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付録 - 1
関係機関からの公式レター

付録 – 1.1
MOC からのレター
（初期運用における道路規格について）

The Government of the Union of Myanmar

Ministry of Construction

Department of Highways

Naypyitaw

Date: May 16 , 2017

Ref. no.:DDG/JICA /2017-18/070

To: Kotaro NISHIGATA
Senior Representative
JICA Myanmar Office

Re: Reply for road classification of the new Bago-Kyaikto Highway and the provision of offi cce space and the counterpart personnel

Dear Kotaro NISHIGATA,

With reference to new Bago-Kyaikto Highway Project, we would like you to reply following the information for support to the Preparatory Survey for East-West Economic Corridor Highway Development Project.

We are hereby replying a letter for our opinion.

(1) Road classification of the new Bago-Kyaikto Highway

Currently, DOH decided to be adopted 2 lane Asphalt Concrete Pavement width of 7 m with 1.5 m seal paved shoulder. DOH has also decided to plan of highway/non-access control classifi cation and ASEAN Highway Design Standard for the project. In future, DOH has a plan to develop as a 4 lane Asphalt Concrete Pavement.

(2) Providing office space to JICA Survey Team

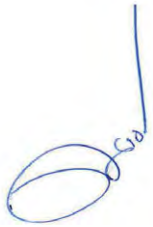
JICA Study Team shall be provided Ministry of Construction's Phayakalay base camp.

(3) Provision of the counterpart personnel to JICA Survey Team

As counterpart officials for the JICA Study Team, DOH shall assign an Officer of Department of Highways of Bago District.

We are looking forward to cooprate with you.

Very truly yours,



Name: Aung Myint Oo
Title: Deputy Director General
Department of Highways
Ministry of Construction

C.C.: Office copy

付録 – 1.2
MOC からのレター
（将来の道路規格について）

The Government of the Union of Myanmar
Ministry of Construction
Department of Highways
Naypyitaw

Date: June , 8 , 2017
Ref. no.: DDG/JICA/BKH/2017-18/ 048

To: Takehiro Yasui
Director
Southest division 4,
Southest and the Pacific department,
Japan International Cooperation Agency

Subject: **Reply for our further opinion on road classification of the new Bago-Kyaikto Highway**

Dear Mr Yasui,

With reference to your letter dated on 26th May 2017, we would like you to reply for our further opinion on road classification of the new Bago-Kyaikto Highway.

As we early mentioned, we have a plan to upgrade the Bago-Kyaikto Highway to 4 lanes Asphalt Concrete Pavement in the future, we are already aware the difficult to modify the structure of birdge, our opinion will therefore consider the bridge design could be the requirements 4 lanes design for the new Sittaung Bridge with Expressway standard in the expected future's extension.

We are looking forward to cooprate with you.
Very truly yours,

Khin Maung Kyaw
Deputy Director General
Department of Highways
Ministry of Construction

C.C.: JICA Myanmar Office
Office copy

付録 – 1.3
DWIR からのレター
（新シッタン橋における桁下余裕高について）

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန
ရေအရင်းအမြစ်နှင့်မြစ်ချောင်းများဖွံ့ဖြိုးတိုးတက်ရေးဦးစီးဌာန
နေပြည်တော်

စာအမှတ်၊ ၂၂၈/ရလထ/ရအန - ၆၀/၂၀၁၇
ရက် စွဲ၊ ၂၀၁၇ ခုနှစ်၊အောက်တိုဘာလ ၁၇ ရက်

အကြောင်းအရာ။ **စစ်တောင်းတံတားအသစ် တည်ဆောက်ရေးစီမံကိန်း၏ တံတားဒီဇိုင်းအတွက် သင့်တော်သော ရေလမ်းကင်းလွတ် အကျယ်/အမြင့် သတ်မှတ်ပေးနိုင်ပါရန် တင်ပြခြင်း**

ရည် ညွှန်း ချက် ။ ဆောက်လုပ်ရေးဝန်ကြီးဌာန၊ တံတားဦးစီးဌာန၏ (၁၁-၁၀-၂၀၁၇) ရက်စွဲပါ စာအမှတ်၊ တံတား/ညွှန်ချုပ်/နပတ/၂၀၁၇-၂၀၁၈(၉၀၄)

၁။ ဆောက်လုပ်ရေးဝန်ကြီးဌာန မှ East-West Economic Corridor Highway လမ်း၊ ကျိုက်ထို-ကမာဝဲ-သနပ်ပင်-သီလဝါအပိုင်းပေါ်တွင် JICA ၏အကူအညီဖြင့် တည်ဆောက်မည့် စစ်တောင်းတံတားအသစ် တည်ဆောက်ရေးစီမံကိန်း၏ တံတားဒီဇိုင်းအတွက် သင့်တော်သော ရေလမ်းကင်းလွတ် အကျယ်/အမြင့် သတ်မှတ်ပေးနိုင်ပါရန် ဆောက်လုပ်ရေးဝန်ကြီးဌာန၊ တံတားဦးစီးဌာနမှ ရည်ညွှန်းချက်ပါစာဖြင့် အကြောင်းကြားလာပါသည်။

၂။ စစ်တောင်းတံတားအသစ်၏ တံတားဒီဇိုင်းအတွက် ရေလမ်းကင်းလွတ်အမြင့် (၆.၁ မီတာ)၊ တံတားခန်းဖွင့် (၁၀၄ မီတာ) ကို သတ်မှတ်မည်ဆိုပါက ကန့်ကွက်ရန်မရှိပါကြောင်း ပြန်ကြားအပ်ပါသည်။

ထွန်းလွင်ဦး
ညွှန်ကြားရေးမှူးချုပ်

ညွှန်ကြားရေးမှူးချုပ်
တံတားဦးစီးဌာန

Republic of Union of Myanmar

Ministry of Transport and Communication

DWIR

Naypyitaw

(Translation)

Letter No. 228/ Ya La Hta / Ya Aa Na – 60 / 2017

Date – 2017 / October / 17

Subject: To specify an appropriate navigation clearance (width/height) for the design of New Sittaung Bridge Construction Project

Reference: Ministry of Construction/ Date of (11-10-2017) of Department of Bridge / Letter no. Bridge/DG / Na Pa Ta/ 2017 – 2018 (904)

1. Ministry of Construction / Department of Bridge informed the contents of reference letter of DWIR in order to specify an appropriate navigation clearance (width / height) for the design New Sittaung Bridge Construction Project that is expected to be implemented with JICA assistance.

2. For the design of New Sittaung Bridge, DWIR has no objection to the proposed navigation clearance width (104m) and height (6.1m).

付録 – 1.4
DWIR からのレター
（ガイドバンクの建設について）

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန
ရေအရင်းအမြစ်နှင့်မြစ်ချောင်းများဖွံ့ဖြိုးတိုးတက်ရေးဦးစီးဌာန
နေပြည်တော်

စာအမှတ်၊ ၃ /ရလထ/ရအန-၆၀(၈၈)/၂၀၁၈
ရက် စွဲ၊ ၂၀၁၈ ခုနှစ်၊ ဖေဖော်ဝါရီလ (၂) ရက်

သို့

ညွှန်ကြားရေးမှူးချုပ်
တံတားဦးစီးဌာန
ဆောက်လုပ်ရေးဝန်ကြီးဌာန

အကြောင်းအရာ။ **စစ်တောင်းတံတားသစ် (ကျိုက်ထို) တည်ဆောက်ရေး စီမံကိန်းအတွက် Counter Measure For River Bank Erosion and Scour နှင့် ပတ်သက်၍ သဘောထားမှတ်ပြန်ကြားပေးပါရန်ကိစ္စ**

ရည် ညွှန်း ချက်။ ဆောက်လုပ်ရေးဝန်ကြီးဌာန၊ တံတားဦးစီးဌာန၏ (၆-၂-၂၀၁၈) ရက် နေ့စွဲပါ စာအမှတ်၊ တံတား/ EWECII/ နပတ/ ၂၀၁၇-၂၀၁၈/ ၀၄

၁။ စစ်တောင်းတံတားသစ် (ကျိုက်ထို) တည်ဆောက်ခြင်းစီမံကိန်းတွင် တံတား၏ Upstream ဘက်၊ River Bank Erosion and Scour အတွက် စစ်တောင်းမြစ်၏ လက်ယာဘက်၌ နည်းလမ်း (၁) Guide Bank (1.42 km) တည်ဆောက်ခြင်း (သို့မဟုတ်) နည်းလမ်း (၂) Road Embankment နှစ်ဘက်တွင် Slope Protection (0.7 km) တည်ဆောက်ခြင်းနှင့် စစ်တောင်းမြစ် လက်ဝဲဘက်ကမ်း၌ မြေထိန်းနံရံ (Revetment 0.33 km) တည်ဆောက်ခြင်းတို့နှင့်ပတ်သက်၍ သဘောထားမှတ်ချက်ပြန်ကြားပေးနိုင်ပါရန် ဆောက်လုပ်ရေးဝန်ကြီးဌာန၊ တံတားဦးစီးဌာနမှ ရည်ညွှန်းချက်ပါစာဖြင့် ညှိနှိုင်းအကြောင်းကြားလာပါသည်။

၂။ အဆိုပါကိစ္စနှင့်ပတ်သက်၍ JICA Study Team မှ Mr Hironobu KUROE နှင့်အဖွဲ့အား (၂-၂-၂၀၁၈) ရက်နေ့၌ မိမိတို့ဦးစီးဌာနအစည်းအဝေးခန်းမတွင် တွေ့ဆုံဆွေးနွေးခဲ့ပြီး ဖြစ်ပါသည်။ ကနဦးလေ့လာခြင်း (Prefeasibility Study) အတွက် ဆောင်ရွက်သင့်သည်များ ဖြစ်သည့် Upstream ရှိ Shan Gyaing River တွင် Guide Bank (၁.၄၂) ကီလိုမီတာတည်ဆောက် ရန်နှင့် ဆွတ်ပန်းဘက်ကမ်းတွင် ကမ်းထိန်း (၀.၃၃) ကီလိုမီတာ ဆောင်ရွက်ရန် တင်ပြလာခြင်း အပေါ် မိမိတို့ဦးစီးဌာနအနေဖြင့် ကန့်ကွက်ရန်မရှိပါကြောင်းနှင့် အမှန်တကယ်ဆောင်ရွက်ရန်၊ ဒီဇိုင်း

ရေးဆွဲမည့်အချိန်တွင် အသေးစိတ်တိုင်းတာရန်နှင့် Tidal Bore Effect အား ထည့်သွင်းစဉ်းစားရန် လိုအပ်မည်ဖြစ်ပါကြောင်း ပြန်ကြားအပ်ပါသည်။

ညွှန်ကြားရေးမှူးချုပ် (ကိုယ်စား)
(ကိုကိုဦး-ဒုတိယညွှန်ကြားရေးမှူးချုပ်)

Republic of the Union of Myanmar

Ministry of Transport and Communication

DWIR

Naypyitaw

(Translation)

Letter no. 3/ YaLaHta/ Ya Aa Na – 60(08)/2018

Date – 9 / February / 2018

ATT; Director General

Department of Bridge

Ministry of Construction

Subject: Request for comment upon Countermeasure for Riverbank Erosion and Scour of New Sittaung Bridge project

Reference: Ministry of Construction / Department of Bridge Letter no. Bridge / EWECII / NaPaTa / 2017 – 2018/ 04

1. Ministry of Construction / Department of Bridge requested for the comment with reference letter upon Riverbank Erosion and Scour of the right-side of the bank Alt.1 Guide Bank (1.42km) or Alt.2 Road Embankment with slope protection (0.7km) and the left side of the bank (Revetment 0.33km).
2. As above mention matter, Mr. Hironobu Kuore from JICA Study met with us at our meeting room on 2, Feb 2018. We, DWIR, has no objection for Guide Bank (1.42km) at the upstream near Shan Gyaing River and Revetment (0.33km) at Supanu village bank side. Moreover, it shall considered as follow:
    1. truly implementation,
    2. carry out detail survey at Detail Design Stage
    3. Considering of Tidal Bore Effect.

On behalf of DG

Ko Ko Oo (DDG)

付録 – 1.5
MR からのレター
（軌道上の建築限界について）

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ
ဆောက်လုပ်ရေးဝန်ကြီးဌာန
ဝန်ကြီးရုံး
နေပြည်တော်

အကြောင်းအရာ။ **စစ်တောင်းတံတားအသစ် တည်ဆောက်ရေးစီမံကိန်း၏ တံတားဒီဇိုင်းအတွက် သင့်တော်သော လမ်းအူကြောင်း ရွေးချယ်ပေးနိုင်ရေးနှင့် ရေလမ်းကင်းလွတ်အမြင့် သတ်မှတ်ပေးနိုင်ပါရန်ကိစ္စ**

ရည် ညွှန်း ချက် ။ ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာန၏ ၂၀၁၇ ခုနှစ် အောက်တိုဘာလ (၁၀)ရက်နေ့စွဲပါ စာအမှတ်၊ ပဆ-(၃)/(ဧရာဝတီ-DWIR)/(၄၈)

၁။ စစ်တောင်းတံတားအသစ် တည်ဆောက်ရေးစီမံကိန်း၏ တံတားဒီဇိုင်းအတွက် သင့်တော်သော လမ်းအူကြောင်းရွေးချယ်ပေးနိုင်ရေးနှင့် ရေလမ်းကင်းလွတ်အမြင့် သတ်မှတ်ပေးနိုင်ပါရန်နှင့် ပတ်သက်၍ စစ်တောင်းတံတားအသစ်အတွက် တံတားအူကြောင်းလျာထားရန် ကွင်းဆင်းတိုင်းတာမှုများ ဆောင်ရွက်ရန်လိုအပ်မည်ဖြစ်ပါသဖြင့် ကွင်းဆင်းတိုင်းတာရေးလုပ်ငန်းများအား ဆောက်လုပ်ရေးဝန်ကြီးဌာနမှ စရိတ်ဖြင့် ဆောင်ရွက်ရန် လိုအပ်မည်ဖြစ်ပါကြောင်းနှင့် တံတားအသစ်၏ ချဉ်းကပ်လမ်းတွင်တည်ရှိသည့် မီးရထားလမ်းနှင့်ပတ်သက်၍ Vertical Clearance အား မြန်မာ့မီးရထားမှ ရထားသံလမ်းမျက်နှာပြင်အထက် အနည်းဆုံး (၁၉'-၆")သတ်မှတ်ထားပါကြောင်း ပို့ဆောင်ရေးနှင့်ဆက်သွယ်ရေးဝန်ကြီးဌာနမှ ပြန်ကြားလာခြင်းအပေါ် အမြဲတမ်းအတွင်းဝန်မှ အောက်ပါအတိုင်း မှတ်ချက်ပြုထားပါသည် -

DG (တံတား)

ဆောင်ရွက်ပါ

၂။ အမြဲတမ်းအတွင်းဝန်၏ အထက်ပါ မှတ်ချက်ကို သိရှိလိုက်နာ ဆောင်ရွက်သွားပါရန် ရည်ညွှန်းချက်ပါ စာမိတ္တူနှင့်အတူ ပူးတွဲပေးပို့ အကြောင်းကြားအပ်ပါသည်။

ပြည်ထောင်စုဝန်ကြီး(ကိုယ်စား)
ရန်နောင်၊ ညွှန်ကြားရေးမှူး

ညွှန်ကြားရေးမှူးချုပ်
တံတားဦးစီးဌာန

စာအမှတ်၊ ၃၇/ဌာနခွဲ-၃/၂၀၁၇(JICA)(စီ ၂၆၉၆)
ရက် စွဲ ၊ ၂၀၁၇ ခုနှစ် အောက်တိုဘာလ ၂၄ ရက်

မိတ္တူကို
ဒုတိယညွှန်ကြားရေးမှူးချုပ် (စီမံရေး/ တည်ဆောက်ရေး/ ထိန်းသိမ်းရေး)၊ တံတားဦးစီးဌာန

Republic of Union of Myanmar Government

Ministry of Construction

Minister Office

Naypyidaw

(Translation)

Subject: To select the appropriate alignment and to specify the navigation clearance for the design of New Sittaung Bridge Project

Reference: Ministry of Transportation and Communication, Date of 2017/ October/ 10, Letter No. PaSa-(3)/ (Ayeyarwady-DWIR)/ (48)

1. Regarding the selection of the appropriate alignment and to specify the vertical clearance for the design of New Sittaung bridge project, field survey should be carried out to select appropriate alignment by the budgets Ministry of Construction. Vertical clearance for the railway which is located near the New Sittaung Approach Bridge should be19feet 6inch at minimum from the top surface of railway according to the replied from MOT.

   DG (Bridge)
   Proceed
2. We hereby, Permanent Secretary of the above comments shall be noted information attached with a copy of the referral

On behalf of Prime Minister

Yan Naung / Director

DG

DOB

Letter No. 37/branch-3/2017(JICA)(c 2696)

Date – 2017 / October / 16

Copy to: DDG (Planning/ Construction / Maintainacne) DOB

付録 - 2

概略設計図面集

MINISTRY OF CONSTRUCTION

JAPAN INTERNATIONAL COOPERATION AGENCY

Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section)

Preliminary Design Drawing
(New Sittaung Bridge)

October 2019

Oriental Consultants Global Co., Ltd.
NIPPON KOEI CO., LTD.
International Development Center of Japan
Metropolitan Expressway Company Limited.

Table of Contents

(A) . GENERAL

PROJECT LOCATION MAP

JAPAN INTERNATIONAL COOPERATION AGENCY MINISTRY OF CONSTRUCTION	ORIENTAL CONSULTANTS GLOBAL CO., LTD NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION) DRAWING TITLE: PROJECT LOCATION MAP SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

(B) . ROAD

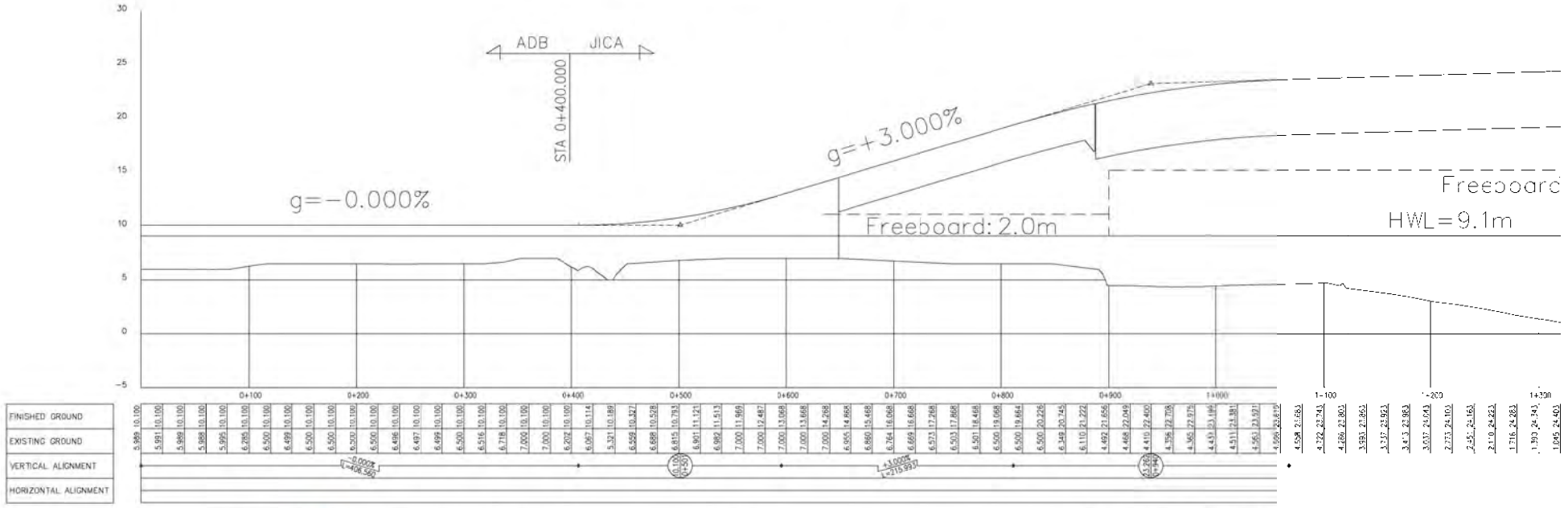
PLAN AND PROFILE (1)

PLAN

S=1/2000

PROFILE

H=1/2000, V=1/200



JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD
	INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED
	METROPOLITAN EXPRESSWAY COMPANY LIMITED

REMARKS

THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)

DRAWING TITLE: PLAN AND PROFILE (1)

SCALE: AS SHOWN

DRAWING NO.:

SHEET NO.:

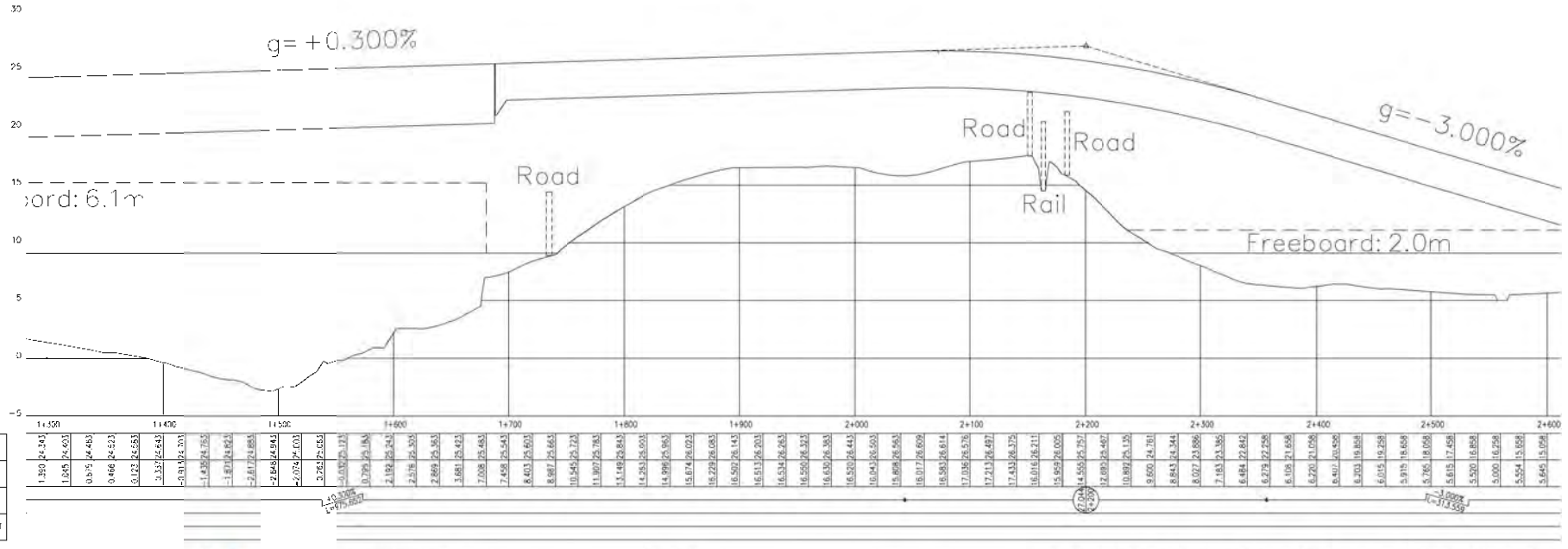
PLAN AND PROFILE (2)

PLAN

S=1/2000

PROFILE

H=1/2000, V=1/200



JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF CONSTRUCTION

ORIENTAL CONSULTANTS GLOBAL CO., LTD
NIPPON KOEI CO., LTD
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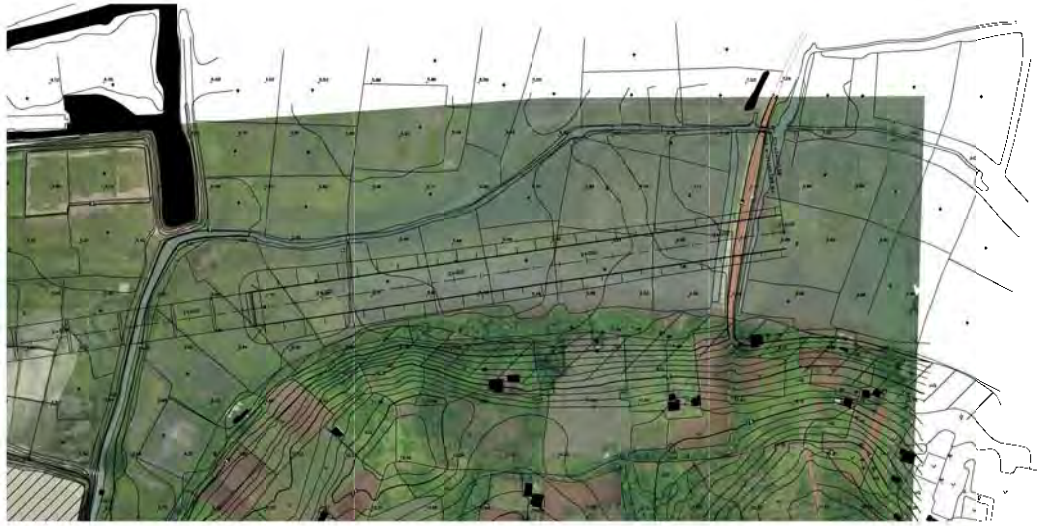
DRAWING TITLE: PLAN AND PROFILE (2)

SCALE	AS SHOWN
DRAWING NO.	
SHEET NO.	

PLAN AND PROFILE (3)

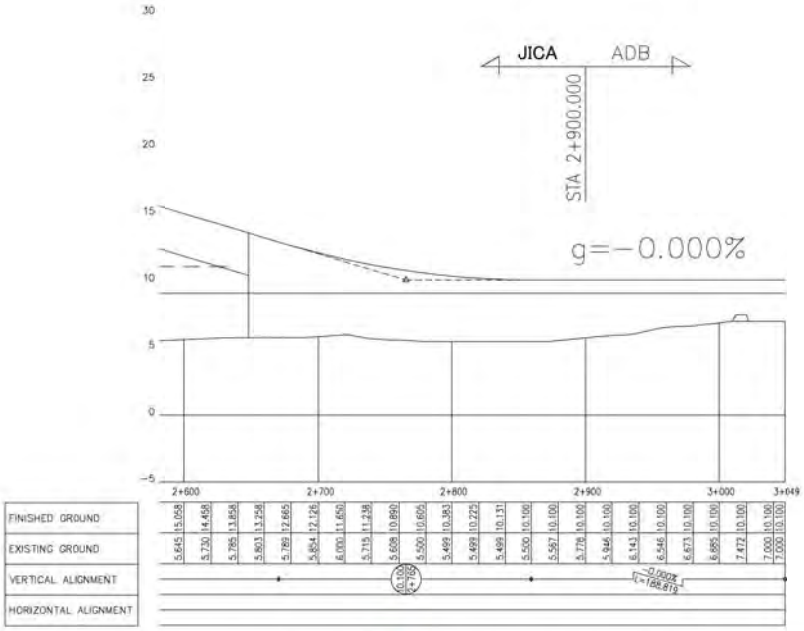
PLAN

S=1/2000



PROFILE

H=1/2000, V=1/200



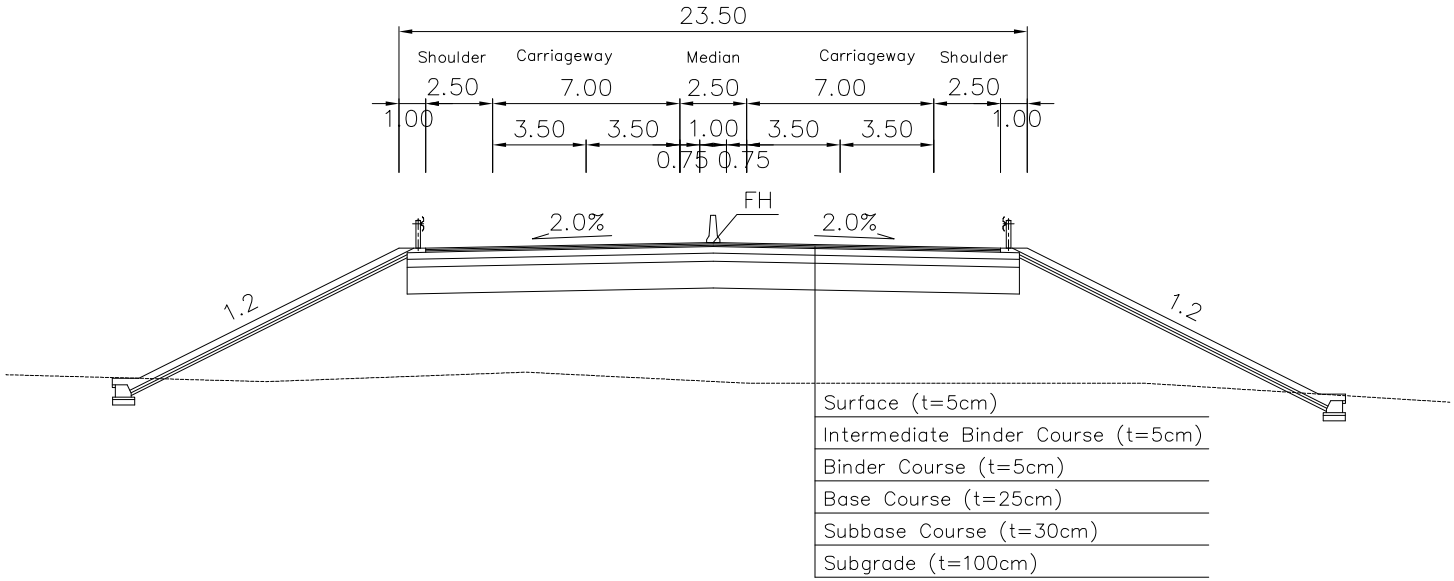
JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED	REMARKS
MINISTRY OF CONSTRUCTION		

THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)

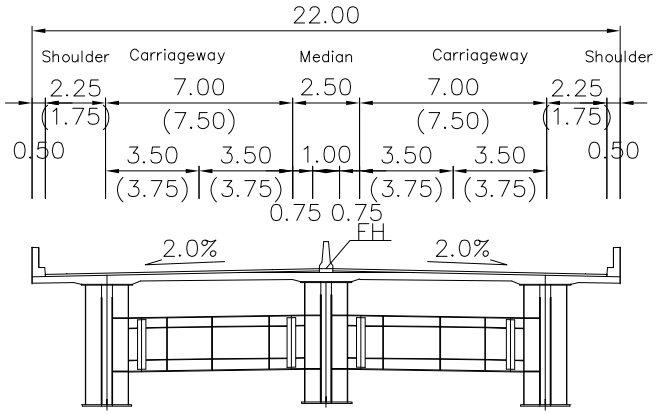
DRAWING TITLE	SCALE	AS SHOWN
PLAN AND PROFILE (3)	DRAWING NO.	
	SHEET NO.	

TYPICAL CROSS SECTION

EARTH WORK S=1/100



BRIDGE S=1/100



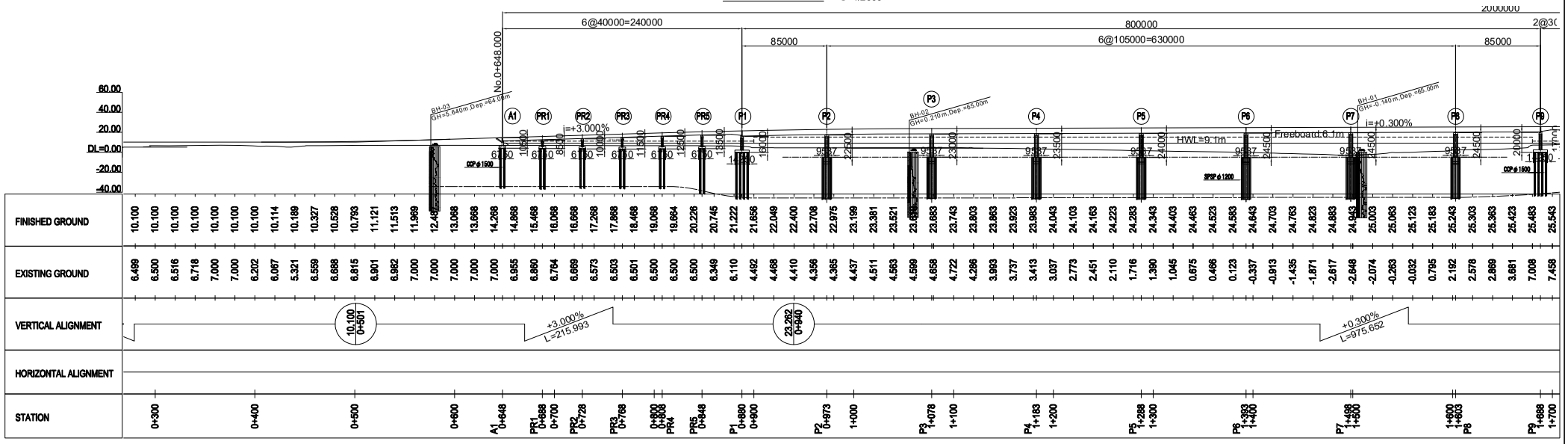
NOTE : ( ) SHOWS THE CONFIGURATION FOR FUTURE OPERATION STAGE

JAPAN INTERNATIONAL COOPERATION AGENCY MINISTRY OF CONSTRUCTION	ORIENTAL CONSULTANTS GLOBAL CO., LTD NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION) DRAWING TITLE: TYPICAL CROSS SECTION SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

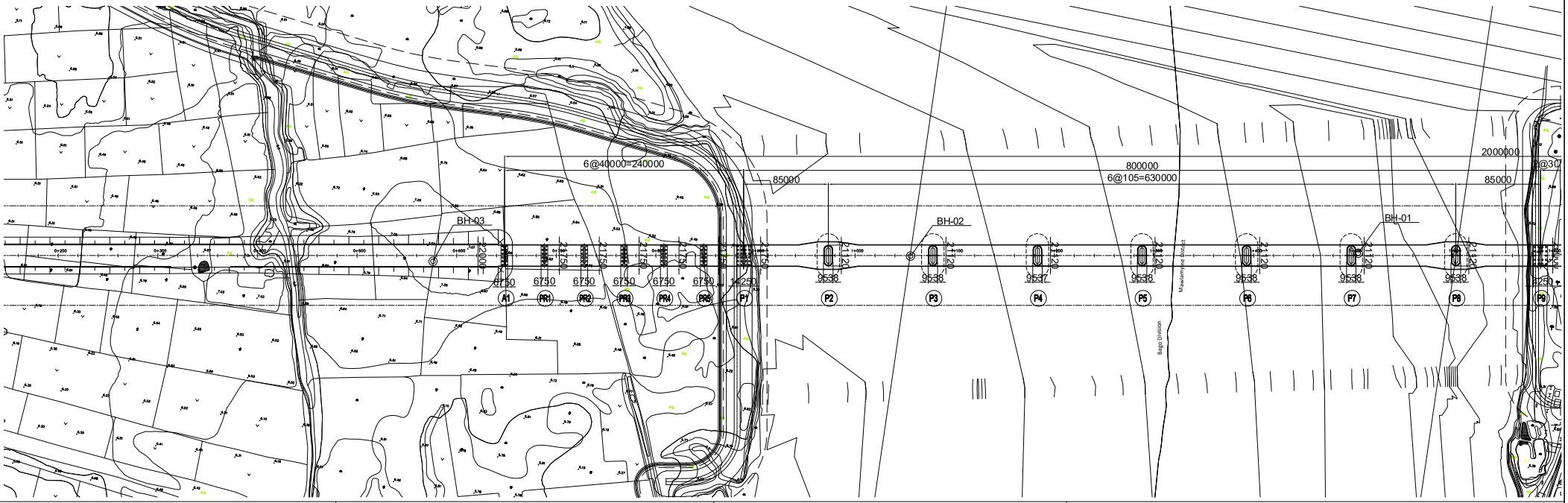
(C) . BRIDGE

NEW SITTAUNG BRIDGE GENERAL VIEW (1)

SIDE VIEW S=1/2000



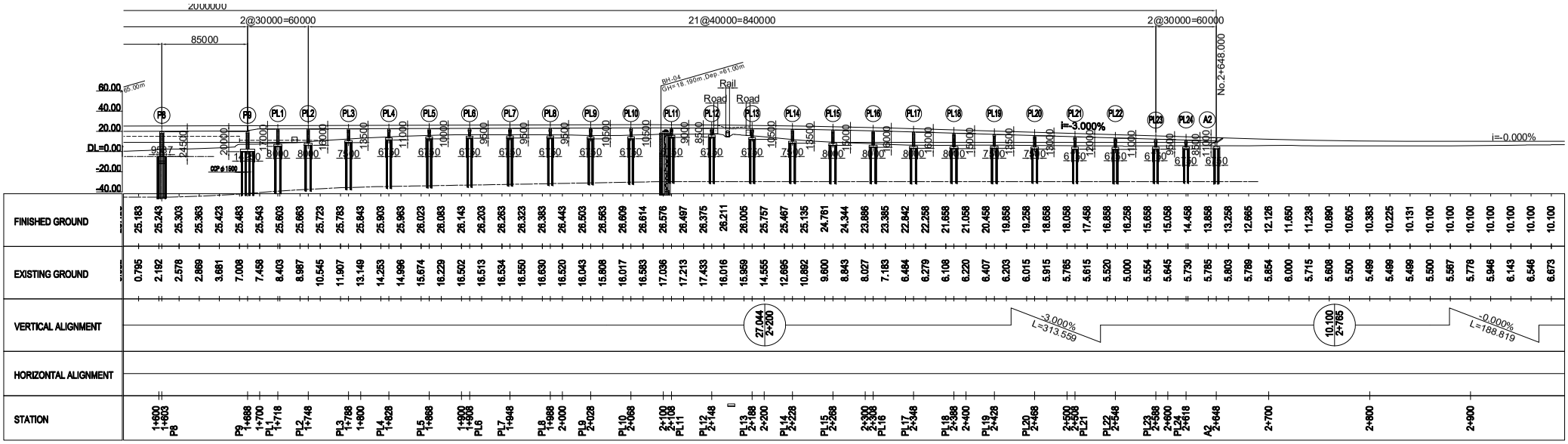
PLAN VIEW S=1/2000



JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: NEW SITTAUNG BRIDGE GENERAL VIEW (1) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

NEW SITTAUNG BRIDGE GENERAL VIEW(2)

SIDE VIEW S=1/2000



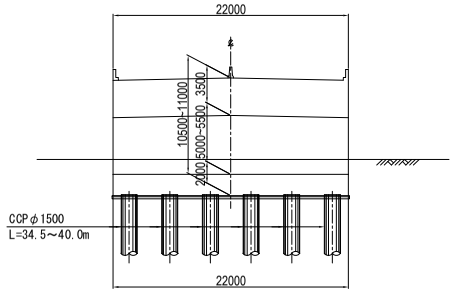
PLAN VIEW S=1/2000

JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: NEW SITTAUNG BRIDGE GENERAL VIEW(2) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

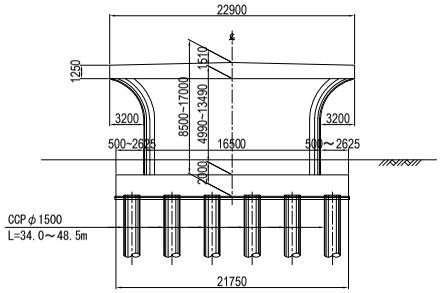
NEW SITTAUNG BRIDGE GENERAL VIEW(3)

SUB STRUCTURE S=1/500

Abutment



Piers on Land



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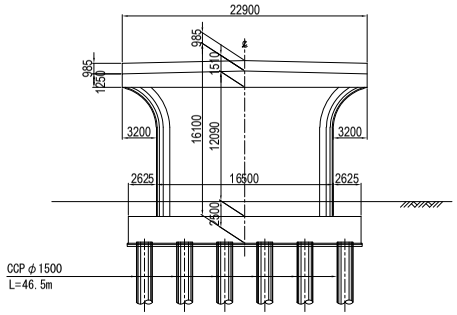
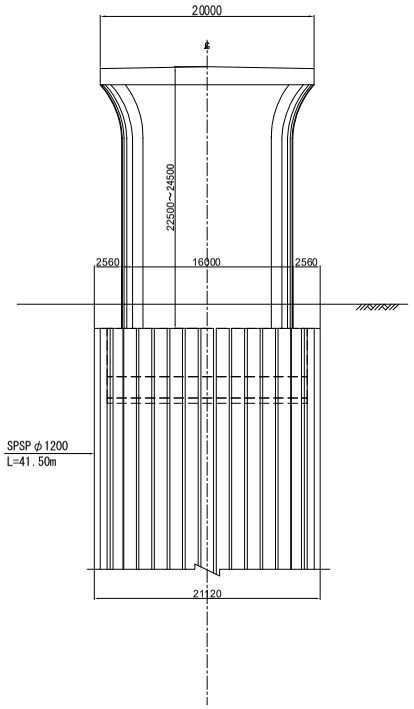


Piers in River



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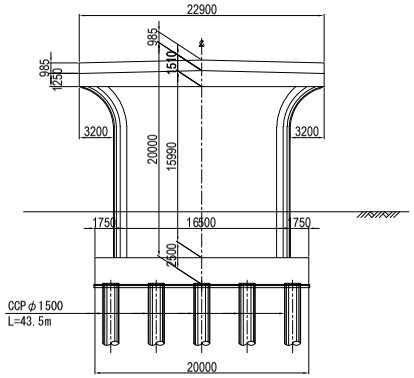
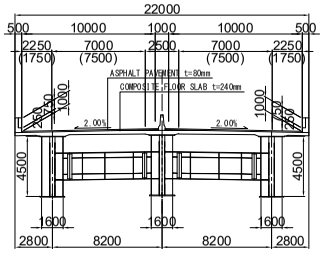
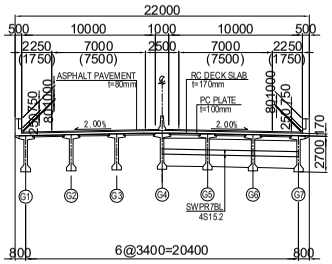


CROSS SECTION S=1/400

STEEL BOX GIRDER



PC-I GIRDER



NOTE : ( ) SHOWS THE CONFIGURATION FOR FUTURE OPERATION STAGE

DESIGN CRITERIA

Road Class & Design Speed	Initial Operation Stage : Class-I under ASEAN Highway Standards / V=100km/h		
	Future Operation Stage : Primary Class under ASEAN Highway Standards / V=120km/h		
Bridge Length (Span Length)	2000m(6@40.0m+85.0m+6@105.0m+85.0m+2@30.0m+21@40.0m+2@30.0m)		
Bridge Width	Initial Operation Stage : 0.50+2.25+2@3.50+2.5+2@3.50+2.25+0.50m		
	Future Operation Stage : 0.50+1.75+2@3.75+2.5+2@3.75+1.75+0.50m		
Pavement	Asphalt Concrete t=80mm		
Longitudinal Gradient	3.000% ~ LEVEL ~ -3.000%		
Cross-fall of Carriageway	2.00 %		
Superstructure Type	6 span Continuous PC-I Girder + 8 span Continuous Steel Box Girder + 25 span Continuous PC-I Girder		
Substructure Type	Abutment	Inverted T-Type	
	Pier	Wall-Type	
Foundation Type	Abutment	Cast in Situ Pile φ1500	
	Pier (Land Area)	Cast in Situ Pile φ1500	
	Pier (River Area)	Steel Pipe Sheet Pile φ1200	
Material Strength			
Superstructure	Girder		σck=40N/mm^2
	Cross Beam		σck=30N/mm^2
	Slab		σck=30N/mm^2
	PC Plate		σck=40N/mm^2
Surface Facility	Curb , Wheel guard		σck=24N/mm^2
Steel	Steel Girder		SS400, SM400,SM490,SM570,S10T
Reinforcing Steel			SD345 (py=345N/mm^2)
Substructure			σck=30N/mm^2
Pre-stressing Steel	Girder	12S15.2(SWPR7B)	
	Cross Beam	4S15.2(SWPR7B)	
	PC Plate	1S9.3(SWPR7A)	

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF CONSTRUCTION

ORIENTAL CONSULTANTS GLOBAL CO., LTD

NIPPON KOEI CO., LTD

INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED

METROPOLITAN EXPRESSWAY COMPANY LIMITED

REMARKS

THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)

DRAWING TITLE: NEW SITTAUNG BRIDGE GENERAL VIEW(3)

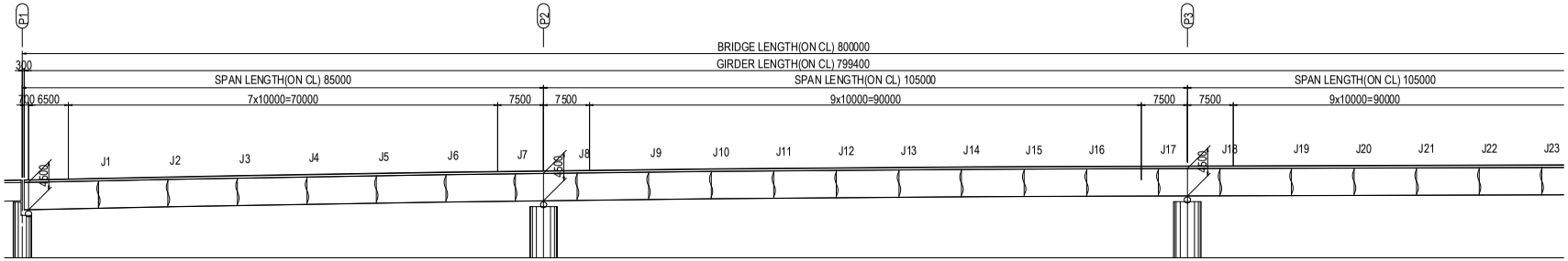
SCALE: AS SHOWN

DRAWING NO.:

