain box are categorized as others as shown in the table below. The following table summarizes bridge type and length.

Table 3.1.3.1 Summary of Types of Bridges

Length		Type				
	Total Number	Steel (I Girder)	RC (I or T girder)	Culvert (Box, Pipe)	Others	None
≧10 (m)	8	7	1	0	0	0
5-10 (m)	11	7	3	0	1	0
5≦ (m)	32	16	7	4	3	3
Not calculated	2	0	0	0	1	1
Total	53	30	11	4	5	4

Source: YUTRA Project Team (2014)

The longest bridge is 41 m, classified as steel I girder. There is another bridge type, which has differences between up line and down line. There are cases where the bridge length is the sleeper interval, and where a superstructure doesn't exist.

3) Bridge Conditions Survey

(1) Survey Methodology

Bridge conditions survey was conducted the same as the side drainage survey, by using Handheld GPS to collect accurate points of all infrastructures. Investigators walked on the track with MR's staff and referred to the bridge list from MR. The items listed below were investigated.

- Visit time
- Bridge Type
- Bridge length (m)
- Detail of length
- Bridge width (m)
- Current condition (A:OK, B:Need repair, C:Dangerous)
  - Superstructure
  - Abut/Pier
  - Shoe

Survey time was given by GPS when investigator arrived at bridge point. Visual inspection was applied for bridge type and current condition by two Japanese engineers and MR staff. Bridge length and width were measured by a laser measure and tape measure. When extra bridges which are not shown on the MR list could be found, these were also investigated.

(2) Result

Collected GPS data is summarized in the table below.

Table 3.1.3.2 Collected GPS Data and MR Bridge List

Infrastructure No	MR's ID No	Station		Mile (MR)		Equivalent to km (MR)	Survey data km	Name of infrastructure	Remarks
		From	to	From	To	Clock Wise	Clock Wise		
B01	C6	Lanmataw	Pyay Rd.	1/1	1/2	1.71	1.55	6	
B02	C11	Ahlone Rd.	Panhlaing Rd.				4.25		Not listed from MR, but existing
B03	C13	Panhlaing Rd.	Kyeemyindaing				5.25		Not listed from MR, but existing
B04	C17	Hletan	Kamayut	5/4	5/5	8.33	8.29	17	
B05	C18	Hletan	Kamayut	5/8	5/9	8.61	8.42	18	
B06	C19BX	Kamayut	Thiri Myine				9.71		Not listed from MR, but existing
B07	C20	Kamayut	Thiri Myine	6/10	6/11	10.35	10.29	20	
B08	C21	Okakyin	Thamine	7/3	7/4	11.49	11.59	21	
B09	C22	Thamine Myothit	Kyuntkon	7/22	7/23	12.76	12.72	22	
B10	C24	Insein	Ywama	9/8	9/9	15.04	15.06	24	
B11	C25	Insein	Ywama	9/15	6/16	15.51	15.51	25	
B12	C26	Ywama	Phwakan	10/10	10/11	16.78	16.81	26	
B13	C27	Phwakan	Aungsanmyo	11/1	11/2	17.80	17.78	27	
B14	C28	Aungsanmyo	Danyingone	11/14	11/15	18.66	18.65	28	
B15	C29	Aungsanmyo	Danyingone	12/1	12/2	19.40	19.46	29	
B16	C30	Aungsanmyo	Danyingone	12/4	12/5	19.60	19.79	30	
B17	C31	Danyingone	Gauk Kwin	12/4	12/5	19.60	20.34	31	
B18	C32BX	Danyingone	Gauk Kwin				20.63		Not listed from MR, but existing
B19	A46	Danyingone	Gauk Kwin	15/14	15/15	20.47	20.72	46	
B20	A45	Danyingone	Gauk Kwin	15/12		20.63	20.85	45	
B21	A44	Danyingone	Gauk Kwin	15/9	15/10	20.80	21.04	44	
B22	A43	Danyingone	Gauk Kwin	14/23	14/24	21.48	21.70	43	
B23	A39	Gauk Kwin	Kyaikkalel	15/15	15/16	20.40	23.52	39	
B24	A38	Gauk Kwin	Kyaikkalel	13/24	14/1	23.04	23.91	38	
B25	A34BX	Kyaikkalel	Mingaladon Buzza				24.70		Not listed from MR, but existing
B26	A33	Kyaikkalel	Mingaladon Buzza	13/6	13/7	24.22	24.72	33	
B27	A32	Mingaladon Buzza	Mingaladon	12/14	12/15	25.29	26.26	32	
B28	A31	Mingaladon	Waibagi	12/1	12/2	26.16	27.21	31	
B29	A30	Mingaladon	Waibagi	11/15	11/16	26.84	28.01	30	
B30	A29	Mingaladon	Waibagi	11/10	11/11	27.18	28.30	29	
B31	A28	Mingaladon	Waibagi	11/5	11/6	27.50	28.32	28	
B32	A27	Waibagi	Okkalapa	11/1	11/2	27.77	28.65	27	
B33	A25	Waibagi	Okkalapa				28.93		Not listed from MR, but existing
B34	A22	Waibagi	Okkalapa	10/6	10/7	29.04	30.01	22	
B35	A20	Paywetseikkon	Kyaukyetwin	9/6	9/7	30.65	31.64	20	
B36	A16	Kyaukyetwin	Tadakalay	8/13	8/14	31.79	32.90	16	
B37	A15	Tadakalay	Yegu	7/20	7/21	32.94	34.02	15	
B38	A14	Tadakalay	Yegu				34.43		Not listed from MR, but existing
B39	A13	Tadakalay	Yegu	7/8	7/9	33.74	34.82	13	

Infrastructure No	MR's ID No	Station		Mile (MR)		Equivalent to km (MR)	Survey data km	Name of infrastructure	Remarks
		From	to	From	To	Clock Wise	Clock Wise		
B40	A12	Yegu	Parame	7/1	7/2	34.21	35.28	12	
B41	A11	Yegu	Parame	6/16	6/17	34.82	35.87	11	
B42	A10	Yegu	Parame	6/2	6/3	35.75	36.61	10	
B43	A8	Parame	Kanbe	5/18	5/19	36.28	37.45	8	
B44	A6	Kanbe	Baukthaw	5/3	5/4	37.30	38.40	6	
B45	A3	Baukthaw	Tarmwe	4/2	4/3	38.97	40.10	3	
B46	A2	Baukthaw	Tarmwe	3/22	3/23	39.24	40.32	2	
B47	A1	Tarmwe	Myittanyunt	3/5	3/6	40.37	41.29	1	
B48	YM9	Myittanyunt	Malwagone	2/18	2/19	41.11	41.89	9	
B49	YM8	Myittanyunt	Malwagone	2/12	2/13	41.51	42.20	8	
B50	YM5BX	Malwagone	Pazundaung				43.72		Not listed from MR, but existing
B51	YM5AX	Malwagone	Pazundaung				43.74		Not listed from MR, but existing
B52	YM3	Pazundaung	Yangon Central	0/13	0/14	44.67	45.24	3	
B53	YM2	Pazundaung	Yangon Central	0/7	0/8	45.07	45.56	2	
None	None			15/15	15/16	20.40		32	Listed from MR, but not existing

Source: MR and YUTRA Project Team (2014)

Nine extra bridges were investigated and 1 listed bridge couldn't be found by this survey. It is considered that weeds and much rubbish covers old bridges day by day; therefore they couldn't seen by this survey.

Although some bridges were close or at same position (for example B11), some other bridges have large differences between position equivalent to km from MR list and survey data position. One of the reasons for difference of total length in Yangon Circular Railway and MR's official data is that it was measured from two directions. To fix the total length is the important task for the next F/S.

Bridge conditions survey result is summarized in the table below.

Table 3.1.3.3 Summary of the Evaluation of Current Conditions of Bridges

Evaluation	Current condition		
	Superstructure	Abut/Pier	Shoe
A	7	11	1
A-B	4	0	1
B	29	31	11
B-C	2	1	1
C	3	3	9
Others	8	7	30
Total	53	53	53

Source: YUTRA Project Team (2014)

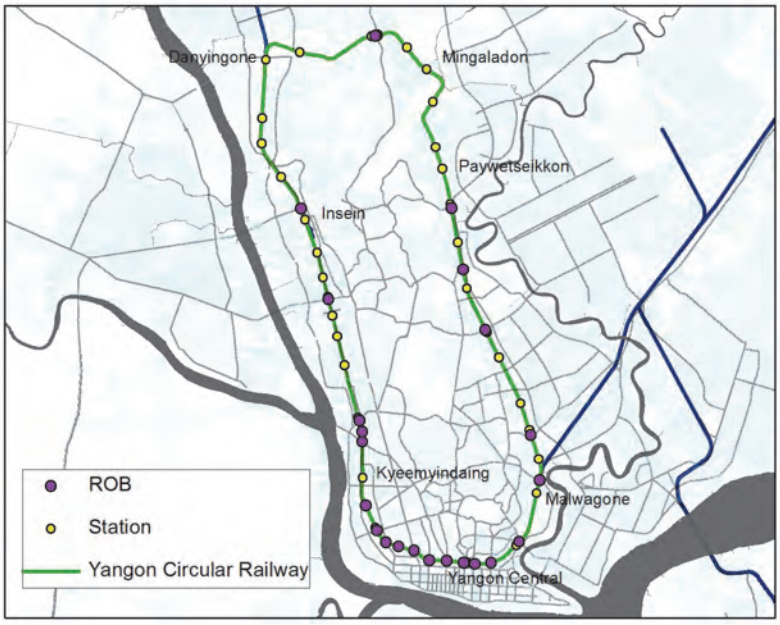
Although some superstructure, abutment/pier have somewhat sound condition, the majorly need repair due to a lot of rust and cracks. Dangerous conditions are also seen due to lack of rivets and deterioration by aging. In case of shoe, it was mostly difficult to

see the shoe, not provided or using wood to adjust the height. Early repair is required to avoid the serious accident. Detailed information of all bridges is shown in Appendix 3-4. In addition, bridge inspection was conducted by MR in 2012. Inspection items included abutment, pier and safety condition. All were evaluated as “GOOD”. Large differences can be seen. Bridge inspection report is shown in Appendix 3-5.

3.1.4 ROB (Flyover for Vehicles)

1) Location of ROB

All ROB which are listed on MR list were investigated by this survey. 25 ROBs are shown in the map below.



Source: YUTRA Project Team (2014)

Figure 3.1.4.1 Location Map of ROB

As location map shows, many ROBs are located near Yangon Central Station, which is a congestion area.

2) Overview of ROB Types

Steel, PC and RC types are applied for ROB. Steel include I girder and arch truss, PC and RC include I girder and T girder. Steel type is used for short span, and PC and RC types are partly used for long span. ROB types are summarized below.

Table 3.1.4.1 Summary of ROB Types

Span	Number	Type		
		Steel (I Girder, Arch truss)	PC (I or T girder)	RC (I or T girder)
1-3 Span	16	7	3	6
4-9 Span	5	0	3	2
>10 Span	4	0	1	3
Total	25	7	7	11

Source: YUTRA Project Team (2014)

In addition, some ROBs are located with FOB. Definition of ROB and FOB is according to the list from MR. 4 ROBs were not evaluated because they had the same condition as FOB.

3) ROB Conditions Survey

(1) Survey Methodology

ROB conditions survey was conducted by the same methodology as bridge survey. Two separate teams investigated the items listed below in two days with GPS.

- Visit time
- ROB Type
- Clearance from Rail Level to under girder
- No. of span
- ROB lane No.
- Current condition (A:OK, B:Need repair, C:Dangerous)
  - Superstructure
  - Abut/Pier
  - Shoe

Survey time could be gotten from GPS, and visual inspection was conducted about ROB type, No. of span, ROB lane No. and current condition by each investigator. Clearance from rail level to under girder of ROB was measured by a laser measure or sometimes tape measure. If extra ROBs which are not shown on the MR list could be found, these were also investigated.

(2) Result

GPS data collection and given from MR list is summarized in the table below.

Table 3.1.4.2 Collected GPS Data and MR ROB List

Infrastructure No	MR's ID No	Station		Mile (MR)		Equivalent to km (MR)	Survey data km	Remarks
		From	to	From	To	Clock Wise	Clock Wise	
R01	C2	Yangon Central	Phaya Rd.	0/4	0/5	0.29	0.33	
R02	C2A	Yangon	Phaya Rd.	0/4	0/5	0.29	0.35	

Infrastructure No	MR's ID No	Station		Mile (MR)		Equivalent to km (MR)	Survey data km	Remarks
		From	to	From	To	Clock Wise	Clock Wise	
		Central						
R03	C5	Phaya Rd.	Lanmataw	0/15	0/16	1.03	0.93	
R04	C6A	Lanmataw	Pyay Rd.	1/0	1/1	1.71	1.52	
R05	C7	Pyay Rd.	Shan Rd.	1/11	1/12	2.37	2.13	
R06	C8	Pyay Rd.	Shan Rd.	1/21	1/22	3.04	2.68	
R07	C10	Shan Rd.	Ahlone Rd.	2/10	2/11	3.91	3.13	
R08	C10A	Shan Rd.	Ahlone Rd.	2/12		4.02	3.63	
R09	C12	Panhlaing Rd.	Kyeemyindaing	2/23	2/24	4.78	4.56	
R10	C16	Hanthawaddy	Hletan	4/8		6.97	6.74	
R11	C16BX	Hanthawaddy	Hletan	4/13	4/14	7.34	7.09	
R12	C16A	Hanthawaddy	Hletan	4/19	4/20	7.74	7.48	
R13	C21BX	Okakyin	Thamine	7/6	7/7	11.70	11.71	
R14	C24A	Insein	Ywama	9/6	9/7	14.92	14.92	
R15	A34A	Kyaikkalel	Mingaladon Buzza	13/13		23.78	24.72	
R16	A34B	Kyaikkalel	Mingaladon Buzza	13/14		23.76	24.77	
R17	A17AX	Kyaukyetwin	Tadakalay	20/18	20/19	20.78	32.33	
R18	A13A	Tadakalay	Yegu	7/13	7/14	33.40	34.46	
R19	A10AX	Yegu	Parame	6/5	6/6	35.54	36.62	
R20	A1A	Tarmwe	Myittanyunt	3/18	3/19	39.50	40.51	
R21	A1DX	Tarmwe	Myittanyunt	3/18	3/19	39.50	40.52	Same as R20
R22	YM8A	Myittanyunt	Malwagone	2/17	2/18	41.17	42.11	
R23	YM5	Malwagone	Pazundaung	1/2	1/3	43.80	44.33	
R24	YM2A	Pazundaung	Yangon Central	0/7	0/8	45.07	45.54	
R25	C1	Pazundaung	Yangon Central	0/0	0/1	43.93	46.10	
None	None			5/15	5/16	36.49		Listed from MR, but this is for Mandalay line

Source: MR and YUTRA Project Team (2014)

R20 and R21 are recognized as the same ROB by MR list; however, it should be defined as different ROB between R20 and R21. Another extra ROB couldn't be found and one ROB couldn't be investigated by this survey. It might be removed intentionally or something happened to break or destroyed by natural disaster. Summary of ROB conditions survey is shown in the table below.

Table 3.1.4.3 Summary of the Evaluation of Current Conditions of ROB

Evaluation	Current condition		
	Superstructure	Abut/Pier	Shoe
A	12	11	1
A-B	0	0	0
B	11	14	1
B-C	1	0	0
C	1	0	0
Others	0	0	23
Total	25	25	25

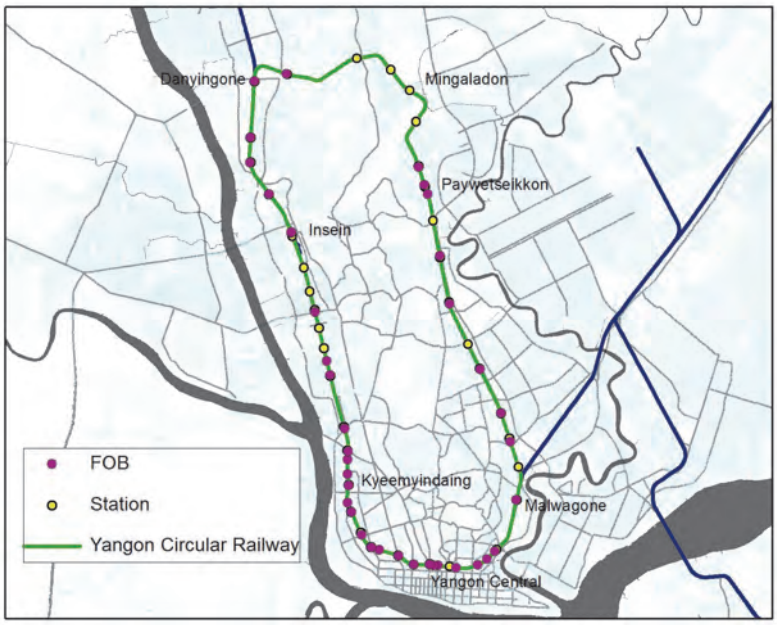
Source: YUTRA Project Team (2014)

Almost half of superstructures and abutment/Piers were evaluated as in good condition and the other half were evaluated as in need of repair. Most shoes couldn't be seen or do not exist. In addition, the lowest height from the rail level to under girder is 3.82 m, despite construction gauge being 3.81 m. There is only 1 cm clearance. After performing rehabilitation of rail track, rail level might be raised a little bit since it has happened that the train head touched the bottom of ROB. Some flyovers are seen in this situation in Yangon Circular Railway. Detailed information of all ROBs is shown in Appendix 3-6.

3.1.5 FOB (Overpass for Pedestrian)

1) Location of FOB

35 FOB are found as shown in the map below.



Source: YUTRA Project Team (2014)

Figure 3.1.5.1 Location Map of FOB

21 FOB are located in the station for going across to the opposite side of station. It seems many people cross the track between trains. This might make disease dangerous situation if train operation head becomes higher than now. Therefore, some educational and physical devices are required for high speed operation.

Other 11 FOB are located out of the station area. These seem to be used because there are walls or other obstacles to prevent crossing the track.

2) Overview of FOB Types

Steel truss type is mainly used for FOB. RC type is also found for three places. Two new FOBs are under construction.

Table 3.1.5.1 Summary of the Types of FOB

	Number	Type	
		Steel Truss	RC
1 Span	15	15	0
2~3 Span	11	8	3
>4 Span	3	3	0
None	3	3	0
Total	32	29	3

Source: YUTRA Project Team (2014)

Long span FOBs are located in large stations, Kyeemyindaing station and Insei station. Other FOBs are located in other stations or between each station.

3) FOB Conditions Survey

(1) Survey Methodology

FOB conditions survey methodology is the same as for side drainage,. Two separate teams investigated the items listed below in two days with GPS.

- Visit time
- FOB Type
- Clearance from Rail Level to under girder
- No. of span
- Location
  - Inside of station
  - Out of station
- Current condition (A:OK, B:Need repair, C:Dangerous)
  - Superstructure
  - Abut/Pier
  - Shoe

(2) Result

GPS survey data and MR list are summarized in the table below.

Table 3.1.5.2 Collected GPS Data and MR FOB List

Infrastructure No	MR's ID No	Station		Mile		Equivalent to km	Survey data km	Name of infrastructure	Remarks
		From	to	From	To	Clock Wise	Clock Wise		
F01	C3	Yangon Central	Phaya Rd.	0/11	0/12	0.77	0.63	Bogyoke Market	
F02	C4	Yangon Central	Phaya Rd.	0/14	0/15	0.97	0.78	Pha Ya Road	
F03	C5AX	Lanmataw	Pyay Rd.	1/1	1/24	2.41	1.48	Lan Ma Taw	Listed byMR list, but same as R04

Infrastructure No	MR's ID No	Station		Mile		Equivalent to km	Survey data km	Name of infrastructure	Remarks
		From	to	From	To	Clock Wise	Clock Wise		
F04	C6BX	Pyay Rd.	Shan Rd.	1/6	1/7	2.04	2.10	Pyay Road	Listed byMR list, but same as R05
F05	C9	Pyay Rd.	Shan Rd.	1/23	1/24	3.17	2.80	Sayama Road	
F06	C10BX	Shan Rd.	Ahlone Rd.	2/1	2/2	3.31	3.10	Shan Road	Listed byMR list, but same as R07
F07	C10CX	Shan Rd.	Ahlone Rd.	2/5	2/6	3.59	3.66	Ahlone	Listed byMR list, but same as R09
F08	C12AX	Panhlaing Rd.	Kyeemyindaing	3/1	3/2	4.92	4.55	Pah Hlaing	
F09	C12BX	Panhlaing Rd.	Kyeemyindaing	3/8	3/9	5.39	4.90	Taw Lan Shaw Lan	
F10	C13A	Panhlaing Rd.	Kyeemyindaing	3/12	3/13	5.66	5.50	Kyi Myin Dine	
F11	C13B	Kyeemyindaing	Hanthawaddy	3/17	3/18	6.00	5.90	Than Ta Dar	
F12	C14AX	Kyeemyindaing	Hanthawaddy	4/0	4/1	6.47	6.41	Pah Pin Gyi	
F13	C15	Hanthawaddy	Hletan				6.70	A Ma Ka (21)	Not listed from MR, but existed
F14	C16CX	Hanthawaddy	Hletan	4/19	4/20	7.74	7.50	Han Tha Waddy	
F15	C19	Kamayut	Thiri Myine	5/16	5/17	9.14	9.46	Hle Dan	
F16	C19A	Kamayut	Thiri Myine				9.96		Not listed from MR, but existed
F17	C21AX	Okakyin	Thamine	7/5	7/6	11.63	11.73	Thamine	
F18	C23A	Insein	Ywama	9/1	9/2	14.58	14.60	Insein	
F19	C23B	Insein	Ywama	9/2	9/3	14.64	14.64	Insein Factory	
F20	C25CX	Insein	Ywama	10/1	10/2	16.19	16.19	Ywa Ma	
F21	C27AX	Aungsanmyo	Danyingone	11/8	11/9	18.26	18.36	Aung San	
F22	C30A	Danyingone	Gauk Kwin	12/14	12/15	20.27	20.33	Da Nyin Gone	
F23	A43AX	Danyingone	Gauk Kwin	15/4	15/5	21.14	21.89	Gout Kwin	
F24	A21DX	Okkalapa	Paywetseikkon	10/3	10/4	29.25	30.26	Okkalapa	
F25	A21BX	Okkalapa	Paywetseikkon	9/16	9/17	29.99	30.92	Paywatseikkone	
F26	A21AX	Paywetseikkon	Kyaukyetwin	9/11	9/12	30.33	31.26	Paywatseikkone Zay	
F27	A15AX	Kyaukyetwin	Tadakalay	8/4	8/5	32.40	33.46	Tadakalay	
F28	A12AX	Yegu	Parame	7/2	7/3	34.14	35.17	Ye Ku	
F29	A7BX	Kanbe	Baukthaw	5/13	5/14	36.62	37.70	Kan Be	
F30	A4	Baukthaw	Tarmwe	4/11	4/12	38.37	39.39	Bauk Htaw	

Infrastructure No	MR's ID No	Station		Mile		Equivalent to km	Survey data km	Name of infrastructure	Remarks
		From	to	From	To	Clock Wise	Clock Wise		
F31	A1CX	Tarmwe	Myittanyunt	3/20	3/21	39.37	40.45	Ta Mawe	
F32	YM7	Malwagone	Pazundaung	2/5	2/8	41.91	42.57	Mahlwa Gone	
F33	YM4	Pazundaung	Yangon Central	0/21	1/1	42.93	44.58	Pazun Taung	
F34	YM3A	Pazundaung	Yangon Central	0/15	0/16	43.96	44.96	Kyi Taw	
F35	YM2B	Pazundaung	Yangon Central	0/10	0/11	44.87	45.34	Ye Kyaw	
F36	C1AX	Pazundaung	Yangon Central	0/1		45.53	46.11	Yangon	

Source: MR and YUTRA Project Team (2014)

In the case of F03, F04, F06 and F07, although these 4 FOBs are defined as separated infrastructures with ROB according to MR list, those infrastructures were recognized as the same infrastructure by this survey. In addition, 2 extra FOBs were found. Evaluation of all FOBs is summarized in the table below.

Table 3.1.5.3 Summary of the Evaluation of current Conditions of FOB

Evaluation	Current condition		
	Superstructure	Walking panel	Pier
A	15	15	17
A-B	0	0	0
B	14	9	12
B-C	0	3	0
C	1	1	1
None	2	4	2
Total	32	32	32

Source: YUTRA Project Team (2014)

Half of superstructures are evaluated as in good condition and others are in need of repair or in serious condition. In addition, lowest height from rail level to under girder is 3.88 m. FOB also has the same serious condition for construction gauge. Detailed information of all FOBs is shown in Appendix 3-7.

3.2 General Condition of Existing Machinery

3.2.1 Rolling Stocks

1) Outline

For Yangon Circular Railway, average 23 train sets were operated in 2013. There were two types of train sets: diesel locomotive with passenger coach-type and diesel railcar-type (RBE: Rail Bus Engine). Of these, 17 train sets are “locomotive with passenger coach” and these are composed of one locomotive with five or six coaches. Both locomotive and coaches are quite deteriorated due to aging and lack of proper maintenance, and therefore it is hard to accelerate/decelerate quickly. 6 train sets are “diesel railcar-type” with one or two cars and the diesel railcars are operated not in the Yangon Circular Railway but on the suburban lines. The number of rolling stock for

Yangon Circular Railway is summarized in the table below.

Table 3.2.1.1 Average Number of Operated Rolling Stock in Yangon Circular Railway in 2013

Rolling Stock Type	Number	Remarks
Diesel Locomotive	17	900HP,1100HP, 1200HP, 1600HP
Passenger Coach	91	
Rail Bus Engine (RBE)	6	Manufactured in Japan

Note: HP means Horsepower

Source: MR

Locomotive	Coach	RBE(Rail Bus Engine)
		

Source: YUTRA Project Team (2014)

Figure 3.2.1.1 Sample Pictures of Rolling Stock in Yangon Circular Railway

Above information discussed average number in 2013. MR owns 31 locomotives and operated numbers are changing every day. The table below lists the current information as of 13th March 2013.

Table 3.2.1.2 Current Number of locomotives as of 13th March 2013

Locomotives	Owned	Operated	Spare	Maintenance	Heavy Repair
DD900(ABC)	7	4	1	0	2
DD900(AAR)	4	2	1	1	0
DD1100(AAR)	9	4	1	1	3
DF1200(ABC)	9	7	1	1	0
DF1600(ABC	2	2	0	0	0
Total	31	19	4	3	5

Source: MR

19 locomotives were currently operated at that time. Each type has one spare except DF1600HP. 3 locomotives are maintained and 5 locomotives are now under heavy repair in Insein workshop. 900HP, 1200HP and 1600HP are classified as Diesel Electric, and 1100HP is classified Diesel Hydraulic. There are two types of couplers: ABC and AAR. Current Information of RBE (Rail Bus Engine) is summarized in the table below.

Table 3.2.1.3 Current Number of RBE in 13th March 2013

RBE type	Owned	Operated	Spare	Maintenance	Heavy Repair
RBE5000	11	6	3	0	2
RBE2500	17	4	4	0	9
Total	28	10	7	0	11

Note: RBE means Rail Bus Engine

Source: MR

MR owns 28 RBEs currently. 10 RBEs are running currently and 7 RBEs are stocked for spare. 11 RBEs are currently undergoing heavy repair.

2) Locomotive

(1) 900HP Locomotives

One type of 900HP locomotive is used in Yangon Circular Railway. MR own 11 numbers of 900HP locomotives and theses were procured in 1974 and 1977. Six 900HP locomotives are currently used in Yangon Circular Railway. Detailed specs and procurement information are listed below.

Table 3.2.1.4 Specs and Procurement information about 900HP Locomotives

	900HP 175V12 ASHR	
Procured Numbers at this time	16	13
Put into Service Year	1974	1977
Procured country	France	
Max speed (km/h)	88.5	
Height (mm)	3502.5	
Length(mm)	10200	
Weight (ton)	48	
Axle load (ton)	12	

Source: MR

40 years has passed from first arrival in service. Deteriorated by aging is clearly visible. Locomotive height is 3502.5 mm exceeding car gauge set of 3200 mm. Procurement of rolling stock should be considered with geometric condition and infrastructure renovation. Detailed information of locomotives is shown in Appendix 3-8.

(2) 1100HP Locomotives

Nine 1100HP locomotives were given from China according to the interview to MR staff. 4 locomotives are currently operated, one is for spare, one is under maintenance and 3 locomotives are undergoing heavy repairing. Detailed specs and procurement information couldn't be gotten from MR.

(3) 1200HP Locomotives

Four types of 1200HP locomotives are used and one type of coupler is applied in Yangon Circular Railway. 9 locomotives are owned by MR, and 7 are operated, 1 is for spare and 1 is undergoing maintenance. Detailed specs and procurement information are summarized below.

Table 3.2.1.5 Specs and Procurement information about 1200HP Locomotives

	1200HP DEL V16 ASHR	1200 HP DEL V12 BZSHR				1200HP DEL V12 RVR		1200HP DEL 12 V 396 TC13
Procured Numbers at that time	6	27	1	4	15	4	4	4
Put into Service Year	1958	1964	1969	1969	1970	1984	1985	1996
Procured country	France	France				France	France	France
Max speed (km/h)	88.5	88.5				88.5	88.5	90
Height (mm)	3505.2	3450				3450		-
Length(mm)	12000	13400				-		13900
Weight (ton)	63.6	62				66	-	-
Axle load (ton)	10.6	10.33				-	-	12

Source: MR

First service started in 1958 year, over 50 years ago. All 1200HP locomotives are not also satisfied with car gauge, but in range of construction gauge. Detail information of locomotives are shown in Appendix 3-9

(4) 1600HP Locomotives

One type of 1600 HP locomotive is used in Yangon Circular Railway. Although many 1600HP locomotives were procured as mention below table, currently MR owns 2 locomotives. All of 2 locomotives are operated.

Table 3.2.1.6 Specs and Procurement information about 1200HP Locomotives

	1600HP DEL V16BZSHR		
Procured Numbers at that time	10	14	21
Put into Service Year	1971	1974	1979
Procured country	France	France	France
Max speed (km/h)	89.6	89.6	89.6
Height (mm)	3450	3450	3450
Length(mm)	14789.94	14789.94	15204
Weight (ton)	71.85	71.85	71.832
Axle load (ton)	11.97	11.97	11.95

Source: MR

The locomotives are too old and height does not correspond with car gauge. Detailed information of locomotives are shown in Appendix 3-10

3) Coach

91 coaches are operated in Yangon Circular Railway. Air-conditioning is not provided in those coaches. Of these, specs for 49 coaches detailed information could be gotten from MR. All coaches seem to be deteriorated by aging even though procurement information is not mentioned by MR's information. One sample of coach specs is shown below.

Table 3.2.1.7 Sample of Specs of Coach

Items	
Type of Coach	BDUEZ
Total Length of Coach (mm)	15925.8
Center to Center of Bogie (mm)	11201.4
Total Length include Buffer (mm)	17119.6
Body width (mm)	2819.4
Body Height(mm)	3403.6
Weight (Ton)	27.2

Source: MR

BDUEZ type of coach means “Bogie, Day time operation, Upper class, Electrical, Vestibule”. Total length of coach is approximately 16 m and weight is 27 tons. Height is the same issue as locomotives. Detailed information of 49 coaches is shown in Appendix 3-11.

4) RBE (DMU)

6 RBE (Rail Bus Engine) are currently operated in Yangon Circular Railway. Please note that the definition of RBE that MR recognizes is DMU (Diesel Multiple Unit). All of RBEs were procured from Japan. One of the latest RBE provides air-conditioning. Information of RBE is summarized below.

Table 3.2.1.8 Information of RBE

RBE No.	RBE Type	Company's Name	Engine Type	Transmission
RBE-2504	LE-20	Justmeet Corporation	Nissan PE6 HT-03A	SCR 09-1B-4B
RBE-2512	NT-100	Meiwa Technika	Nissan PE6 HT-03A	TACN 22-1103C
RBE-2524	LEDC	Meiwa Technika	Nissan PE6 HT-03A	SCR 09-1B-4B
RBE-2530	NT-120D	NAS Imco: Ltd	NIGATA 13HS	TACN 22-1103C
RBE-2531	NT-120D	NAS Imco: Ltd	NIGATA 13HS	TACN 22-1103C
RBE-2533	LE-20	Meiwa Technika	Nissan PE6 HT-03A	TACN 22-1103C
RBE-2544	NT-100	Meiwa Technika	NIGATA 13HS	TACN 22-1103C
RBE-2547	NT-100	Meiwa Technika	NIGATA 13HS	TACN 22-1103C
RBE-5002	KIHA-52	West Corporation	TACN 22-1103C	DF 115A
RBE-5008	KIHA-52	West Corporation	NIGATA 13HS	DF 115A
RBE-5018	KIHA-52	West Corporation	NIGATA 13HS	DF 115A
RBE-5019	KIHA-58	West Corporation	NIGATA 13HS	DF 115A

Source: MR

This table information is about Insein maintenance shed, and it was not currently operated. Japanese styles of RBE are used. “LE”, “LEDC”, “NT” and “KIHA” mean diesel rail car in Japan.

3.2.2 Depots and Workshops

1) Maintenance Schedule

All rolling stocks which are operated in the Yangon Circular Railway have regular maintenance in Insein Maintenance Shed which is located beside Insein station. According to the regulations of Myanmar Railways, the conduct of regular maintenance is

divided in eight stages, from M-1 (lightest maintenance) to M-8 (heaviest maintenance). Insein Maintenance Shed can treat between M-1 and M-5, and heavier maintenance is conducted in Insein Maintenance Workshop.

Table 3.2.2.1 Locomotive Maintenance Schedule of Rolling Stock

Maintain	Period
M1	Daily
M2	After Running 250 Hours
M3	After Running 500 Hours
M4	After Running 1000 Hours
M5	After Running 2000 Hours
M6	After Running 6000 Hours
M7	After Running 12000 Hours
M8	After Running 24000 Hours

Source: MR

Table 3.2.2.2 RBE Maintenance Schedule of Rolling Stock

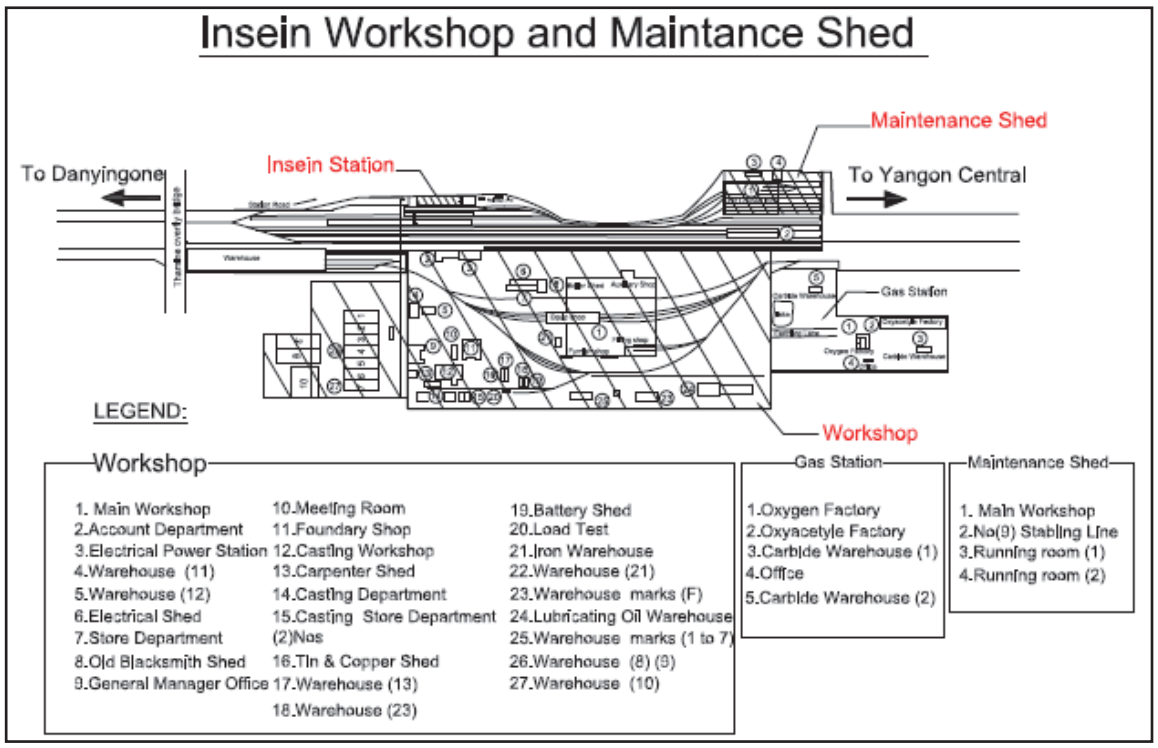
Maintain	Period
M1	Daily
M2	After Running 250 Hours
M3	After Running 500 Hours
M4	After Running 1000 Hours
M5	After Running 2000 Hours
M6	After Running 4000 Hours
M7	After Running 6000 Hours
M8	After Running 12000 Hours

Source: MR

Maintenance schedule a slightly different between locomotive and RBE. RBE requires early maintenance.

2) Insein Workshop

Insein workshop was established in 1875 under department of Mechanical and Electrical Engineering of Myanmar Railway. Annually, 25 general overhauls and 20 semi overhauls and over 100 repairs are treated. Originally heavy repair of steam locomotives were targeted, but the works were expanded for the repair of electric generating sets, IC engines, pumps and compressors for watering arrangements. The workshop is situated at the western side of the Insein Railway station, which is about 10 miles from Yangon downtown. The area of the workshop compound is 26.78 acres (10.84 ha) including the Gas plant. Currently, employees total about 900 persons.



Source: MR

Figure 3.2.2.1 Layout of Insein Workshop and Maintenance Shed

3) Insein Maintenance Shed

Insein maintenance shed was built in 1958 at near Insein station and workshop. This maintenance shed is mainly for light maintenance M1 to M5. The area of factory yard is 8.36 ha located south of Insein station and east of Workshop as shown in the above figure. Currently, employees total 295 persons. In day time, inspection and maintenance of the wagon, RBE, locomotives and coaches are conducted. At night, the rolling stocks are cleaned.

4) Malwagone Depot and Maintenance Shed

Malwagone shed was constructed in 1957. Malwagone maintenance shed is provided for locomotives and freight train for suburban line. Operated types and sections which are treated in this shed are listed below.

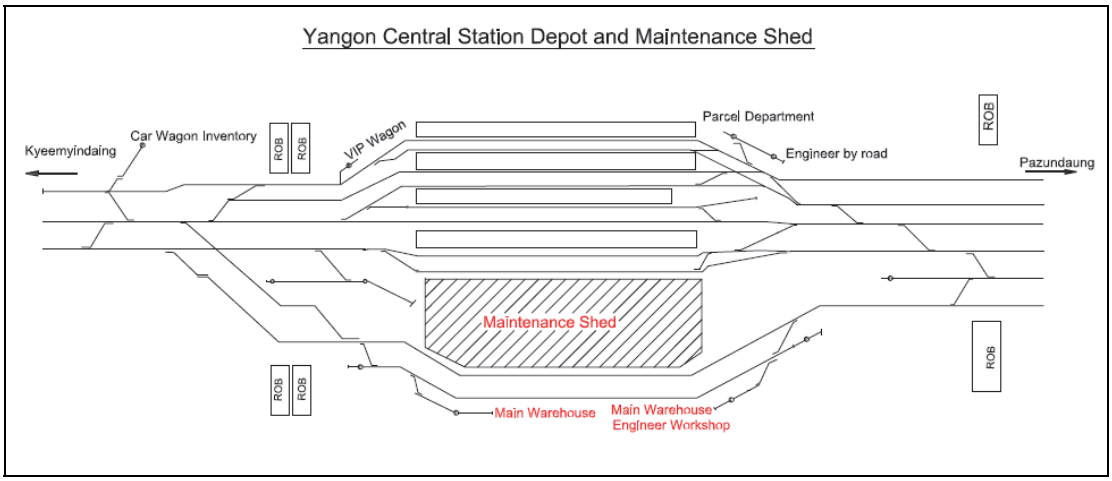
Table 3.2.2.3 Operated Types and Sections

Type	Section
Passenger	Yangon-Mandalay-Yangon
	Yangon-Neypyitaw-Yangon
	Yangon-Pyay-Yangon
	Yangon-Malamying-Yangon
	Yangon-Pyinmana-Yangon
	Yangon-Pyay-Yangon
	Yangon-Togyaunggale-Yangon
	Yangon-Togyaunggale-Ohphosu-Yangon
Freight	Yangon-Mayohoung
	Malwagone-Hlaing Test
	Malwagone-Paleik
	Malwagone-Zinkyait
	Malwagone-Mottama
	Kyit Myint Taing-Pyay
	Kyit Myint Taing-Pakokko
	Bota Taung-Myaingkalay
	Malwagone-Myohoung
	Tonepho-Myaingkalay
	Malwagone-Moekaung
	Malwagone-Shwe Nyaung

Source: MR

5) Yangon Central Station Depot and Maintenance Shed

Yangon central station depot and maintenance shed was established in 1950 and is located between Yangon Central station and Bo Gyoke Aung San Road. The area of this shed is about 28,000 m^2. About 350 person are employed. Layout of maintenance shed is shown below.

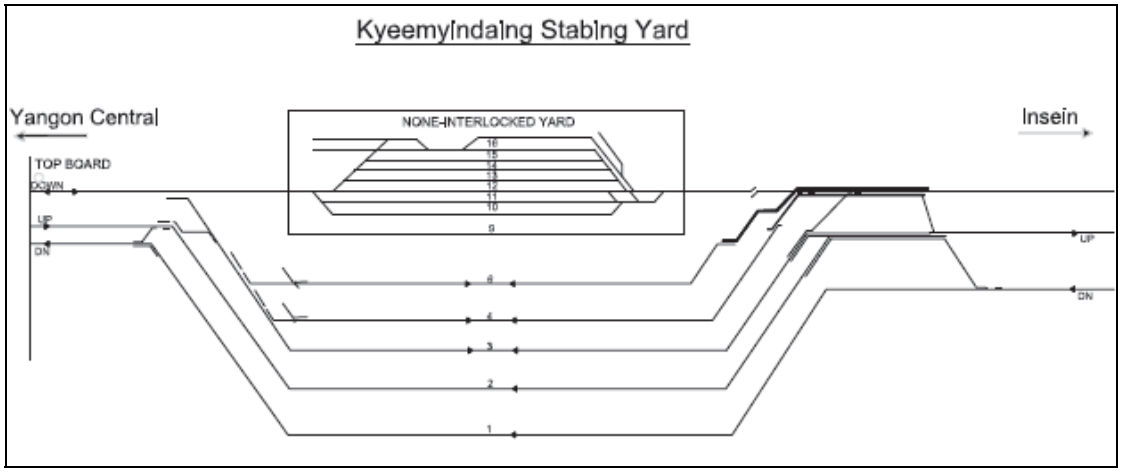


Source: MR

Figure 3.2.2.2 Layout of Yangon Central Station Depot and Maintenance Shed

6) Kyeemyindaing Stabling Yard

Kyeemyindaing stabling yard layout is shown in the figure below.



