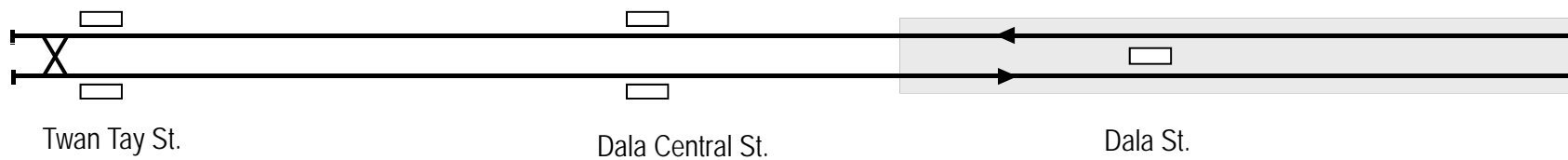
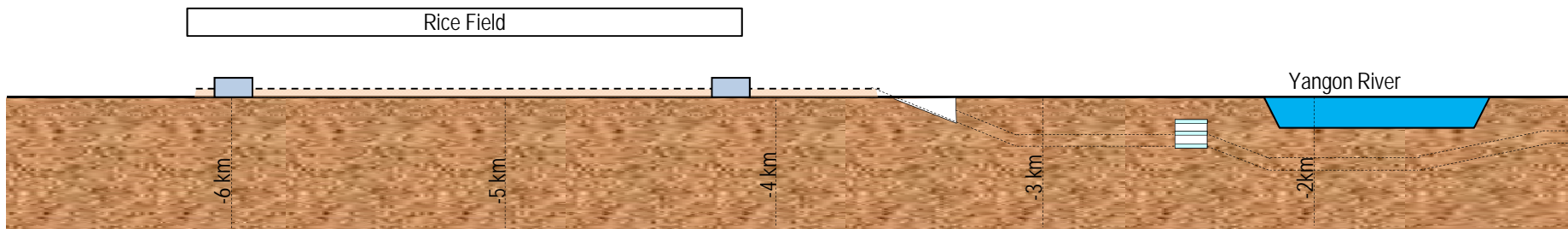