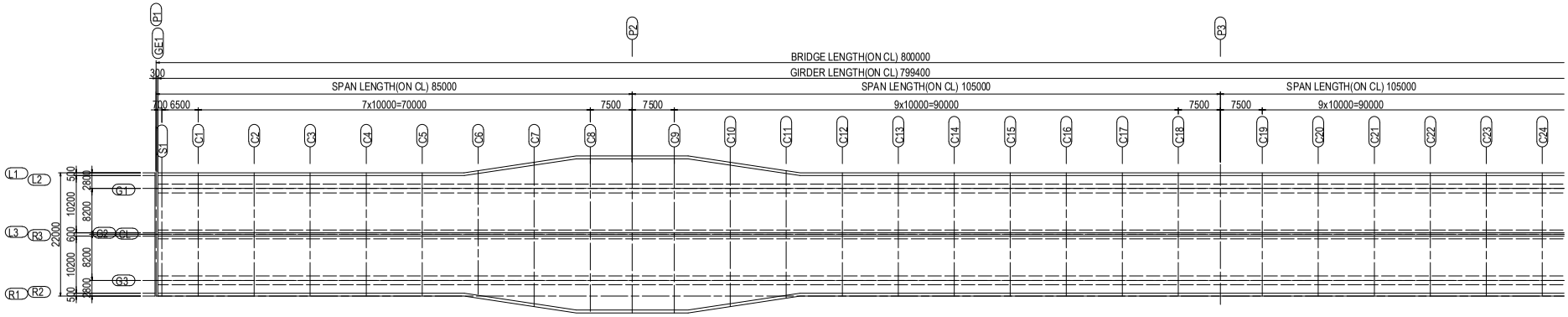
SHEET NO.:

GENERAL VIEW OF SUPERSTRUCTURE (1)
(STEEL BOX GIRDER)

SIDE VIEW S=1:400



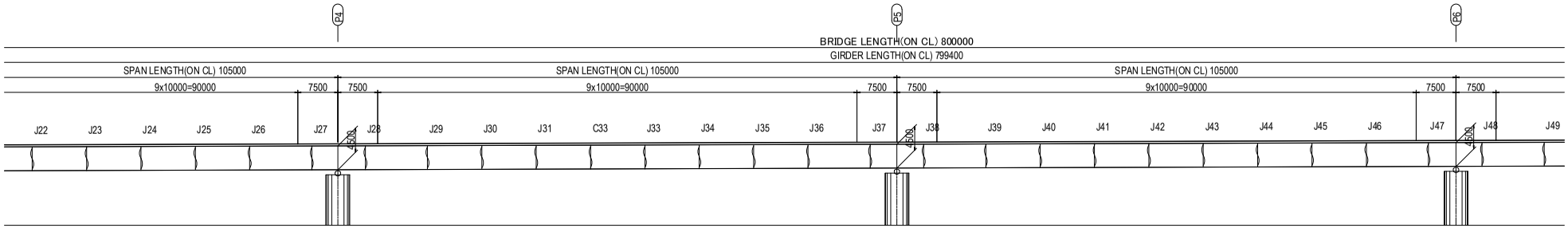
PLAN S=1:400



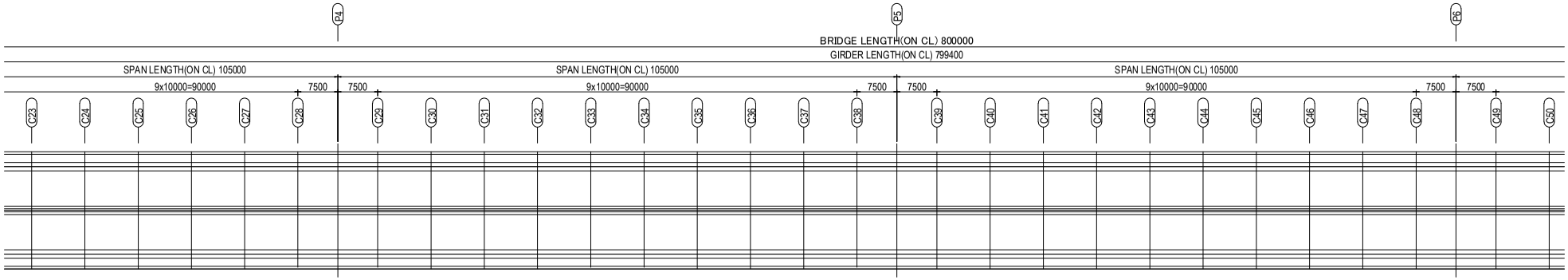
JAPAN INTERNATIONAL COOPERATION AGENCY MINISTRY OF CONSTRUCTION	ORIENTAL CONSULTANTS GLOBAL CO., LTD NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION) DRAWING TITLE: GENERAL VIEW OF SUPERSTRUCTURE (1) (STEEL BOX GIRDER) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

GENERAL VIEW OF SUPERSTRUCTURE (2)
(STEEL BOX GIRDER)

SIDE VIEW S=1:400



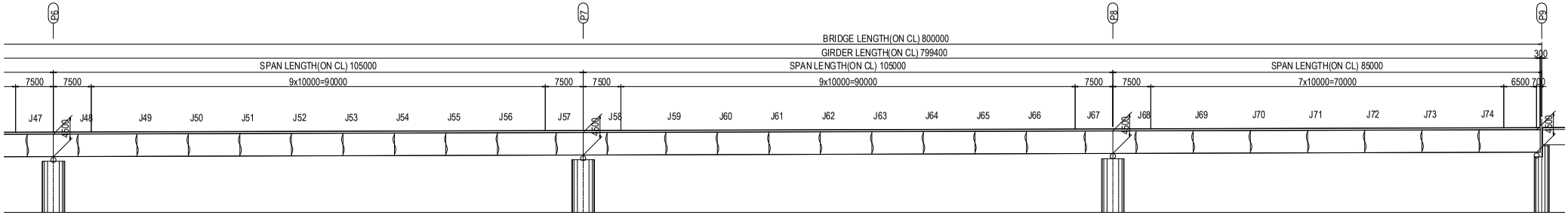
PLAN S=1:400



JAPAN INTERNATIONAL COOPERATION AGENCY MINISTRY OF CONSTRUCTION	ORIENTAL CONSULTANTS GLOBAL CO., LTD NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION) DRAWING TITLE: GENERAL VIEW OF SUPERSTRUCTURE (2) (STEEL BOX GIRDER) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

GENERAL VIEW OF SUPERSTRUCTURE (3)
(STEEL BOX GIRDER)

SIDE VIEW S=1:400



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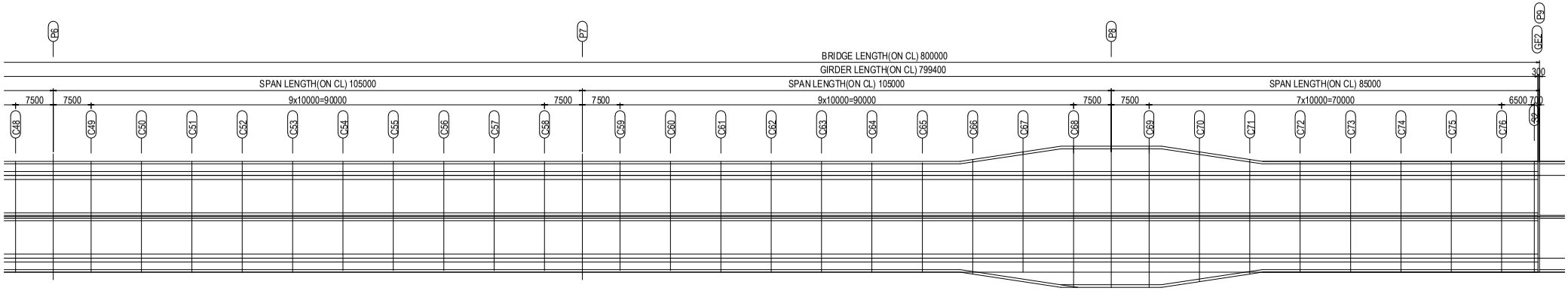
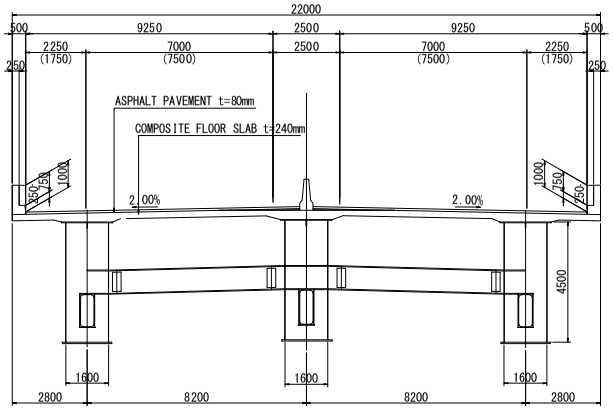


JAPAN INTERNATIONAL COOPERATION AGENCY MINISTRY OF CONSTRUCTION	**ORIENTAL CONSULTANTS GLOBAL CO., LTD** NIPPON KOEI CO., LTD **INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED** **METROPOLITAN EXPRESSWAY COMPANY LIMITED**	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION) DRAWING TITLE: GENERAL VIEW OF SUPERSTRUCTURE (3) (STEEL BOX GIRDER) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

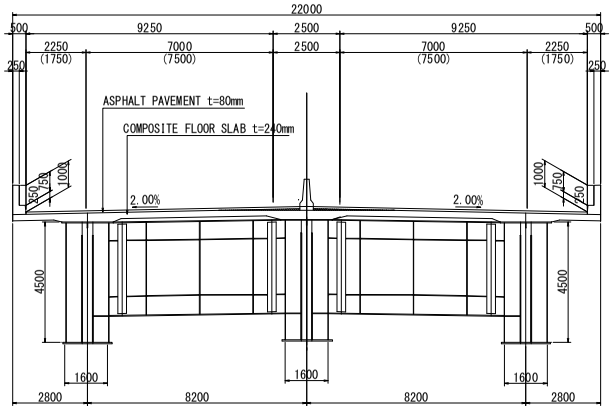
GENERAL VIEW OF SUPERSTRUCTURE (4)

TYPICAL CROSS SECTION S=1:100

CROSS BEAM



P1, P9



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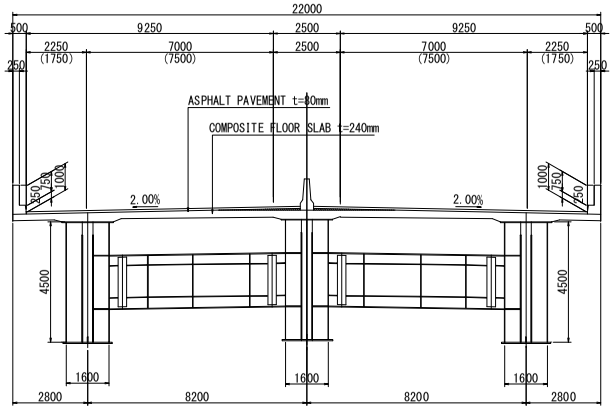


DESIGN CONDITION

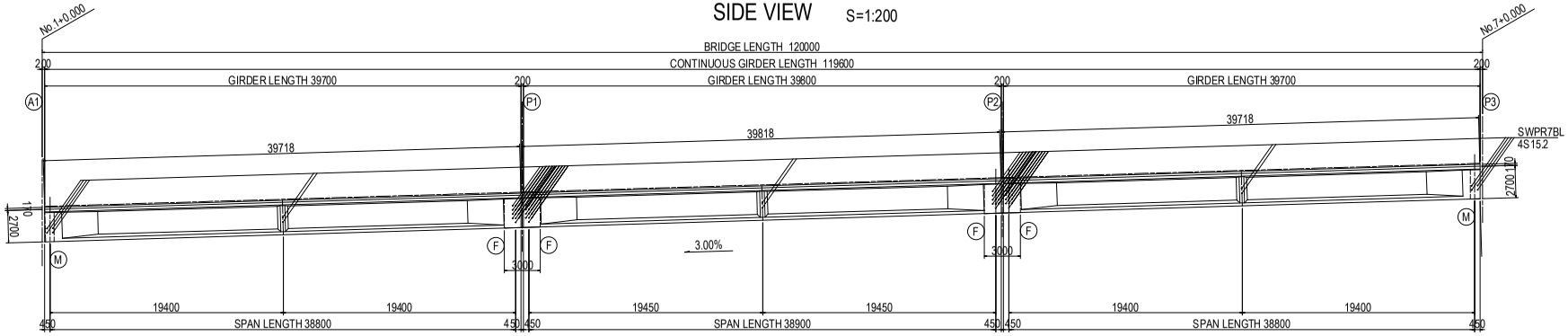
ROAD CLASS	Initial Operation Stage : Class-I (ASEAN Highway Standards)
	Future Operation Stage : Primary (ASEAN Highway Standards)
BRIDGE TYPE	8 span continuous steel box girder
BRIDGE LENGTH	L = 800.000 m
SPAN LENGTH	L = 85.000 + 6x105.000 + 85.000 m
WIDTH OF THE BRIDGE	TOTAL : 22.000 m Initial Operation Stage : L = 0.500 +2.250 + 7.000 + 2.500 + 7.000 + 2.250 + 0.500 m Future Operation Stage : L = 0.500 +1.750 + 7.500 + 2.500 + 7.500 + 1.750 + 0.500 m
PLANE CONFIGURATION	A=150.0～R=∞～A=130.0～R=320.0
HORIZONTAL ALIGNMENT	R=∞
LONGITUDINAL SLOPE	3.000% ↙
CROSS SLOPE	LEFT : 2.000% ↙ RIGHT : 2.000% ↘
ANGLE OF SKEW	90°00'00"
PAVEMENT	ASPHALT PAVEMENT t = 80 mm
SLAB	COMPOSITE FLOOR SLAB t=240mm
LIVE ROAD	HL-93, HS-25
DESIGN STANDARD	Specifications for highway bridges(Japan Road Association) AASHTO LRFD Bridge Design Specifications (2010, 5th edition)*Live Load Only

NOTE : ( ) SHOWS THE CONFIGURATION FOR FUTURE OPERATION STAGE

JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: GENERAL VIEW OF SUPERSTRUCTURE (4) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

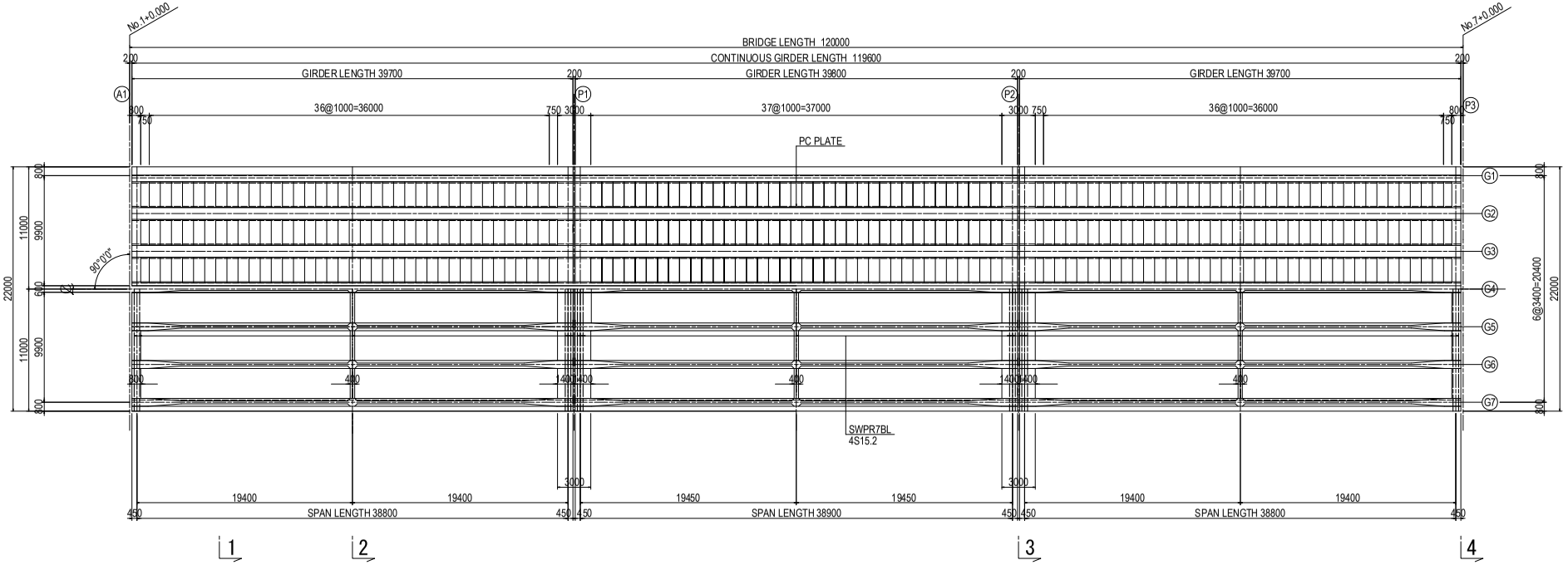
GENERAL VIEW OF SUPERSTRUCTURE (1)
(PC-I GIRDER)

SIDE VIEW S=1:200



1 2 3 4

PLAN S=1:200



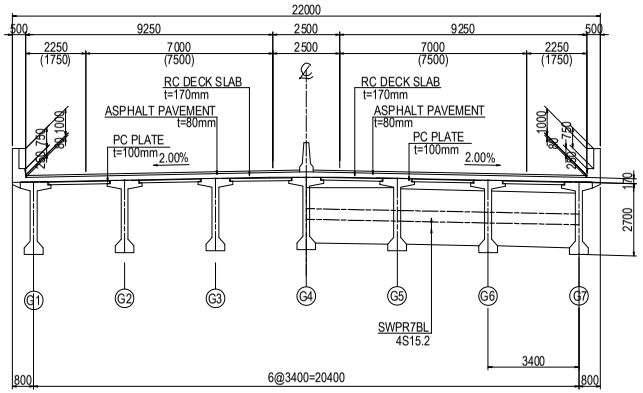
1 2 3 4

JAPAN INTERNATIONAL COOPERATION AGENCY MINISTRY OF CONSTRUCTION	ORIENTAL CONSULTANTS GLOBAL CO., LTD NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION) DRAWING TITLE: GENERAL VIEW OF SUPERSTRUCTURE (1) (PC-I GIRDER) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

GENERAL VIEW OF SUPERSTRUCTURE (2)

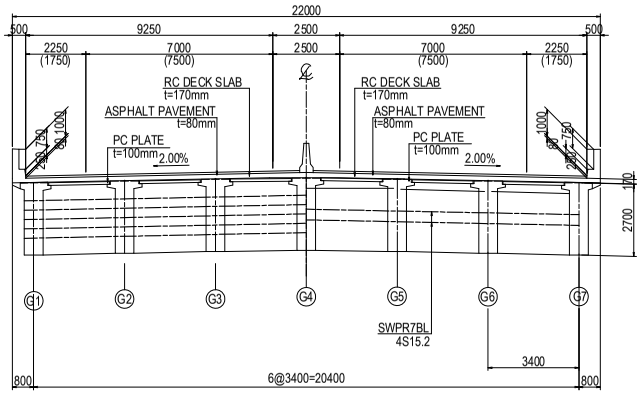
CROSS SECTION S=1:100

1-1



2-2

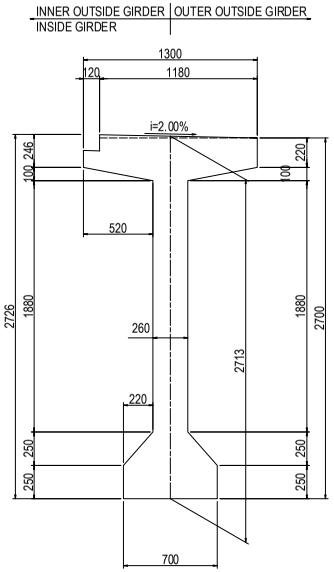
3-3



4-4

CROSS SECTION OF MAIN GIRDER S=1:20

STANDARD SECTION



DESIGN CONDITION

ROAD GLASS	Initial Operation Stage : Class-I (ASEAN Highway Standards) Future Operation Stage : Primary (ASEAN Highway Standards)
BRIDGE TYPE	3 span continuous PC-I girder bridge with composite deck(PC plate and RC deck)
BRIDGE LENGTH	L = 120.000 m
SPAN LENGTH	L = 38.800m + 38.900m + 38.800m
WIDTH OF THE ROAD	TOTAL : 22.000 m Initial Operation Stage : L = 0.500 +2.250 + 7.000 + 2.500 + 7.000 + 2.250 + 0.500 m Future Operation Stage : L = 0.500 +1.750 + 7.500 + 2.500 + 7.500 + 1.750 + 0.500 m
HORIZONTAL ALIGNMENT	R=∞
LONGITUDINAL SLOPE	3.000%
CROSS SLOPE	LEFT : 2.000% RIGHT : 2.000%
ANGLE OF SKEW	A.1,P.1,P.2,P.3, : 90°00'00"
PAVEMENT	ASPHALT PAVEMENT t = 80 mm
SLAB	RC DECK SLAB t = 170 mm
PLATE	PC PLATE t = 100 mm
LIVE ROAD	HL-93, HS-25
DESIGN STANDARD	Specifications for highway bridges(Japan Road Association) AASHTO LRFD Bridge Design Specifications (2010, 5th edition)*Live Load Only

MATERIALS STRENGTH

(N/mm²)

CONCRETE		MAIN GIRDER	CROSS BEAM	PC PLATE	RC SLAB	COUPLING CONCRETE
DESIGN STANDARD STRENGTH OF CONCRETE		40.0	30.0	40.0	30.0	30.0
BENDING COMPRESSIVE STRESS	IMMEDIATELY AFTER PRESTRESSING	19.0	14.0	19.0	——	——
	OTHERS	14.0	11.0	15.0	10.0	10.0
BENDING TENSILE STRESS	IMMEDIATELY AFTER PRESTRESSING	-1.5	-1.2	-1.5	——	——
	DEAD LOAD	0.0	0.0	0.0	——	——
	OTHERS	-1.5	-1.2	0.0	——	——
MEAN SHEAR STRESS CONCRETE CAN CARRY		0.55	0.45	——	——	——
MAXIMUM MEAN CONCRETE SHEAR STRESS	IN CASE WHERE ONLY SHEAR FORCES	5.3	4.0	——	——	——
ALLOWABLE DIAGONEL TENSILE STRESS (DEAD LOAD)	IN CASE WHERE ONLY SHEAR FORCES	-1.0	-0.8	——	——	——
ALLOWABLE DIAGONEL TENSILE STRESS (LIVE LOAD)	IN CASE WHERE ONLY SHEAR FORCES	-2.0	-1.7	——	——	——

(N/mm²)

PC STRAND		SWPR7BL 12S15.2mm	SWPR7BL 4S15.2mm	SWPR7AL 1S9.3mm
TENSILE STRENGTH		1850	1850	1700
YIELD POINT		1600	1600	1450
ALLOWABLE TENSILE STRESS	DURING PRESTRESSING	1440	1440	1305
	IMMEDIATELY AFTER PRESTRESSING	1295	1295	1190
	UNDER DESIGN LOAD	1110	1110	1020

(N/mm²)

REINFORCING STEEL		MAIN GIRDER	CROSS BEAM	RC SLAB	COUPLING CONCRETE
STEEL TYPE		SD345	SD345	SD345	SD345
YIELD POINT		345	345	345	345
ALLOWABLE TENSILE STRESS	DEAD LOAD	——	——	100	100
	DESIGN LOAD	180	180	140	160
	EARTHQUAKE LOAD	——	200	——	——

NOTE : ( ) SHOWS THE CONFIGURATION FOR FUTURE OPERATION STAGE

JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF CONSTRUCTION

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INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED

METROPOLITAN EXPRESSWAY COMPANY LIMITED

REMARKS

THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)

DRAWING TITLE: GENERAL VIEW OF SUPERSTRUCTURE (2) (PC-I GIRDER)

SCALE: AS SHOWN

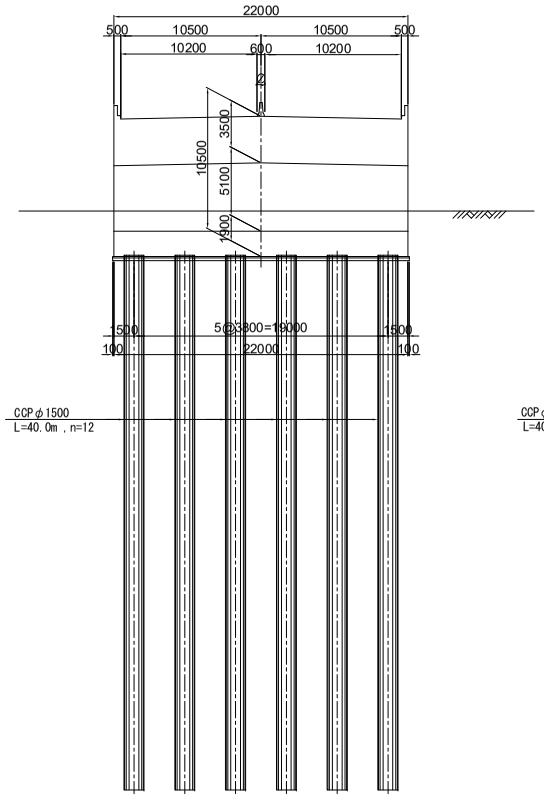
DRAWING NO.:

SHEET NO.:

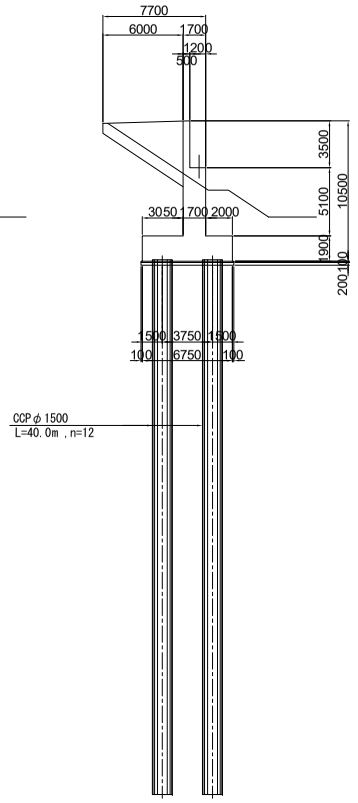
SUBSTRUCTURE AND FOUNDATION (1)

A1
Scale 1:400

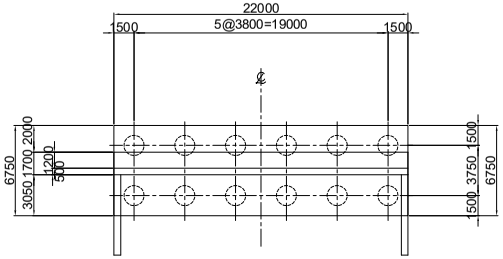
FRONT VIEW



SIDE VIEW

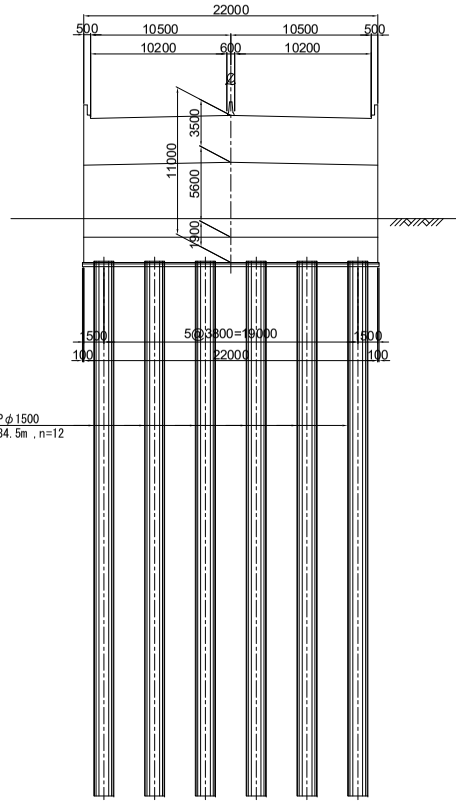


PLAN VIEW

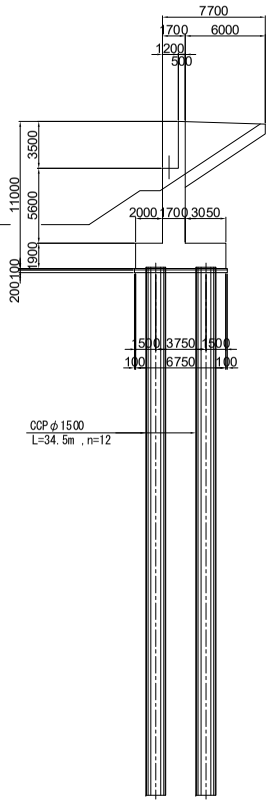


A2
Scale 1:400

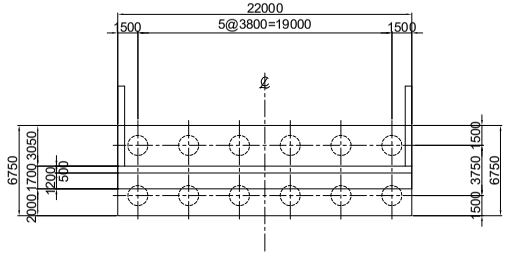
FRONT VIEW



SIDE VIEW



PLAN VIEW



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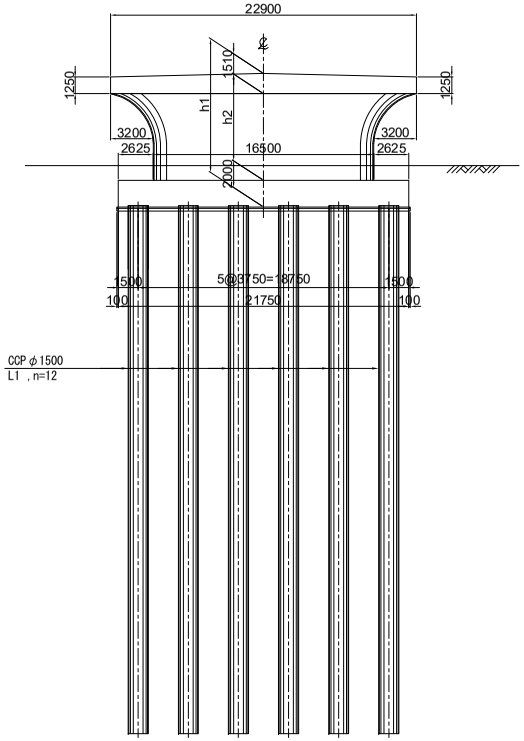
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: SUBSTRUCTURE AND FOUNDATION(1) SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

SUBSTRUCTURE AND FOUNDATION (2)

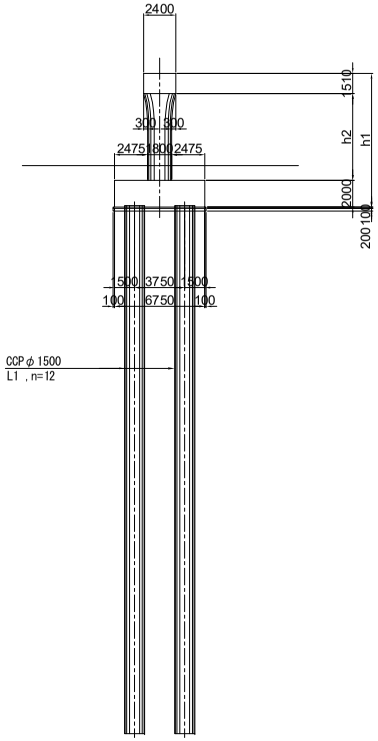
PR1,2,3

Scale 1:400

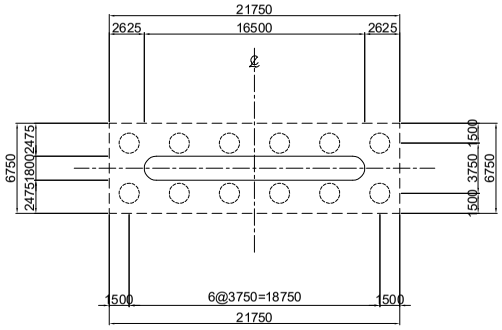
FRONT VIEW



SIDE VIEW



PLAN VIEW

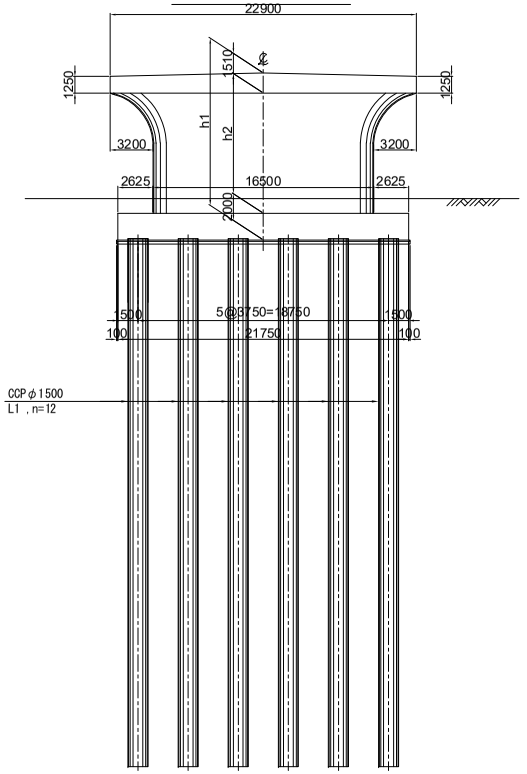


	h1	h2	L1
PR1	8.500	4.990	40.500
PR2	10.000	6.490	39.500
PR3	11.500	7.990	39.500

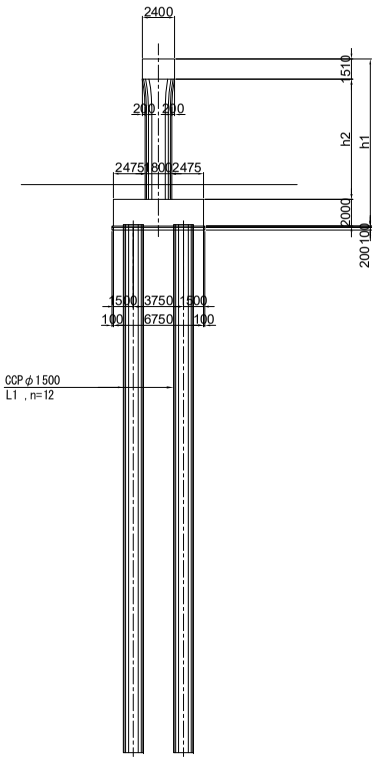
PR4,5

Scale 1:400

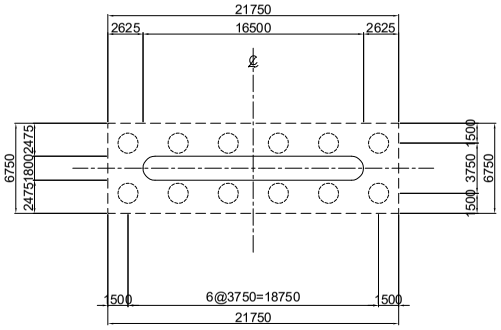
FRONT VIEW



SIDE VIEW



PLAN VIEW



	h1	h2	L1
PR4	12.500	8.990	40.000
PR5	13.500	9.990	45.000

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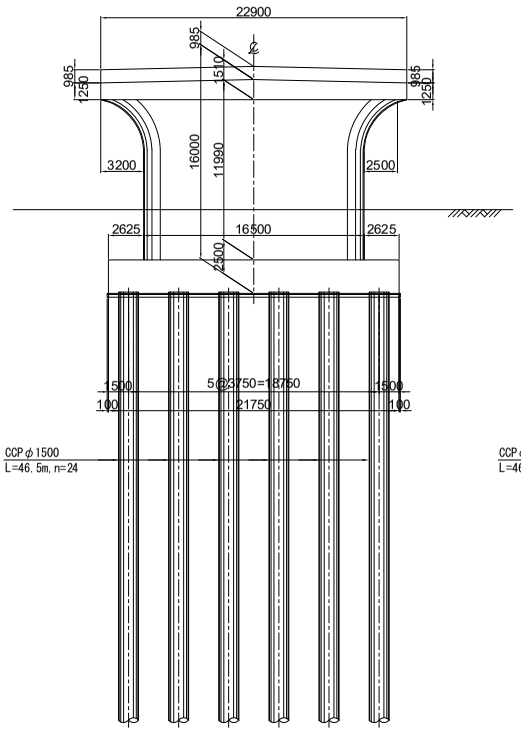
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: SUBSTRUCTURE AND FOUNDATION(2) — SCALE: AS SHOWN; DRAWING NO.; SHEET NO.

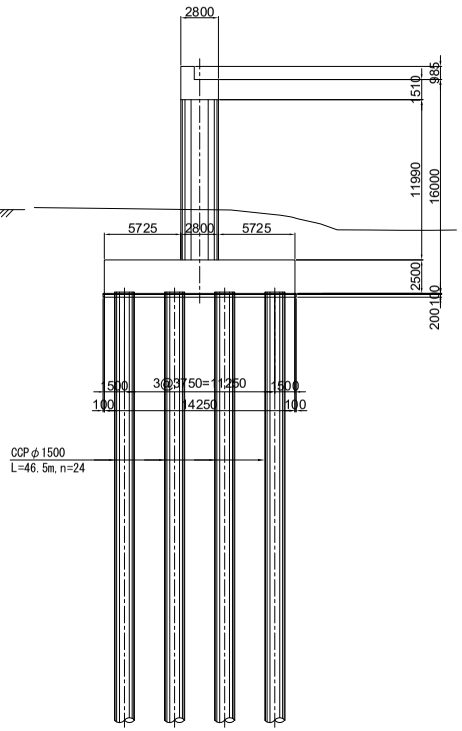
SUBSTRUCTURE AND FOUNDATION (3)

P1
Scale 1:400

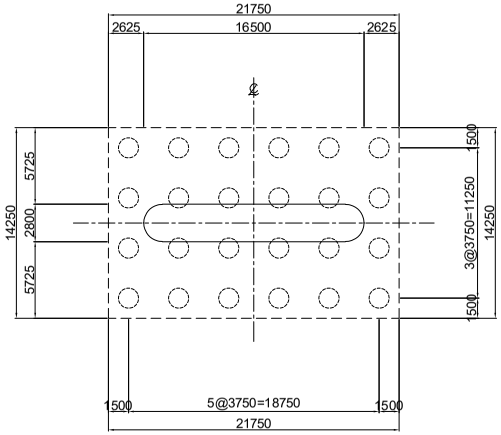
FRONT VIEW



SIDE VIEW

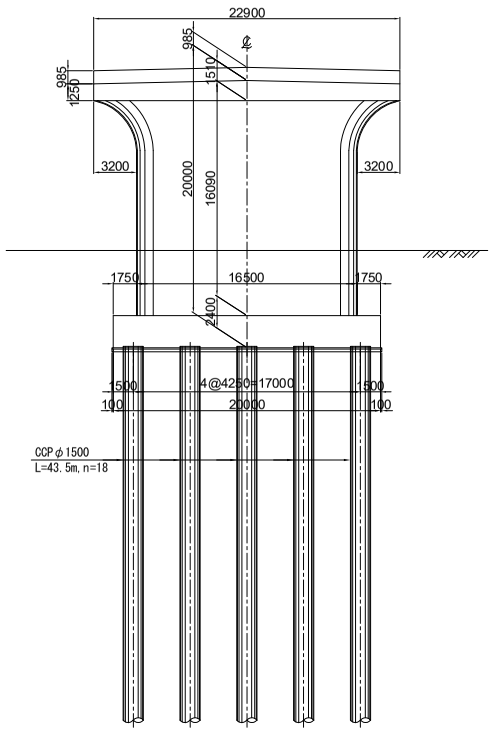


PLAN VIEW

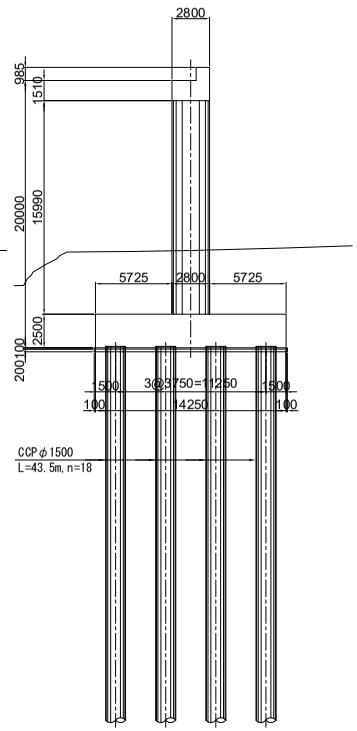


P9
Scale 1:400

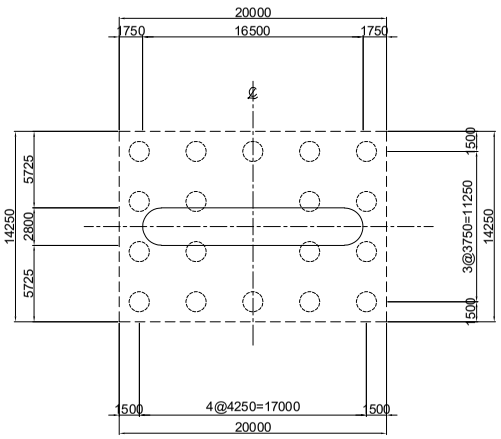
FRONT VIEW



SIDE VIEW



PLAN VIEW



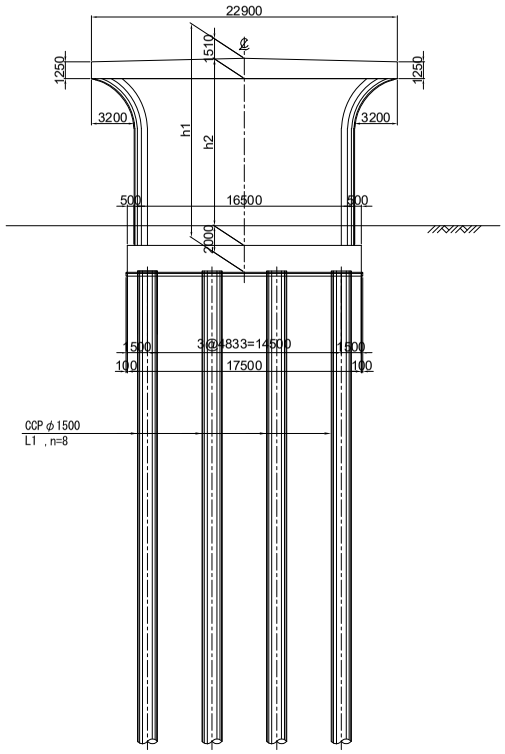
JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)	
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: SUBSTRUCTURE AND FOUNDATION(3)	SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

SUBSTRUCTURE AND FOUNDATION (4)

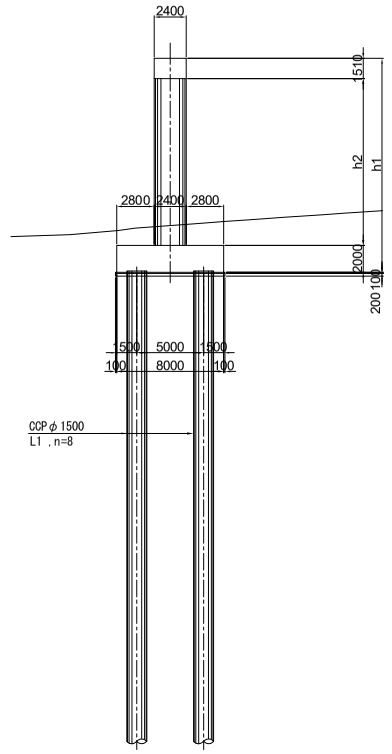
PL1,2,15,16,17,18

Scale 1:400

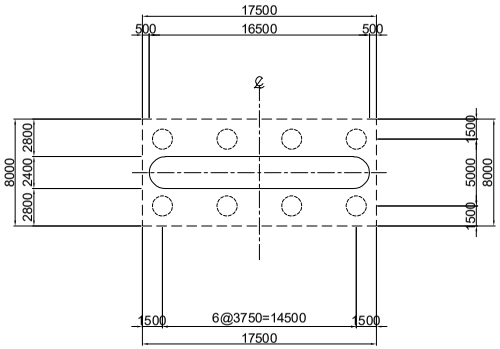
FRONT VIEW



SIDE VIEW



PLAN VIEW

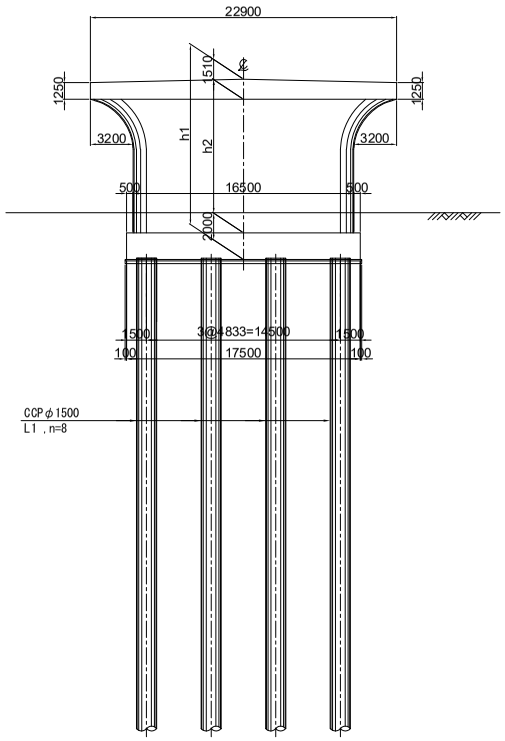


	h1	h2	L1
PL1	17.000	13.490	46.500
PL2	16.000	12.490	45.500
PL15	15.000	11.490	38.000
PL16	16.000	12.490	36.000
PL17	16.000	12.490	35.000
PL18	15.000	11.490	34.500