Source: MR

Figure 3.2.2.3 Layout of Kyeemyindaing Stabling Yard

No.1 and 2 lines are mainly provided for Yangon Circular Railway, and non–interlocking yard is not fully occupied; thus these spaces can be utilized for any purpose.

3.2.3 Maintenance Facilities

1) Maintenance Facilities for Rolling Stock

The quantity and current condition of maintenance equipment for rolling stock is summarized in the table below as described by MR staff.

Table 3.2.3.1 Maintenance Equipment Types of Rolling Stock

No	Types	Quantity	Current condition
1	Pop tester	1	good
2	Air compressor	2	good
3	Over head crane 5 ton	1	good
4	Diesel oil pump	1	good
5	20kva (generator)	2	good
6	Welding machine	3	good
7	Water tank and pump that fills 3200 gallon	2	good
8	Battery charger	2	good
9	Electric lifting jack	8	good
10	Washing machine (High pressure)	3	good
11	Za 7262(2) ton truck	1	good
12	Fuel injection pump (calibrating machine)	1	damaged
13	HSD tank gallon (fills 10000)	1	good
14	HSD tank gallon (fills 7200)	1	good

Source: MR

One equipment is damaged; however, condition of other maintenance equipment is available to conduct maintenance. All equipment is stored in Insein maintenance shed.

2) Maintenance Facilities for Civil Work

Maintenance equipment of civil work is listed below with quantity and current condition.

Table 3.2.3.2 Maintenance Equipment Types of Civil Work

No	Equipment	Number	Current Condition
1	Shovel	4	good
2	Rakes ballast	62	good
3	Jin craw (for 75lb=34kg, 60lb=27kg)	1	good
4	Bar claw	66	good
5	Beater iron	193	50% good
6	Auger (1/2"φ = D=1.27cm)	17	good, not usually used
7	Auger (5/8"φ = D-1.59cm)	2	good, usually used
8	Level sprit	10	good
9	Powrah	40	90% good
10	Spanner (for 75lb=34kg, 60lb=27kg)	13	good
11	Straight edge wooden	17	good
12	Pan puller	8	good
13	Rail tong	5	good
14	Hammer (10lb=4.5kg, 31lb=14kb, 51lb=23kg)	34	good
15	Wire claw	100	good
16	Rail drilling machine	1	good
17	Rail cutting machine	1	not good, but used
18	Rail grinding machine (portable)	1	not good, but used
19	Track jacks	20	50% good
20	Rail creep adjuster	1	good
21	Hand tie tamper	2	good

Source: Interview to MR

All maintenance equipment is kept at Yangon Central station warehouse, and MR staff take them to each site. Some equipment is recommended to replace with new ones due to the bad condition and in spite of currently being used. In addition, it is difficult to use hand tie tampers because sleeper interval is irregular.

3.3 General Condition of Existing Safety System

3.3.1 Signal

1) Overview of Signal System

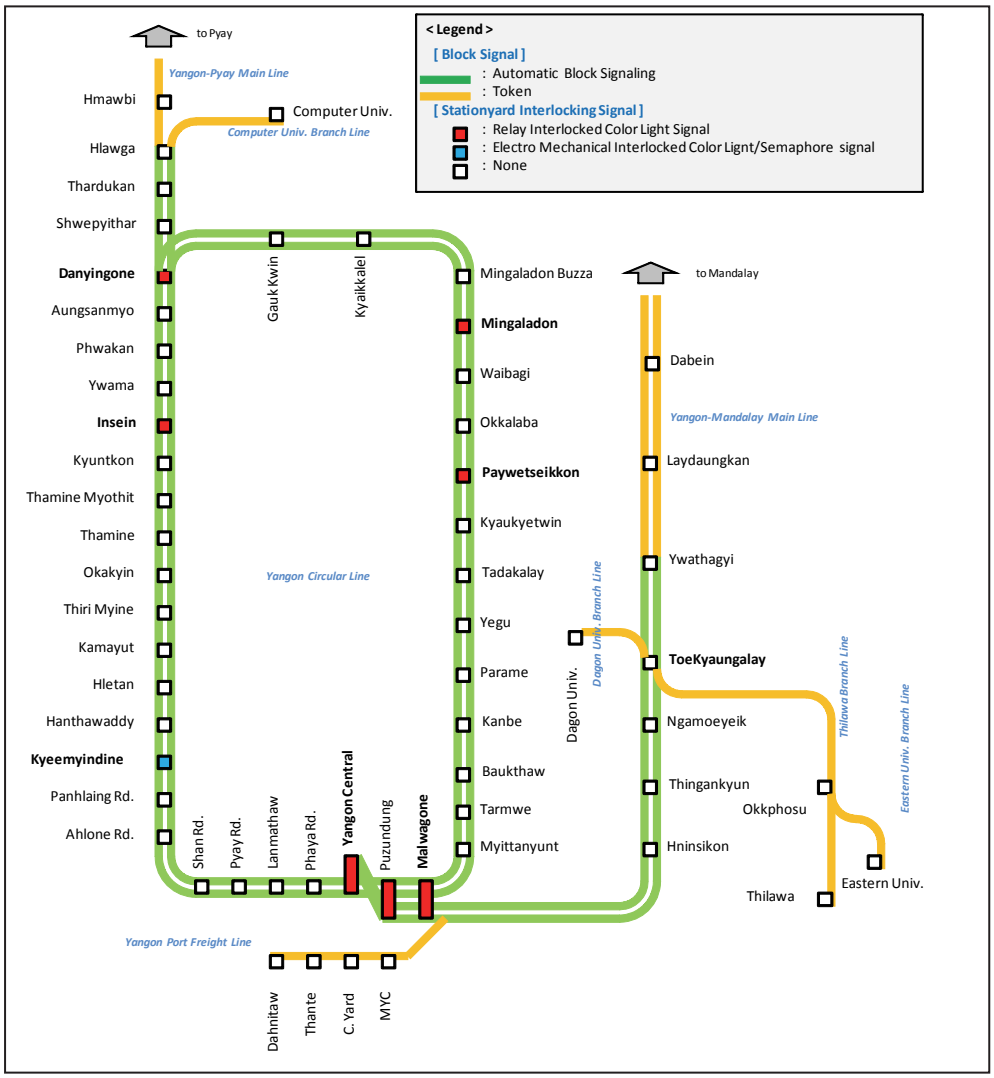
As block system, Automatic Block Colour Light Signal is applied for all Yangon Circular Railway. The first Automatic Block Colour Light Signal made in the U.S. by Westinghouse was installed for the 5.6 km section of Yangon Circular Railway in 1950. After that, Automatic Block Colour Light Signals made in Germany and Korea was installed incrementally for the other line sections from 1970 to 2000. The signalling system applies track circuit as train detection system. However, it is frequently short-circuited due to water retained on the tracks due to bad drainage during the rainy season, and the signal shows red colour continuously because of fail-safe system.

Regarding the signalling system inside main station yard in Yangon Circular Railway, seven stations have Relay Interlocked Colour Light Signal and one station has Electromechanical Interlocked Colour Light Signal and Semaphore Signal.

Schematic figure of the signalling system in Yangon Circular Line including Suburban line is shown below.

Source: YUTRA Project Team (2014)

Figure 3.3.1.1 Current Automatic Block Colour Light Signal



Source: Traffic Data Yangon Circular Railway 2012

Figure 3.3.1.2 Signalling System in Yangon Circular Railway

Schematic figure of Yangon Central, Malwagon station and Kyeemingdaing station, Insein station are shown in Appendix 3-12

2) Interlocking System

Interlocking system is provided at 8 stations in Yangon Circular Railway. 6 large stations is provided for stabling yard and 2 minor station, Mingaladon and Paywetseikkon station, is provided for crossover as shown in the picture.

Source: YUTRA Project Team (2014)

Figure 3.3.1.3 Signal and Crossover

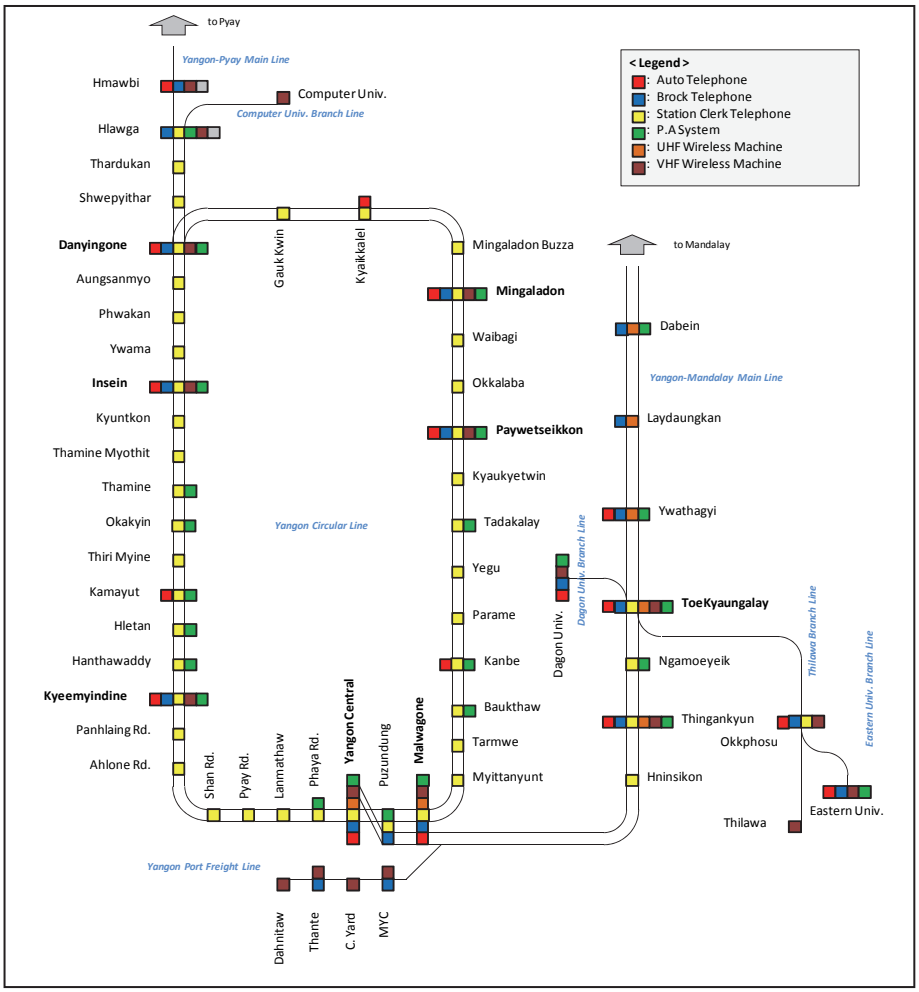
In Yangon Central station, there are 174 routes; electric interlocking devices made by Westinghouse are used since 1950 year. All equipment including signal cable is still used.

3) Block System

There are two types of block systems in the whole Yangon line: Automatic Block System is applied in Yangon Circular Railway and some suburban line, and Absolute Block System is adopted in only suburban line in Yangon. At least three blocks are provided from station to station. Three colours were chosen in Yangon Circular Railway. Basically, green colour means train can operate with normal speed and yellow colour means train can operate with speed restriction. The surprising point is that trains can go forward even when the light shows red colour. According to the interview to MR staff, trains can enter the next block after waiting one minute with high consciously operation.

3.3.2 Telecommunication

Recently, telecommunication environment has been improved. All telecommunication cables are laid underground except for Yangon Central station to AhloneRd station.



Source: Traffic Data Yangon Circular Railway 2012

Figure 3.3.2.1 Telecommunication Equipments installed in Yangon Circular Railway

Six types of telecommunications system are installed in Yangon Circular Railway. All stations have Station Clerk Phone and 15 main stations have some additional systems such as UHF transceiver, VHF transceiver, auto phone, block phone, and P.A. system as shown in the figure above.

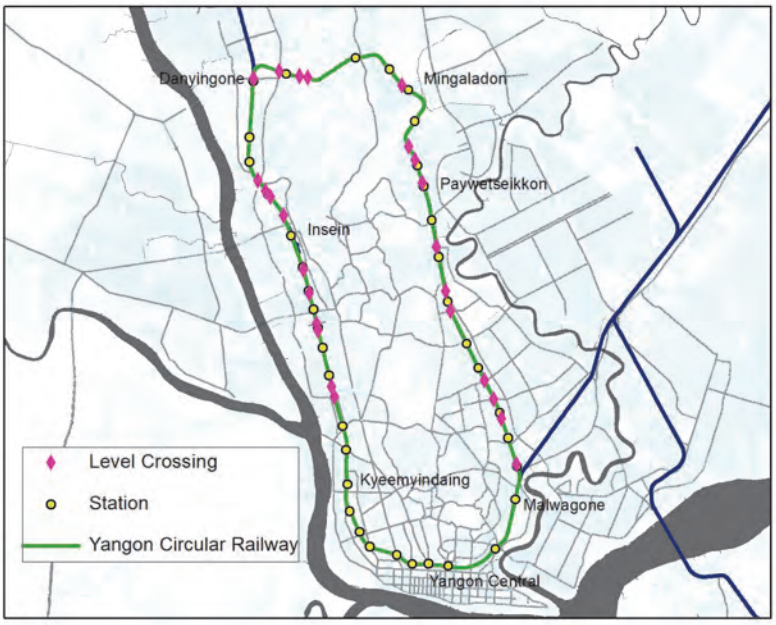
3.3.3 OCC

At present, train operation is controlled by “dispatcher” who takes care of partial section, and no modernized OCC is provided in Yangon Central Railway. In the future plan, Yangon Central station will be the most appropriate place to install the OCC for Yangon Circular Railway and the other suburban line because of a hub of Yangon.

3.3.4 Level Crossings

1) Location of Level Crossings

25 level crossings are located at mainly out of CBD as in the map shown below.



Source: YUTRA Project Team (2014)

Figure 3.3.4.1 Location Map of Level Crossings

2) Overview of Level Crossings

There are three types of barriers (Up/Down, Open/Close and Slide Gate styles) as shown in the pictures below. All styles are managed manually.

UP/Down	Open/Close	Gate
		

Source: YUTRA Project Team (2014)

Figure 3.3.4.2 Pictures of all Barrier Types

Issues of level crossings are neighbouring signal and taking long time to operate manually compared to automatic operation. It causes road traffic jams. This situation was found in 12 places, and it impairs the shortening of train operation interval. It is recommended that the following actions be conducted as countermeasures;

- To install automatic operating level crossing system in order to minimize barrier closing time;
- To replace level crossings with flyovers (ROB). The height of ROB shall be considered as part of the future electrification requirements.

3) Operation System

The staff stand in the level crossing with flag. Staff can take action when the alarm alerts

or red light being on. When the alarm appears, staff lower the gate and wave a flag to get out of level crossing and not to come inside for drivers and pedestrians. In case of broken alarm or light, it seems the gate is lowered by staff decision before the train comes.

4) Level Crossings Conditions Survey

(1) Survey Methodology

Level Crossings conditions survey was conducted the same as for side drainage, bridge, ROB and FOB surveys. Investigators interviewed staff about appropriate work when alarm and light occurs. Survey items are listed below.

- Visit time
- Width(m)
- Lane No.
- Pavement Type
- Road Category
- Barrier Type
- Automatic Alarm
- Hut
- Beside Road Intersection or not
- Current Condition of Pavement (A:OK, B:Need repair, C:Dangerous)

Survey time was given by GPS. Lane No., pavement type, barrier type, beside road intersection or not, current condition were investigated by visual survey. Road category, automatic alarm and hut were asked to MR staff whether organized MR or not and whether alarm is working properly or not. Width was measured by tape measure.

(2) Result

GPS survey data is summarized below.

Table 3.3.4.1 Collected GPS Data and MR Level Crossings List

Infrastructure No	MR's ID No	Station		Mile (MR)		Equivalent to KM	Survey data KM	Remarks
		From	to	From	To	Clock Wise	Clock Wise	
L01	C18AX	Hletan	Kamayut	5/11	5/12	8.80	8.64	
L02	C18BX	Hletan	Kamayut	5/16	5/17	9.14	9.01	
L03	C20AX	Thiri Myine	Okakyin	6/21	6/22	11.09	11.05	
L04	C20BX	Okakyin	Thamine	6/25	6/26	11.36	11.28	
L05	C21CX	Thamine	Thamine Myothit	7/16	7/17	12.36	12.37	
L06	C22AX	Thamine Myothit	Kyuntkon	8/5	8/6	13.24	13.23	
L07	C23CX	Insein	Ywama	9/5	9/6	14.85	15.24	
L08	C25AX	Insein	Ywama	9/18	9/19	14.11	16.04	
L09	C25BX	Ywama	Phwakan	10/0	10/1	16.19	16.31	
L10	C25DX	Ywama	Phwakan	10/7	10/8	16.59	16.77	
L11	C31AX	Danyingone	Gauk Kwin	12/16	12/17	20.40	20.41	

Infrastructure No	MR's ID No	Station		Mile (MR)		Equivalent to KM	Survey data KM	Remarks
		From	to	From	To	Clock Wise	Clock Wise	
L12	A43BX	Danyingone	Gauk Kwin	15/7	15/8	20.93	21.68	
L13	A42BX	Gauk Kwin	Kyaikkalel	14/20	14/21	21.67	22.42	
L14	A42AX	Gauk Kwin	Kyaikkalel	14/16	14/17	21.95	22.70	
L15	A31AX	Mingaladon Buzza	Mingaladon	12/8	12/9	25.70	26.75	
L16	A23BX	Waibagi	Okkalapa	10/14	10/15	28.51	29.51	
L17	A21EX	Waibagi	Okkalapa	10/6	10/7	29.04	30.03	
L18	A21CX	Okkalapa	Paywetseikkon	9/17	9/18	29.91	30.86	
L19	A15BX	Kyaukyetwin	Tadakalay	8/9	8/10	32.07	33.16	
L20	A13CX	Tadakalay	Yegu	7/9	7/10	33.68	34.73	
L21	A11AX	Yegu	Parame	6/22	6/23	34.42	35.45	
L22	A7AX	Kanbe	Baukthaw	5/6	5/7	37.09	38.16	
L23	A4CX	Kanbe	Baukthaw	4/19	4/20	37.83	38.89	
L24	A4BX	Baukthaw	Tarmwe	4/9	4/10	38.50	39.63	
L25	A1BX	Tarmwe	Myittanyunt	3/5	3/6	40.37	41.31	

Source: MR and YUTRA Project Team (2014)

All level crossings could be found by this survey. Items of interviews to MR staff is summarized in the table below.

Table 3.3.4.2 Summary of Interviews to MR Staff about Level Crossing Concern

Width(m)	Number	Road Category		Hut	
		Public	Private	With	Without
<10 (m)	14	8	6	10	4
>10 (m)	11	11	0	11	0
Total	25	19	6	21	4

Source: YUTRA Project Team (2014)

All level crossings more than 10 m width are categorized as public and managed by MR, and all huts were located there. Visual inspection result is summarized below.

Table 3.3.4.3 Summary of the Evaluation of current Conditions of Level Crossings

Width(m)	Pavement Type			Barrie type				Beside road intersection	
	Asphalt	Concrete	Earth	Gate	Open	Down	None	Beside	Not
<10 (m)	7	2	5	4	9	3	2	8	6
>10 (m)	11	0	0	6	7	2	0	4	7
Total	18	2	5	10	16	5	2	12	13

Source: YUTRA Project Team (2014)

More than 10 m width level crossings all have asphalt pavements. On the other hand, three of short width level crossings are not paved, but dirt. In case of barrier type, different type of barriers can be seen between western side and eastern side at similar level crossings. Totally 12 level crossings are beside an intersection. This might cause traffic jam or accident as mentioned before.

Detailed information of all level crossings is shown in Appendix 3-13

3.4 General Condition of Related Facilities

3.4.1 Railway Stations

1) Overview of Stations

Opposite platform along double tracks is applied in many stations, as shown in the figure below. On the other hand, large stations, having several tracks, have island platforms and also have large yards surrounded by fence for not only station facilities including station building, platform, main lines, but also marshalling yard, depot lines, inspection yard, etc. The blocking of track cross way is one of the most important things to reduce accidents, as mentioned before in FOB section, since many people cross on the track directly even though FOB is provided properly. All station platform types, size and facilities for pedestrian are investigated and summarized as in the table below.

Source: YUTRA Project Team (2014)

Figure 3.4.1.1 Opposite type Platforms

Table 3.4.1.1 Summary of Station Types and Station Facilities

No.	Station	Platform Type A…Island, B…Opposite	Size of station A…Large, B…Normal,	Facilities for Pedestrian to across the track A…Flyover, B…Level crossing, C…None	Remarks
1	Yangon Central	A	A	A	Shed
2	Phaya Rd.	B	B	A	
3	Lanmataw	B	B	A	
4	Pyay Rd.	B	B	A	
5	Shan Rd.	B	B	A	
6	Ahlone Rd.	B	B	A	
7	Panhlaing Rd.	A	B	A	
8	Kyeemyindaing	A	A	A	
9	Hanthawaddy	B	B	A (under construction)	
10	Hletan	B	B	A	
11	Kamayut	B	B	C	
12	Thiri Myine	B	B	C	
13	Okakyin	B	B	B	
14	Thamine	B	B	A	
15	Thamine Myothit	B	B	B	
16	Kyuntkon	B	B	B	
17	Insein	A	A	A	Depot, Workshop
18	Ywama	B	B	A,B	
19	Phwakan	B	B	C	
20	Aungsanmyo	B	B	A	
21	Danyingone	A	A	A,B	Private market
22	Gauk Kwin	B	B	A	
23	Kyaikkalel	B	B	C	
24	Mingaladon Buzza	B	B	C	
25	Mingaladon	B	B	C	
26	Waibagi	B	B	C	
27	Okkalapa	B	B	A	
28	Paywetseikkon	B	B	A(No under girder)	
29	Kyaukyetwin	B	B	C	
30	Tadakalay	B	B	A	
31	Yegu	B	B	A	
32	Parame	B	B	C	
33	Kanbe	B	B	A	
34	Baukthaw	B	B	A (under construction)	
35	Tarmwe	B	B	A (under construction)	
36	Myittanyunt	B	B	B	
37	Malwagone	A	A	A	Shed
38	Pazundaung	A	A	A	

Source: YUTRA Project Team (2014)

Each item is discussed in the next section based on the above survey result.

(1) Platform

Island and opposite type of platform are classified in Yangon Circular Railway, and opposing platform is applied majorly. Island platform is applied at Panhlain Rd. and large stations which are Yangon Central, Kyeemyindaing, Insein, Danyingon, Maalwagone and Pazungaung.

Low height platform is applied for all stations in Yangon Circular Railway as shown in the figure below. The low height platform is suitable for stations in the rural area which has small number of operated trains and enough time for boarding/alighting. It should be considered in the near future to change the platform height from current low height to middle or high height in order to shorten the boarding/alighting time and to be convenient for all train users from the viewpoint of the importance and high frequency train operation in Yangon Circular Railway.

Source: YUTRA Project Team (2014)

Figure 3.4.1.2 Low Height Platform

(2) Station Size

Large size station is defined based on whether track siding exists and has more than 3 platforms. Normal size is defined as no track siding, but there is ticket counter and a bench. Small size of station indicates nothing at all about station facilities.

Yangon Central, Kyeemyindaing, Insein, Danyingon, Maalwagone and Pazungaung station which have several track siding for express train/freight train etc. and have station building with ticket counter, kiosk, etc., therefore these stations were classified as large stations. All other stations were classified as normal size station which has only ticket counter and bench under the eaves. Small size stations do not exist in Yangon Circular Railway.

In many cases, express trains with long/middle distance trains stop at platform which is beside the station building in order to be convenient for the long distance travel passengers.

(3) Facilities for Pedestrian

Flyover or level crossing for pedestrian should be located at all stations. Such flyover is defined as whether any flyover facilities are available for pedestrian. Although FOB and ROB were defined by MR list, in case of the above mentioned conditions survey, this flyover isn't defined the same as the conditions survey. The most important point is whether pedestrians have to walk on the track or not when they cross platforms. As above survey results table show, many stations provide flyover for pedestrians. Some level crossings are also located near stations to cross the track; however, 9 stations don't provide any facilities for pedestrians. Pedestrian flow in the station should be discussed more.

(4) Feeder Facilities

All stations don't have bus stop for transport feeder facilities. It seems that it's not difficult to catch taxi at a neighbouring road. It should be considered to make space for taxi or bus stop to improve the usage and availability of public transportation.

2) Development Station Plaza

Railway station has huge potential of to promote economic growth, transport access, and urban development. Some stations are successful examples of railway station development in Japan. There are many attractive facilities which include shopping, restaurant, square etc. Generally speaking, transit space to another railway line, taxi and bus are well provided. As for Yangon Circular Railway station, unused area is present in Yangon station and other large stations as the picture shows. Transport feeder facilities, bus stop and taxi space are not well provided as mention above. Yangon Central station is the largest station in Yangon Circular Railway and high demand is forecast. Hence, Yangon Circular Railway stations should be developed for more convenient access and as an attractive place.

Source: YUTRA Project Team (2014)

Figure 3.4.1.3 In Front of Yangon Central Station

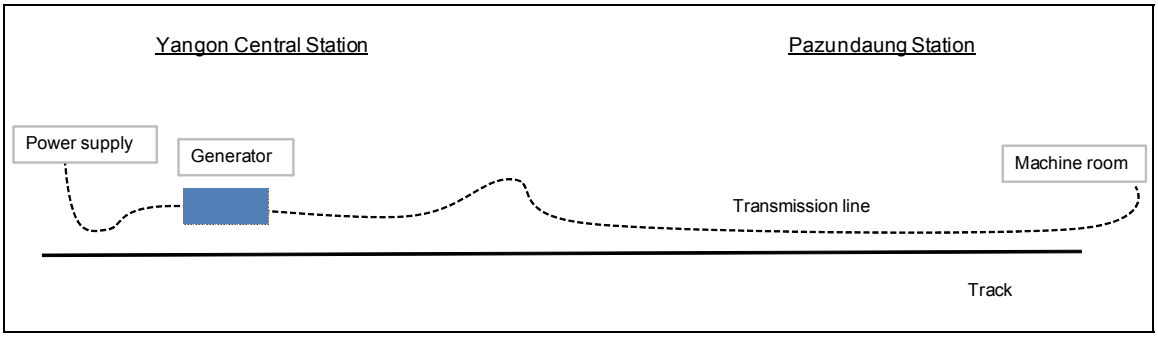
Stations for development of station plazas are Yangon Central, Kyeemyindaing, Insein, Danyingone and Malwagone station.

3.4.2 Power Supply

Electric interlocking system is applied in Yangon Circular Railway. Basic information of the related power supply condition is summarized below.

- Yangon Electricity Supply Board (YESB) transformers and Myanma Railways transformers supply three phase or single phase electric power to all stations of Yangon Circular Railway.
- Depots utilize three phase power supply from Yangon Electricity Supply Board (YESB) transformers.

In the future plan, Diesel power supply is provided in power equipment room for backup in case of power failure. This is supplied for signals in Yangon Central station and Pazundaung station. The future plan of routing of power supply is shown in the figure below.



Source: The Project for Installation of Operation Control Center System and Safety Equipment

Figure 3.4.2.1 Power Supply Routing

3.5 Issues and Considerations

All of current conditions have problems for achieving continuous operation. To achieve safe and comfortable operation, improvement of track work, civil work and replace the rolling stock are the main issues. In addition, convenient and attractive railway facilities should be constructed by considering station plaza and feeder facilities. In all cases, integrated consideration should be required to improve all these issues. The issues raised in this chapter are summarized below.

1) Track Condition and Earthwork Condition

Currently, track condition is a very serious situation in Yangon Circular Railway. Track irregularity is often seen due to the poor ballast arrangement and irregular sleeper interval. In addition, roadbed condition is quite bad due to flooding in every rainy season, slope shoulder is broken by erosion, and side drainage facilities are quite poor (not existing or not working even when installed). This may cause derailments and speed is extremely restricted currently. Improvement of track condition is the highest priority issue to support high speed operation in the near future.

2) Infrastructure Condition (Bridge, ROB, FOB)

One of the most important issues is that MR does not have any correct and updated inventory for infrastructure, and Mile Post recorded by MR is also not correct. It should be modified and fixed correctly by conducting topographical survey.

According to the MR's bridge inspection record, all investigated items were evaluated "GOOD". However, it is clear that more than half of bridges should be repaired to prevent serious accident. Especially, regarding the substructure including foundation, there is no method to evaluate the current integrity due to old brick structure, no design drawing, etc.

Other incidental infrastructure, ROB and FOB, were also investigated by conditions survey. Approximate half of infrastructures are quite good condition, and the other half require repair. The most notable serious condition is height from rail level to under girder. The lowest height has only 1 cm clearance of construction gauge. This means there is no room to expand the current construction gauge.

3) Rolling Stock

The present rolling stocks show obvious deterioration. Diesel locomotive with passenger coach type is mainly used and recently RBE is procured and operated in Yangon Circular

Railway. Coach with locomotive is one of the causes of low frequency operation because it takes time to replace locomotives. Another issue is car gauge. Many rolling stocks do not satisfy car gauge although it is in the range of construction gauge.

4) Depot and Workshop

Although Insein workshop is provided for heavy maintenance from M-6 to M-8, the obligation is only for locomotives and there is no facility for RBE at present. Light maintenance is conducted in maintenance shed at Insein station, Yangon Central station and Malwagone. Malwagone maintenance shed is provided for freight and suburban line, and daily cleaning is done in Yangon Central maintenance shed; therefore Insein maintenance shed is intensively operated for Yangon Circular Railway rolling stock.

In case of conducting upgrading project, heavy maintenance workshop should be located along or near the upgrade section of Yangon Circular Railway for newly procured rolling stock (DMU/DEMU).

5) Safety System

All safety systems are not well modernized. Level crossing is operated manually by staff, automatic signalling system is quite old-fashioned and telecommunication is conducted by unstable walky-talky or commercial phone every time a train comes.

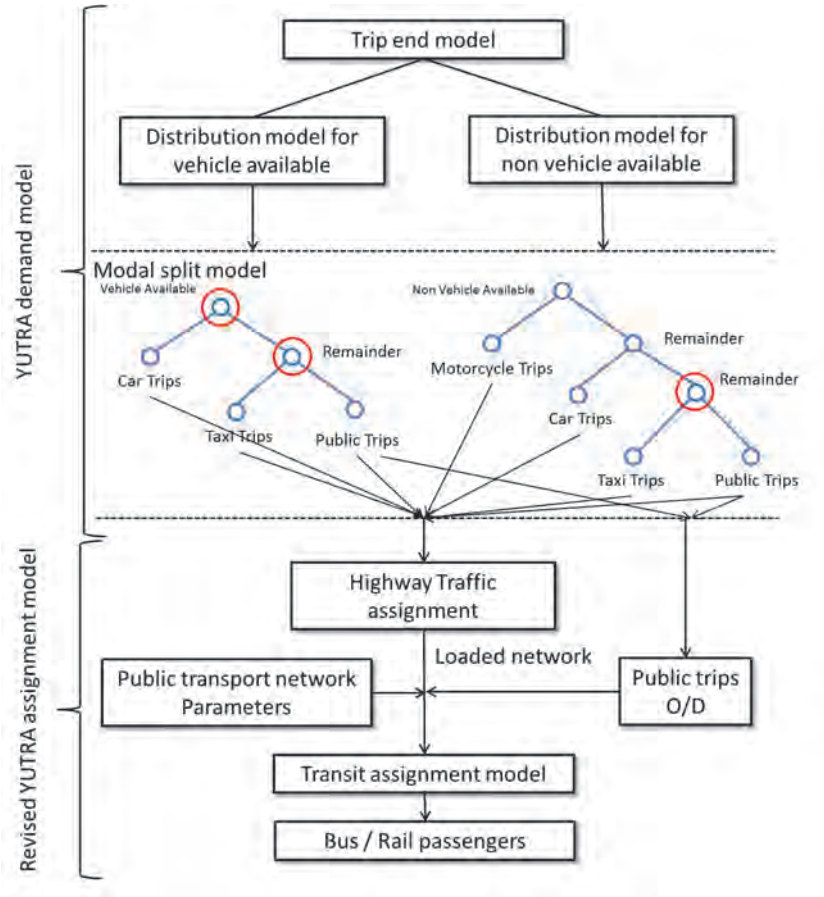
6) Related Facilities

Yangon Central station has a huge development potential because of sufficient land, high demand and good location. To realize high speed and high frequency operation, platforms and facilities for pedestrian also should be improved. This has become more important to provide the feeder facilities to allow seamless transits. All related facilities should be discussed with train operations and maintenance.

4 CONSIDERATION OF DEMAND FORCAST

4.1 YUTRA Demand Model and Updates for YCR pre-feasibility study

YUTRA strategic demand forecast model was modified for the pre-feasibility study to prepare preliminary demand forecast for the Yangon Circular Railway lines. Following figure illustrates the overall structure of the updated YUTRA demand model. The initial three stages of the YUTRA 4-stage model were retained and only the travel demand assignment model was enhanced to include a public transport (Transit) assignment sub-model. The transit assignment model assigns the public transport trips to bus & railway routes as operated. The transit assignment process is based on minimum generalised cost of travel between each origin and destination pair, and it includes: fare, access/ egress time, walk time, wait time (based on route headway), in vehicle time and transfer time (if applicable). The output from the transit assignment model is the boarding and alighting passengers at bus stop, rail station, and line volumes. The input parameters used for the transit assignment are summarised in Table 4.1.1. The bus, railway and BRT fares are applied as average fare as charged by the existing public operators, and are increased for forecast years in line with the forecast growth in GRDP/Capita.



Source: YUTRA Project Team (2014)

Figure 4.1.1 YCR Pre-Feasibility Study Demand Model Outline

Table 4.1.1 YCR Transit Assignment Parameters

Description	Parameter Value
Bus	
Number of Bus Routes	311
Fare (Kyat)	25.9/km (2018); 71.8/km (2035)
Average Daily Headway (min)	10
Ave. Operating Speed (km/h)	80% of mix traffic speed (kph)
Railway Network (Inc. YCR, other Yangon Railways in YUTRA and UMRT)	
Number of Routes	(14 lines in 2018); (16 lines in 2035)
Fare (Kyat)	25.9/km (2018); 71.8/km (2035)
Average Daily Headway (minutes)	10 (2018 YCR and UMRT) 5 (2035YCR and UMRT) 30 (Other Intercity)
Average Railway Operating Speed (km/h)	15 (Before upgrade) 44 (After upgrade) 40 (UMRT)
Bus Rapid Transit	
Number of Structural Routes	7
Fare (Kyat)	25.9/km (2018); 71.8/km (2035)
Average Daily Headway (min)	2
Average Operating Speed (km/h)	20
Ferry Services	
Number of Crossings	2
Fare (Kyat)	70.0+14.0/km (2018); 194+38.8/km (2035)
Headway (min)	10
Ave. Operating Speed (km/h)	20
Other Data Input for Transit Assignment	
Value of time for public person trips (Kyat/min)	15.4 (2018); 42.7 (2035)
Total Daily Public Transport Trips (Pax)	3,915,368 (2018); 5,672,602 (2035)
Other Forecast Year Network	YUTRA Master Plan (Do Maximum Case)

Source: YUTRA Project Team (2014)

4.2 Demand Forecast for Circular Railway

Following tables present the number of boarding and alighting passengers for the forecast years of 2018 and 2035. The total boarding passengers of YCR is expected to increase from the current demand of around 76,900 pax/day to 254,000 pax/day in 2018 and to 583,300 pax/day by 2035. Yangon Central Station is expected to attract the highest boarding in forecast years, and is expected to reach 108,000 pax/day by 2035.

The demand at some small stations is forecast to be low is feature of the YUTRA strategic model – as the catchment area of each station is not spatially defined at the level of detail required for such station-by-station demand forecast. This demand forecast limitation is being addressed and is discussed in the next section of this chapter.

The 2018 & 2035 YCR forecast total passenger boardings are compared with the actual 2012 passengers. The YUTRA Master Plan Forecast is also given in the same Table 4.2.3. There is virtually no significant difference in the total forecast patronage due to change in modelling procedure.

Table 4.2.1 Number of Boarding and Alighting Passengers in 2018

YCR Station	Clockwise operation (pax/day/oneway)			Anti-clockwise operation (pax/day/oneway)			Total (pax/day/twoway)	
	Boarding	Alighting	Line Volume	Boarding	Alighting	Line Volume	Boarding	Alighting
1 Yangon Central	11,900	9,900	11,900	18,500	9,700	9,700	30,400	19,600
2 Phaya Rd.	2,400	3,700	10,700	2,900	3,800	10,600	5,300	7,500
3 Lanmataw	-	1,200	9,500	1,500	3,800	13,000	1,500	5,000
4 Pyay Rd.	12,000	3,100	18,400	3,200	3,400	13,200	15,200	6,500
5 Shan Rd.	200	3,200	15,500	3,200	400	10,300	3,400	3,600
6 Ahlone Rd.	100	2,300	13,300	900	900	10,300	1,000	3,200
7 Panhlaing Rd.	1,200	1,700	12,800	2,500	500	8,300	3,700	2,200
8 Kyeemyindaing	10,000	-	22,700	-	13,300	21,600	10,000	13,300
9 Hanthawaddy	2,100	100	24,700	200	1,500	22,900	2,300	1,600
10 Hletan	14,900	8,100	31,500	6,900	13,300	29,300	21,800	21,400
11 Kamayut	100	-	31,500	100	-	29,300	200	-
12 Thiri Myine	100	-	31,600	100	-	29,300	200	-
13 Okakyin	-	-	31,600	400	-	28,900	400	-
14 Thamine	20,400	10,300	41,700	9,800	15,500	34,700	30,200	25,800
15 Thamine Myothit	100	100	41,700	-	-	34,700	100	100
16 Kyuntkon	-	4,300	37,300	400	-	34,300	400	4,300
17 Insein	3,100	23,100	17,400	16,600	700	18,300	19,700	23,800
18 Ywama	100	8,900	8,600	12,100	-	6,300	12,200	8,900
19 Phwakan	100	100	8,600	-	-	6,300	100	100
20 Aungsanmyo	100	6,400	2,300	4,500	500	2,300	4,600	6,900
21 Danyingone	4,400	300	4,400	300	10,400	10,900	4,700	10,700
22 Gauk Kwin	7,400	-	11,700	-	8,800	19,700	7,400	8,800
23 Kyaikkalel	4,900	300	16,400	7,300	9,000	21,400	12,200	9,300
24 Mingaladon Buzza	2,700	-	19,100	-	10,300	31,700	2,700	10,300
25 Mingaladon	800	100	19,800	-	1,200	32,900	800	1,300
26 Waibagi	-	-	19,800	-	-	32,900	-	-
27 Okkalapa	-	6,400	13,400	12,400	-	20,500	12,400	6,400
28 Paywetseikkon	500	300	13,600	300	300	20,500	800	600
29 Kyaukyetwin	200	9,100	4,600	13,100	400	7,800	13,300	9,500
30 Tadakalay	3,200	-	7,800	-	4,400	12,100	3,200	4,400
31 Yegu	800	400	8,200	100	400	12,400	900	800
32 Parame	3,300	100	11,300	-	3,800	16,200	3,300	3,900
33 Kanbe	5,200	100	16,400	200	6,100	22,000	5,400	6,200
34 Baukthaw	300	1,200	15,500	1,700	600	20,900	2,000	1,800
35 Tarmwe	600	2,100	14,000	2,800	1,300	19,500	3,400	3,400
36 Myittanyunt	400	6,800	7,600	7,600	400	12,300	8,000	7,200
37 Malwagone	2,300	4,300	5,600	5,200	2,000	9,200	7,500	6,300
38 Pazundaung	600	2,100	4,100	2,700	1,000	7,500	3,300	3,100
*Total	116,500	120,100	-	137,500	127,700	-	254,000	247,800

* The deference between boarding and alighting passengers is due to passenger transferring to/ from other railway routes.