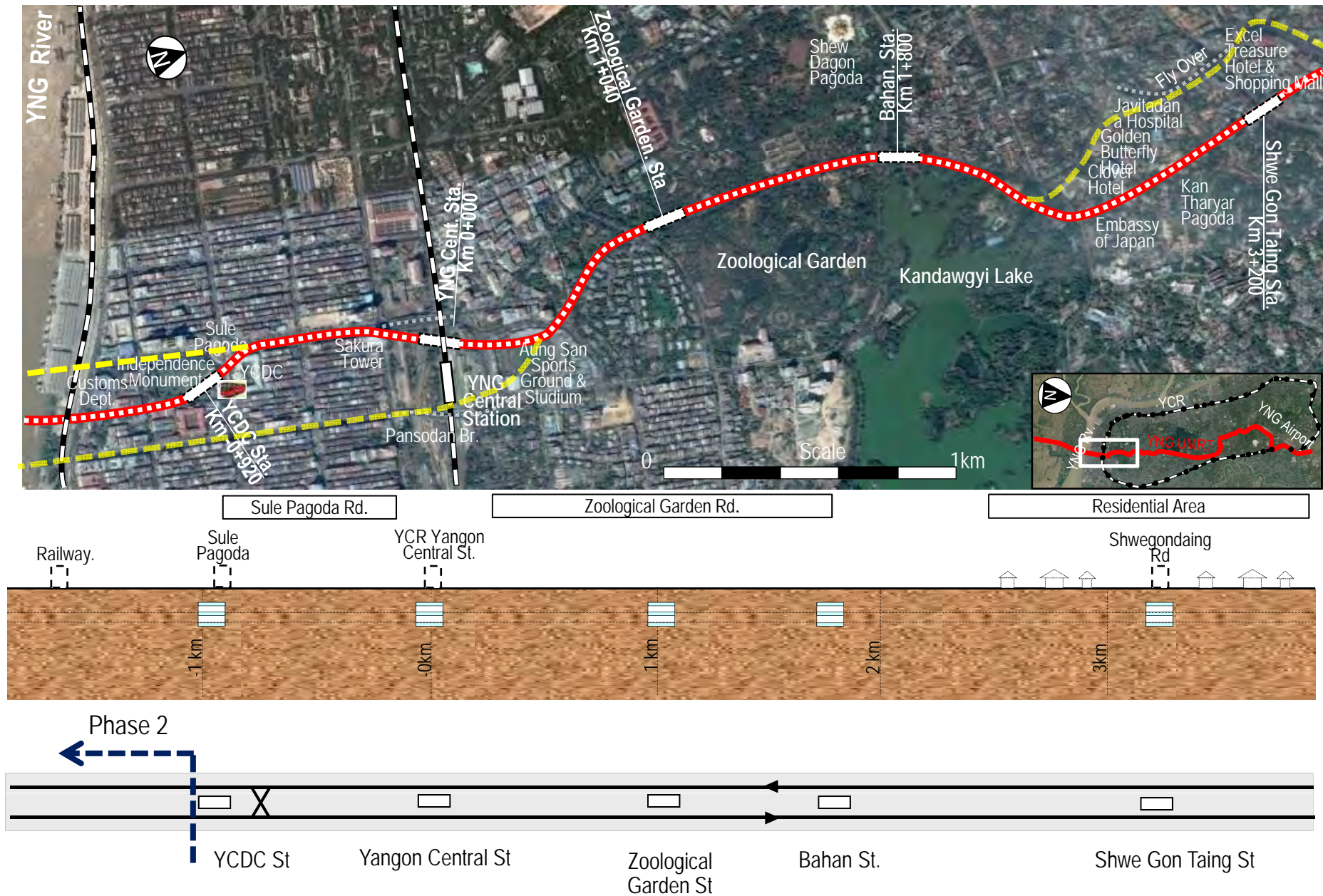
APPENDIX 1

Schematic Plan and Profile

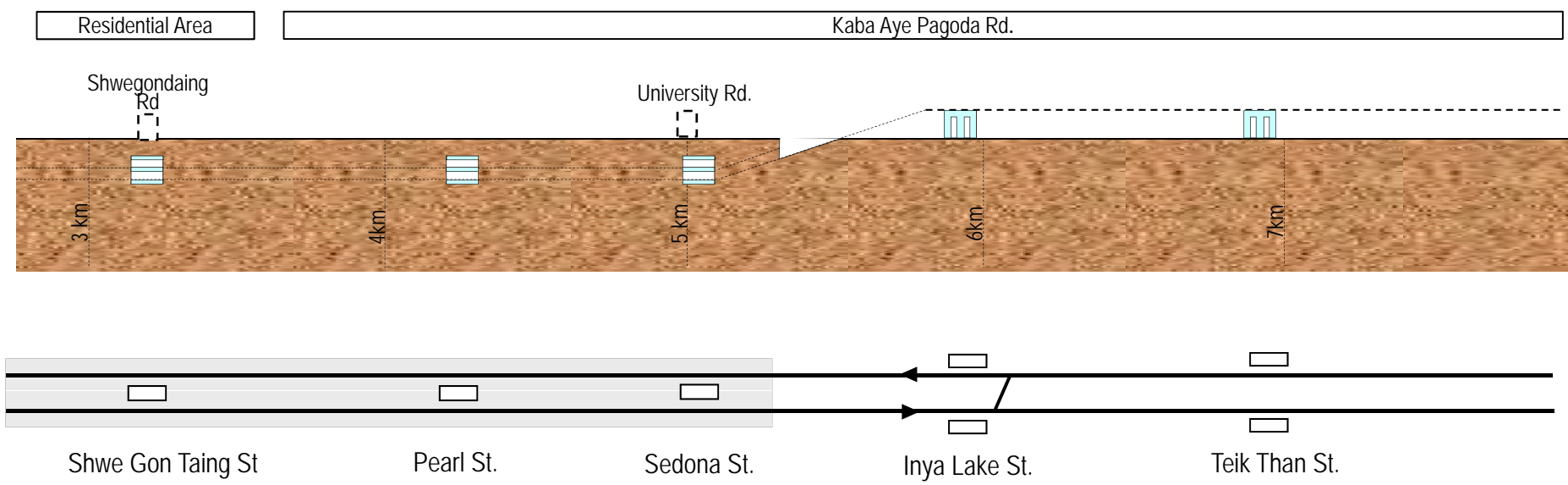
Schematic Plan & Profile in Phase 2



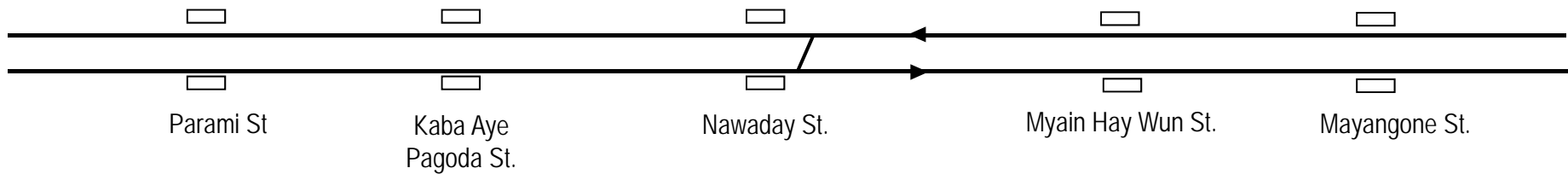
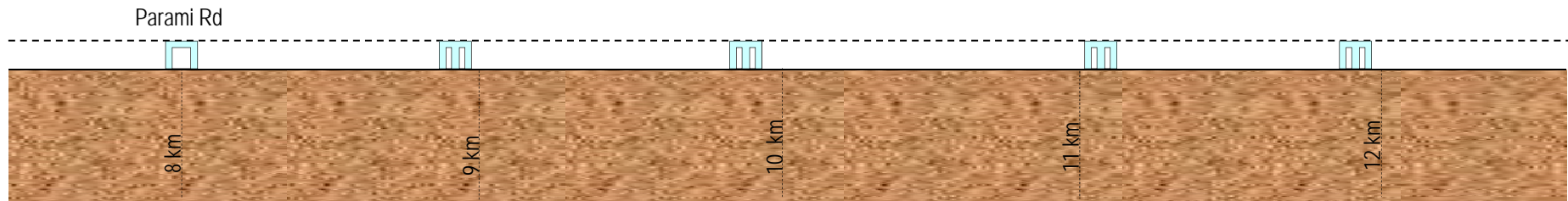
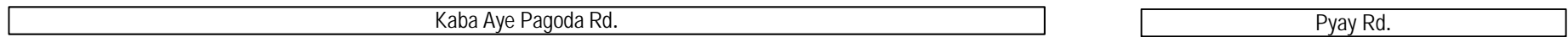
Schematic Plan & Profile in Phase 1 (1/5)



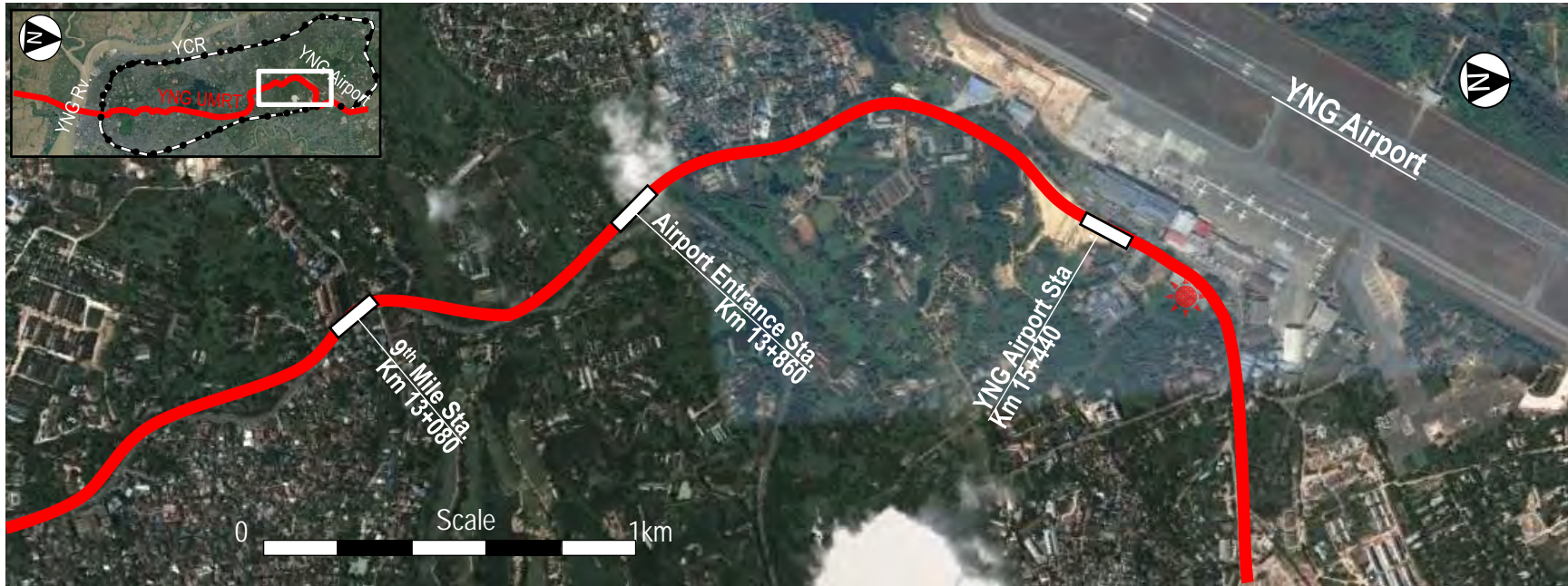
Schematic Plan & Profile in Phase 1 (2/5)