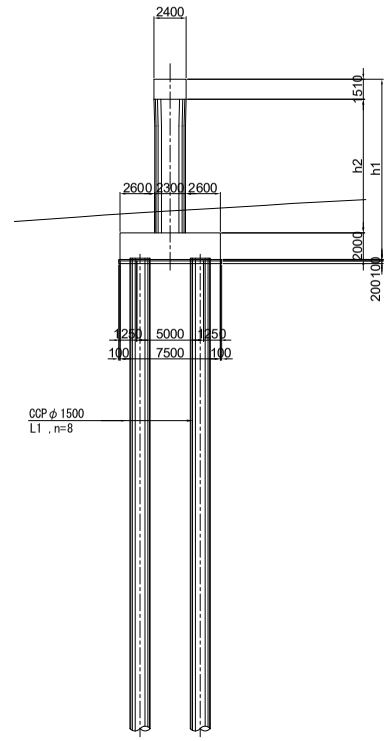
PL3,14,19,20

Scale 1:400

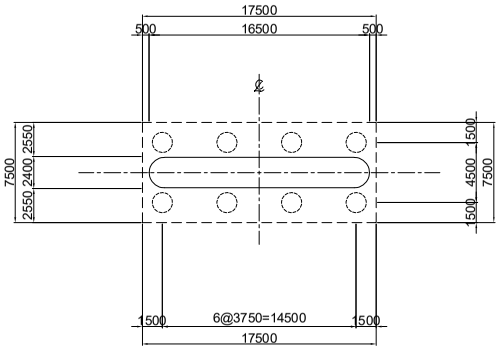
FRONT VIEW



SIDE VIEW



PLAN VIEW



	h1	h2	L1
PL3	13.500	9.990	46.500
PL14	13.500	9.990	40.000
PL19	13.500	9.990	35.000
PL20	13.000	9.490	34.000

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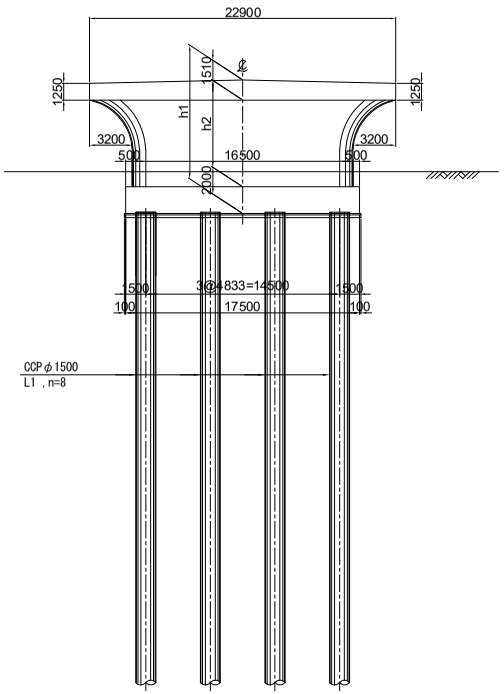
SUBSTRUCTURE AND FOUNDATION (5)

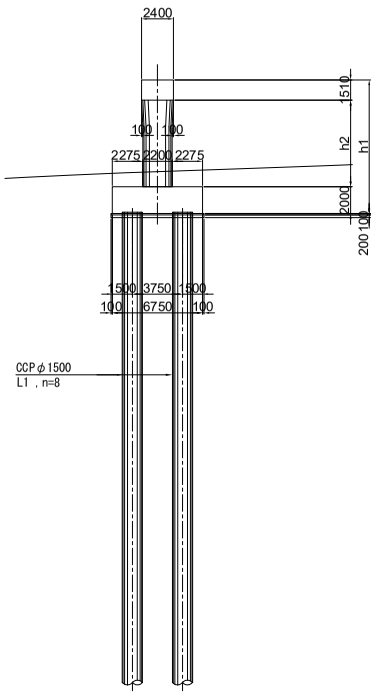
PL4,5,6,7,8,9,10,11,12,13,21,22,23,24

Scale 1:400

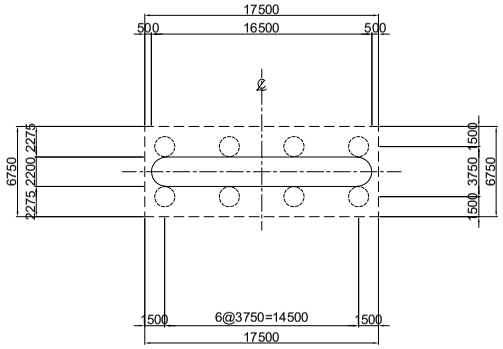
FRONT VIEW



SIDE VIEW



PLAN VIEW

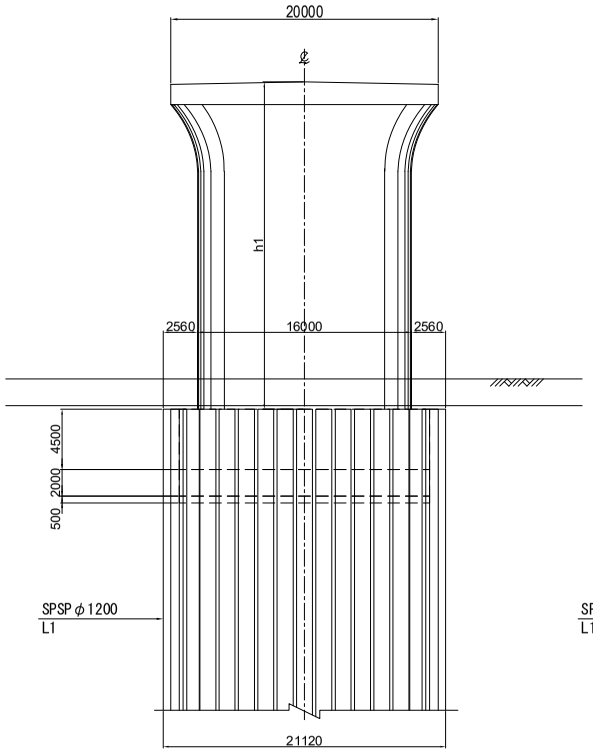


	h1	h2	L1
PL4	11.000	7.490	48.000
PL5	10.000	6.490	48.500
PL6	9.500	5.990	48.500
PL7	9.500	5.990	47.500
PL8	9.500	5.990	47.000
PL9	10.500	6.990	45.500
PL10	10.500	6.990	45.000
PL11	9.000	5.490	45.500
PL12	8.500	4.990	46.000
PL13	10.500	6.990	43.500
PL21	12.000	8.490	34.000
PL22	11.000	7.490	34.000
PL23	9.500	5.990	34.000
PL24	8.500	4.990	34.000

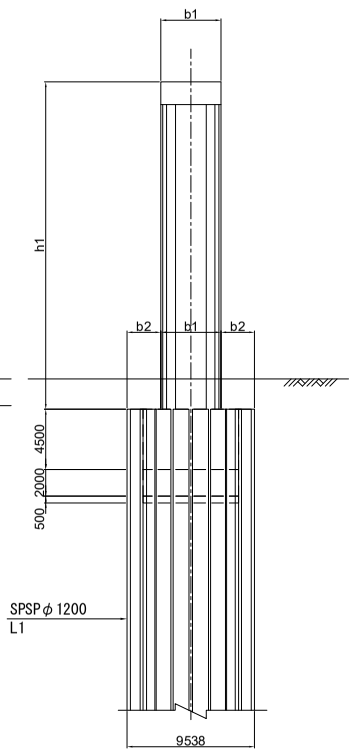
P2,3,4,5,6,7,8

Scale 1:400

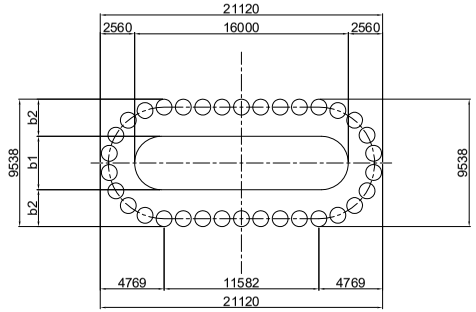
FRONT VIEW



SIDE VIEW



PLAN VIEW



	h1	b1	b2	L1
P2	22.500	4.000	2.769	41.450
P3	23.000	4.000	2.769	41.450
P4	23.500	4.000	2.769	41.450
P5	24.000	4.000	2.769	41.450
P6	24.500	4.000	2.769	41.450
P7	24.500	4.000	2.769	41.450
P8	24.500	4.000	2.769	41.450

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REMARKS

THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)

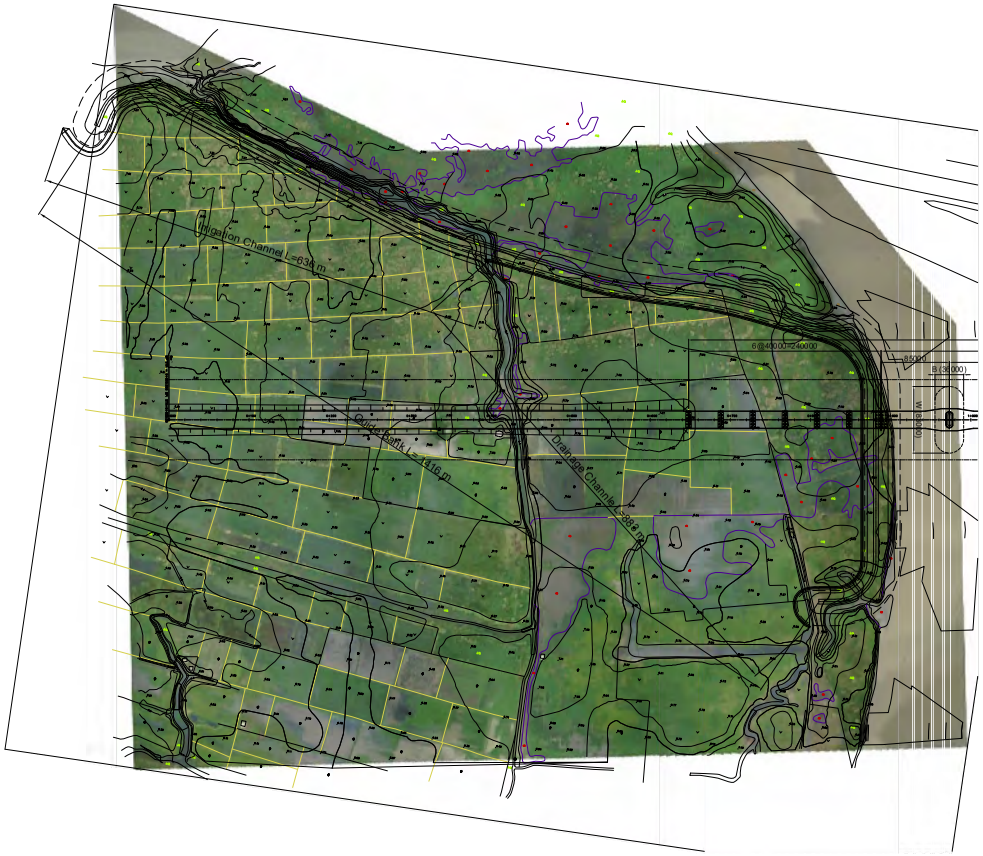
DRAWING TITLE: SUBSTRUCTURE AND FOUNDATION(5)

SCALE: AS SHOWN

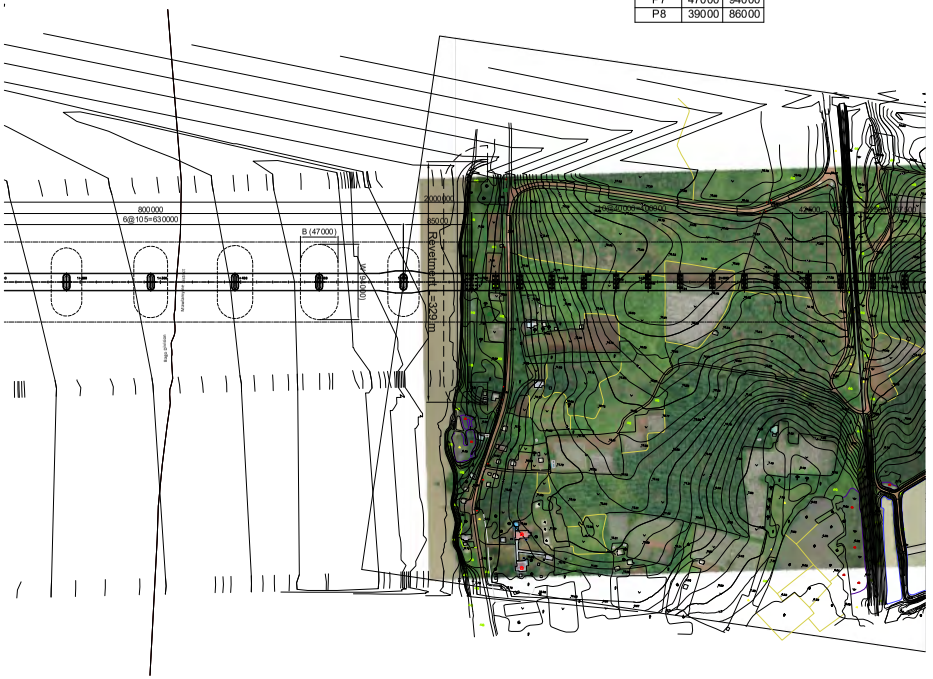
DRAWING NO.:

SHEET NO.:

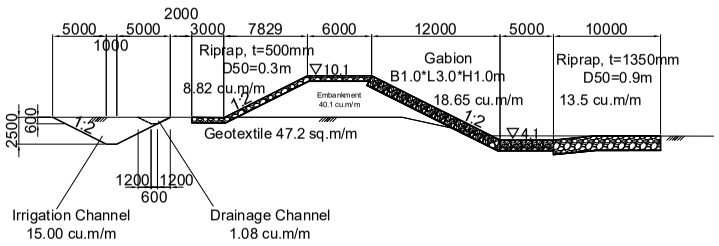
BANK AND SCOUR PROTECTION



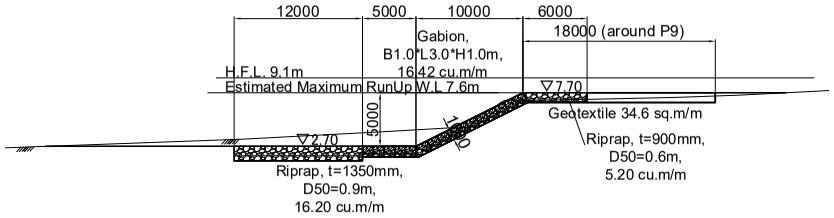
Pier No	B	W
P2	36000	83000
P3	36000	83000
P4	38000	85000
P5	42000	89000
P6	44000	91000
P7	47000	94000
P8	39000	86000



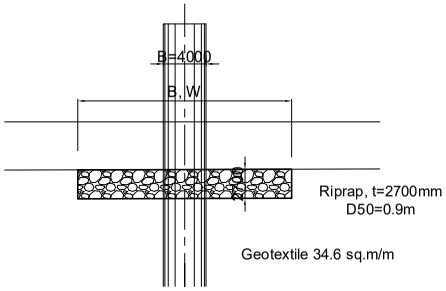
GUIDE BANK
(Right Bank)



REVETMENT PROTECTION
(Left Bank)



SCOUR PROTECTION
(Pier)



JAPAN INTERNATIONAL COOPERATION AGENCY	ORIENTAL CONSULTANTS GLOBAL CO., LTD	REMARKS	THE PREPARATORY SURVEY FOR THE EAST-WEST ECONOMIC CORRIDOR HIGHWAY DEVELOPMENT PROJECT(NEW BAGO-KYAIKTO HIGHWAY SECTION)
MINISTRY OF CONSTRUCTION	NIPPON KOEI CO., LTD INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INCORPORATED METROPOLITAN EXPRESSWAY COMPANY LIMITED		DRAWING TITLE: BANK AND SCOUR PROTECTION SCALE: AS SHOWN DRAWING NO.: SHEET NO.:

MINISTRY OF CONSTRUCTION

JAPAN INTERNATIONAL COOPERATION AGENCY

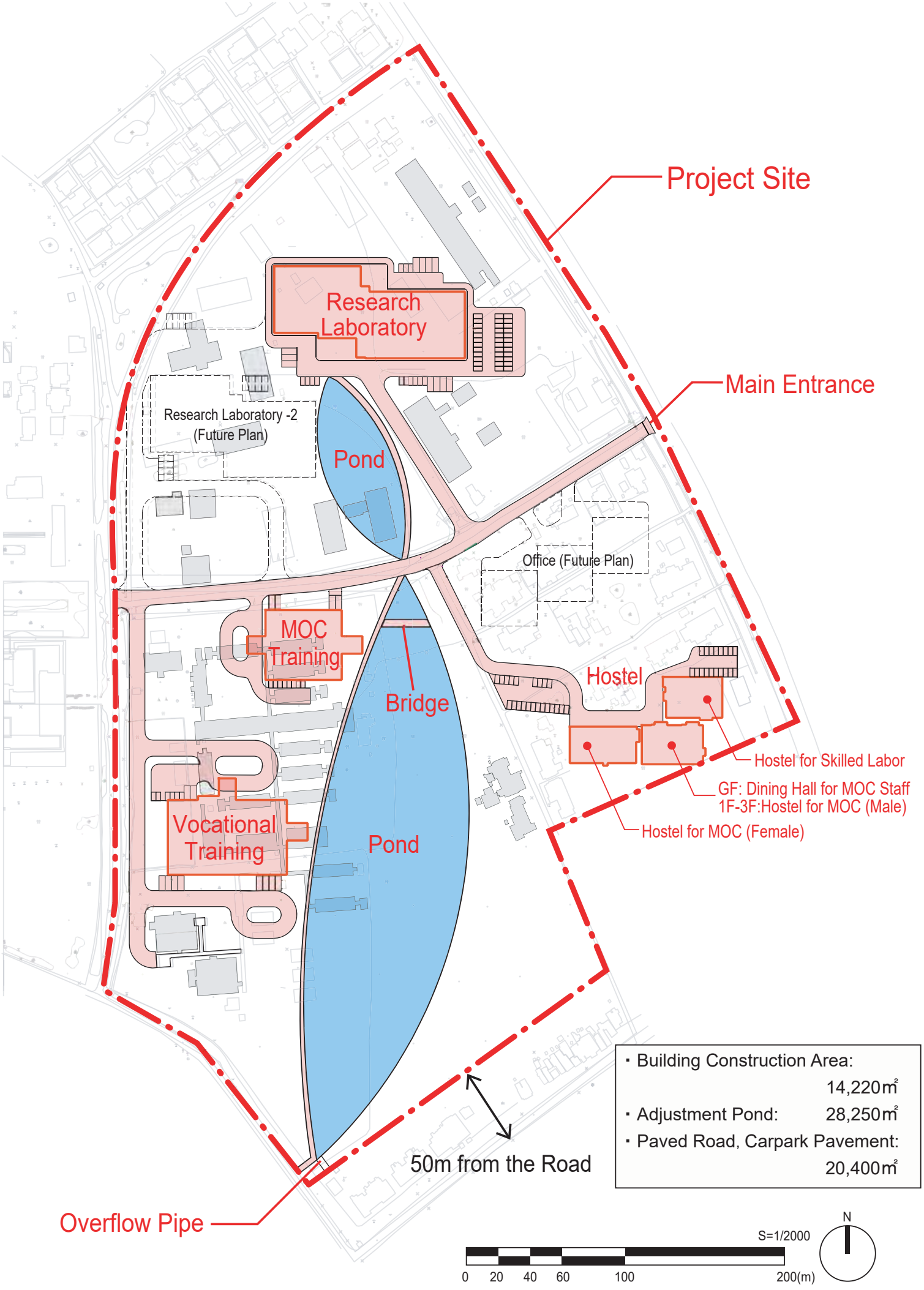
Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section)

Preliminary Design Drawing
(Upgrading of Thuwunna Research Laboratory and Training Center)

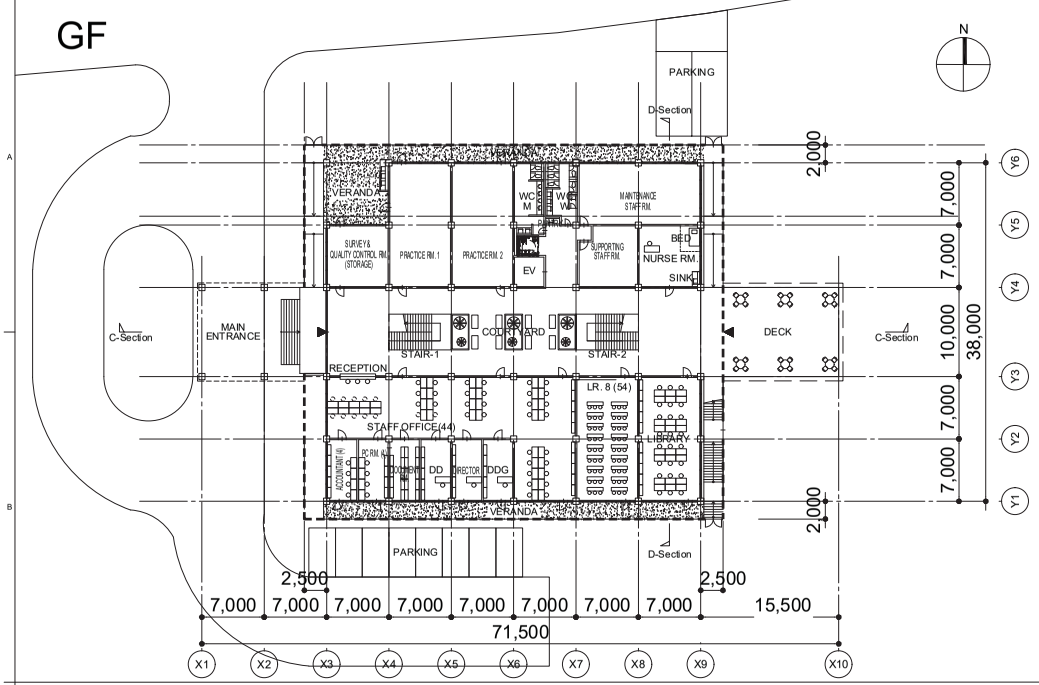
December 2019

Oriental Consultants Global Co., Ltd.
NIPPON KOEI CO., LTD.
International Development Center of Japan
Metropolitan Expressway Company Limited.

Table of Contents


Project Site
Research Laboratory
Main Entrance
Research Laboratory -2
(Future Plan)
Pond
Office (Future Plan)
MOC Training
Bridge
Hostel
Hostel for Skilled Labor
GF: Dining Hall for MOC Staff
1F-3F:Hostel for MOC (Male)
Hostel for MOC (Female)
Vocational Training
Pond
50m from the Road
Overflow Pipe
・Building Construction Area: 14,220㎡
・Adjustment Pond: 28,250㎡
・Paved Road, Carpark Pavement: 20,400㎡
N
S=1/2000
0 20 40 60 100 200(m)

GF



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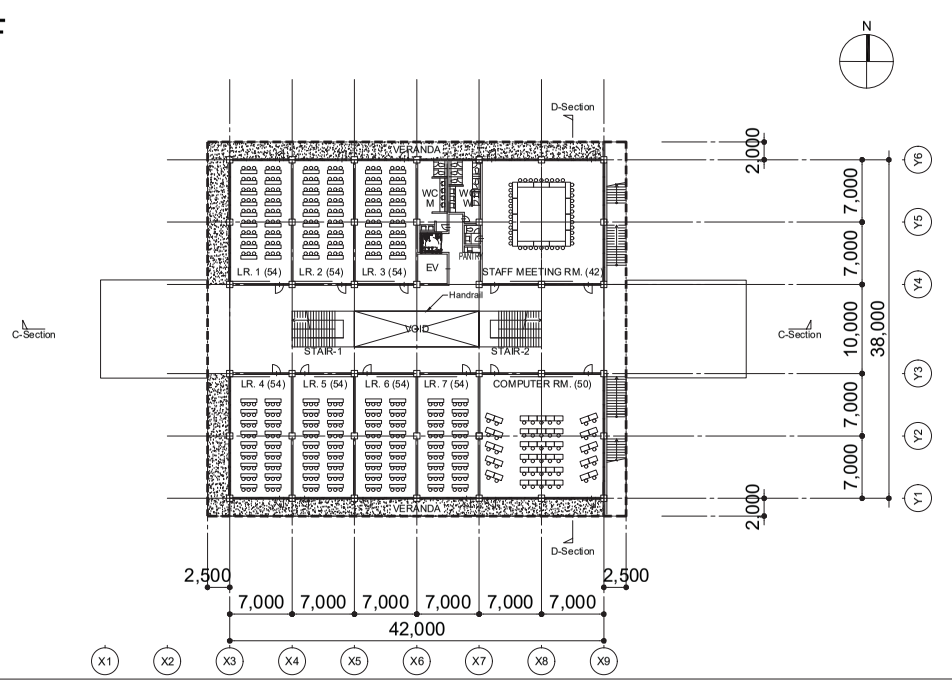

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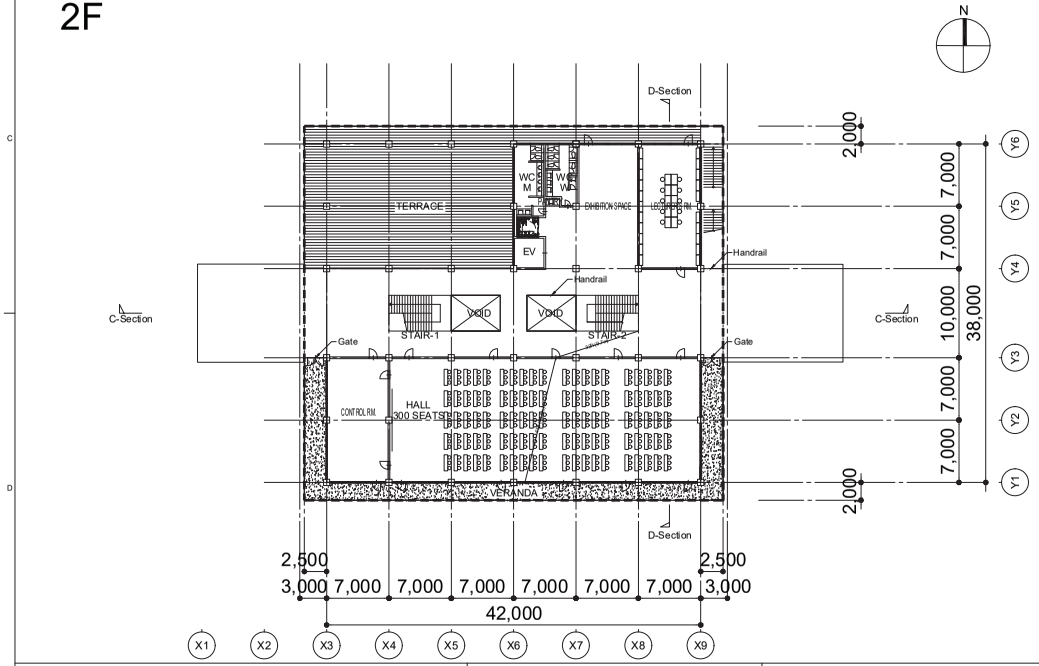

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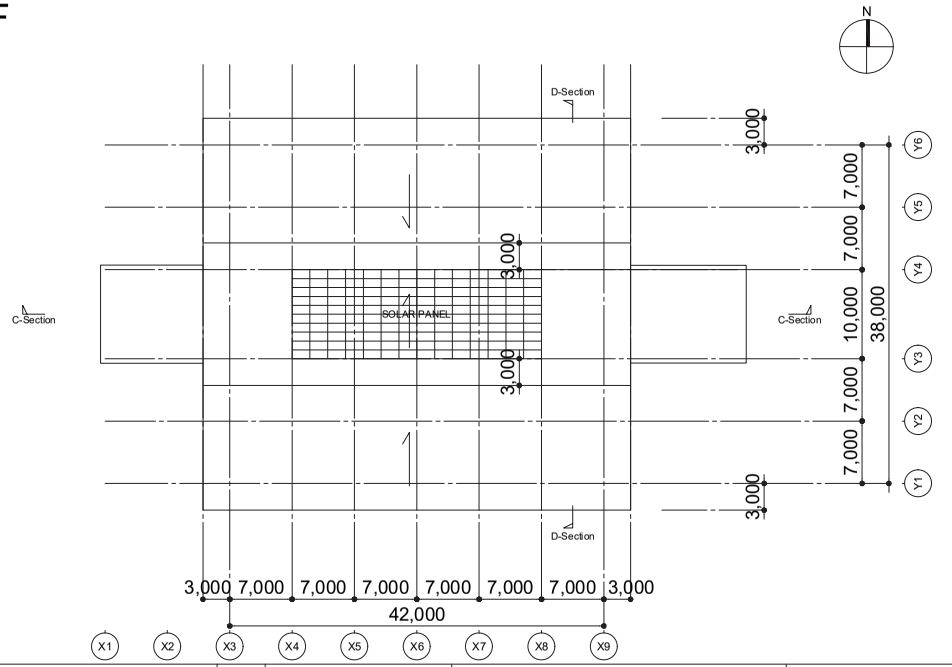

PROJECT

Preparatory Survey for the East-West Economic Corridor Highway Development Project
(New Bago-Kyaikto Highway Section)
Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

REV	REVISION	DATE
A	XXXX	##/##/##

DRAWN BY: OCG
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE: PLAN
MOC TRAINING

DATE: DEC. 10, 2019
SHEET SIZE: A3
SCALE: 1:600

DRAWING NO. A-001

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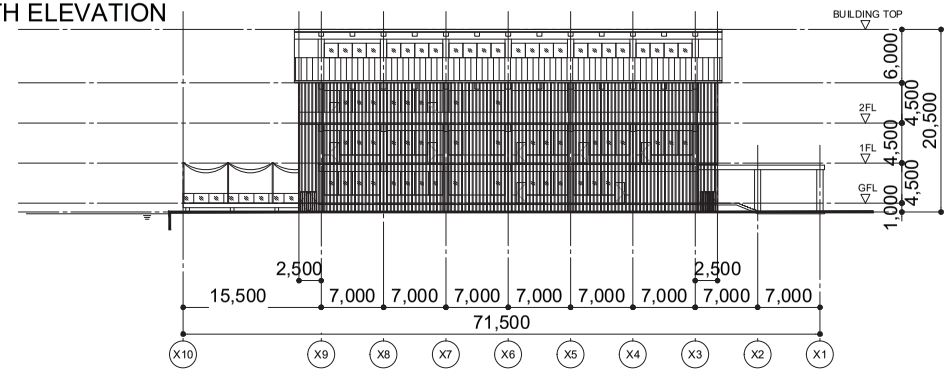

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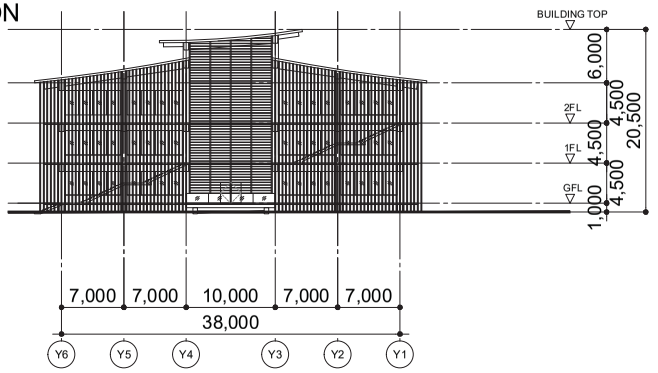

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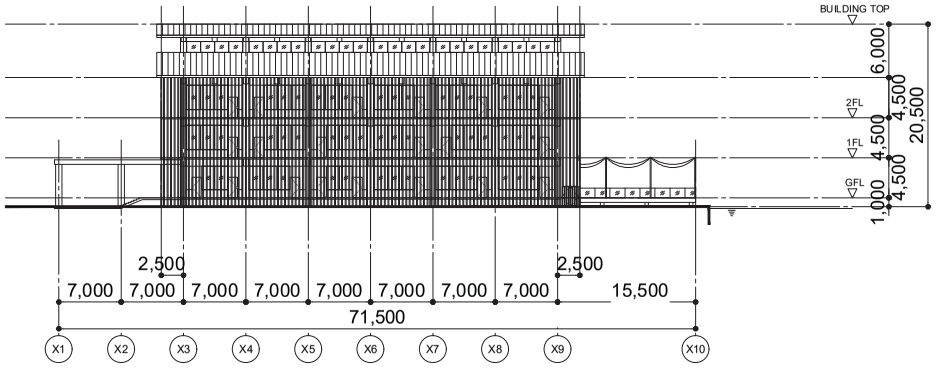

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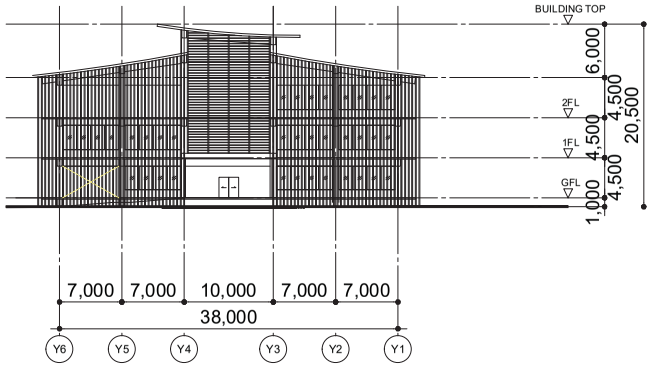

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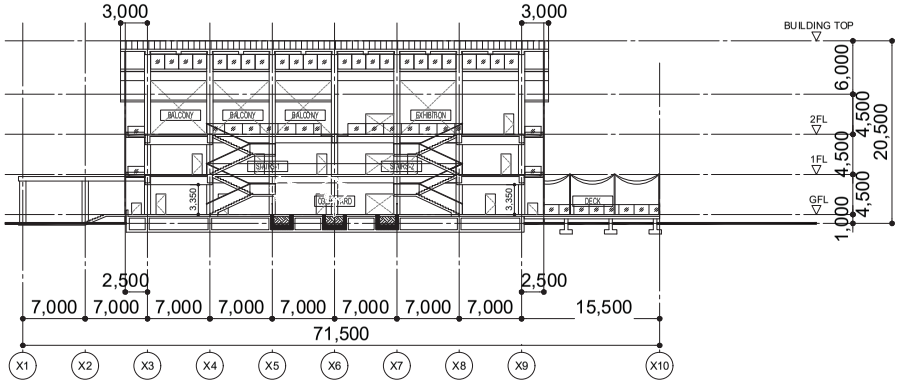

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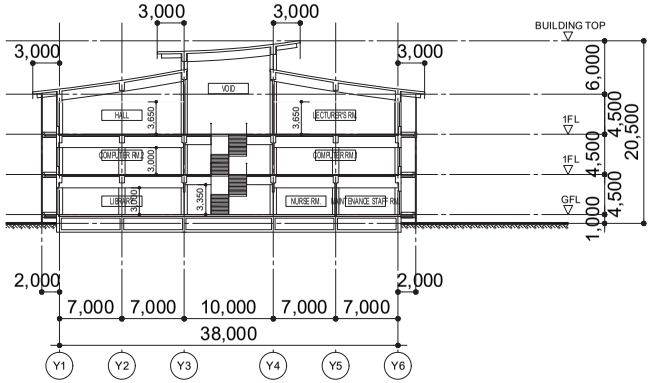


PROJECT
Preparatory Survey for the East-West Economic Corridor Highway Development Project
(New Bago-Kyaikto Highway Section)
Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

REV	REVISION	DATE
1	XXXX	##########

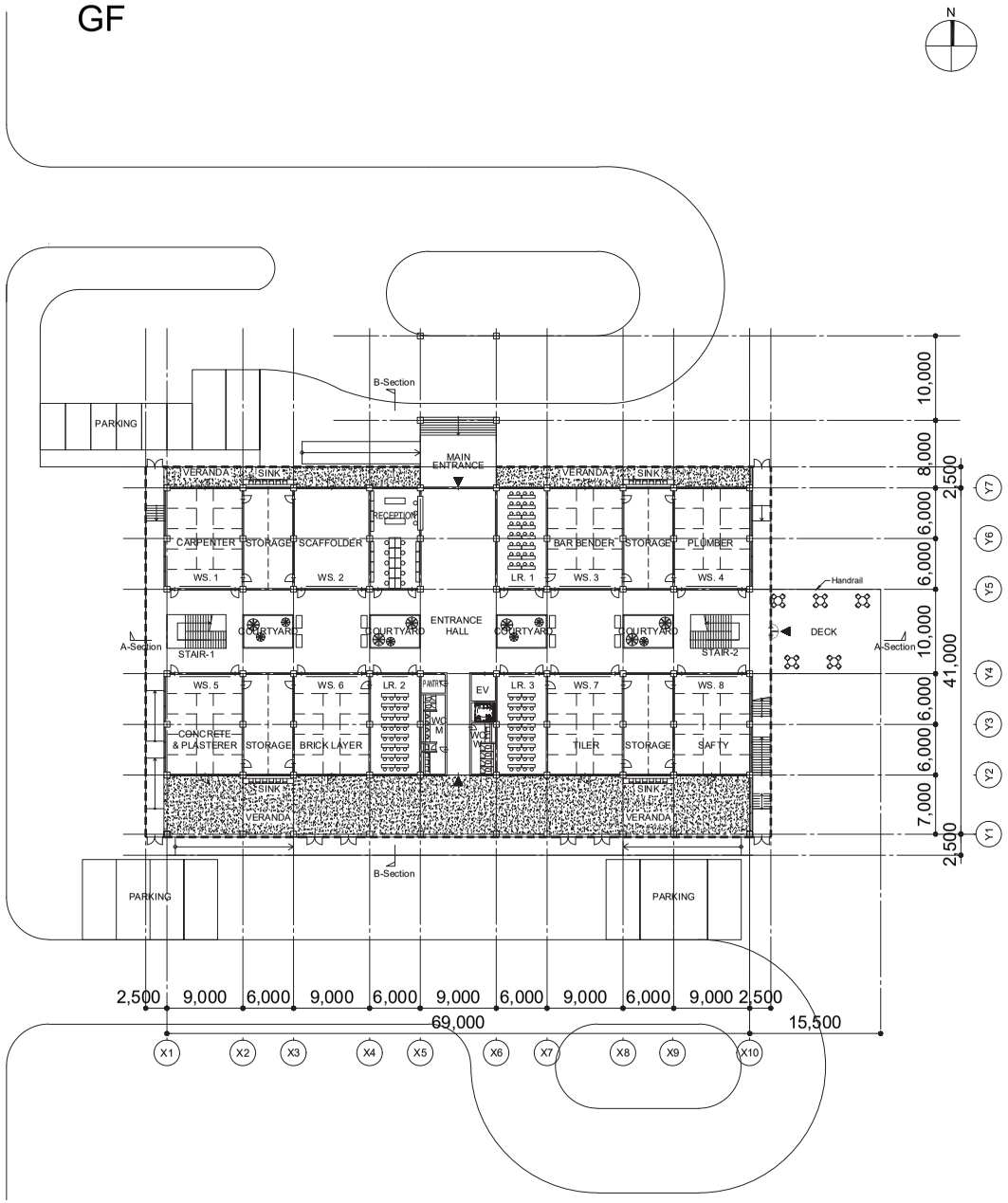
DRAWN BY: Yamaguchi
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
ELEVATION AND SECTION
MOC TRAINING

DATE: JUNE 26, 2019
SHEET SIZE: A3
SCALE: 1:600

DRAWING NO.
A-002

GF



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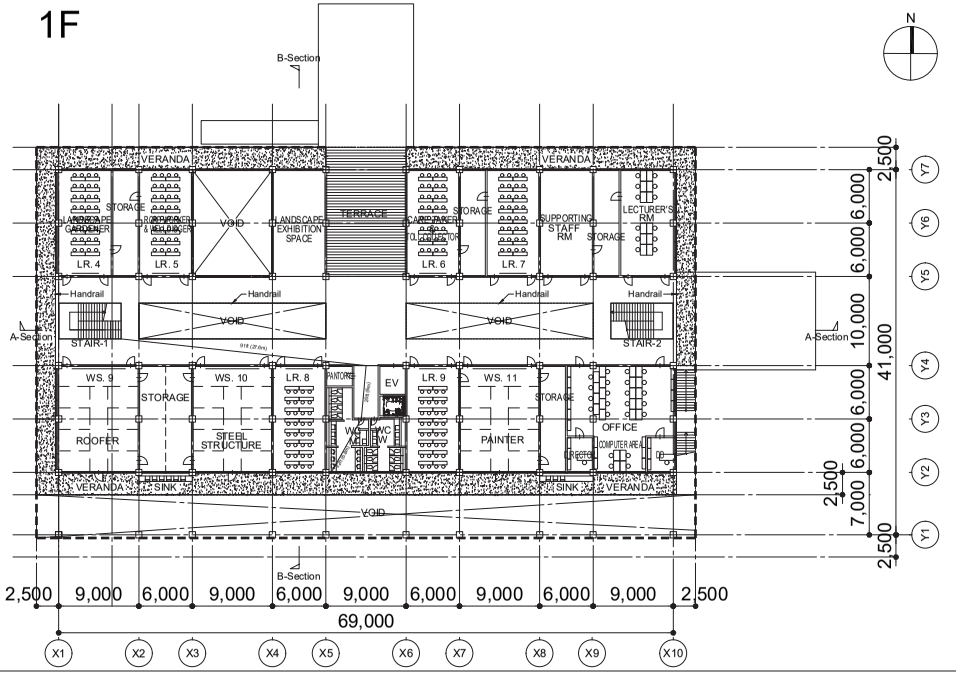

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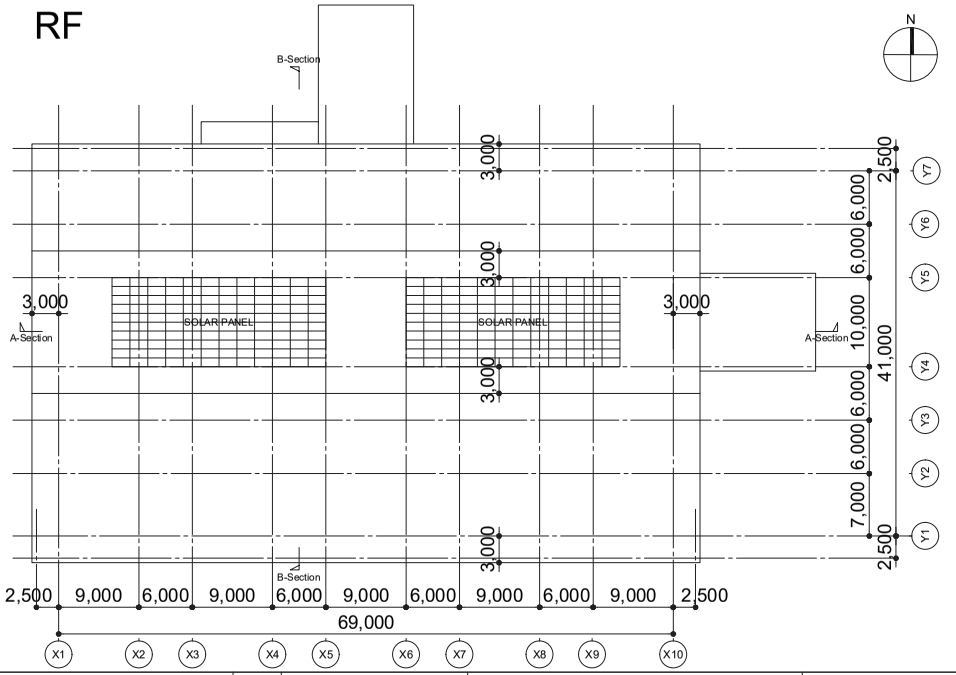

PROJECT: Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center	CONSULTANT: ORIENTAL CONSULTANTS GLOBAL CO., LTD. TOKYO OPERA CITY TOWER 9F, 20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU, TOKYO 163-1409, JAPAN	* NOT FOR CONSTRUCTION	REV: A / REVISION: XXXX / DATE: ##########	DRAWN BY: OCG; CHECKED BY: XXXXX; APPROVED BY: XXXXX	TITLE: PLAN VOCATIONAL TRAINING; DATE: DEC. 10, 2019; SHEET SIZE: A3; SCALE: 1:600	DRAWING NO. A-003