Source: YUTRA Project Team (2014)

Table 4.2.2 Number of Boarding and Alighting Passengers in 2035

YCR Station	Clockwise operation (pax/day/oneway)			Anti-clockwise operation (pax/day/oneway)			Total (pax/day/twoway)	
	Boarding	Alighting	Line Volume	Boarding	Alighting	Line Volume	Boarding	Alighting
1 Yangon Central	58,000	61,800	58,000	55,400	41,900	41,900	113,400	103,700
2 Phaya Rd.	7,900	8,000	57,900	7,400	6,500	41,000	15,300	14,500
3 Lanmataw	-	3,600	54,200	4,000	3,500	40,500	4,000	7,100
4 Pyay Rd.	10,000	10,200	54,100	6,700	4,900	38,700	16,700	15,100
5 Shan Rd.	800	7,200	47,700	9,000	7,700	37,300	9,800	14,900
6 Ahlone Rd.	2,300	6,400	43,600	1,700	2,600	38,200	4,000	9,000
7 Panhlaing Rd.	1,300	11,000	33,900	9,100	1,200	30,200	10,400	12,200
8 Kyeemyindaing	18,900	1,200	51,600	1,200	18,500	47,500	20,100	19,700
9 Hanthawaddy	3,100	1,800	52,900	1,600	1,700	47,600	4,700	3,500
10 Hletan	23,700	13,500	63,000	7,300	16,200	56,500	31,000	29,700
11 Kamayut	100	100	63,000	200	100	56,300	300	200
12 Thiri Myine	100	200	62,900	300	100	56,100	400	300
13 Okakyin	-	1,100	61,900	1,100	-	55,100	1,100	1,100
14 Thamine	16,600	23,600	54,900	21,900	14,700	47,900	38,500	38,300
15 Thamine Myothit	100	100	54,800	100	-	47,800	200	100
16 Kyuntkon	-	2,300	52,600	7,700	-	40,100	7,700	2,300
17 Insein	10,300	23,200	39,600	13,900	8,500	34,700	24,200	31,700
18 Ywama	5,800	1,800	43,700	3,400	11,800	43,100	9,200	13,600
19 Phwakan	1,300	600	44,400	1,600	3,400	44,900	2,900	4,000
20 Aungsanmyo	3,000	6,200	41,200	3,200	5,500	47,200	6,200	11,700
21 Danyingone	51,100	700	25,500	1,200	29,800	5,500	52,300	30,500
22 Gauk Kwin	3,900	-	29,400	-	6,500	11,900	3,900	6,500
23 Kyaikkalel	8,400	21,500	16,300	600	21,600	32,900	9,000	43,100
24 Mingaladon Buzza	15,700	-	31,900	-	23,700	56,600	15,700	23,700
25 Mingaladon	100	-	32,000	-	4,200	60,800	100	4,200
26 Waibagi	4,900	500	36,400	700	3,100	63,200	5,600	3,600
27 Okkalapa	700	2,300	34,800	22,300	200	41,100	23,000	2,500
28 Paywetseikkon	1,800	-	36,600	800	1,500	41,900	2,600	1,500
29 Kyaukyetwin	2,100	8,600	30,100	12,300	2,900	32,400	14,400	11,500
30 Tadakalay	6,600	-	36,600	200	10,500	42,700	6,800	10,500
31 Yegu	3,000	1,800	37,800	2,800	1,100	41,000	5,800	2,900
32 Parame	10,600	300	48,100	1,000	10,500	50,400	11,600	10,800
33 Kanbe	9,100	2,000	55,200	1,800	8,000	56,700	10,900	10,000
34 Baukthaw	2,600	6,100	51,700	5,400	4,200	55,500	8,000	10,300
35 Tarmwe	4,200	5,800	50,100	6,700	5,100	53,900	10,900	10,900
36 Myittanyunt	7,800	17,100	40,700	18,000	6,100	42,000	25,800	23,200
37 Malwagone	20,100	16,700	44,100	18,000	9,300	33,200	38,100	26,000
38 Pazundaung	11,500	17,800	37,800	7,200	6,300	32,300	18,700	24,100
*Total	327,500	285,100	-	255,800	303,400	-	583,300	588,500

* The deference between boarding and alighting passengers is due to passenger transferring to/ from other railway routes.

Source: YUTRA Project Team (2014)

Table 4.2.3 Total YCR Daily Patronage

Year	2012	2018	2035
Actual	76,900	-	-
YUTRA Master Plan	-	280,600	631,400
Pre-FS Model	-	254,000	583,300

Source: YUTRA Project Team (2014)

4.3 Issues and Considerations

4.3.1 General Considerations

For the YCR pre-feasibility study (PFS) the forecast travel demand, as presented in the previous section was made using modified YUTRA model. The model refinements and update tasks which will yield the suitable detailed demand forecast are outlined in the following sections.

4.3.2 Further YUTRA Model Refinement for YCR Feasibility

An initial review of the YUTRA Master Plan model was carried out at the PFS stage. The model was found to be stable and the changes made to the 'assignment' sub-model at the PFS stage did not impact the overall travel demand forecast for the YCR. However, it proposed to conduct stated preference survey to estimate 'true' value of time of travellers, as it has major impact on the choice of mode. The main reason for this is that currently there is no 'true' mass transit mode available in Yangon. The current rail travel is mostly by the low income population, students, and those who can access the railway conveniently and directly. The results of the stated preference surveys will be used to update the value of time in the three mode choice models as shown in Figure 4.1.1.

4.3.3 Refinement of YUTRA Traffic Zone System

The YUTRA study area zone system is coarse, and it was noted that there are a number of zones in which there are more than one YCR stations. Therefore this model could not show the exact number of passengers from each station. Figure 4.3.1 shows the current YCR 38 stations and the YUTRA traffic zone system. It is proposed that the YUTRA traffic zone system would be refined for the YCR Feasibility Study (FS), such that each station catchment area is represented by a single traffic zone. This would have the advantage that every station would have its own patronage catchment area depending on the level of travel demand to/ from that zone.

In addition this would assist in modelling any TOD proposals and their direct impact on the overall demand forecast for that station. The TOD proposals will be examined in the FS based on potential for development in and around the station area for each station, if possible.

4.3.4 YCR Station Spacing

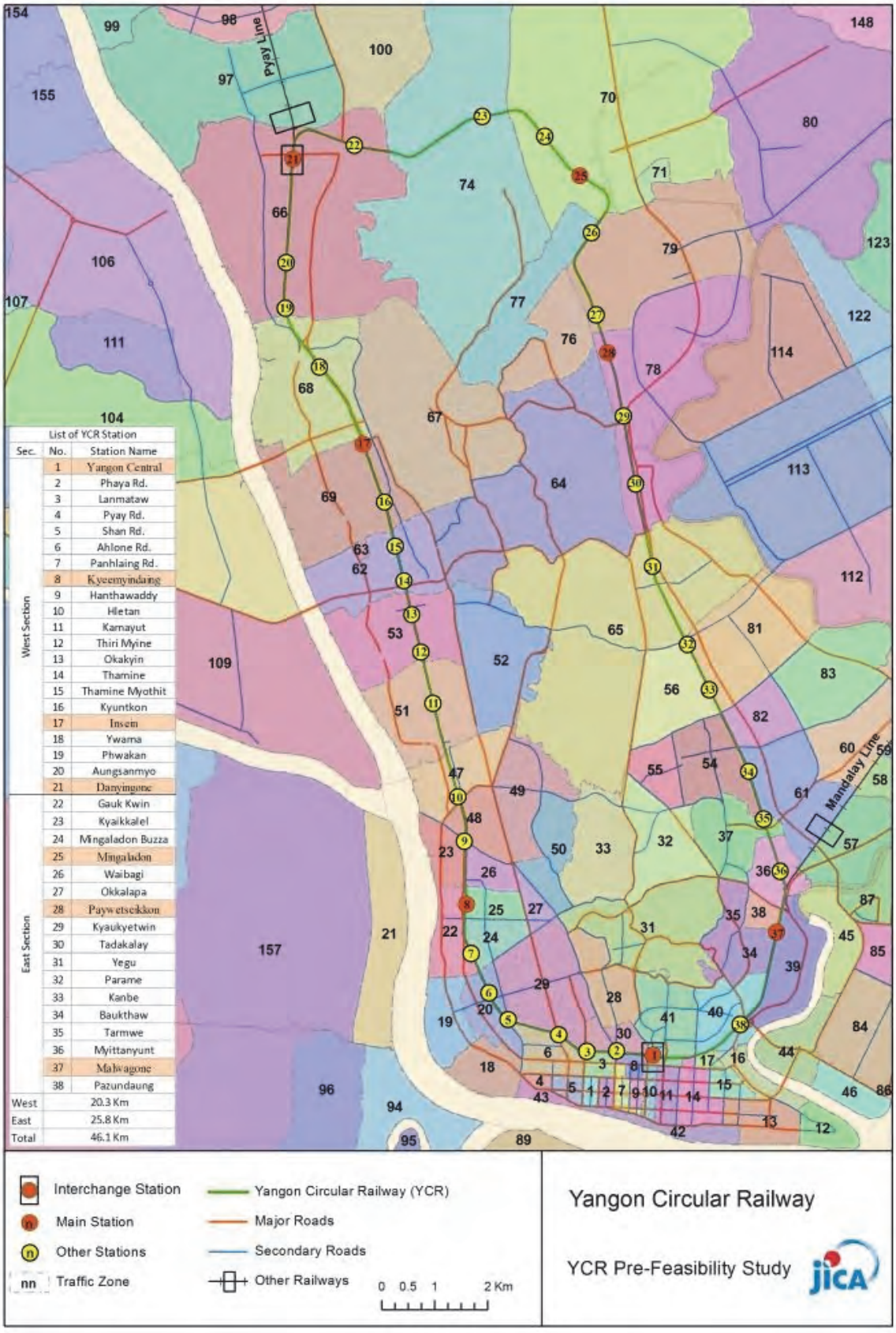
There are 38 stations on the YCR, and all YCR clockwise and anti-clockwise operating trains stop at all stations. These stations are diagrammatically shown in Figure 4.3.2, which also gives the distances between stations. It was noted that there are a number of stations where the distance between stations is less than one kilometre. This is further illustrated in Figure 4.3.3. Ideally, for a medium capacity mass transit system, the distance between stations should be about 1.0km. This represents a catchment radius of 500m, a distance which is comfortable to walk to catch a reliable mass transit system.

The impact of station spacing of less than 1.0km has direct effect on the average journey for medium to long distances. This is illustrated in Figure 4.3.3, by the low average speed between closely spaced stations, and also by the overall low journey speed for the west

and east sections of the line. Low journey speeds make the system less attractive for people to choose mass transit mode. Such lower operating speeds also adversely impact the train operating costs. It is therefore proposed that during the FS, the viability of the closely spaced station would be scrutinised, according to the patronage, and some of these stations may be eliminated.

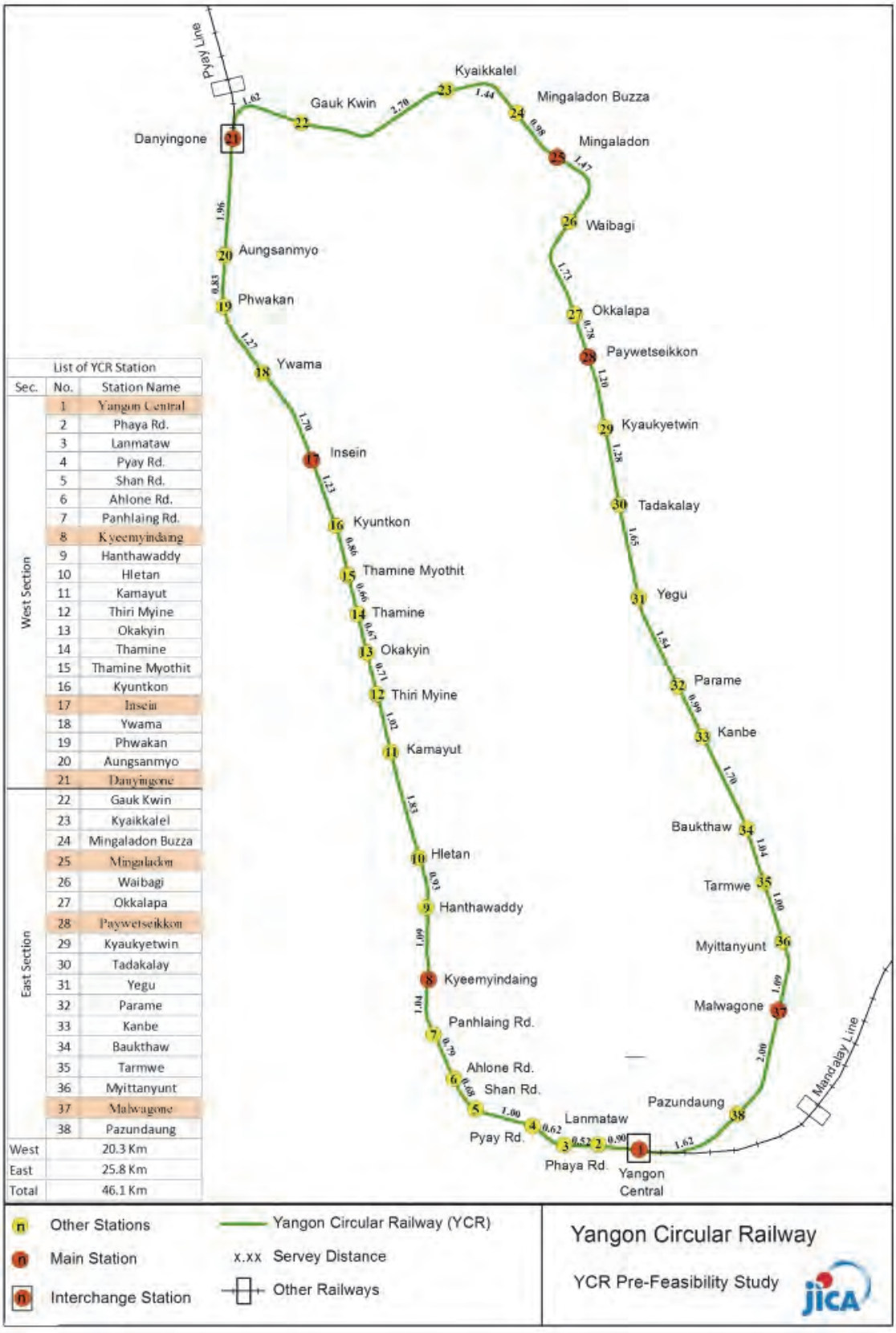
The other alternative would be to operate express and local trains to serve selected (major) and all stations respectively. Such train operations tend to be difficult to manage and sustained over long peak periods. However, these aspects will be studied in detail later at the FS stage of the project.

Conversely, there are a number of stations which are more than 1.5km from the adjacent station. The large distances between stations increases the travel speed, as the train would travel longer distance at maximum speed, but the patronage will be limited from the areas which are within the station walk-in catchment (within 500m radius). During the FS there would be opportunities to add station(s), between those stations where the distance between adjacent stations is more than 1.5km.



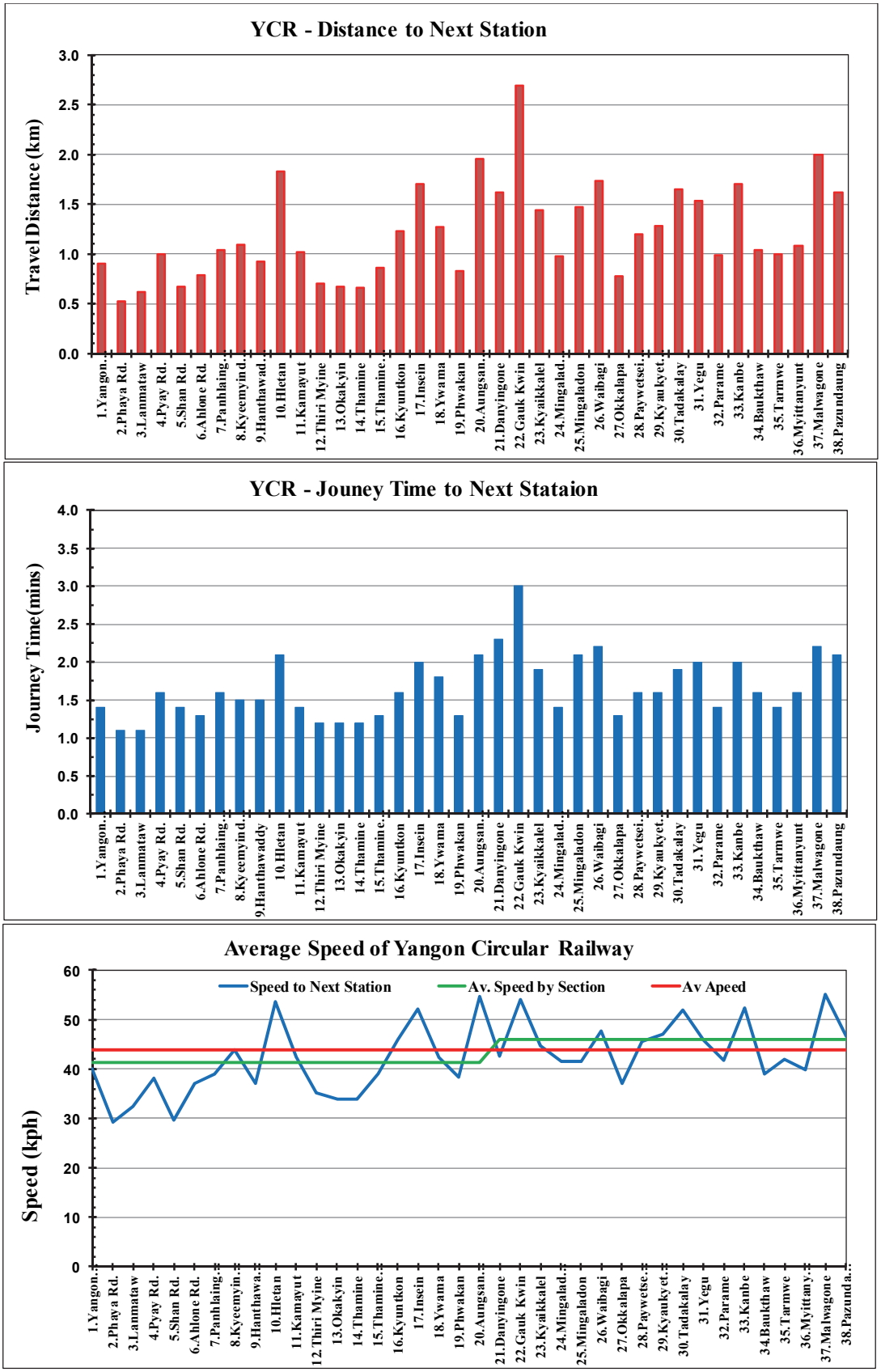
Source: YUTRA Project Team (2014)

Figure 4.3.1 The Current YCR 38 Stations and the YUTRA Traffic Zone System



Source: YUTRA Project Team (2014)

Figure 4.3.2 The Distances between Stations



Source: YUTRA Project Team (2014)

Figure 4.3.3 Distance to Next Station, Journey Time to Next Station and Average Speed after the rehabilitation of YCR

5 SURVEY ON ENVIRONMENTAL AND SOCIAL CONSIDERATION

5.1 Policies, Legislation and Institutional Framework Related to Yangon Circular Railway – 1 Environmental Conservation and Environmental Impact Assessment

5.1.1 Legislation Related to Environmental Conservation

Major legislations relevant to environmental conservation are shown in Table 5.1.1.1.

Table 5.1.1.1 Laws and Regulations Relevant to Environment

	Name of Laws, rules etc.	Year
1. Constitution and Environmental Policy		
	Constitution of the Republic of the Union of Myanmar	2008
	Myanmar National Environmental Policy	1994
	National Sustainable Development Strategy 2009	2009
2. Environmental Conservation		
	Myanmar Environmental Conservation Law 2012	2012
	Environmental Impact Assessment Procedures (Draft) 2013	2013
3.Biodiversity and Natural Conservation		
	Wildlife Protection Act 1936	1936
	Myanmar Marine Fisheries Law 1990	1990
	Fresh Water Fisheries Law 1991	1991
	Forest Law 1992	1992
	Animal Health and Development Law 1993	1993
	Protection of Wildlife and Conservation of Natural Area Law 1994	1994
	Conservation of Water Resources and River Law 2006	2006
	National Biodiversity Strategy Action Plan in Myanmar 2012	2012
4. Urban Development and Management		
	The City of Rangoon Municipal Act 1922	1922
	Law Amending the City of Yangon Development Law 1996	1963
	City of Yangon Development Law 1990	1990
	The City of Yangon Municipal Amendment Act 1961	1961
5. Land Acquisition and resettlement		
	The Upper Burma Land and Revenue Regulation	1889
	The Land Acquisition Act 1894	1894
	Transfer of Immovable Property Restriction Act	1947
	Land Nationalization Act	1953
	Disposal of Land Tenancies Law	1963
	Transfer of Immovable Property Restriction Law	1987
	Farmland Law 2012	2012
	Farmland Rules 2012	2012
	Vacant, Fallow, Virgin Land Management Law 2012	2012
	Vacant, Fallow, Virgin Land Management Rules 2012	2012
6. Pollution Control and Occupational Health		
	Factory Act	1951
	Standing Order 2_95 Occupational Health Plan 1995	1995
	Standing Order 3_95 Water and Air Pollution Control Plan 1995	1995

	Name of Laws, rules etc.	Year
	Occupational Safety and Health Law (Draft)	2012
	The Science and Technology Development Law 1994	1994
	Myanmar Mines Law 1994	1994

Source: YUTRA Project Team (2013)

1) Environmental Conservation Law, 2012

To establish sound environment policies, utilization of water, land, forests, mineral, marine resources and other natural resources for conservation of the environment and preventing its degradation, the National Environment Policy of Myanmar was proclaimed on 5 December 1994. Then the drafting of 'Myanmar Agenda 21' followed the Policy in 1997.

However, since then the progress in development of environmental policy has passed with rather slow step. In addition, the legal framework for environment protection has been indebted to sectorial laws and these laws do not possess holistic vision on environmental protection.

In order to solve the above situation the Environmental Conservation Law was established and enacted by the Union Hluttaw on 30th March 2012, and promulgated on 1st April 2012.

The Law consists of the objectives, formation of the environmental conservation committee, environmental conservation functions and powers of the Ministry of Environment Conservation and Forestry (MOECAF), environmental emergency, and so on.

Outline of Environmental Conservation Law is shown in Table 5.1.1.2.

Table 5.1.1.2 Outline of Environmental Conservation Law

Chapter	The Outline (Excerpt)
1) Title and Interpretation	This Law shall refer to as the Environmental Conservation Law.
2) Objectives	For implementation of Myanmar's National Environment Policy.
3) Organizing the Environment Conservation Committee	1) The Union government shall organize an Environment Conservation Committee, Republic of the Union of Myanmar, assigning the Union Minister of the Ministry of Environment as the Chairman and shall constitute appropriate members. 2) In organizing the committee, the Vice-chairman, Secretary, and Joint-Secretary shall be assigned and designated to serve the task.
4) Obligations and authoritative right of the Ministry on Environment Conservation	In order for the Ministry of Environment to implement environment conservation effectively, the State, at the expense of budget fund under the head income of other sources, shall allocate fund in the State account on Environment Conservation in accordance with the Financial Rules and Regulations.
5) Emergency Condition on Environment	The Committee, upon notice of an emergency condition that is occurring or may possibly occur across the nation or in certain region or state or in certain territory shall notify the occurrence and submit the matter immediately to the Union government.
6) Environment Quality and Specifications	The ministry under the agreement of the Union government and the committee, for the benefit of the public in accordance with the development of science and technology, or with the requirement of work may make amendments on the environment quality specifications in compliance with time and place.
7) Environmental Conservation	Under this item the following issues on environmental conservation were discussed: a) Using chemicals which may vividly jeopardize environment; b) Transporting polluted materials, hazardous materials, keeping under storage, application, processing and discarding at the industries; c) Discarding materials produced from

Chapter	The Outline (Excerpt)
	metals, industrial mineral ores, raw materials, gem extraction, and processing; d) Discarding filthy, dirty, and wastage matters. e) Cleansing and processing; f) Implementation of development and construction; and g) Implementation of other required environmental pollution.
8) City Locality Environment Management	In taking up measures for City Locality Environment Management in accordance with the instructions and guidelines given by the committee, the ministry shall confer to government departments concerned, government organizations, private organizations, and private individuals on the matters requiring advice
9) Conservation of Natural Resources and Cultural Heritage	Under the existing law, the ministry shall cooperate with government departments concerned and government organizations on matters relating with prescribed cultural heritage; regions existing such heritage; cultural/monumental buildings and perpetuation of natural land and territories.
10) Advance Permit Issue	The ministry with the approval of the Union government may prescribe works requiring advance permit application that may jeopardize or endanger the environment quality, or work sites or factories and workshops.
11) Insurance	Party holding advance permit shall have to provide an insurance in accordance with the nature of work, worksite, factory or workshop under existing law to cover any accident jeopardizing the environment.
12) Restrictions	1) No party shall enter and execute the worksites, factory or workshops which require to apply advance permit in accordance with this law. 2) No party shall violate any restriction provided under the Rules Notification, Orders, Directives, Board, Transport of Sales on certain products or materials which may jeopardize the environment and prohibited by the ministry.
13) Penalties and Punishments	If any party is find convicted of committing violation of Rules, Notifications, Orders, Directives or any restrictions provided in the procedures, corresponding punishment of imprisonment not more than one year or an appropriate fine or both maybe imposed.
14) General	Government department concerned and government organization having the right to issue license, permit, co-registration on those works, worksite, factory, or workshop, shall issue permit to those works holding advance permit.

Source: Environmental Conservation Law, 2012

The summary of the objectives are as follows:

- To implement the Myanmar National Environment Policy;
- To provide the basic principles and give guidance on the systematic integration of environmental conservation matters in a sustainable development process;
- To promote a good and clean environment and to conserve the natural and cultural heritage for the benefit of both present and future generations;
- To reclaim the ecosystems that are at the early stages of degradation as soon as possible;
- To manage the prevention of natural resources degradation and to enable its sustainable use;
- To implement the promotion of public understanding and dissemination of educational program on environmental awareness;
- To promote the international, regional, and bilateral cooperation in environmental affairs; and
- To enable the cooperation among government departments, government organizations, international organizations, non-governmental organizations, and

individuals in matters of environmental conservation.

It is noteworthy that Myanmar laws do not contain any descriptions related to the system of environmental impact assessment (EIA) for development projects as well as to SEA at present. Moreover, the systems of public involvement in the decision-making process are not also prescribed in the law. This is considered as a significant gap between the Myanmar laws and JICA Guidelines.

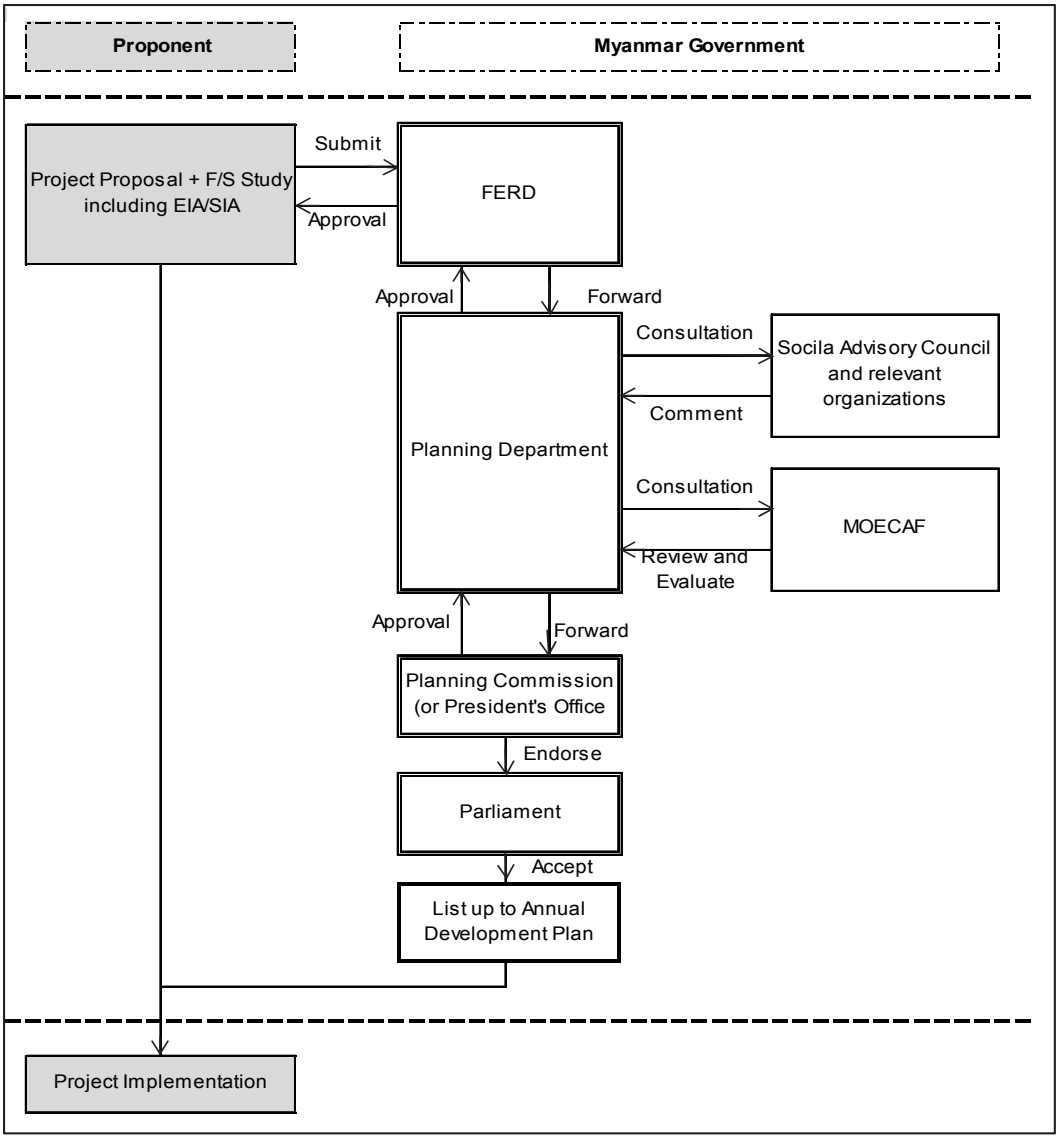
In addition, compared with national level legislation, Yangon City does not have particular provisions or ordinances for environmental conservation.

5.1.2 Regulations for Environmental Impact Assessment (EIA)

1) Existing situation of EIA regulations in Myanmar

At present, in the case of official development scheme by the foreign public sector including foreign donors, the approval for the project implementation is attained after several processes as follows (See Figure 5.1.2.1):

- At first, the project proponent shall submit project proposal documents together with a feasibility study report including the results of Environmental Impact Assessment (EIA)/Social Impact Assessment (SIA) to the Foreign Economic Relations Department (FERD) of Ministry of National Planning and Economic Development (MNPED).
- After examining all the required documents by FERD, the documents are forwarded to the Planning Department of MNPED.
- The Planning Department consults with the Social Advisory Council and other relevant organizations as well as MOECAF for examination in detail the documents. In this process MOECAF reviews and evaluates the results of EIA/SIA in terms of environmental and social considerations.
- After all the above organizations approved the submitted documents, the Planning Department forwards the documents together with the results of the above examination and evaluation to the Planning Commission (or the President's Office).
- After the approved of the documents, the Planning Commission will endorse them together with its recommendation to the Parliament.
- In the Parliament, after acceptance of the project approval, the project will be registered into the national annual project list without which no project is able to be conducted in the target year.



Source: YUTRA Project Team (2013)

Figure 5.1.2.1 Existing Procedures of Project and Environment Approval

However, Article 7 of the Environmental Conservation Law stipulates that the Ministry of Environment, Conservation and Forestry (MOECAF) has responsibility for laying down and carrying out of a system of EIA and SIA as to whether or not a project or activity to be undertaken by any government department, organization or person may cause a significant impact on the environment.

The above law, however, does not stipulate the detail procedures to be taken for conducting environmental impact assessment. With regard to this, MOECAF has been working for the drafting of the "Environmental Conservation Rules" in which "Environmental Impact Assessment Procedures" (hereafter, "the EIA procedures") shall be stipulated. As of January 2013, the EIA Procedures has been drafted and waiting for further brush up and official enactment. The draft of the EIA procedures stipulates that MOECAF shall be the Executing Agency for the purpose of the rules stipulated in the document.

2) Outline of EIA Procedures

The EIA Procedures are composed of 7 chapters and 22 articles with appendices as shown in Table 5.1.2.1.

Table 5.1.2.1 Outline of EIA Procedures

Chapter/Article	Major points
I Title and Definition	
Article 1	The Procedure is called as EIA Rule.
Article 2	The definition of the expressions in the Rule.
II Establishment of Environmental Impact Assessment process	
Article 3	Any project or business or activity undertaken in Myanmar by any ministry, government department, organization, corporation, local government, which likely to have significant impact on environment, is required to undertake EIA.
Article 4	MOECAF is the Executive Agency for the purpose of the Rule.
	EIA Committee shall be established and the committee will give environmental approval with the recommendation of MOECAF.
	Any projects which require IEE or EIA shall not be issued a permit by the MIC or any relevant authority without written approval of MOECAF.
	For projects involving facilities which already exist or under construction, the owner will undertake environmental/social compliance audit to identify concerns related to impacts on involuntary resettlement and indigenous peoples, and take appropriate actions.
Article 5	a) The powers and functions of the MOECAF under the Procedure are as follows: (1) to identify project screening criteria (2) to approve guidelines for IEE or EIA (3) to review and approve IEE/EIA report (4) to evaluate Environmental Management Plan (EMP) (5) to monitor and enforce implementation of the EMP (6) Others
	b) The functions and duties of the EIA Committee under the Procedure are: (1) to recommend approval of project screening criteria to MOECAF (2) to recommend approval of IEE/EIA report to MOECAF (3) to recommend approval of the EMP to MOECAF
Article 6	MOECAF shall arrange, as it deems necessary, for public participation of civil society and relevant agencies in the conduct of IEE/EIA and in the implementation of EMP
III Screening	
Article 7	The project shall present the project proposal for screening to MOECAF.
Article 8	Schedule I and II are defined as the criteria for conduct of IEE/EIA.
Article 9	Schedule III is also defined as sensitive areas where no project shall be conducted.
IV Scoping	
Article 12	All proponents for the projects that are required to carry out a full EIA, either by virtue of Schedule II or III or by order of the MOECAF shall conduct scoping process.
V Investigation	
Article 13	Project proponent shall carry out a full analysis and investigation of all the potential environmental impacts, both adverse and beneficial of the proposed project.

Chapter/Article	Major points
VI Reporting, review and approval	
Article 14	Project proponent required to carry out EIA shall prepare EIA report in the format defined by MOECAF.
Article 15	Upon receipt of the IEE/EIA report including EMP,MOECAF shall invite the relevant agencies, institutions, civil society organizations, and project-affected persons to provide comments and suggestions on the report.
Article 16	MOECAF shall approve or refuse the IEE/EIA report as a basis for environmental clearance on the recommendation of EIA Committee.
VII Monitoring	
Article 18	MOECAF shall carry out monitoring of the implementation of the approved EMP by the project proponent.

Source: Compiled from Environmental Impact Assessment Procedures (Draft)

3) IEE/EIA required projects

Lists of projects, which are required of IEE/EIA are provided in Schedule I and II of the EIA Procedures.

(1) Schedule I projects

All projects that are likely to have some adverse environmental impacts, but of lesser degree and/or significance than those of Schedule II projects, an Initial Environmental Examination (IEE) is required to determine whether or not significant environmental impacts warranting an EIA (full EIA) are likely. If the EIA is not required, the report of the IEE is regarded as the final environmental assessment report.

(2) Schedule II projects

All projects that are likely to have potential for significant adverse environmental impacts, an EIA (full) is required to address such significant impacts.

Lists of IEE/EIA required projects related to transport development are shown in Table 5.1.2.2.

Table 5.1.2.2 List of IEE/EIA Required Transport Project of Infrastructure Development

Purpose and type of project	Project feature (size, etc.)
(I) IEE required project (Schedule I)	
1) River Training Works	All projects
2) Construction of Bridges	more than 50 feet and less than 200 feet
3) Port Development	All projects
(II) EIA (full EIA) required project (Schedule II)	
1) Construction of Highways and fly-over	all projects if recommended by IEE
2) Ports Development	all projects if recommended by IEE
3) Construction of Subways	all projects if recommended by IEE
4) Construction of Bridges	more than 200 feet
5) Construction of Shipyards	dead weight tonnages greater than 5,000 tons
6) Construction of Airports	airstrips of 8,200 feet (2,500 meters) or longer
7) Construction of Railways including Construction of new routes	all projects if recommended by IEE

Note: Project activities other than new construction such as rehabilitation, extension and/or improvement are not clearly stipulated.

Source: Compiled from Environmental Impact Assessment Procedures (Draft, 2013)

(3) Schedule III

In addition, Schedule III identifies environmentally, ecologically and socio-culturally sensitive areas which should not be included in any development project and a reasonable distance should be ensured from such areas so as not to cause any permanent damage or result in any adverse environmental, ecological or social impacts (Table 5.1.2.3).

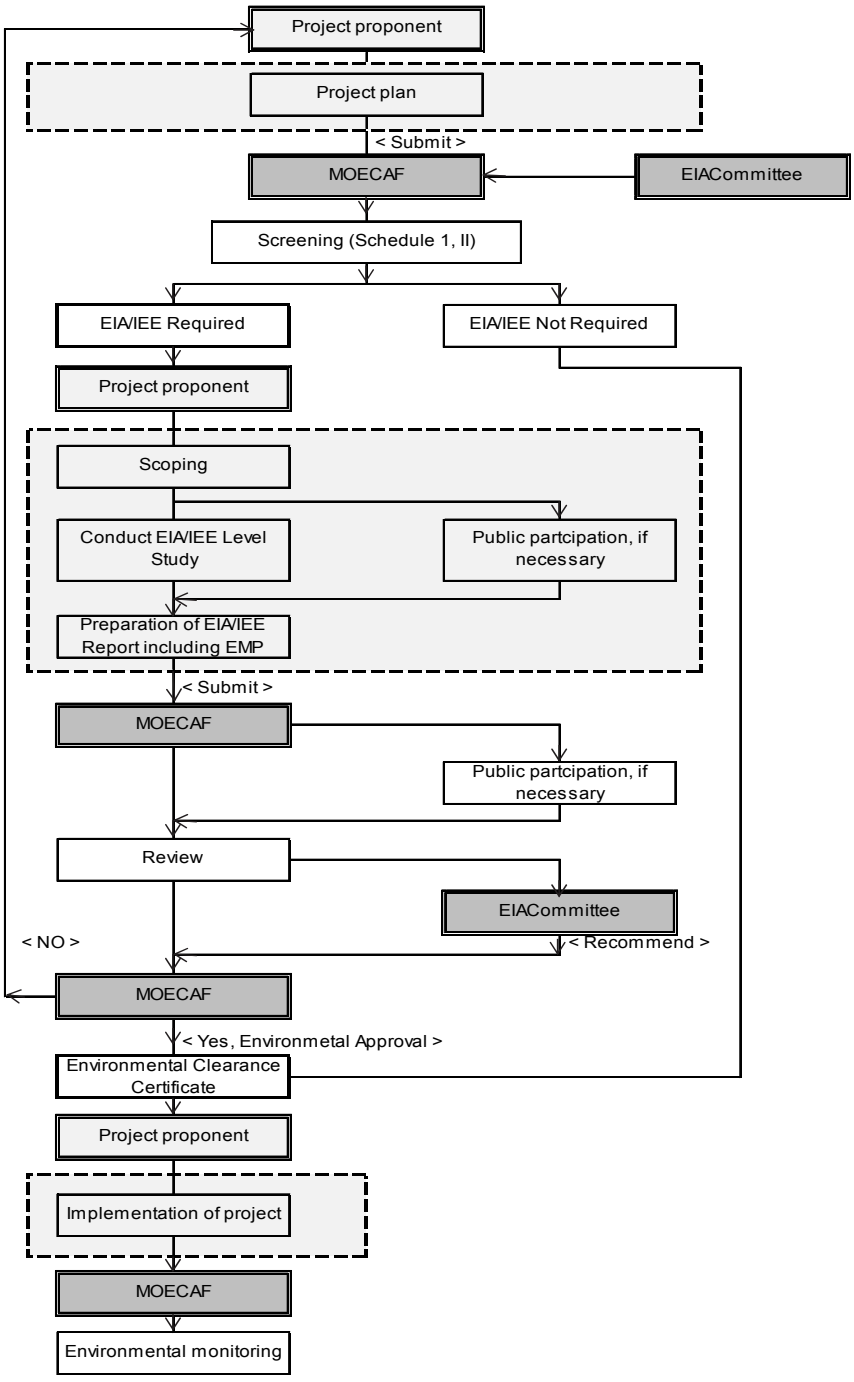
Table 5.1.2.3 Environmentally, Ecologically and Socio-cultural Sensitive Area (Schedule III)

No.	Sensitive Areas
1	Areas of unique historical, cultural, archaeological, scientific or geographical significance
2	Wetlands
3	Ecologically fragile area
4	National parks, wildlife sanctuaries and protected areas
5	Wilderness areas containing rare or endangered species of flora or fauna and their habitat
6	Areas susceptible to natural hazards
7	Major sources of public drinking water
8	Areas surrounding lakes and reservoirs
9	Resort areas and areas closed to oyster fishing and pearl farms areas
10	Flooded of flood plain on other or other hazardous zones

Source: Environmental Impact Assessment Procedures (draft, 2013)

(4) Processes of Environmental approval

Schematic processes of Environmental approval in the EIA Procedures are shown in Figure 5.1.2.2.



Note: MOECAF - Ministry of Environmental Conservation and Forests
Source: Enivironmental Impact Assessment Procedures (Draft, 2013)

Source: YUTRA Project Team (2013)

Figure 5.1.2.2 Schematic Processes of Environmental Approval

(5) Gaps of Environmental and Social Considerations between Myanmar legislation and JICA Guidelines

At present roles and importance of environmental and social considerations in the planning and implementation of projects are not necessarily recognized in Myanmar. To cope with this, the Environmental Conservation Law was just enacted in 2012 and EIA Procedures were proposed as described the above.

Regarding policies for environmental and social considerations, those of JICA guidelines are basically same as those of World Bank and ADB.

Table 5.1.2.4 shows results of comparison between the policies of Myanmar legislations including the EIA Procedures and those of JICA Guidelines. It is found that there are still considerable gaps between Myanmar legislations and JICA Guidelines.