Schematic Plan & Profile in Phase 1 (3/5)

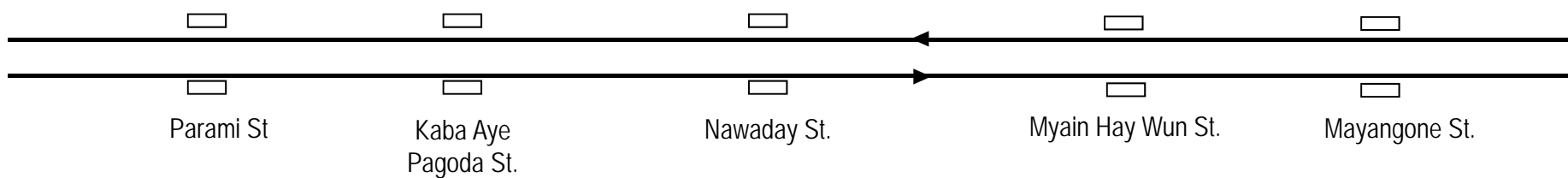
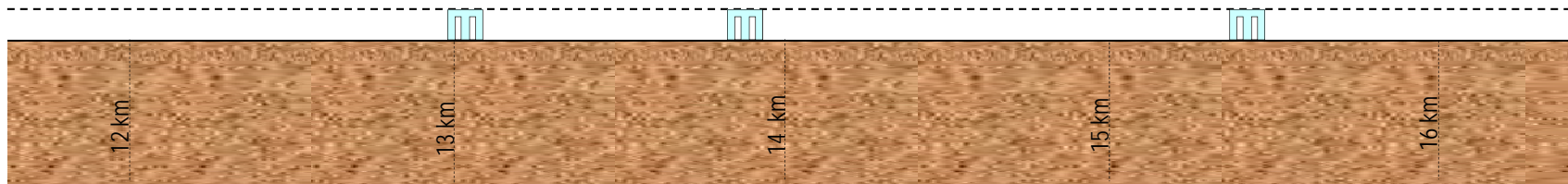


Schematic Plan & Profile in Phase 1 (4/5)



Pyay Rd.

Yangon Airport Rd.



Parami St

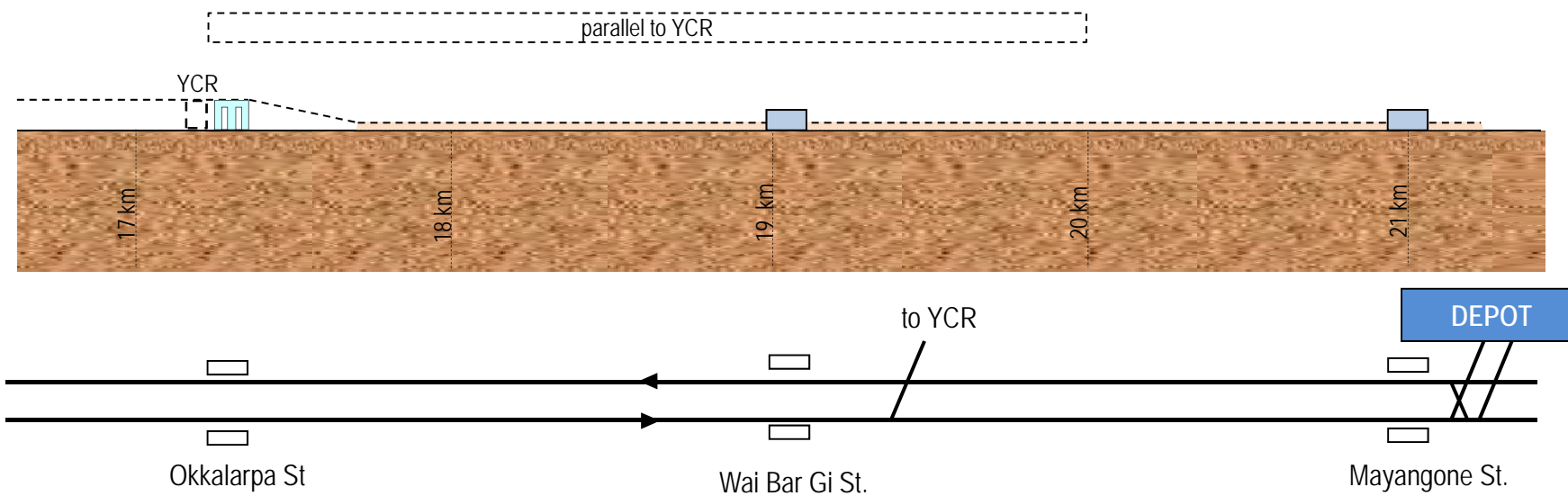
Kaba Aye
Pagoda St.

Nawaday St.

Myain Hay Wun St.

Mayangone St.

Schematic Plan & Profile in Phase 1 (5/5)



APPENDIX 2

Presentation Material

Data Collection Survey for Yangon Urban Mass Rapid Transit Line1 Project

Meeting Material

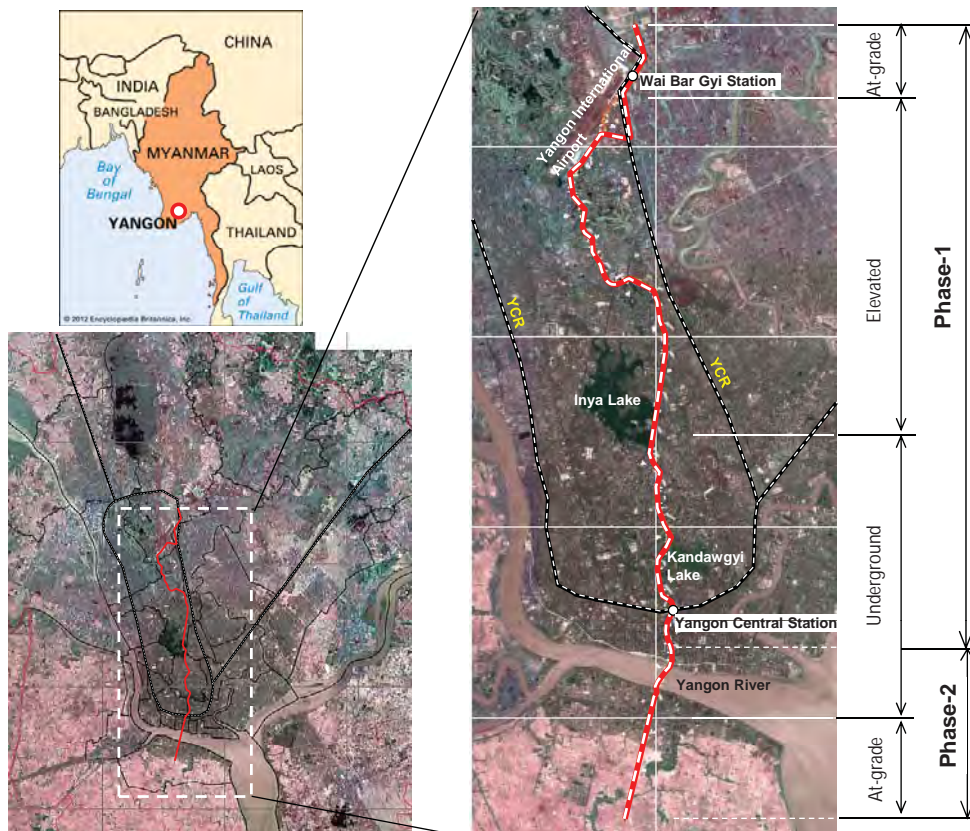
October. 2014

Japan International Cooperation Agency (JICA)