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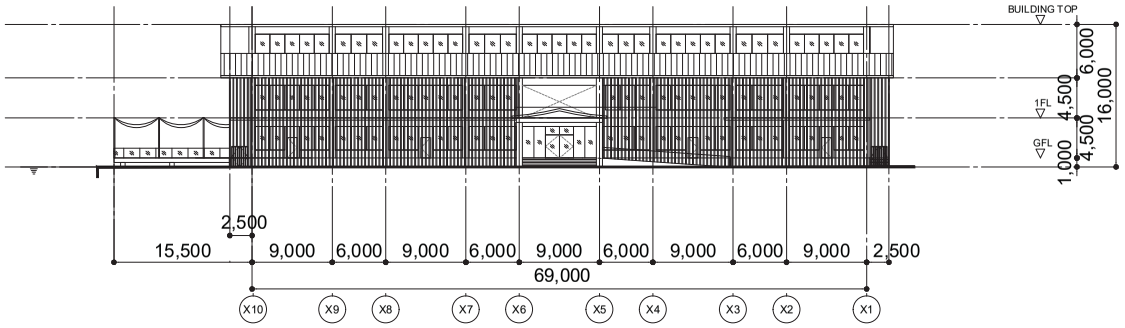

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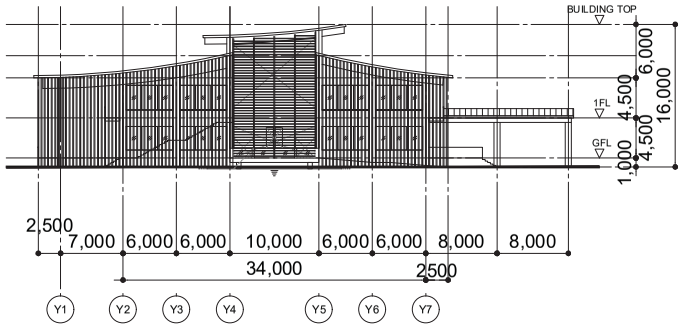

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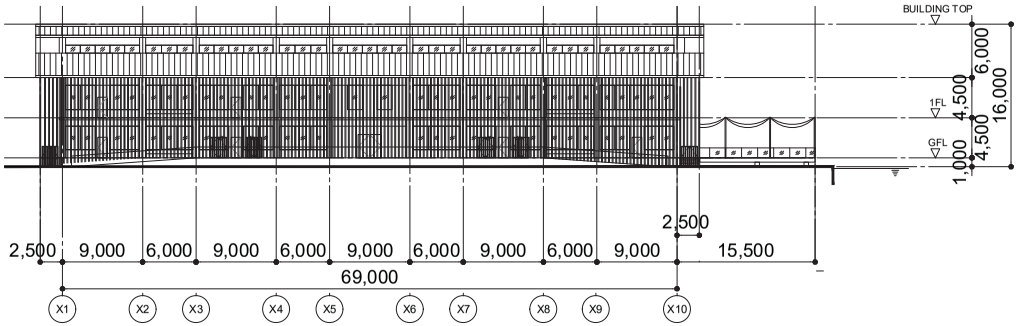

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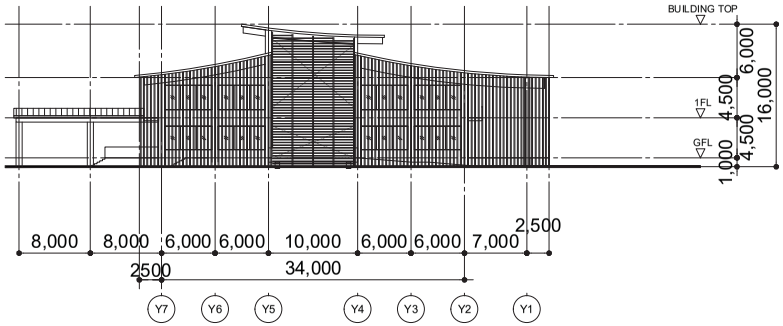

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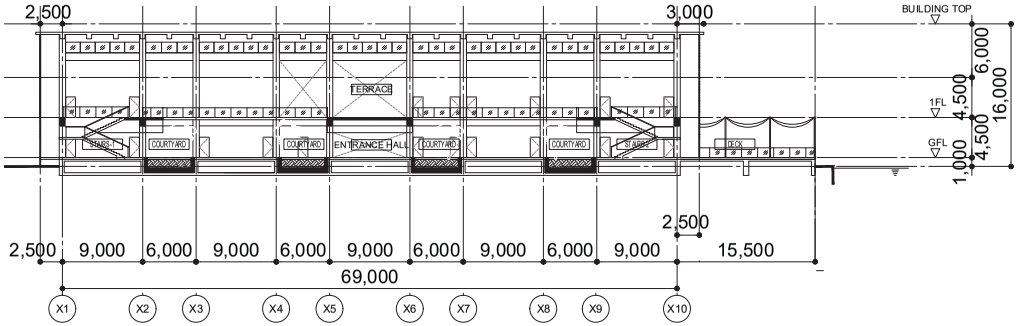

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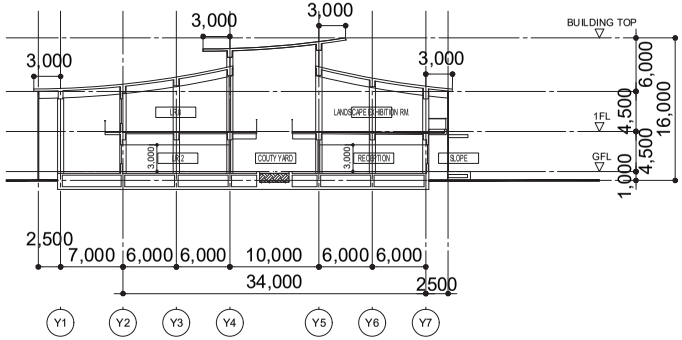

PROJECT	CONSULTANT		
Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center	ORIENTAL CONSULTANTS GLOBAL CO., LTD. TOKYO OPERA CITY TOWER 9F, 20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU, TOKYO 163-1409, JAPAN	* NOT FOR CONSTRUCTION	

REV	REVISION	DATE
A	XXXX	##########

DRAWN BY:	OCG
CHECKED BY:	XXXXX
APPROVED BY:	XXXXX
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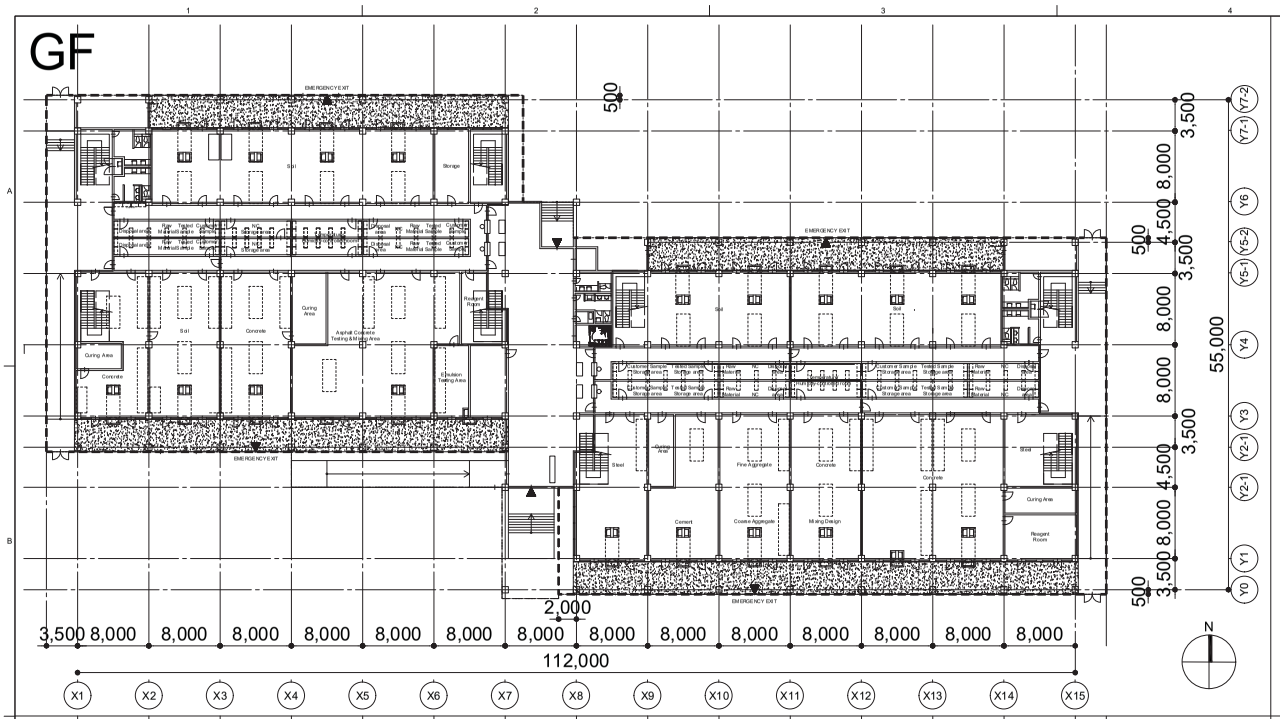
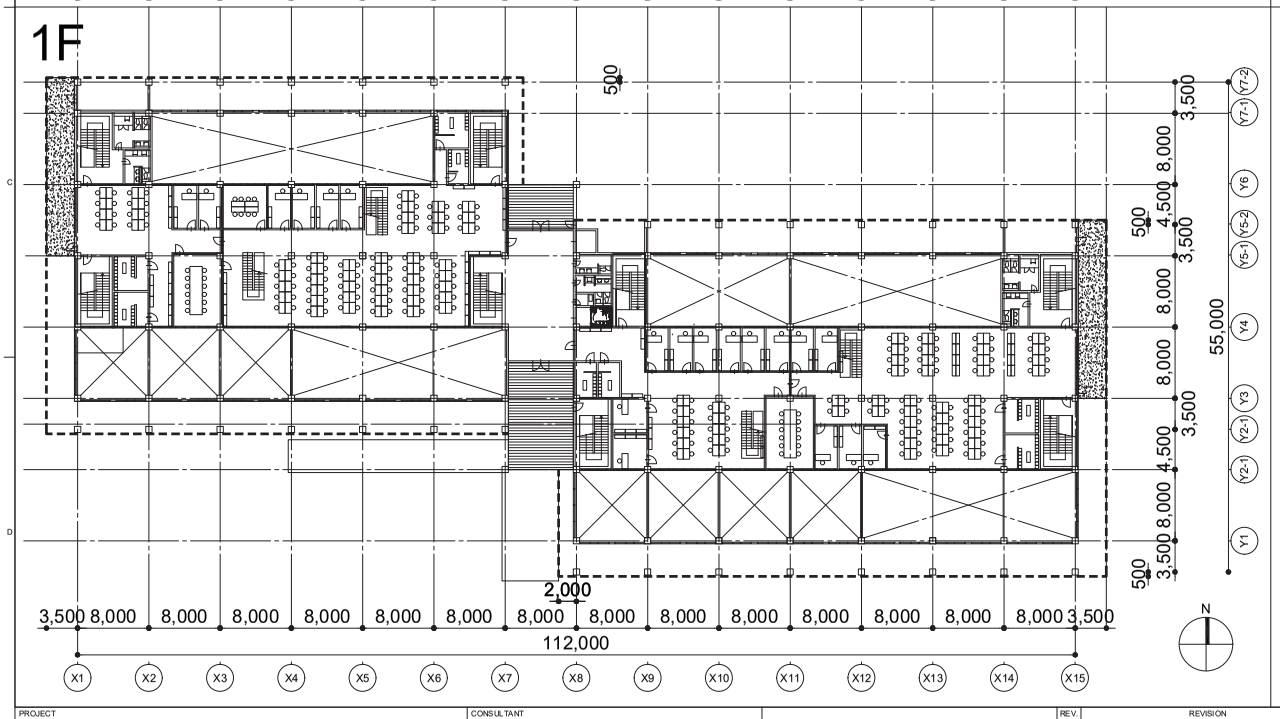
DATE:	OCT. 04, 2019
SHEET SIZE	A3
SCALE	1:600
DRAWING NO.	A-004





PROJECT

Preparatory Survey for the East-West Economic Corridor Highway Development Project
(New Bago-Kyaikto Highway Section)
Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

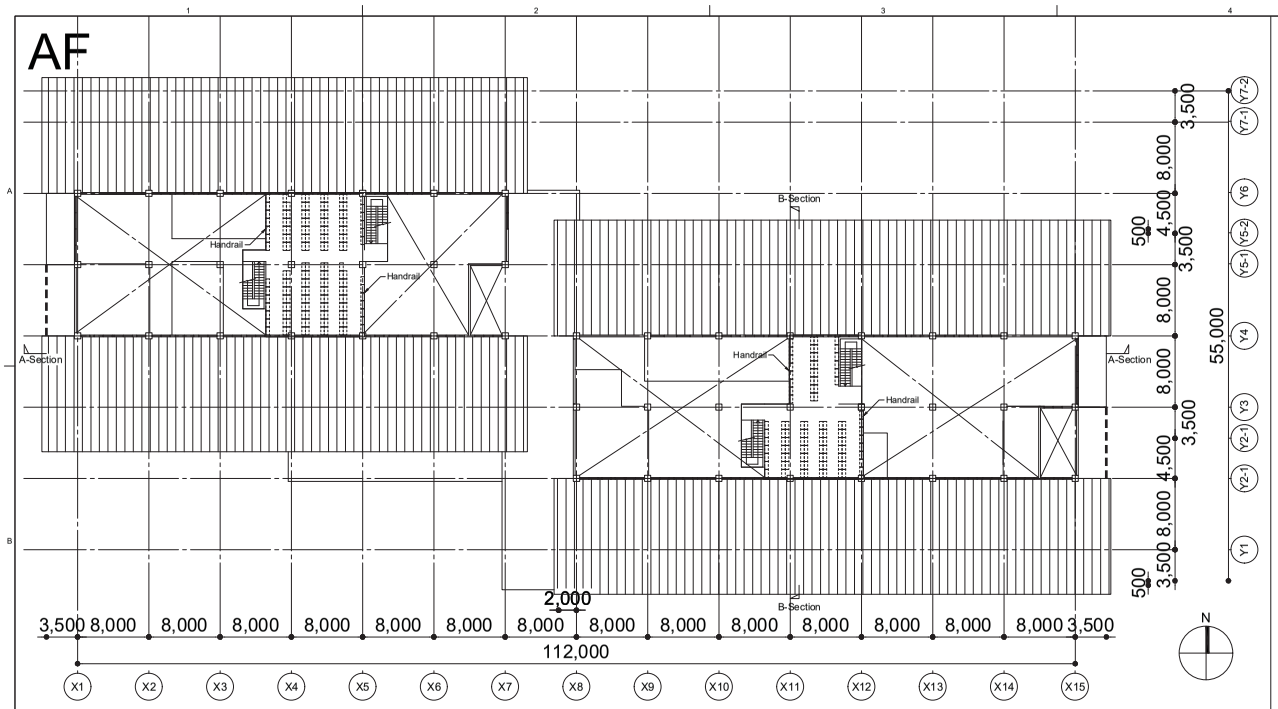
REV.	REVISION	DATE

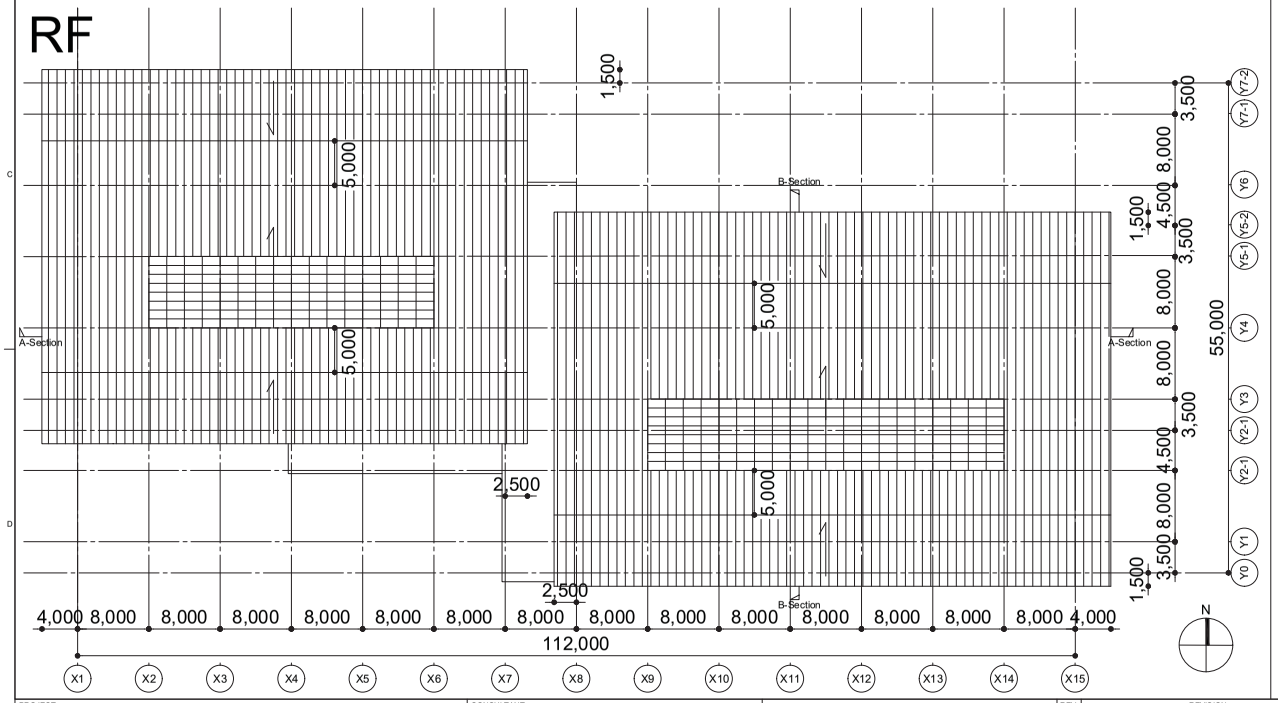
DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE: PLAN-1 RESEARCH

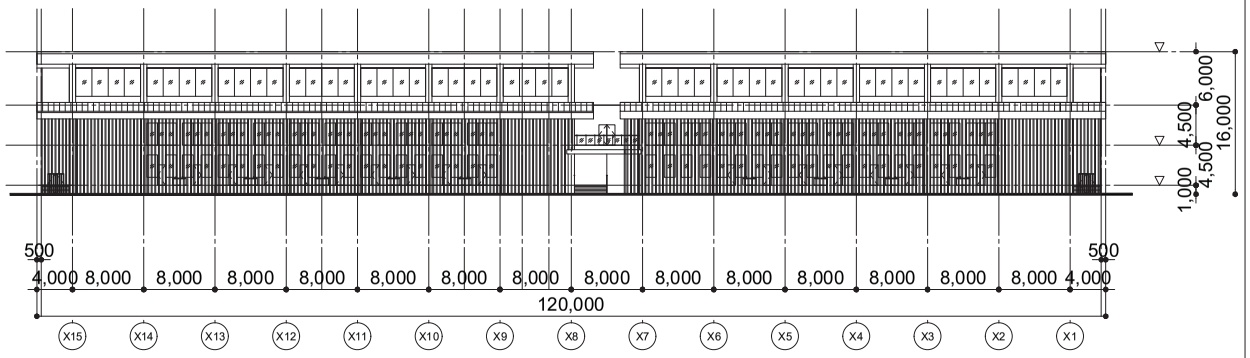
DATE: OCT. 04, 2019
SHEET SIZE: A3
SCALE: 1:600

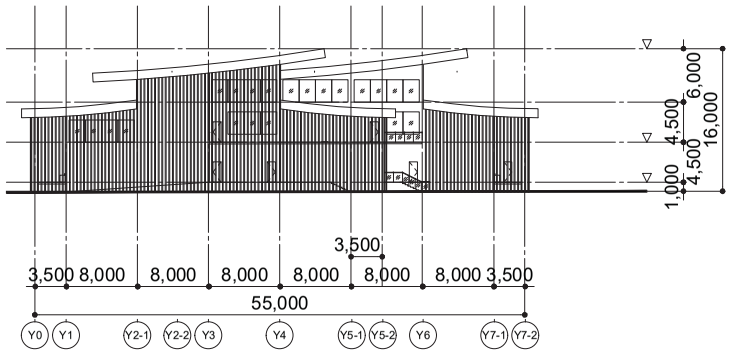
DRAWING NO. A-005

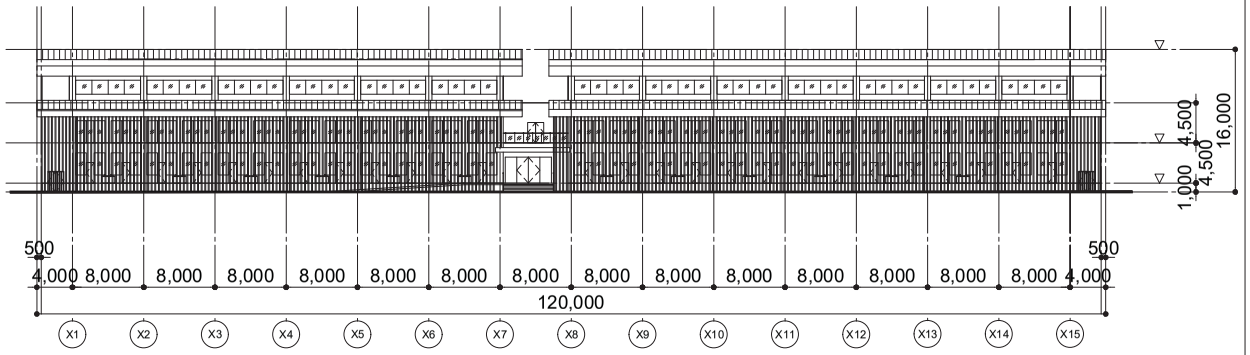


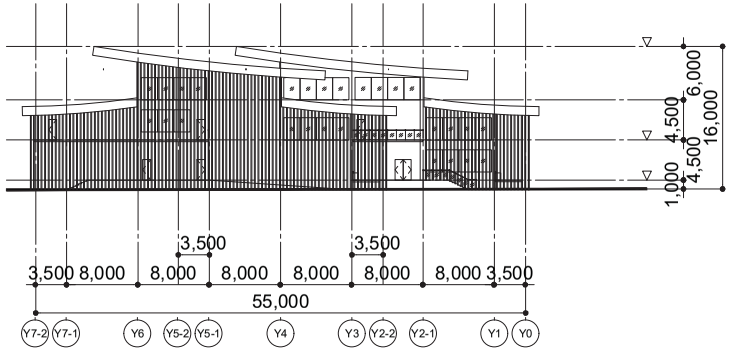


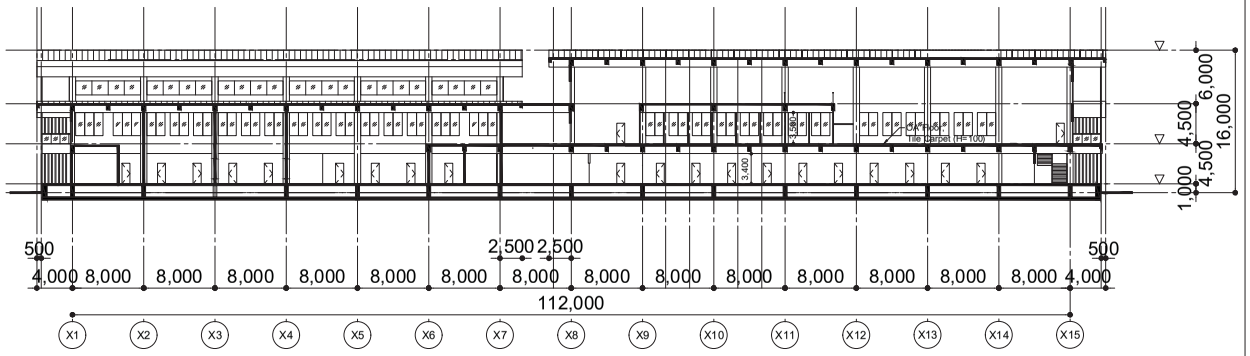
PROJECT: Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center	CONSULTANT: ORIENTAL CONSULTANTS GLOBAL CO., LTD. TOKYO OPERA CITY TOWER 9F, 20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU, TOKYO 163-1409, JAPAN	* NOT FOR CONSTRUCTION	REV	REVISION	DATE	DRAWN BY: OC Global CHECKED BY: XXXXX APPROVED BY: XXXXX	TITLE: PLAN-2 RESEARCH DATE: OCT. 04, 2019 SHEET SIZE: A3 SCALE: 1:600	DRAWING NO. A-006

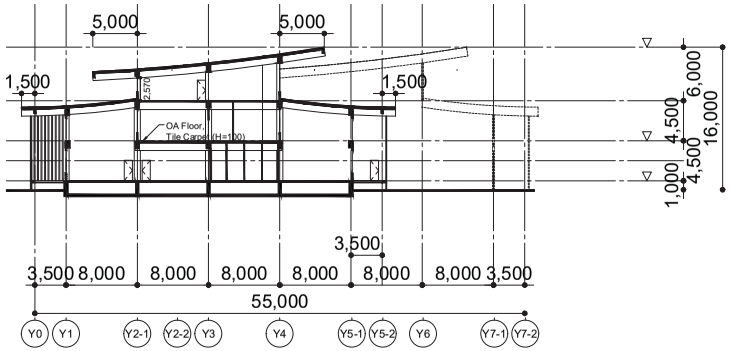












PROJECT Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center	CONSULTANT ORIENTAL CONSULTANTS GLOBAL CO., LTD. TOKYO OPERA CITY TOWER 9F, 20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU, TOKYO 163-1409, JAPAN	* NOT FOR CONSTRUCTION	REV	REVISION	DATE	DRAWN BY: OC Global CHECKED BY: XXXXX APPROVED BY: XXXXX	TITLE ELEVATION AND SECTION RESEARCH DATE: OCT. 04, 2019 SHEET SIZE: A3 SCALE: 1:600	DRAWING NO. A-007

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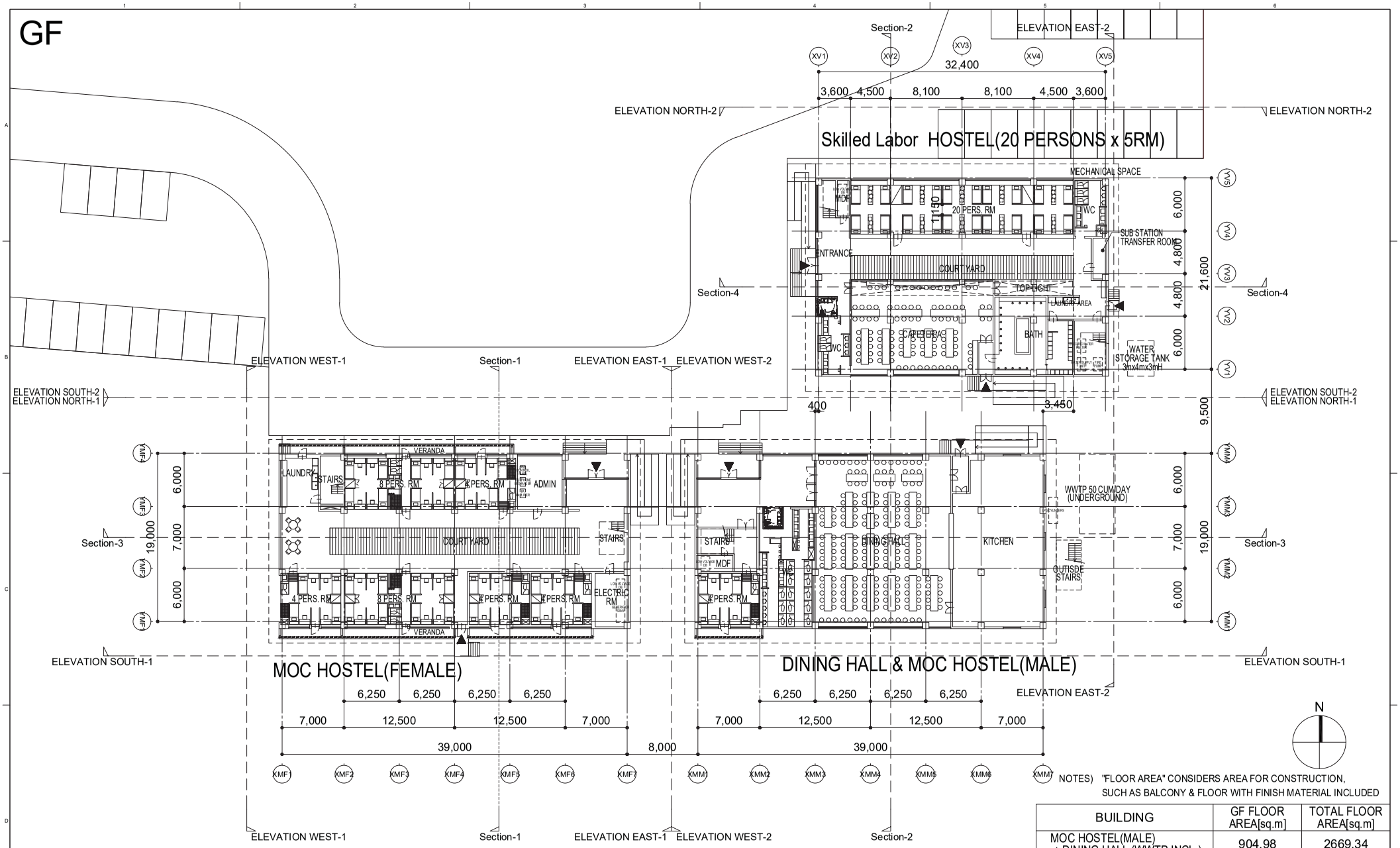


NOTES) "FLOOR AREA" CONSIDERS AREA FOR CONSTRUCTION, SUCH AS BALCONY & FLOOR WITH FINISH MATERIAL INCLUDED

BUILDING	GF FLOOR AREA[sq.m]	TOTAL FLOOR AREA[sq.m]
MOC HOSTEL(MALE) + DINING HALL (WWTP INCL.)	904.98	2669.34
MOC HOSTEL(FEMALE)	893.13	2547.04
SKILLED LABOR HOSTEL (WATER STORAGE TANK INCL.)	816.36	2058.21
TOTAL	2614.47	7274.59

PROJECT
Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

REV	REVISION	DATE

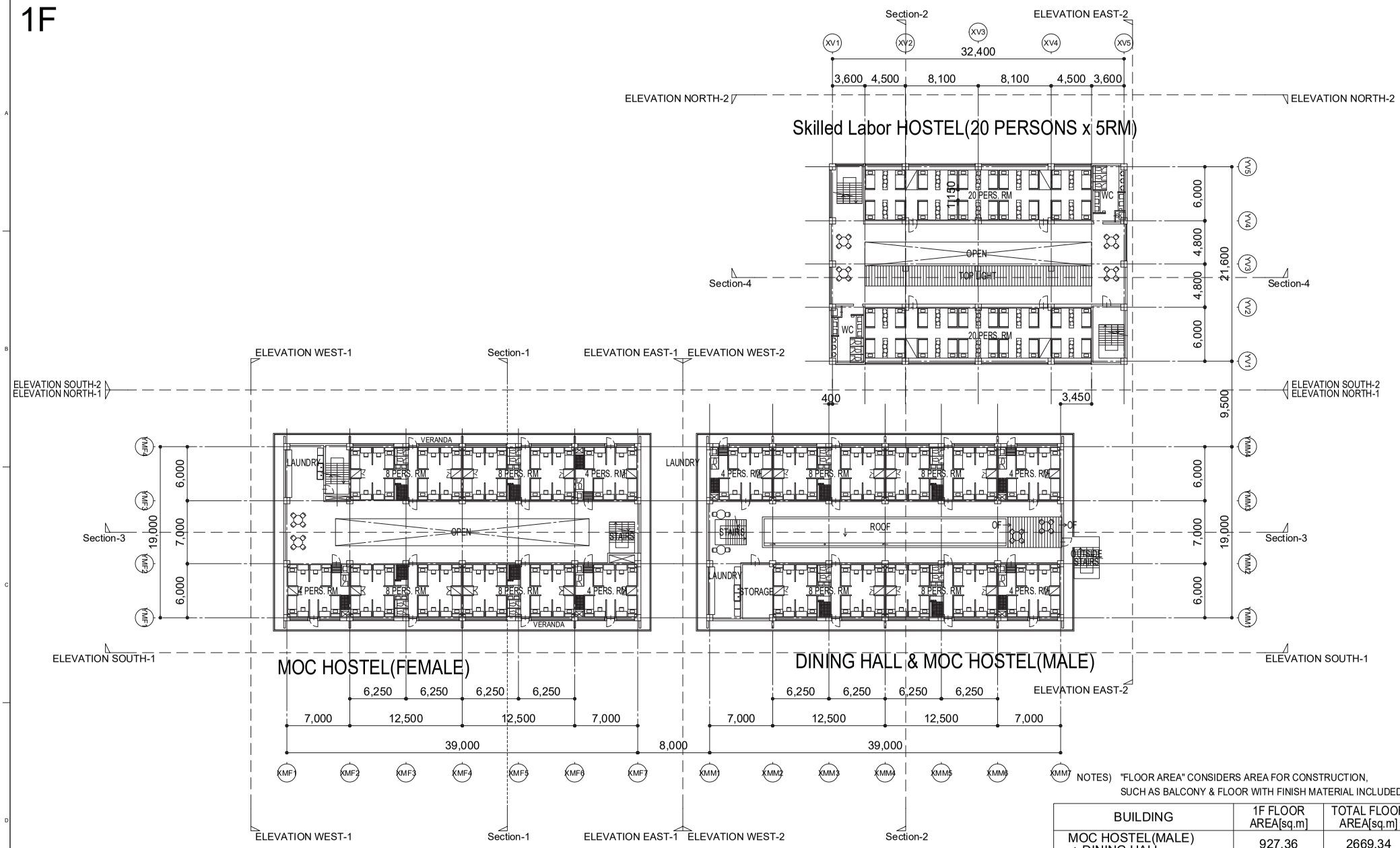
DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
PLAN-GF
VOC & MOC HOSTEL, DINING HALL

DATE: NOV. 25, 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-008

1F



NOTES) "FLOOR AREA" CONSIDERS AREA FOR CONSTRUCTION, SUCH AS BALCONY & FLOOR WITH FINISH MATERIAL INCLUDED

BUILDING	1F FLOOR AREA[sq.m]	TOTAL FLOOR AREA[sq.m]
MOC HOSTEL(MALE) + DINING HALL	927.36	2669.34
MOC HOSTEL(FEMALE)	839.41	2547.04
SKILLED LABOR HOSTEL	660.31	2058.21
TOTAL	2427.08	7274.59

PROJECT
Preparatory Survey for the East-West Economic Corridor Highway Development Project
(New Bago-Kyaikto Highway Section)
Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

REV	REVISION	DATE

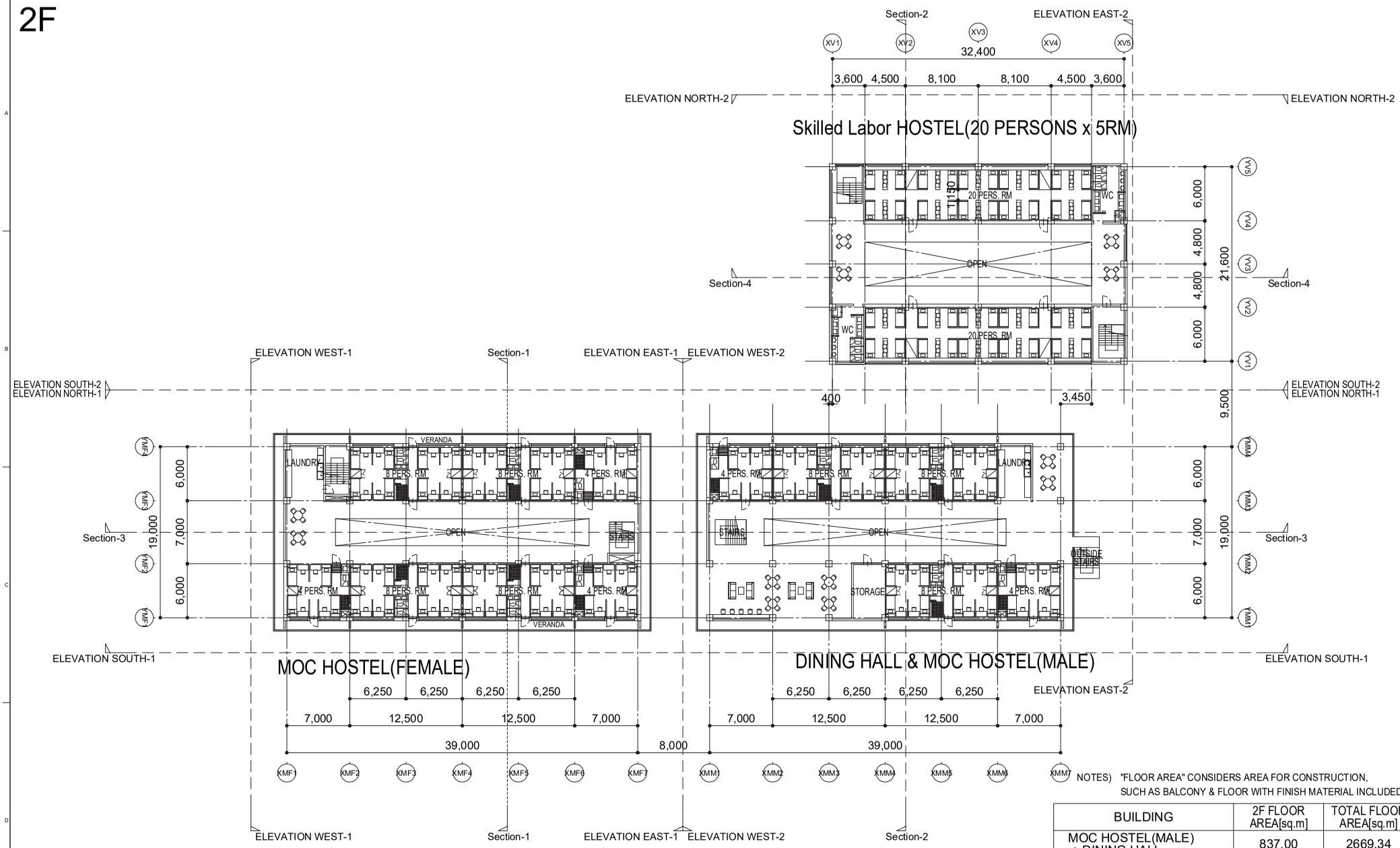
DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
PLAN-1F
VOC & MOC HOSTEL, DINING HALL

DATE: NOV. 25, 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-009

2F



NOTES) "FLOOR AREA" CONSIDERS AREA FOR CONSTRUCTION, SUCH AS BALCONY & FLOOR WITH FINISH MATERIAL INCLUDED

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MOC HOSTEL(MALE) + DINING HALL	837.00	2669.34
MOC HOSTEL(FEMALE)	814.50	2547.04
SKILLED LABOR HOSTEL	581.54	2058.21
TOTAL	2233.04	7274.59

PROJECT
Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

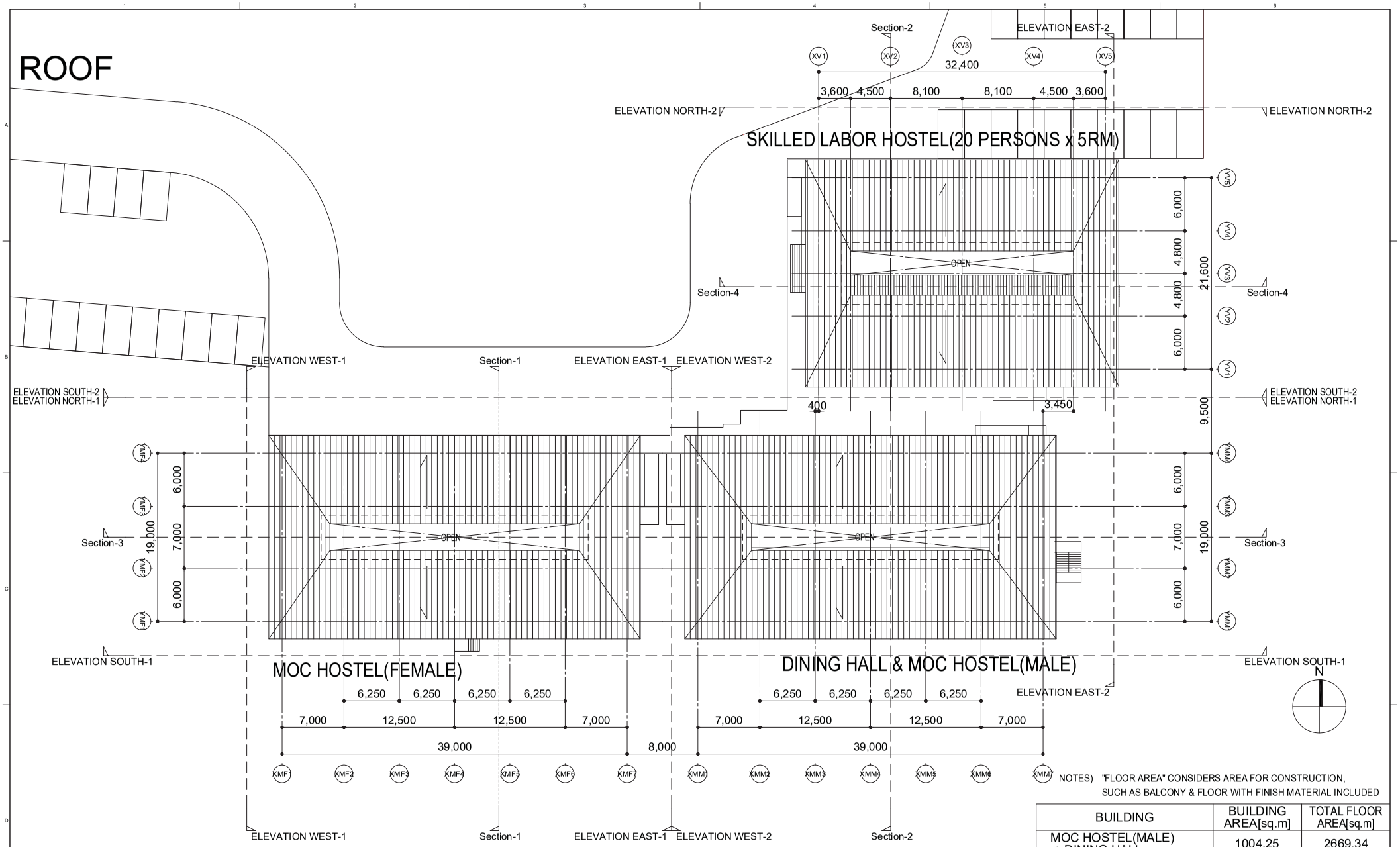
REV	REVISION	DATE

DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
PLAN-2F
VOC & MOC HOSTEL, DINING HALL

DATE: NOV. 25, 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-010



NOTES) "FLOOR AREA" CONSIDERS AREA FOR CONSTRUCTION, SUCH AS BALCONY & FLOOR WITH FINISH MATERIAL INCLUDED

BUILDING	BUILDING AREA[sq.m]	TOTAL FLOOR AREA[sq.m]
MOC HOSTEL(MALE) + DINING HALL	1004.25	2669.34
MOC HOSTEL(FEMALE)	901.79	2547.04
SKILLED LABOR HOSTEL	876.20	2058.21
TOTAL	2782.24	7274.59

PROJECT
Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) Upgrading of the Thuwunna Research Laboratory and Training Center

CONSULTANT
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
TOKYO OPERA CITY TOWER 9F,
20-2, NISHISHINJUKU 3-CHOME, SHINJUKU-KU,
TOKYO 163-1409, JAPAN

* NOT FOR CONSTRUCTION

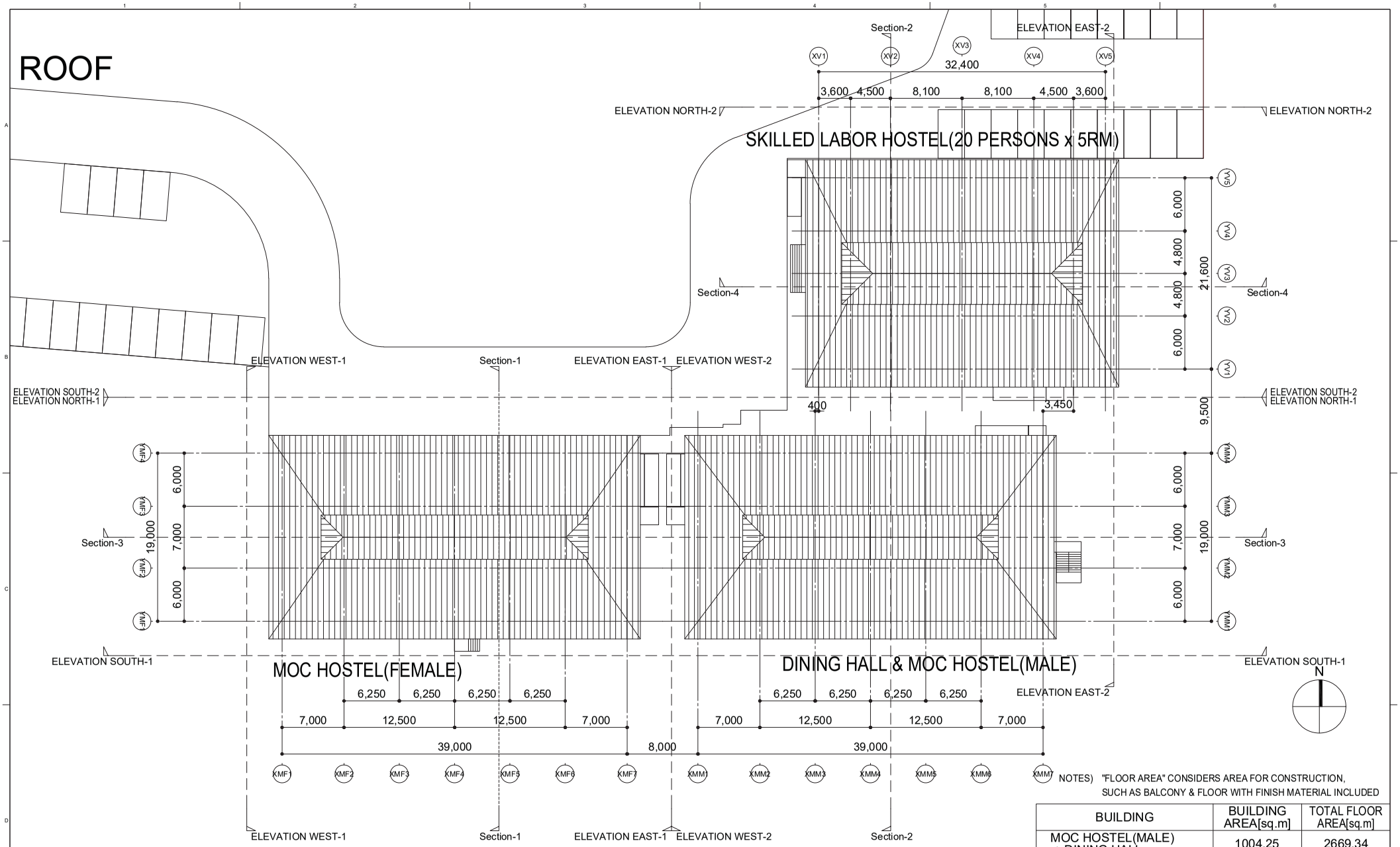
REV	REVISION	DATE

DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
PLAN-ROOF
VOC & MOC HOSTEL, DINING HALL