Table 5.1.2.4 Gaps between the JICA Guidelines for Environmental and Social Considerations (JICA Guidelines) and Myanmar legislations

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
(1) **Underlying Principles**		
1. Environmental impacts that may be caused by projects must be accessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	Procedures (A 9,13)	Article 9 of the Procedures requires IEE or EIA for proposed projects based on types activities according to the defined thresholds.
		Article 13 of the Procedures stipulates to analyze feasible alternatives as well as mitigation measures. There is no description which stipulates the timing of above implementation.
2. Such examinations must be endeavored to include an analysis of environment and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social and technical analyses of projects.	Procedures (A 13)	Article 13 of the Procedure stipulates to analyze feasible alternatives, mitigation measures as well as cost and benefit.
3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures, and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts.	Procedures (A 9,13,14)	Article 9 of the Procedures requires IEE or EIA for proposed projects based on types to projects activities according to the defined thresholds. Article 13 of the Procedure stipulates to analyze feasible alternatives as well as mitigation measures.
		Article14 of the Procedures requires the preparation of EIA report for the EIA required project and preparation of EMP for IEE/EIA required project. On the other hand, there is no description so far which stipulates IEE report for IEE require project.
4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seed their opinions, in order to increase accountability.	Procedures (A 4)	Article 4 of the Procedures requires the establishment of EIA Committee composed of at least five persons with necessary expertise.
		The committee's duty is to recommend approval of the submitted IEE/EIA and EMP.
(2) Examination of Measures		

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environment and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures.	Procedures (A 13)	Article 13 of the Procedures stipulates to investigate of all potential environmental impacts including an analysis of feasible alternatives and mitigation measures. Conduct of compensation measure is not stipulated in the Procedures.
2. Appropriate follow-up plan and system, such as monitoring plans and environmental management plants, must be prepared; the costs of implementing such plans and systems, and the financial methods to find such costs, must be determined. Plans for projects with particularly large potential adverse impact must be accompanied by detailed environmental management plans.	Procedures (A 13,14)	Article 13 of the Procedures stipulates to analyze feasible alternatives, mitigation measure as well as cost & benefit. Article 14 of the Procedures requires the preparation of EMP for IEE/EIA required project.
(3) Scope of Impacts to Be Assessed		
1. The impacts to be accessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accident, water usage, climate change, ecosystem, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood , utilization of land and local resources, social institution such as social capital and local decision-making institution, existing social infrastructure and services, vulnerable	Procedures (A 13)	The items of likely impacts are not clearly stated in the Procedures. Article 13 of the Procedures prescribes that a project proponent shall carry out a full analysis and investigation of all the potential impacts, both adverse and beneficial, of the proposed projects.
2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	None	No laws were identified, which mentioned assessment and examination of derivative, secondary, and cumulative impacts as well as the impacts of projects which are indivisible from the project in a reasonable extent.
(4) **Compliance with Laws, Standards, and Plans**		

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction.	The Environmental Conservation Law 2012 (A 28, 29)	No law directly prescribes that projects must comply with the laws, ordinances, and standards related to environmental and social considerations.
		Article 28 of The Environmental Conservation Law prescribes that "No one shall, without the prior permission, operate business, work-site or factory, workshop which is required to obtain the prior permission under this Law"
		Article 29 of the law stipulated that "No one shall violate any prohibition contained in the rules, notifications, orders, directives and procedures issued under this Law."
2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas.	Procedures (A 8)	Schedule 3 stipulated by Article 8 of the Procedures prescribes that projects must, in principle, be undertaken outside of Environmentally, Ecologically and Socio-culturally Sensitive Area.
	The Protection and Preservation of Cultural Heritage Regions Law (Article 18)	This law stipulates that no person shall construct, extend, renovate a building or extend the boundary of ancient monumental zone or ancient site zone without prior permission granted under this law.
(5) **Social Acceptability**		
1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.	Procedures (A 6,15)	Article 6 of the Procedures stipulates that MOECAF shall arrange for public participation of civil society and relevant agencies in conduct of IEE/ EIA and EMP.
		Article 15 of the Procedures stipulates that MOECAF shall invite civil society organizations and affected persons to provide comments and suggestions on IEE/ EIA report.
2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, and the poor and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.	Procedures (A 4)	Article 4 of the Procedures prescribes implementation of necessary actions for the project which potentially gives adverse impact on indigenous people and causes involuntary resettlement. However, the details of actions are not provided in the Procedures.
(6) **Ecosystem and Biota**		
1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	The Environmental Conservation Law 2012 (A 18)	The Environmental Conservation Law prescribes that relevant government departments/organizations shall carry out conservation, management, beneficial use, sustainable use and enhancement regional cooperation of environmental natural resources.

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
	The Forest Law 1992 (A 40)	Article 40 of the Forest Law (1992) prescribes that cause of any damage to reserved forest and its environment is prohibited and will be punished.
	The Protection of Wildlife and Conservation of Natural Areas Law 1994 (A 36)	Article 36 of The Protection of Wildlife and Conservation of Natural Areas Law prescribes that cause of any damage to protected areas is prohibited and will be punished.
2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way to ensure the prevention of illegal logging	The Forest Law 1992 (A 17, 40)	The Law stipulates that forest produce may only be extracted after obtaining a permit.
(7) **Involuntary Resettlement**		
1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.	Procedures (A 4)	The Procedures prescribes implementation of necessary actions for the project which potentially gives impact on involuntary resettlement. However, the details of actions are not provided in the Procedures.
2. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.	Land Acquisition Act 1894 (A 3)	Article 3 of the Land Acquisition Act stipulates that a person who has right in land would be entitled to claim a compensation if the land were acquired under this Act.
	Farmland Rules 2012 (A 64)	Article 64 of Farmland Rules stipulates compensation in farmland acquisition for the interest of the State or public.
	Land Acquisition Act 1894 (A 23)	Article 23 of the Act stipulates that damages on standing crops and trees, on land, properties, incidental to relocate residence or business and losses of profits due to land acquisition are considered for compensation although it does not clearly state to support PAPs can improve or at least restore their standard of living. However, these laws do not clearly state any more details of compensation and supporting measures.
3. Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the	Procedures (A 15)	Article 15 of the Procedures describes that relevant agencies, institutions, civil society organizations, and project-affected persons are invited as appropriate to provide comments and suggestions on the IEE/ EIA/ EMP reports. However, it does not describe resettlement action plan.

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
affected people and their communities.	Land Acquisition Act 1894 (A 5A, 18)	Article 5A of the Land Acquisition Act stipulates that any person whose land is affected (acquired) can claim the objection for the land acquisition within thirty
4. For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP4.12, Annex A.	None	No laws were specifically mentioned about the requirement of resettlement action plans for large-scale involuntary resettlement. According to GAD of MOHA Land Acquisition and Resettlement Action Plan (LARAP) will be required for the large-scale developments and the GAD will approve it.
(8) Indigenous People		
1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous people for their losses.	Procedures (A 4)	The Procedures prescribes implementation of necessary actions for the project which potentially gives impacts on indigenous people without the details.
2. When projects may have adverse impacts on indigenous people, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.		
3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B.		

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
(9) Monitoring		
1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.	Procedures (A -18)	The Procedures prescribes that a project proponent shall prepare and submit an EMP with the IEE/ EIA reports. The MOECAF shall carry out monitoring of the implementation of the approved EMP by the project proponent although there was little information regarding the method or terms of the monitoring conduction.
2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans.	None	
3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.	None	No laws were identified, which stated that project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.
(10) Others		
1. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	Land Acquisition Act of 1894 (A 4)	Article 4 of the Act stipulates that a notification of land requirement for public purposes is published to start surveys and land marking although it does not state the details of surveys to establish eligibility through an initial baseline survey (including population census).
2. Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Land Acquisition Act of 1894 (A 9)	Article 9 of the Act stipulates regarding occupier (if any) of land and all persons known or believed to have rights on lands are notified or invited for explanations although the eligibility is not clearly prescribed in the Act.
3. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WBOP4.12 Para.11)	None	No law was identified on preference to land-based resettlement strategies for displaced persons.
4. Provide support for the transition period (between displacement and livelihoods are land-based. (WB OP4.12 Para 6)	None	No law was identified on the provision of support for the transition period.
5. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line , landless, elderly women and children, ethnic minorities etc. (WB OP4.12Para.8)	None	No law was identified on particular attention to vulnerable groups.

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between JICA Guidelines/WB OP4.12 and Law of Myanmar
6. For projects that entail land acquisition or involuntary resettlement for fewer than 200 people, abbreviated resettlement plan is to be prepared, (WB OP4.12 Para.25)	None	No law was identified on the criteria of preparing abbreviated resettlement plan.

Note: JICA - JICA Guidelines for Environmental and Social Considerations, WB - World Bank Safeguard Policy, Procedures - Environmental Assessment Procedures (Draft, 2013,by MOECAF), A - Article.

Source: JICA Guidelines for Environmental and Social Considerations (2010.4) and World Bank OP 4.12 and relevant Myanmar legislation

5.1.3 Environmental Quality Standards

In Article 10 of the Environmental Conservation Law, 2012, MOECAF may, with the approval of the Union Government and the Committee, stipulate the environmental quality standards for items such as surface water quality, underground water quality, air quality, noise and vibration etc., although the standards have yet been established until November 2013.

However, some emission and/or discharge standards and environmental standards have been established by other ministries and practically used standards and/or guidelines as references.

1) Pollution control standards at generation source

The Private Industrial Enterprise Law (1990) stipulates that one of the basic principles of the law is to avoid or reduce the usage of the technology which causes environmental pollution. In addition, the law also stipulates that one of the duties of Ministry of Industry (MOI) is to secure or not allow any pollution to cause any adverse effect on environment as well as health of residents and factory workers.

Standing Order 3/95, Water and Air Pollution Control Plan (MOI) stipulates that factories shall conduct monitoring of wastewater for items defined in the Order and emission and effluent standards as shown in Table 5.1.3.1 and Table 5.1.3.2**.**

Table 5.1.3.1 Emission Standards

Gas	mg/m^3	ppm
CO_2	9000	500
CO	55	50
H_2S	14	10
Ammonia	18	25
Benzene	30	10

Source: MOI Standing Order 2/95 Occupational Health Plan 1995

Table 5.1.3.2 Effluent Standard

Item	Threshold	Standard Value
BOD(5days at 20°C)	max	20ppm or more but not exceeding 60ppm,depending on geography of wastewater discharging point
Suspended solids	max	30 ppm
Dissolve solids	max	2000 ppm

Item	Threshold	Standard Value
pH Value	Between 5 and 9	
Permanganate value	max	60 ppm
Supplied (as H2S)	max	1 ppm
Cyanide (as HCN)	max	0.2 ppm
Oil and grease	max	5 ppm
Tar	none	
Formaldehyde	max	1 ppm
Phenols and cresols	max	1 ppm
Free chlorine	max	1 ppm
Zinc	max	5 ppm
Chromium	max	0.5 ppm
Arsenic	max	0.25 ppm
Copper	max	1.0 ppm
Mercury	max	0.005 ppm
Cadmium	max	0.03 ppm
Barium	max	1.0 ppm
Selenium	max	0.02 ppm
Lead	max	0.2 ppm
Nickel	max	0.2 ppm
Insecticides	none	
Radioactive materials	none	
Temperature	max	40° C
Color and Odor	Not objectionable when mixed in receiving water	

Source: MOI Standing Order 3/95: Water and Air Pollution Control Plan

2) Regulation of wastewater discharge in YCDC area

Section 7 (7) of the YCDC Order No. 10/ 99 prohibits discharging of wastewater into common properties. Nobody shall be allowed to dispose and/ or flow sewage and wastewater from any activity, such as business, factory, into drainage, creeks and rivers without necessary treatment for compliance with standards, norms and criteria designated by the agency concerned. Effluent standards from factories and facilities are shown in Table 5.1.3.3**.**

Table 5.1.3.3 Effluent Standards for Wastewater from Factory and Facilities

	Item	Value
1	pH	6-9.6
2	BOD	20-60 ppm
3	COD	< 200 ppm
4	TS	up to 2000 ppm
5	SS	up to 500 ppm

Source: Proposed National Standard from Occupational Health Division, Department of Health under Ministry of Health

3) Water Quality Standards

With regard to the water quality, however, the guidelines proposed in the workshops in 1990 and 2011 (Draft), and the World Health Organization (WHO) Guidelines were compared in Table 5.1.3.4. Compared with 1990, the values for 2011 tended to be closer to the WHO Guideline. However, for copper and iron, the values are less strict than in the WHO Guidelines.

Table 5.1.3.4 Water Quality Standard in Myanmar

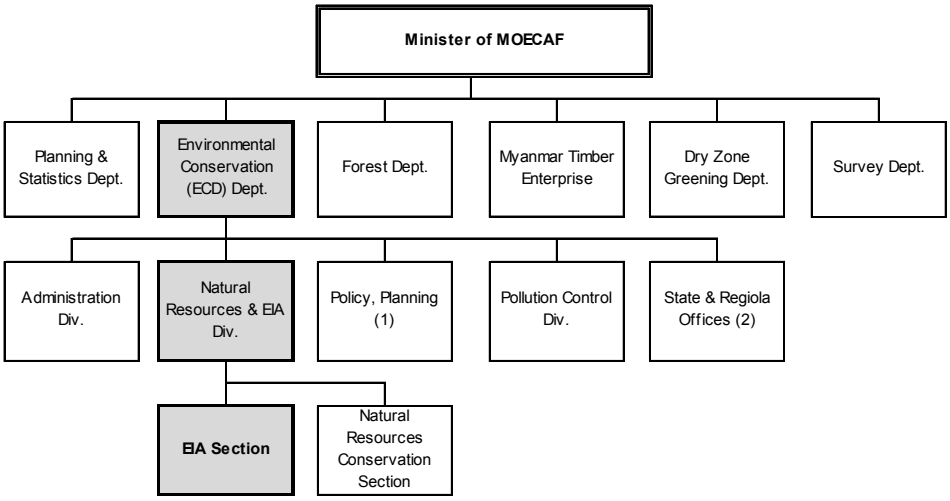
No.	Parameters	Unit	Myanmar Standard		WHO Guideline
			1990	2011 (Draft)	
1	pH	-	6.5-9.2	6.5-8.5	Preferably<8.0
2	Turbidity	NTU	20	5	5
3	Colour	Pt-unit	6.5-9.2	15	15
4	Aluminum (Al)	mg/l	0.2	0.2	0.2
5	Arsenic (As)	mg/l	0.05	0.05	0.01
6	Calcium (Ca)	mg/l	75-200	100	-
7	Chloride (Cl)	mg/l	200-600	250	250
8	Copper (Cu)	mg/l	1.0	2.0	1.0
9	Cyanide (CN)	mg/l	0.05	0.07	0.07
10	Hardness	mg/l	500	500	-
11	Iron (Fe)	mg/l	0.5-1.5	1	0.3
12	Manganese (Mn)	mg/l	0.3	0.3(0.1)	0.1
13	Lead (Pb)	mg/l	0.05	0.01	0.01
14	Magnesium (Mg)	mg/l	30-150	500	-
15	Nitrate (NO_3)	mg/l	10(as N)	50	-
16	Sulfate	mg/l	400	250	250
17	Total dissolved	mg/l	1000	1000	1000
18	Zinc (Zn)	mg/l	5-15	3	3
19	Total Coliform	No/100ml	0	0	0
20	*E.Coli*	No/100ml	0	0	0

Source: The Study on the Improvement of Water Supply and Wastewater Treatment in Yangon (2012, METI, Japan)

5.1.4 Institutional Framework for Environmental Conservation

The Ministry of Forest was re-named as the Ministry of Environmental Conservation and Forestry (MOECAF) on September 6th 2011 in order to undertake both environmental and forest conservation and management more effectively. It is after about 90 years from 1923, when the Ministry of the same name was firstly formed.

MOECAF consists of six departments as shown in Figure 5.1.4.1. In MOECAF Environmental Conservation Department (ECD) is responsible for environmental affairs including EIA. ECD has four divisions with state and regional offices.



Note: (1) Policy, Planning & International Relations, Research and Extension Division, (2) State & Regional Offices (Yangon, Mandalay, Sagaing, Bago, Taninthari)

Source: Edited from documents by MOECAF

Figure 5.1.4.1 Organization Chart of MOECAF

Among them EIA Section has following duties and responsibilities:

- To develop EIA procedure and regulations to avoid, minimize and/or mitigate adverse environmental impacts,
- To monitor the implementation of environmental conservation,
- To review EIA reports for development projects.

5.2 Policies, Legislation and Institutional Framework Related to Yangon Circular Railway – 2 Land Acquisition and Resettlement

5.2.1 Legislation Related to Land Acquisition

The Land Acquisition Act 1894 promulgated in the British Colonial Era is even now the core law for land acquisition and resettlement in Myanmar. The contents of the Act are shown in Table 5.2.1.1. According to the State Constitution (2008), 'The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water and in the atmosphere in the Union'. Although the socialist system was abolished in 1988, the existing land law and directions are still in effect today without formal revision.

Table 5.2.1.1 Contents of Land Acquisition Act 1894

Part I	Preliminary
Part II	Acquisition
Part III	Reference to Court and Procedure Thereon
Part IV	Apportionment of Compensation
Part V	Payment
Part VI	Temporary Occupation of Land
Part VII	Acquisition of land for Companies
Part VIII	Miscellaneous

Source: Land Acquisition Act, 1894

There are many significant laws which govern land issues, land administration, and land ownership in Myanmar such as Land Nationalization Act (1953), Disposal of Tenancies Law(1963), Land Acquisition Act(1894), Forest Law(1992), Farm Land Law (2012), and so on (See Table 5.1.1.1).

5.2.2 Types and Classes of Land

From an administrative point of view, land can be classified into the following eleven categories

1) Freehold Land

Freehold land can be interpreted as “ancestral land”. It is transferable in accordance with the “Land Acquisition Act”.

2) Grant Land

“Grant land” is owned by the government. Land of the government may be disposed by grant or lease to any person or entity for a stipulated period. The lease period could range from 10 years, to 30 years or even up to 90 years, etc.

3) Garden Land

“Garden land” is a kind of “agricultural land”, but the type of crop(s) grown in the garden land is different from those usually grown in the agricultural land.

4) Grazing Land

Grazing land is stipulated in the Nationalization Act (1953) as grazing of cattle and no revenue is expected from the levy.

5) Cultivable Land, Fallow Land, and Waste Land

This is a land which the right to cultivate/utilize may be granted by the government to state-owned economic organizations etc. A maximum period of 30 years may be granted to cultivate/utilize the land.

6) Forest Land

“Forest land” is declared and administered in accordance with the “Forest Law”. Permission is required from the ministry in extracting timber, cutting fire-wood, producing charcoal, etc.

7) Town Land

In most cases it could be classified under either “freehold land” or “grant land”. However, the land belongs to a specific categorization because the town is the owner of the land.

8) Village Land

Village land also belongs to a specific categorization like “town land” because the village is the owner of the land.

9) Cantonments

“Cantonments” is a specific type of land acquired by the government for exclusive use by

the military. The land will be acquired under the “Land Acquisition Act” and exempted from land tax.

10) Monastery Land

The land which the Ministry of Home Affairs may declare as “monastery land” and it is obtained based on the “Land Acquisition Act”.

5.2.3 Land Acquisition Process

According to the Land Acquisition Act 1984, land acquisition process are summarized to following 5 steps and shown in Figure 5.2.3.1.

1) Preliminary investigation,

A notification is publicized in gazette and the substance of public notice is given at convenient places. Preliminary investigations are conducted, which include any surveys, digging/boring, delineation of the land boundaries.

2) Hearing of objections,

Objection to the land acquisition are collected in writing within 30 days. The Collector examines the objections and make consensus against the objections. If the Collector decides necessity, a report containing recommendations on the objections is submitted to the President of Union for the decision.

3) Declaration of intended acquisition,

The declaration of land acquisition is publicized in the Gazette, and stated at the district or other territorial division in which the land situates. The declaration includes the purposes, approximate area, location and plan.

4) Enquiry into measurements, value and claims, and award by the collector,

(4-1) The Collector marks out and measures the land, and give the public notice at convenient places near the land. The notice is also provided to persons known or believed to be interested in the land.

(4-2) Examination of Award (Area of Land and Compensation)

The Collector proceeds to inquire into objections to the measurement, the value of the land at the date of the publication of the notification, the respective eligibilities to claim the compensation and examines an award based on the area of the land, compensation including opinions of PAPs and the apportionment of compensation among PAPs.

The award is filed for conclusive evidence between the Collector and the persons interested in the land. The Collector immediately notices the awards to the persons who are not presented or their representatives when the award made.

The Collector makes any efforts to fix the enquiry.

(4-3) Grievance

If deliberation reaches agreement, Award Committee issues the decision concerning type and amount of compensation. If not reach agreement, the deliberation is continued until reach agreement. If the affected people and Award Committee cannot conclude with the

further deliberation meeting, GAD can intermediate between them.

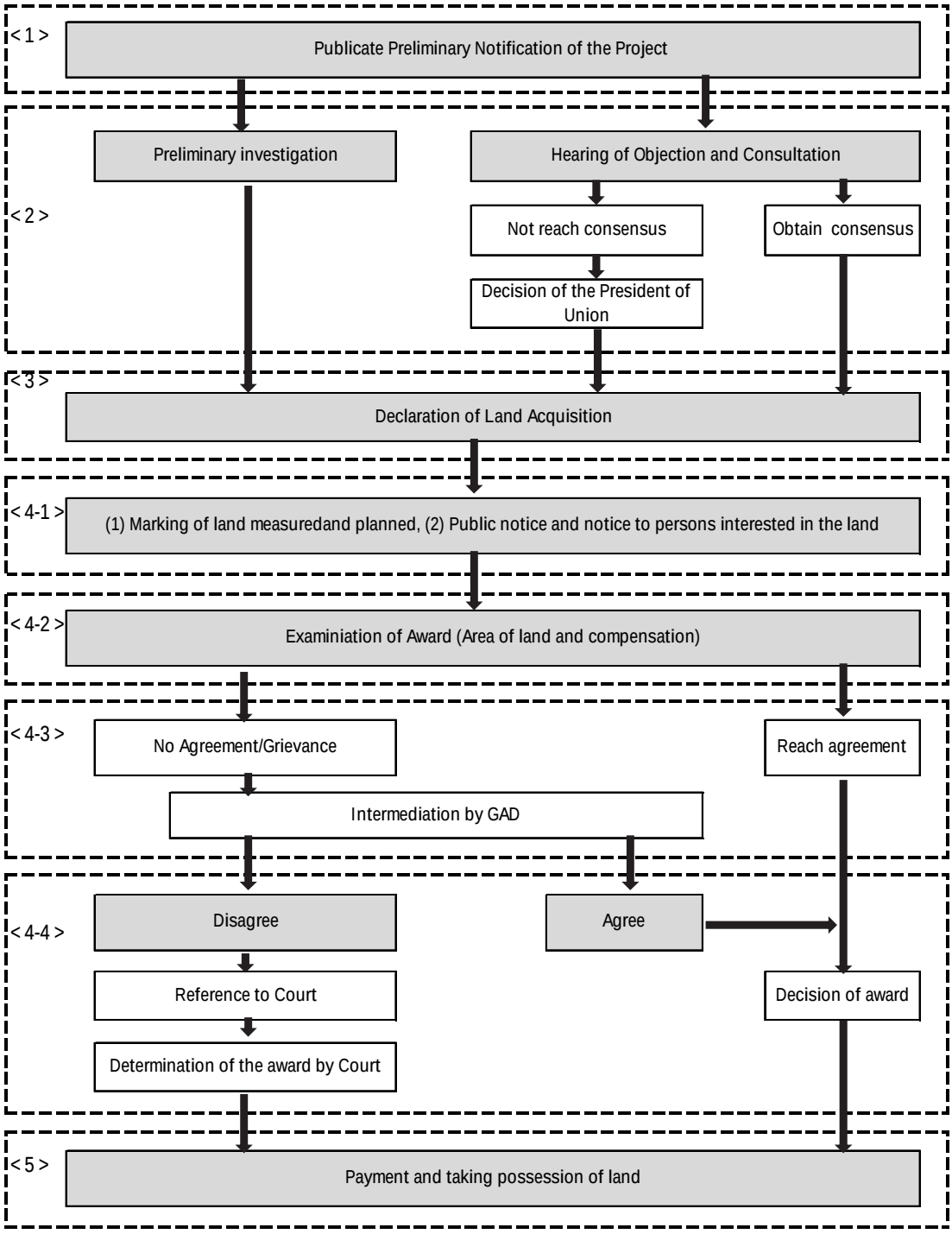
(4-4) Reference to Court

Any person interested in the land who do not accept the award can required that the matter be referred by the Collector for the determination of the Court with written application, whether the objection to the measurement of the land, the amount of the compensation, the person to whom it is payable, or the apportionment of the compensation among the persons interested.

If the persons agree the compensation, the particular are specified in the award for the conclusive evidence. If any disputes arise, the Collector may refer the disputes to the decisions of the Court.

5) Payment and Taking possession of land

The Collector pays compensation and takes possession of the land. The Collector gives the persons sufficient time to remove their property without inconvenience before taking possession.



Source: YUTRA Project Team (2013)

Figure 5.2.3.1 Procedures of Land Acquisition under Myanmar Legislation

5.2.4 Gaps of Involuntary Resettlement Policy between Myanmar Legislation and JICA Guidelines

Although Land Acquisition Act was promulgated in 1894, the Act may cover the fundamental policies of compensation for land acquisition in Myanmar.

Table 5.2.4.1 summarizes the results of comparison between the JICA Guidelines/the

World Bank's safeguard policies and Myanmar legislation on land acquisition and involuntary resettlement. There are found several gaps between them. For example, neither the avoidance and minimization of involuntary resettlement and loss of livelihood nor the requirement of preparation of Resettlement Action Plan is stated in any law. For the compensation only market value of the land is considered. No law is identified on the participation of project Affected Persons (PAPs) in public consultation in the land acquisition and resettlement procedures.

Table 5.2.4.1 Gaps of Involuntary Resettlement Policy between Myanmar Legislation and JICA Guidelines

No.	JICA Guidelines/World Bank	Laws of Myanmar	Gaps between JICA Guidelines/World Bank and Laws of Myanmar
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICAGL)	None	No law was identified
2	When population displacement is unavoidable , effective measures to minimize impact and to compensate for losses should be taken.(JICAGL)	Land Acquisition Act of 1894 (Article 3)	Article 3 of the Land Acquisition Act stipulates that a person who has right in land would be entitled to claim compensation if the land were acquired under this Act. However, it does not state effective measures to minimize impact.
		Farm Land Law of 2012 (Article 26)	Article 26 of the Farmland Law of2012 stipulates that suitable compensation and indemnity in farmland acquisition for the interest of the State or public would be taken.
		Farmland Rules of 2012 (Article 64)	Article 64 of the Farmland Rules of 2012 stipulates that the compensation in farmland for the interest of the State or public would be taken.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.(JICAGL)	Land Acquisition Act of 1894 (Article 23)	Land Article 23 of the Act stipulates that damages on standing crops and trees, land, properties, incidentals to relocate residence or business and losses of profits due to land acquisition are considered for compensation although it does not clearly state to support PAPs can improve or at least restore their standards of living.
4	Compensation must be based on the fu11 replacement cost.as much as possible. (JICAGL)	Land Acquisition Act of 1894 (Article 23)	Article 23 of the Act stipulates that "the market value of the land at the date of the publication of the notification" is considered, although it does not state "the full replacement cost."
5	Compensation and other kinds of assistance must be provided prior to displacement. (JICAGL)	Land Acquisition Act of 1894 (Article 23)	Article 23 of the Act stipulates that damages on standing crops and trees, on land, properties, incidentals to relocate residence or business and losses of profits due to land acquisition.

No.	JICA Guidelines/World Bank	Laws of Myanmar	Gaps between JICA Guidelines/World Bank and Laws of Myanmar
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICAGL)	None	No law specifica1ly mentions the requirement of resettlement action plans for large-scale involuntary resettlement.
7	In preparing a resett1ement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICAGL)	None	Almost same as the JICAGL
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICAGL)	None	Almost same as the JICAGL
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICAGL)	None	Almost same as the JICAGL
10	Appropriate and accessible grievance mechanism must be established for the affected people and their communities. (JICAGL)	Land Acquisition Act of 1894 (Article 5A, 18)	Article 5A of the Land Acquisition Act stipulates that any person whose land is affected (acquired) can object to the land acquisition within thirty days of the notification. Besides, Article 18 stipulates that any PAP who has not accepted the award can refer to the Court for determination.
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits (WBOP4.12 Para.6)	Land Acquisition Act of 1894 (Article 4)	Article 4 of the Act stipulates that a notification of land requirement for public purposes is published to start surveys and land marking although it does not state the details of surveys to establish eligibility through an initial baseline survey (including population census).
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal right to the land they occupying. (WB OP4.12 Para.11)	Land Acquisition Act of 1894 (Article 9)	Article 9 of the Act stipulates regarding occupier (if any) of land and all persons known or believed to have rights on lands are notified or invited for explanations although the eligibility is not clearly prescribed in the Act.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihood are land-based. (WB OP 4.12 Para.11)	None	No law was identified on preference to land-based resettlement strategies for displaced person.
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4.12 Para.6)	None	No law was identified on the provision of support for the transition period.

No.	JICA Guidelines/World Bank	Laws of Myanmar	Gaps between JICA Guidelines/World Bank and Laws of Myanmar
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities, etc. (WB OP4.12 Para.8)	None	No law was identified on particular attention to vulnerable groups.
16	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP 4.12 Para. 25)	None	No law was identified on the criteria of abbreviated resettlement plan.

Source: Land related laws of Myanmar and JICA Guidelines (2010.4) and World Bank OP 4.12.

5.2.5 Institutional Framework for Land Acquisition and Resettlement

Agencies responsible for land acquisition differ from those of management of land acquisition as shown in Table 5.2.5.1.

Table 5.2.5.1 Responsible Agencies for Land Acquisition

Land		City Development Committee (CDC)	MOAI	MOECAF (Forest Dept.)	GAD (Ministry of Home Affairs)
1	Yangon, Nay Pyi Taw and Mandalay Cities	X			X
2	Farmland, vacant, fallow and virgin land		X		X
3	Forest lands			X	
4	Other town and village lands				X

Source: YUTRA Project Team (2013)

Role and function of organizations for implementing land acquisition are shown in Table 5.2.5.2.

Table 5.2.5.2 Role and Function of Organization for Implementing Land Acquisition

Organization	Role and Function
Land Administration Department (LAD)	1) For non-agricultural land, LAD at township level investigates land use, area size, landownership and tenant, and prepares necessary documents and maps for land acquisition. 2) The LAD routinely handles transfer of land titles or subdivisions of plots, etc. and prepares land lease certificates.
Settlement and Land Record Department (SLRD)	1) For agricultural lands, the SLRD under the MOAI at township level investigates area size and land ownership, prepares necessary documents and maps for land acquisition. 2) The SLRD surveys market prices of lands, buildings, crops and trees for compensation.
Award Committee	The Award Committee chaired by the respective Township Administrators is established to examine the award (entitlement, amount of compensation).
District Administrator	The District Administrator issues land lease grant for land not exceeding one (1) acre (The Lower Burma Town and Village Lands Manual, 1899).
General Administration Department (GAD), Ministry of Home Affairs (MOHA)	The GAD issues land lease grant for land exceeding five (5) acres (The Lower Burma Town and Village Lands Manual, 1899)

Source: YUTRA Project Team (2013)

5.3 Legal and Regulatory Framework Related to Development, Planning and Management of Yangon City

5.3.1 The State Level - Constitution

The State Constitution of the Republic of the Union of Myanmar was ratified and promulgated by the National Referendum held in May 2011. In the Constitution some of the provisions related to the urban planning and land management are summarized as follows:

- The Union is the ultimate owner of all lands and natural resources in the area. (Section 37)
- Citizens are given the right for private property. (Section 37);
- The Union guarantees the right to ownership and the use of property. (Section 372);
- Every citizen has the duty to assist the Union in preserving and safeguarding the cultural heritage, conserving the environment, striving for the development of human resources, and protecting and preserving the public property. (Section 390).

5.3.2 City of Yangon Development Law

As for Yangon City area, the City of Yangon Development Law was enacted in 1990 and ordered the formation of the YCDC in order to carry out the development works of Yangon City. The Law stipulated that YCDC shall lay down the policy, give guidance, supervise or implement the following duties and responsibilities (Section 7):

- Preparation of civil projects and new towns;
- Administration of lands;
- Determining only of the population which should be allowed to settle properly;
- Construction, repair and demolition of buildings, squatter buildings, and squatter wards;
- Demolition and re-settlement of squatter huts, squatter buildings, and squatter wards;
- Construction of roads, bridges, and maintenance thereof;
- Stipulation of conditions for traffic, parking of vehicles, and slow moving vehicles;
- Construction of gardens, parks, playgrounds, and recreation centers, and maintenance thereof;
- Carrying out works for the lighting of roads;
- Carrying out works for water supply;
- Construction of reservoirs and pipelines, and maintenance thereof;
- Carrying out works for sanitation;
- Carrying out works for public health;
- Construction, maintenance, and administration of markets;

- Stipulation of conditions for road side stalls; and
- Carrying out precautionary measures against fires.

The Law also gives YCDC the following powers (Section 9):

- Demarcating and re-demarcating the territorial limit of Yangon City (the City of Yangon Municipality);
- The right to operate works independently with funds owned by YCDC;
- Prescribing, reviving, assessing, and collecting duties and taxes with their rates relating to development works, in accordance with the existing laws;
- The right to apply the foreign currency derived from the lease of building, lease of lands or by other means, for development works;
- The right to carry out works contributing to city development by making contracts with local and foreign organizations and with local and foreign individuals;
- The right to take loans and grants from the government or from foreign organizations, and being responsible for its payment;
- The right to carry out works by forming sub-committees work-wise;
- Arranging modern methods and systems in order to carry out the development works effectively;
- Exercising the powers conferred under the City of Yangon Municipal Act, rules, and bye-laws;
- Exercising the powers conferred from time to time by the chairman of the State Law and Order Restoration Council Law.

In addition, Section 10 of the Law stipulates that notwithstanding anything contained in the existing City of Yangon Municipal Act, State Housing and Town and Country Development Board Act, and other existing laws, powers relating to the formulation and implementation of civil projects, and establishment of new towns and administration of town lands within the limits of the Yangon City, shall vest in YCDC.

5.3.3 Laws Related to Urban Planning and Land Management

Since the adoption of the new constitution in 2008, relevant laws and regulations need to be enacted or modified, but this process is far from being quick in move. Consequently, some of the old British era laws and regulations are still in use for matters of urban planning, land management, and housing.

1) Land Acquisition Act (1894)

As mentioned in 5.2.1, this British era act is still effective at present due to the lack of new legislation relevant to land acquisition. The Act stipulates that a land could be acquired by the government if it was deemed to be in the interest of the public. Religious lands such as pagodas, stupas, shrines, and cemeteries were not subject for acquisition.

2) Rangoon Development Trust Act (1920)

In 1920, the Rangoon Development Trust Act was enacted under the British rule. This resulted in the establishment of Rangoon Development Trust in 1921, with powers that include the followings:

- Purchase/acquisition of immovable property;
- Project development planning and land management;
- Levy of revenue taxes and lease fees of land
- Purchase, lease, and transfer of land and management through other methods; and
- Establishment of laws, regulations, and instructions as necessary.

The Rangoon Development Trust, based on the Act, conducted long-term and short-term leases of land, and thus allowed use of land, and conducted issuance of land lease licenses, permits and abrogates for construction, industrialization, agriculture, and other special purposes.

3) State's Housing Rehabilitation and Town and Villages Development Board Act (1951)

In 1951, three years after the independence, the State's Housing Rehabilitation and Town and Villages Development Board Act was promulgated in order to solve the shelter problem occurring at the time as people were moving in to Rangoon from rural areas in large numbers.

The act stipulated that the provision of shelter would be performed through town and village development projects and public housing rehabilitation projects along with systematic management process.

- Any land (or building, if it exists on the land) could be acquired through the Land Acquisition Act (1894)
- This act enabled town and village development, supervision of public housing rehabilitation, management and improvement of land management, and others on the nationwide basis.

4) Urban Rent Control Act (1952, amended in 1960)

Shortly after the World War II, a large number of people migrated to the cities and the issue of housing became serious and acute. This Act regulated the rents in the urban areas to a low and affordable level. This Act is still in effect, keeping the housing rents in the urban areas to a considerably low level so that proper maintenance of rented properties has become economically unbearable for most property owners.

5) Farmland Law (2012)

The Law is to be accompanied by Farmlands Bylaws and Vacant, Fallow, and Virgin Lands Management Bylaws to be approved by the Union Government. The Farmland Law enables all farmers across the country to enjoy land use rights, in which the farmer can register.

6) Other Related Laws and Regulations

The legislative system inherited from the colonial period is highly comprehensive. The following laws and rules are listed according to specific concerns to the human settlement sector.

- Towns Act, 1870;
- Lower Burma Towns and Village Act, 1894;
- Municipal Act, 1898;
- Land Revenue Manual, 1907;
- Land Rules, 1922;
- City of Rangoon Municipal Act, 1924 ;
- Underground Water Rules, 1941;
- Requisitioning (Emergency Provisions), 1947;
- Land Nationalization Act, 1953;
- Town Planning Act (Draft Proposal), 1961;
- City of Yangon Development Law (SLORC Law No. 11/90), 1990;

7) Bylaws of YCDC

As a result of SUDP, 24 bylaws, which have been enacted between 1995 and 2001, are even effective in YCDC. The contents of the bylaws cover all spheres of the city's administration front, varying from management, urban planning to infrastructure, and commercial registration.

5.4 Inventory Survey on Yangon Circular Railway

5.4.1 Purpose and Methodology

1) Purpose of the survey

In general, occurrence and extent of land acquisition and resettlement will be depending upon the scope and scale of development plan of Yangon Circular Railway (YCR). As far as the project plans are limited to those such as renewal of railway track and railway station yard within ROW of MR, land acquisition is not expected.

However, at present many portion of ROW of Yangon Circular Railway owned by Myanmar Railways, are occupied by structures such as houses, building and huts and farmland and vendors and the legality of their occupation is not clear.

Therefore, there are some possibilities to occur involuntary resettlement and generation of Project Affected Persons (PAPs) is expected to removal and/or relocation of structures and disturbance of business activities for securing space and/or structures occupied on ROW due to the project.

In addition, along ROW of the Railway there are found public facilities such as schools and hospitals, and religious facilities such as monasteries, mosques. In general, these facilities

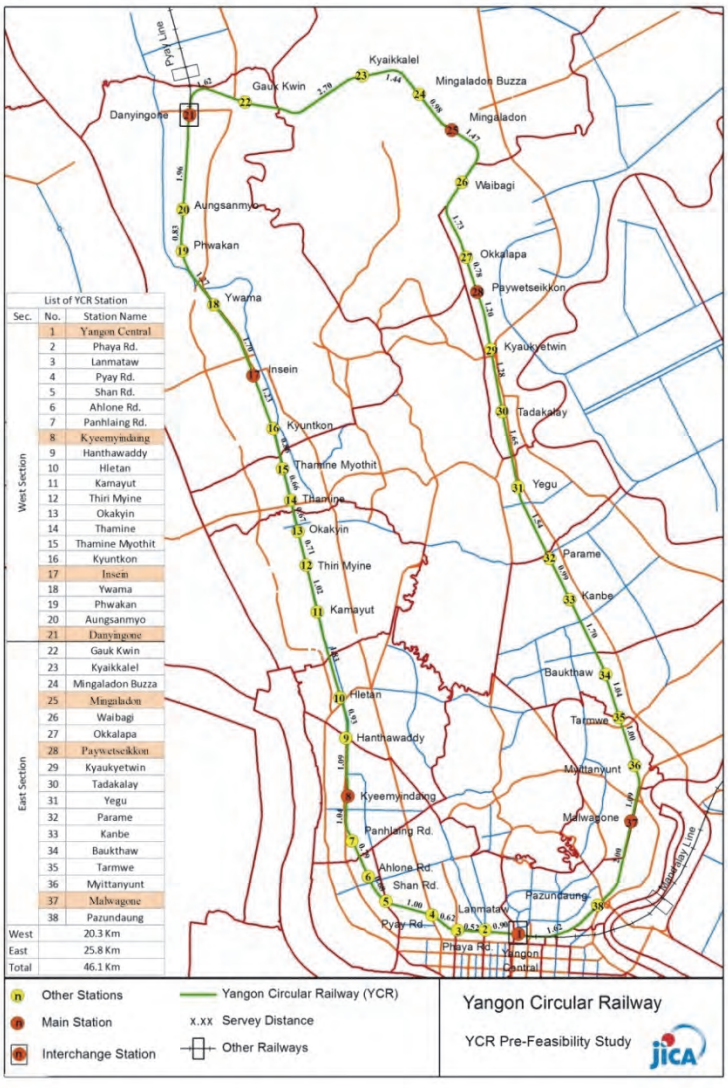
are susceptible to environmental impacts and required to be kept quiet. Thus, they are called as “sensitive receptors”.

It is expected that construction work and operation of proposed Yangon Circular Railway Modernization Projects may cause adverse impacts to the sensitive receptors.

Purpose of the survey is to confirm roughly existing land use and structures within and along ROW of Yangon Circular Railway, in order to secure land and space for renewal and construction of Yangon Circular Railway.

2) Survey Area

Survey area is within and along ROW of existing Yangon Circular Railway as shown in Figure 5.4.1.1.



Source: YUTRA Study Team (2013)

Figure 5.4.1.1 Location of Yangon Circular Railway Stations and Sections in the Survey Area

3) Method of the Survey and Data Compilation

The survey was conducted by following methods:

- Physical observation from running train of Circular Railway.
- On-site survey including interview and hearing on land use and structures in and around railway stations and sections.

Results of observation and collected information were filled in respective column in the data sheet as shown in Table 5.4.1.1 for each corresponding railway station or section.

Table 5.4.1.1 Inventory Survey Data Sheet

YCR- Inventory Survey Sheet ( )	
1) Railway Station/Section	
2) Coordinates (Entrance of RWS):	
3) Date & Time of survey:	
4) Within ROW (width of ROW: about m)	
Track	
Left part	a) Buildings b) Structures c)Trees d) Shop, vendor etc. Encroachment (illegal occupants with houses, shops etc.)
Right part	a) Buildings b) Structures c)Trees d) Shop, vendor etc. Encroachment (illegal occupants with houses, shops etc.)
5) Left side of ROW (TS & Ward)	
Land use	a) Farmland b) Residential c) Industrial d) Commercial e)road f) Others
Road and traffic condition	a) Road b) ROB c) FOB d) Traffic conditions
Building/Structure/Tree	a) Buildings b) Structures c) Trees d) Others
Sensitive receptor (No)	a)School b) Hospital c) Monastery d) Temple e) Mosq e) Others
6) Right side of ROW (TS & Ward)	
Land use	a) Farmland b) Residential c) Industrial d) Commercial e)road f) Others
Road and traffic condition	a) Road b) ROB c) FOB d) Traffic conditions
Building/Structure/Tree	a) Buildings b) Structures c) Trees d) Others
Sensitive receptor (No)	a)School b) Hospital c) Monastery d) Temple e) Mosq e) Others
7) Environmental conditions	
8) Remarks	
(1) Map of Railway station/section (The Map of Yangon- Sreet Directory, 4th edition 2009-2010) (2) Plan of ROW, (3) Photos	
Note: YCL - clockwise direction	

Source: YUTRA Project Team (2013)

5.4.2 Results of the Survey

1) Data sheets of Inventory Survey

Data sheets for 76 stations and sections are shown in **Appendix 5**.

2) Inventory Survey Data within ROW and along ROW

Compiled data of inventory survey within ROW and along ROW are shown in Table 5.4.2.1 and Table 5.4.2.2 respectively.