1

LOCATION MAP

YUMRT
Yangon Urban Mass Rapid Transit



2

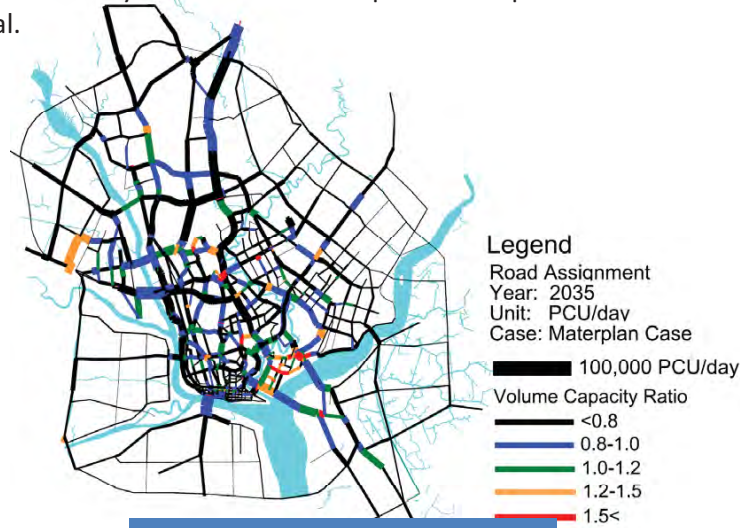
1) TRAFFIC DEMAND FORECAST BY YUTRA (2014)

The results of the traffic demand forecast indicated;

- 1) Most of the major arterial roads will be saturated in “DO-NOTHING” case.
- 2) Based on the results of demand forecast, two (2) new urban railways are proposed; one in north-south direction, and the other in east-west direction.
- 3) YUTRA proposes that integration between railway network and other public transport network especially of BRTs and buses is essential.



DO-NOTHING CASE (2035)



DO-MAXIMUM CASE (2035)

2) RAILWAY NETWORK PROPOSED IN YUTRA (2014)

YUTRA proposes that two (2) UMRT lines are needed to deal with the future traffic demand.

Short-term(2018)

- YCR Modernization (Phase -1)
- Yangon Central Station Redevelopment

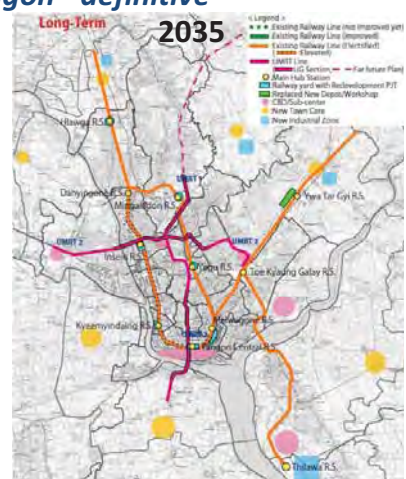
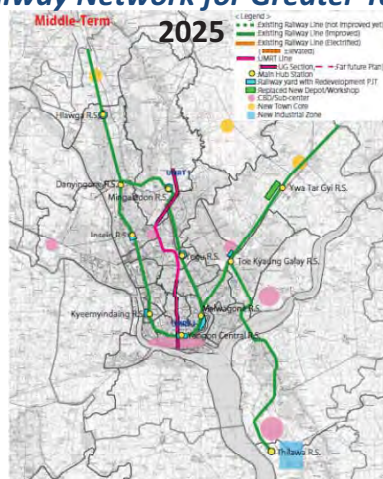
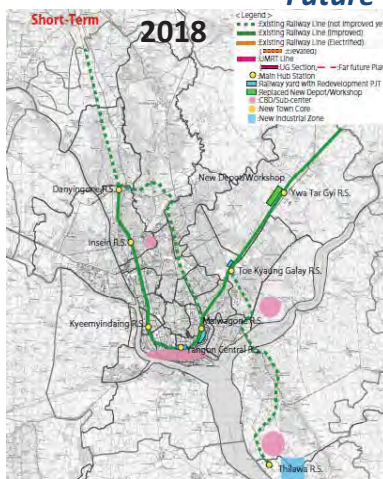
Mid-term(2025)

- Yangon Mandalay Line Improvement
- YCR Modernization (Phase-2)
- UMRT Line 1 (North-South Line)**

Long-term(2030-2035)

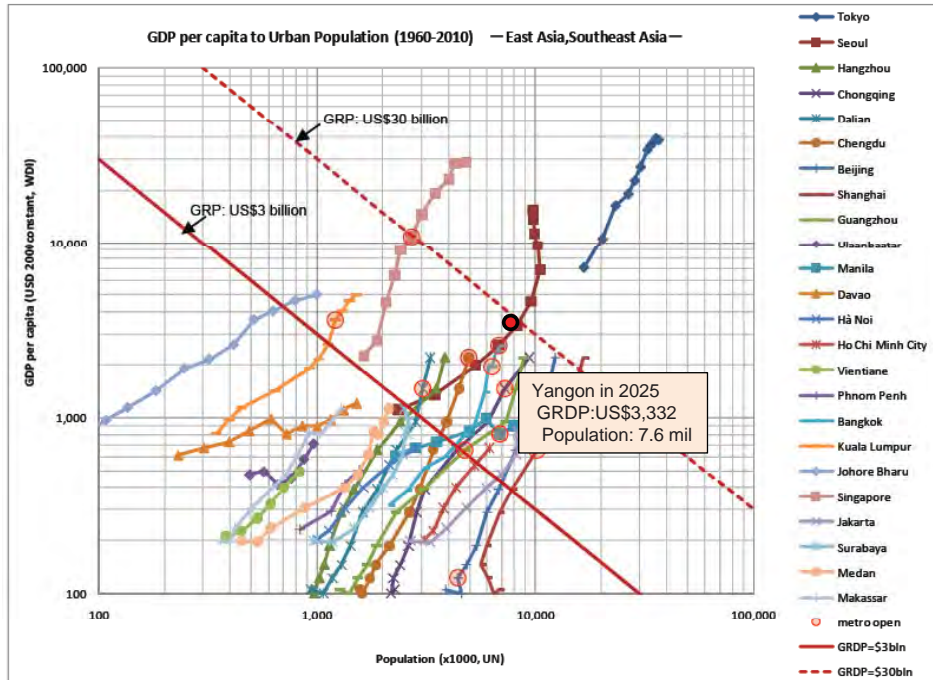
- Yangon Mandalay Line Improvement
- UMRT Line 2(East-West Line) 2031
- UMRT Line 1 (Extension) 2035**

Future Railway Network for Greater Yangon - definitive



3) TIMING OF FIRST UMRT

Yangon city will reach to the socio-economic level where sustainable UMRT operation is possible.