DATE: DEC. 10, 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-011



NOTES) "FLOOR AREA" CONSIDERS AREA FOR CONSTRUCTION, SUCH AS BALCONY & FLOOR WITH FINISH MATERIAL INCLUDED

BUILDING	BUILDING AREA[sq.m]	TOTAL FLOOR AREA[sq.m]
MOC HOSTEL(MALE) + DINING HALL	1004.25	2669.34
MOC HOSTEL(FEMALE)	901.79	2547.04
SKILLED LABOR HOSTEL	876.20	2058.21
TOTAL	2782.24	7274.59

PROJECT
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DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
PLAN-TOP ROOF
VOC & MOC HOSTEL, DINING HALL

DATE: DEC. 10, 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-012

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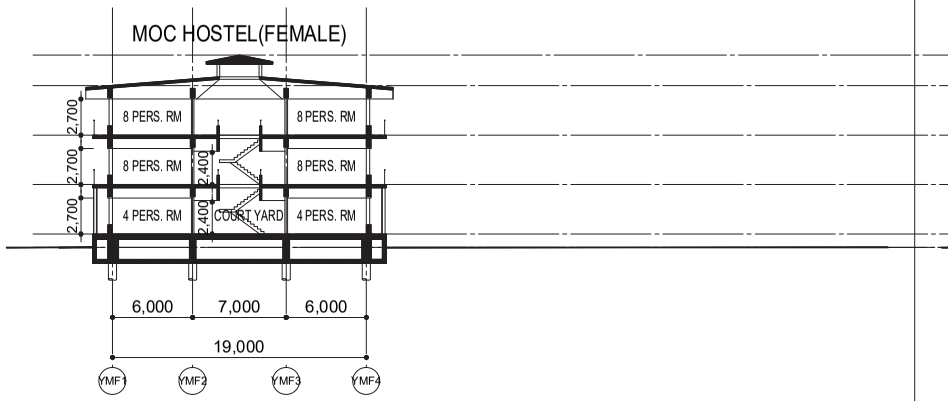
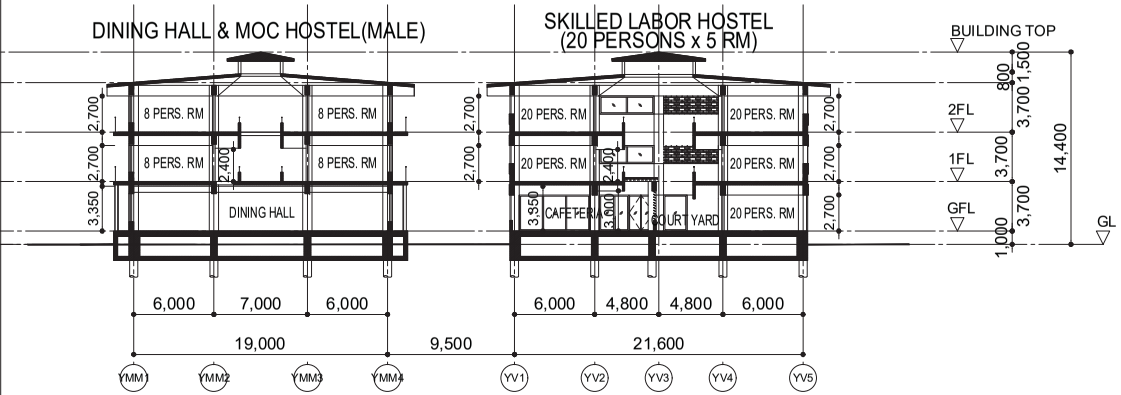


SECTION-2



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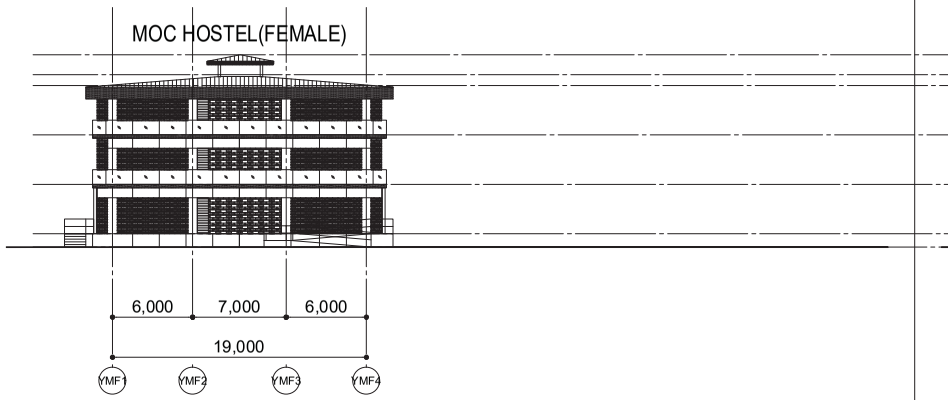

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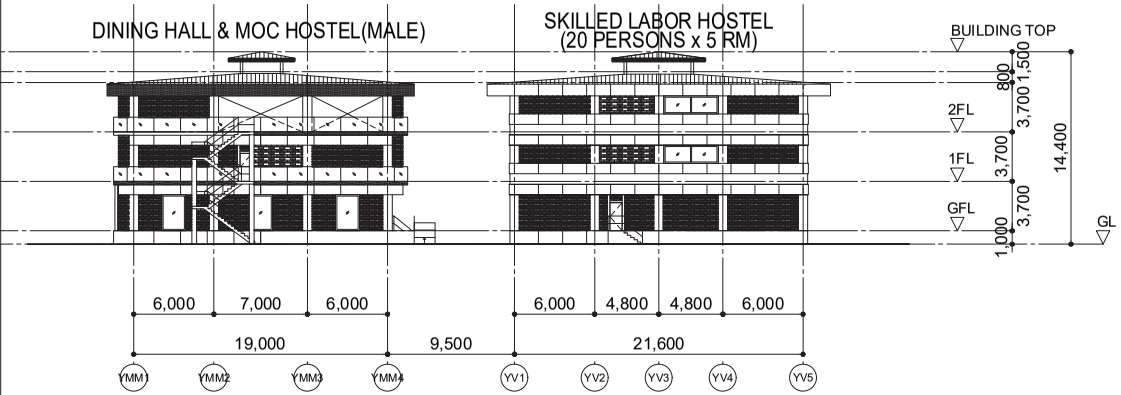

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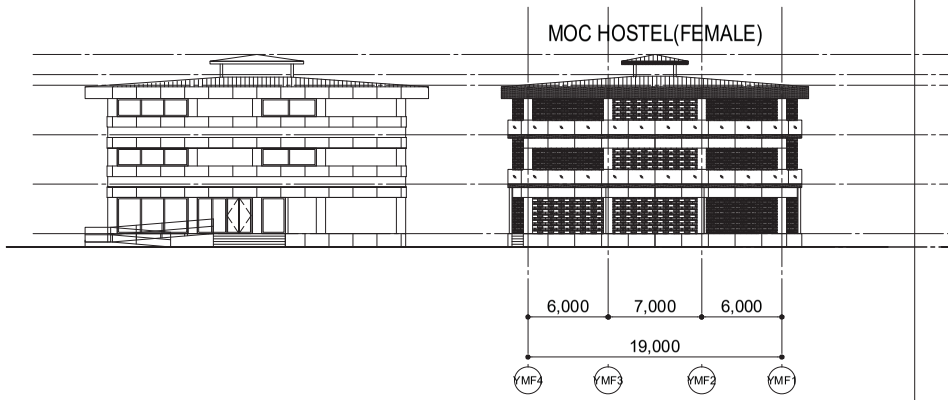

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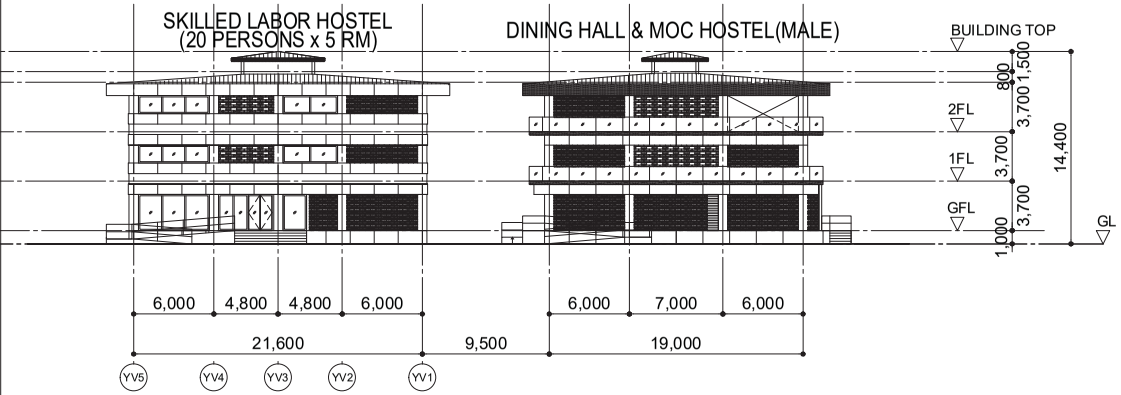

PROJECT

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REV.	REVISION	DATE

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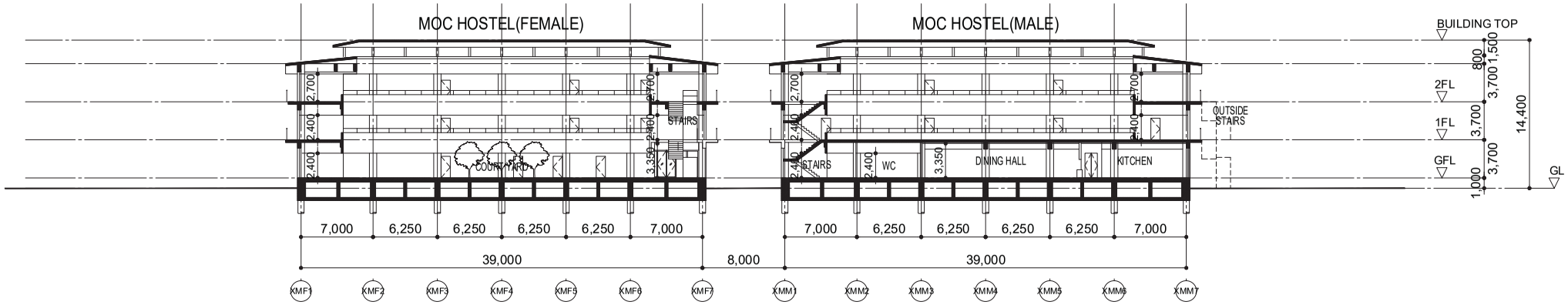
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
ELEVATION-1
VOC & MOC HOSTEL, DINING HALL

DATE: OCT. 09 , 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-013

SECTION-3



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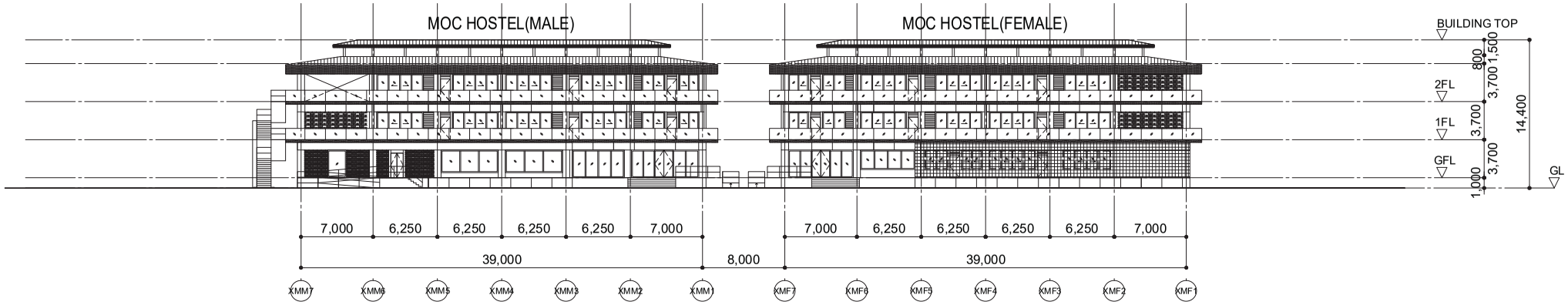

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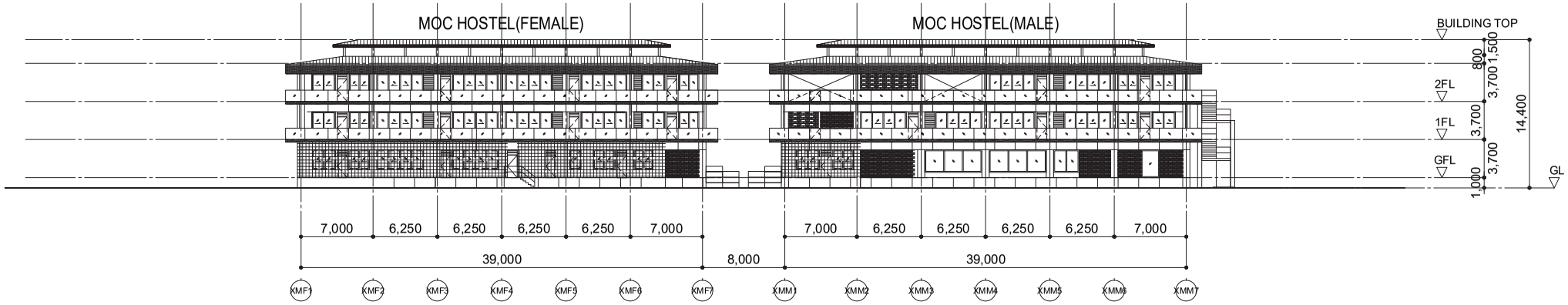

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REV	REVISION	DATE

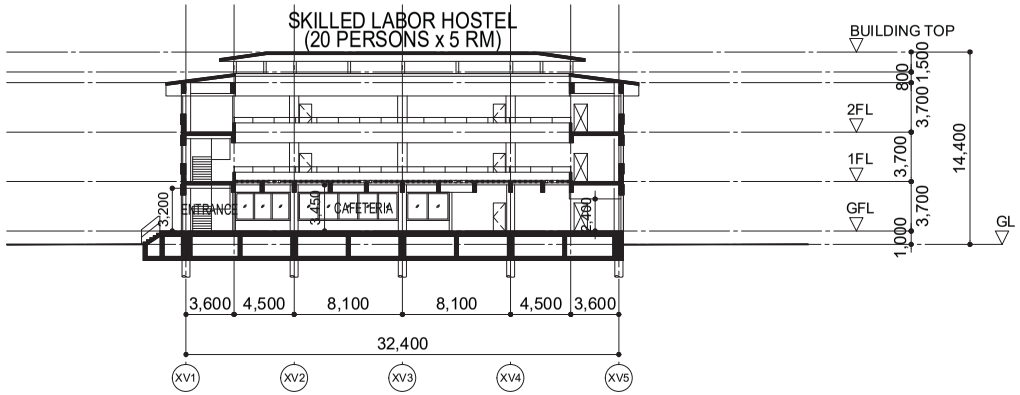
DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
ELEVATION-2
VOC & MOC HOSTEL, DINING HALL

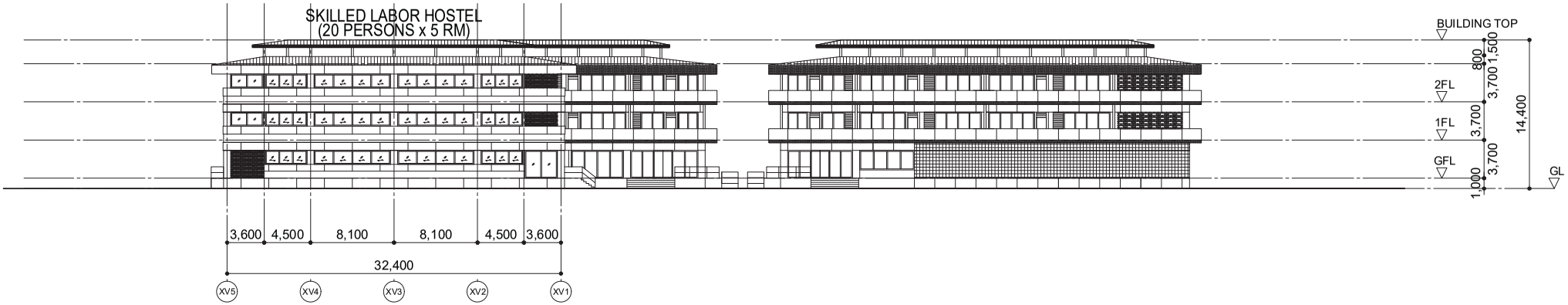
DATE: OCT. 09 , 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-014

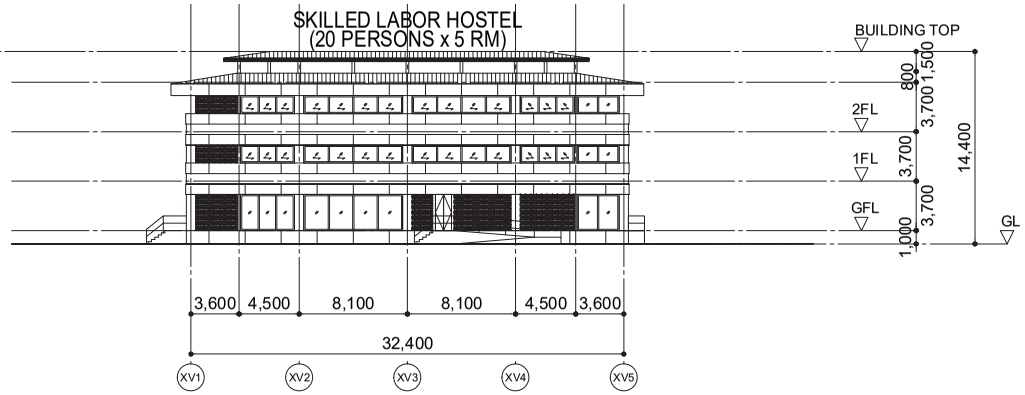
SECTION-4



ELEVATION NORTH-2



ELEVATION SOUTH-2



PROJECT
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REV	REVISION	DATE

DRAWN BY: OC Global
CHECKED BY: XXXXX
APPROVED BY: XXXXX

TITLE
ELEVATION-3
VOC & MOC HOSTEL, DINING HALL

DATE: OCT. 09 , 2019
SHEET SIZE: A3
SCALE: 1:400

DRAWING NO.
A-015

付録 - 3

地形測量調査報告書

TOPOGRAPHIC AND RIVER SURVEY

FOR

PREPARATORY SURVEY FOR THE

EAST-WEST ECONOMIC CORRIDOR IMPROVEMENT PROJECT (PHASE 2)

Final Report

November, 2017

Asia Air Survey Myanmar Co., Ltd.

Contents

1. INTRODUCTION

1.1 Background and Objective

The topographical survey works for the New Sittaung Bridge (hereinafter referred to as “the Work”) is a part of the Preparatory Survey for the East-West Economic Corridor Improvement Project (Phase 2)(hereinafter referred to as “the Project”).

The Asia Air Survey Myanmar Co., Ltd (hereinafter referred to as “the AASMM”) executed “Topographic, Bathymetric and River condition survey and Interview Survey under the supervision of the JICA Study Team for the Project.

This Survey was carried out to collect the natural conditions include the terrain information in the Project for preliminary design of bridges/roads and cost estimation. Therefore, the objective of the Work is to provide preliminary data regarding the topographic formation and hydrographical change of the area along the Sittaung River.

1.2 Location of the Survey

The location of the Survey is in and around the candidate site of New Sittaung Bridge crossing the estuary of Sittang River.
The working area of each survey is described as follow.

<Benchmark Installation>
Figure 1 shows the location of the benchmarks.

Source: AAS MM

Figure 1 Location of Benchmarks

1.2.1 Control Leveling Survey

Leveling Survey was conducted to transfer the station height which is operated by the Irrigation Department of Ministry of Agriculture and Irrigation to mean sea level (herein after referred to as “MSL”) height, to determine the origin height used in the topographical survey and river survey.

Station Height Location

MK-BM: Mokpalin Station (N 17.440° , E 96.878°)

SH-BM: Shan Gaing Water gate Station (N 17.419° , E96.843°)

Origin height for the topographical survey and river survey

GCP-05L (GCP on the left bank side)

Figure 2 shows network of leveling survey.

Source: AAS MM

Figure 2 Control Leveling Survey Route

1.2.2 Topographic Survey

The land part which the bridge designed in the Project connects was extracted as the area of topographic survey. That area was defined by the coordinates shown in the table 1.
Figure 3 shows topographic survey area.

Table 1 Coordinates of Digital Topographic Mapping Area

Node	E	N	Remarks
RB1	274838.829	1924839.198	A=0.500+0.233 km^2
RB2	275824.225	1925009.476	
RB3	275739.086	1925502.174	
RB4	274753.69	1925331.896	
RB5	275534.111	1925690.015	
RB6	275061.121	1925608.281	
RB7	274685.579	1925726.054	
LB1	276474.733	1925121.885	A=0.750 km^2
LB2	277911.357	1925294.235	
LB3	277925.828	1925794.026	
LB4	276389.594	1925614.583	
		Total	A=1.483 km^2

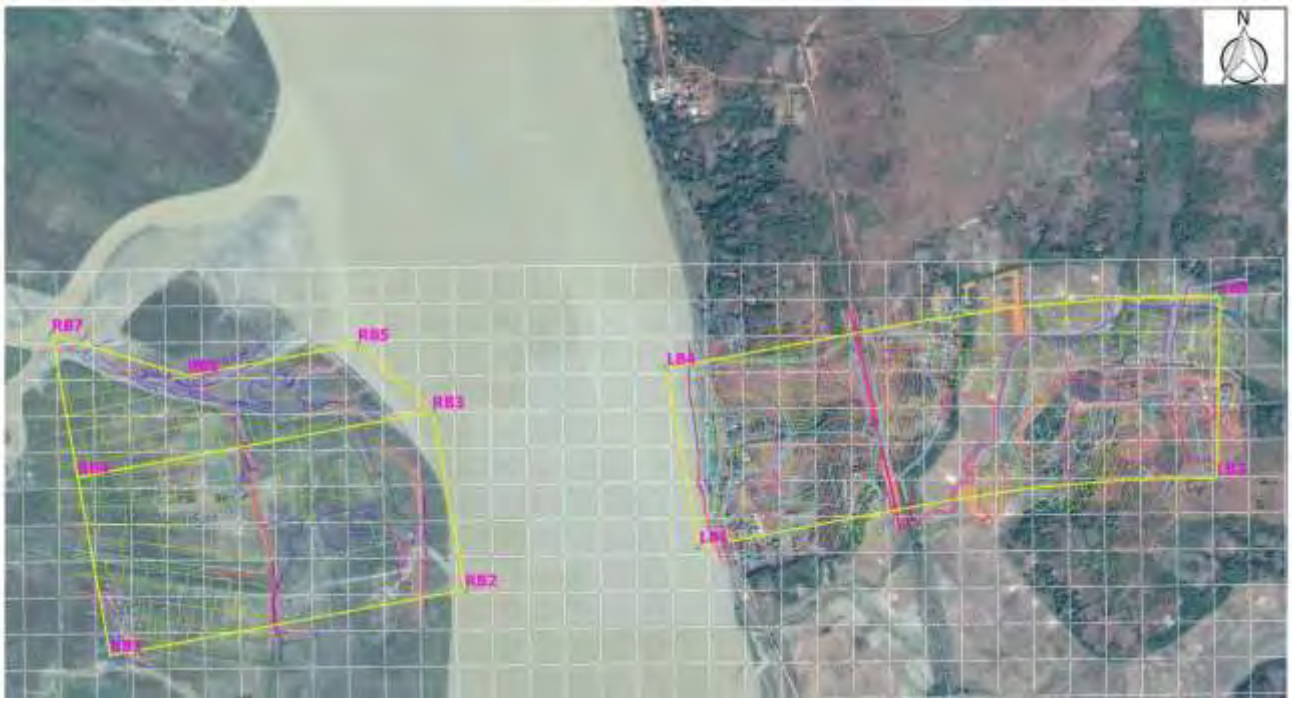


Figure 3 Topographic Mapping Area

Source: AAS MM

1.2.3 River Survey

The twelve river survey lines for the river sectional survey are observed to understand the natural conditions of the river and secure topographical information in wide-ranging areas of candidate sites.
Cross sections were selected to get an insight into section characteristics in the project area of the new bridge of Sittaung.
Table 2 shows the coordinates of each survey line and the related survey lengths. Figure 4 shows the location of these survey lines.

Table 2 Coordinates of River Sectional Survey

River Station Point	River Survey Line ID	Coordinates (m) by WGS84 UTM47N				Survey Line Length (m)	Remarks
		Left Bank		Right Bank			
		X1	Y1	X2	Y2		
80+697	RSL 11	274627.43	1938089.65	273858.02	1938157.22	772.38	Existing old NH8 Bridge
73+279	RSL 10	274719.29	1930707.29	274051.98	1930872.39	687.69	Existing NH8 Bridge
70+339	RSL 9	275494.89	1928515.25	274202.48	1927638.03	1562	
68+715	RSL 8	276299.95	1926942.34	275103.12	1926481.61	1282.45	
67+336	RSL 7	276589.37	1925649.1	275421.54	1925447.3	1185.13	
66+621	RSL 6	276726.88	1925419.16	275217.84	1925158.4	1514.94	
66+507	RSL 5	276737.1	1925167.22	275572.33	1924965.95	1182.05	Proposed New Bridge Center
66+321	RSL 4	276861.56	1924398.22	275671.94	1924386.39	1189.67	
65+227	RSL 3	276802.17	1923531.86	275857.11	1923104.21	1037.32	
62+898	RSL 2	277572.9	1920703.14	275730.83	1921577.23	2038.94	
58+530	RSL 1	276315.52	1918124.55	272156.08	1917084.14	4287.58	
31+168	RSL 0b	291977.23	1902904.53	267999.65	1895268.46	25164.14	
					Total	41904.29	12 Survey Lines

Source: AAS MM

Figure 4 Location Map of the River Sectional Survey

1.2.4 Interview Survey

The following 30 locations were selected to study the situation regarding the flooding occurred in the past around the project area from the local resident peoples.
Figure 5 shows 30 locations for the interview survey.

Source: AAS MM

Figure 5 Location of the Interview Survey

1.2.5 Measurement of Water Level and Flow Speed

The measurement of Water Level was carried out from 25 May 2017 to 1 June 2017 with 24-hours Water Level Records. The Water Velocity measurement was also conducted from 2 June 2017 to 30 June 2017 with 24-hours records.
The following figure shows the location of the Water Level and Flow Speed survey work.
This location was chosen to fix the instrument such as gauge in the river.

Figure 6 Location of the Water Level and Flow Speed Source: AAS MM

1.2.6 Video Shooting of Tidal Bore

A tidal bore, often simply given as bore in context, is a tidal phenomenon in which the leading edge of the incoming tide forms a wave (or waves) of water that travels up a river or narrow bay against the direction of the river or bay's current.

Source: AAS MM

Figure 7 Location of the Video Shooting of Tidal Bore

1.3 Geographic Reference System

The following coordinate system was adopted in this survey (Table 3).

Table 3 Coordinate system used in this survey

Ellipsoid	WGS84 (World Geodetic System 1984)
Projection	Universal Transverse Mercator (UTM) Projection
UTM Zone	Zone Number N47
Origin of Central Meridian	99 degree east of Meridian International
Origin of Latitude	Equator
Scale factor at the origin	0.9996
False Easting	(0,500,000) at equator
Vertical Datum	BM height adopted by Myanmar Survey Department
Unit of measurement	Meter

1.4 Survey Period and Schedule

Table 4 shows the survey period and schedule during which this survey was conducted.

Table 4 Survey Period and Schedule

No.	Survey Working Item	2017						
		May	June	July	August	Sept	Oct	Nov
1	Benchmark Installation							
2	Control Leveling Survey	→						
3	Topographic Survey acquire by UAV				→	→		
4	River survey	→	→	→				
5	Interview Survey for Historical Maximum/Normal Levels and Flood Situations		→					
6	Measurement of Water Level and Flow Speed	→	→				→	
7	Video Shooting of Tidal Bore		→				→	

1.5 Organization

The persons engaged in the Survey Works and their duties are as shown in the following Table 5.

Table 5 Persons Engaged in the Survey Works and Duties

Name	**Duties**
Mr. Min Thu	Project Manager
Mr. Thein Htike Zaw	Benchmark installation and Control Leveling Survey
Mr. Min Aung	Topographic Survey acquire by UAV
Mr. Win Aung Tun	River Survey
Mr. Kaung Kyaw Hein	Interview Survey for Historical Maximum/Normal Levels and Flood Situations
Mr. Nyan Kyaw Thet	Measurement of Water Level and Flow Speed
Mr. Than Htike Oo	Video Shooting of Tidal Bore
Mr. Wunna Tun	Quality Control and Final Product

1.6 Equipment

Table 6 shows the equipment used in this survey.

Table 6 Equipment of the Survey Work

No.	Survey Instruments	Qty	Softwares
1	Spectra Precision SP80 GNSS Receiver(one base two rover)	1set	Auto CAD Civil 3D Land Desktop
2	Topcon GR5 GNSS Receiver (one base two rover)	1set	Trimble Business Center TBC
3	Topcon Hipper II GNSS Receiver (one base two rover)	1set	Magnet Field
4	Nikon nivo 2m Total Station	2set	Azuka
5	Nikon NPL 322	1set	Info 5.6
6	Topcon GTS 7503 Total Station	1set	Auto CAD Map 3D 2014
7	Focus DL 15 Digital Level	2set	UAS Master 6.0
8	Topcon B2 Auto Level	2set	Global Mapper
9	Garmin Aqua Map Sounder 80xS	4set	
10	Leica Digital Sprinter 150m		Sprinter Downloader

2. SCOPE OF WORK

Table 7 shows the Quantities of Execution of this Survey.

Table 7 Survey Work Description

No.	Survey Work Item	Work Volume	Description
1	Benchmark Installation	2-Points	
2	Control Leveling Survey	112km	3-route
3	Topographic Survey acquire by UAV	1.5km^2	
4	River survey	80.8km	12-Cross Section
5	Interview Survey for Historical Maximum/Normal Levels and Flood Situations	30-Locations	Client Selected Locations
6	Measurement of Water Level	50-Days	24-hrs, 12-hrs and 6-hrs
7	Measurement of Water Velocity	43-Days	24-hrs, 12-hrs and 6-hrs
8	Video Shooting of Tidal Bore	4-Days	(1:30hrs/day)

3. METHODOLOGY

3.1 Bench Mark Installation (Appendix 1)

In bench mark installation, benchmarks (hereinafter refer to as “the BM”) installed at the feasibility study remained without being destroyed. Therefore we decided to verify the position accuracy of this remaining BM without new installation.
Figure 8 shows the BM installed at the feasibility study.

Figure 8 the BM installed at the feasibility study. Source: AAS MM

Source: AAS MM

Figure 9 GPS Network of Sittaung

The static survey was conducted based on the GPS observation network plan (Figure 9) and the following observation specifications in the GPS observation.

Reference point : GCP0565 and YT16
New Point : RSL-5L and RSL-5R

Observation specifications:

Frequency	: Multiple Frequencies
Observation interval	: 1 second
Elevation mask	: less the 10 degree
Horizontal Precision	: less than 0.05m + 1.000 ppm
Vertical Precision	: less than 0.1m + 1.000 ppm

Especially, the observation of about 4 hours was carried out because the distance from the existing BM to the new point exceeds 30km.

Table 8 and Table 9 show result of the base line processing and 3D adjustment.

Table 8 The Base Line Processing

Items	Session1
Solution Type	Fixed
Frequency Used	Multiple Frequencies
Horizontal Precision (Base Line)	0.008m
Vertical Precision (Base Line)	0.048m
Processing Duration	4:01:32
Processing interval	1 second

Table 9 The 3D Adjustment Unit: m

Point name	Coordinate E	E error	Coordinate N	N error	Height	H error
GCP0565	263,581.580	Fixed	1,937,206.680	Fixed	8.096	Fixed
YT16	231,615.115	Fixed	1,918,470.967	Fixed	9.983	Fixed
RSL-5L	276,769.644	0.023	1,924,603.903	0.018	7.090	Fixed
RSL-5R	275,648.766	0.022	1,924,565.411	0.019	6.479	0.152

In the baseline processing, Fixed answers were obtained in all sessions, and the horizontal accuracy (Base Line; 0.008m) and height accuracy (Base Line; 0.048) were also obtained.
The 3D adjustment accuracy of horizontal coordinate of RSL-5L and 5R was 0.029 m on average. In addition, the height accuracy of RSL-5R was 0.152m.
For this reason, processed coordinates satisfy the accuracy of GCP for the 1:1,000 scale topographic map and bathymetric survey

The following Figure 10 and Figure 11 show the description of new points.

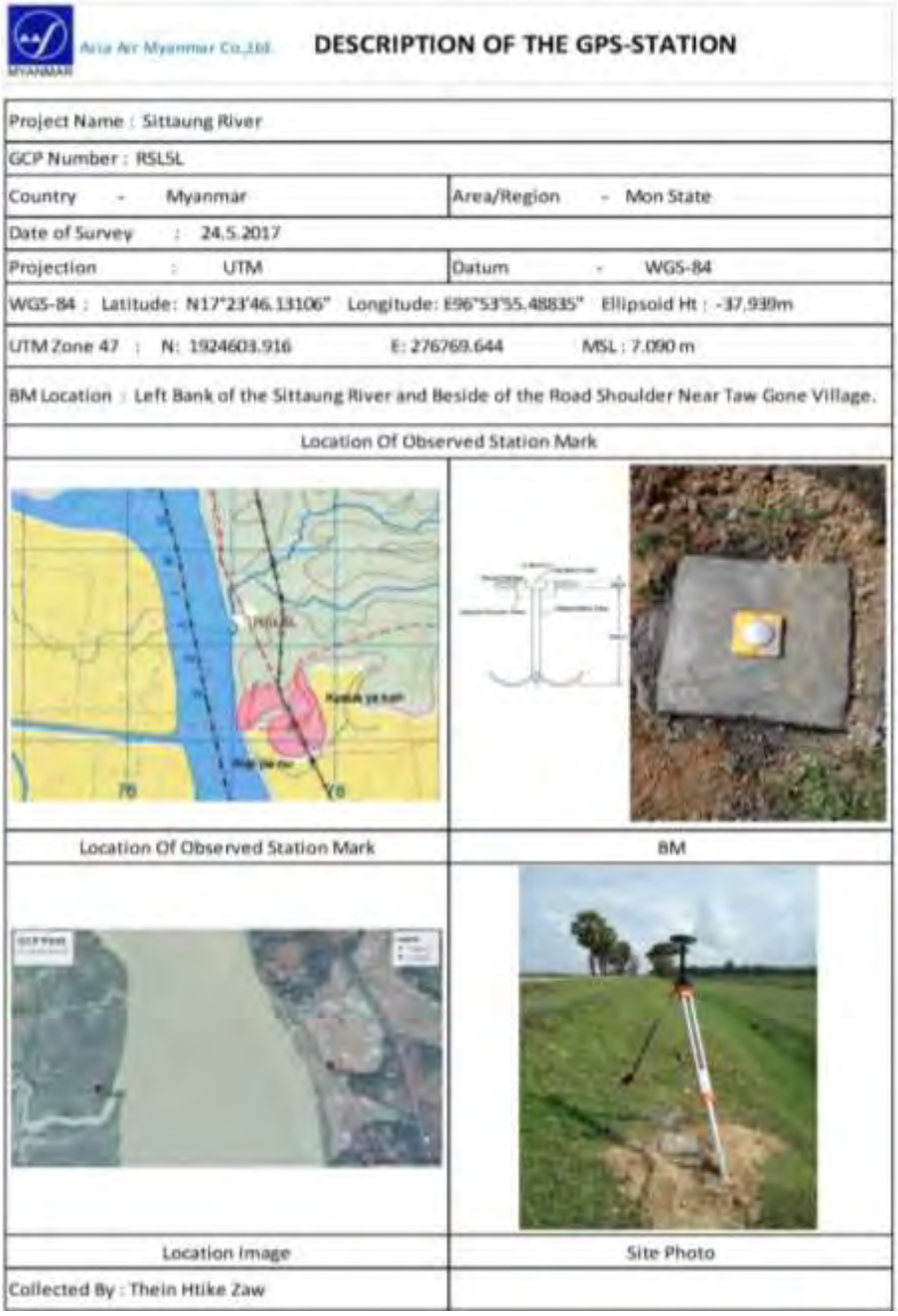
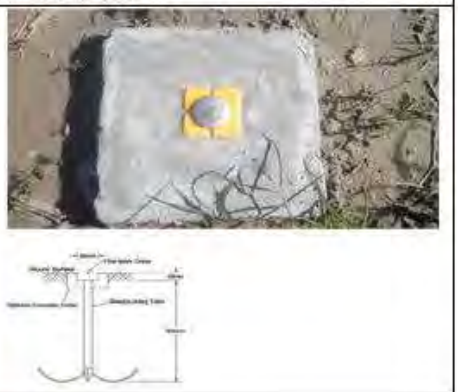


Figure 10 Point of description (RSL-5L) Source: AAS MM

Asia Air Myanmar Co.,Ltd.
MYANMAR

DESCRIPTION OF THE GPS-STATION

Project Name : Sittaung River	
GCP Number : RSL5R	
Country - Myanmar	Area/Region - Mon State
Date of Survey : 24.5.2017	
Projection : UTM	Datum - WGS-84
WGS-84 : Latitude: N17°23'44.47807" Longitude: E96°53'17.53880" Ellipsoid Ht : -37.995m	
UTM Zone 47 : N: 1924565.411 E: 275648.766 MSL : 6.479 m	
BM Location : Right Bank of the Sittaung River Near Taw Gone Village.	
Location Of Observed Station Mark	



Location Of Observed Station Mark | BM

Location Image | Site Photo

Collected By : Thein Htike Zaw

Source: AAS MM

Figure 11 Point of description (RSL-5R)

3.2 Control Leveling Survey (Appendix 2)

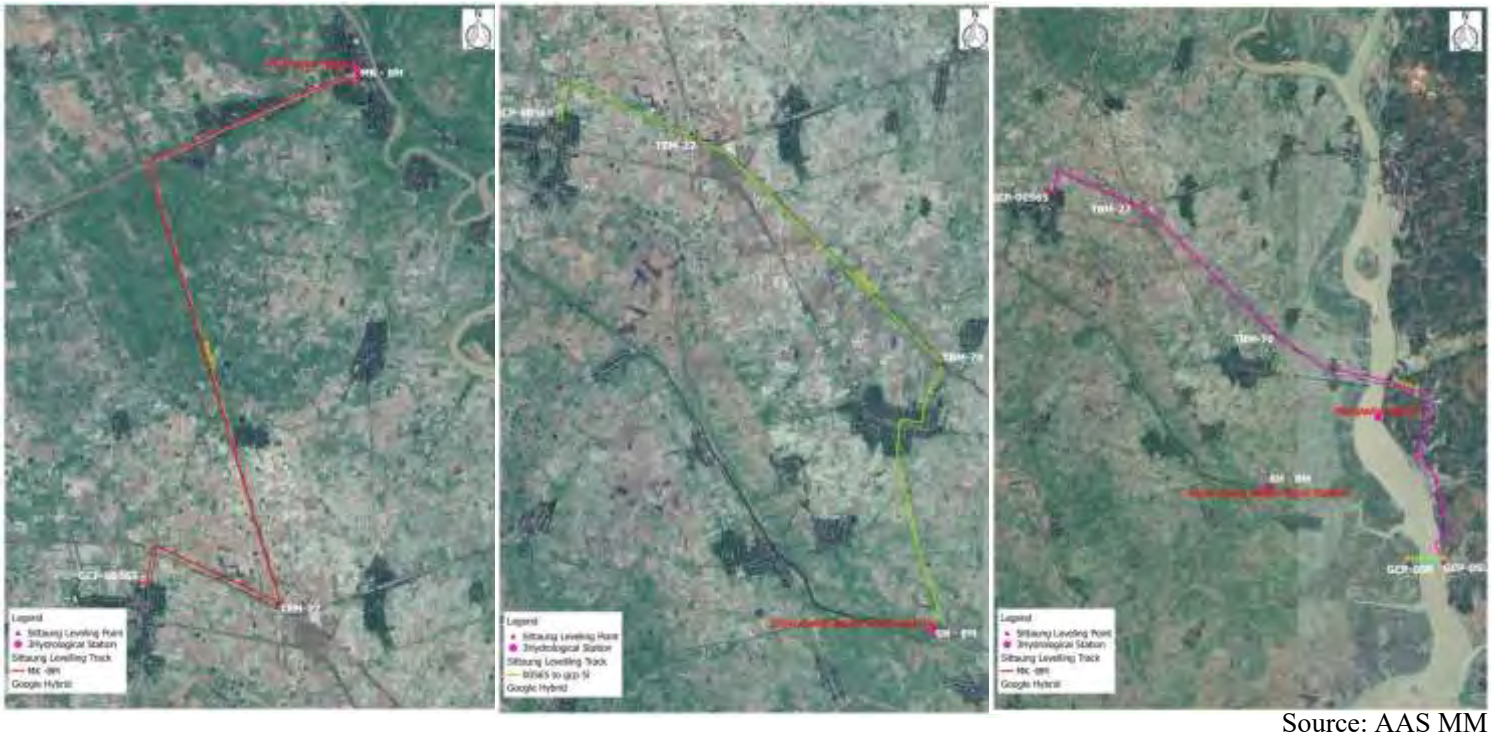
Leveling is a branch of surveying, the object of which is to find the elevation of a given point with respect to the given or assumed datum. Establish a point at a given elevation with respect to the given or assumed datum.

Leveling is the measurement of geodetic height using an optical leveling instrument and a level staff or rod having a numbered scale. Common leveling instruments include the spirit level, the dumpy level, the digital level, and the laser level.

It is very important to understand the difference between the two at the first place, from the definition it is pretty clear as to why it is done.

Before any construction starts its important to make sure the land is in level and doesn't have much difference in gradient. If it has, then foundation has to be laid accordingly, so for this purpose surveying and leveling is carried out.

The method used for control leveling survey is the direct leveling and 3 leveling routes prepared.
The 1st route started from GCP-00565 which is the existing Myanmar Survey Datum Benchmark pillar in MSL and finished at MK-BM in Myint Kyoe Station (double run forward and backward).
The 2nd route started from GCP-0056 and finished at SH-BM (Shan Gaing Water Gate Station).
And the 3rd route started from GCP-00565, and finished at GCP-05L Mokpalin Staion. The section between the GCP-05L and GCP-05R are crosses a river.
Figure 12 shows the 3 routes of control leveling survey.



Source: AAS MM

Figure 12 Routes of the Control Leveling Survey

Appendix 2: calculation book of control leveling survey

We calculate the MSL height based on the observed data. 10mm $\sqrt{D}$ Formula was used in this project. The following Table shows the Tolerance and Accuracy. From the Table 10, we understand the every route leveling accuracy was within the tolerance. Table 11 shows the final height of GCP and BM.

Table 10 Leveling Survey Accuracy of Each Routes

No.	Distance (km)	Accuracy (m)	Tolerance (m)
Route-1	7.4 km	0.0078 m	0.0192 m
Route-2	11.8 km	0.0178 m	0.024 m
Route-3	13.05	0.006 m	0.026 m

Table 11 Final Height Lists of GCP

PtID	Elevation (m)	Adjustment Level (m)	Accuracy (mm)	
			Avg: Elevation	Avg: Distance
GCP-0565	8.0960	8.0960	0.0078	0.0192
MK -BM	8.3250	8.3143	0.0214	0.0373
SG- BM	7.8513	7.8602	0.0178	0.02426408
BM-RSL5L	7.0866	7.0901	-6.9150	34.929

3.3 Topographic Survey acquired by UAV (Appendix 3)

Topographic Surveys are used to identify and map the contours of the ground and existing features on the surface of the earth or slightly above or below the earth's surface (i.e. trees, buildings, streets, walkways, manholes, utility poles, retaining walls, etc.). If the purpose of the survey is to serve as a base map for the design of a residence or building of some type, or design a road or driveway, it may be necessary to show perimeter boundary lines and the lines of easements on or crossing the property being surveyed, in order for a designer to accurately show zoning and other agency required setbacks.
Therefore, we created the topographic map by the following procedure.