Table 5.4.2.1 YCR-Inventory Survey Data -1 Inventory Survey within ROW

S.N.	Railway Station (Section)	Length (km)	Township / ward	Encroachment on ROW (Left side)**						Encroachment on ROW (Right side)**					
				Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***	Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***
1	Yangon Central Station	0	Minglar Taung Nyunt / Thein Byu Miyayahta	X	-	-	-	-		XXX	XXX	XXX	-	-	T
1-2	Yangon Central St. - Phaya Rd.St.	0.57	(Dagon / Yawmin Gyee) (Pabedan / No 5)	-	-	-	-	-	T	-	-	-	-	-	T, drainage
2	Phaya Rd. Station	0.57	(Dagon / Yawmin Gyee) (Pabedan / No 5)	-	-	X	-	-		-	-	-	-	-	T
2-3	Phaya Rd. - Lanmataw	0.61	(Dagon / U Wizarya) (Latha / No 10)	X	-	-	-	-	T	X	-	-	-	-	T
3	Lanmataw Station	1.18	(Dagon / U Wizarya) (Latha / No 10)	-	-	-	-	-	T	-	-	-	-	-	T
3-4	Lanmataw St. - Pyay Rd. St.	0.71	(Dagon / U Wizarya) (Latha / No 12)	-	-	-	-	-	T	-	-	-	-	-	T
4	Pyay Rd. Station	1.89	(Dagon / Pyay Road (East)) (Lanmadaw / No 12)	-	-	-	-	-	T	X	-	X	-	-	T
4-5	Pyay Rd. St.- Shan Rd. St.	0.95	(Dagon / Pyay Road (West)) (Lanmadaw / No 9)	X	-	-	-	-	T	-	-	-	-	-	T
5	Shan Rd. Station	2.84	Dagon / Pyay Road (West) (Lanmadaw / No 8)	X	-	X	-	-	T	X	-	-	-	-	
5-6	Shan Rd St.- Ahlone Rd. St.	0.73	Ahlone / Kayinchan	-	-	-	-	-	T	-	-	-	-	-	T
6	Ahlone Rd. Station	3.57	Ahlone / Kayinchan	X	-	X	-	-		-	-	-	-	-	T
6-7	Ahlone Rd. St.- Panhlaing Rd. St.	0.72	Ahlone / Kayinchan	-	-	X	-	-	T	-	-	-	-	-	T
7	Panhlaing Rd. Station	4.29	(Sanchaung / Pun Hlaing) (Kyee Myin Daing / Kayin Amyotha)	X	-	X	-	-	T	X	-	-	-	-	T
7-8	Panhlaing Rd. St.- Kyeemyindaing St.	0.99	(Sanchaung / Pun Hlaing,Thiri Khaymar,Lin lun south) (Kyee Myin Daing / Kayin Amyotha,Bawga, Ohbo)	X	-	-	-	-	T	X	-	-	-	-	T
8	Kyeemyindaing Station	5.28	(Sanchaung / Linlun (South)) (Kyee Myin Daing / Ohbo)	X	-	X	-	-	T	-	-	-	-	-	T

S.N.	Railway Station (Section)	Length (km)	Township / ward	Encroachment on ROW (Left side)**						Encroachment on ROW (Right side)**					
				Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***	Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***
8-9	Kyeemyindaing St.- Hanthawaddy St.	1.2	(Sanchaung / Linlun (South),Thantadar, Wailuwun south,WailuwunNorth) (Kyee Myin Daing / Ohbo)	-	-	-	-	-	T	-	-	-	-	-	T
9	Hanthawaddy Station	6.48	(Sanchaung / Wailuwun (North)) (Kyee Myin Daing / Thayet Taw (North))	-	-	-	-	-	T	-	-	-	-	-	T
9-10	Hanthawaddy St.- Hletan St.	0.97	Kamayut / (No.6 / No.7& No.8)	-	-	-	-	-	T	-	-	-	-	-	T
10	Hletan Station	7.45	Kamayut / (No.3 / No.4)	X	-	-	-	-	T	X	-	X	-	-	
10-11	Hletan St. - Kamayut St.	1.59	Kamayut / (No.3 / No.4)	X	X	-	-	-	T	-	-	-	-	XXX	T
11	Kamayut Station	9.04	Hlaing / (No.5 /No.7)	-	-	X	-	-	T	-	X	-	-	-	T
11-12	Kamayut St. - Thiri Myine St.	0.96	Hllllaing No5 No14 &Hlaing No7,No13	-	X	-	-	-	T	-	-	-	-	-	T
12	Thiri Myine Station	10	Hlaing / (No14 / No 13)	-	X	-	-	-	T	-	-	-	-	-	
12-13	Thiri Myine St. - Okakyin St.	0.72	Hlaing / (No14,No15 / No 13, No16)	-	-	-	-	-	T	-	-	-	-	-	
13	Okakyin Station	10.72	Hlaing / (No15/ No16)	X	X	X	-	-	T	-	-	-	-	-	T
13-14	Okakyin St. - Thamine St.	0.73	Mayangone / (No1/No2)	-	X	-	-	-	T	-	-	-	-	-	T
14	Thamine Station	11.45	Mayangone / (No1/No2)	X	X	X	-	-	T	-	X	X	-	-	
14-15	Thamine St. - Thamine Myothit St.	0.85	Mayangone / (No1/ No2)	-	-	-	-	-	T	-	-	-	-	-	T
15	Thamine Myothit Station	12.3	Mayangone / (No8/ No2)	-	-	-	-	-	T	-	-	-	-	-	
15-16	Thamine Myothit - Kyuntkon	0.87	Mayangone / (No1/ No2)	-	-	-	-	-	T	-	-	-	-	-	
16	Kyuntkon Station	13.17	Insein / Gyogon Ward (West)	X	X	X	-	-	T	-	-	-	-	-	T
16-17	Kyuntkon - Insein	1.21	Insein / Gyogon Ward (West)	X	XXX	-	-	X	T	X	-	-	-	X	T
17	Insein Station	14.38	Insein / Gyogon Ward (West)	X	-	X	-	-	T	X		-	-	-	T

S.N.	Railway Station (Section)	Length (km)	Township / ward	Encroachment on ROW (Left side)**						Encroachment on ROW (Right side)**					
				Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***	Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***
											-				
17-18	Insein St. - Ywama St.	1.59	Insein / (Ywama(Middle)/ Ywama(East))	-	-	-	-	-	T	-	X	-	-	-	T
18	Ywama Station	15.97	Insein / (Ywama(Middle)/ Ywama(East))	-	-	-	-	-	T	-	-	-	-	-	T
18-19	Ywama St. - Phwakan St.	1.38	Insein / (Ywama(Middle) Phawkan / Ywama(East))	-	-	-	-	X	T	-	-	-	-	X	T
19	Phwakan Station	17.35	Insein / Phaw Kan	-	-	-	-	-	T	-	-	-	-	-	T
19-20	Phwakan St. - Aungsanmyo St.	0.97	Insein / (Sint Gu)	-	-	-	-	X	T	-	-	-	-	X	T
20	Aungsanmyo Station	18.32	Insein / (Sint Gu/ Aung San)	-	X	X	-	-	T	X	X	X	-	X	T
20-21	Aungsanmyo St. - Danyingone St.	1.9	Insein / Danyin Gone	-	X	-	-	X	T	X	X	-	-	X	T
21	Danyingone Station	20.22	Insein / Danyin Gone	X	X	XXX	-	-		X	X	XXX	-	-	
21-22	Danyingone St. - Gauk Kwin St.	1.63	Insein / Danyin Gone	X	X	-	-	X	T	X	X	-	X	X	T
22	Gauk Kwin Station	21.85	Insein / Danyin Gone	X	-	X	-	-	T	X	X	X	-	-	T
22-23	Gauk Kwin St. - Kyaikkalel St.	2.72	Insein / Danyin Gone & Mingaladon	-	-	-	-	-	T	-	-	-	-	-	T
23	Kyaikkalel Station	24.57	Mingalardon / Mingalardonzay	-	-	-	-	-	T	X	-	X	-	-	T
23-24	Kyaikkalel St. - Mingaladon Buzza St.	1.44	Mingaladon (Paukgon/ Sanpya)	-	-	X	-	-	T	-	-	-	-	-	T
24	Mingaladon Buzza Station	26.01	Mingladon / Sangyiwa	-	-	-	-	-	T	X	-	-	-	X	T
24-25	Mingaladon Buzza St. - Mingaladon St.	0.98	Mingladon / Sangyiwa	-	-	-	-	-	T	X	-	-	-	-	T
25	Mingaladon Station	26.99	Mingaladaon / Chit Ti gone, Ka Yae Pin Yeik Mon	-	-	X	-	-	T	X	-	-	-	-	T
25-26	Mingaladon St. - Waibagi St.	1.52	Mingaladon (Ananpin, Chit Ti Gon)	-	-	-	-	X	T	-	-	-	-	X	T

S.N.	Railway Station (Section)	Length (km)	Township / ward	Encroachment on ROW (Left side)**						Encroachment on ROW (Right side)**					
				Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***	Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***
26	Waibagi Station	28.51	(North Okkalapa / Wai Bar Gi) (Mingalardon/ Kyanginzu)	X	-	-	-	-	T	-	-	-	-	-	T
26-27	Waibagi St. - Okkalapa St.	1.73	(North Okkalapa / Wai Bar Gi) (Mingalardon/ Ananpin)	X	X	-	-	-	T	X	-	-	-	X	T
27	Okkalapa Station	30.24	North Okkalapa / (Pa Ywet Seit Gone/ Ka Khway)	X	X	X	-	-	T	X	X	-	-	-	T
27-28	Okkalapa St. - Paywetseikkon St.	0.79	North Okkalapa / (Pa Ywet Seit Gone/ Tadar Gyee)	-	X	-	-	-	T	X	XXX	-	-	-	
28	Paywetseikkon Station	31.03	North Okkalapa / (Gangal/ Tadar Gyee)	-	X	X	-	X		-	X	X	-	-	T
28-29	Paywetseikkon St. - Kyaukyetwin St.	1.21	North Okkalapa / Kyauk Yae Twin,Tadar Gyee	-	X	X	-	X	T	-	X	-	-	-	T
29	Kyaukyetwin Station	32.24	North Okkalapa / Kyauk Yae Twin	-	X	X	-	X	T	-	X	X	-	-	T
29-30	Kyaukyetwin St. - Tadakalay St.	1.3	North Okkalapa / Kyauk Yae Twin	-	X	X	-	-	T	-	X	X	-	-	T
30	Tadakalay Station	33.54	North Okkalapa / No 1 & No 2	-	X	X	-	X	T	X	X	X	-	-	T
30-31	Tadakalay St. - Yegu St.	1.65	North Okkalapa / No 1	X	X	X	-	X	T	-	X	X	-	X	T
31	Yegu Station	35.19	Mayangone / No 8	X	X	X	-	-	T	X	-	X	-	-	T
31-32	Yegu St. - Parame St.	1.54	Mayangone / No 8 & No 9	-	X	X	-	-	T	-	-	-	-	X	T
32	Parame Station	36.73	(Yankin / No 8) (South Okkalapa / No3)	X	X	X	-	X	T	X	X	X	-	-	T
32-33	Parame St.- Kanbe St.	0.99	(Yankin / No8,No 9) (South Okkalapa / No3)	-	-	-	-	-	T	-	-	-	-	-	T
33	Kanbe Station	37.72	(Yankin / No 9) (South Okkalapa / No3)	X	X	X	-	-		X	X	X	-	-	
33-34	Kanbe St.- Baukthaw St.	1.72	(Yankin / No12, No13) (Thingangyun / Mi Gyaung Kan-3) South Okkalapa(No3,No 8)	-	-	X	-	-	T	-	-	X	-	-	T
34	Baukthaw Station	39.44	(Yankin / No16) (Thingangyun / Mi Gyaung Kan-3)	-	-	-	-	-	T	X	-	-	-	-	T
34-35	Baukthaw St. - Tarmwe St.	1.05	Tarmwe / Tarmwe Lay, Yankin/ No16, Thingangyun/MiGyaung Kan 1&2)	X	X	X	-	X	T	X	-	-	-	-	T

S.N.	Railway Station (Section)	Length (km)	Township / ward	Encroachment on ROW (Left side)**						Encroachment on ROW (Right side)**					
				Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***	Buildings	Huts (illegal)	Shops and vendors	Farming	Water vegetables (pond)	Trees***
35	Tarmwe Station	40.49	Tarmwe / Tarmwe Lay	X	-	-	-	-	T	X	-	X	-	-	T
35-36	Tarmwe St. - Myittanyunt St.	1	Tarmwe / Tarmwe Lay, Myittar Nyunt	-	-	-	-	-	T	-	X	X	-	-	T
36	Myittanyunt Station	41.49	Tarmwe / Myittar Nyunt	X	-	X	-	X	T	-	-	-	-	-	T
36-37	Myittanyunt St. - Malwagone St.	1.09	(Tarmwe / Myittar Nyunt, Nat Chaung,MahlawgonHtay Kyew Ka) (Mingalar Taung Nyunt/ Pathein Nyunt)	-	-	-	-	-		X	-	-	-	-	T
37	Malwagone Station	42.58	(Tarmwe / Pathein Nyunt) (Mingalar Taung Nyunt / Ma Hlwa Gone)	X	-	-	-	-	T	X	X	X	-	-	T
37-38	Malwagone St. - Pazundaung St.	2.02	Mingalar Taung Nyunt (Ma Hlwa Gone, Satsan, Kyi Taw,Tharyargone) Tarmwe (Kyauk Myaung Gyi East, Kyauk Myaung Ryi, Bolein Aung Minglar)	X	-	-	-	-	T	-	-	-	-	-	T
38	Pazundaung Station	44.6	Mingalar Taung Nyunt (Kyi Taw / Taung Lone Pyan)	X	X	X	-	-	T	-	-	-	-	-	
38-1	Pazundaung St. - Yangon Central St.	1.82	Mingalar Taung Nyunt (Kyi Taw, Thein Phyu Miyahtar, Taung Nyunt Miyahtar, Indepadance) & Pazuntaung/ No8	X	-	-	-	-		X	-	-	-	-	T
1	Yangon Central Station	46.42	Minglar Taung Nyunt / Thein Byu Miyayahta												

Note 1: * Based on Clockwise direction
Note 2: ** Number of observed structures; XXX (many - more than 10), XX (several - 5-10), X (a few - 1-4), (-) - nothing
Note 3 *** T – trees

Source: YUTRA Project Team (2013)

Table 5.4.2.2 YCR-Inventory Survey Data-2 along ROW

S.N.	Railway Station (Section)	Length (km)	Left side of ROW				Right side of ROW				Enviromental condition+	Remarks
			Land use*	Road**	Buildings/ Structures***	Sensitive receptors****	Land use*	Road**	Buildings/ Structures***	Sensitive receptors****		
1	Yangon Central Station	0	Com	Byogyoke Aung San Rd.	Build	-	Com	Kun Chan St.	Build	-		
1-2	Yangon Central St. - Phaya Rd.St.	0.57	Com	Byogyoke Aung San Rd.	Build	Church	Com	Yaw Min Gyi St.	Build	-	Noise Pollution	Construction site
2	Phaya Rd. Station	0.57	Com	Byogyoke Aung San Rd.	Build	School /Church	Com	Yaw Min Gyi St.	Build	-	Noise Pollution	
2-3	Phaya Rd. - Lanmataw	0.61	Gov	Byogyoke Aung San Rd.	Build	School / Hospital	Res	-	Build	-		
3	Lanmataw Station	1.18	Gov	Byogyoke Aung San Rd.	Build	University	Res	-	Build	-		
3-4	Lanmataw St. - Pyay Rd. St.	0.71	Gov	Min Ye Kyaw Swar Rd.	Build	University / Hospital	Res	-	Build	-		
4	Pyay Rd. Station	1.89	Res	-	Build	-	Com	anonymous St.	Build	School		
4-5	Pyay Rd. St.- Shan Rd. St.	0.95	Gov	-	Build	School / Hospital	Com	-	Build	School / Hospital/ Monastery		
5	Shan Rd. Station	2.84	Res	Min Ye Kyaw Swar Rd.	Build	-	Res	-	Build	Hospital		
5-6	Shan Rd St.- Ahlone Rd. St.	0.73	Res	Min Ye Kyaw Swar Rd.	Build	School	Res	-	Build	School		
6	Ahlone Rd. Station	3.57	Res	-	Build/ Struc	School	Res	Ahlone Butar St.	Build	-		Ethnic minority area(Pwo Kayin)
6-7	Ahlone Rd. St.- Panhlaing Rd. St.	0.72	Res	Lower Kyee Myin Dain Rd.	Build	School /Church	Res	Baho Rd.	Build	School / Hospital/ Monastery		Ethnic minority area(Pwo Kayin)
7	Panhlaing Rd. Station	4.29	Res	Lower Kyee Myin Dain Rd.	Build	-	Res	-	Build	-		
7-8	Panhlaing Rd. St.- Kyeemyindaing St.	0.99	Com	Lower Kyee Myin Dain Rd.	Build/ Struc	-	Res	-	Build	Monastery		
8	Kyeemyindaing Station	5.28	Com	Upper Kyee Myin Dain Rd.	Build	-	Res	Butar St.	Build	Monastery		

S.N.	Railway Station (Section)	Length (km)	Left side of ROW				Right side of ROW				Enviromental condition+	Remarks
			Land use*	Road**	Buildings/ Structures***	Sensitive receptors****	Land use*	Road**	Buildings/ Structures***	Sensitive receptors****		
8-9	Kyeemyindaing St.- Hanthawaddy St.	1.2	Com	Upper Kyee Myin Dain Rd.	Build	School	Res	Baho Rd.	Build	-		
9	Hanthawaddy Station	6.48	Res	Upper Kyee Myin Dain Rd.	Build	-	Religious	Baho Rd.	Build	Hindu Temple		
9-10	Hanthawaddy St.- Hletan St.	0.97	Res	Hantharwaddy Rd.	Build	Monastery	Res	Baho Rd.	Build	Monastery		
10	Hletan Station	7.45	Res	Private St.	Build	-	Res	Padamya	Build	-		
10-11	Hletan St. - Kamayut St.	1.59	Com/ Res	Bayint Naung Rd.	Build	School / monk statue	Com	Baho Rd.	Build	Monastery, pagoda		water vegetable
11	Kamayut Station	9.04	Res	Myayadanar St.	Build	-	Com	Baho Rd.	Build	-		
11-12	Kamayut St. - Thiri Myine St.	0.96	Res	Myayadanar St.	Build	School / Monastery/ Budda statue	Com	Baho Rd.	Build	Monastery	water pollution	under bridge
12	Thiri Myine Station	10	Res	Apyin Wingabar St.	Build	-	Com	Baho Rd.	Build	Monastery, pagoda		
12-13	Thiri Myine St. - Okakyin St.	0.72	Res	Apyin Wingabar St.	Build	Monastery	Ind/ Res	Baho Rd.	Build	-		
13	Okakyin Station	10.72	Res	anonymous st.	Build	-	Rel	Baho Rd.	Build	-		
13-14	Okakyin St. - Thamine St.	0.73	Com/ Res	-	Build	Mosque	Com	Baho Rd.	Build	School		
14	Thamine Station	11.45	Com/ Res	-	Build/ Struc	-	Com	Baho Rd.	Build	School / Monastery		illegal Occupants
14-15	Thamine St. - Thamine Myothit St.	0.85	Res	anonymous st.	Build/ Struc	-	Com	Baho Rd.	Build	Monastery		illegal Occupants
15	Thamine Myothit Station	12.3	Res	-	Build	-	Com	Baho Rd.	Build	-		
15-16	Thamine Myothit - Kyuntkon	0.87	Res	No 1 st.	Build	School	Res	Baho Rd.	Build	Monastery		
16	Kyuntkon Station	13.17	Ind	-	Build	-	Play ground	Baho Rd.	Space	-		
16-17	Kyuntkon - Insein	1.21	Ind/ Gov	-	Build	-	Ind/ Gov	Baho Rd.	Build	-	Noise Pollution	illegal Occupants
17	Insein Station	14.38	Ind/ Gov	Thiri St.	Build/ Struc	-	Play	Lower Mingaladon Rd.	Space	-	Noise Pollution	illegal Occupants
17-18	Insein St. - Ywama St.	1.59	Gov	-	Build/	Templ	Res	Lower	Build/	School /	water	gas pipe line

S.N.	Railway Station (Section)	Length (km)	Left side of ROW				Right side of ROW				Enviromental condition+	Remarks
			Land use*	Road**	Buildings/ Structures***	Sensitive receptors****	Land use*	Road**	Buildings/ Structures***	Sensitive receptors****		
					Struc	e, pagoda		Mingaladon Rd.	Struc	Hospital	pollution	
18	Ywama Station	15.97	Res	-	Build/ Struc	-	Res	Lower Mingaladon Rd.	Build	-	Noise Pollution	
18-19	Ywama St. - Phwakan St.	1.38	Ind	Bayint Naung Rd.	Build/ Struc	-	Res	Danyin Kone Rd.	Build/ Struc	-	water pollution	
19	Phwakan Station	17.35	Ind	-	Build	-	Res	-	Build/ Struc	-	Noise Pollution	
19-20	Phwakan St. - Aungsanmyo St.	0.97	Res	-	Build/ Struc	School	Res	-	Build/ Struc	-	water pollution	
20	Aungsanmyo Station	18.32	Res/ Ind	-	Build	-	Res	-	Build/ Struc	-		illegal Occupants
20-21	Aungsanmyo St. - Danyingone St.	1.9	Res	-	Build	-	Res	Ywar lae St.	Bulid	Monastery/ pagoda	water pollution	
21	Danyingone Station	20.22	Com	-	Structure	-	Com/ Res	-	Build/ Struc	Monastery		illegal Occupants
21-22	Danyingone St. - Gauk Kwin St.	1.63	Farm/ Ind	-	Build/ Struc	-	Farm	-	Struc	-		illegal Occupants/gas pipe line
22	Gauk Kwin Station	21.85	Res	-	Build/ Struc	-	Res/ Ind	-	Build/ Struc	-		slum area
22-23	Gauk Kwin St. - Kyaikkalel St.	2.72	Army	-	bushes	-	Army	-	Bushes	-		gas pipe line
23	Kyaikkalel Station	24.57	Army	-	Build	-	Army	-	Build	Hospital/ pagoda		
23-24	Kyaikkalel St. - Mingaladon Buzza St.	1.44	Army /Res	Ywar lel St.	Build/ Struc	Monastery/ pagoda	Army/ Res	-	Build/ Struc	Monastery		illegal occupants/ water pipe line
24	Mingaladon Buzza Station	26.01	Farm	-	farm	-	Res	-	Build/ Struc	Monastery	Noise Pollution	illegal occupants
24-25	Mingaladon Buzza St. - Mingaladon St.	0.98	Farm	-	farm	-	Farm/ Res	-	Build	Monastery	Noise Pollution	
25	Mingaladon Station	26.99	Res	-	Build	-	Res	Kha Yae Pin Yeik Mon St.	Build	-	Noise Pollution	
25-26	Mingaladon St. - Waibagi St.	1.52	Farm/ Res/ Com	-	Build	-	Farm/ Res/ Airport	Kha Yae Pin Yeik Mon St.	Build	-	Noise Pollution	
26	Waibagi Station	28.51	Res	Waigagi Myo Pat Rd.	Build	-	Airport	Kha Yae	Space	-	Noise	

S.N.	Railway Station (Section)	Length (km)	Left side of ROW				Right side of ROW				Enviromental condition+	Remarks
			Land use*	Road**	Buildings/ Structures***	Sensitive receptors****	Land use*	Road**	Buildings/ Structures***	Sensitive receptors****		
								Pin Yeik Mon St.			Pollution	
26-27	Waibagi St. - Okkalapa St.	1.73	Res	Waigagi Myo Pat Rd.	Build	-	Airport	Kha Yae Pin Yeik Mon St./ Bayint Naung St.	Build	School/ Monastery	Noise Pollution	illegal occupants
27	Okkalapa Station	30.24	Res	Myo Pat Rd.	Build/ Struc	-	Res	Bayint Naung St.	Build	Monastery		illegal occupants
27-28	Okkalapa St. - Paywetseikkon St.	0.79	Res	Myo Pat Rd.	Build	Monastery	Res	Bayint Naung St.	Build	School/ Monastery		illegal occupants (about 300HH)
28	Paywetseikkon Station	31.03	Res	Myo Pat Rd.	Build/ Struc	-	Res	Bayint Naung St.	Struc	-		illegal occupants
28-29	Paywetseikkon St. - Kyaukyetwin St.	1.21	Com	Myo Pat Rd.	Build	Monastery/ pagoda	Res	Bayint Naung St.	Build	Monastery		
29	Kyaukyetwin Station	32.24	Com	Thu Dhamar Rd.	Build	-	Res	anonymous St.	Build	Monastery		
29-30	Kyaukyetwin St. - Tadakalay St.	1.3	Gov	Thu Dhamar Rd.	Build	Monastery	Com/ Res	Thu Meik Tar St.	Build	Monastery		illegal occupants
30	Tadakalay Station	33.54	Com	Thu Dhamar Rd.	Build	-	Com/ Res	Thu Meik Tar St.	Struc	-		illegal occupants
30-31	Tadakalay St. - Yegu St.	1.65	Com/ Res	Thu Dhamar Rd.	Build	Hospital	Com/ Res	Thu Meik Tar St.	Build	School/ Monastery		illegal occupants
31	Yegu Station	35.19	Space	Thu Dhamar Rd.	Space	-	Res	Mya Sabei St.	Build/ Struc	-		
31-32	Yegu St. - Parame St.	1.54	Farm/ Res/ Com	Waizayandar Rd.	Build/ Struc/ Vegetable farms	-	Res	Mya Sabei St.	Build	-	water pollution	illegal occupants
32	Parame Station	36.73	Res	Zizawar St.	Build/ Struc	-	Res	-	Build	-	water pollution	illegal occupants
32-33	Parame St.- Kanbe St.	0.99	Res	Shukhinthar St.	Build	Monastery	Res	Padauk Myaing St.	Build	-		
33	Kanbe Station	37.72	Res	anonymous St.	Build	-	Com/ Res	Padauk Myaing St./Shae Tho St.	Build	Monastery		
33-34	Kanbe St.- Baukthaw	1.72	Resl/ Ind	South Okkalapa No6	Build	Monas	Res	Aung	Build	-		

S.N.	Railway Station (Section)	Length (km)	Left side of ROW				Right side of ROW				Enviromental condition+	Remarks
			Land use*	Road**	Buildings/ Structures***	Sensitive receptors****	Land use*	Road**	Buildings/ Structures***	Sensitive receptors****		
	St.			Industrial Rd.		tery		Chanthar St.				
34	Baukthaw Station	39.44	Res	Mya Lan St.	Build	-	Com/ Res	-	Build	school		
34-35	Baukthaw St. - Tarmwe St.	1.05	Farm/ Res	-	Build	Monastery/ Mosque	Res	anonymous St.	Build	Monastery		illegal occupants
35	Tarmwe Station	40.49	Res	-	Build	-	Res	-	Build	-		
35-36	Tarmwe St. - Myittanyunt St.	1	Res	Set Hmu St. No1	Build	School	Res	Dagon Lwin St.	Build	School/ Monastery		
36	Myittanyunt Station	41.49	Res	Set Hmu St. No1	Build/ Struc	-	Res	Dagon Lwin St.	Build	Monastery		
36-37	Myittanyunt St. - Malwagone St.	1.09	Res	Set Hmu St. No1/ Thanthumar Rd.	Build/ Struc	-	Res	Dagon Lwin St./ Myopat st.	Build	-	water pollution	
37	Malwagone Station	42.58	Res	Pathein nyunt St.	Build/ Struc	-	Res	Myopat St.	Build	-	water pollution	
37-38	Malwagone St. - Pazundaung St.	2.02	Com/ Res	Upper Pazundaung Rd.	Build/ Struc	Hindu Temple	Res	-	Build	-		
38	Pazundaung Station	44.6	Com/ Res	Upper Pazundaung Rd.	Build/ Struc	Monastery	Res	-	Build/ Struct	Monastery		
38-1	Pazundaung St. - Yangon Central St.	1.82	Com/ Res	Mahar Thukha St.	Build	Monastery	Com/ Res	Bo Min Yaung Rd, 99 St.	Build/ Struct	Monastery	water pollution	Ethnic Minority area (Bingali)
1	Yangon Central Station	46.42										

Note 1: Based on Clockwise direction
Note 2: * Com – Commercial, Gov – Government, Res – Residential, Ind – Industrial, Farm – Farmland, Play – Playground, Army – Army
Note 3: ** (-) – No road
Note 4: *** Build ^- Building, Struc – Structure
Note 5: **** Sensitive receptor
Note 6: Observed environmental condition

Source: YUTRA Project Team (2013)

3) Major Findings of Structures/Facilities and Land Use within ROW and along ROW

Major finding of structures/facilities and land use are as follows:

(1) Occupation by houses and building on ROW

Hundreds of houses, buildings for living and business are observed to occupy on rather large area within ROW of Yangon Central St.,Insein St.etc. They are mostly illegal according to Myanmar Railways. However, Residing people have already established their communities since several decades ago

Within ROW near Okkalapa St. spaces are occupied not only by small huts but also by big houses and buildings. In addition, several monasteries were found.

In some sections between railway stations small huts occupied spaces close to railway track.

(2) Occupation by farming

Farmland for vegetables and aquaculture of water spinach using small pool close to railway track are observed for many sections, especially northern parts of YCR.

(3) Occupation by vendors

Vendors selling vegetables and other goods are observed in many stations such as Daningone St. and Okkalapa St. In addition, temporary open market is held in some of railway station yards and in some of sections crossing railway track.

(4) Sensitive receptors along ROW

Along ROW sensitive receptors such as monasteries, Hindu temples are also observed.

Results of findings are shown in Figure 5.4.2.1 to Figure 5.4.2.4.

		
Residential and commercial area: (38-1) Northern area of Pazundaung St. and Yangon Central St.	Old squatter area with about 200 households: (16-17) Kyuntkon St.- Insein St.	New squatters area (16-17) Weastern part of Kyuntkon St.- Insein St.
		

Shops and Monastreies: (14-15) Thamine St.-Thamine Myothit St.	Huts: (28) western part of Paywetseikkon St.	Monastery and higher class residence: (27-28) Okkalapa St. – Paywetseikkon St.)
		
Western part of ROW (Pazundan Creek RS.)	Insein-demolished huts near railway track	Train and squatter: Thiri Myine St.-Okakyin St.

Source: YUTRA Project Team (2013)

Figure 5.4.2.1 Occupation on ROW of Myanma Railways

		
Vendors: (21) Danyingone ST..	Vendors and passengers: (21) Danyngone RS.	Garbage handling workers and huts: (12-13)Thiri Myine St. –Okakyin St.
		
Garbage handling workers and huts: (1) Yangon Central St.	Temporary open market-crossing: (28-29) Paywetseikkon St. –Kyaukyetwin St. Kone St.	Vendors in station yard:(12) Thiri Myine St.

Source: YUTRA Project Team (2013)

Figure 5.4.2.2 Occupation on ROW (business activities)

		
Spreading water spinach in the pool: (10-11) Hletan St. -Kamayut St.	Farmland for vegetables: (21-22) Danyingone St. - Gauk Kwin St.	Farmland for vegetables: (31-32)Yegu St.-Parami St.

		
Water spinach field: (27) Okkalapa St.	Water spinach field: (27-28) Okkalapa-Paywetseikkon Section	Insein RS. – Farming near railway track: (17) Insein St.

Source: YUTRA Project Team (2013)

Figure 5.4.2.3 Occupation on ROW (farmland and pool)

		
Hindu temple: (37) Malwagone St.	Hindu temple: (9) Hanthawaddy St.	Monastery: near (12) Thiri Myine St.
		
4) Buddhist praying structure : (11-12) Kamayut St.– Thiri Myine St.	Pagoda: (27) Okkalapa St.	Mosque: near (11-12) Kamayut –Thiri Myine St.

Source: YUTRA Project Team (2013)

Figure 5.4.2.4 Sensitive Receptors along ROW

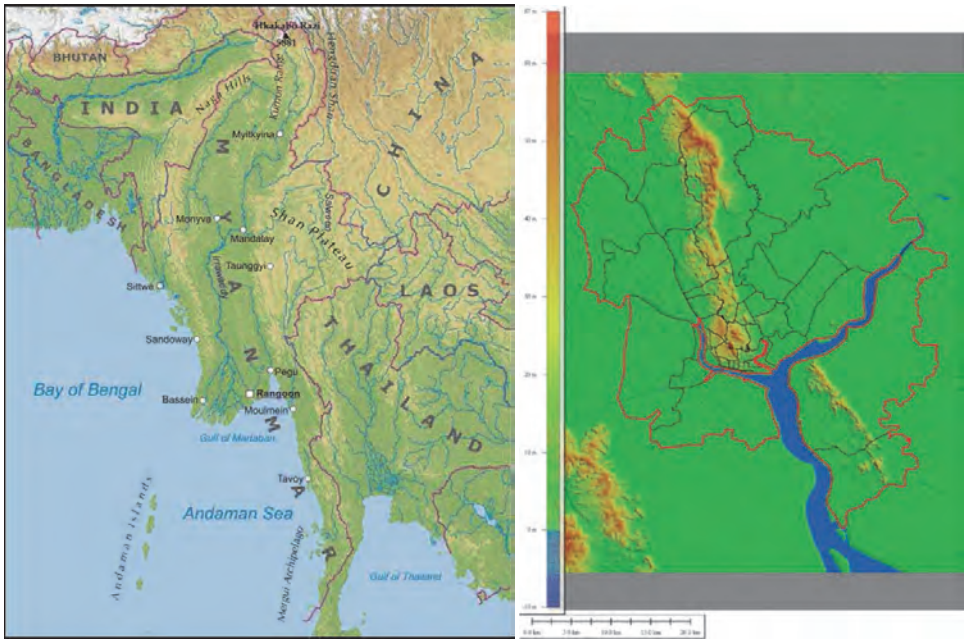
5.5 Natural Conditions to Be Considered for Planning the Projects

Based on the results of the Project for Strategic Urban Development programme (SUDP, JICA (2013)), existing natural conditions to be considered for planning candidate projects for Yangon Circular Railway modernization are described below.

5.5.1 Natural Condition of Yangon City area

1) Topographic Features of Myanmar and Yangon City Area

Myanmar, with the total area of 678,500 km^2, generally slopes downward from the north to south. Mt. Hkakabo Razi, located in Kachin State is the highest mountain in Myanmar with an elevation of 5,881 m. (Figure 5.5.1.1)



a) Physical Map of the Republic of the Union of Myanmar b) Topographic Map of the Greater Yangon

Source: JICA SUDP Study Team (2013)

Figure 5.5.1.1 Topographical Map of Myanmar and Surrounding Area of Yangon City

Yangon City is located 34 km upstream from the river mouth of Yangon River. The City has low hills which are a long and narrow spur of Pegu Yomas hill range in the central area running in N-S direction with an average height of 30 m and degenerates gradually into delta plains in eastwards and westwards.

2) Water Body in Yangon City Area

In Yangon City area the largest water body is the Yangon River and the second largest one is the Bago River.. Both of the water bodies are influenced by tides and have saline water. In regard to inland waters, the Mingaladon Township, comprising Hlaw Ga Lake (the major source of water supply for the Greater Yangon), Botahtaung, Dagon and Pazundaung Townships have 1.0 to 2.0 ha of water body within each Township. Botahtaung and Pazundaung Townships are suffering from rainwater congestion problem due to scarcity of water bodies.

3) Geological and soil conditions

There is the Andaman Trench in Bengal Bay, west of Myanmar, in which the Indian Plate is moving northward and subducting underneath the Burma Plate from west to east. Sagaing Fault, boundary between Burma Plate and Sunda Plate, is located eastern of Myanmar which tends to cause large scale earthquakes in Greater Yangon.

Most of Greater Yangon area consists of fluvial flood plain which is associated with the area lies in the delta of the Ayeyawaddy River and along Yangon, Hlaing and Bago rivers and Nga Moeyeik Creek. The rivers transfer and deposit sediments, and form soils which can be classified and described below.

4) Climate

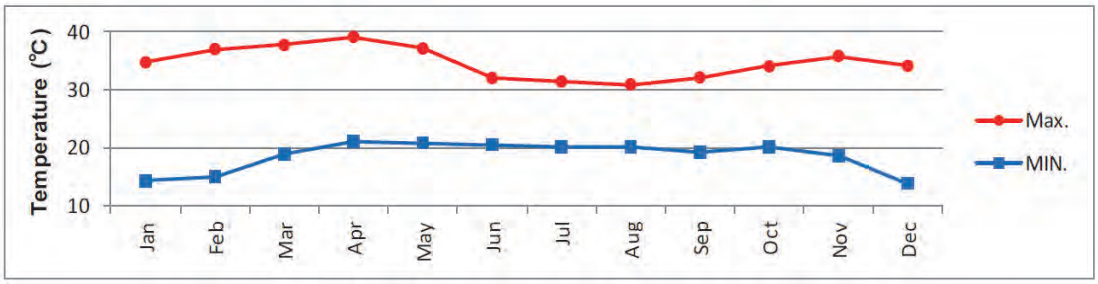
Yangon City area is located in tropical monsoon climate, characterized by three distinct

seasons, namely, summer (March to middle of May), rainy (Middle of May to middle of October), and cool (Middle of October to February) seasons.

The Kaba-aye Meteorological Station has been observing meteorological conditions of Greater Yangon since 1968 for six parameters, i.e. temperature, humidity, wind speed and its direction, evaporation, sunshine hours, and rainfall.

(1) Temperature

Generally, temperature in April is high, the maximum monthly temperature recorded in April 2001 was 39.1 °C. Minimum monthly temperature recorded in December 2004 was 13.8 °C The difference between the monthly maximum and monthly minimum temperature is more than 20 °C from December to February and around 10 °C from June to August, which are the peak seasons of monsoon rainfall (Figure 5.5.1.2).



Source: SUDP, JICA (2013)

Figure 5.5.1.2 Mean Maximum and Minimum Temperature at Kaba-aye (1991-2008)

(2) Relative Humidity

The humidity difference between the morning and evening is quite small. The annual mean relative humidity at 9:30 and at 18:30 is 72.3% and 72.8%, respectively. The maximum mean monthly relative humidity is 90.6% in August, while the minimum mean monthly relative humidity is 51.4% in February

(3) Wind Speed and Direction

Annual mean wind speed at the Kaba-aye Station is 1.1 m/s. Maximum wind speed was 42.9 m/s recorded in May 2008 at the time of Cyclone Nargis. Wind directions are generally in the SW during summer (March to middle of May) and rainy (Middle of May to middle of October) seasons, and NE in the cool season (Middle of October to February).

(4) Evaporation

Annual mean evaporation is 1,348.6 mm. Evaporation in the summer of March to middle of May is higher than that in rainy season of middle of May to middle of October. Maximum mean monthly evaporation is 183.6 mm in April.

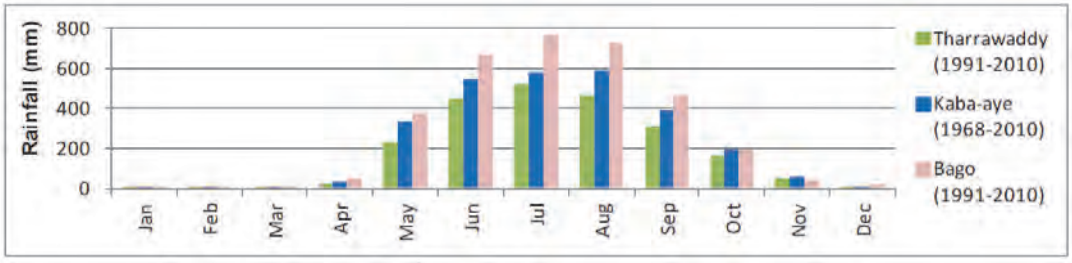
(5) Sunshine Hours

Sunshine hours during December to April are approximately 8-10 hours a day, while that during June to August are approximately 2-3 hours a day due to monsoon rainy weather.

(6) Rainfall

As shown in Figure 5.5.1.3 at Kaba-aye Meteorological Station, mean annual rainfall is

2,749 mm and maximum mean monthly rainfall is 591 mm in August and minimum mean monthly rainfall is 3 mm in January and February. Maximum annual rainfall was recorded as 3,592 mm in 2007. Maximum monthly rainfall was 868 mm in August 1968 and minimum monthly rainfall was zero in the past several months. On the other hand, Mean annual rainfall in Bago is 3305 mm while that in Tharrawaddy is 2,220 m.



Source: SUDP, JICA (2013)

Figure 5.5.1.3 Mean Monthly Rainfall in and around Greater Yangon

Special feature of rainfall in Yangon City area is short in duration and intensity. Remarkably, 50-year probable 60-minute rainfall intensity exceeds 100 mm/hour. Such a high intensity of rainfall is a major cause of inundation problems in downtown Yangon.

5) Tidal Conditions of Rivers

At present available information from Myanmar Port Authority (MPA) is limited to past observation records at Yangon Port (Sule Pagoda Wharf, 16° 46' latitude and 96° 10' longitude) and the river mouth of Yangon River (Elephant point, 16° 30' latitude and 96° 18' longitude). According to the records, the highest high water level (HHWL) is +6.74 m, mean water level (MWL) is +3.121 m and ground elevation is normally indicated from MWL. Thus, it can be said that HHWL around Yangon Port is approximately +3.619 m on ground elevation basis (Table 5.5.1.1).

On the other hand, Myanmar International Terminal Thilawa, a private firm operating the terminal, has observed tidal condition at the Thilawa Terminal for more than 16 years.

According to their information, maximum water level was recorded during a storm in 2007 at +4.14 m, and Cyclone Nargis in May 2008 caused approximately 0.5 m higher than this, although the water level was not recorded.