Source: The Research on Practical Approach for Urban Transport Planning, JICA, 2011

4) SCOPE AND SCHEDULE OF THE SURVEY

General

- ✓ This survey is conducted within a framework of YUTRA to accelerate the implementation of YUMRT Line 1 (Gold Line) and to collect basic data and information as reference for a next step of the project.

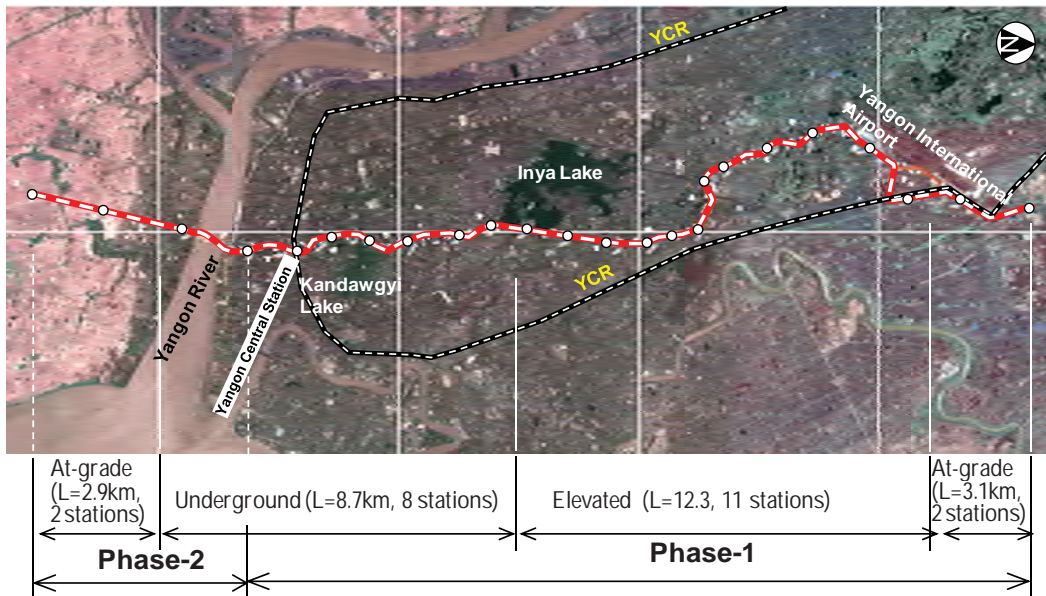
	2014				
	July	August	September	October	November
Route Review		■			
Selection of Station Location		■			
Proposal on Technical Requirement		■	■		
Selection of Structures			■		
Operation Plan			■		
Track Layout Plan			■		
Alignment Plan			■		
Preliminary Cost Estimate				■	
Preliminary Implementation Plan		■			
Social Consideration			■		
Economic Analysis				■	
Report					▼ DfR ▼ FR

2. OUTLINE FEATURES OF YUMRT

✓ Major Features of YUMRT

27 km-long Urban Mass Rapid Transit (UMRT) in Yangon

Type	Phase-1		Phase-2	
	Station	Length	Station	Length
Underground	7 nos	6.5 km	1 nos	2.2 km
Elevated	11 nos	12.3 km	0	0
At-grade	2 nos	3.1 km	2 nos	2.9 km
Total	20 nos	21.9 km	3 nos	5.1 km



7

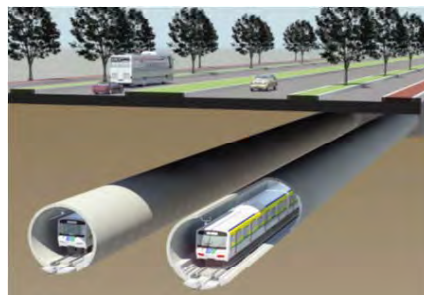
2. OUTLINE FEATURES OF YUMRT

✓ Cross Sectional Concept of YUMRT

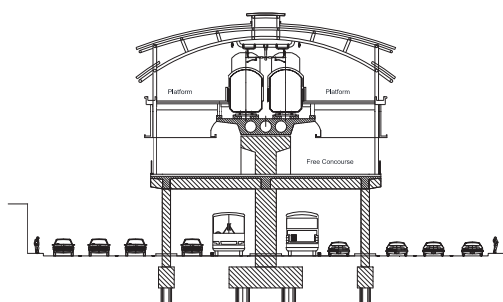
Elevated Guide way



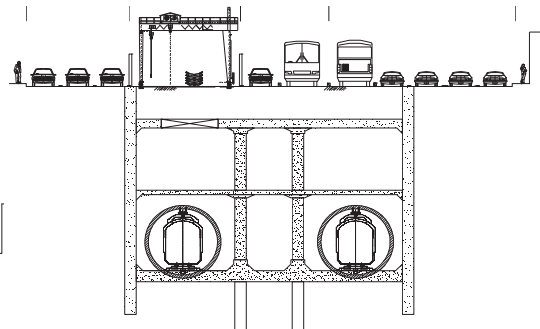
Underground Guide way



Elevated Station




Underground Station



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3. EXISTING CONDITIONS OF THE ROUTE

<p>① Maha Bandula Park St</p>  <ul style="list-style-type: none"> - Narrow one way road without side strip and walkway. - Buildings/ houses stand side by side on both sides of the street. 	<p>② Sule Pagoda Road</p>  <ul style="list-style-type: none"> - Wide side strip with additional parking lanes on both sides of the road. - Divided by fence.
<p>③ Zoological Garden Road</p>  <ul style="list-style-type: none"> - One way section (3 lanes).. 	<p>④ Lakeside of Inya Lake</p>  <ul style="list-style-type: none"> - Very wide green zone on the lakeside. - Transition of structure (elevated to underground) planned on the green zone.



3. EXISTING CONDITIONS OF THE ROUTE

<p>⑤ Kabar Aye Pagoda Road</p>  <ul style="list-style-type: none"> - Jersey barriers on the centre. (6 lanes) - Narrow walkway on both sides of the road. 	<p>⑥ Pyay Road</p>  <ul style="list-style-type: none"> - No median on the centre (6 lanes). - Successive steep curves.
<p>⑦ Yangon Airport Road</p>  <ul style="list-style-type: none"> - No median on the centre. (4 lanes) - Wide green zone on both sides of the road - Successive steep curves 	<p>⑧ Wai Bar Gyi Station (Circular Railway)</p>  <ul style="list-style-type: none"> - A YUMRT station is planned adjacent to the existing Wai Bar Gyi Station.