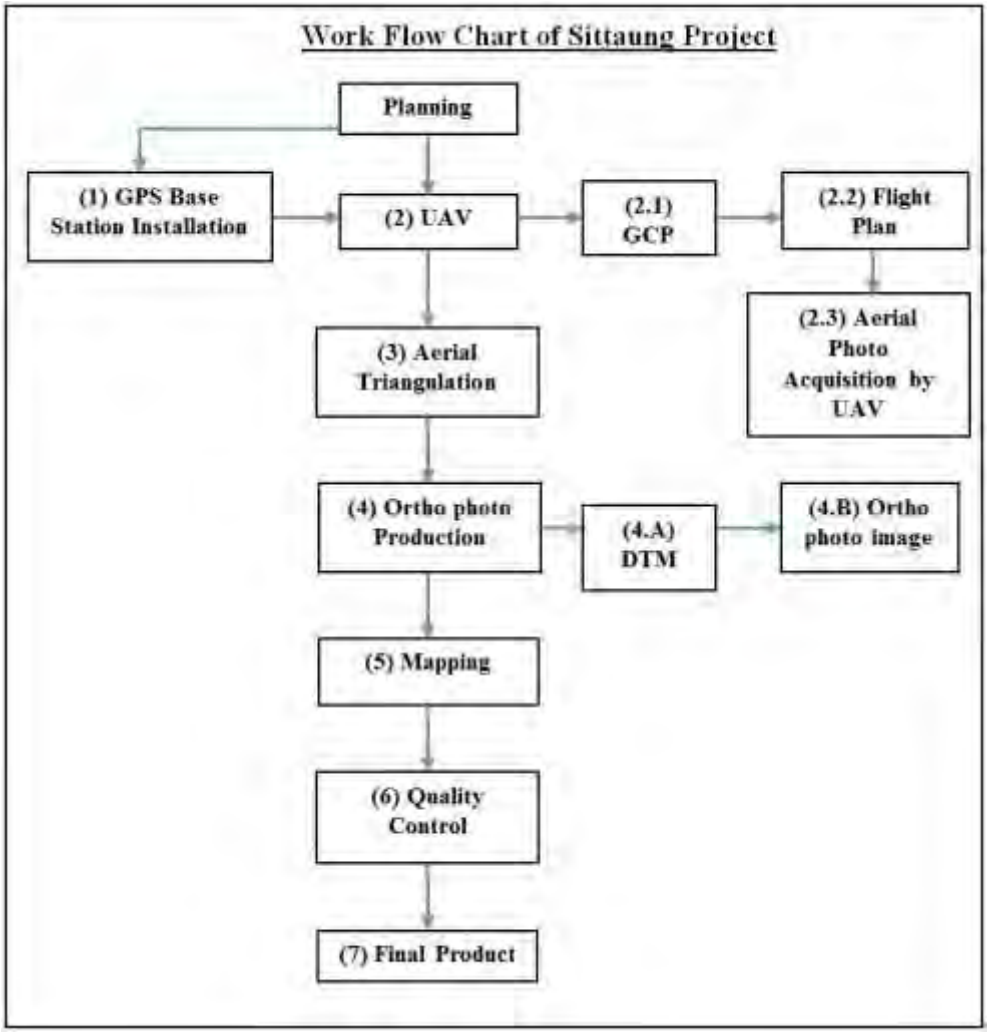


Figure 13 Photo of the Work Flow Chart for Topographic Mapping

(1) installation of GPS Base Station for UAV

AASMM installed the GPS Base Station while UAV takes aerial photography at the existing BM position. Figure 14 shows photo of installed the GPS Base Station.
In addition we setup the target for the triangulation. The following Figure shows the Target plan.

Source: AAS MM

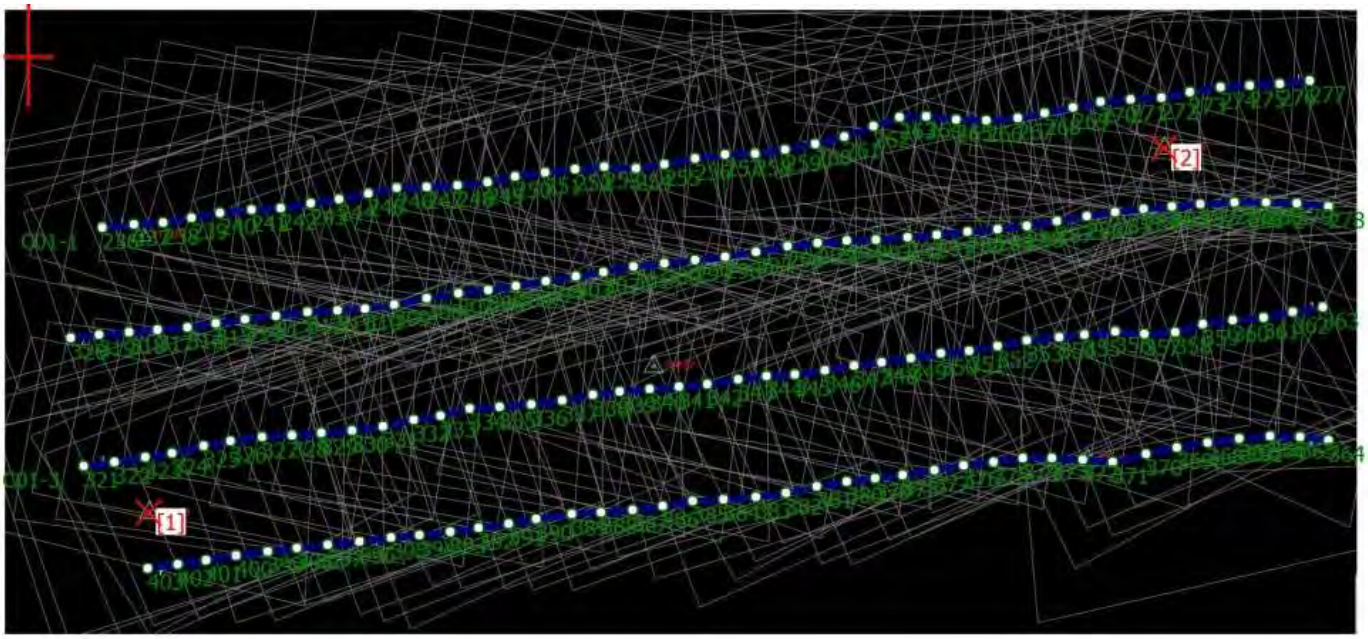
Figure 14 Installation of the GPS Base Station.

(2) Aerial Photo Acquisition by UAV

The aerial photo acquisition by UAV was carried out according to the flight plan created based on the following specifications.

- Ground sampling distance : 6cm
- Number of flight line : 11 lines
- Overlap : 80%
- Sidelap : 60%
- Camera : SONY (Model – ILCE-5100)

Figure shows flight plan of UAV. The number of aerial photos taken by UAV is 354-pictures. The figure shows one of aerial photographs.



Source: AAS MM

Figure15 Flight Plan of UAV

Source: AAS MM

Figure 16 UAV

Source: AAS MM

Figure 17 Aerial Photo of the Digital Topographic Mapping Area

Overlap, cloudy, shadow and smoke of aerial photograph taken by UAV was evaluated.
Effective of the Clouds, Shadow and Smoke could not be seen over the principle point of any Photograph. In addition, there was no missing Aerial Photograph. Therefore, we produced the following Images.

(Products)
/Thumbnail (small re-sized) images; 8 bits JPEG.
/Aerial Photo Images; 8 bit RGB color uncompressed TIFF image

(3) Aerial Triangulation

The aerial triangulation was conducted to calculate the exterior orientation of photo center (hereinafter EO parameter) which is X, Y, Z, Omega, Phi, Kappa. Advanced photogrammetric software package, which can provide the means for automatic tie and pass point, which will enhance the accuracy and robustness of the bundle adjustment is used.

In the calculation of triangulation, the GCP from the GPS Base Station used as the control point, 6 tie points at least measured each stereo model for extraction of EO parameter.
Table 12 shows accuracy of aerial triangulation.

Table 12 GCP Accuracy

	residuals horizontal control points in [meter]		
	control point ID	rx	ry
GCP accuracy: Part-1	STP-05	0.004	0.007
	STP-06	-0.008	-0.005
	STP-07	0.011	-0.005
	STP-08	-0.006	0.002
	STP-09	-0.001	0.001

	residuals vertical control points in [meter]		
	control point ID	rz	
	STP-05	-0.011	
	STP-06	-0.004	
	STP-07	0.034	
	STP-08	-0.002	
	STP-09	-0.016	
GCP accuracy: Part-2	residuals horizontal control points in [meter]		
	control point ID	rx	ry
	STP-02	-0.006	-0.003
	STP-03	0.005	0.004
	STP-04	-0.002	0.001
	STP-10	0.004	-0.002
	residuals vertical control points in [meter]		
	control point ID	rz	
	STP-02	0	
	STP-03	0.001	
	STP-04	-0.001	
	STP-10	0	

The final accuracy of the aerial triangulation show below;

- Part-1 Horizontal Error RMS; 0.007mm

  MAX; 0.012mm

  Height Error RMS; 0.013mm

  MAX; 0.034mm

- Part-2 Horizontal Error RMS; 0.005mm

  MAX; 0.007mm

  Height Error RMS; 0.001mm

  MAX; 0.001mm

Appendix: EO parameter list

(4) Ortho Photo Production

a) Digital Terrain Model

The digital terrain model (hereinafter refer to as "DTM") was generated to meet the following requirements.

A vertical accuracy STD 1.5m (90% confidence Level)
Post (resolution) of 10 meter
DTM will be generated from stereo matching points and topographic break lines

Figure shows the DTM image created in this work.

Source: AAS MM

Figure 18 DTM image created in this work

b) Ortho Photo Image

The Ortho photo image is created to meet the following requirements.

Horizontal accuracy of at least 60cm
Ground Sample Distance (GSD) is within 1.5m
Final digital Ortho photo shall be covered 1: 1,000 digital mapping areas and its surrounding area.

At the beginning, the aerial Ortho photo image is obtained by was generated by converting aerial photograph of the central projection. DTM, EO parameter and aerial photograph are used for conversion from this central projection.

The final result of seamless color mosaic image was created by mosaicking each aerial Ortho photo image. The centers of the each image used to minimize the undesirable effect of building lean and obstruction, especially in areas with tall buildings or landmarks. In addition, color balancing between the images was adjusted to make the overall color tone natural.

The aerial Ortho photo image was saved as Geo Tiff format with World File(TFW). The images uncompressed, and have horizontal scan lines with the top left origin.

(5) Digital Topographic Mapping (1: 1, 000)

All natural and artificial terrain features such as rivers, streams, forests, paddy field, farms, plantations, roads, paths, houses, schools, public buildings, cemeteries, etc. interpreted and plotted. The detailed specification of plotting for topographic feature code is referred to the map symbol specification.
Table 13 shows feature's specification.

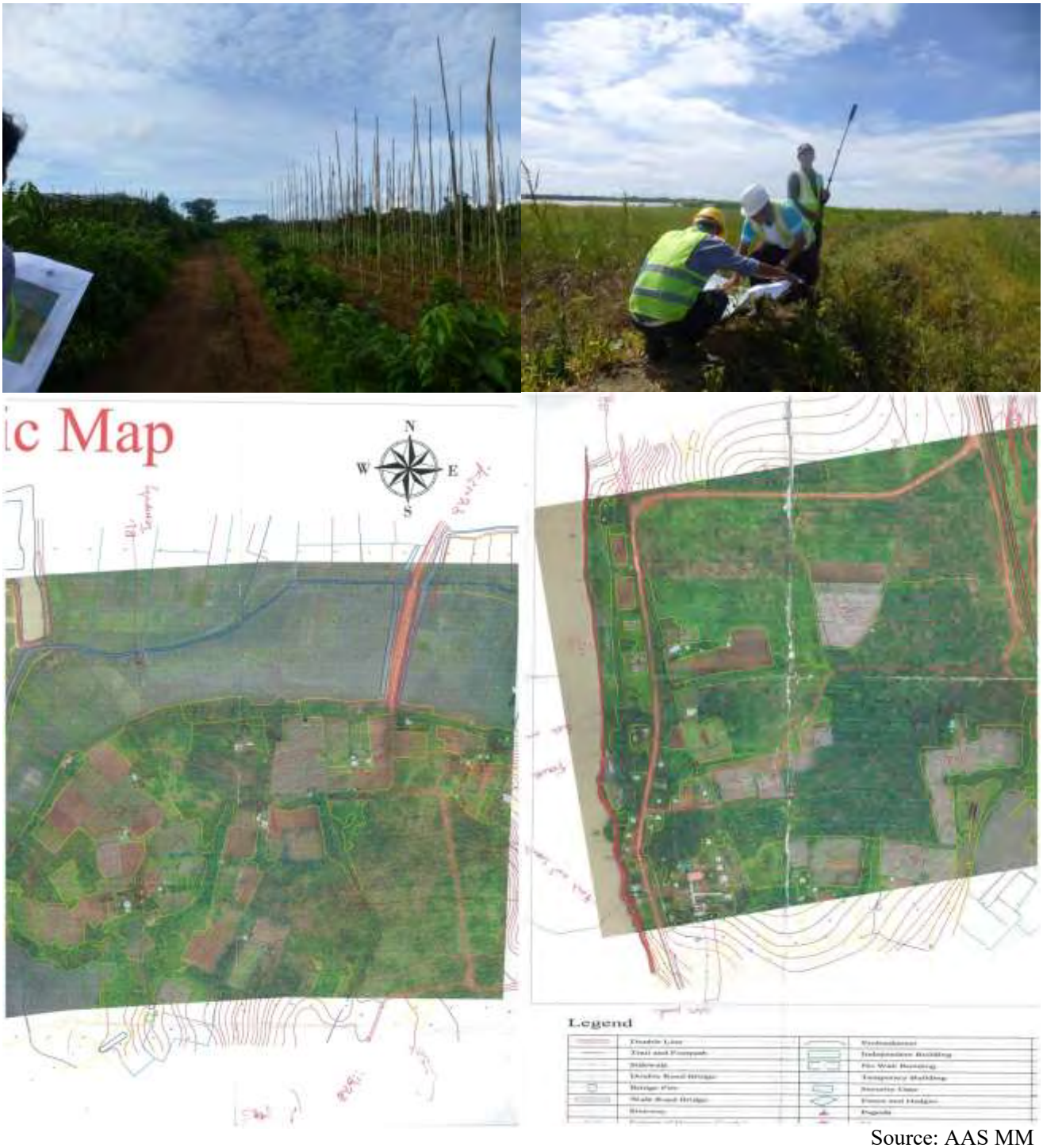
Table 13 Feature's Specification

	Double Line		Independent Building		Low Voltage Electric Pole
	Trail and Footpath		No Wall Building		Street Light
	Sidewalk		Temporary Building		Water Course
	Double Road Bridge		Security Gate		Stream Rivulet
	Bridge Pier		Fence and Hedges		Big Cannel
	Walk Road Bridge		Pagoda		Small Cannel
	Stairway		Monastery		Pond, Basin and Reservoir
	Culvert of Drianage Conduit		Telephone Pole		Fishpond
	Tunnel		Water Tower		Swamp Area
	Embankment		Soler Pannal		Sand and Gravel Lands
	Water Direction Arrow		Independent Tree		Normal Contour Line
	Vegetation Boundary		Grass		Intermediate Contour Line
	Cultivated Land Limit		Coniferous Forest		BM (Benchmcnt) Point
	Rice Field		Other Trees		RTK Survey Point
	Cultivated Field or Plantation		Broadleaf Forest		Spot Height
	Bare Land		Top Slope (Concrete)		Grid (100meter)
	Bush and Scrub		Low Slope (Concrete)		T-Grid
	Banana		Top Slope (Artificial)		Regional Boundary
	Palm		Low Slope (Artificial)		District Boundary
	Bamboo		Master Contour Line		Township Boundary

In principle, index contour lines of every 2.5m interval for 1: 1,000 scale map and photogrammetric spots heights at every 4 cm to 4 cm density on the scaled map measured and plotted intermediate contour lines (half of index contour lines) measured and plotted on the flat area. In case of the steep terrain area contour interval changed in accordance with topographic terrain condition.

(6) Quality Control

The following two verifications were carried out as the quality control.
Field verification: confirmation of features that cannot be confirmed with aerial photographs on the field.



Source: AAS MM

Figure 19 Field Verification of Digital Topographic Map

Height verification: contour height and ground height re-checking by mapping software.
Table 14 shows the result of verification

Table 14 Result of Verification

FID	GROUND HEIGHT	ORTHO HEIGHT
0	18.4	18.35
1	5.8	5.81
2	8.3	8.29
3	8.9	8.91
4	12.6	12.58
5	11.7	11.69
6	10.4	10.41
7	6.6	6.61
8	18.3	18.29
9	14.3	14.29
10	6.9	6.91
11	4.3	4.32
12	3.6	3.58
13	18.9	18.89
14	3.1	3.11

(7) Final Product

The results to topographic survey by UAV are as follows:

1) 1: 1, 000 digital topographic map data: AutoCAD DWG and PDF formats 2 sets

2) 1: 1, 000 digital topographic maps: Print manuscripts in A0 sheets 2 sets

3) 1: 1, 000 Ortho photo map data: ECW, Geo Tiff and A0 plots 2 sets

4) DTM data: Text file 2 sets

3.4 River Survey (Appendix 4)

The river survey was conducted to understand the natural conditions of the river and secure topographical information in wide-ranging areas of candidate sites.
There are 12 survey lines to observe as shown in Figure 20. The following equipment was used for the river sectional survey.

-RTK and sonar, Garmin Aqua Map Sounder 80xS,

-Accuracy 0.1% of depth and measure simultaneously with RTK measurement.

-SP80 Rover or GR5

-The accuracy of Horizontal is 20mm+1ppm

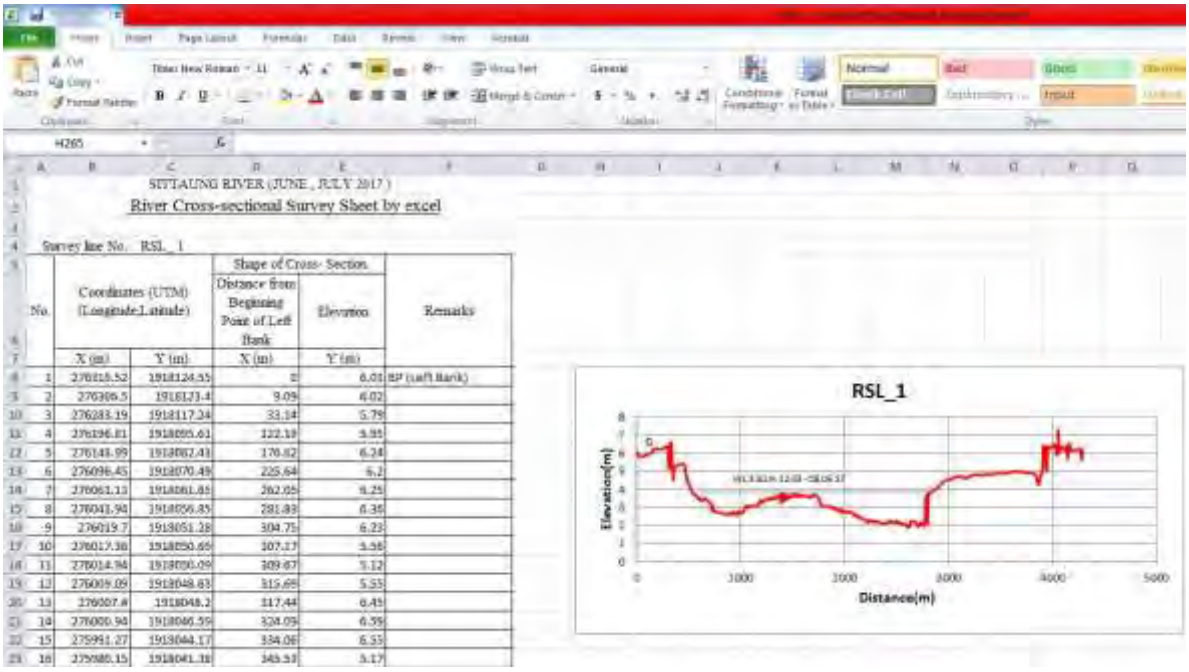
Source: AAS MM

Figure 20 Photos of Observation Work on the River

Source: AAS MM

Figure 21 Garmin Aqua Map Sounder 80xS

The height of the river bed was determined by subtracting the depth from the water level of simultaneous observation. The water depth was measured through the receiving single signal that the instrument transmitted a sound wave. After completion of field work, data processing was executed.
The river cross section data was created according to the Excel format shown in the figure.



SITTAUNG RIVER (JUNE , JULY 2017)

River Cross-sectional Survey Sheet by excel

Survey line No. RSL_1

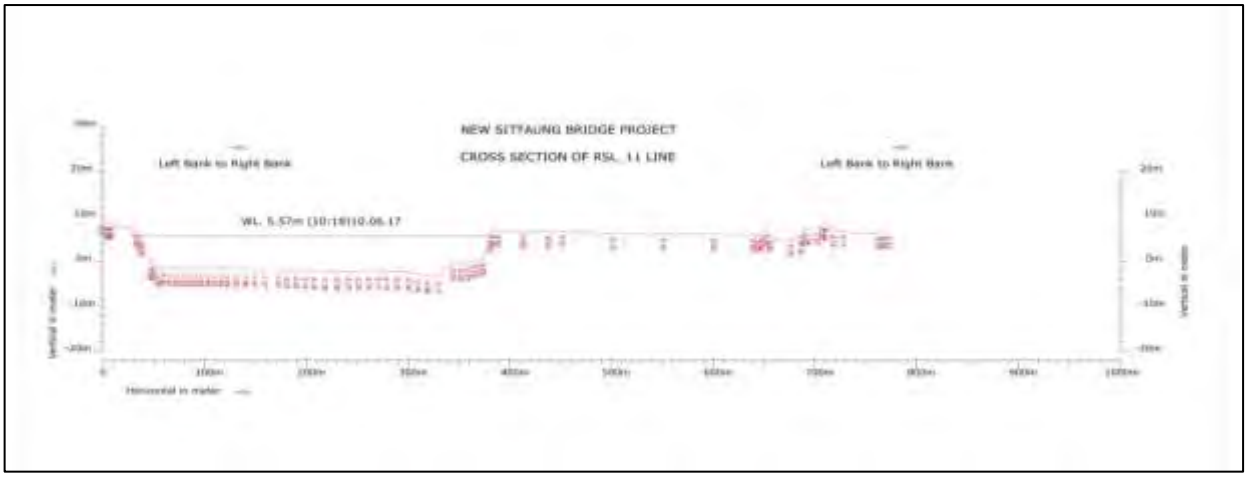
No.	Coordinates (UTM) (Longitude,Latitude)		Shape of Cross- Section		Remarks
			Distance from Beginning Point of Left Bank	Elevation	
	X (m)	Y (m)	X (m)	Y (m)	
1	276018.52	1918124.55	0	6.01	BP (left Bank)
2	276009.5	1918123.4	9.09	6.02	
3	276283.19	1918117.24	33.14	5.79	
4	276196.81	1918095.61	122.19	5.95	
5	276148.99	1918082.43	176.82	6.24	
6	276096.45	1918070.49	225.64	6.2	
7	276061.13	1918061.85	262.05	6.25	
8	276041.94	1918056.85	281.83	6.36	
9	276019.7	1918051.28	304.75	6.23	
10	276017.36	1918050.69	307.17	5.56	
11	276014.94	1918050.09	309.67	5.12	
12	276009.09	1918048.63	315.69	5.55	
13	276007.8	1918048.2	317.44	6.45	
14	276000.94	1918046.59	324.09	6.59	
15	275991.27	1918044.17	334.06	6.33	
16	275985.15	1918041.38	340.53	5.17	

Source: AAS MM

Figure 22 River Cross Section Data Format

In addition, the river cross section drawing was prepared based on the following specifications.

Horizontal Scale	:	1/
Vertical Scale	:	1/
Format	:	AutoCAD DWG
Height Standard	:	MSL
Output paper size	:	A0



Source: AAS MM

Figure 23River Cross Section Drawing

All of the river cross section data and drawing are attached in Appendix 4.

3.5 Interview Survey for Historical Maximum/Normal Levels and Flood Situations (Appendix 5)

The objective of this survey is to study the situation regarding the flooding occurred in the past around the project area. Therefore, Flood mark survey and interview to local resident peoples were conducted.

The interview for flood survey was conducted by way of questioning to local resident peoples.
The following eleven questions were used.

1.1 Have you ever experienced flooding near here?
1.2 When the historical flood occurred?
1.3 When the historical flood occurred, how much was the highest water level?
2.1 How many centimeters or meters is the average high water level or tidal level every year?.
2.2 How many centimeters or meters is the highest water level in the flood that occurred in your life?
3.1 Does the flood occurred by the tidal bore?
3.2 If the flooding occurs, how many meters is the water level and tidal bore height?
4.1 What time/which month is the tidal bore coming around this area?
4.2 Which month is the biggest tidal bore coming?
4.3 Does the tidal bore come around this area?
5.1 If heavy rain falls, will flooding occur?

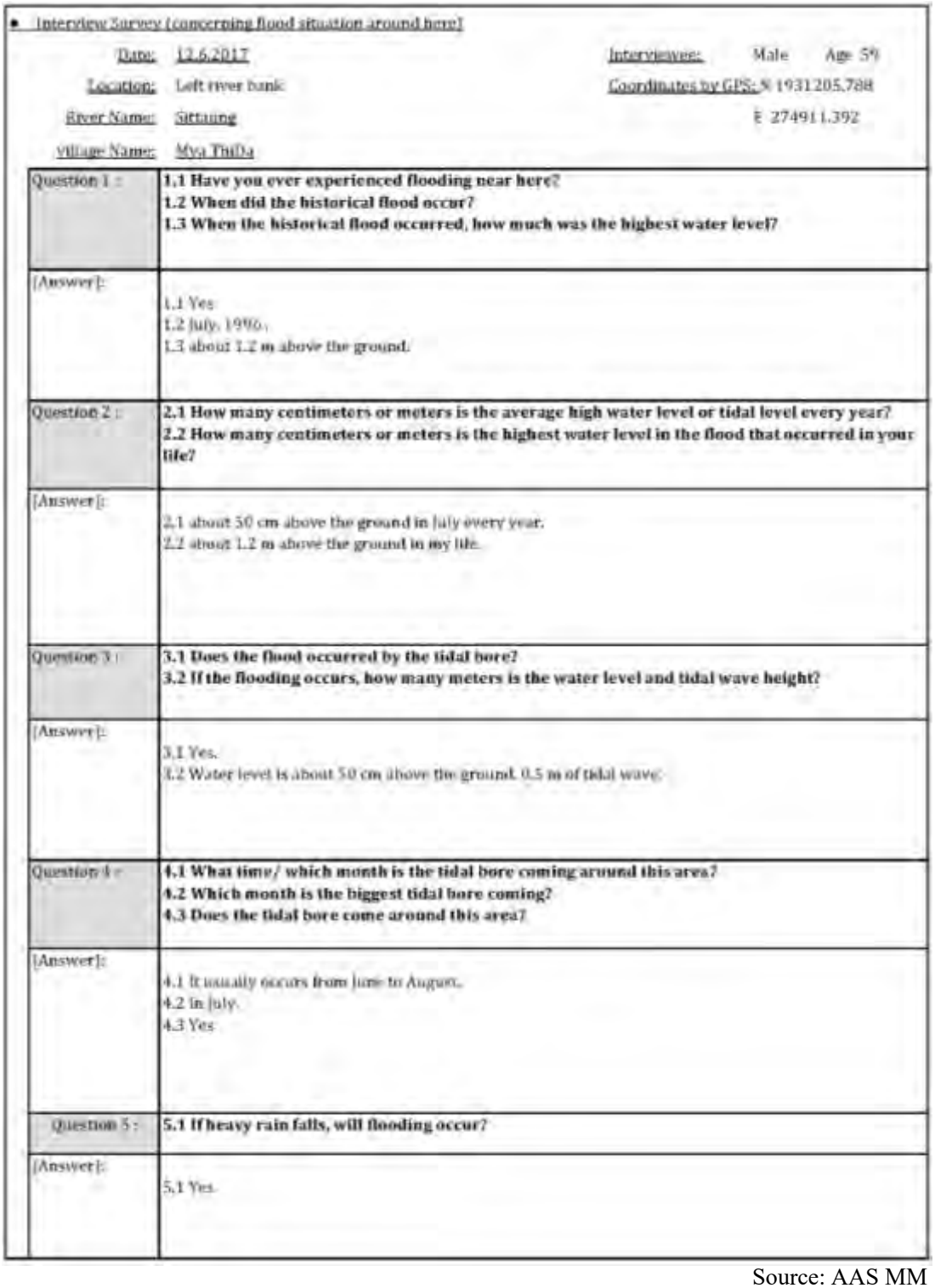
Figure 24 show template of interview sheet.

Source: AAS MM

Figure 24 Template Inventory Sheet of the Interview Survey

Flood situation and historical maximum/normal flood level of 31 points were collected by the interview of the each location. In addition, the height of ground and flood mark of Surveyed points was measured by Total Station and RTK survey Instrument, and inventory items such as sketch of selected point, photo, coordinate and answer were entered in the inventory sheet (Figure 24 and Figure 25).

Appendix 5 shows all of Inventory Sheets.



- Interview Survey (concerning flood situation around here)

Date: 12.6.2017 Interviewee: Male Age: 59

Location: Left river bank Coordinates by GPS: N 1931205.788

River Name: Sittaung E 274911.392

Village Name: Mya ThiDa

Question 1 :	**1.1 Have you ever experienced flooding near here?** **1.2 When did the historical flood occur?** **1.3 When the historical flood occurred, how much was the highest water level?**
[Answer]:	1.1 Yes 1.2 July, 1996. 1.3 about 1.2 m above the ground.
Question 2 :	**2.1 How many centimeters or meters is the average high water level or tidal level every year?** **2.2 How many centimeters or meters is the highest water level in the flood that occurred in your life?**
[Answer]:	2.1 about 50 cm above the ground in July every year. 2.2 about 1.2 m above the ground in my life.
Question 3 :	**3.1 Does the flood occurred by the tidal bore?** **3.2 If the flooding occurs, how many meters is the water level and tidal wave height?**
[Answer]:	3.1 Yes. 3.2 Water level is about 50 cm above the ground. 0.5 m of tidal wave.
Question 4 :	**4.1 What time/ which month is the tidal bore coming around this area?** **4.2 Which month is the biggest tidal bore coming?** **4.3 Does the tidal bore come around this area?**
[Answer]:	4.1 It usually occurs from June to August. 4.2 In July. 4.3 Yes
Question 5 :	**5.1 If heavy rain falls, will flooding occur?**
[Answer]:	5.1 Yes.

Source: AAS MM

Figure 25 Inventory Sheet-1 of the Interview Survey

Photo: Location:

Flood Image:

Source: AAS MM

Figure 26 Inventory Sheet-2 of the Interview Survey

3.6 Measurement of Water Level and Flow Speed (Appendix 6)

The water level and the water flow velocity measurement were executed to understand the river condition. The survey method, the result of the water level measurement and the water flow velocity are described below.

3.6.1 Water Level Measurement

Fixed point observation for water level was carried out by reading the gauge scale. Observation intervals were performed once every other hour. The measurement of water levels was conducted from 25 May 2017 to 30 June 2017.

1. During spring tide: 24 hours, 10 days at least
2. During neap tide: 12 hours, 4 days at least
3. Other period except above periods (; half tide, midway between spring and neap tides): Daytime, 14 days at least

Source: AAS MM

Figure 27 Water Level Measurement and Coordinate of Water Level Gauge

In addition, we conducted the 2nd time Water Level Measurement in 30 October 2017 to 12 November 2017.

1. During spring tide: 24 hours, 5 days at least
2. During neap tide: 12 hours, 2 days at least
3. Other period except above periods (; half tide, midway between spring and neap tides): Daytime, 7 days at least

All of the recorded results were stored in Appendix 6.

Table 15 shows a result of Water Level measurement. All of this result was stored in Appendix 6.

Table 15 Result of Water Level Measurement

Date	**Time**	W.L (m)	**Date**	**Time**	W.L (m)	**Date**	**Time**	W.L (m)
25/5/2017	6:00	5.683	26/5/2017	1:00	5.203	27/5/2017	1:00	5.313
	7:00	5.378		2:00	5.158		2:00	5.233
	8:00	5.158		3:00	5.075		3:00	5.093
	9:00	5.02		4:00	4.808		4:00	5.043
	10:00	4.941		5:00	4.788		5:00	4.983
	11:00	4.887		5:03	5.493		5:45	5.943
	12:00	4.878		5:15	5.683		6:00	5.933
	13:00	4.74		5:30	5.803		6:15	6.023
	14:00	4.673		5:45	5.893		6:30	6.123
	15:00	4.614		6:00	5.943		6:45	6.193
	16:00	4.511		6:15	5.913		7:00	6.113
	16:15	4.517		6:30	5.903		7:15	6.093
	16:17	5.501		6:45	5.863		7:30	6.043
	16:30	5.511		7:00	5.823		7:45	5.973
	16:45	5.531		8:00	5.623		8:00	5.913
	17:00	5.945		9:00	5.413		9:00	5.713
	17:15	5.916		10:00	5.323		10:00	5.533
	17:30	5.918		11:00	5.243		11:00	5.433
	17:45	5.993		12:00	5.158		12:00	5.333
	18:00	5.998		13:00	5.013		13:00	5.243
	19:00	5.949		14:00	4.923		14:00	5.153
	20:00	5.693		15:00	4.833		15:00	5.043
	21:00	5.547		16:00	4.793		16:00	4.963
	22:00	5.378		16:50	6.013		17:00	4.933
	23:00	5.318		17:00	5.893		17:30	6.223
	24:00	5.253		17:15	6.073		17:45	6.183
				17:30	6.153		18:00	6.163
				17:45	6.093		18:15	6.423
				18:00	6.253		18:30	6.353
				18:15	6.433		18:45	6.513
				18:30	6.373		19:00	6.513
				18:45	6.273		19:15	6.413
				19:00	6.273		19:30	6.413
				20:00	6.053		19:45	6.363
				21:00	5.853		20:00	6.323
				22:00	5.733		21:00	6.023
				23:00	5.613		22:00	5.823
				24:00	5.473		23:00	5.683
							24:00	5.553

Station - Sittaung River near Supanu village Kyaik hto Township Location : - 17° 23' 52.68"N , 96° 53' 48.07"E Date : 2.6.2017			**Station - Sittaung River near Supanu village Kyaik hto Township** Location : - 17° 23' 52.68"N , 96° 53' 48.07"E Date : 3.6.2017		
Time	**Water Level**	**Velocity @ 1 meter depth from surface**	**Time**	**Water Level**	**Velocity @ 1 meter depth from surface**
24 Hour	MSL (m)	(m/sec)	24 Hour	MSL (m)	(m/sec)
1:00	_	_	1:00	_	_
2:00	_	_	2:00	_	_
3:00	_	_	3:00	_	_
4:00	_	_	4:00	_	_
5:00	_	_	5:00	_	_
6:00	4.693	0.045	6:00	4.543	0.057
7:00	4.693	0.049	7:00	4.543	0.062
8:00	4.683	0.045	8:00	4.543	0.057
9:00	4.683	0.036	9:00	4.543	0.057
10:00	4.673	0.000	10:00	4.523	0.049
11:00	4.653	0.023	11:00	4.533	0.062
12:00	4.633	0.023	12:00	4.523	0.066
13:00	4.623	0.019	13:00	4.533	0.083
14:00	4.593	0.057	14:00	4.523	0.075
15:00	4.593	0.053	15:00	4.533	0.066
16:00	4.593	0.062	16:00	4.593	0.083
17:00	4.593	0.066	17:00	4.593	0.079
18:00	4.593	0.066	18:00	4.593	0.083
19:00	_	_	19:00	_	_
20:00	_	_	20:00	_	_
21:00	_	_	21:00	_	_
22:00	_	_	22:00	_	_
23:00	_	_	23:00	_	_
0:00	_	_	0:00	_	_
	Max: Velocity	0.066		Max: Velocity	0.083
	Min: Velocity	0.000		Min: Velocity	0.040

3.6.2 Water Flow Velocity Measurement

The measurement of water flow velocity was conducted by the specifications and equipment as shown in the Table 16.

The vale port current flow meter was set at a specified depth and the signal returned from it was obtained at the receiver, and the water flow velocity was observed.

Table 16 Specifications and Equipment of Water Flow Velocity Measurement

Item	Description
measurement point	Fixed Point Observation
measurement depth	Velocity at 1 m depth under water surface
measurement season Season-1 Season-2	 From 2.6.2017 to 30.6.2017 From 30.10.2017 to 12.11.2017
measurement time	24-hrs, 12-hrs and 6-hrs
equipment	Vale port current flow meter Accuracy ± 1.5% of reading above 0.15 m/s, ± 0.004 m/s below 0.15 m/s

Source: AAS MM

Figure 28 Equipment of Water Flow Velocity Measurement

Table 17 shows a result of Water Flow Velocity measurement. All of this result were stored in Appendix 6.

Table 17 Result of the Water Flow Velocity Measurement

Station - Sittaung River near Supanu village Kyaik hto Township Location : - 17° 23' 52.68"N , 96° 53' 48.07"E Date : 2.6.2017			**Station - Sittaung River near Supanu village Kyaik hto Township** Location : - 17° 23' 52.68"N , 96° 53' 48.07"E Date : 3.6.2017		
Time	**Water Level**	**Velocity @ 1 meter depth from surface**	**Time**	**Water Level**	**Velocity @ 1 meter depth from surface**
24 Hour	MSL (m)	(m/sec)	24 Hour	MSL (m)	(m/sec)
1:00	_	_	1:00	_	_
2:00	_	_	2:00	_	_
3:00	_	_	3:00	_	_
4:00	_	_	4:00	_	_
5:00	_	_	5:00	_	_
6:00	4.693	0.045	6:00	4.543	0.057
7:00	4.693	0.049	7:00	4.543	0.062
8:00	4.683	0.045	8:00	4.543	0.057
9:00	4.683	0.036	9:00	4.543	0.057
10:00	4.673	0.000	10:00	4.523	0.049
11:00	4.653	0.023	11:00	4.533	0.062
12:00	4.633	0.023	12:00	4.523	0.066
13:00	4.623	0.019	13:00	4.533	0.083
14:00	4.593	0.057	14:00	4.523	0.075
15:00	4.593	0.053	15:00	4.533	0.066
16:00	4.593	0.062	16:00	4.593	0.083
17:00	4.593	0.066	17:00	4.593	0.079
18:00	4.593	0.066	18:00	4.593	0.083
19:00	_	_	19:00	_	_
20:00	_	_	20:00	_	_
21:00	_	_	21:00	_	_
22:00	_	_	22:00	_	_
23:00	_	_	23:00	_	_
0:00	_	_	0:00	_	_
	Max: Velocity	0.066		Max: Velocity	0.083
	Min: Velocity	0.000		Min: Velocity	0.040

3.7 Video Shooting of Tidal Bore (Appendix 7)

The Video Shooting of Tidal Bore was conducted in two times. The first time was started from 25-May-2017 to 28-May-2017. The following Table 18 and Figure 29, 30 shows the first time video shooting of tidal bore.

Table 18 Video Shooting of Tidal Bore

No.	Date	Start Time	End Time	Equipment
1	25-May-17	3:59 PM	5:49 PM	Panasonic HC-W850 Video Camera
2	26-May-17	4:30 PM	5:58 PM	Panasonic HC-W850 Video Camera
3	27-May-17	4:48 PM	5:54 PM	Panasonic HC-W850 Video Camera
4	28-May-17	5:51 PM	6:57 PM	Panasonic HC-W850 Video Camera

Source: AAS MM

Figure 29 Shows Most the Capture Image of the Day of Highest Tidal Bore.

Figure 30 The Capture Image of the Day of Highest Tidal Bore Source: AAS MM

The 2nd time Video Shooting of Tidal Bore was started from 2-November-2017 to 6-November-2017. The following Table 19 and Figure 31, 32 shows the 2nd time Video Shooting of Tidal Bore.

Table 19 Video Shooting of Tidal Bore

No.	Date	Start Time	End Time	Equipment
1	2-Nov-17	3:42 PM	6:01 PM	Panasonic HC-W850 Video Camera
2	3-Nov-17	3:42 PM	6:23 PM	Panasonic HC-W850 Video Camera
3	4-Nov-17	3:53 PM	5:13 PM	Panasonic HC-W850 Video Camera
4	5-Nov-17	4:46 PM	5:47 PM	Panasonic HC-W850 Video Camera
5	6-Nov-17	4:52 PM	6:12 PM	Panasonic HC-W850 Video Camera

Source: AAS MM

Figure 31 Shows Most the Capture Image of the Day of Highest Tidal Bore.