Table 5.5.1.1 Tidal Features of Yangon Port (Sule Pagoda Wharf)

Items	Tidal Height (m)	Observed Date
Highest high Water Level (HHWL)	+6.74	Sep. 1899
Mean Water Level (MWL)	+3.121	Up to 1936
Lowest Low Water Level at Bo Aung Kyaw Street Wharf	-0.24	Dec. 1902
Indian Spring Low Water Mark	+0.338	-

Source: SUDP (2013)

6) Natural Disaster

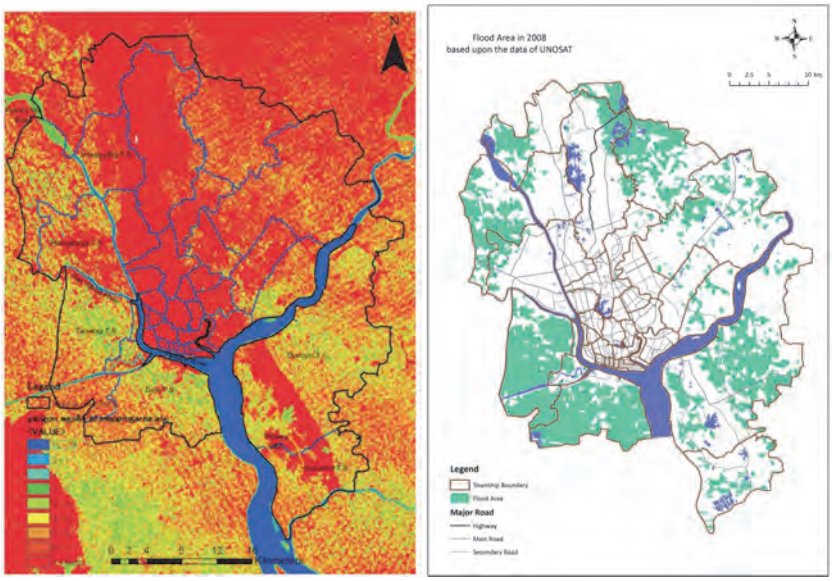
(1) Floods

According to “Hazard Profile of Myanmar (2009)” flooding is one of the major hazards in Myanmar, accounting for 11% of all losses caused by disasters. It adversely affects all aspects of human activities not only from a humanitarian aspect but from the regional and national economic aspects. Floods in Myanmar usually occur during two distinct periods: from June to August and from late September to October, with the largest intensity observed in August at the peak of the monsoon season.

Floods in Greater Yangon including Yangon City area can be classified into three types:

- River floods;
- Localized flood inundations in urban areas due to a combination of such factors as cloudburst, poor infiltration rate, poor drainage infrastructure (possibly due to climate change, heat island phenomenon); and in rural areas due to decrepit dams, dykes and levees;
- Floods due to cyclone and storm surge.

A digital elevation map focusing on the lowland area was made in the SUDP as shown in Figure 5.5.1.4 In the Figure red colored areas are relatively higher elevations above El. 7.0 m and have less disaster risks against river floods and storm surges. Yangon Circular Railway area belongs to almost the same area, thus, they have also less disaster risks against river floods and storm surges. This is also suggested by flood inundated data by Cyclone Nargis 2008 as shown in Figure 5.5.1.4.



(1) Digital Elevation Map (2) Flood Inundation Area by Cyclone Nargis

Source: JICA SUDP (2013)

Figure 5.5.1.4 Digital Elevation Map and Flood Inundation Area by Cyclone Nargis

However, the areas suffer from inundation due to drainage congestion during the

rainy season.

(2) Earthquake

In the Bay of Bengal west of Myanmar, there is the Andaman Trench where the Indian Plate is moving northward and is subducting underneath the Burma Plate from west to east. In east Myanmar, there is the Sagaing fault which is the boundary between Burma Plate and Sunda Plate. Hence, magnitude 7.0+ earthquakes occurred more than 16 times and six earthquakes of around magnitude 7.0 hit the main cities along the Sagaing fault such as Yangon, Bago and Mandalay from 1930 to 1956. Significantly, Yangon experienced six huge earthquakes around the 1930's.

Therefore, Greater Yangon apparently faces a potential risk of significant earthquake disaster, despite the fact that earthquakes seldom hit Greater Yangon in the immediate past.

(3) Thunder

According to data from Ministry of Social Welfare, Relief and Resettlement, more than 100 people died due to lightning in 2011. Among them, 40 people died in Bago Region. Thus, lightning shall be considered as a serious disaster in the country. People in Myanmar are generally ashamed of dying from lightning attacks because of their religious belief.

(4) Landslide

Yangon City area is situated at the southern extremity of a long narrow spur of the Bago Yoma. The most notable feature of the topography is the central ridge known as Shwedagon-Mingladon anticlinal ridge. Therefore, the central part of the area is higher than its limbs. Most types of landslides that occurred in these areas are creeps, earth flow and slumps or block slides. Soil creeps occurred at Shwe-Taung-Kyar, Botahtaung and Hninsigon Bobwa Yeiktha. Earth flow types of landslides are observed at Dhamazedi Road. Slumps or block slides are noted at Inya Myaing, University Avenue Road, and Cantonment, west of Yangon Zoological Garden. As one of countermeasures to cope with them, most of the slopes in Yangon City are protected by concrete walls or other artificial structures.

(5) Tsunami

The tsunami caused by the earthquake in the Indian Ocean off Sumatra in 2004 hit the delta area south of Myanmar, causing the deaths of about 64 people. A large tsunami might cause severe damages along the west coast of Myanmar if a large scale earthquake occurs around the Andaman trench. However, according to SUDP report, anticipated maximum tsunami height is less than 1.0 m thanks to the topographic conditions of Yangon River and the deltaic area.

5.6 Results of Initial Environmental Examination (IEE)

5.6.1 Outline of Proposed Project Plan

Whole features of Yangon Circular Railway Modernization project will be determined later. Thus, at present following project components was assumed.

- Rehabilitation of railway track
- Construction of railway transport related facilities and structures
- Others

5.6.2 Procedures of Preliminary Environmental Scoping

1) Setting of Environmental Components and Items

To grasp whole features of possible environmental impacts caused by the project, it is necessary to identify and evaluate environmental component and item, which compose of environmental and social considerations, one by one and to integrate the impacts.

According to the JICA Guidelines for Environmental and Social Considerations, possible impacts to be assessed include those on human health and safety, as well as on the natural environment, which are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.

In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed with regard to environmental and social considerations, so far as it is rational to do so.

In this examination by taking into consideration the JICA Guidelines, and relevant laws and regulations of Myanmar Government, together with environmental condition of the areas related to Yangon Circular Railway, following three environmental components and 37 items (Social Environment 20, Natural environment 9, and Environmental pollution 8) as indicators expressing environmental and social conditions.

2) Activities due to the project

Activities due to the project by stage are shown in Table 5.6.2.1 possible impacts are identified by using impact matrix comparison and the extent of the impacts are also evaluated one by one with rating against the above mentioned 37 environmental items.

Table 5.6.2.1 Anticipated Activities due to the Project

Project Stage	Anticipated Activities by the Project
Planning Stage (I)	Securing land/space for YCR and related facilities
	Securing temporary land/space for construction work
	Change of utilization of land and local resources
Construction Stage (II)	Procurement of construction materials, equipment, plants, etc.
	Civil engineering works such as earth moving
	Operation of construction machines, vehicles, plants, etc.

Project Stage	Anticipated Activities by the Project
	Installation of construction work offices worker's camps, storage sites, etc.
	Construction of YCR and related facilities and structures including rehabilitation of railway track
Operation Stage (III)	Operation of YCR and related facilities and structures
	Spatial occupancy of YCR and related facilities and structures

Source: JICA SUDP (2013)

3) Preliminary Environmental Scoping

Preliminary environmental scoping was carried out by comparing activities due to the assumed project plan with the above mentioned 37 environmental items as shown in Table 5.6.3.1

5.6.3 Results of Preliminary Scoping

Preliminary scoping are carried out assuming the projects relevant to Yangon Circular Railway Modernization and shown in Table 5.6.3.1.

Table 5.6.3.1 Preliminary Scoping of Yangon Circular Railway Modernization Project

Item	Rating		Identification and evaluation of anticipated impacts and their reasons
	I/II	III	
(1) Social Environment			
1) Land acquisition/resettlement	B-		1) In general, occurrence and extent of land acquisition and resettlement will be depending upon the scope and scale of development plan of Yangon Circular Line (YCL). As far as the projects are limited to such as renewal of railway track and railway station yard within ROW of MR, land acquisition is basically not expected. 2) However, some parts of ROW were occupied by structures such as houses, buildings and activities such as farming and vending in railway yard whether legal or illegal. Therefore, generation of Project Affected Persons (PAPs) are expected due to removal and/or relocation of structures and disturbance of business activities. 3) Cutting or replanting of trees is also expected.
		C-	Disturbance to vendors is somewhat expected at railway station yard, if operation of railway line is changed after renovation.
2) Local economy such as employment and livelihood etc.	B+		Beneficial impacts such as creation of employment opportunity for construction works are expected.
		A+	1) Through renovation of YCL existing railway transport will be upgraded to faster and safer, which may give rise to more convenience and comfort to passengers as well as making easier access to working place and social services. 2) In addition, passengers delivering and selling agricultural products to consumers by train will be also benfitted. These may result in improvement living condition and acceleration the growth of local economy.
3) Utilization of land and local resources	C-		1) Quarries and/or borrow pits will be utilized for procurement of construction materials. 2) Water for construction work including worker's camp may compete with existing water resources.
		D	No negative impact is expected.
4) Existing social	B-		Location and route of utilities such as electric poles,

Item	Rating		Identification and evaluation of anticipated impacts and their reasons
	I/II	III	
infrastructures and services			telephone line, water supply and sewer line are not known at present.
		A+	Renewal of YCL may give rise to improve significantly public transport activity as basic social infrastructure in Yangon City.
5) Social institutions such as social infrastructure and local decision-making institutions	C-		The project itself intends to improve railway transport, which is major portion of public transport in Yangon City. However, if information disclosure of the project plan, and procedure and public participation are not properly conducted, anxieties and complaints may spread over the people and communities resulting in difficulties for obtaining thorough understanding of the project and consensus with them.
		C-	
6) Vulnerable group such as the poor, women, children, elderly, disabled etc.	C-		1) In some parts along YCL and compounds of Myanmar Railways communities and huts of the poor are distributed. 2) The project may create employment opportunity of vulnerable group such as the poor and women for construction work.
		B+	1) Vulnerable group such as children and women are also encouraged by the improvement of access to hospitals and schools in Yangon City due to faster and safer train operation by renovation of YCL.
7) Ethnic minority	C-		1) Myanmar is an ethnically diverse nation with 135 distinct ethnic groups. 2) Communities of some ethnic minority groups are found in the project area.
		C-	
8) Misdistribution of benefit and damage	C-		1) The project itself intends to improve railway transport, which is major portion of public transport in Yangon City and may not cause any misdistribution of benefit and damage to residents and passengers. 2) There is, however, some possibility of misdistribution of benefit and damage, if the project plan including procedures to the implementation including construction work and resettlement matters are not properly disseminated and consulted with concerned residents and passengers and other stakeholders.
		C-	
9) Local conflict of interests	C-		1) The project itself intends to improve railway transport, which is major portion of public transport in Yangon City and may not cause any local conflict of interests. 2) There is, however, some possibility of the conflict, if the project plan including procedures to the implementation including construction work and resettlement matters are not properly disseminated and consulted with concerned residents and passengers and other stakeholders.
		C-	
10) Cultural and historical heritage site	C-		1) In Yangon City there are many cultural and historical heritage sites. However, distribution of these sites along and around YCL is not known at present.
		D	No negative impact is expected.
11) Religious Facilities	C-		Along railway lines and adjacent roads religious facilities such as pagodas, monasteries, Hindu temples, mosques, churches are distributed. These facilities are required to keep clean and quiet environment. Air pollutants and noise generation by construction work may cause negative impacts on these sensitive receptors.
		C-	No negative impact is expected.
12) Landscape	D		Change in existing landscape is expected to be negligible.
		C-	Some impacts on landscape is expected depending upon location and scale of planned facilities and structures, if any.

Item	Rating		Identification and evaluation of anticipated impacts and their reasons
	I/II	III	
13) Water rights, fishing rights and rights of common	C-		1) Water rights belong to Department of Water Resources Improvement. 2) In Myanmar there are two types of fishing rights; one is "fishing grant", which is given with specified river area and another is "license", which is a permit of fishing. 3) Rights of commons are not known at present.
		D	
14) Public health and Sanitation (including infectious diseases such as HIV/AIDS)	C-		Air pollutants such as dust, SPM, NOx, SOx emitted from construction vehicles and machines and construction work may cause some adverse effect to respiratory organs.
		D	No negative impact is expected.
15) Infectious diseases such as HIV/AIDS	B-		1) Construction workers and truck drivers are considered as having high potential for the spread of sexually transmitted diseases (STDs) and HIV/AIDS due to their mobility. 2) It was reported infection with HIV/AIDS and venereal disease at worker's camp during road construction stage in other developing countries.
		D	No negative impact is expected.
16) Working condition (including occupational health)	B-		In general, many workers will be engaged in construction work and stay at worker's camps under poor living conditions. Thus, the health and occupational safety of the workers may be jeopardized in case of severe working condition and in rainy season.
		D	No negative impact is expected.
17) Hazards/security risks	B-		Although the project activities will not causing hazard and risks, migration of workers from other areas may worsen condition of public security and increase in community awareness.
		D	No negative impact is expected.
18) Accidents	B-		Occurrence of accidents may increase due to deploying machines and plants and handling construction materials as well as traffic accidents due to construction vehicles.
		B+	Renovation of YCL may bring about more safer operation of train and result in reduction of cases of accidents
19) Sunlight shading	D		YCL runs at grade level in urban and semi urban area. Thus, negative impact on sunlight shading is not expected.
		D	
20) Radio-frequency interference	C-		Many sections of YCL is located in built-up urban area Thus, some possibility of negative impact on radio frequency interference is expected.
		C-	
(2) Natural Environment			
21) Topography and Geology	C-		1) No large-scale land alteration is expected due to construction work. 2) It is, however, not known whether r proper soil strength data such as bearing power of soil, which are thought to be necessary to construction plan of facilities and structures data is existing or not.
		D	No negative impact is expected.
22) Soil erosion	C-		No large-scale land cutting and filling are expected. However, if improper soil embankment works are performed it is likely to cause soil erosion in rainy season.
		D	No negative impact is expected.
23) Groundwater	C-		There is some possibility of pumping up of groundwater, if water supply is not available.
		D	
24) Hydrological situation/Drainage pattern	C-		1) In the project area drainage congestion is severe problem due to hard natural conditions (low elevation, short and intense rainfall during monsoon season, large difference between low and high tide), rapid urbanization (high-run-off

Item	Rating		Identification and evaluation of anticipated impacts and their reasons
	I/II	III	
			rate associated with buildings and pavements) as well as insufficient maintenance. Consequently drainage condition is very poor with capacity and insufficient maintenance. 2) Wastewater generation from construction work may give rise additional negative impacts to result in poorer condition and inundation especially in rainy season.
		C-	Railway service area of YCL is located in flat and low land area. Thus, rise of water level of Yangon River in case of high tide, flooding and cyclone may bring about inundation of railway facilities and structures in some sections.
25) Coastal zone	C-		Railway service area of YCL is located in flat and low land area. Thus, rise of water level of Yangon River in case of high tide, flooding and cyclone may bring about inundation of railway facilities and structures.
		D	
26) Protected Area and parks	C-		1) There is neither protected area nor environmentally sensitive area in and around the project area. However, distribution of city parks are not known.
		D	No negative impact is expected.
27) Fauna, Flora, Biodiversity and Ecosystem	C-		1) Detailed data on endangered fauna and flora species are not known at present. 2) Planted trees along railway line contribute to the greenery and visual amenity providing relaxation and recreation area to local residents. Thus, cutting or removal of trees along railway line may spoil environment with greenery and amenity. 3) Air pollutants emission from construction vehicles and machines, and earthmoving and construction work may affect trees and plants around the construction site.
		D	Expected impact is not known.
28) Micro-climate	D		Neither construction of tall buildings nor a large scale reclamation is planned. Thus, change in micro-climate is not expected.
		D	
29) Global warming/climate change	B-		Generation of greenhouse gases such as CO_2 due to construction vehicles and machines .is expected in a small scale and temporary. Thus, impact on global warming and climate change is negligible.
		B+	Renovation of YCL may give rise more faster and safer operation. This will enhance modal shift to railway transport from road transport and results in reduction of greenhouse gases generation such as CO_2.
(3) Environmental Pollution			
30) Air pollution	B-		1) In Myanmar at present air quality standards are not established. 2) Air pollutants emission such as PM and NOx from construction vehicles and machines, and earthmoving and construction work may deteriorate air quality temporarily.
		B+	Renewal of railway line may give rise to modal shift to railway transport from road transport. This results in reduction of air pollutants generation such as PM and NOx.
31) Water pollution	B-		Water pollution is expected due to following pollutant generation from construction work, although temporarily: (i) Run-off of dirty water including soils from cutting, filling and excavation of earthmoving work. (ii) Wastewater from worker' camps and construction office. (iii) Spilling over of toxic materials such as oil and lubricants.
		D	No negative impact is expected.

Item	Rating		Identification and evaluation of anticipated impacts and their reasons
	I/II	III	
32) Soil contamination	B-		Leakage of toxic materials such as lubricating oil from construction vehicles and machines may give rise to soil contamination.
		D	No negative impact is expected.
33) Bottom sediment	D		No negative impact is expected.
		D	No negative impact is expected.
34) Solid waste	B-		Generation of soil, sand and construction waste is expected at quarry, borrow pits, site of construction work and worker's camp, etc.
		B-	Generation of solid waste from railway line and related facilities.
35) Noise and Vibration	B-		Generation of noise and vibration from construction machines and vehicles is expected, although ambient noise and vibration standards were not established in Myanmar.
		B+	Renewal of railway track and condition of train operation may reduce generation of noise and vibration.
36) Ground Subsidence	C-		Data of ground strength and bearing power of soil, which are relating to occurrence of ground subsidence is not known at present.
		C-	
37) Offensive odor	C-		At resent impact is unknown.
		D	No negative impact is expected.

Note 1: * Environmental items are chosen as indicators expressing environmental and social conditions based on JICA Guidelines for Environmental and Social Environment (2010.4) and relevant legislation of Myanmar Government as well as the project plan and environmental condition of the project area.

Note 2: ** Regarding the impacts on "Gender" and "Children's Right" might be related to all items of Social Environment.

Note 3: *** Rating - In general, both positive impact (+) and negative impact (-) are expected due to the anticipated project activities. Thus the following rating criteria are adopted with respect to the extent of impacts:

A (+/-) – Significant positive/negative impact is expected,

B (+/-) – Positive/negative impact is expected to some extent,

C (+/-) - Extent of positive/negative impact is unknown or not clear (Further examination is needed. It should be taken into consideration that impacts may become clear as study progresses.),

Blank - Negligible or No impact is expected.

Note 4: **** I - Planning Stage, II - Construction Stage, III - Operation Stage, T - Overall Stages

Source: JICA YUTRA Study Team (2013)

5.6.4 Preparation of TORs for Feasibility Study at Next Step

In order to identify and evaluate expected impacts due to proposed projects, existing information and data is not sufficient. Thus, it is required to further survey to collect and analyse necessary information and data. Table 5.6.4.1 shows further necessary information and data together with survey method.

Table 5.6.4.1 TORs for Feasibility Study

Item	Rating		Necessary Information and Data	Survey Method
	I/II	III		
Scope of candidate Projects	-	-	Candidate projects and project scope including components and project area	1) Confirm the project plan as a whole. 2) Collect most recent information about procedures and conditions for environmental approval (Environmental Clearance certificate) and other relevant permissions.
Stakeholder meetings	-	-	1) In general, in order to promote information disclosure and public involvement to the project, it is necessary to hold stakeholder meetings and conduct individual consultation. 2) Stakeholder meetings are desirable to be held at both earlier stage and before preparing draft final report.	To hold stakeholder meeting at two stage by participation of Project Affected Persons (PAPs), passengers and concerned communities. (1) Stakeholder meetings for project plan. (2) Stakeholder meetings for results of IEE and Abbreviated Resettlement Plan (ARP).
Institutional arrangement of counter part	-	-	Institutional arrangement for environmental and social considerations of the projects including setting section and staff as well as necessary budget.	Consultation with Myanmar Railways
(1) Social Environment				
1) Land acquisition/resettlement	B-		1) Distribution of ROW of MR along YCL. 2) Identify the occurrence of involuntary resettlement on ROW along YCL. 3) Most recent procedures and compensation/assistance conditions of land acquisition and resettlement in Myanmar 4) Obtain Environmental Clearance Certificate from MOECAF.	1) Confirm ROW map along YCL to MR. 2) Conduct detailed inventory survey on ROW along YCL. 3) Collect most recent information on legal and institutional framework for resettlement and compensation. 4) Collect most recent information about procedures and conditions for environmental approval (Environmental Clearance certificate) and other relevant permissions.
		C-	Operation plan after renovation.	Confirm operation plan in the project
2) Local economy such as employment and livelihood etc.	B+		Livelihood of peoples who have houses, shops, farmland and business activities such as vending, waste collection etc. within ROW regardless of legality.	1) Collect information from concerned Township and Ward offices 2) Interview survey, if necessary.
		A+	-	-
3) Utilization of land and local resources	C-		1) Procurement plan for construction materials, if necessary. 2) Existing land and water resources (surface water and groundwater) use in the project area	1) Confirm procurement plan for construction materials.2) Collect information about existing land and water resources use and regulation.
		D	-	-
4) Existing social infrastructures and services	B-		(1) Existing installation of utilities along YCR and within ROW. (2) Existing social infrastructure and services around the project site.	1) Collect information about utilities along road and within ROW. 2) Collect information about existing social infrastructure and services around the project site.
		A+		
5) Social institutions such as social infrastructure and local decision-making institutions	B-		1) Community structures and local decision-making institutions of concerned area. 2) Existing important or hot issues of the communities.	1) Collect necessary information from concerned Townships and Ward offices 2) Interview survey of concerned organizations and peoples, if necessary.
		A+	-	-

Item	Rating		Necessary Information and Data	Survey Method
	I/II	III		
6) Vulnerable group such as the poor, women, children, elderly, disabled etc.	C-		Distribution of vulnerable groups and urban poor in the project area	1) Refer to SUDP data. 2) Collect further information from Township offices and conduct field survey, if necessary
		B+	-	-
7) Ethnic minority	C-		Distribution of ethnic minority groups in the project area.	1) Refer to SUDP data. 2) Collect further information from Township offices and conduct field survey, if necessary
		C-		
8) Misdistribution of benefit and damage	C-		1) Cases, causes and solutions of misdistribution of benefit and damage in the project area. 2) Data on community structures and important issues in the project area	1) Collect information about cases, causes and solutions of misdistribution of benefit and damage in the project area. 2) Hold stakeholder meetings and individual consultation to concerned communities and people, if necessary.
		C-		
9) Local conflict of interests	C-		1) Past cases, causes and solutions of local conflicts of interests in the project area. 2) Information disclosure and stakeholder consultation to concerned communities and people.	1) Collect information about cases, causes and solutions of local conflict of interests in the project area. 2) Hold stakeholder meetings and individual consultation to concerned communities and people, if necessary.
		C-		
10) Cultural and historical, heritage site	C-		Inventory data of cultural and historical heritage sites along YCR	1) Refer to SUDP data. 2) Collect information about cultural and historical heritage sites along YCR.
		D	-	-
11) Religious Facilities	C-		Inventory survey of religious facilities along and within ROW of YCL.	1) Refer to SUDP data. 2) Collect information about religious facilities along and within ROW of YCR. 3) Inventory survey, if necessary.
		C-		
12) Landscape	D			1) Survey on existing fine landscape along and within ROW of YCR. 2) Confirm design of railway related facilities and structures.
		C-	Confirm project design plan for facilities and structures,	
13) Water rights, fishing rights and rights of common	C-		Existing situation of rights of common	Collect information from YCDC and other concerned organizations.
		D	-	-
14) Public health and Sanitation (including infectious diseases such as HIV/AIDS)	C-		Existing situations of public health including prevalence and cause of diseases, and the sanitary condition in the project area.	1) Refer to SUDP data. 2) Collect further information about public health and sanitary conditions in the project area.
		D	-	-
15) Infectious diseases such as HIV/AIDS	B-		Existing cases and causes infectious diseases including HIV/AIDS in the project area.	1) Refer to SUDP data. 2) Collect further information from concerned organizations including NGO.
		D	-	-
16) Working condition (including occupational health)	B-		1) Data of situation and regulations of working condition including occupational health in the project area. 2) Working condition in construction work and railway operation	1) Refer to SUDP data and collect information from existing reports and relevant organizations, if necessary. 2) Confirm the project plan.
		D	-	-
17) Hazards/security risks	B-		Existing data of natural disasters and cases and causes of security risks in the project area.	1) Refer to SUDP data and collect information from existing reports and relevant organizations, if necessary.
		C-		

Item	Rating		Necessary Information and Data	Survey Method
	I/II	III		
				2) Confirm the project plan.
18) Accidents	B-		Existing data of cases and causes of accidents in the project area.	1) Refer to SUDP data and collect information from existing reports and relevant organizations, if necessary. 2) Confirm the project plan.
		C-		
19) Sunlight shading	D		-	-
		D	-	-
20) Radio-frequency interference	C-		Existing data of radio frequency interference in the project area.	Collect information from existing reports and relevant organizations, if necessary.
		C-		
(2) Natural Environment				
21) Topography and Geology	C-		Existing topographic and geological conditions in the project area	1) Refer to SUDP data and collect further information from relevant reports and organizations. 2) Topographic and geological survey including boring test, if necessary.
		C-		
22) Soil erosion	C-		Existing condition and usage of groundwater in the project area	Collect necessary soil data including bearing power of soil by boring test etc.
		D	-	-
23) Groundwater	C-		Existing condition and usage of groundwater in the project area	1) Refer to SUDP data and collect further information from relevant reports and organizations.
		C-		
24) Hydrological situation/Drainage pattern	C-		Existing data of hydrological situation and drainage condition, natural disasters in the project area.	Refer to SUDP data and collect further information from relevant reports and organizations.
		C-		
25) Coastal zone	C-		Existing data of river banks, tidal conditions, natural disasters in the project area.	Refer to SUDP data and collect further information from relevant reports and organizations.
		C-		
26) Protected Area and parks	C-		Distribution and usage of city parks and greenery areas along YCL.	Refer to SUDP data and collect information from relevant reports organizations such as MOECAF and YCDC-Parks, Playgrounds and Gardening Department.
		D	-	-
27) Flora, Fauna, Biodiversity and Ecosystem	C-		1) Existing data of fauna, flora, biodiversity and ecosystem including endangered species in the project area. 2) Forests, trees and greeneries in the project area	1) Refer to SUDP data and collect information from relevant reports organizations such as MOECAF and YCDC-Parks, Playgrounds and Gardening Department. 2) Inventory survey, if necessary.
		D	-	-
28) Micro-climate	D		-	-
		D	-	-
29) Global warming/climate change	B-		1) Existing conditions related to global warming and climate change in the project area. 2) Greenhouse gas emissions from construction work (construction machines, vehicles, plants etc.)	1) Refer to SUDP and relevant existing data. 2) Clarify working plan including specifications of construction machines and vehicles and construction plants
		B+	-	-
(3) Environmental Pollution				
30) Air pollution	B-		1) Existing air quality conditions. 2) Environmental and emission standards to be referred to. 3) Air pollutant	1) Refer to SUDP and collect relevant existing data. Conduct actual air quality survey in the project area, if necessary.

Item	Rating		Necessary Information and Data	Survey Method
	I/II	III		
			emissions from construction work (construction machines, vehicles, plants etc.)	2) Refer to Japanese and WHO standards. 3) Clarify working plan including specifications of construction machines and vehicles and construction plants
		B+	-	-
31) Water pollution	C-		1) Existing air quality conditions. 2) Environmental and emission standards to be referred to. 3) Wastewater generation from construction work (excavation, cutting, filling, washing etc.)	1) Refer to SUDP and collect relevant existing data. Conduct actual air quality survey in the project area, if necessary. 2) Refer to Japanese and WHO standards. 3) Clarify detailed plan of construction work
		D		
32) Soil contamination	B-		1) Existing situation of soil contamination, if any. 2) Generation of hazardous materials such as lubricants, heavy metals etc. from construction machines, vehicles and plants.	1) Refer to SUDP and relevant existing data. 2) Clarify detailed plan of construction work.
		D	-	-
33) Bottom sediment	D		-	-
		D	-	-
34) Solid waste	B-		1) Required procedures and permission to collect, storage, transport, treatment and disposal of generated wastes from construction work. 2) Clarify types and amount of solid waste generation from construction work.	1) Confirm plan of construction work. 2) Collect proper information from YCDC-Pollution Control and Cleansing Department. 2) Confirm executing plan of construction work.
		B-	1) Required procedures and permission to collect, storage, transport, treatment and disposal of solid waste. 2) Types and amount of solid waste generation from railway operation, if any.	1) Collect proper information from YCDC-Pollution Control and Cleansing Department. Confirm plan of railway operation. 2) Confirm railway operation plan.
35) Noise and Vibration	B-		1) Existing ambient noise quality.. 2) Noise and vibration standards to be referred to. 3) Feature of noise and vibration generation from construction work (construction machines, vehicles, plants etc.).	1) Refer to SUDP and collect relevant existing data. Conduct actual ambient noise survey in the project area, if necessary. 2) Refer to Japanese and WHO standards. 3) Clarify working plan including specifications of construction machines and vehicles and construction plants.
		B+	-	-
36) Ground Subsidence	C-		Existing situation of ground subsidence in the project area.	1) Collect information in the project area. 2) Confirm project plan, if necessary.
		D	-	-
37) Offensive odor	C-		Existing situation of offensive odor in the project area.	1) Collect information in the project area. 2) Confirm project plan, if necessary.
		D	-	-

Source: YUTRA Study Team (2013)

5.6.5 Mitigation Measures

The above mentioned impacts should be fully taken into considerations to conduct further baseline survey in case of lack of required information and to examine the possible mitigation measures and monitoring as much as possible.

- Baseline survey will be done to make further understanding of existing environment and the effects expected to be caused by the project activities
- Mitigation measures will minimize the negative impact to an acceptable level through the planning, construction and operation phases.
- Monitoring is required to ensure that the specified mitigation measures are properly carried out through construction and operation stages.

1) In General

Major items of environmental and social considerations in planning and implementation of prioritized projects are described below.

(1) Comply with both Legislation of Myanmar Government and JICA Guidelines for Environmental and Social Considerations

In general, it is necessary to comply with both Legislation of Myanmar Government and the JICA Guidelines. At the same time it is also necessary to take into considerations differences of policies and legislation between them such as EIA/IEE requirement, processes of Environment Approval, land acquisition and resettlement policy.

According to the JICA Guidelines, EIA (full EIA)/IEE requirement for projects including transport development are as follows:

- Full EIA is required for category A projects, which are likely to have significant adverse impacts on the environment and society.
- An IEE is required for category B projects, whose potential adverse impacts on the environment and society are less adverse than those of Category A projects.
- Neither full EIA nor IEE is required for Category C projects, which are likely to have minimal or little adverse impact on the environment and society.

On the other hand, based on the Environmental Impact Assessment Procedures (draft, 2013), which was prepared by MOECAF and have been waiting for official enactment through discussion in the Inter-Ministry Committee. most of transport development projects are required of full EIA as shown in Table 5.6.5.1.

Table 5.6.5.1 List of IEE/EIA Required Project Related to Transport Development

Purpose and type of project	Project feature (size, etc.)
(I) IEE required project (Schedule I)	
1) River Training Works	All projects
2) Construction of Bridges	more than 50 feet and less than 200 feet
3) Port Development	All projects
(II) EIA (full EIA) required project (Schedule II)	
1) Construction of Highways and fly-over	all projects if recommended by IEE
2) Ports Development	all projects if recommended by IEE
3) Construction of subways	all projects if recommended by IEE
4) Construction of Bridges	more than 200 feet
5) Construction of Shipyards	dead weight tonnages greater than 5,000 tons
6) Construction of Airports	airstrips of 8,200 feet (2,500 meters) or longer
7) Construction of Railways including Construction of new routes	all projects if recommended by IEE

Source: Compiled from Environmental Impact Assessment Procedures (draft, 2013)

(2) Public participation and information disclosure

Public participation is another pillar of SEA as well as information disclosure. Thus, information disclosure and public participation should be fully considered for all the stakeholders from early stage of planning for obtaining thorough understanding and consensus of the people and communities. In addition, delay or standstill of the project implementation and a split of communities may occur, if fully considerations are not taken to minimize misdistribution of benefits and damage, and to avoid local conflict of interest.

(3) Comparison of Alternative Project Plans

Proposed projects should be evaluated with alternatives including “no action” case in SEA and/or EIA process.

(4) Formulation of Environmental Management Plan including Monitoring

Environmental Management Plan (EMP) should be prepared by incorporating mitigation measures and environmental monitoring plan as well as the roles of implementing, supervising and responsible organizations

2) Social Environment

(1) Land acquisition and Resettlement Issues

One of the most critical issues in development projects is land acquisition and resettlement. In the transport development if land of Right of Way (ROW) is required for transport alignment and related structures, land acquisition and resettlement issues occur.

In order to make clear the occurrence of land acquisition and resettlement, following survey are needed in general:

- Survey on ownership, usage and usufruct right in the project site.
- Inventory survey on facilities and structures along corridor/road and encroachment on the ROW.

- Identify the occurrence and features of land acquisition and resettlement and anticipated PAPs through the detailed survey of ROW based on cadastral map.
- Survey on legal and institutional framework for resettlement and compensation.

From the results of comparison between the JICA Guidelines and Myanmar legislation on land acquisition and involuntary resettlement, there are found several gaps between them. For example, neither the avoidance and minimization of involuntary resettlement and loss of livelihood nor the requirement of preparation of Resettlement Action Plan is stated in any law. For the compensation only market value of the land is considered. No law is identified on the participation of project Affected Persons (PAPs) in public consultation in the land acquisition and resettlement procedures.

If the occurrence of land acquisition and resettlement are anticipated, project proponent should provide adequate information to PAPs and consult with stakeholders including PAPs to reach an agreement or thorough understanding of the issues from an early stage of the project plan as much as possible.

Project proponent should also formulate Resettlement Action Plan (full or abbreviated) and monitor result of compensation and restoring living conditions and livelihood after implementation.

(2) Special Concerns with Cultural, Historical and Religious Facilities

In Greater Yangon many religious facilities such as temples, monasteries, mosques and churches as well as pagodas are distributed and are important income resource for the city by attracting foreign tourists by attractive place to foreign guests. At the same time, these facilities are highly linked to ordinary life of religious citizens. Thus, it is necessary to avoid or to keep sufficient distance from these facilities in route selection of alignment in the project plan.

(3) Avoid a Split of Community

Structures of road and railway line may cause a split of community, i.e. interruption the crossing movement of people and cattle to both side of road and railway line and may disturb communication in the communities.

To avoid split of community and interference of crossing movement, devices such as underpass and walking bridge are required for road and railway structure design.

(4) The Poor, Indigenous or Ethnic people

In general, the vulnerable groups such as poor, indigenous of ethnic people are easily damaged and are difficult to share with benefit from the projects. Therefore, give the vulnerable groups in the project area higher priority to having a chance to construction work and training to get working skills. In addition, the vulnerable people should be taken fully considerations to compensate properly or support to restore the present living condition in case of involuntary resettlement, even if they are illegal occupants.

(5) Working Conditions

A large scale of construction work including underground station requires a large number of construction workers would engage the work. Thus, safety and health condition of the

workers may be jeopardized due to construction work.

Prepare tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents accidents, and management of hazardous materials.

Plan and implement intangible measures for individuals involved in the project, such as the establishment of a safety and health program, and safety training for workers etc.

(6) Infectious Diseases such as HIV/AIDS

In general, road construction workers, and construction vehicle drivers are considered as having high potential for the spread of sexually transmitted diseases (STDs) and HIV/AIDS virus due to their mobility. Infection with HIV/AIDS and venereal disease was often reported at worker's camps during road construction in other countries.

(7) Measures against disaster/hazards

Flooding is one of the major hazards in Myanmar accounting for some 10% of all losses by disasters. Among them localized flood inundations in urban areas may aggravate traffic congestion. Considerations should be proper mounting of road surface and making gutter to keep good drainage condition in the project plan.

3) Natural Environment and Environmental Pollution

(1) Topographical and Geological Conditions

In transport projects considerable scale topographical and geological alteration are expected for construction of railway track and related facilities and structures including renovation and extension. In these cases precise topographical and detailed geotechnical survey are necessary.

(2) Protected Areas

In Greater Yangon Hlawga Park is only one designated protected area where is managed strictly as Watershed Protection Forest. The Park has the objectives of providing environmental education facilities and protecting the forest and plant cover in the catchment area of the Hlawga Lake. Thus, it is necessary to consider avoiding the route close to these areas in the project plan.

(3) Flora, Fauna and Ecosystem

In Greater Yangon three threatened animal species and two threatened plant species were reported. These are likely to distribute in protected area (Hlawga Park) and forest area. Thus, it is necessary to consider avoiding the route close to these areas in the project plan.

Trees along roads and railway lines and in parks and green spaces are important components to keep “green and clean” environment and contribute to aesthetic amenity in the city. Thus, cutting and/or removal of trees should be minimized and is required of prior permission with compensation fee from YCDC.

(4) Global Warming/climate change

Generation of greenhouse gases (GHG) such as CO2 which may affect global warming

and climate change are expected from plants, vehicles, boats and machines at construction work, and operation of transport services and related facilities. Regarding factors of CO2 emissions from railway and inland waterway transport are less than that from road transport. Therefore, modal shift to railway and inland waterway transport is preferable in terms of prevention of global warming.

(5) Air pollution

In general, higher emissions of air pollutants, which will be resulted from increased number of traveling vehicles. In addition, poor emission control of vehicles due to insufficient maintenance and inspection may accelerate to spew out bad smell and black smoke. Therefore, modal shift to railway and inland waterway transport is aso preferable in terms of prevention of air pollution.

Consider preventive measures against air pollution due to construction plants, vehicles and machines during construction stage and transport services and related facilities during operation stage in the project plan.

5.7 Local Consultants and TOR Related to Environmental and Social Considerations

5.7.1 Local Consultants

Table 5.7.1.1 shows short list of local consultants who can conduct survey on environmental and social considerations.

Table 5.7.1.1 Short List of Local Consultants in Environmental and Social Considerations

	Name of Consultant	Major activities	Contact person	Address	Phone (Mobile)	E-mail address
1	Mya Yar Pin Co., Ltd	Geotechnical survey	Mr.Thein Paing, project Director	No.2B, Myaung Mya Street, Sanchaung Township, Yangon	+951-524163 (09-5155614)	myayarpin.geotech@gmail.com
2	SUNTAC Technologies	GIS and Mapping	Sun Wynn, Director	Rm. 7 Buiding 8 Myanmar Info-Tech, Hlaing (11052), Yangon	+951-652245 (09-51066768)	sunwyin@suntactechnologies.com
3	Myanmar Engineering Consulting Co., Ltd	Social survey	Ms. Than Than Myint, Director	No.30 (G), Inya Road, Kamaryuit Township, Yangon	+951-510833 (09-5419398)	thanthan.myint@gmail.com

	Name of Consultant	Major activities	Contact person	Address	Phone (Mobile)	E-mail address
4	Resource and Environment Myanmar,	Environmental survey (air, water, noise, ecosystem)and EIA	Mr. Win Naing Tun, Director	8702 Delta Plaza, Shwegondaing Rd., Bahan, Yangon	+959-73013448 (09-5196758)	kokowinnaingtun@gmail.com
5	Myanmar Sustainable Development and Engineering Services Company. Ltd.	Environmental survey and EIA	Aung Nanda, Managing Director	No.21(I), U Kyaw Hla St., 7 Miles, Mayangone Township, Yangon	+951-655849 (09-5160905)	nanda@myanmarsustainableengineers.com
6	GEO-FRIENDS Engineering and Construction Co., Ltd.	Geological survey	Mr. Myint Kyi Htun	1136 (B), Thumingalar Road, 6 Block, South Okkalapa Township, Yangon	+951-561431 (09-5149518)	myintkyitun92@gamil.com
7	FUKKEN Co., Ltd.	Geological survey	Mr. Shi Thu Aung	No.5-C, Wingabar Road, Bahan, Yangon	+951-544856	ksithuthein@gmail.com

Source: YUTRA Study Team (2013)

5.7.2 TORs of Survey on Environmental and Social Considerations

1) TOR of Baseline Environmental Data Survey for the Feasibility Study of Yangon Circular Railway Modernization Project

(1) Purpose

The purpose of the Survey is to collect and analyze data relevant to the present status of social, natural and environmental conditions within and along ROW of Yangon Circular Railway composed of 38 railway stations.

(2) Scope of Works

Items for collection of baseline data and information are existing conditions of social environment, natural environment and environmental pollution, and involuntary resettlement.

(i) Social Environment

- Population and demography;
- Vulnerable groups;
- Land use and regulations;
- Local resources; distribution of water and energy resources;
- Economic activities;

- Water Rights, fishing rights and rights of common;
- Social infrastructure and services; a) present condition of utility services, education, medical services, b) distribution of major infrastructure and public facilities
- Cultural, archaeological, historical and religious properties;
- Public health; sanitary condition, prevalence of diseases including HIV/AIDS and waterborne diseases.
- Natural disaster and hazards; cyclones, earthquake, flood, drought, etc.
- Accidents; cases and causes of traffic and other accidents

(ii) Natural Environment

- Geology
- Topography
- Solis
- Climate and meteorology
- Hydrologic condition and ground water
- Landscape
- Flora; protected, endangered or rare species within or surrounding areas
- Fauna; protected, endangered or rare species within or surrounding areas
- Protected areas
- River and other water bodies
- Species of commercial importance
- Global warming/Climate change

(iii) Environmental Pollution

- Air pollution;
- Water pollution;
- Soil pollution;
- Bottom sediment pollution;
- Noise and vibration pollution;
- Solid waste;
- Ground subsidence;
- Offensive odors.by peoples.

(iv) Inventory survey on scale and feature of involuntary resettlement (IR)

- Inventory survey on structures within and along ROW of Yangon Circular Railway.

- Identify scale and features of involuntary resettlement, i.e., project-affected persons (PAPs), land, structures, assets, etc.
- Major existing activities within and along ROW of Yangon Circular Railway
- Situation of occupancy: ownership, tenants, illegal occupants, etc. of land, houses, structures etc.

(3) Methodology

Basically survey should be conduct by collection of secondary data and field survey by hearing and interviewing. Actual environmental survey should be conducted for such items of air quality and ambient noise, if necessary,

2) TOR for Survey on Preparation Abbreviated resettlement Plan (ARP) for the Feasibility Study of Yangon Circular Railway Modernization Project

(1) Purpose

It is required to examine the occurrence of land acquisition and/or resettlement with size and scale to secure land and/or space for the Project, and to make measures for appropriate compensation and resettlement assistance.