DESIGN CRITERIA FOR ALIGNMENT PLANNING

Criteria		Description/ Value	Justification
1	Speed	Maximum 100km/h (Elevated/ At-grade) 80km/h (Underground)	Standard as UMRT. Speed at underground section is slower due to poor visibility.
		Schedule 30km/h	Speed is one of the main characteristics of UMRT. At least 30km/h shall be sustained.
2	Minimum horizontal curvature	Main track 300m (Absolute minimum: 200m)	R200m curvature requires speed limit. To keep UMRT run fast, applying R200m curvature shall be minimized.
		Platform 400m	Smaller curvature causes larger gap between cars and platform.
3	Gradient	35%	Standard max gradient as UMRT.

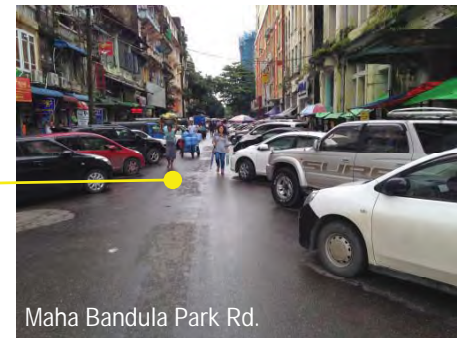
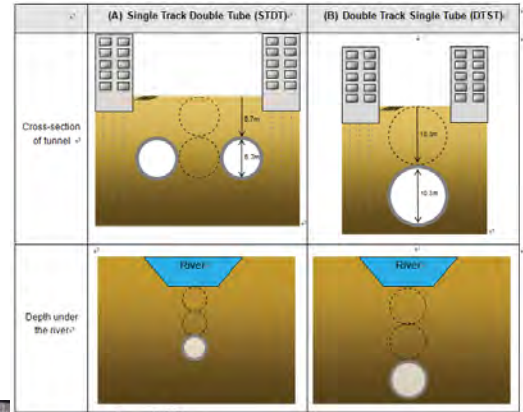
Southern terminal station is proposed to be located in front of YCDC. The Alignment passes through in between YCDC and Sule Pagoda.



✓ ALIGNMENT ALTERNATIVES

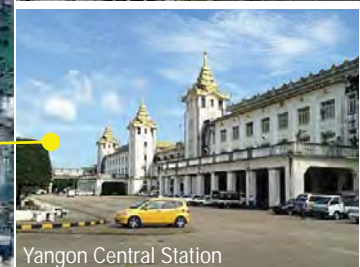
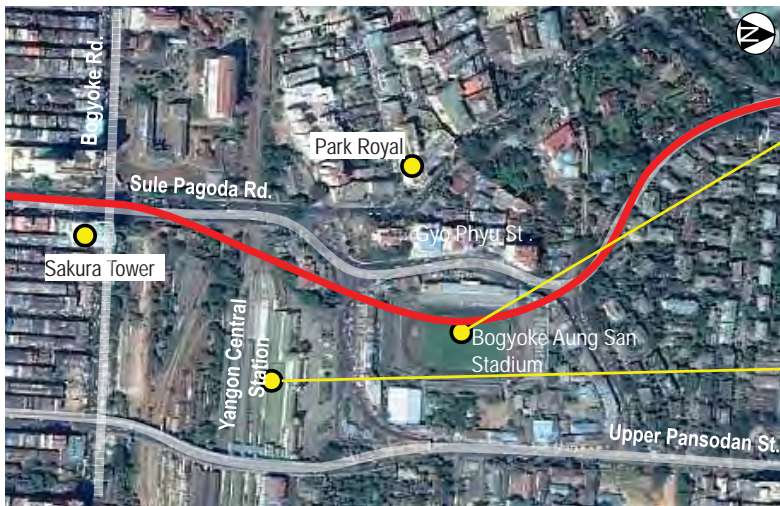
The proposed alignment passes through very narrow one way street named Maha Bandula Park Rd. in phase-2. To avoid possible resettlement and land acquisition in a historical area, two options are proposed,

- 1) Applying Singe Tube Double Track Shield
- 2) Passing beneath Sule Pagod Rd.



Because of the successive sharp curves and narrowness of existing one-way road, the proposed route runs under the existing Bogyoke Aung San Stadium, since low-height structure does not seem to have any underground support structures such as piles.

Part of the station location crosses with existing Yangon Central Station considering the accessibility and connectivity to/from UMRT station.

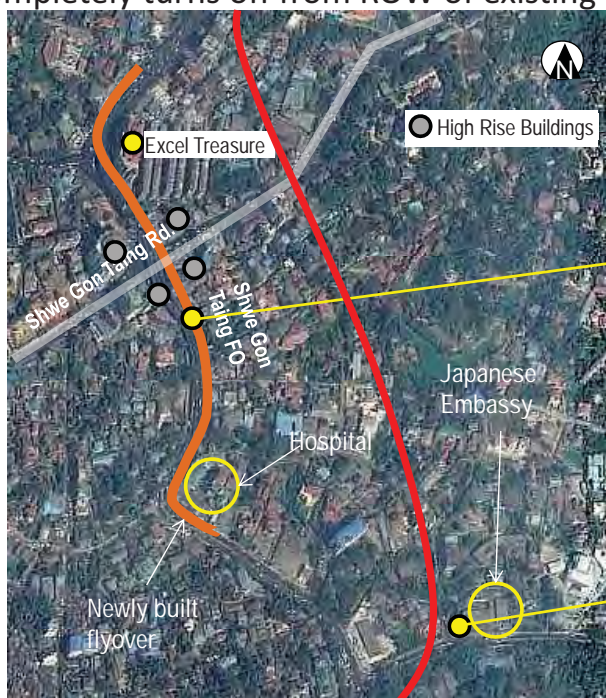


✓ ALIGNMENT ALTERNATIVES

There is an ongoing station development in Yangon Central Station. Final location of the station has to be determined through the discussions with relevant authorities, the contractor and other stake holders.



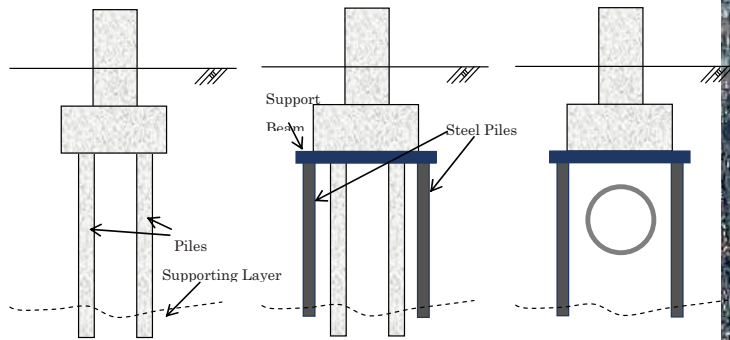
It is difficult for the railway alignment to follow existing road alignment since it is too devious where a newly-built flyover exists. In this section, proposed alignment completely turns off from ROW of existing roads.