Source: AAS MM

Figure 32 The Capture Image of the Day of Highest Tidal Bore

4. LIST OF TABLE

5. LIST OF FIGURE

6. APPENDIX

Appendix 1 Benchmark
Appendix 2 Control Leveling Survey
Appendix 3 Topographic Survey
Appendix 4 River Survey
Appendix 5 Interview Survey
Appendix 6 Measurement of Water Level and Flow Speed
Appendix 7 Video Shooting of Tidal Bore

付録 - 4

ボーリング柱状図

BORE HOLE No. **BH-01**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 1 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : -0.14m (Sep level ; 6.86m)

COORDINATE : E 276291.996 ; N 1925472.229 DEPTH : 65.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : Full

DATE : 11.11.2017 ~ 24.11.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)
1 ~ 6	-6.14	6.00	6.00		gray	Very soft to soft	Clayey SILT	Very soft to soft, gray, moist, low to medium plasticity, Clayey SILT			
7 ~ 14	-14.14	14.00	8.00		light to dark gray	Very loose to medium dense	Silty SAND	Very loose to medium dense, light to dark gray, moist, fine to medium grained, Silty SAND GL-(12.00 & 13.00)m; soft, brownish gray, moist, low to medium plasticity, Sandy CLAY latyer is observed as intercalted layer at that depth	11.11.17 9.00		
15 ~ 18	-18.14	18.00	4.00		light gray	Loose to medium dense	Clayey SAND	Loose to medium dense, light gray, moist, low plastic Clayey SAND			
19 ~ 28	-28.14	28.00	7.00		light gray to reddish brown	Stiff to hard	Sandy CLAY	Stiff to hard, light gray to reddish brown, moist, low to medium plasticity, Sandy CLAY with trace of fine gravel GL-(22.00 ~ 23.00)m; dense, reddish brown, moist, low plastic Clayey SAND layer is observed as intercalated layer at that depth	13.11.17 23.00	20.00 Ø112	
29 ~ 31					reddish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, reddish brown, moist, low to medium plastic, Clayey SAND with trace of fine to medium gravel Continue to next sheet			

STANDARD PENETRATION TEST
TEST METHOD (ASTM)

CURVE OF BLOW ●

N-Value (Blows / 30cm)

0 10 20 30 40 50

DEPTH GL - (m)	N-Value (Blows / 30cm)
1.00	0/30
2.00	1/30
3.00	1/30
4.00	1/30
5.00	3/30
6.00	5/30
7.00	4/30
8.00	3/30
9.00	13/30
10.00	11/30
11.00	10/30
12.00	4/30
13.00	2/30
14.00	7/30
15.00	6/30
16.00	6/30
17.00	13/30
18.00	11/30
19.00	14/30
20.00	14/30
21.00	18/30
22.00	30/30
23.00	33/30
24.00	29/30
25.00	28/30
26.00	35/30
27.00	32/30
28.00	37/30
29.00	27/30
30.00	44/30
31.00	

SAMPLING

SAMPLE (Type & No.)	DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)
P-1	1.00			
W-1	1.45			
P-2	2.00			
	2.45			
P-3	3.00			
	3.45			
P-4	4.00			
	4.45			
P-5	5.00			
	5.45			
P-6	6.00			
	6.45			
P-7	7.00			
	7.45			
P-8	8.00			
	8.45			
P-9	9.00			
	9.45			
P-10	10.00			
	10.45			
P-11	11.00			
	11.45			
P-12	12.00			
	12.45			
P-13	13.00			
	13.45			
P-14	14.00			
	14.45			
P-15	15.00			
	15.45			
P-16	16.00			
	16.45			
P-17	17.00			
	17.45			
P-18	18.00			
	18.45			
P-19	19.00			
	19.45			
P-20	20.00			
	20.45			
P-21	21.00			
	21.45			
P-22	22.00			
	22.45			
P-23	23.00			
	23.45			
P-24	24.00			
	24.45			
P-25	25.00			
	25.45			
P-26	26.00			
	26.45			
P-27	27.00			
	27.45			
P-28	28.00			
	28.45			
P-29	29.00			
	29.45			
P-30	30.00			
	30.45			

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
- T-1 Undisturbed Sample (Piston sampler)
- D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test
VS Vane Shear Test
PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

Remarks

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BORE HOLE No. **BH-01**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 2 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : -0.14m (Sep level ; 6.86m)

COORDINATE : E 276291.996 ; N 1925472.229 DEPTH : 65.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : Full

DATE : 11.11.2017 ~ 24.11.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
31												31.00	31/30		P-31	31.00				31
																31.45				
32									14.11.17 32.00			32.00	28/30		P-32	32.00				32
																32.45				
33												33.00	50/23		P-33	33.00				33
																33.38				
34												34.00	29/30		P-34	34.00				34
																34.45				
35												35.00	50/28		P-35	35.00				35
																35.43				
36												36.00	50/11		P-36	36.00				36
																36.26				
37												37.00	50/25		P-37	37.00				37
																37.40				
38									15.11.17 38.00			38.00	33/30		P-38	38.00				38
																38.45				
39												39.00	27/30		P-39	39.00				39
																39.45				
40												40.00	30/30		P-40	40.00				40
																40.45				
41												41.00	24/30		P-41	41.00				41
																41.45				
42												42.00	31/30		P-42	42.00				42
																42.45				
43												43.00	28/30		P-43	43.00				43
																43.45				
44												44.00	26/30		P-44	44.00				44
																44.45				
45	-45.14	45.00	17.00		reddish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, reddish brown, moist, low to medium plastic Clayey SAND with trace of fine to medium gravel				45.00	26/30		P-45	45.00				45
																45.45				
46					light gray to reddish brown	Very stiff to hard	Sandy CLAY	Very stiff to hard, light gray to reddish brown, moist, fine grained, low to medium plasticity, CLAY with fine to medium grained lateritic gravel	16.11.17 46.00			46.00	42/30		P-46	46.00				46
																46.45				
47												47.00	40/30		P-47	47.00				47
																47.45				
48												48.00	37/30		P-48	48.00				48
																48.45				
49								GL-(58.00 & 59.00)m; fine to medium lateritic gravel percent increased at that depths				49.00	33/30		P-49	49.00				49
																49.45				
50												50.00	50/26		P-50	50.00				50
																50.41				
51									17.11.17 51.00			51.00	33/30		P-51	51.00				51
																51.45				
52												52.00	50/23		P-52	52.00				52
																52.38				
53												53.00	26/30		P-53	53.00				53
																53.45				
54												54.00	27/30		P-54	54.00				54
																54.45				
55												55.00	23/30		P-55	55.00				55
																55.45				
56									18.11.17 56.00			56.00	29/30		P-56	56.00				56
																56.45				
57												57.00	23/30		P-57	57.00				57
																57.45				
58												58.00	50/23		P-58	58.00				58
																58.38				
59												59.00	50/30		P-59	59.00				59
																59.45				
60									22.11.17 60.00			60.00	31/30		P-60	60.00				60
																60.45				
61												61.00								61

Continue to next sheet

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
- T-1 Undisturbed Sample (Piston sampler)
- D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test

VS Vane Shear Test

PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Remarks

BORE HOLE No. **BH-01**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 3 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : -0.14m (Sep level ; 6.86m)

COORDINATE : E 276291.996 ; N 1925472.229 DEPTH : 65.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : Full

DATE : 11.11.2017 ~ 24.11.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
61					light gray to reddish brown	Very stiff to hard	Sandy CLAY	Very stiff to hard, light gray to reddish brown, moist, fine grained, low to medium plasticity, CLAY with fine to medium grained lateritic gravel				61.00	24/30		P-61	61.00				61
62									23.11.17 62.00			62.00	35/30		P-62	61.45 62.00				62
63								GL-(58.00 & 59.00)m; fine to medium lateritic gravel percent increased at that depths				63.00	46/30		P-63	62.45 63.00				63
64												64.00	40/30		P-64	63.45 64.00				64
65	-65.59	65.45	20.45						24.11.17 65.00			65.00	41/30		P-65	64.45 65.00				65
66								This borehole is terminated at GL-65.00m, according to the termination criteria.				65.45 66.00								66
67												67.00								67
68												68.00								68
69												69.00								69
70												70.00								70
71												71.00								71
72												72.00								72
73												73.00								73
74												74.00								74
75												75.00								75
76												76.00								76
77												77.00								77
78												78.00								78
79												79.00								79
80												80.00								80
81												81.00								81
82												82.00								82
83												83.00								83
84												84.00								84
85												85.00								85
86												86.00								86
87												87.00								87
88												88.00								88
89												89.00								89
90												90.00								90
91												91.00								91

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

P-1	Disturbed sample (SPT sample)	PBT	Permeability Test
T-1	Undisturbed Sample (Piston sampler)	VS	Vane Shear Test
D-1	Undisturbed Sample (Denison sampler)	PMT	Pressuremeter Test
	Rock core sample (Single core tube)		
	Rock core sample (Double core tube)		
	Rock core sample (Core Loss)		
W-1	Water sample		

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Remarks

BORE HOLE No. **BH-02**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 1 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 0.21m (Sep level ; 5.71m)

COORDINATE : E 275847.708 ; N 1925404.325 DEPTH : 65.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : Full

DATE : 27.11.2017 ~ 2.12.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW / N-Value (Blows / 30cm)	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
1					gray	Very soft to firm	Clayey SILT	Very soft to soft, gray, moist, low to medium plasticity, Clayey SILT	27.11.17 1.00	1.00 Ø112		1.00	1/30		P-1 W-1	1.00 1.45				1
2												2.00	1/30		P-2	2.00 2.45				2
3												3.00	1/30		P-3	3.00 3.45				3
4												4.00	1/30		P-4	4.00 4.45				4
5												5.00	1/30		P-5	5.00 5.45				5
6												6.00	1/30		P-6	6.00 6.45				6
7												7.00	3/30		P-7	7.00 7.45				7
8												8.00	2/30		P-8	8.00 8.45				8
9												9.00	2/30		P-9	9.00 9.45				9
10												10.00	3/30		P-10	10.00 10.45				10
11												11.00	5/30		P-11	11.00 11.45				11
12												12.00	3/30		P-12	12.00 12.45				12
13												13.00	4/30		P-13	13.00 13.45				13
14	-13.79	14.00	14.00									14.00	6/30		P-14	14.00 14.45				14
15					gray	Very loose to medium dense	Silty SAND	Very loose to medium dense, gray, wet to moist, fine to medium grained, Silty SAND with trace of clay				15.00	10/30		P-15	15.00 15.45				15
16												16.00	5/30		P-16	16.00 16.45				16
17												17.00	4/30		P-17	17.00 17.45				17
18												18.00	16/30		P-18	18.00 18.45				18
19												19.00	16/30		P-19	19.00 19.45				19
20												20.00	14/30		P-20	20.00 20.45				20
21												21.00	10/30		P-21	21.00 21.45				21
22									28.11.17 22.00			22.00	15/30		P-22	22.00 22.45				22
23												23.00	17/30		P-23	23.00 23.45				23
24												24.00	17/30		P-24	24.00 24.45				24
25	-24.79	25.00	11.00									25.00	23/30		P-25	25.00 25.45				25
26					reddish brown to light gray	Very stiff to hard	Sandy CLAY	Very stiff to hard, reddish brown to light gray, moist, low to medium plasticity, Sandy CLAY with trace of fine gravel				26.00	34/30		P-26	26.00 26.45				26
27												27.00	23/30		P-27	27.00 27.45				27
28												28.00	22/30		P-28	28.00 28.45				28
29												29.00	26/30		P-29	29.00 29.45				29
30												30.00	22/30		P-30	30.00 30.45				30
31												31.00								31

Continue to next sheet

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

P-1	Disturbed sample (SPT sample)	PBT	Permeability Test
T-1	Undisturbed Sample (Piston sampler)	VS	Vane Shear Test
D-1	Undisturbed Sample (Denison sampler)	PMT	Pressuremeter Test
	Rock core sample (Single core tube)		
	Rock core sample (Double core tube)		
	Rock core sample (Core Loss)		
W-1	Water sample		

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

Remarks

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BORE HOLE No. **BH-02**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 2 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 0.21m (Sep level ; 5.71m)

COORDINATE : E 275847.708 ; N 1925404.325 DEPTH : 65.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : Full

DATE : 27.11.2017 ~ 2.12.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
31					reddish brown to light gray	Very stiff to hard	Sandy CLAY	Very stiff to hard, reddish brown to light gray, moist, low to medium plasticity, Sandy CLAY with trace of fine gravel				31.00	15/30		P-31	31.00 31.45				31
32												32.00	24/30		P-32	32.00 32.45				32
33												33.00	23/30		P-33	33.00 33.45				33
34												34.00	27/30		P-34	34.00 34.45				34
35												35.00	28/30		P-35	35.00 35.45				35
36									29.11.17 36.00			36.00	27/30		P-36	36.00 36.45				36
37												37.00	42/30		P-37	37.00 37.45				37
38												38.00	34/30		P-38	38.00 38.45				38
39	-38.79	39.00	14.00									39.00	33/30		P-39	39.00 39.45				39
40					reddish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, reddish brown, moist, low to medium plastic Clayey SAND with trace of fine to medium gravel				40.00	22/30		P-40	40.00 40.45				40
41												41.00	29/30		P-41	41.00 41.45				41
42												42.00	21/30		P-42	42.00 42.45				42
43												43.00	18/30		P-43	43.00 43.45				43
44												44.00	32/30		P-44	44.00 44.45				44
45												45.00	22/30		P-45	45.00 45.45				45
46									30.11.17 46.00			46.00	44/30		P-46	46.00 46.45				46
47												47.00	50/30		P-47	47.00 47.45				47
48												48.00	50/30		P-48	48.00 48.45				48
49												49.00	50/30		P-49	49.00 49.45				49
50												50.00	45/30		P-50	50.00 50.45				50
51	-50.71	51.00	12.00									51.00	35/30		P-51	51.00 51.45				51
52					gray	Very stiff to hard	CLAY	Very stiff to hard, gray, moist, low to medium plasticity, CLAY with with silt and trace of fine gravel GL-(61.00 & 62.00)m; medium dense to dense, gray, moist, fine grained, low plastic clayey SAND layer observed as intercalated layer at that depths				52.00	43/30		P-52	52.00 52.45				52
53												53.00	23/30		P-53	53.00 53.45				53
54												54.00	45/30		P-54	54.00 54.45				54
55												55.00	23/30		P-55	55.00 55.45				55
56									1.12.17 56.00			56.00	50/30		P-56	56.00 56.45				56
57												57.00	32/30		P-57	57.00 57.45				57
58												58.00	26/30		P-58	58.00 58.45				58
59												59.00	26/30		P-59	59.00 59.45				59
60												60.00	19/30		P-60	60.00 60.45				60
61												61.00								61

Continue to next sheet

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
- T-1 Undisturbed Sample (Piston sampler)
- D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test

VS Vane Shear Test

PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Revision No.	Rev: 01
Revision Date	28.12.2017

Remarks

BORE HOLE No. **BH-02**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 3 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 0.21m (Sep level ; 5.71m)

COORDINATE : E 275847.708 ; N 1925404.325 DEPTH : 65.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : Full

DATE : 27.11.2017 ~ 2.12.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW / N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
61												61.00	19/30		P-61	61.00				61
																61.45				
62												62.00	50/18		P-62	62.00				62
																62.33				
63												63.00	32/30		P-63	63.00				63
																63.45				
64												64.00	36/30		P-64	64.00				64
																64.45				
65	-65.16	65.37	14.37		gray	Very stiff to hard	CLAY	Very stiff to hard, gray, moist, low to medium plasticity, CLAY with with silt and trace of fine gravel GL-(61.00 & 62.00)m; medium dense to dense, gray, moist, fine grained, low plastic clayey SAND layer observed as intercalated layer at that depths	2.12.17 65.00			65.00	50/22		P-65	65.00 65.37				65
66								This borehole is terminated at GL-65.00m, according to the termination criteria.				66.00								66
67												67.00								67
68												68.00								68
69												69.00								69
70												70.00								70
71												71.00								71
72												72.00								72
73												73.00								73
74												74.00								74
75												75.00								75
76												76.00								76
77												77.00								77
78												78.00								78
79												79.00								79
80												80.00								80
81												81.00								81
82												82.00								82
83												83.00								83
84												84.00								84
85												85.00								85
86												86.00								86
87												87.00								87
88												88.00								88
89												89.00								89
90												90.00								90
91												91.00								91

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

P-1	Disturbed sample (SPT sample)	PBT	Permeability Test
T-1	Undisturbed Sample (Piston sampler)	VS	Vane Shear Test
D-1	Undisturbed Sample (Denison sampler)	PMT	Pressuremeter Test
	Rock core sample (Single core tube)		
	Rock core sample (Double core tube)		
	Rock core sample (Core Loss)		
W-1	Water sample		

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Remarks

BORE HOLE No. **BH-03**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 1 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 5.64m

COORDINATE : E 275374.097 ; N 1925329.905 DEPTH : 64.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : 1.50m

DATE : 14.11.2017 ~ 22.11.2017

CLIENT

Japan International Cooperation Agency(JICA)

ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)
0.64	5.00	5.00	brownish gray	Firm to stiff	Clayey SILT	Firm to stiff, brownish gray, moist, low to medium plasticity, Clayey SILT		5.00 Ø112	▽
			brownish gray to gray	Loose to dense	Silty SAND	Loose to dense, brownish gray to gray, moist to wet, fine to medium grained, Silty SAND with trace of Clay	14.11.17 18.00		
23.36	29.00	29.00	mottled gray and yellowish brown	Medium dense	Clayey SAND	Medium dense, mottled gray and yellowish brown, moist, low to medium plastic Clayey SAND with trace of fine to medium gravel	15.11.17 30.00		

Continue to next sheet

STANDARD PENETRATION TEST
TEST METHOD (ASTM)

DEPTH GL - (m)	N-Value (Blows / 30cm)
1.00	6/30
2.00	9/30
3.00	12/30
4.00	5/30
5.00	8/30
6.00	7/30
7.00	13/30
8.00	6/30
9.00	5/30
10.00	6/30
11.00	14/30
12.00	14/30
13.00	14/30
14.00	28/30
15.00	30/30
16.00	37/30
17.00	37/30
18.00	47/30
19.00	50/30
20.00	40/30
21.00	40/30
22.00	23/30
23.00	27/30
24.00	26/30
25.00	29/30
26.00	30/30
27.00	33/30
28.00	37/30
29.00	24/30
30.00	22/30

CURVE OF BLOW ●

N-Value (Blows / 30cm)

0 10 20 30 40 50

SAMPLING

SAMPLE (Type & No.)	DEPTH GL - (m)
P-1	1.00 – 1.45
P-2 (W-1)	2.00 – 2.45
P-3	3.00 – 3.45
P-4	4.00 – 4.45
P-5	5.00 – 5.45
P-6	6.00 – 6.45
P-7	7.00 – 7.45
P-8	8.00 – 8.45
P-9	9.00 – 9.45
P-10	10.00 – 10.45
P-11	11.00 – 11.45
P-12	12.00 – 12.45
P-13	13.00 – 13.45
P-14	14.00 – 14.45
P-15	15.00 – 15.45
P-16	16.00 – 16.45
P-17	17.00 – 17.45
P-18	18.00 – 18.45
P-19	19.00 – 19.45
P-20	20.00 – 20.45
P-21	21.00 – 21.45
P-22	22.00 – 22.45
P-23	23.00 – 23.45
P-24	24.00 – 24.45
P-25	25.00 – 25.45
P-26	26.00 – 26.45
P-27	27.00 – 27.45
P-28	28.00 – 28.45
P-29	29.00 – 29.45
P-30	30.00 – 30.45

TCR (%) | SCR (%) | RQD (%)

SCALE (m) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
- T-1 Undisturbed Sample (Piston sampler)
- D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test
VS Vane Shear Test
PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Remarks

BORE HOLE No. **BH-03**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 2 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 5.64m

COORDINATE : E 275374.097 ; N 1925329.905 DEPTH : 64.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : 1.50m

DATE : 14.11.2017 ~ 22.11.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
31					mottled gray and yellowish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, reddish brown, moist, low to medium plastic Clayey SAND with trace of fine to medium gravel				31.00	21/30		P-31	31.00 - 31.45				31
32												32.00	15/30		P-32	32.00 - 32.45				32
33												33.00	28/30		P-33	33.00 - 33.45				33
34												34.00	21/30		P-34	34.00 - 34.45				34
35												35.00	28/30		P-35	35.00 - 35.45				35
36												36.00	26/30		P-36	36.00 - 36.45				36
37	-31.36	37.00	8.00									37.00	14/30		P-37	37.00 - 37.45				37
38					yellowish brown	Medium dense	Silty SAND	Medium dense, yellowish brown, moist, fine to medium grained, Silty SAND				38.00	26/30		P-38	38.00 - 38.45				38
39												39.00	30/30		P-39	39.00 - 39.45				39
40	-34.36	40.00	3.00						16.11.17 40.00			40.00	22/30		P-40	40.00 - 40.45				40
41					red mottled light	Very stiff to hard	Sandy CLAY	Very stiff to hard, red mottled light gray, moist, medium to high plasticity, Sandy CLAY with trace of lateritic fine gravel				41.00	21/30		P-41	41.00 - 41.45				41
42												42.00	31/30		P-42	42.00 - 42.45				42
43												43.00	25/30		P-43	43.00 - 43.45				43
44								GL- (41 m to 44.45)m, fine to medium gravel, Clayey SAND				44.00	34/30		P-44	44.00 - 44.45				44
45												45.00	31/30		P-45	45.00 - 45.45				45
46								GL- (52 m to 54.45)m, dense, fine to medium grained, moist, SAND, with trace of gravel				46.00	31/30		P-46	46.00 - 46.45				46
47												47.00	46/30		P-47	47.00 - 47.45				47
48	-42.36	48.00	8.00									48.00	28/30		P-48	48.00 - 48.45				48
49					mottled gray and reddish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, mottled gray and reddish brown, moist, fine to medium grained, low plastic Clayey SAND with fine to medium gravel	17.11.17 49.00			49.00	38/30		P-49	49.00 - 49.45				49
50												50.00	27/30		P-50	50.00 - 50.45				50
51												51.00	23/30		P-51	51.00 - 51.45				51
52												52.00	34/30		P-52	52.00 - 52.45				52
53												53.00	30/30		P-53	53.00 - 53.45				53
54												54.00	27/30		P-54	54.00 - 54.45				54
55												55.00	50/28		P-55	55.00 - 55.43				55
56									18.11.17 56.00			56.00	50/29		P-56	56.00 - 56.44				56
57												57.00	29/30		P-57	57.00 - 57.45				57
58												58.00	40/30		P-58	58.00 - 58.45				58
59												59.00	29/30		P-59	59.00 - 59.45				59
60									21.11.17 60.00			60.00	50/15		P-60	60.00 - 60.30				60
61								Continue to next sheet				61.00								61

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
- T-1 Undisturbed Sample (Piston sampler)
- D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test

VS Vane Shear Test

PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Remarks

BORE HOLE No. **BH-03**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 3 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 5.64m

COORDINATE : E 275374.097 ; N 1925329.905 DEPTH : 64.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : 1.50m

DATE : 14.11.2017 ~ 22.11.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW / N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
61					mottled gray and reddish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, mottled gray and reddish brown, moist, fine to medium grained, low plastic Clayey SAND with fine to medium gravel				61.00	50/30		P-61	61.00 – 61.45				61
62												62.00	50/15		P-62	62.00 – 62.30				62
63												63.00	50/25		P-63	63.00 – 63.40				63
64	-58.78	64.42	16.42						22.11.17 / 64.00			64.00	50/27		P-64	64.00 – 64.42				64
65								This borehole is terminated at GL-64.00m, according to the termination criteria.				65.00								65
66												66.00								66
67												67.00								67
68												68.00								68
69												69.00								69
70												70.00								70
71												71.00								71
72												72.00								72
73												73.00								73
74												74.00								74
75												75.00								75
76												76.00								76
77												77.00								77
78												78.00								78
79												79.00								79
80												80.00								80
81												81.00								81
82												82.00								82
83												83.00								83
84												84.00								84
85												85.00								85
86												86.00								86
87												87.00								87
88												88.00								88
89												89.00								89
90												90.00								90
91												91.00								91

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
- T-1 Undisturbed Sample (Piston sampler)
- D-1 Undisturbed Sample (Denison sampler)
- Rock core sample (Single core tube)
- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test

VS Vane Shear Test

PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Revision No.	Rev: 01
Revision Date	28.12.2017

Remarks

BORE HOLE No. **BH-04**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 1 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 18.19m

COORDINATE : E 276878.949 ; N 1925554.997 DEPTH : 61.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : 11.5m

DATE : 27.11.2017 ~ 2.12.2017

CLIENT

Japan International Cooperation Agency(JICA)

ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION
12.90	6.00	6.00	mottled gray and reddish brown	Medium dense to very dense	Clayey SAND	Medium dense to very dense, mottled gray and reddish brown, moist, fine to medium grained, low plastic Clayey SAND with trace of fine to medium grained latertic gravel
-1.81	20.00	14.00	mottled gray and reddish brown	Stiff to very stiff	CLAY	Stiff to very stiff, mottled gray and reddish brown, medium to high plasticity, CLAY with silt and trace of fine grined sand
			reddish brown to light gray	Very stiff to hard	CLAY	Very stiff to hard, reddish brown to light gray, moist, medium to high plasticity, CLAY with trace of fine gravel and silt GL-(22.00 ~ 22.45)m; medium dense, brownish yellow, moist low plasticity, Clayey SAND layer is observed as intercalated layer at that depth

Continue to next sheet

DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)
	2.00 Ø112	
21.11.17 12.00		▽
28.11.17 26.00		
29.11.17 30.00		

STANDARD PENETRATION TEST
TEST METHOD (ASTM)

DEPTH GL - (m)	N-Value (Blows / 30cm)
1.00	13/30
2.00	50/25
3.00	21/30
4.00	16/30
5.00	17/30
6.00	13/30
7.00	13/30
8.00	
9.00	13/30
10.00	
11.00	21/30
12.00	23/30
13.00	27/30
14.00	19/30
15.00	19/30
16.00	24/30
17.00	24/30
18.00	22/30
19.00	26/30
20.00	18/30
21.00	16/30
22.00	28/30
23.00	34/30
24.00	29/30
25.00	29/30
26.00	28/30
27.00	36/30
28.00	38/30
29.00	38/30
30.00	28/30
31.00	

CURVE OF BLOW ●

N-Value (Blows / 30cm)

0 10 20 30 40 50

SAMPLING

SAMPLE (Type & No.)	DEPTH GL - (m)
P-1	1.00
	1.45
P-2	2.00
	2.40
P-3	3.00
	3.45
P-4	4.00
	4.45
P-5	5.00
P-6	6.00
P-7	7.00
	7.45
D-1	8.00~8.35 (35) cm
P-8	9.00
	9.45
D-2	10.00 (80/30) cm
	10.80
P-9	11.00
	11.45
P-10	12.00
W-1	12.45
P-11	13.00
	13.45
P-12	14.00
	14.45
P-13	15.00
	15.45
P-14	16.00
	16.45
P-15	17.00
	17.45
P-16	18.00
	18.45
P-17	19.00
	19.45
P-18	20.00
	20.45
P-19	21.00
	21.45
P-20	22.00
	22.45
P-21	23.00
	23.45
P-22	24.00
	24.45
P-23	25.00
	25.45
P-24	26.00
	26.45
P-25	27.00
	27.45
P-26	28.00
	28.45
P-27	29.00
	29.45
P-28	30.00
	30.45

TCR (%) | SCR (%) | RQD (%)

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

- P-1 Disturbed sample (SPT sample)
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- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test
VS Vane Shear Test
PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

Remarks

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BORE HOLE No. **BH-04**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 2 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 18.19m

COORDINATE : E 276878.949 ; N 1925554.997 DEPTH : 61.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : 11.5m

DATE : 27.11.2017 ~ 2.12.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION
31 ~ 35	-16.81	35.00	15.00		reddish brown to light gray	Very stiff to hard	CLAY	Very stiff to hard, reddish brown to light gray, moist, medium to high plasticity, CLAY with trace of fine gravel and silt GL-(22.00 ~ 22.45)m; medium dense, brownish yellow, moist low plasticity, Clayey SAND layer is observed as intercalated layer at that depth
36 ~ 48	-29.81	48.00	13.00		mottled gray and reddish brown	Medium dense to dense	Clayey SAND with gravel	Medium dense to dense , mottled gray and reddish brown, moist, fine graied, low plasticity, Clayey SAND with fine to medium gravel
49 ~ 56	-37.81	56.00	8.00		mottled gray and yellowish brown	Very stiff to hard	Sandy CLAY	Very stiff to hard, mottled gray and yellowish brown, moist, fine grained, low to medium plasticity, Sandy CLAY with trace of fine gravel
57 ~ 61					mottled gray and yellowish brown to light gray	Medium dense to very dense	Clayey SAND with gravel	Medium dense to very dense , mottled and yellowish brown to ligh gray, moist, fine grained, low plastic Clayey SAND with fine to medium gravel

Continue to next sheet

DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)
30.11.17 43.00		
1.12.17 54.00		

STANDARD PENETRATION TEST
TEST METHOD (ASTM)

DEPTH GL - (m)	N-Value (Blows / 30cm)
31.00	28/30
32.00	41/30
33.00	32/30
34.00	29/30
35.00	27/30
36.00	28/30
37.00	16/30
38.00	41/30
39.00	44/30
40.00	24/30
41.00	46/30
42.00	30/30
43.00	33/30
44.00	27/30
45.00	26/30
46.00	37/30
47.00	50/30
48.00	29/30
49.00	28/30
50.00	32/30
51.00	21/30
52.00	23/30
53.00	27/30
54.00	31/30
55.00	33/30
56.00	27/30
57.00	50/30
58.00	24/30
59.00	50/28
60.00	50/15
61.00	

CURVE OF BLOW ●

N-Value (Blows / 30cm)

0 10 20 30 40 50

SAMPLING

SAMPLE (Type & No.)	DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)
P-29	31.00 - 31.45			
P-30	32.00 - 32.45			
P-31	33.00 - 33.45			
P-32	34.00 - 34.45			
P-33	35.00 - 35.45			
P-34	36.00 - 36.45			
P-35	37.00 - 37.45			
P-36	38.00 - 38.45			
P-37	39.00 - 39.45			
P-38	40.00 - 40.45			
P-39	41.00 - 41.45			
P-40	42.00 - 42.45			
P-41	43.00 - 43.45			
P-42	44.00 - 44.45			
P-43	45.00 - 45.45			
P-44	46.00 - 46.45			
P-45	47.00 - 47.45			
P-46	48.00 - 48.45			
P-47	49.00 - 49.45			
P-48	50.00 - 50.45			
P-49	51.00 - 51.45			
P-50	52.00 - 52.45			
P-51	53.00 - 53.45			
P-52	54.00 - 54.45			
P-53	55.00 - 55.45			
P-54	56.00 - 56.45			
P-55	57.00 - 57.45			
P-56	58.00 - 58.45			
P-57	59.00 - 59.43			
P-58	60.00 - 60.30			

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
		Hard	over 30

Sample key

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- Rock core sample (Double core tube)
- Rock core sample (Core Loss)
- W-1 Water sample

PBT Permeability Test
VS Vane Shear Test
PMT Pressuremeter Test

RQD (%)	Term
0 - 25	Very poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
Very thick	> 2000
Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

Term	Spacing (mm)
Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	< 20

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Remarks

BORE HOLE No. **BH-04**

BORING LOG

Job No. FKYB-2017-004

Sheet No. 3 OF 3

PROJECT NAME : East - West Economic Corridor Improvement Project (Phase - II)

LOCATION : Nearly Supanu Village , Mon State

GROUND LEVEL : 18.19m

COORDINATE : E 276878.949 ; N 1925554.997 DEPTH : 61.00m

BORING EQUIPMENT : TOHO "D1"

BORING METHOD : Rotary Direct Circulation

ORIENTATION : Vertical

GROUND WATER LEVEL : 11.5m

DATE : 27.11.2017 ~ 2.12.2017

CLIENT

Japan International Cooperation Agency(JICA)

SCALE (m)	ELEVATION (m)	DEPTH GL - (m)	THICKNESS (m)	DIAGRAM	COLOUR	RELATIVE DENSITY (or) CONSISTENCY	SOIL NAME	SOIL DESCRIPTION	DATE & DEPTH (m)	CASING (DEPTH (m) & DIAMETER (mm))	WATER DEPTH (m)	STANDARD PENETRATION TEST TEST METHOD (ASTM) DEPTH GL - (m)	N-Value (Blows / 30cm)	CURVE OF BLOW / N-Value (Blows / 30cm) 0 10 20 30 40 50	SAMPLING SAMPLE (Type & No.)	SAMPLING DEPTH GL - (m)	TCR (%)	SCR (%)	RQD (%)	SCALE (m)
61	-42.81	61.00	5.00						2.12.17			61.00	40/15		P-59	61.00				61
	-43.31	61.30	0.30		light gray	Hard	CLAY	Hard, light gray mottled with reddish brown, moist, intermediate to high plasticity, CLAY	61.00							61.30				
62								This borehole is terminated at GL-61.00 m, according to the termination criteria.				62.00								62
63												63.00								63
64												64.00								64
65												65.00								65
66												66.00								66
67												67.00								67
68												68.00								68
69												69.00								69
70												70.00								70
71												71.00								71
72												72.00								72
73												73.00								73
74												74.00								74
75												75.00								75
76												76.00								76
77												77.00								77
78												78.00								78
79												79.00								79
80												80.00								80
81												81.00								81
82												82.00								82
83												83.00								83
84												84.00								84
85												85.00								85
86												86.00								86
87												87.00								87
88												88.00								88
89												89.00								89
90												90.00								90
91												91.00								91

NOTES

Relative density description		Consistency description	
Relative density	SPT N-Value (meas)	Consistency	SPT N-Value (meas)
Very loose	0 - 4	Very soft	under 2
Loose	4 - 10	Soft	2 - 4
Medium dense	10 - 30	Firm	5 - 8
Dense	30 - 50	Stiff	9 - 15
Very dense	over 50	Very stiff	16 - 30
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VS Vane Shear Test

PMT Pressuremeter Test

RQD (%)	Term
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25 - 50	Poor
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75 - 90	Good
90 - 100	Excellent

Planner structure

Term	Spacing (mm)
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Thick	600 - 2000
Medium	200 - 600
Thin	60 - 200
Very thin	20 - 60
Thickly laminated	6 - 20
Thinly laminated	< 6

Discontinuities

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Very widely spaced	> 2000
Widely spaced	600 - 2000
Medium spaced	200 - 600
Closely spaced	60 - 200
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Remarks

付録 - 5

EIA 報告書

The East-West Economic Corridor Improvement Project (Construction of New Sittaung Bridge)

Environmental and Social Impact Assessment

Updated 2nd version base on Review Committee held on 25th of July

(September 2019)

Ministry of Construction

Republic of the Union of Myanmar

The East-West Economic Corridor Improvement Project (New Sittaung Bridge)

Environmental and Social Impact Assessment

Updated version
base on Review Committee held on 25th of July

Table of Contents

CHAPTER 1 INTRODUCTION

1.1. Objectives and Background of the Project

The Republic of the Union of Myanmar (hereinafter referred to as "Myanmar") has been continuing high economic growth for the shift to democratization (March 2011). There is active trade with neighboring Thailand in the background. Trade between the two countries is expected to further expand in the future, but current maritime transport via the Malay Peninsula is very inefficient. As an alternative means of transportation to the sea, it is expected that the East-West Economic Corridor (hereinafter referred to as "EWEC") connecting the two countries by land will be developed early. The Thai side section of EWEC has been improved with international standard that can correspond to international logistics. On the other hand, there are many bottleneck sections that impede smooth land transportation, such as weight limitation due to aging of bridges, incorrect alignment and profile such as steep and sharp curves, passage through dense urban areas, etc. Therefore, the government of Myanmar has put the development of the route as a priority issue and has promoted improvement through the support of international organizations and Thai government.

As a result, from Thai border to Thaton and Mawlamyine section, it has been improved to a two-lane paved road corresponding to international standard, thereby domestic and international logistics are expected to be activated. Meanwhile, the issues such as traffic congestion and deterioration of safety are beginning to surface. Particularly, the traffic congestion is predicted to occur due to the mixture of regional traffic and transit traffic because the existing road passes through the urban area from Bago to Kyaikto section about 100 km from Thaton to Yangon. Therefore, in order to separate regional traffic and transit traffic to ensure safety, it is necessary to build alternative highway that can divert the traffic from urban areas in the section.

Under these circumstances, Japan International Cooperation Agency (hereinafter referred to as "JICA") and Asia Development Bank (hereinafter referred to as "ADB") cooperated to agree for the implementation of the Feasibility Study (F/S) necessary for the development of the new arterial road in this section. JICA is planning to implement F/S related to the construction of the New Sittaung Bridge (hereinafter referred to as "the Study"), and ADB is planning to implement F/S related to road from Bago to Kyaikto section, respectively. The Study is mainly concerned for the "Construction of the New Sittaung Bridge" (hereinafter referred to as "the Project"), which is the objective to implement the Project by JICA's Official Development Assistance (hereinafter referred to as "ODA") loan, and is required to assess the validity of the implementation by Japan's ODA loan cooperation project, including justification of project cost, project implementation system, and environmental and social considerations for the purpose of the construction of the New Sittaung Bridge.

1.2. Outline of the EWEC Project

The objective of the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) (hereinafter referred to as "the EWEC Project") is the development of a new arterial road of about 64.5 km connecting Bago from Kyaikto. The subject of the Study is for the New Sittaung Bridge section of about 2.5 km total length, in which JICA's loan is studied. The outline of the EWEC Project is shown in Table 1.2.1.

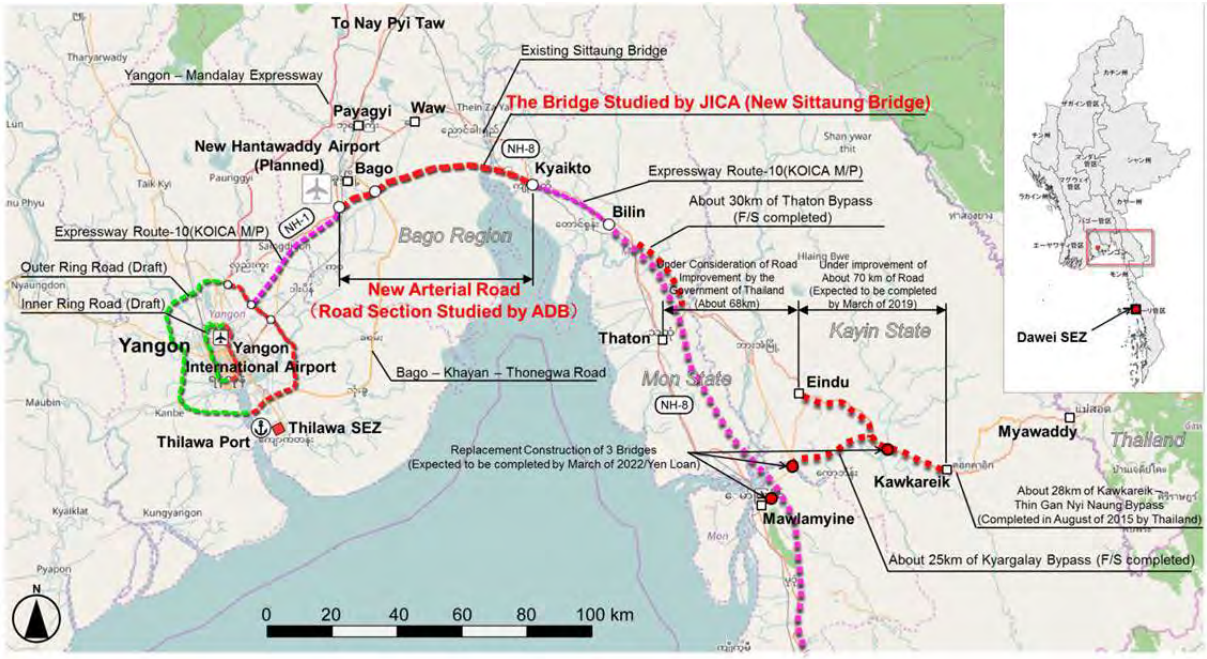
Table 1.2.1 Outline of the EWEC Project

Project Name	East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section)
Project Purpose	To improve the efficiency of international and domestic logistics by responding to the increasing traffic demand of the section by improving the new arterial road from Bago to Kyaikto section of the EWEC, thereby contributing to the vitalization of Myanmar's trade.
Project Outline	・Construction of New Sittaung Bridge (total length of 2.5 km) (study object of JICA's loan) ・Development of new arterial road (total length of 64.5 km) (study object of ADB's loan) ・Consulting service (Detailed design, tender assistance)
Project Area	Mon State and Bago Region
Related government Agency	Ministry of Construction(MOC), Department of Bridge (DOB) and Department of Highways (DOH)

Source: JICA Study Team

1.3. Project Area

The details of the EWEC Project area are shown in Figure 1.3.1.



Note) ADB road section shown in red is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.

Source: JICA Study Team

Figure 1.3.1 Project Location Map

1.4. Necessity and Objective of EIA Study for the Construction of New Sittaung Bridge

With regard to consideration of necessity of EIA, according to EIA Procedure 2015, a construction of bridge more than 2km is mandated to take process of EIA.

1.5. Related Government Ministries / Agencies

1.5.1. Responsibilities on Road and Bridges

The Project Proponent for the construction of New Sittaung Bridge is the Department of Bridge (DOB) of the Ministry of Construction (MOC) of the Government of the Republic of the Union of Myanmar. The Ministry of Construction is responsible for the country's construction and maintenance of infrastructures, including transport infrastructures such as roads and bridges.

Under Minister's Office, there are five departments namely, Department of Buildings, Department of Highways (DOH), Department of Bridge (DOB) and Department of Urban and Housing Development.

In addition to organization in the headquarters, MOC has Special Units for both road and bridge all over the country, which consists of 24 units for road and 20 units (including 4 construction units) for bridge. Actual site works for both construction and maintenance are implemented by Special Units. Therefore, MOC is working closely between headquarters and Special Units. Moreover, construction and maintenance of bridges with more than 50 feet in length (approximately 15 meters) is conveniently undertaken by Special Units under DOB. On the other hand, construction and maintenance of bridges with 50 feet of less in length is undertaken by Special Units of local offices under DOH.

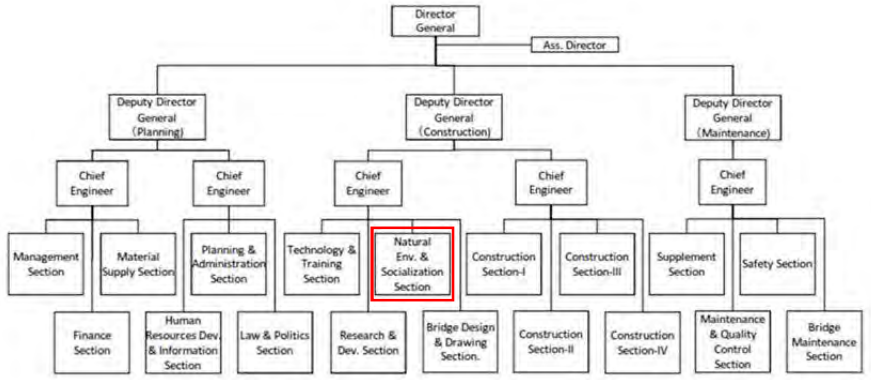
1.5.2. Tentative Schedule and Responsibilities on the Project

Relevant responsible organization(s) for the project at every stage are shown below. The table is also showing the commitment to be followed by the proponent for each project phase.

Table 1.5.1 Tentative Schedule and Relevant Responsible Organization

Stage	Schedule (as of Sep 2019)	Direct Responsible Organization	Responsible / Focal Point (following information shall be filled out during reviewing)
1.FeasibilityStage	2017-2019	-Central Department of Bridge (DOB): Planning and Design -Natural environment & Socialization Section of DOB: EIA/RAP preparation and obtaining approval (See following figure)	Department of Bridge/MOC Name: Address: Contact:
2. Construction	2021-2024	-Project Management Unit established by central DOB: Management of construction and EIA/RAP implementation	PMU (Project Management Unit) Name: Address: Contact:
3. Operation & Maintenance	2025-	-Special Unit 9 under DOB: Implementation of management and maintenance -Natural environment & Socialization Section of DOB: Natural and Social Environment	Special Unit 9 Name: Address: Contact:

Source: JICA Study Team



Source: JICA Study Team

Figure 1.5.1 Responsible Organization for Natural and Social Environment under DOB

1.6. Post-Construction and Operation

As mentioned in "1.5.2. Tentative Schedule and Responsibilities on the Project", after construction of the new Sittaung Bridge, the responsible agency for maintenance is Special Unit 9 under DOB. New Sittaung Bridge and connected Kyaikto – Bago Bypass might be expressway and it will be managed and operated by Department of Highway under MOC.

1.7. Structure of the Report

The structure of the report is as follows:

Chapter 1	Introduction
Chapter 2	Policy, Legal and Institutional Framework
Chapter 3	Project Description and Alternative Selection
Chapter 4	Description of the Surrounding Environment
Chapter 5	Screening and Scoping
Chapter 6	Impact and Risk Assessment and Mitigation Measure
Chapter 7	Cumulative Impact Assessment
Chapter 8	Environmental Management Plan
Chapter 9	Public Consultation and Disclosure
Chapter 10	Schedule toward Project Implementation
Chapter 11	Other Items and Activities to be Considered

1.8. Information of Third Party for Preparation of EIA

The EIA has prepared under DOB/MOC in cooperation with JICA Study Team and following third party and specialists.

Table 1.8.1 Third Party Members for Preparation of EIA

Name (Sur name, Given name)	Registration / License No. by ECD	Organization	Contact details	Area of expertise
Team Leader of the team U Saw Win		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Ecology, Forestry and Biodiversity

Name (Sur name, Given name)	Registration / License No. by ECD	Organization	Contact details	Area of expertise
Daw Khin May Lwin		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Water and Waste, Soil and pollution
Daw Thein Mwe Khin		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Social Impact Assessment and Social Surveys
Daw Saw Zar Chi		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Vibration, Erosion and Geology
Daw May Thu Htet		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Socio-economist
U Pyae Phyo Kyaw		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	GIS/CAD, Geology and Soil
Daw May Oo		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Field Surveyor
Daw Thae Nandar		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Field Surveyor
Daw Nyein Chan Thu		E Guard Environmental Services Co., Ltd.	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Field Surveyor
U Yan Paing Tun		E Guard Environmental Services Co., Ltd	No.11, Airport Avenue Lane, 10 miles, Pyay Road, Saw Bwar Gyi Gone Insein Township, Yangon 11011, Myanmar. Tel : +95 1 9667757, Fax : +95 1 666512	Field Surveyor

Source: JICA Study Team

CHAPTER 2 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

2.1. Laws and Regulations Regarding Environmental and Social Impact Assessment

(1) Environmental Policy, Strategy and Legal Framework

A legal system with regard to the environment is established in Myanmar. The Environmental Conservation Law, a core law to protect and enhance the environmental viability in Myanmar, was issued in March 2012. The Ministry of Natural Resources and Environmental Conservation (hereinafter referred to as "MONREC") has promulgated the Environmental Conservation Rules in 2014, and the Environmental Impact Assessment (EIA) Procedures and environmental quality standards was issued in 2015.

(2) Environmental Management Legislation

1) Environmental Conservation Law

The principal law governing environmental management in Myanmar is the Environmental Conservation Law, which was issued in March 2012. The law stipulates which government bodies are in charge of environmental conservation as well as their relevant roles and responsibilities. The law touches on water, noise, vibration and solid waste qualities, but does not provide specific standards to be met. It also mentions both environmental and social impact assessments. In the context of project development, it is important to note that the law adopts the notion of 'polluter/beneficiary pays principle' as it implies that the project promoters are responsible for covering all environmental and social costs generated by the project. The law serves as the basis for founding the Environmental Conservation Department (ECD) under MONREC. Following the Environmental Conservation Law are two legal arrangements such as Environmental Conservation Rules and EIA Procedures.

2) Environmental Conservation Rules

The Environmental Conservation Rules was promulgated in 2014 and provides a platform to bridge the Environmental Conservation Law with more specific and practical rules and guidelines including EIA Procedures and environmental quality standards.