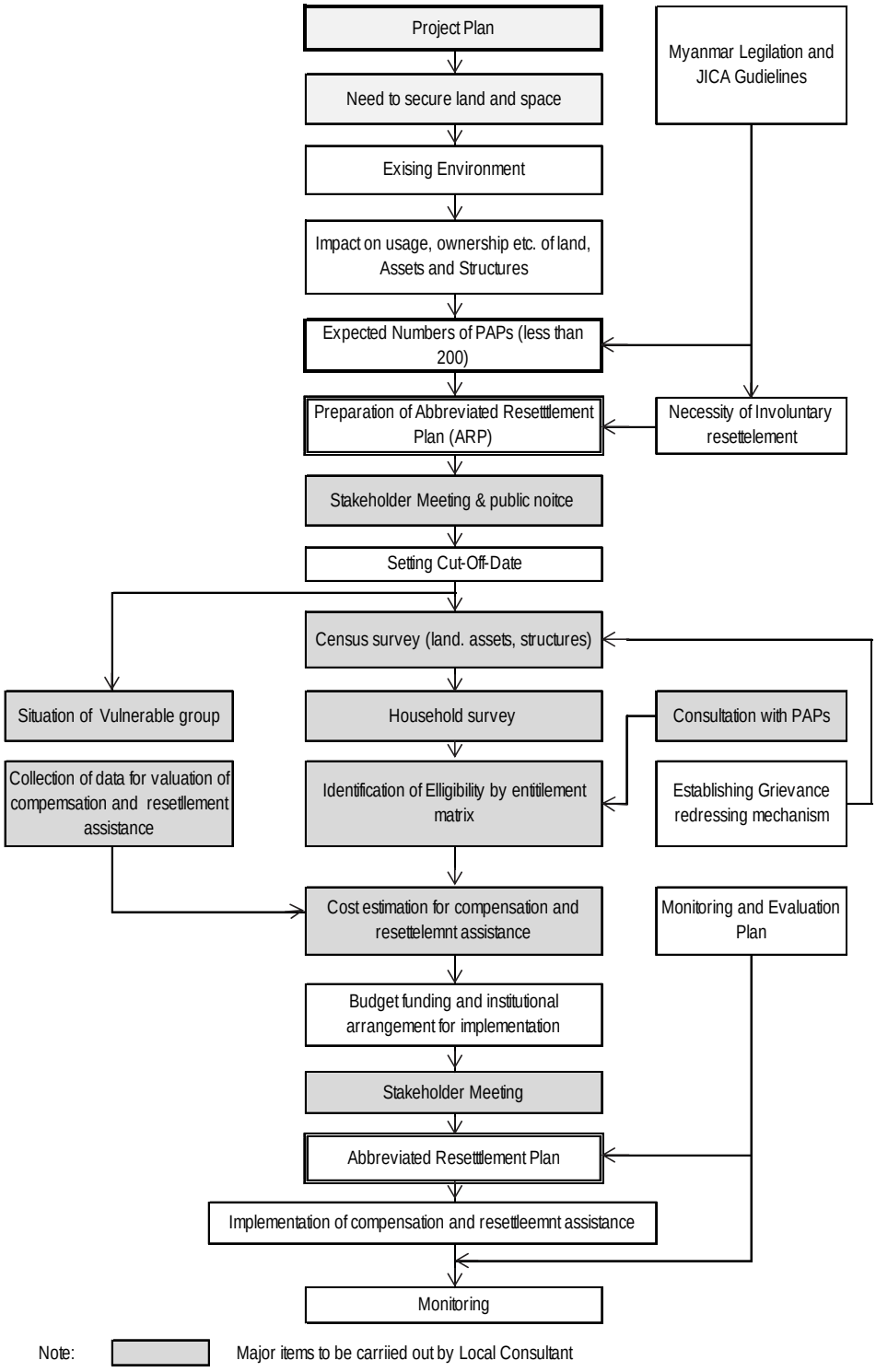
Through preliminary examination the occurrence of involuntary resettlement, i.e. land acquisition and resettlement was expected with some but less than of 200 resettled Project Affected Persons (PAPs) due to the Project. Therefore, it is required to prepare Abbreviated Resettlement Plan (ARP) for implementation of appropriate compensation and resettlement assistance to PAPs according to “JICA Guidelines for Environmental and Social Considerations (2010.4).

The purpose of the Survey is to collect and analyze relevant data and information for the preparation of ARP.

(2) Scope of Works

Survey should be conducted to obtain necessary data and make suitable analysis for preparation of Abridged Resettlement Plan (ARP) based on the JICA Guidelines.

Procedures of ARP and contents of ARP (some change is available) are shown in Figure 5.7.2.1 and Table 5.7.2.1.



Source: JICA SUDP (2013)

Figure 5.7.2.1 Procedures of Preparation of ARP

Table 5.7.2.1 Contents of ARP (Tentative)

Item
Executive Summary
1. Introduction
2. Analysis of the legal framework regarding land acquisition and resettlement
3. Necessity and features of land acquisition and resettlement
4. Inventory survey and population census survey on affected land, assets and structures, and population
5. Household survey on livelihood and living condition of PAPs
6. Basic data for valuation of compensation cost and resettlement assistance such as replacement cost
7. Vulnerable groups in the project area
8. Eligibility determination of PAPs for compensation and resettlement assistance
9. Valuation of compensation and income restoration measures
10. Grievance redress and establishing grievance mechanism
11. Institutional arrangement for implementation of compensation and resettlement assistance
12. Implementation schedule for compensation and resettlement assistance
13. Estimation of cost and budget
14. Monitoring and evaluation plan
15. Support of stakeholder meetings and consultation with PAPs hosted by Public Works Department
16. Appendices
17. Others

Source: JICA SUDP (2013)

Survey items should contain contents of the ARP and be as follows.

(i) Inventory survey and population census survey on affected land, assets and structures, and population

- By field survey and alignment drawn on topographical map, it should be identified with all the affected land, assets and structures for the situation of usage and ownership etc.
- The survey should be conducted by applying survey sheets will be provided later.
  - Inventory survey on land
  - Inventory survey on assets (houses, buildings etc.)
  - Inventory survey on structures (trees, crops, livestock etc.)
  - Population census
- It should also be identified for all the PAPs with the situation such as ownership, rent, lease, with both legal and illegal rights.

(ii) Household survey on livelihood and living condition of PAPs

- Detailed household survey should be conducted on PAPs corresponding to at least 20% of numbers of PAPs for numbers of family, livelihood, income, social-cultural characteristics, etc.

(iii) Collection of data for valuation of compensation cost and resettlement assistance

- Collect and analyze data and information for valuation of compensation cost and resettlement assistance.
  - Replacement cost of land, assets and structures
  - Income restoration cost for resettlement assistance

(iv) Survey on vulnerable groups in the project area

- Existence and situation of vulnerable groups such as poor, elderly, women, children, indigenous people, ethnic group, disabled etc., who are required to specific assistance in the project site, if any.

(v) Eligibility determination of PAPs for compensation and resettlement assistance

- Determine eligibility of PAPs for compensation and resettlement assistance by using entitlement matrix referring to cut-off-date.

(vi) Valuation of compensation and income restoration measures

- Valuation of compensation for loss of land, assets and/or structures based on replacement price valuation of assets
- Valuation of income restoration measures to improve or to restore at least level of living condition and livelihood of PAPs based on results of income restoration survey

(vii) Support of Stakeholder meetings and consultation with PAPs hosted by Myanmar Railways

- Support work for stakeholder meetings hosted by Myanmar Railways to be held at initial planning of resettlement with setting cut-off-date and after draft ARP.

3) Survey areas and location

The survey shall be carried out in the proposed project area of Yangon Circular Railway. The area and location will be provided later.

6 STUDY FOR THE CIRCULAR RAILWAY STATION PLAZA PLANNING ASSOCIATED WITH URBAN DEVELOPMENT

6.1 Required Area for the Station Plaza Space (2035) and Present Condition

The present condition of 38-station of Yangon circular railway and its result for future demand are shown as from Table 6.2.1.1 to Table 6.2.1.39. And the summary of calculation result of station plaza space is shown as below.

Table 6.2.1.1 Result of Calculation of Station Plaza Space

No.	Name of Station	Present condition of Station Plaza (m^2)	Calculation of Station Plaza Space (m^2) Formula of year-98(1998) /MLIT, Japan			Existing Development Plan
			Total	Traffic function area	Environmental function area	
1	Yangon Central	10,000	11,100	6,300	4,800	RL-7,RL-8, BRT2&5, UMRT-1
2	Phaya Road	-	1,400	800	600	
3	Lanmataw	-	800	500	300	
4	Pyay Road	-	1,600	900	700	BRT2
5	Shan Road	-	700	400	300	
6	Ahlone Road	-	500	300	200	
7	Panhlaing Road	-	900	500	400	BRT2
8	Kyeemyindaing	-	1,900	1,100	800	RL-6, RL-9
9	Hanthawaddy	-	300	200	100	
10	Hletan	-	2,500	1,500	1,000	
11	Kamayut	-	100	50	50	
12	Thiri Myine	-	100	50	50	
13	Okakyin	-	100	50	50	
14	Thamine	-	1,700	1,000	700	BRT3
15	Thamine Myothit	-	100	50	50	
16	Kyuntkon	-	700	400	300	
17	Insein	1,500	1,900	1,100	800	RL-6,RL-10, BRT, UMRT-2
18	Ywama	-	1,300	700	600	BRT2
19	Phwakan	-	600	300	300	
20	Aungsanmyo	-	1,200	700	500	
21	Danyingone	-	2,500	1,500	1,000	RL-6
22	Gauk Kwin	-	1,700	1,000	700	BRT2
23	Kyaikkalel	-	3,100	1,800	1,300	
24	Mingaladon Buzza	-	4,800	2,800	2,000	
25	Mingaladon	-	5,000	3,000	2,000	
26	Waibagi	-	1,000	600	400	UMRT-1
27	Okkalapa	-	2,900	1,700	1,200	
28	Paywetseikkon	-	600	300	300	
29	Kyaukyetwin	-	4,900	2,900	2,000	
30	Tadakalay	-	900	500	400	
31	Yegu	-	200	100	100	BRT3, UMRT-1
32	Parame	-	1,900	1,100	800	BRT3
33	Kanbe	-	800	500	300	
34	Baukthaw	-	400	200	200	
35	Tarmwe	-	2,100	1,200	900	BRT9
36	Myittanyunt	-	3,100	1,900	1,200	
37	Malwagone	-	800	500	300	RL-14
38	Pazundaung	-	3,000	1,800	1,200	

Table 6.2.1.2 Present Condition of YANGON CENTRAL Station

No.	1	**Name of Station**	Yangon Central
Present condition of surrounding area		Connect with Kun Chan Road, Pansodan St. and Gyo Phyu St. at the north entrance. Southern entrance connects Bo Gyoke Road, although the access route is poor. Station plaza is used for parking lots.	

Satellite image of a station

Photos of a station

Station Plaza (east direction)

Station Plaza (west direction)

Number of Stopping Train (2013)

per day	102	per peak hour	17

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

Generation of railway passenger (Alighting)			Attraction of railway passenger (Boarding)			Total railway passenger (pax/day)		
13,713	40,300	75,100	10,997	52,400	88,800	24,690	92,700	163,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(114)	Number of stopping taxi	(1,187)
Number of bus passenger	4,540	Number of taxi passenger	2,918

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	100	172	Number of stopping taxi	325	577
Number of bus passenger	4,020	6,899	Number of taxi passenger	798	1,420

Population (Radius of 5 km) (2010)

Estimated population (per.)	23,654	Population density (per./km2)	301

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
30.2 *(42%)*	0.0	21.7 *(31%)*	19.5 *(27%)*	0.0	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	362 *(1%)*	31,013 *(99%)*	0	0	0

Existing Plan around Station		RL-07 short term	RL-08 short term
Future Plan of Public Transportation System		BRT (-2018)	UMRT-1 (-2025)
Present Station Plaza Area	10,000 m^2	**Required Area for Station Plaza Area**※	11,100 m^2
for Traffic Functions※	6,300 m^2	for Environmental Functions※	4,800 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.3 Present Condition of HPAYA ROAD Station

No.	2	**Name of Station**	Phaya Road
Present condition of surrounding area		Entrance to the station building adjoins U Wisara Road.	
Satellite image of a station		**Photos of a station**	

Entrance of a station building

U Wisara Road

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,051	9,500	13,900	2,895	7,800	12,000	5,946	17,300	25,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(39)	Number of stopping taxi	(41)
Number of bus passenger	1,521	Number of taxi passenger	99

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	19	28	Number of stopping taxi	62	93
Number of bus passenger	771	1,111	Number of taxi passenger	153	229

Population (Radius of 5 km) (2010)			
Estimated population (per.)	16,575	Population density (per./km2)	211

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
19.2	0.0	23.8	0.0	0.0	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	16,111 *(51%)*	0	0	0	15,264 *(49%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,400 m^2
for Traffic Functions※	800m^2	for Environmental Functions※	600 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.4 Present Condition of LANMATAW Station

No.	3	**Name of Station**	Lanmataw
Present condition of surrounding area		Entrance to the station building adjoins Lanmataw Road.	
Satellite image of a station		**Photos of a station**	

Steps of a station building

Lan Ma Daw Road

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
193	4,600	8,300	952	1,900	4,100	1,145	6,500	12,400

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(20)	Number of stopping taxi	(4)
Number of bus passenger	778	Number of taxi passenger	8

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	8	14	Number of stopping taxi	24	46
Number of bus passenger	301	549	Number of taxi passenger	60	113

Population (Radius of 5 km) (2010)			
Estimated population (per.)	7,104	Population density (per./km2)	90.5

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
4.6	0.0	22.1	0.0	0.0	3.3

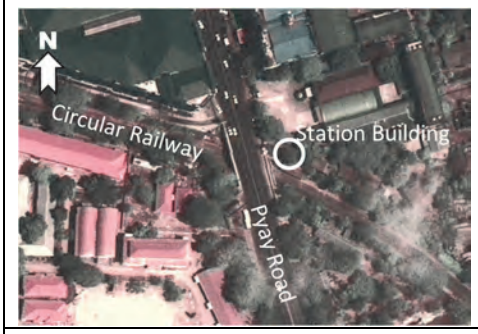
Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	16,116 *(51%)*	0	0	0	15,259 *(49%)*

Existing Plan around Station		-	-
Future Plan of Public Transportation System		-	-
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	800 m^2
for Traffic Functions※	500m^2	for Environmental Functions※	300 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.5 Present Condition of PYAY ROAD Station

No.	4	**Name of Station**	Pyay Road
Present condition of surrounding area		Entrance to the station building adjoins Pyay Road.	
Satellite image of a station		**Photos of a station**	



Entrance of a station buildong

Pyay Road

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
58	10,400	15,200	611	17,500	16,700	669	27,900	31,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(13)	Number of stopping taxi	(0)
Number of bus passenger	482	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	30	34	Number of stopping taxi	96	113
Number of bus passenger	1,191	1,349	Number of taxi passenger	237	278

Population (Radius of 5 km) (2010)			
Estimated population (per.)	5,056	Population density (per./km2)	64.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
5.5	0.0	40.1	0.0	0.0	7.7

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
12,173 *(39%)*	0	11,929 *(38%)*	0	0	0	7,273 *(23%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,600 m^2
for Traffic Functions※	900 m^2	for Environmental Functions※	700 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.6 Present Condition of SHAN ROAD Station

No.	5	**Name of Station**	Shan Road
Present condition of surrounding area		Entrance to the station building adjoins Boho Rd. and Min Ye Kyaw Zwa Rd.	
Satellite image of a station		**Photos of a station**	

Station building facing Boho Road

Boho Road

Number of Stopping Train (2013)

per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
21	4,800	6,600	895	3,900	4,900	916	8,700	11,500

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(17)	Number of stopping taxi	(0)
Number of bus passenger	666	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	10	12	Number of stopping taxi	31	42
Number of bus passenger	388	498	Number of taxi passenger	77	102

Population (Radius of 5 km) (2010)

Estimated population (per.)	10,198	Population density (per./km2)	129.8

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
2.6	0.0	56.4	0.0	1.1	1.2

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	22,308 *(71%)*	0	0	1,557 *(5%)*	7,510 *(24%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	700 m^2
for Traffic Functions※	400 m^2	for Environmental Functions※	300 m^2

Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan

Table 6.2.1.7 Present Condition of AHLONE ROAD Station

No.	6	**Name of Station**	Ahlone Road
Present condition of surrounding area	Entrance to the station building adjoins Ahlon Road.		
Satellite image of a station	**Photos of a station**		

Steps of a station from Ahlone Road

Ahlone Road

AhoNumber of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
176	4,800	5,500	667	1,100	3,700	843	5,900	9,200

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(15)	Number of stopping taxi	(4)
Number of bus passenger	577	Number of taxi passenger	9

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	7	10	Number of stopping taxi	23	33
Number of bus passenger	280	400	Number of taxi passenger	56	82

Population (Radius of 5 km) (2010)

Estimated population (per.)	14,636	Population density (per./km2)	186.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.5	0.0	53.0	0.0	3.9	0.9

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	13,384 *(43%)*	0	1,231 *(4%)*	210 (1%)	16,551 *(53%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	500 m^2
for Traffic Functions※	300 m^2	for Environmental Functions※	200 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.8 Present Condition of PANHLAING ROAD Station

No.	7	**Name of Station**	Panhlaing Road
Present condition of surrounding area		Entrance to the station building adjoins Hone Lane Road.	
Satellite image of a station		**Photos of a station**	

Station building facing Hone Lane Road

Hone Lane Road

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
168	6,100	8,600	678	3,900	6,400	846	10,000	15,000

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(15)	Number of stopping taxi	(0)
Number of bus passenger	577	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	11	16	Number of stopping taxi	37	54
Number of bus passenger	452	649	Number of taxi passenger	90	134

Population (Radius of 5 km) (2010)			
Estimated population (per.)	23,384	Population density (per./km2)	297.7

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
3.4	0.0	65.7	1.6	0.4	1.2

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	28,359 *(90%)*	1,130 *(4%)*	0	0	1,885 *(6%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	900 m^2
for Traffic Functions※	500 m^2	for Environmental Functions※	400 m^2

Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan

Table 6.2.1.9 Present Condition of KYEEMYINDAING Station

No.	8	**Name of Station**	Kyeemyindaing
Present condition of surrounding area		Entrance to the station building adjoins Upper Kyeemyindaing Rd. Eastern entrance is next to the market	
Satellite image of a station		**Photos of a station**	

Station building facing residental street

Steps of a viaduct facing Upper Kyee Myin Daing Road

Number of Stopping Train (2013)

per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,019	12,400	18,700	1,603	16,200	18,200	4,622	28,600	36,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(10)	Number of stopping taxi	(36)
Number of bus passenger	371	Number of taxi passenger	88

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	31	39	Number of stopping taxi	100	131
Number of bus passenger	1,240	1,572	Number of taxi passenger	246	323

Population (Radius of 5 km) (2010)

Estimated population (per.)	33,959	Population density (per./km2)	432.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
2.2	0.0	47.1	6.5	0.4	1.5

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	11,689 *(37%)*	17,427 *(56%)*	0	0	2,259 *(7%)*

Existing Plan around Station		RL-06 short term	RL-09 middle term
Future Plan of Public Transportation System		-	-
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,900 m^2
for Traffic Functions※	1,100 m^2	for Environmental Functions※	800 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.10 Present Condition of HANTHAWADDY Station

No.	9	**Name of Station**	Hanthawaddy
Present condition of surrounding area		Entrance to the station building adjoins Upper Kyeemyindaing Rd. and Hanthawaddy road.	
Satellite image of a station		**Photos of a station**	

Station building facing Han TharWaddy Road

Han TharWaddy Road

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
133	2,100	2,600	617	1,800	2,300	750	3,900	4,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(5)	Number of stopping taxi	(0)
Number of bus passenger	184	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	4	5	Number of stopping taxi	14	18
Number of bus passenger	173	21o	Number of taxi passenger	34	43

Population (Radius of 5 km) (2010)			
Estimated population (per.)	23,097	Population density (per./km2)	294.1

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
8.9	0.0	45.4	3.6	0.0	8.3

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
1,044 *(3%)*	0	12,539 *(40%)*	5,187 *(17%)*	0	3,556 *(11%)*	9,050 *(29%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	300 m^2
for Traffic Functions※	200 m^2	for Environmental Functions※	100 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.11 Present Condition of HLETAN Station

No.	10	**Name of Station**	Hletan
Present condition of surrounding area		Connected to the station building on the approach road of approximate 50m from Boho Road and Hle Dan Road.	
Satellite image of a station		**Photos of a station**	

Accsess road of a station building

Viaduct of Hle Dan Road

Number of Stopping Train (2013)

per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
1,876	18,700	26,600	2,528	16,400	24,700	4,404	35,100	51,300

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(8)	Number of stopping taxi	(0)
Number of bus passenger	317	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	39	55	Number of stopping taxi	126	183
Number of bus passenger	1,559	2,191	Number of taxi passenger	310	451

Population (Radius of 5 km) (2010)

Estimated population (per.)	21,948	Population density (per./km2)	279.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
2.4	13.9	47.4	2.5	0.0	5.5

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
779 *(2%)*	0	18,149 *(58%)*	4,300 *(14%)*	0	8,147 *(26%)*	0

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	2,500 m^2
for Traffic Functions※	1,500 m^2	for Environmental Functions※	1,000 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.12 Present Condition of KAMAYUT Station

No.	11	**Name of Station**	Kamayut
Present condition of surrounding area		Entrance to the station building adjoins Boho Road and rail. Western entrance is next to the residential area.	

Satellite image of a station

Photos of a station

Station building facing Boho Road

Boho Road

Number of Stopping Train (2013)

per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,126	100	200	1,808	100	200	4,934	200	400

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(4)	Number of stopping taxi	(14)
Number of bus passenger	143	Number of taxi passenger	33

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	1	1	Number of stopping taxi	1	1
Number of bus passenger	9	17	Number of taxi passenger	2	3

Population (Radius of 5 km) (2010)

Estimated population (per.)	17,282	Population density (per./km2)	220.0

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.9	0.1	60.8	3.8	0.0	1.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	14,192 *(45%)*	7,637 *(24%)*	0	0	9,547 *(30%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	100 m^2
for Traffic Functions※	50 m^2	for Environmental Functions※	50 m^2

Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan

Table 6.2.1.13 Present Condition of THIRI MYINE Station

No.	12	**Name of Station**	Thiri Myine
Present condition of surrounding area	Entrance to the station building adjoins Boho Road and rail.		

Satellite image of a station

Photos of a station

Station Building facing residental area

Boho Road

Number of Stopping Train (2013)

per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,127	100	100	860	100	300	3,987	200	400

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(8)	Number of stopping taxi	(7)
Number of bus passenger	305	Number of taxi passenger	17

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	1	1	Number of stopping taxi	1	1
Number of bus passenger	9	16	Number of taxi passenger	2	3

Population (Radius of 5 km) (2010)

Estimated population (per.)	15,052	Population density (per./km2)	191.6

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.8	0.2	59.5	2.3	0.0	7.4

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	23,693 *(76%)*	2,740 *(9%)*	0	3,859 *(12%)*	1,089 *(3%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	100 m^2
for Traffic Functions※	50 m^2	for Environmental Functions※	50 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.14 Present Condition of OKAKYIN Station

No.	13	**Name of Station**	Okakyin
Present condition of surrounding area		Entrance to the station building adjoins Boho Road.	

Satellite image of a station

Photos of a station

Station building facing Boho Road

Boho Road

Number of Stopping Train (2013)

per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
224	0	100	1,276	200	300	1,500	200	400

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(6)	Number of stopping taxi	(7)
Number of bus passenger	218	Number of taxi passenger	17

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	1	1	Number of stopping taxi	1	1
Number of bus passenger	8	16	Number of taxi passenger	2	3

Population (Radius of 5 km) (2010)

Estimated population (per.)	15,951	Population density (per./km2)	203.1

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
3.5	1.6	46.7	1.6	0.0	5.9

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
302 *(1%)*	2,125 *(7%)*	14,305 *(46%)*	3,344 *(11%)*	0	6,235 *(20%)*	5,065 *(16%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	100 m^2
for Traffic Functions※	50 m^2	for Environmental Functions※	50 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.15 Present Condition of THAMINE Station

No.	14	**Name of Station**	Thamine
Present condition of surrounding area		Entrance to the station building adjoins Boho road. Eastern entrance is next to the market	
Satellite image of a station		**Photos of a station**	

Station Building facing market place

Boho Road and Tha Maing Bu Tar Yone Rd. viaduct

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
4,751	18,400	16,900	2,949	12,600	15,900	7,700	31,000	32,800

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(4)	Number of stopping taxi	(4)
Number of bus passenger	141	Number of taxi passenger	9

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	35	35	Number of stopping taxi	113	117
Number of bus passenger	1,396	1,400	Number of taxi passenger	277	288

Population (Radius of 5 km) (2010)			
Estimated population (per.)	20,058	Population density (per./km2)	255.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.6	0.0	57.9	0.7	0.0	5.7

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
4,424 *(14%)*	0	10,620 *(34%)*	3,764 *(12%)*	0	0	12,567 *(40%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,700 m^2
for Traffic Functions※	1,000 m^2	for Environmental Functions※	700 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.16 Present Condition of THAMINE MYOTHIT Station

No.	15	**Name of Station**	Thamine Myothit
Present condition of surrounding area		Entrance to the station building adjoins Boho road..	
Satellite image of a station		**Photos of a station**	

Entrance of a station building facing Boho Road

Boho Road with median strip

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
1,211	100	200	1,517	0	100	2,728	100	300

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(5)	Number of stopping taxi	(0)
Number of bus passenger	167	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	1	1	Number of stopping taxi	1	1
Number of bus passenger	5	13	Number of taxi passenger	1	3

Population (Radius of 5 km) (2010)			
Estimated population (per.)	20,075	Population density (per./km2)	255.6

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.5	2.7	58.7	1.0	0.0	3.2

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	6,447 *(21%)*	19,454 *(62%)*	3,325 *(11%)*	0	272 (1%)	1,877 *(6%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	100 m^2
for Traffic Functions※	50 m^2	for Environmental Functions※	50 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.17 Present Condition of KYUNTKON Station

No.	16	**Name of Station**	Kyuntkon
Present condition of surrounding area		Entrance to the station building adjoins Boho road.. A signalized intersection is in the south side of the station.	
Satellite image of a station		**Photos of a station**	

Entrance of station building

Boho Road and railway crossing

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
256	2,200	8,100	1,000	1,700	2,400	1,256	3,900	10,500

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(3)	Number of stopping taxi	(0)
Number of bus passenger	93	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	4	12	Number of stopping taxi	14	40
Number of bus passenger	174	476	Number of taxi passenger	35	98

Population (Radius of 5 km) (2010)			
Estimated population (per.)	6,038	Population density (per./km2)	76.9

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.9	0.0	10.7	2.2	0.0	0.1

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	80	7,758 *(25%)*	0	0	23,537 *(75%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	700 m^2
for Traffic Functions※	400 m^2	for Environmental Functions※	300 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.18 Present Condition of INSEIN Station

No.	17	**Name of Station**	Insein
Present condition of surrounding area		Entrance to the station building/plaza adjoins Boho road.	
Satellite image of a station		**Photos of a station**	

Existing station plaza of an Insein Station

Insein Bataryon Road

Number of Stopping Train (2013)			
per day	79	per peak hour	13

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,857	11,300	18,400	4,758	10,300	21,200	8,615	21,600	39,600

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(2)	Number of stopping taxi	(19)
Number of bus passenger	78	Number of taxi passenger	45

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	24	42	Number of stopping taxi	77	140
Number of bus passenger	957	1,669	Number of taxi passenger	190	344

Population (Radius of 5 km) (2010)			
Estimated population (per.)	9,573	Population density (per./km2)	121.9

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	1.5	25.7	5.8	4.5	0.2

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	47 *(0.1%)*	0	14,474 *(46%)*	0	0	16,854 *(54%)*

Existing Plan around Station		RL-06 short term	RL-10 middle term
Future Plan of Public Transportation System		BRT (-2018)	UMRT-1 (-2025)
Present Station Plaza Area	1,500 m^2	**Required Area for Station Plaza Area**※	1,900 m^2
for Traffic Functions※	1,100 m^2	for Environmental Functions※	800 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.19 Present Condition of YWAMA Station

No.	18	**Name of Station**	Ywama
Present condition of surrounding area	Entrance to the station building adjoins rural road.		
Satellite image of a station		**Photos of a station**	

Station building (left side)

Rural Road

Number of Stopping Train (2013)

per day	54	per peak hour	9

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
335	4,700	9,500	1,239	7,500	2,700	1,574	12,200	12,200

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(2)	Number of stopping taxi	(0)
Number of bus passenger	76	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	13	14	Number of stopping taxi	42	46
Number of bus passenger	523	554	Number of taxi passenger	104	114

Population (Radius of 5 km) (2010)

Estimated population (per.)	11,449	Population density (per./km2)	145.8

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.1	0.5	21.0	0.5	0.0	2.9

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
2,024 *(6%)*	0	7,310 *(23%)*	2,733 *(9%)*	0	2,571 *(8%)*	16,738 *(53%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,300 m^2
for Traffic Functions※	700 m^2	for Environmental Functions※	600 m^2

Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan

Table 6.2.1.20 Present Condition of PHWAKAN Station

No.	19	**Name of Station**	Phwakan
Present condition of surrounding area		Entrance to the station building/rail adjoins War Oo St.	
Satellite image of a station		**Photos of a station**	


Station building


Access road of station buiding (War Oo Street)

Number of Stopping Train (2013)			
per day	54	per peak hour	9

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
155	4,100	5,400	926	4,100	6,900	1,081	8,200	12,300

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(3)	Number of stopping taxi	(0)
Number of bus passenger	100	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	9	13	Number of stopping taxi	29	43
Number of bus passenger	361	515	Number of taxi passenger	72	106

Population (Radius of 5 km) (2010)			
Estimated population (per.)	11,589	Population density (per./km2)	147.6

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
7.4	30.8	22.4	0.3	0.0	7.1

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
11,359 *(37%)*	0	13,722 *(44%)*	2,535 *(8%)*	0	2,267 *(7%)*	1,210 *(4%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m2	**Required Area for Station Plaza Area**※	600 m2
for Traffic Functions	300 m2	for Environmental Functions	300 m2

Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan

Table 6.2.1.21 Present Condition of AUNGSANMYO Station

No.	20	**Name of Station**	Aungsanmyo
Present condition of surrounding area		Entrance to the station building adjoins rural road.	
Satellite image of a station		**Photos of a station**	

Station building (right side)

Access from Lower Mingalardon Rd.

Number of Stopping Train (2013)			
per day	54	per peak hour	9

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
413	5,400	12,100	766	2,500	12,700	1,179	7,900	24,800

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(2)	Number of stopping taxi	(0)
Number of bus passenger	72	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	9	26	Number of stopping taxi	29	88
Number of bus passenger	363	1,051	Number of taxi passenger	72	216

Population (Radius of 5 km) (2010)			
Estimated population (per.)	4,735	Population density (per./km2)	60.3

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
2.4	12.3	35.3	0.3	0.0	23.7

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	1,310 *(4%)*	18,244 *(58%)*	3.086 *(10%)*	0	8,699 *(27%)*	317 *(1%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,200 m^2
for Traffic Functions※	700 m^2	for Environmental Functions※	500 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.22 Present Condition of DANYINGONE Station

No.	21	**Name of Station**	Danyingone
Present condition of surrounding area		Entrance to the station building/platform adjoins Danyingone St.	
Satellite image of a station		**Photos of a station**	

Station building (left side) and markets on platforms

Da Nyin Gone Station Rd. with median strip

Number of Stopping Train (2013)			
per day	54	per peak hour	9

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
7,880	1,300	26,000	4,072	1,400	26,400	11,952	2,700	52,400

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(4)	Number of stopping taxi	(29)
Number of bus passenger	144	Number of taxi passenger	71

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	3	56	Number of stopping taxi	10	186
Number of bus passenger	118	2,226	Number of taxi passenger	24	458

Population (Radius of 5 km) (2010)			
Estimated population (per.)	2,332	Population density (per./km2)	29.7

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
2.9	11.0	5.1	0.3	5.3	26.3

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
13,168 *(42%)*	0	6,374 *(20%)*	3,072 *(10%)*	2,515 *(8%)*	5,884 *(19%)*	363 *(1%)*

Existing Plan around Station	RL-06 short term	-
Future Plan of Public Transportation System	-	-
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	2,500 m^2
for Traffic Functions※	1,500 m^2	for Environmental Functions※	1,000 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.23 Present Condition of GAUK KWIN Station

No.	22	**Name of Station**	Gauk Kwin (Golf Course)
Present condition of surrounding area		Entrance to the station building/platform adjoins Market Street	
Satellite image of a station		**Photos of a station**	

Station building (right side)

Lower Mingalardon Road

Number of Stopping Train (2013)			
per day	14	per peak hour	2

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
45	1,500	21,000	216	1,600	2,100	261	3,100	23,100

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(2)	Number of stopping taxi	(0)
Number of bus passenger	70	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	3	27	Number of stopping taxi	11	90
Number of bus passenger	136	1,079	Number of taxi passenger	27	222

Population (Radius of 5 km) (2010)			
Estimated population (per.)	2,332	Population density (per./km2)	29.7

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	3.9	10.8	0.1	0.0	22.6

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
399 *(1%)*	0	1,849 *(6%)*	1,231 *(4%)*	0	5,056 (16%)	22,840 *(73%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,700 m^2
for Traffic Functions※	1,000 m^2	for Environmental Functions※	700m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.24 Present Condition of KYAIKKALEL Station

No.	23	**Name of Station**	Kyaikkalel
Present condition of surrounding area		Entrance to the station building/platform adjoins approach road of Pyay Road.	
Satellite image of a station		**Photos of a station**	


Station building and platform


Access road from Pyay Road

Number of Stopping Train (2013)			
per day	14	per peak hour	2

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
27	3,700	33,800	492	700	22,700	519	4,400	56,500

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(5)	Number of stopping taxi	(13)
Number of bus passenger	199	Number of taxi passenger	31

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	5	61	Number of stopping taxi	17	206
Number of bus passenger	210	2,459	Number of taxi passenger	42	506

Population (Radius of 5 km) (2010)			
Estimated population (per.)	1,677	Population density (per./km2)	21.3

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	0.0	6.3	0.2	0.0	3.7

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	654 *(2%)*	2,008 *(6%)*	0	1,400 *(4%)*	27,313 *(87%)*

Existing Plan around Station		-	-
Future Plan of Public Transportation System		-	-
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	3,100 m^2
for Traffic Functions※	1,800m^2	for Environmental Functions※	1,300 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.25 Present Condition of MINGALADON BUZZA Station

No.	24		**Name of Station**	Mingaladon Buzza				
Present condition of surrounding area	Station building is 1,000m from Pyay Rd to the east.							
Satellite image of a station	**Photos of a station**							
	 Entrance of station building  Access road in field							
Number of Stopping Train (2013)								
per day	14		per peak hour	2				
Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team								
General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
141	38,800	48,000	367	26,600	57,000	508	65,400	105,000
Departure/Arrive Trip for Station by Bus and Taxi								
Present Condition (2013) (vehicle, pax /day)								
Number of stopping bus	(1)		Number of stopping taxi	(0)				
Number of bus passenger	34		Number of taxi passenger	0				
Future Demand Value (2025, 2035) (vehicle, pax /peak hour)								
Number of stopping bus	74	110	Number of stopping taxi	238	370			
Number of bus passenger	2,946	4,418	Number of taxi passenger	585	909			
Population (Radius of 5 km) (2010)								
Estimated population (per.)	10,153		Population density (per./km2)	129.3				
Land Uses (Radius of 500m) ha								
Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation			
0.0	0.0	28.5	0.1	0.0	48.3			
Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body								
Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others		
0	0	9,823 (31%)	599 *(2%)*	0	20,953 *(67%)*	0		
Existing Plan around Station		-		-				
Future Plan of Public Transportation System		-		-				
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	4,800 m^2					
for Traffic Functions※	2,800m^2	for Environmental Functions※	2,000 m^2					
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan							

Table 6.2.1.26 Present Condition of MINGALADON Station

No.	25	**Name of Station**	Mingaladon
Present condition of surrounding area	Station building is 250m from Khayae Pin Rd to the south.		
Satellite image of a station	**Photos of a station**		

Station building facing road

Airport Surrounding Road

Number of Stopping Train (2013)			
per day	34	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
2,517	20,600	53,700	2,307	38,000	44,900	4,824	58,600	98,600

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(2)	Number of stopping taxi	(8)
Number of bus passenger	51	Number of taxi passenger	19

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	62	106	Number of stopping taxi	201	354
Number of bus passenger	2,489	4,238	Number of taxi passenger	494	872

Population (Radius of 5 km) (2010)			
Estimated population (per.)	6,994	Population density (per./km2)	89.0

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	0.0	44.9	0.2	0.0	29.6

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	0	21,016 (67%)	2,441 *(8%)*	6,004 *(19%)*	1,915 *(6%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	5,000 m^2
for Traffic Functions※	3,000 m^2	for Environmental Functions※	2,000 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.27 Present Condition of WAIBAGI Station

No.	26	**Name of Station**	Waibagi
Present condition of surrounding area	Entrance to the station building adjoins airport surroundings road.		
Satellite image of a station	**Photos of a station**		

Station building and platform

Airport Surrounding Road

Number of Stopping Train (2013)			
per day	34	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
251	4,600	10,400	737	5,300	10,400	988	9,900	20,800

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(0)
Number of bus passenger	39	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	11	22	Number of stopping taxi	35	74
Number of bus passenger	432	884	Number of taxi passenger	86	182

Population (Radius of 5 km) (2010)			
Estimated population (per.)	5,860	Population density (per./km2)	74.6

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	0.0	15.4	0.1	0.3	27.4

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

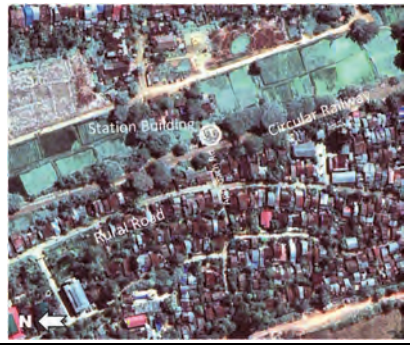
Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	3,619 *(12%)*	775 *(2%)*	588 *(2%)*	16,159 *(52%)*	10,234 *(33%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	UMRT-1 (-2025)

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,000 m^2
for Traffic Functions※	600 m^2	for Environmental Functions※	400 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.28 Present Condition of OKKALAPA Station

No.	27	**Name of Station**	Okkalapa
Present condition of surrounding area		Small station around the airport	
Satellite image of a station		**Photos of a station**	



Station building and platform

Access street from rural road

Number of Stopping Train (2013)

per day	34	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
1,276	9,400	23,600	981	11,000	39,700	2,257	20,400	63,300

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(4)
Number of bus passenger	17	Number of taxi passenger	9

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	22	65	Number of stopping taxi	72	218
Number of bus passenger	890	2,609	Number of taxi passenger	177	537

Population (Radius of 5 km) (2010)

Estimated population (per.)	19,053	Population density (per./km2)	242.6

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	0.0	42.9	0.1	0.0	13.1

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	19,219 *(61%)*	1,105 *(4%)*	0	8,409 *(27%)*	2,643 *(8%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	2,900 m^2
for Traffic Functions※	1,700 m^2	for Environmental Functions※	1,200 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.29 Present Condition of PAYWETSEIKKON Station

No.	28	**Name of Station**	Paywetseikkon
Present condition of surrounding area	Small station south direction of the airport.		
Satellite image of a station	**Photos of a station**		

Station building and platform

Access street

Number of Stopping Train (2013)			
per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
2,671	300	1,000	1,729	300	1,500	4,400	600	2,500

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(3)	Number of stopping taxi	(13)
Number of bus passenger	115	Number of taxi passenger	30

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	1	3	Number of stopping taxi	2	9
Number of bus passenger	26	104	Number of taxi passenger	5	21

Population (Radius of 5 km) (2010)

Estimated population (per.)	17,425	Population density (per./km2)	221.9

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.8	0.0	64.9	0.1	0.8	4.7

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	15,243 *(49%)*	745 *(2%)*	5,196 *(17%)*	9,424 *(30%)*	735 *(2%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	600 m^2
for Traffic Functions※	300 m^2	for Environmental Functions※	300 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.30 Present Condition of KYAUKYETWIN Station

No.	29	**Name of Station**	Kyaukyetwin
Present condition of surrounding area		Entrance to the station building/platform adjoins service road of Radio Station Road.	
Satellite image of a station		**Photos of a station**	

Station building and platform

Entrance of a S.B. facing Radio Station Road IC

Number of Stopping Train (2013)

per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
2,112	40,900	54,400	1,259	28,800	5,893	33,300	69,700	87,700

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(0)
Number of bus passenger	17	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	78	96	Number of stopping taxi	253	321
Number of bus passenger	3,135	3,837	Number of taxi passenger	623	790

Population (Radius of 5 km) (2010)

Estimated population (per.)	11,675	Population density (per./km2)	148.7

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
4.0	12.9	40.9	0.0	0.0	5.3

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
3,252 *(10%)*	0	22,257 *(71%)*	330 *(1%)*	0	5,536 *(18%)*	0

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	4,900 m^2
for Traffic Functions※	2,900 m^2	for Environmental Functions※	2,000 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.31 Present Condition of TADAKALAY Station

No.	30	**Name of Station**	Tadakalay
Present condition of surrounding area		Entrance to the station building/platform adjoins Thudhamma Road.	
Satellite image of a station		**Photos of a station**	

Station building and platform

Thudhamma Road and bus (stop) bay

Number of Stopping Train (2013)			
per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
2,392	6,600	9,400	1,633	5,000	7,300	4,025	11,600	16,700

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(3)	Number of stopping taxi	(7)
Number of bus passenger	93	Number of taxi passenger	9

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	13	18	Number of stopping taxi	42	60
Number of bus passenger	520	721	Number of taxi passenger	103	148

Population (Radius of 5 km) (2010)			
Estimated population (per.)	17,391	Population density (per./km2)	221.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.5	0.0	64.5	0.3	1.1	2.2

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	18,717 *(60%)*	3,060 *(10%)*	4,442 *(14%)*	0	5,157 *(16%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	900 m^2
for Traffic Functions※	500 m^2	for Environmental Functions※	400 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.32 Present Condition of YEGU Station

No.	31	**Name of Station**	Yegu
Present condition of surrounding area		Entrance to the station building/platform adjoins Thudhamma Road.	
Satellite image of a station		**Photos of a station**	


Station building and platform


Wai Za Yan Tar Road (concrete pavement)

Number of Stopping Train (2013)			
per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
206	900	400	926	1,200	2,600	1,132	2,100	3,000

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(0)
Number of bus passenger	29	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	2	3	Number of stopping taxi	7	10
Number of bus passenger	91	116	Number of taxi passenger	18	24

Population (Radius of 5 km) (2010)			
Estimated population (per.)	7,835	Population density (per./km2)	99.8

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
3.9	0.0	24.8	0.4	0.0	5.6

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
2,763 *(9%)*	0	22,280 *(71%)*	3,506 *(11%)*	0	681 *(2%)*	2,145 *(7%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	UMRT-1 (-2025)

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	200 m^2
for Traffic Functions※	100 m^2	for Environmental Functions※	100 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.33 Present Condition of PARAME Station

No.	32	**Name of Station**	Parame
Present condition of surrounding area		Entrance to the station building/platform adjoins Parame Road viaduct.	