4. ALIGNMENT

✓ ALIGNMENT ALTERNATIVES

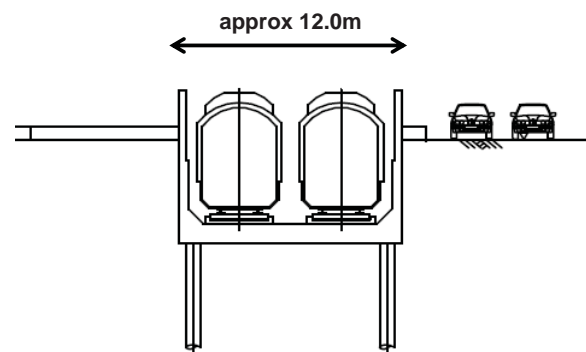
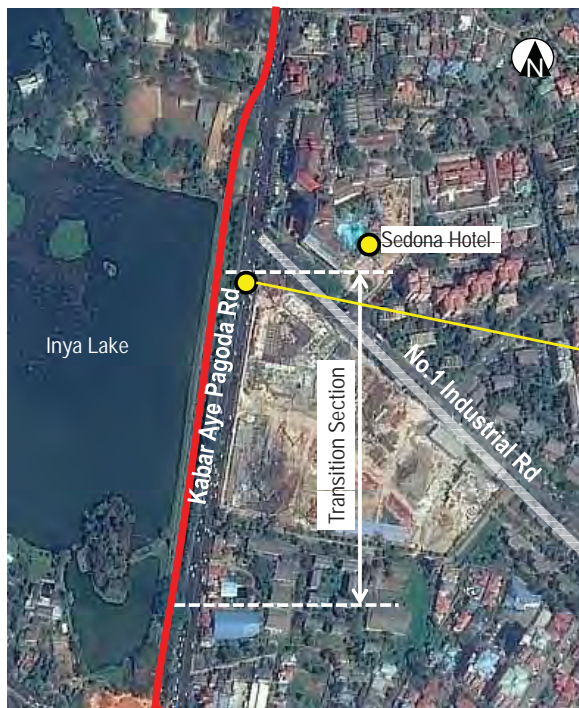
In case that development of laws to allow public structures under private property cannot be achieved, an alternative route plan is proposed. In this alternative, since tunnel goes under the flyover, special construction method such as underpinning method should be applied.



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4. ALIGNMENT

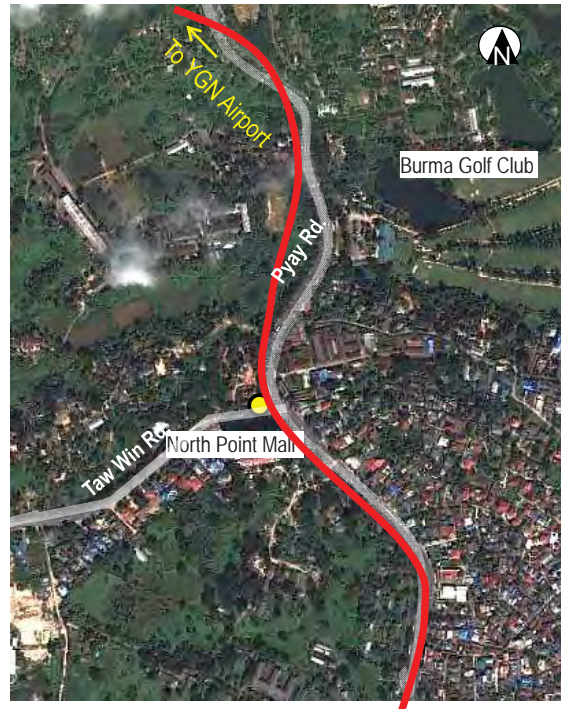
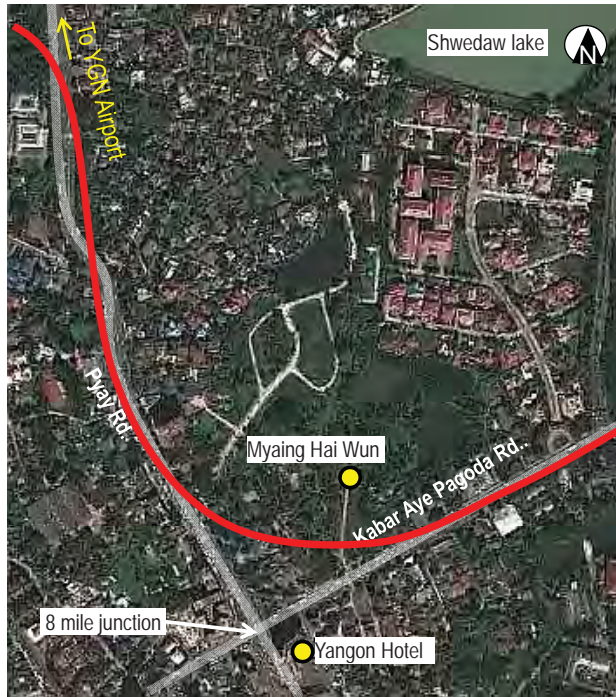
Transition section from underground to elevated is proposed to be east lake side of Inya lake.



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4. ALIGNMENT

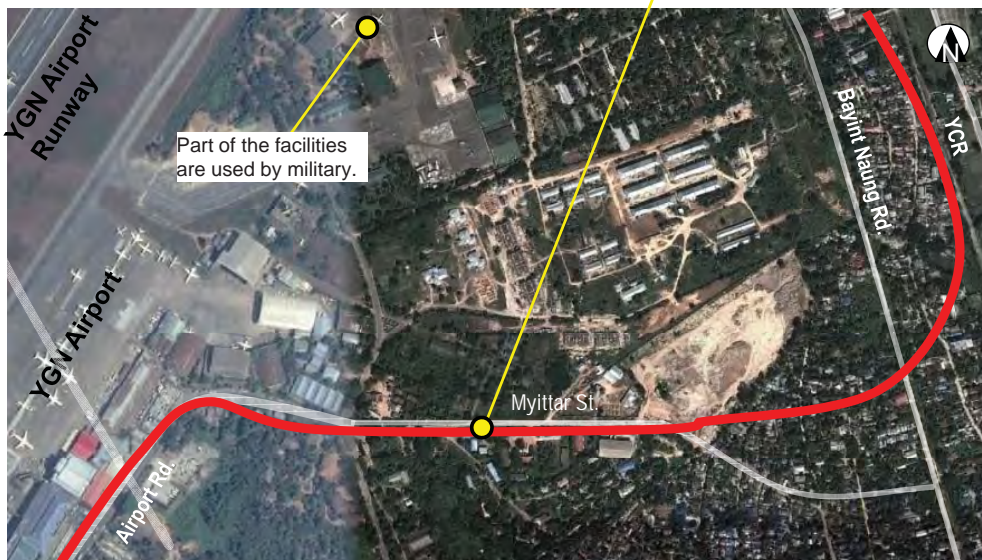
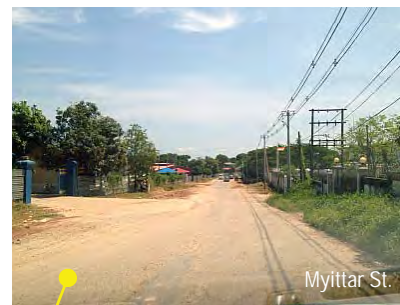
There are many devious road (e.g. Pyay Rd, Yangon Airport Rd.) section where the proposed alignment cannot fall within ROW of existing road.



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4. ALIGNMENT

In order not to interfere with the airport facilities, alignment turns its direction to the east where public road is not developed well.



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BASIC POLICY FOR SETTING DESIGN CRITERIA FOR YUMRT

It is important to connect YUMRT line with to-be-improved Yangon Circular Railway considering the followings;

- **MAINTENABILITY** Depot and workshop can be shared by YUMRT and existing railways. This will avoid double investment on the various railway facilities and thus contribute to reduce maintenance cost.
- **FLEXIBILITY** Track structures and other systems (signaling, power supply etc,) need be the same as those to be applied to YCR in the future. This enables maintenance know-hows and human resources to be shared by YUMRT and YCR.
- **EXPANDABILITY** Connecting YUMRT with YCR enables inter operation of YUMRT and existing Myanmar railway

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PROPOSED DESIGN CRITERIA

Criteria			Description/ Value	
			Improved YCR	YUMRT Line 1
1	Gauge		1,000mm	1,000mm
2	Speed	Maximum	80km/h	100km/h (Elevated/ At-grade) 80km/h (Underground)
		Schedule	30km/h	30km/h
3	Minimum horizontal curvature	Main track	291m (6 degree)	300m (5.8 degree) (Absolute minimum: 200m (8.5 degree))
		Platform	-	400m
4	Gradient		5‰	35‰
5	Traction System	System	To be determined	Overhead Catenary
		Voltage	To be determined	1500V DC

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1) CONSTRUCTION AND PROCUREMENT COST ESTIMATE

Item	Phase-1 (mil JPY)	Phase-2 (mil JPY)
Civil (incl. station E&M)		
✓ At-grade	2,530 ~ 3,092	2,514 ~ 3,072
✓ Underground	70,323 ~ 84,949	17,046 ~ 20,834
✓ Elevated	26,315 ~ 32,162	0
Depot	9,995 ~ 12,215	0
System	47,087 ~ 57,553	8,178 ~ 9,995
Rolling Stock	25,184 ~ 30,780	5,724 ~ 6,995
Total	181,433 ~ 221,751	33,461 ~ 40,896

Note : the figure above is the cost for construction and procurement only. Price escalation, contingency, tax, land acquisition cost, interest during construction and Engineering Services fee etc, are not included.

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ECONOMIC EVALUATION

Economic evaluation results are shown in the following table;

Project Title	EIRR (%)	NPV (USD Mil.)	B/C
UMRT Line-1 Project	14.7%	580	1.5

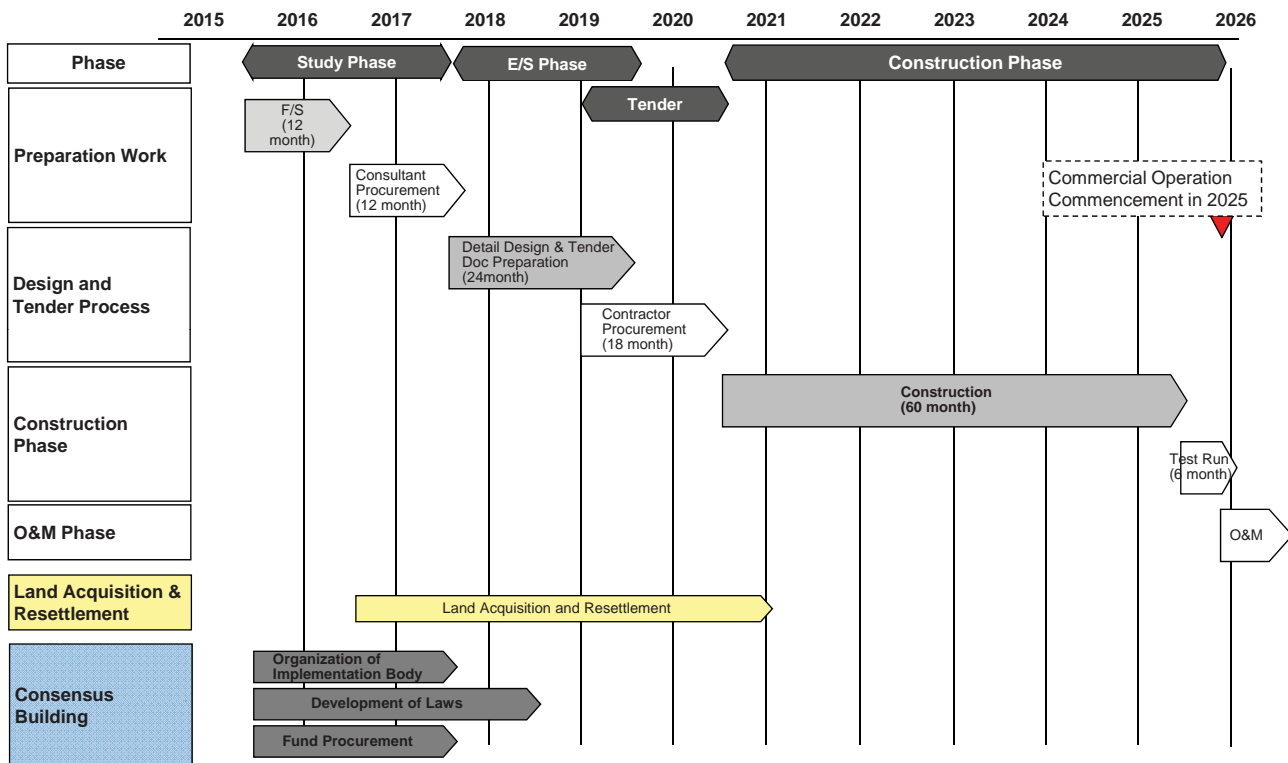
Sensitivity analysis for the following three scenarios;

- ✓ 30% increase in the cost stream
- ✓ 30% decrease in the benefit stream
- ✓ Both case (30% cost increase and 30% benefit decrease)

Benefit \ Cost	Base	30% decrease
	Base	14.7%
30% increase	11.6%	7.7%

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✓ IMPLEMENTATION SCHEDULE FOR CONSTRUCTION & PROCUREMENT



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8. CONCLUSION

- 1) Technical Specifications need to be the same as future-improved YCR for future mutual operation.
- 2) Actions for development of laws and regulations to allow public structures to be constructed under private property need to be taken.
- 3) Feasibility study needs to be commenced as soon as possible to meet the operation commencement in 2025 as shown in YUTRA. Detailed studies including implementation plan and financial scheme need to be carried out in the feasibility study.
- 4) Coordination with other projects such as Yangon Central Station Development project needs to be well-considered.

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