Satellite image of a station

Photos of a station

Station building and platform

Access sidewalk form station building (Parami Rd. viaduct)

Number of Stopping Train

per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
133	12,600	13,200	757	16,400	22,700	890	29,000	35,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(12)
Number of bus passenger	17	Number of taxi passenger	29

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	31	37	Number of stopping taxi	102	124
Number of bus passenger	1,257	1,478	Number of taxi passenger	250	304

Population (Radius of 5 km) (2010)

Estimated population (per.)	12,614	Population density (per./km2)	160.6

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
1.4	0.0	62.9	0.0	0.0	6.2

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	19,000 *(61%)*	0	0	12,375 *(39%)*	0

Existing Plan around Station		-	-
Future Plan of Public Transportation System		BRT (-2018)	-
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	1,900 m^2
for Traffic Functions※	1,100 m^2	for Environmental Functions※	800 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.34 Present Condition of KANBE Station

No.	33	**Name of Station**	Kanbe
Present condition of surrounding area	Station building is 200m from Wai Za Yan Tar Rd to the west.		
Satellite image of a station	**Photos of a station**		


Entrance of a station building


Wai Za Yan Tar Road

Number of Stopping Train (2013)			
per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,088	7,900	7,700	1,730	7,200	7,300	4,818	15,100	15,000

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(0)
Number of bus passenger	10	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	17	16	Number of stopping taxi	54	54
Number of bus passenger	669	640	Number of taxi passenger	133	132

Population (Radius of 5 km) (2010)			
Estimated population (per.)	30,075	Population density (per./km2)	382.9

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	0.0	71.2	0.3	0.0	1.9

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	26,217 *(84%)*	2,584 *(8%)*	0	0	2,575 *(8%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	800 m^2
for Traffic Functions※	500 m^2	for Environmental Functions※	300 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.35 Present Condition of BAUKTHAW Station

No.	34	**Name of Station**	Baukthaw
Present condition of surrounding area	Entrance to the station building adjoins Baukthaw St.		

Satellite image of a station

Photos of a station

Station building (wooden type)

Access road from Baukthaw Street

Number of Stopping Train (2013)

per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
186	1,700	3,700	932	800	2,200	1,118	2,500	5,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1	Number of stopping taxi	(0)
Number of bus passenger	9	Number of taxi passenger	0

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	3	6	Number of stopping taxi	9	22
Number of bus passenger	115	259	Number of taxi passenger	23	53

Population (Radius of 5 km) (2010)

Estimated population (per.)	14,133	Population density (per./km2)	179.9

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.4	1.8	57.9	1.0	0.0	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	13,864 *(44%)*	9,266 *(30%)*	0	0	8,244 *(26%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	400 m^2
for Traffic Functions※	200 m^2	for Environmental Functions※	200 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.36 Present Condition of TARMWE Station

No.	35	**Name of Station**	Tarmwe
Present condition of surrounding area		Entrance to the station building/platform adjoins Lay Danungkan Rd. viaduct.	
Satellite image of a station		**Photos of a station**	

Station building and platform

Ray Daungkan Road viaduct

Number of Stopping Train (2013)			
per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
2,805	15,500	21,900	969	15,900	20,800	3,774	31,400	42,700

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(1)	Number of stopping taxi	(7)
Number of bus passenger	8	Number of taxi passenger	17

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	35	46	Number of stopping taxi	112	152
Number of bus passenger	1,381	1,821	Number of taxi passenger	274	375

Population (Radius of 5 km) (2010)			
Estimated population (per.)	10,326	Population density (per./km2)	131.5

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.6	0.0	55.4	0.0	0.6	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	25,704 *(82%)*	0	5,672 *(18%)*	0	0

Existing Plan around Station	-	-
Future Plan of Public Transportation System	BRT (-2018)	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	2,100 m^2
for Traffic Functions※	1,200 m^2	for Environmental Functions※	900 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.37 Present Condition of MYITTANYUNT Station

No.	36	**Name of Station**	Myittanyunt
Present condition of surrounding area		Entrance to the station building adjoins Dagon Lwin St. in the resident area.	
Satellite image of a station		**Photos of a station**	

Station building facing Dagon Lwin Street

Dagon Lwin Street

Number of Stopping Train (2013)			
per day	38	per peak hour	6

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
333	25,700	37,900	1,189	31,600	38,600	1,522	57,300	76,500

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(0)	Number of stopping taxi	(7)
Number of bus passenger	0	Number of taxi passenger	17

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	62	81	Number of stopping taxi	201	272
Number of bus passenger	2,493	3,249	Number of taxi passenger	495	669

Population (Radius of 5 km) (2010)			
Estimated population (per.)	20,838	Population density (per./km2)	265.3

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
0.0	0.1	66.5	0.3	0.0	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	28,817 *(92%)*	0	2,558 *(8%)*	0	0

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	3,100 m^2
for Traffic Functions※	1,900 m^2	for Environmental Functions※	1,200 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.38 Present Condition of MALWAGONE Station

No.	37	**Name of Station**	Malwagone
Present condition of surrounding area		Entrance to the station building (on the bridge) adjoins Myo Pat St.	
Satellite image of a station		**Photos of a station**	

Station office on a viaduct

Myo Pat Street

Number of Stopping Train (2013)			
per day	102	per peak hour	17

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
3,297	5,000	6,400	2,464	4,700	12,200	5,761	9,700	18,600

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(0)	Number of stopping taxi	(3)
Number of bus passenger	0	Number of taxi passenger	7

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	11	19	Number of stopping taxi	35	64
Number of bus passenger	429	761	Number of taxi passenger	85	157

Population (Radius of 5 km) (2010)			
Estimated population (per.)	44,643	Population density (per./km2)	568.4

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
2.1	0.0	55.9	8.2	0.0	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	18,877 *(60%)*	12,111 *(39%)*	0	0	388 *(1%)*

Existing Plan around Station		RL-14 short term	-
Future Plan of Public Transportation System		-	-
Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	800 m^2
for Traffic Functions※	500 m^2	for Environmental Functions※	300 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

Table 6.2.1.39 Present Condition of PAZUNDAUNG Station

No.	38	**Name of Station**	Pazundaung
Present condition of surrounding area		Entrance to the station building (on the bridge) adjoins Upper Pazundaung Rd..	
Satellite image of a station		**Photos of a station**	

Entrance of station office on a viaduct

Upper Pazundaung Road

Number of Stopping Train (2013)			
per day	102	per peak hour	17

Railway Passenger Interview Survey and Future Demand (2013, 2025 and 2035) Source; JICA Study Team

General railway passenger			Attraction of railway passenger			Total railway passenger (pax/day)		
929	22,000	30,700	3,263	24,500	35,200	4,192	46,500	65,900

Departure/Arrive Trip for Station by Bus and Taxi

Present Condition (2013) (vehicle, pax /day)

Number of stopping bus	(0)	Number of stopping taxi	(12)
Number of bus passenger	0	Number of taxi passenger	29

Future Demand Value (2025, 2035) (vehicle, pax /peak hour)

Number of stopping bus	51	69	Number of stopping taxi	164	232
Number of bus passenger	2,035	2,779	Number of taxi passenger	404	572

Population (Radius of 5 km) (2010)			
Estimated population (per.)	35,777	Population density (per./km2)	501.8

Land Uses (Radius of 500m) ha

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation
5.4	0.0	35.5	2.6	0.0	0.0

Land Uses (Radius of 100m) m^2 Others; Governmental Units, Public Facilities, Utilities and Water Body

Commercial & Business	Industries	Residential Area	Rail Station Area	MR own Land	Vegetation	Others
0	0	10577 *(34%)*	4,477 *(14%)*	0	0	16,321 *(52%)*

Existing Plan around Station	-	-
Future Plan of Public Transportation System	-	-

Present Station Plaza Area	0 m^2	**Required Area for Station Plaza Area**※	3,000 m^2
for Traffic Functions※	1,800 m^2	for Environmental Functions※	1,200 m^2
Remarks	※Station Plaza area calculated (m^2) by year-98(1998) formula / MLIT, Japan		

6.2 Study for the Proper Place Selection Integrally with Urban Development

6.2.1 Existing Urban Development/Redevelopment Plan along the Circular Railway

MR has large land for station yard, depot, workshop, etc. along the railway line in the study area as shown in the table below. This land is appropriate for redevelopment and TOD because projects can be conducted inside railway area without land acquisition and resettlement. In addition, in some circular railway stations, there are several UMRT and BRT plan, therefore the development/redevelopment plan of each station plaza should be considered with these traffic development plans.

Table 6.2.1.40 Transportation Development Plan

No.	Name of Station	Name of project	MR's yard for redevelopment
1	(01) Yangon Central	**RL-7**:Yangon Central Station Redevelopment Project (Short-term) **RL-8**:New Integrated Depot and Workshop Construction Project Phase1 (Short-term) **UMRT Line1**:Construction project/North-South Line (Middle-term) **BRT 2**:Phase 1A – from Danyingone Junction-CBD **BRT 5**:Phase 1B – from Aungmingalar H/W Bus Terminal-CBD	approximately 16 ha
2	(04) Pyay Road	**BRT 2**:Phase 1A – from Danyingone Junction-CBD	-
3	(07) Panhlaing Road	**BRT 2**:Phase 1A – from Danyingone Junction-CBD	-
4	(08) Kyeemyindaing	**RL-6**:TOD Enhancement Project along Yangon Circular Railway Western Half (Short-term) **RL-9**:Kyee Myin Daing Station Yard Redevelopment Project (Middle-term)	approximately 5 ha
5	(14) Thamine	**BRT 3**:Phase 1A – from Dagon Ayeyar H/W-Dagon Thiri Garden	-
6	(17) Insein	**RL-6**:TOD Enhancement Project along Yangon Circular Railway Western Half (Short-term) **RL-10**:Insein Workshop Area Redevelopment Project (Middle-term) **UMRT Line2**:Construction project/East-West Line (Long-term) **BRT 2**:Phase 1A – from Danyingone Junction-CBD	approximately 26 ha
7	(18) Ywama	**BRT 2**:Phase 1A – from Danyingone Junction-CBD	-
8	(21) Danyingone	**RL-6**:TOD Enhancement Project along Yangon Circular Railway Western Half (Short-term)	-

No.	Name of Station	Name of project	MR's yard for redevelopment
9	(22) Gauk Kwin	**BRT 2**:Phase 1A – from Danyingone Junction-CBD	-
10	(26) Waibagi	**UMRT Line1**:Construction project/North-South Line (Middle-term)	-
11	(31) Yegu	**UMRT Line1**:Construction project/North-South Line (Middle-term) **BRT 3**:Phase 1A – from Dagon Ayeyar H/W-Dagon Thiri Garden	-
12	(32) Parame	**BRT 3**:Phase 1A – from Dagon Ayeyar H/W-Dagon Thiri Garden	-
13	(35) Tarmwe	**BRT 9**:Phase 2A – from Myaynigone Junction-Thingangyun Sanpya Market	-
14	(37) Malwagone	**RL-14**:Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station) (Short-term)	approximately 61 ha

Source: YUTRA Project Team (2013)

6.2.2 Categorize of the Station Plaza Plan

Each station plaza plan is categorized to 5 (five) classes as the following, based on the above-mentioned "Calculation result of station plaza space" and "Present condition and transportation development plan".

- Category-1; Stations which are important in traffic function and the land acquisition for the station plaza is relatively easy.
- Yangon Central, Keemyindaing and Insein
- Category-2; Stations which are important in traffic function, however, the land acquisition for the station plaza is relatively difficult.
- Danyingone, Parame and Tarmwe
- Category-3; Traffic demand is not so large, although there are plans such as BRT.
- Pyay Road, Panhlaing Road, Thamine, Ywama, Gauk Kwin, Waibagi, Yegu and Malwagone
- Category-4; Traffic demand is large, although there are no plan such as BRT.
- Hletan, Kyaikkalel, Mingaladon Buzza, Mingaladon, Okkalapa, Kyaukyetwin, etc.
- Category-5; Traffic demand is not so large, and there are no plan such as BRT.
- Phaya Road, Lanmataw, shan Road, Ahlone Road, Hanthawaddy, Kamayut, etc

Table 6.2.2.1 Categorize of Station Plaza Plan

No.	Name of Station	MR's Yard for redevelop-ment (m^2)	Calculation of Station Plaza Space (m^2)	Existing Development Plan	Categorize of Station Plaza Plan
1	Yangon Central	160,000	11,100	RL-7,RL-8, BRT2&5, UMRT-1	Category-1
2	Phaya Road	-	1,400		Category-5
3	Lanmataw	-	800		Category-5
4	Pyay Road	-	1,600	BRT2	Category-3
5	Shan Road	-	700		Category-5
6	Ahlone Road	-	500		Category-5
7	Panhlaing Road	-	900	BRT2	Category-3
8	Kyeemyindaing	50,000	1,900	RL-6, RL-9	Category-1
9	Hanthawaddy	-	300		Category-5
10	Hletan	-	2,500		Category-4
11	Kamayut	-	100		Category-5
12	Thiri Myine	-	100		Category-5
13	Okakyin	-	100		Category-5
14	Thamine	-	1,700	BRT3	Category-3
15	Thamine Myothit	-	100		Category-5
16	Kyuntkon	-	700		Category-5
17	Insein	260,000	1,900	RL-6,RL-10, BRT, UMRT-2	Category-1
18	Ywama	-	1,300	BRT2	Category-3
19	Phwakan	-	600		Category-5
20	Aungsanmyo	-	1,200		Category-5
21	Danyingone	-	2,500	RL-6	Category-2
22	Gauk Kwin	-	1,700	BRT2	Category-3
23	Kyaikkalel	-	3,100		Category-4
24	Mingaladon Buzza	-	4,800		Category-4
25	Mingaladon	-	5,000		Category-4
26	Waibagi	-	1,000	UMRT-1	Category-3
27	Okkalapa	-	2,900		Category-4
28	Paywetseikkon	-	600		Category-5
29	Kyaukyetwin	-	4,900		Category-4
30	Tadakalay	-	900		Category-5
31	Yegu	-	200	BRT3, UMRT-1	Category-3
32	Parame	-	1,900	BRT3	Category-2
33	Kanbe	-	800		Category-5
34	Baukthaw	-	400		Category-5
35	Tarmwe	-	2,100	BRT9	Category-2
36	Myittanyunt	-	3,100		Category-4
37	Malwagone	610,000	800	RL-14	Category-3
38	Pazundaung	-	3,000		Category-4

Source: YUTRA Project Team (2013)

6.3 Introduction of the Facility Development Plan for the Railway Elderly/Disabled Person and Road Users

In Japan, the guidelines and the design standards about the facilities for elderly/disabled person are already prepared, and the utilization to the project is expected. The guidelines of facilities of Japan is extracted as below.

6.3.1 Policy of Transfer Paths based on the Universal Design

1) Transfer Path for Convenient Travel

In consideration of the convenient travel for elderly/disabled person, it is necessary to start up and stop train/vehicle smoothly as they possibly use station plaza alone and for public passage. In addition, it is also necessary to ensure the continuity of the walking path in entire movement.

2) Public Passage and Entrance

In consideration of convenient travel for elderly/disabled person, the public passage and entrance is necessary to easily approach.

3) Entrance of Ticket Office, Waiting Room and Information Desk

In consideration of convenient travel for elderly/disabled person, it is necessary to easily approach the entrance of ticket sales office, waiting room and information desk. Particularly, it is necessary to consider that a wheelchair user does not make a detour to move.

4) Passage

In consideration of the facilitation of movement for elderly/disabled person, it is necessary to secure a line of flow with the continuity and to consider that there is no complicated corner/ wall and obstacle, pillar and other facilities.

5) Slope

For a wheelchair user, the installation of slopes relieving stairway is necessary. In the installation of a slope, it is important for a wheelchair user, elderly/disabled person and a stroller user to pass through a corridor. Therefore the width and the tilt slope are necessary to be considered.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.1.1 Slope beside Stairway

6) Stairway

The stairway is a spot of feeling a big stress during the transfer path. Particularly, it is necessary to consider the smooth use for an elderly/disabled person and a visually impaired person.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.1.2 Handrail of Stairway

7) Elevator

An elevator is the perpendicular moving facility which is effective for all users such as an elderly/disabled person, independent wheelchair user and the stroller user. Therefore, it is necessary to consider that all users can move easily and safely.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.1.3 Elevator of Wheelchair User

8) Escalator

It is necessary to consider the length/speed of a horizontal section of step for using by elderly/disabled person.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.1.4 Entrance/Exit Part of Escalator

6.3.2 Policy of Instruction and Information Guidance Facilities based on the Universal Design

1) Indicating Equipment

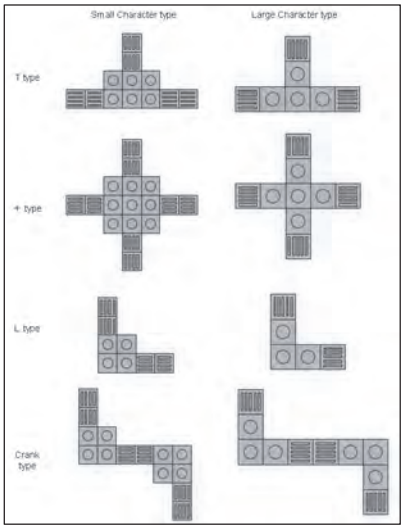
In an installation of indicating equipment, it is necessary to exhibit enough their functions of original facility. At the same time, it is necessary that the user can collect information by the same equipment with various kinds of information/communication limitation.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.2.1 Indicating Equipment

2) Instruction and Guidance Equipment for Visually Impaired Person

A Tactile paving is the most effective device for the instruction/guidance fpr a visually impaired person at present. In consideration of the arrangement plan of passenger facilities, it is effective to install at the predetermined position for transfer. In installation stage, it is necessary to clarify the point/location of instruction and to be un-detour. In addition, it is necessary to consider the finishing type of neighboring floorings.



Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.2.2 Tactile Paving Type (Small and Large Type)

3) Instruction and Guidance Equipment for Emergency

Even in the case of emergency, it is important that elderly/disabled person can evacuate smoothly and safely. Therefore it is necessary to prepare facilities based on the regulations of the fire station-affiliated laws, ordinances and local government.

6.3.3 Policy of Facilities based on the Universal Design

1) Rest Room

For all users, it is important to access it easily.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.3.1 Rest Room of Wheelchair User

2) Ticket Sales Office, Waiting Room and Information Desk

For a wheelchair user, it is structurally difficult to use a ticket gate and the counter of the information desk. Particularly, it is necessary to consider about the height and the riser of a desk. It is important to avoid his knee or a foot support for a wheelchair user hits against the lower part of a desk.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.3.2 Information Desk (Low Height Type)

3) Ticket-Vending Machine

To install a ticket vendor machine in the height that a wheelchair user is easy to use. It is necessary to install a riser so that a wheelchair user approaches a ticket vendor machine easily. Because the touch panel type is not available to a visually impaired person, it is necessary to prepare a numeric keypad additionally.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.3.3 Ticket-Vending Machine with Riser

4) Facility of Rest Area

In a large-scale passenger facility (station), it is necessary to prepare facilities for an elderly/disabled person to take a break in consideration for a long-distance trip. In addition, it is better to install facilities for travellers with infants.

6.3.4 Policy of Passenger Facilities based on the Universal Design

1) Ticket Gate

When a wheelchair user passes the ticket gate, there are many cases having difficulty in use of a usual gate. It is better that there is not limitation such as the support of the station officer.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.4.1 Ticket Gate

2) Platform of Station

On a platform of station, it is important to install fall prevention facilities. From the viewpoint of fall prevention of a visually impaired person, it is better to install a home edge warning block, a platform door and a movable home fence. In addition, it is necessary to eliminate uneven steps among a platform and the step of a train as much as possible.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.4.2 Fall Prevention Facilities

3) Platform of Bus Terminal

Bus is the most familiar transportation mode, and elderly/disabled person often use a route bus. In addition, it is expected by the popularization of non-step buses/vehicles that the use such as an elderly/disabled person increases. The platform number, destination of bus, departure time and service information are high need information for users. It is necessary to expand/improve a guide (sound guidance, provide information to a smart phone) for a visually impaired person.

Source: Guideline for UD, MLIT (Japan) 2013

Figure 6.3.4.3 Roofs of Bus Terminal

6.3.5 Consideration at the Planning/Construction Stages based on the Universal Design

1) Consideration at Planning Stage

At a planning stage, it is important to establish an "Universal Design Conference Body (tentative)" which is comprised of a government (expert), a planning group, a design group, a construction group, and a elderly/disabled person group and discuss about the policy of

universal design matter. And it will be very important to understand both a policy of the government (expert) and needs of users.

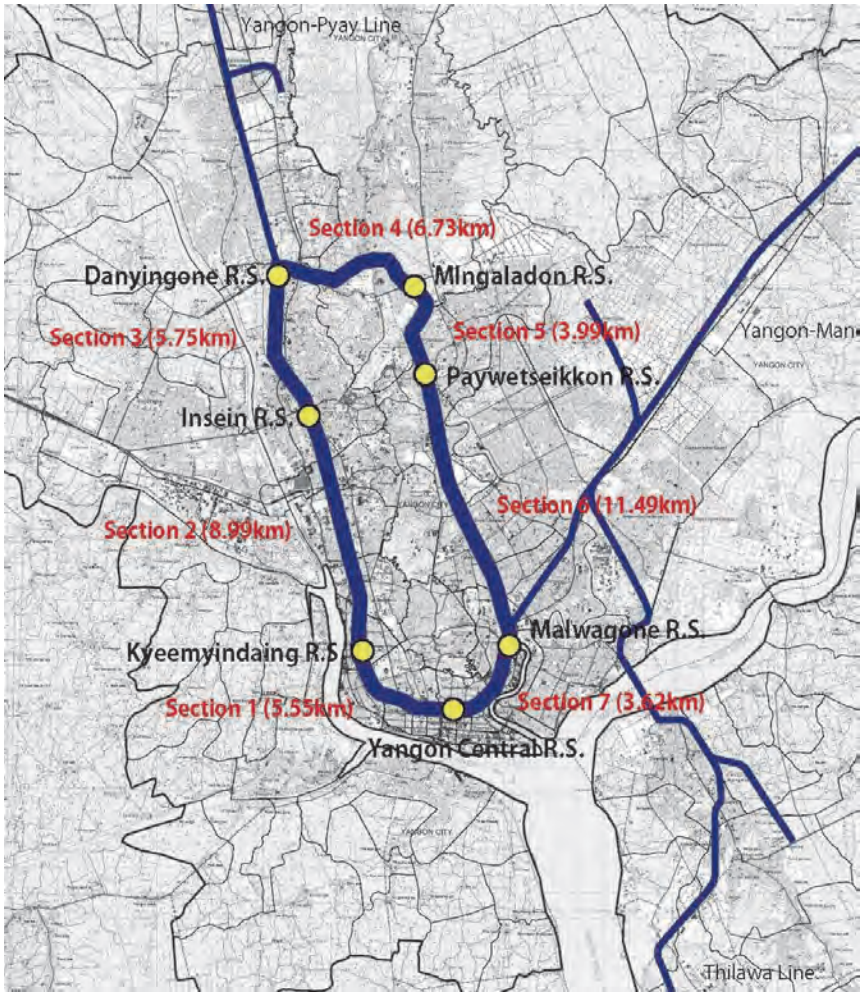
2) Consideration at Construction Stage

At a construction stage, it is important to guide a smooth/safety instruction by worker of construction group.

7 PRELIMINARY COMPARISON FOR PRIORITY SECTION SELECTION

7.1 Divided Sections to be Compared

The total length of the Yangon Circular Railway is 46.12 km. Although all sections are deteriorated and require to be upgraded, it is not realistic that the upgrade work for all sections is conducted at the same time in terms of budgetary limitation and difference of importance among sections. To evaluate priority, the Yangon Circular Railway should be divided into several sections. Boarding / alighting passenger volume is one indication of the relative importance of stations as well as large station yard, train starting point, etc. Based on this criteria, seven (7) stations are identified as follows: Yangon Central station, Kyeemyindaing station, Insein station, Danyingone station, Mingaladon station, Paywetseikkon station, and Malwagone station. Hence, it is decided that Yangon Circular Railway be divided into the seven sections, and each section evaluated for priority.



Source: YUTRA Project Team (2014)

Figure7.1.1.1 Sections and Length for Priority Comparison

7.2 Criteria for Section Comparison and Selection of Priority Section

Criteria for comparison and selection of the priority section is decided based on the six criteria below.

Table7.2.1.17.3.1 Criteria for Comparison and Selection of Priority Sections

Selection Criteria	Detail
Integrity of Upper Plans of Railway Sector	As the upper plan including railway sector plan in Myanmar, there are three plans which are SUDP, YUTRA, and Fact about Myanma Railways (Yearbook of MR). This criteria will confirm whether the priority plan is matching to these upper plans.
Traffic Demand	Based on the data of the current number of train operation, and traffic demand forecast by YUTRA Pre-FS (Chapter 4 of this report), the upgrade work basically prioritize high demand section. It note that the three timings of demand (at present, in 2018 as short-term target year, and in 2035 as long-term target year) are considered for evaluation.
Environmental and Social Impact (including the number of Affected People)	To give high priority to the sections with lower negative environmental impact (lower number of affected peoples). However, the priority should be adjusted when the influence to dense build-up area can be avoided by contriving the scope, design, construction method, etc.
Damage Level of Infrastructure	To give priority to the sections that the track and civil structure are damaged severely.
Technical Feasibility	To give priority to the sections with relatively easy construction work, or difficult work but can be overcome by Japanese technology.
Cost Aspect	To give priority to the sections with low construction cost (excluding rolling stock cost and depot/workshop cost). Rough construction cost is calculated by unit price per km used by YUTRA.

Source: YUTRA Project Team (2014)

The section comparison and selection of the priority section is conducted judging from the whole criteria comprehensively.

7.3 Section Comparison and Selection of Priority Section

7.3.1 Comparison of Sections

1) Consistency with Overall Plans of Railway Sector

There are three overall plans covering railways: SUDP, YUTRA, and Facts about Myanma Railways.

SUDP recommended to improve the western half of Yangon Circular Railway (between Yangon Central station to Danyingone station via Insein station as short-term project because of fitting with the urban functional layout and passing through high population density areas.

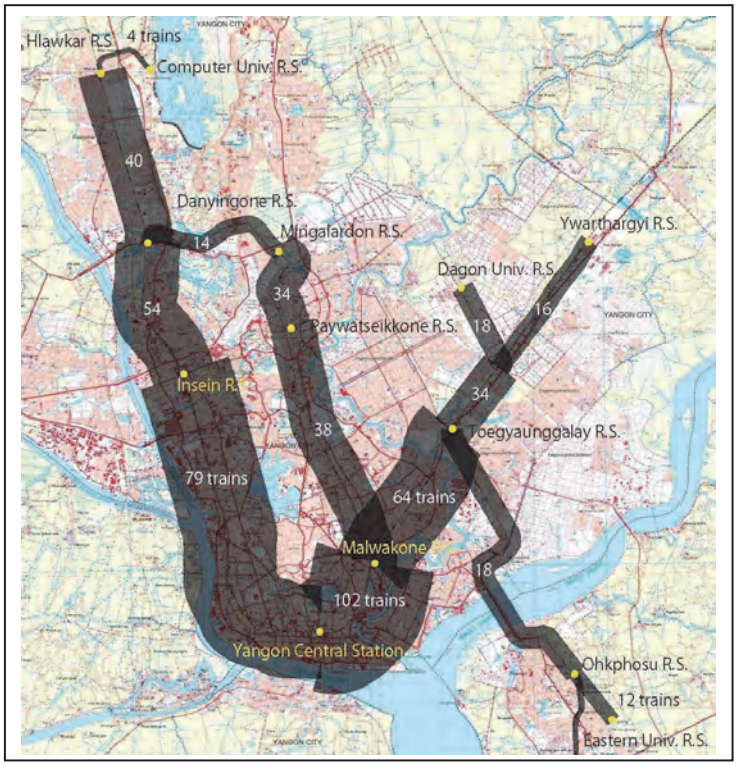
YUTRA also recommended to improve the western half of Yangon Circular Railway as short-term project. Yangon-Mandalay Line was also categorized to be improved as short-term project and this line includes the section between Malwagone station and Yangon Central station.

Facts about Myanmar Railways planned to improve whole Yangon Circular Railway without specifying any difference among sections.

2) Traffic Demand

(1) Current Demand

The figure below shows the current number of train operations. The figure shows the sections between Malwagone station and Insein station via Yangon Central station are the most heavily used corridors in Yangon Circular Railway. Secondly, the section between Insein station and Danyingone station has high demand at present. On the other hand, eastern section between Malwagone station and Danyingone station via Paywetseikkon station and Mingaladon station has relatively low demand. The section between Danyingone station and Mingaladon station has only 14 trains per day.



Source: SUDP, JICA (2013)

Figure 7.3.1.1 Current Number of Train Operations

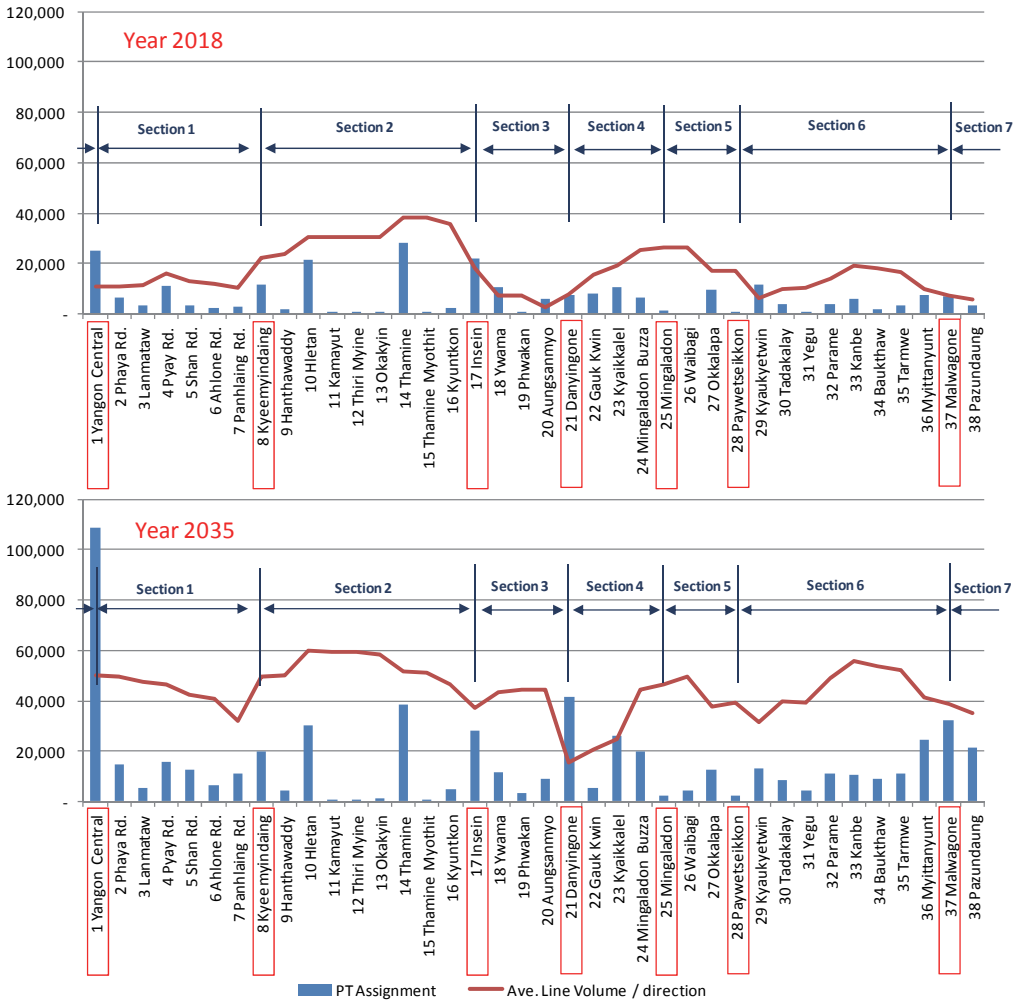
(2) Demand Forecast

The figure below shows the result of traffic demand forecast between stations. The upper and lower figures show the forecast line volume and average boarding and alighting passengers in 2018 and 2035 respectively.

According to the figure, in terms of line volume, the busiest section will be section 2

(kyeemyindaing - Insein) in 2018. There will be huge influence from Mindama sub-center which is located near Insein and opened in 2018.

For 2035, the line volume will be levelled in general, with similarity in both the western half and the eastern half of YCR, although strictly speaking, Section 2 (kyeemyindaing - Insein) will still be the busiest section, and the runners-up will be Section 1 (Yangon Central – Kyeemyindaing), Section 3 (Insein – Danyingone), Section 5 (Mingaladon – Paywetseikkon), Section 6 (Paywetseikkon - Malwagone), and Section 7 (Malwagone – Yangon Central). However, typically forecast future demand has two types: “demand follow type” which follows to natural demand from high dense population area and has high hitting ratio in terms of demand forecast, and “strategic development type” which induces traffic demand by strategic development at future developing areas and requires to conduct land development as planned. The priority section should be considered based on “demand follow type” due to the high hitting ratio, and therefore the western half which already has high train operation frequency is prioritized. On the other hand, the eastern half will be improved as the next project in order to meet expected demand induced from the improved western half and reduce the strategic investment risk.



Source: YUTRA Project Team (2014)

Figure 7.3.1.2 Traffic Demand Forecast in 2018 & 2035 for Each Section

3) Environmental and Social Impact

These are some parts which attract many people and have residents quite close to the railway line. However, such residents do not impinge into the car gauge and all trains can pass without any contact to any buildings and walls. At this stage, it is not clear whether there is anything fatal for construction and operation because of the lack of topographical data. In the next stage, topographical survey will be conducted and the exact width between walls will be measured. Based on the result, the environmental and social impact, mainly the number of affected peoples, can be evaluated.

4) Damage Level of Infrastructure

According to the track condition survey and infrastructure survey, all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections.

5) Technical Feasibility

The sections between Insein station and Mingaladon station via Danyingone station present easy condition for construction because it is rural area with plenty of vacant land.

However, the other sections are in high dense area and appropriate countermeasures will be required. Japanese contractors have many experiences in such severe areas and have technologies to be used to overcome the difficulties.

The section between Malwagone station and Yangon Central station requires to eliminate grade crossing and add a track in order to physically divide the train operation of Yangon Circular Railway train and Yangon-Mandalay Line train. The construction work is difficult due to the complex construction sequences. However, Japanese contractors have many experiences and have technologies to overcome these difficulties.

6) Cost Aspect

Rough construction cost is calculated below based on unit price per km used by YUTRA.

Table 7.3.1.1 Rough Construction Cost

No.	Section	Construction Cost (mil. US$)*	Remarks
1	Yangon Central - Kyeemyindaing	83.3	
2	Kyeemyindaing - Insein	135.0	
3	Insein - Dayingone	86.3	
4	Dayingone - Mingaladon	101.0	
5	Mingaladon - Paywetseikkon	59.9	
6	Paywetseikkon – Malwagone	172.4	
7	Malwagone - Yangon Central	64.3	54.3+10 for add line)

*Note: Rolling stock procurement and depot/workshop cost are not included

Source: YUTRA Project Team (2013)

7.3.2 Selection of Priority Section

According to the discussion above, the priority of each section is summarized in the table

below.

Table 7.3.2.1 Comparison Table for Selection of Priority Section

	Section1: Yangon Central - Kyeemyindaing	Section2: Kyeemyindaing - Insein	Section3: Insein - Dayingone	Section4: Dayingone - Mingaladon	Section5: Mingaladon - Paywetseikkon	Section6: Paywetseikkon – Malwagone	Section7: Malwagone - Yangon Central
Consistency with Upper Plans of Railway Sector	A Recommended by SUDP, YUTRA as short-term project	A Recommended by SUDP, YUTRA as short-term project	A Recommended by SUDP, YUTRA as short-term project	C	C	C	B Recommended by YUTRA as short-term project
Traffic Demand:							
(At present)	A 79 trains/day	A 79 trains/day	B 54 trains/day	D 14 trains/day	C 34 trains/day	C 38 trains/day	A 102 trains/day
(in 2018: short-term goal)	B Line volume: 12,000 pax./day	A Line volume: 31,100 pax./day	C Line volume: 8,800 pax./day	B Line volume: 17,000 pax./day	B Line volume: 23,200 pax./day	B Line volume: 13,500 pax./day	C Line volume: 6,600 pax./day
(in 2035: long-term goal)	B Line volume: 44,100 pax./day	A Line volume: 54,000 pax./day	B Line volume: 42,400 pax./day	C Line volume: 26,300 pax./day	B Line volume: 44,700 pax./day	B Line volume: 44,600 pax./day	B Line volume: 36,900 pax./day
Environmental and Social Impact	N/A To be evaluated by the next FS	N/A To be evaluated by the next FS	N/A To be evaluated by the next FS	N/A To be evaluated by the next FS	N/A To be evaluated by the next FS	N/A To be evaluated by the next FS	N/A To be evaluated by the next FS
Damage Level of Infrastructure	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections	A all infrastructure is deteriorated and there is no remarkable difference of damage level of infrastructures among sections
Technical Feasibility	A in high dense area and any countermeasure will be required. However, Japanese contractors have many experiences to be constructed in these severe area and have technologies to be overcome.	A in high dense area and any countermeasure will be required. However, Japanese contractors have many experiences to be constructed in these severe area and have technologies to be overcome.	A in easy condition for construction due to rural area with plenty vacant land	A in easy condition for construction due to rural area with plenty vacant land	A in high dense area and any countermeasure will be required. However, Japanese contractors have many experiences to be constructed in these severe area and have technologies to be overcome.	A in high dense area and any countermeasure will be required. However, Japanese contractors have many experiences to be constructed in these severe area and have technologies to be overcome.	B The construction work is difficult due to the complex construction sequences for eliminating grade crossing of Yangon Circular Railway and Yangon-Mandalay Line. However, Japanese contractors have many experiences and technologies to be overcome.
Cost	A USD83.3mil.	B USD135.0mil.	A USD86.3mil.	B USD101.1mil.	A USD59.9mil.	C USD172.4mil.	A USD64.3mil.
Total Evaluation Ranking	2nd ranked (26point)	1st ranked (27 point)	3rd ranked (24 point)	7th ranked (19 point)	5th ranked (22 point)	6th ranked (20 point)	4th ranked (23 point)

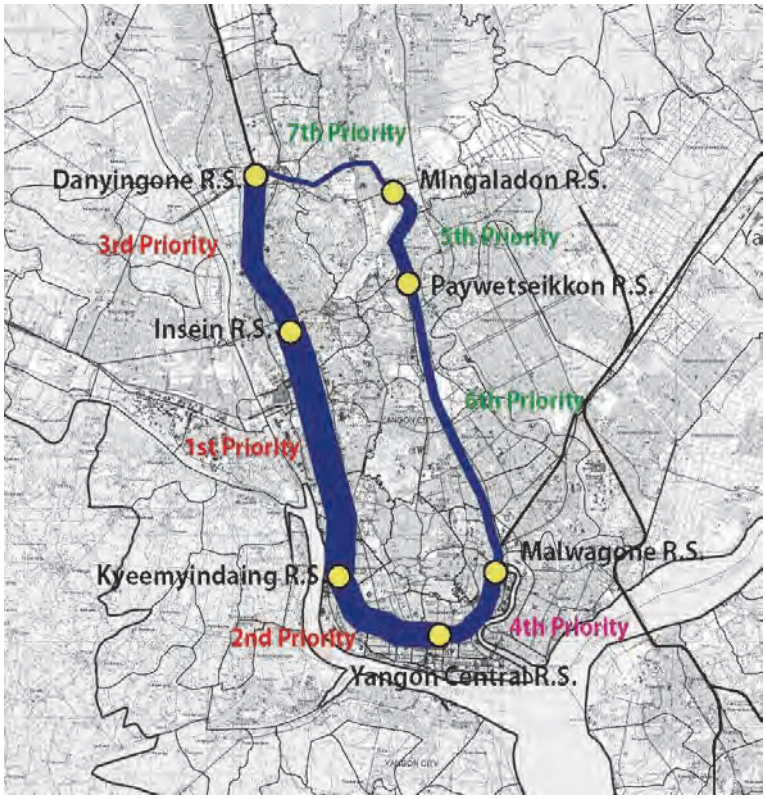
Note: A: Excellent (4 points), B: Good (3 points), C: Fair (2 points), D: Poor (1 point)

Source: YUTRA Project Team (2014)

Total evaluation was conducted based on the evaluation result of each criteria. The evaluation was analyzed quantitatively by scores for each criteria as follows: A or Excellent as 4 points, B or Good as 3 points, C or Fair as 2 points, and D or Poor as 1 point.

As the result, Section2 (Kyeemyindaing - Insein) is evaluated as highest priority section. Secondary, Section1 (Yangon Central – Kyeemyindaing) and Section3 (Insein – Dayingone) are evaluated as 2nd and 3rd ranked priority sections respectively. Section7 (Malwagone - Yangon Central) is evaluated as 4th ranked priority section. The other sections, mainly eastern half of Yangon Circular Railway, are evaluated as lower priority sections in comparison of the western half sections and these section should be improved after the completion of the western half improvement.

A map of evaluation priority of each section is shown below.



Source: YUTRA Project Team (2014)

Figure 7.3.2.1 Evaluation Result for Priority of Each Section

The result is preliminary and should be reviewed in the next FS because the result does not consider the Environmental and Social Impact including the number of Affected People.