3) EIA Procedures

Concrete steps for undertaking EIA are stipulated in the EIA Procedures. The EIA process on the laws is as follows:

a) All development projects in Myanmar are subject to an environmental screening process through which projects will be judged to determine if they require any environmental review and, if so, at which level (i.e. IEE or EIA).

b) EIA includes an environmental management plan and a social impact assessment report.

c) Public participation is required, when deemed necessary, for the Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), and preparation of an Environmental Management Plan (EMP).

d) The project's executing agency forms an EIA Review Committee, which gives recommendations to the Minister of MONREC from an environmental point of view on whether to approve the EIA reports or not. The Minister makes the final decision based on this recommendation. The review period is 60 days for IEE and 90 days for EIA.

e) Members of the EIA Review Committee will be selected by the Minister of MONREC and will

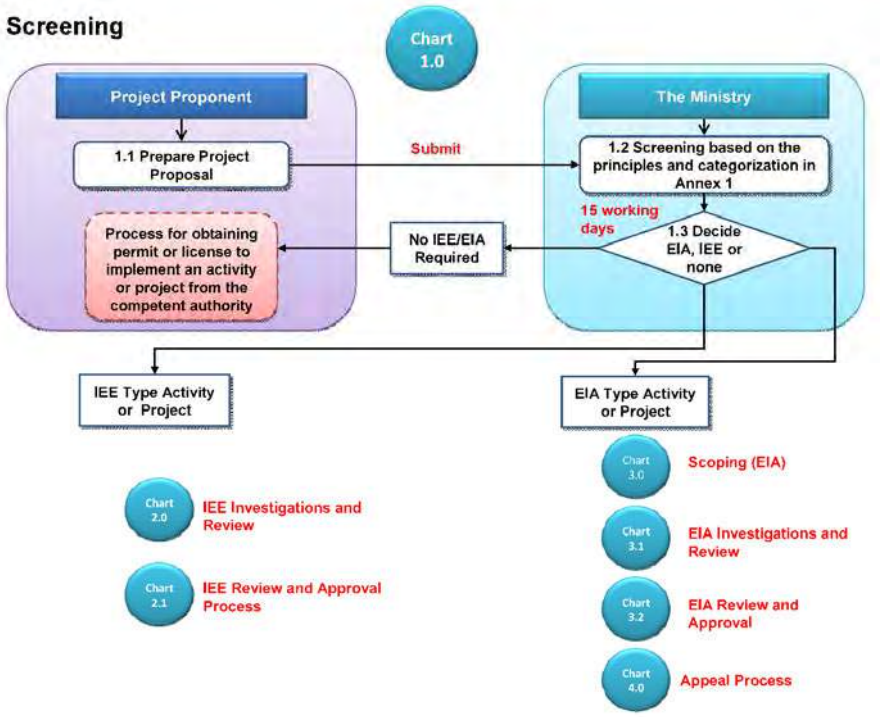
include persons from the industry, academia and civil society, as well as government officials.

f) Involuntary resettlement is carried out under the responsibility of respective regional governments and hence will not be included in the EIA Procedures.

g) Costs involved in conducting EIA are to be covered by the project proponent.

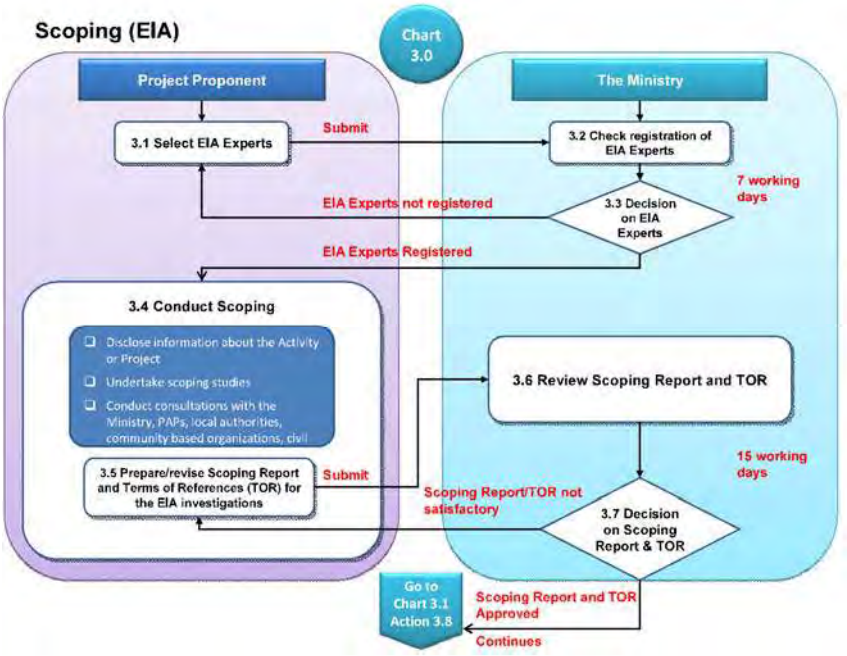
h) EIA can be carried out in Myanmar only by firms that are registered under ECD/MONREC.

The EIA approval process is shown below.



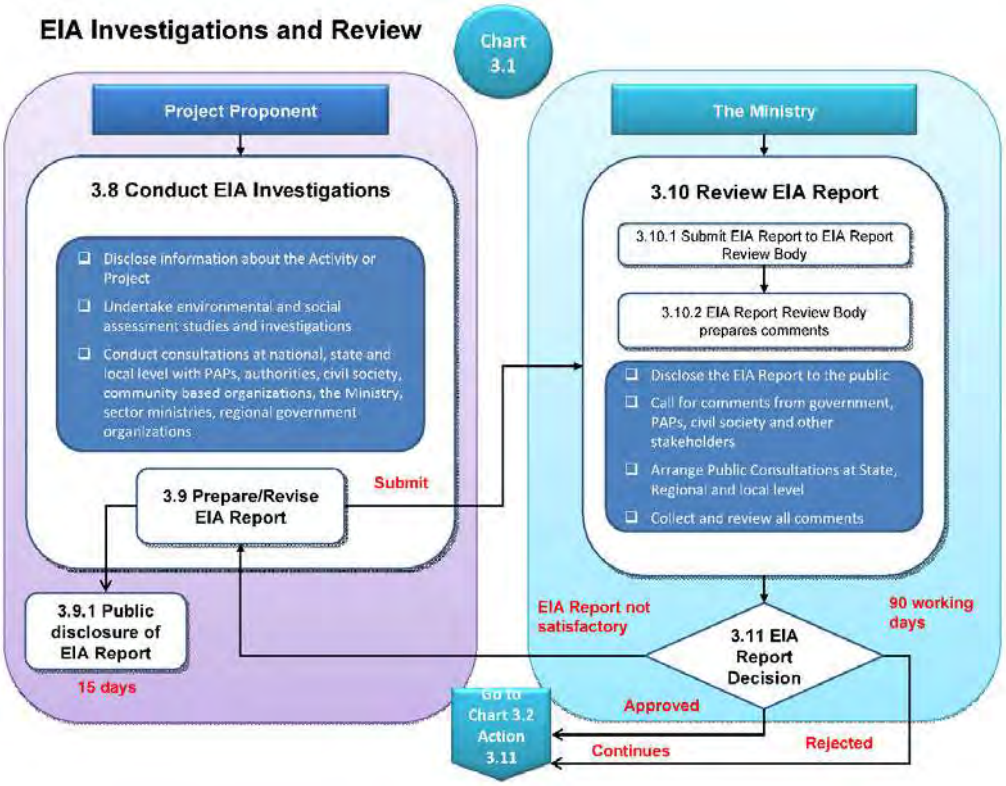
Source: EIA Procedure Law 2015 ANNEX 2 Environmental Assessment Procedure Flowchart

Figure 2.1.1 EIA Process-1 (Screening)



Source: EIA Procedure Law 2015 ANNEX 2 Environmental Assessment Procedure Flowchart

Figure 2.1.2 EIA Process-2 (Scoping)



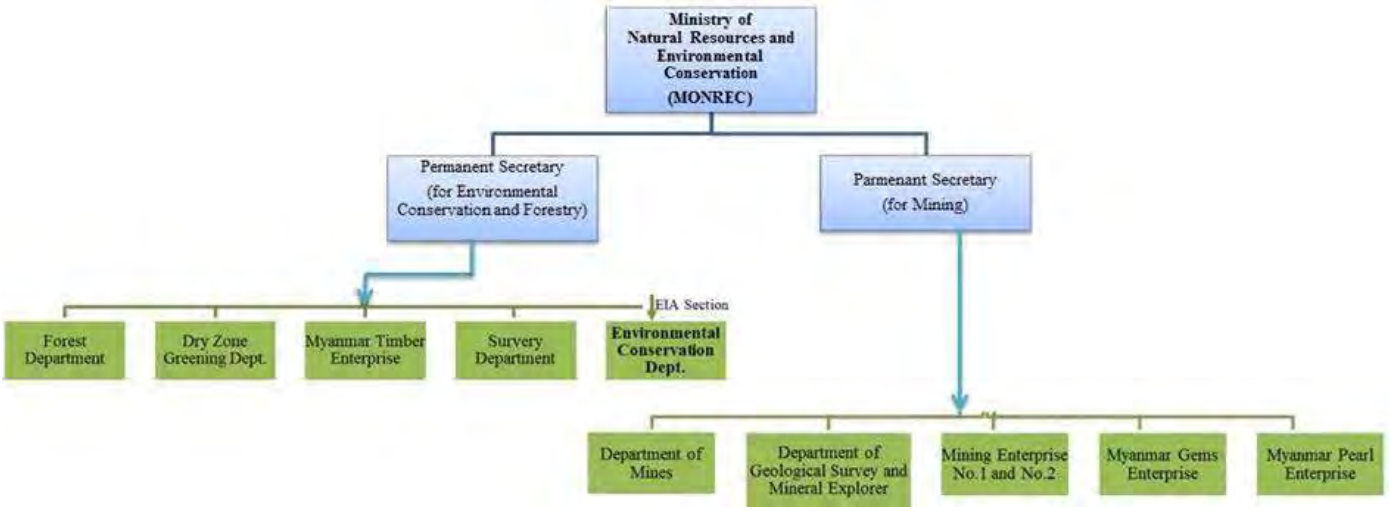
Source: EIA Procedure Law 2015 ANNEX 2 Environmental Assessment Procedure Flowchart

Figure 2.1.3 EIA Process-3 (Approval)

4) Authorized Environmental Organization

The government body with primary responsibility for ensuring and promoting soundness of the environment in Myanmar is the Ministry of Natural Resources and Environmental Conservation (MONREC).

The Environmental Conservation Department is the department responsible for managing the EIA (Environmental Impact Assessment) process as shown in Figure 2.1.4.



Source: JICA Study Team

Figure 2.1.4 Organization Chart of MONREC

(3) Laws and Regulation Regarding the Environmental Screening of the Project

1) Screening on EIA Procedure 2015

According to EIA Procedure Law 2015 as shown in Table 2.1.1, the project for the new construction of bridge longer than 2km with approach road is categorized as project requiring EIA. Additionally, bypass section is also categorized as EIA project since road length is exceeding 50km.

As mentioned in the previous article, the EWEC project is separated into two sections such as New Sittaung Bride and bypass section, and two feasibility studies, including environmental and social studies, are conducted under JICA and ADB, respectively. Thus, MOC has discussed with ECD to conduct two separate EIA(s) from the view of time saving and smooth processing of loan appraisal by the two donors stated.

As the result of discussion between MOC and ECD and screening by ECD, ECD has decided to separate two (2) EIA for the New Sittaung Bridge studied by JICA and the bypass road studied by ADB, respectively, in accordance with letter from ECD to MOC as of August 21st, 2017.

Table 2.1.1 IEE/EIA Project List for the Transportation Project on EIA Procedure Law 2015

Project Type	Criteria	
	IEE	EIA
126. Bridges, River Bridges and Viaducts (new construction)	**Length≥0.2km but <2km**	**Length≥2km**
127. Bridges, River Bridges and Viaducts (upgrading)	Length≥300m	All activities where the Ministry requires that the project shall undergo EIA
129. Expressways and Highways (ASEAN Highway Standard; new construction or widening)	**Length≥2km but <50km**	**Length≥50km**
130. Other Roads (state, region, urban; new construction or widening)	Length≥50km but <100km	Length≥100km
131. Road Improvement (upgrading from seasonal to all weather surface, widening of shoulders)	Length≥50km	All activities where the Ministry requires that the project shall undergo EIA

Source: EIA Procedure Law 2015 (ANNEX 1/Categorization of Economic Activities for Assessment Purposes)

2) Screening on JICA Guidelines

The Kyaikto-Bago Bypass project is divided into two (2) sections as ADB section (Kyaikto – Bago Bypass Road) and JICA Section (New Sittaung Bridge), and it is informed that loan processing will be done separately.

Since these two projects are recognized as one project and falls under the list of sensitive sectors and sensitive characteristics in terms of road and bridge sector and large-scale involuntary resettlement, the EWEC Project is classified as "Category A" in accordance with JICA Guidelines.

(4) Gaps Between the EIA Procedure Law 2015 in Myanmar and JICA's Guidelines

The Project is categorized as Category A. Therefore, EIA activities according to EIA rules are deemed to meet JICA's Guideline Policy as shown below.

Table 2.1.2 Gaps between JICA Guidelines, ADB Safeguard Policy and Myanmar Legislation on EIA

JICA Guideline Policy (Appendix 2. EIA Reports for Category A Projects)	ADB Safeguard Policy Statement (2009) Safeguard Requirements 1: Environment	EIA Procedure Law 2015	Gaps ● between ADB ■ between Myanmar	Policy to fill up gaps in this Study
1. When assessment procedures already exist in host countries and projects are subject to such procedures, project proponents, etc., must officially finish those procedures and obtain the approval of the government of the host country.	No description	The project is required to prepare the EIA and obtain the environmental certificates	●Implementation of EIA is mandatory, but no description about Myanmar EIA Law ■ No gaps	Follow Myanmar laws and JICA Guidelines (EIA approval shall be obtained in accordance with EIA Law 2015)
2. EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	The borrower/client will provide relevant environmental information in a timely manner, including information from the documents in para. 17, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. For illiterate people, other suitable communication methods will be used. (para18)	The EIA rules stipulate that IEE and EIA shall be written in the local language and English.	● No gaps ■ No gaps	Not required

JICA Guideline Policy (Appendix 2. EIA Reports for Category A Projects)	ADB Safeguard Policy Statement (2009) Safeguard Requirements 1: Environment	EIA Procedure Law 2015	Gaps ● between ADB ■ between Myanmar	Policy to fill up gaps in this Study
3. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders, such as local residents, and copying must be permitted.	↑ ditto (para 18) In line with ADB's Public Communications Policy, ADB is committed to working with the borrower/client to ensure that relevant information (whether positive or negative) about social and environmental safeguard issues is made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and to other stakeholders, including the general public, so they can provide meaningful inputs into project design and implementation. ADB will post the following safeguard documents on its website (main text para 53)	A public disclosure of EIA is required	● No description regarding right to take a copy of ESIA report ■ No description regarding right to take a copy of ESIA report	Follow JICA Guidelines (The right to copy shall be allowed by the Government of Myanmar)
4. In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.	Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report. (para 19)	The prescript public consultation is held with project affected persons and other relevant agencies after sufficient announcement of the meeting(s).	● No description regarding information disclosure prior to public consultation ■ No gaps	Follow JICA Guidelines (Project information shall be informed to inhabitants prior to public consultation)
5. If necessary, consultations with relevant stakeholders, such as local residents, should take place throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected and when the draft report is being prepared.	For environment category A projects, such consultations will necessarily include consultations at the early stage of EIA field work and when the draft EIA report is available during project preparation, and before project appraisal by ADB. (para 19 footnote)	The prescript public consultation is held with project affected persons and other relevant agencies such as authorities, civil society, community-based organizations, the Ministry, sector ministries, regional government organizations	● The 1st meeting is held just before EIA site survey ■ Number of meetings is not described	Follow JICA Guidelines (Meetings at scoping and draft EIA stage shall be held twice in this project)

Source: JICA Study Team (JICA Guidelines 2010 and EIA flowchart in EIA rules ECD)

(5) Other related Laws

The other related laws and regulations are shown below:

Table 2.1.3 Other Related Laws and Regulations

No.	Name of Laws and Regulations	Year
Overarching Framework		
	Constitution of the Republic of the Union of Myanmar	2008
	National Environmental Policy	1994
	National Sustainable Development Strategy	2009
Environmental Conservation		
	Environmental Conservation Law	2012
	Environmental Conservation Rules	2014
	Environmental Impact Assessment Procedure	2015
Pollution Control and Health		
	National Environmental Quality (Emission) Guidelines	2015
	Occupational Safety and Health Law (Draft)	2012
	The Factories Act	1989
	Public Health Law	1972
	The Control of Smoking and Consumption of Tobacco Product Law	2016
	The Prevention and Control of Communicable Diseases Law	1995
Biodiversity and Natural Resource Conservation		
	Preservation of Biodiversity and Protected Areas Law	2018
	The Law Relating to Aquaculture	1989
	National Biodiversity Strategy Action Plan in Myanmar	2012
	Forest Law	2018
	Conservation of Water Resources and River Law	2006
Land Acquisition and Resettlement		
	The Land Acquisition Act	1894
	Farmland Law	2012
	Farmland Rules	2012
	Vacant, Fallow, Virgin Land Management Law	2018
	Vacant, Fallow, Virgin Land Management Rules	2012
Urban Development and Management		
	Development Committee Law	2013
	Development Law of Bago Region	2016
International Binding Commitments		
	Vienna Convention for the Protection of the Ozone Layer 1988 and Montreal Protocol on Substances that Deplete the Ozone Layer	1989
	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (CMS)	1983
	Convention on Biological Diversity	1992
	Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and Their Disposal	1992
	United Nations Framework Convention on Climate Change, (UNFCCC)	1992
	Kyoto Protocol	1997
	Asia Least Cost Greenhouse Gas (GHG) Abatement Strategy	1998
	United Nations Agenda 21	1992
	Vibration Standards for Environment of International Standard Organization (ISO) Criterion of International Level	2015
	WHO Environmental Health and Safety guideline	2008
Other Related Regulations		
	Protection of the Right of National Race Law	2015
	Myanmar Investment Law	2016
	Myanmar Fire Brigade Law	2015
	Myanmar Insurance Law	1993
	Labour Organization Law	2011
	The Development of Employment and Skill Law	2013
	The Minimum Wage Law	2013
	Payment of Wages Law	2016
	The Settlement of Labor Dispute Law	2012
	The Leaves and Holiday Act	2014
	Social Security Law	2012
	The Workmen's Compensation Act	1923
	Myanmar Engineering Council Law	2014
	The Protection and Preservation of Cultural Heritage Regions Law	2015
	The Protection and Preservation of Ancient Monument Law	2015
	The Protection and Preservation of Antique Objects Law	2015
	The Motor Vehicles Law	2015
	The Motor Vehicles Rules	1987
	The Law of Relating to Petroleum and Petroleum Products Law	2017
	The Right of National Races Law	2015
	Myanmar Investment Law	2016
	Myanmar Investment Rules	2017
	Highways Law	2000
	Highways Rules	2002

No.	Name of Laws and Regulations	Year
	Settlement of Labor Disputes Law	2012
	Minimum Wages Law	2013
	Workmen Compensation Act	1923
	Leaves and Holidays Act	1951
	Myanmar Fire Force law	2015
	Conservation of Water Resources and Rivers Rules	2013
	The Law relating to Petroleum and Products of Petroleum Law	2017
	Prevention of Hazard from Chemical and Chemical Substances Law	2013
	The Administration of Vacant, Fallow and Virgin Land Law	2012
	Protection of Biodiversity and Protected Area Law	2018
	Export and Import Law,	2012
	Freshwater Fishery Law,	1991
	Myanmar Forest Policy	1995
	The Forest Law	1992
	Land Acquisition Act	1894
	Farmland Law	2012
	Farmland Rules	2012
	The Protection of Wildlife and Conservation of Natural Areas Law	1994

Source: JICA Study Team

2.2. Laws and Regulation Regarding Land Acquisition and Compensation

(1) Land Acquisition and Resettlement Laws and Regulations in Myanmar

Currently in Myanmar, there is no law comprehensively stipulating land acquisition and resettlement. The Land Acquisition Act, enacted in 1894, is still the legal basis for land acquisition in Myanmar. The Land Nationalization Act 1953, which was repealed by the Farmland Law 2012, determines nationalization of farmlands and procedures for conversion of farmlands for other purposes (La Na 39). Resettlement-related issues are depicted in some of the existing laws and regulations. However, in most cases, details such as procedures and conditions related to resettlement issues are yet to be determined. Table 2.2.1 indicates the relevant Myanmar laws and regulations for land acquisition and resettlement which are applicable to lower Myanmar where the Project Area is located.

Table 2.2.1 Relevant Laws in Myanmar

- Farmland Law, 2012
- Farmland Rules, 2012
- Vacant, Fallow and Virgin Lands Management Law, 2012
- Vacant, Fallow and Virgin Lands Management Rules, 2012
- Special Economic Zone Law, 2011
- Constitution of the Republic of the Union of Myanmar, 2008
- Forest Law, 1992
- Transfer of Immovable Property Restriction Law, 1987
- The Law Amending the Disposal of Tenancies Law, 1965
- The Lower Burma Town and Village Land Act, 1899
- Land Acquisition Act, 1894 (Amended in 1937 (Adaptation of Laws Orders), and 1940 (Burma Act 27)
- The Land and Revenue Act 1876 (Amended in 1945 (Burma Act No 12), 1946 (Burma Act No 64), and 1947 (Burma Act No 6)
- The Lower Burma Land Revenue Manual, 1876
- Development Committee Law, 1993
- Directions of Central Land Committee

Source: Prepared based on "Guidance Note on Land Issues Myanmar" UNHCR, UNHABITAT

Among these national laws, relating clauses in key laws are shown as follows:

1) Constitution of the Republic of the Union of Myanmar (2008)

37. The Union:

(a) 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;

(b) Shall enact necessary law to supervise extraction and utilization of State-owned natural resources by economic forces;

(c) Shall permit citizens the right of private property, right of inheritance, right of private initiative and patent in accordance with the law.

357. The Union shall protect the privacy and security of home, property, correspondence and other communications of citizens under the law subject to the provisions of this Constitution.

2) Land Acquisition Act (1894)

- Stipulates that the Government holds rights to take over land where the State assert that such land is needed for public purposes;
- Outlines relevant procedures of land acquisition and the method of valuation of land.

3) Farm Land Law (2012)

- Calls for suitable compensation and indemnity in the case of repossession of farmland in the interest of the Union State.

4) Farm Land Rules (2012)

- Stipulates for farmer's right to work on the farmland;
- States that when farmlands are converted into different forms of land based on the interest of the State or Public, the Stare or Public needs to make compensation to the farmers without delay.

2.2.2. Environmental Standard and Guideline

The Myanmar National Environmental Quality (Emission) Guidelines (2015) provide environmental standards for different sectors and technologies. These Guidelines have been primarily extracted from the International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines, which provide technical guidance on good international industry pollution prevention practice for application in developing countries. Impact assessment and mitigation measure in the following chapters consider these standards shown in Table 2.2.2.

Table 2.2.2 Environmental Standard and Guideline of NEQG and IFC

Area	Items [Unit]	Averaging Period	Guideline Value	
			Myanmar Guideline*1	IFC*2
Air Emission	Nitrogen Dioxide(NO2) [µg/m^3]	1-year	40	40 (guideline)
		1-hour	200	200 (guideline)
	Ozone [µg/m^3]	8-hour daily maximum	100	160 (Interim target-1) 100 (guideline)
	Particulate Matter PM10$_a$ [µg/m^3]	1-year	20	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
		24-hour	50	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
	Particulate Matter PM2.5$_b$ [µg/m^3]	1-year	10	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
		24-hour	25	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
	Sulphur Dioxide(SO2) [µg/m^3]	24-hour	20	125 (Interim target-1) 50 (Interim target-2)

Area	Items [Unit]	Averaging Period	Guideline Value	
			Myanmar Guideline*1	IFC*2
				20 (guideline)
		10-minute	500	500 (guideline)
Water Quality	Biological Oxygen Demand [mg/l]		30	30
	Chemical Oxygen Demand [mg/l]		125	125
	Oil and Grease [mg/l]		10	10
	pH [S.U]		6-9	6-9
	Total Coliform Bacteria [MPNb / 100 ml]		400	400
	Total Nitrogen [mg/l]		10	10
	Total Phosphorus [mg/l]		2	2
	Total Suspended Solids [mg/l]		50	50
Noise Level	Residential, Institutional Educational [One Hour LAeq (dBA)$_d$]	Day Time 07:00-22:00	55	55
		Night Time 22:00-07:00	45	45
	Industrial, Commercial [One Hour LAeq (dBA)$_d$]	Day Time 07:00-22:00	70	70
		Night Time 22:00-07:00	70	70

Note: a Particulate matter 10 micrometers or less in diameter
b Particulate matter 2.5 micrometers or less in diameter
c Standard Unit
d Equivalent continuous sound level in decibels

Source: *1: National Environmental Quality (Emission) Guidelines (MONREC, December 29th, 2015)
*2: International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines (IFC, April 30th, 2007)

2.3. Relevant Upstream Plan in Myanmar

In 2018, Government of Myanmar has established Myanmar Sustainable Development Plan (MSDP) (2018 – 2030) for sustainable development considering the priority of national issues.

In this MSDP roadmap prioritizes following issues,

[Pillar-1 PEACE & STABILITY]

Goal 1: Peace, National Reconciliation, Security & Good Governance

Goal 2: Economic Stability & Strengthened Macroeconomic Management

[Pillar-2 PROSPERITY & PARTNERSHIP]

Goal 3: Job Creation & Private Sector Led Growth

[Pillar-3 PEOPLE & PLANET]

Goal 4: Human Resources & Social Development for a 21st Century Society

Goal 5: Natural Resources & the Environment for Posterity of the Nation

In the economic policy in Myanmar, with regard to road development, the following policy is mentioned;

"4. ***Prioritizing the rapid development of fundamental economic infrastructure***, such as electricity generation, ***roads*** and ports, and establishing a data ID card system, a digital government strategy, and an e-government system."

Additionally descriptions regarding road development have founded in the each goal;

Table 2.3.1 Relevant Description regarding Road Development in the Goals

Goal	Action Plan
Goal-1 Peace, National Reconciliation, Security & Good Governance	Strategy 1.2: Promote equitable and conflict-sensitive socio-economic development throughout all States and Regions It is also critical that the provision of basic infrastructure, services delivery and connectivity are undertaken with enhanced cooperation with existing, ethnic-affiliated service providers and local communities. Basic infrastructure priorities in this context include education and healthcare services, electricity, telecommunications connectivity, and road connections to markets and major cities.
Goal-3 Job Creation & Private Sector Led Growth	Strategy 3.6 Build a priority infrastructure base that facilitates sustainable growth and economic diversification 3.6.6 Upgrade international transport corridors, such as expanding access to expressways for heavy commercial vehicles, rehabilitating and modernizing the pavement for high traffic highways, and improving road safety 3.6.7 Implement measures to improve road user fees framework, including heavy vehicle license fees, fuel levies, and road tolls 3.6.10 Improve rural transport connectivity, including through a new National Rural Road Access Program

Source: The Government of the Republic of the Union of Myanmar/Ministry of Planning and Finance/ Myanmar Sustainable Development Plan (2018 – 2030)August 2018

New Sittaung Bridge is a part of the East – West Economic Corridor, thus construction of bridge will become a part of outcome and goal for this MSDP.

CHAPTER 3 PROJECT DESCRIPTION AND ALTERNATIVE SELECTION

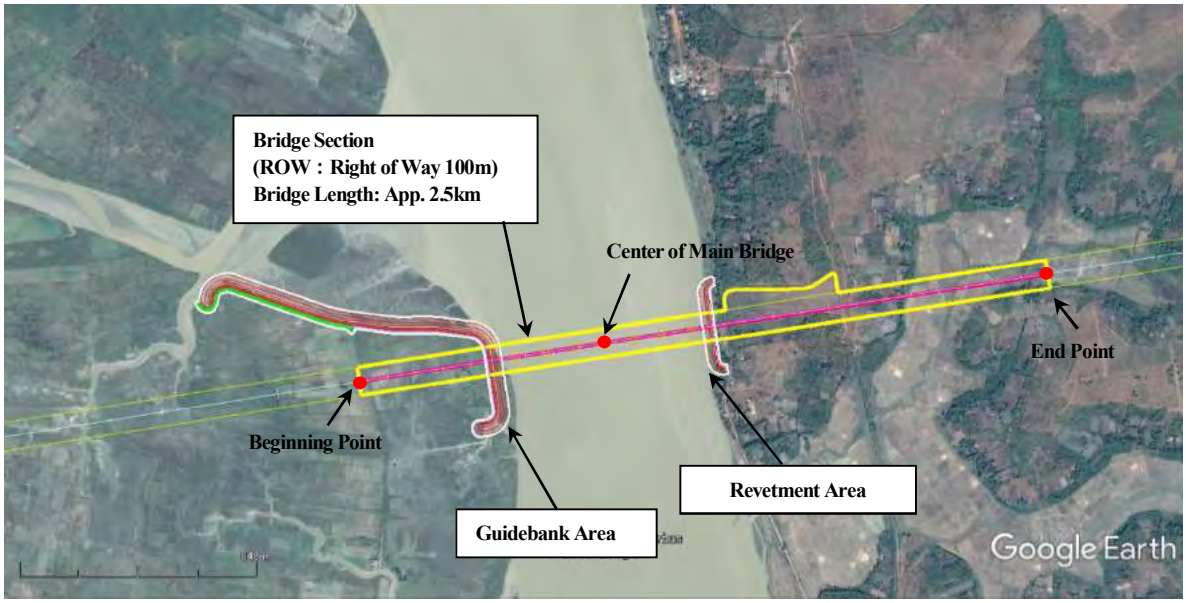
3.1. Project Outline

Project locations, structure components and features are shown below.

Table 3.1.1 Project Outline and Main Component

Component	Structure Specification	Location
1. Bridge with approach road	Main Bridge Length = 800m, Approach Bridge = 1,200m, Approach Road Length = 500m; Approach Road Width :W = 23.5 m, Bridge Width: W = 22m	East Bank: Kyaikto Township, Thaton District, Mon State West Bank: Waw Township, Bago District, Bago Region
2. Guidebank and Revetment	Guidebank Length L = app. 1.5 km (West side bank) Revetment Length = app. 0.3 km (East side bank)	Guidebank: Waw Township, Bago District, Bago Region Revetment : Kyaito Township, Thaton District, Mon State

Note:) Other facilities, such as quarry, borrow pit, construction road and storage space of excavated soil in the river which will be decided by construction contractor during construction stage, are not included for this EIA.
Source: JICA Study Team



Source : Based on Google Earth Satellite Image/ JICA Study Team
Note: End Point: 17°24'22.33"N / 96°54'33.83"E
Beginning Point: 17°24'6.12"N/ 96°52'46.99"E
Center of Main Bridge: 17°24'12.53"N/ 96°53'28.22"E

Figure 3.1.1 Detailed Project Location

3.2. Design Standards and Codes

Prior to the execution of the preliminary design, each design criteria is established for the design of the New Sittaung Bridge. In the 2nd Technical Committee held on 24th October 2017, each design criteria and condition was approved.

3.2.1. Design Standards and Codes for Road Design

The principle design standards for the road design of the New Sittaung Bridge is:

- ASEAN Highway Standards (Oct 9, 2012)

The following design standards are complementally applied for the road design of the New Sittaung Bridge.

- Road Design Criteria in Myanmar, Department of Highways, Ministry of Construction, 2015
- Japanese Expressway Design Criteria

3.2.2. Design Standards and Codes for Bridge Design

The principle design standards for the bridge design of the New Sittaung Bridge is:

- ・ Specification for Highway Bridges (Japan Road Association, 2012) (hereunder "JSHB2012")
- AASHTO LRFD Bridge Design Specifications (2010, 5th edition)

The bridge design shall be conducted based on the above design standards [Note1]. It is noted that live loading is applied in accordance with AASHTO guidelines, and other design loads such as earthquake, temperature, wind, etc., are applied with modified JRA specifications considering local conditions.

3.2.3. Other related Facilities

Other related facilities of the New Sittaung Bridge to be constructed are shown below.

Table 3.2.1 Related Facilities

Item	Description
1. Transmission Line	Transmission line is not installed along the approach road and bridge
2. Fiber Telecommunication	Fiber telecommunication line is not installed along the approach road and bridge
3. Sidewalk	Sidewalk is not constructed on the bridge and approach road due to full controlled access road
4. Electronic Pole	Electronic poles is not installed along the approach road and bridge
5.Water Pipe	Water pipes is not installed along the approach road and bridge
6.Emergency parking	6 points emergency parking are constructed in the bridge and approach road Note) 1 parking space shall be prepared at every 750m length.

3.3. Detailed Drawings

3.3.1. Ground Plan

Detailed drawings are shown in Figure 3.3.1.

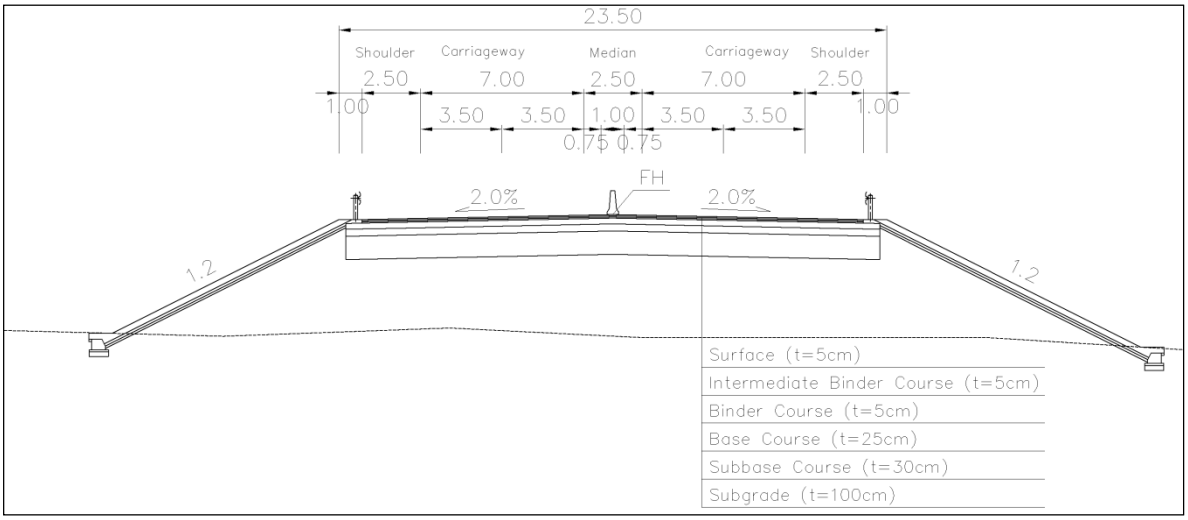
Note[1] In general, the design life of the bridge is 100 years

Source: JICA Study Team

Figure 3.3.1 Ground Plan for Bridge, Approach Road, Revetment and Guidebank

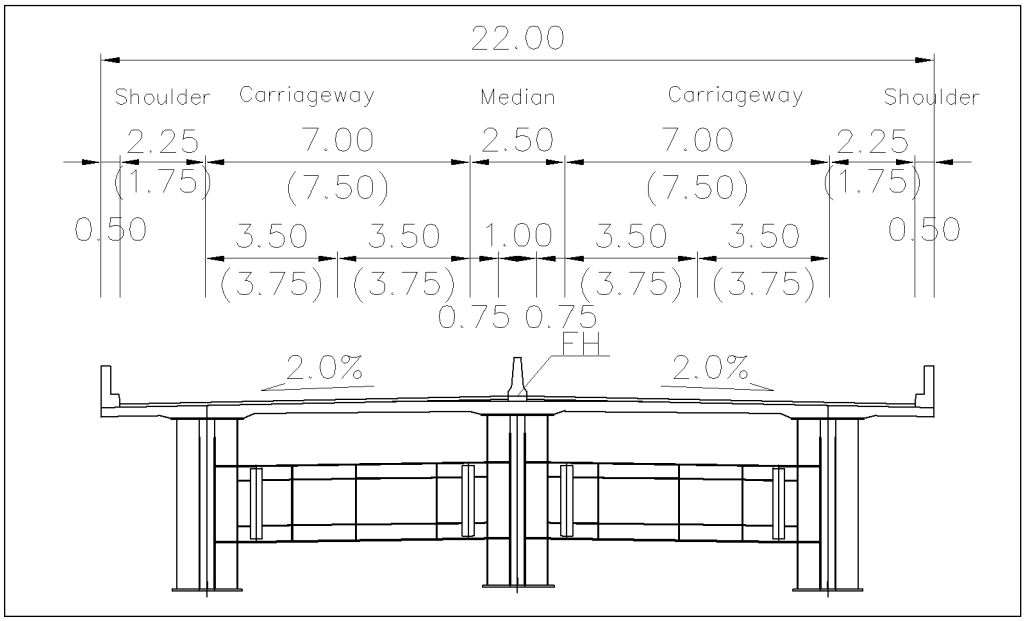
3.3.2. Typical Cross Section

The typical cross section for earthwork, bridge, guidebank and revetment is shown below:



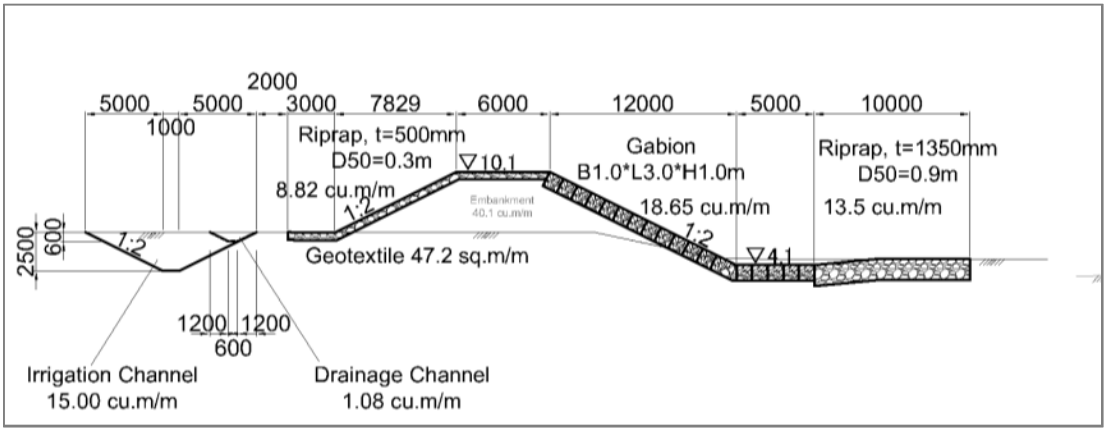
Source: JICA Study Team

Figure 3.3.2 Typical Cross Section at Earthwork Section



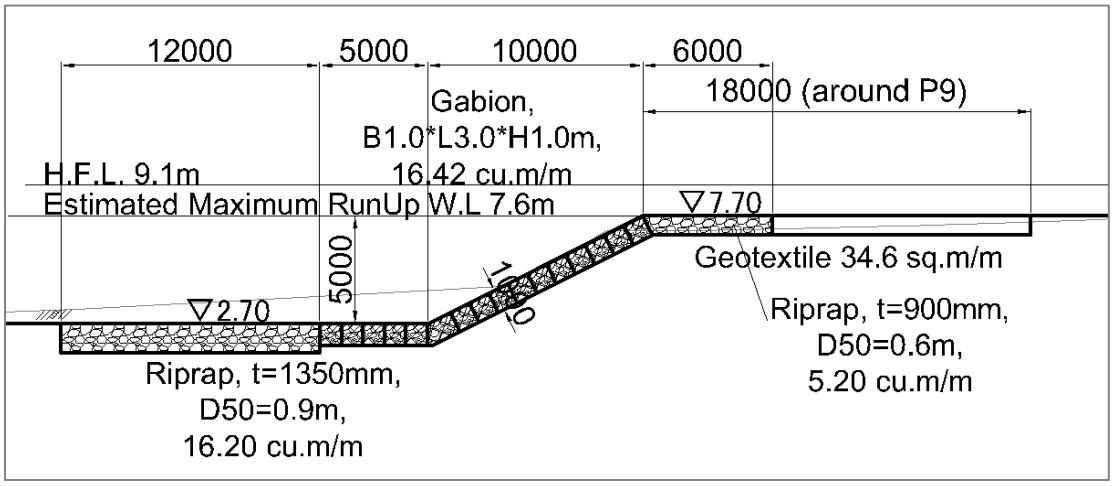
Source: JICA Study Team

Figure 3.3.3 Typical Cross Section at Bridge Section



Source: JICA Study Team

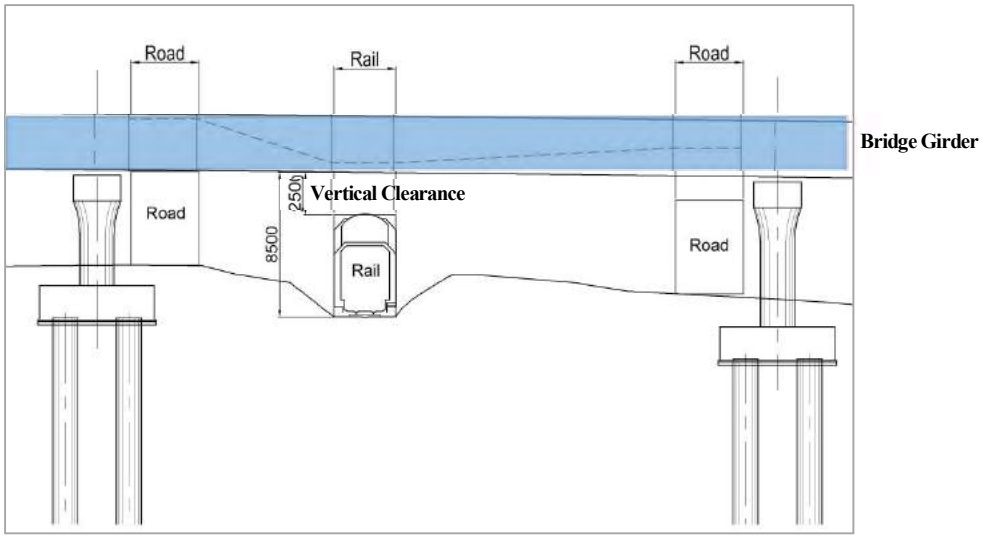
Figure 3.3.4 Typical Cross Section at Guidebank (West Bank)



Source: JICA Study Team

Figure 3.3.5 Typical Cross Section at Guidebank (West Bank)

A sufficient vertical clearance is secured at the railway crossing point as shown in following figure.



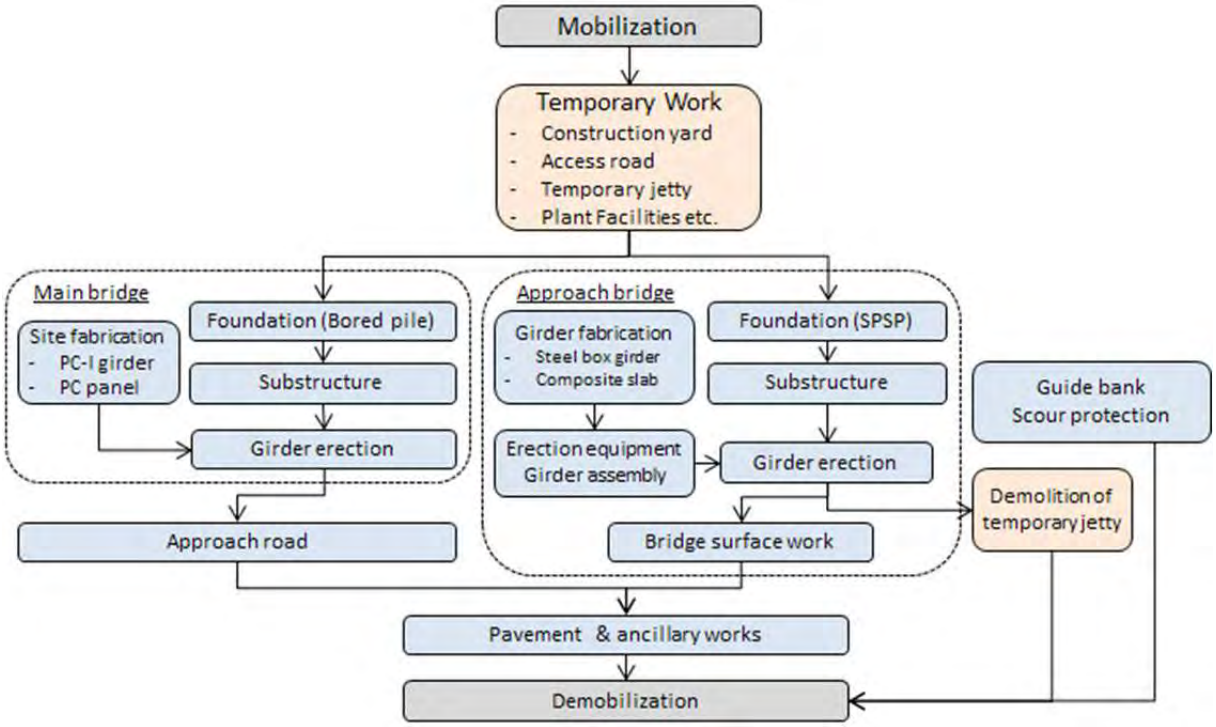
Source: JICA Study Team

Figure 3.3.6 Vertical Clearance at Railway Crossing

3.4. Construction Methodology

3.4.1. Overall Construction Sequence

The major construction sequence for the construction of New Sittaung Bridge is shown in Figure 3.4.1. The key points of the construction methodologies for specific works in this project are introduced in the following sections, excluding general civil works such as earthworks, pavement works, etc.



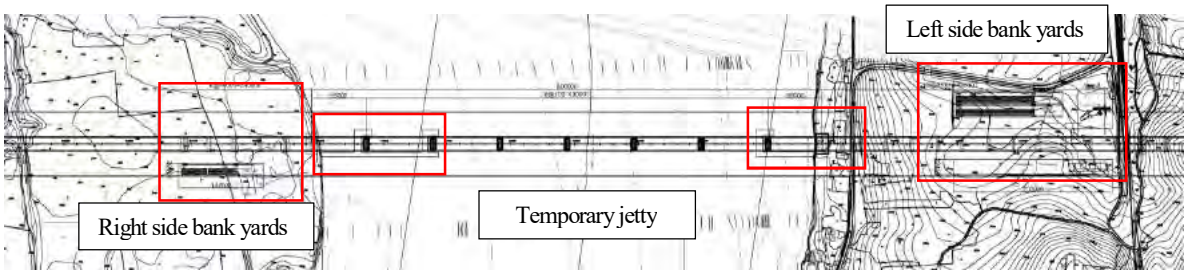
Source: JICA Study Team

Figure 3.4.1 Overall Construction Sequence

3.4.2. Temporary Works

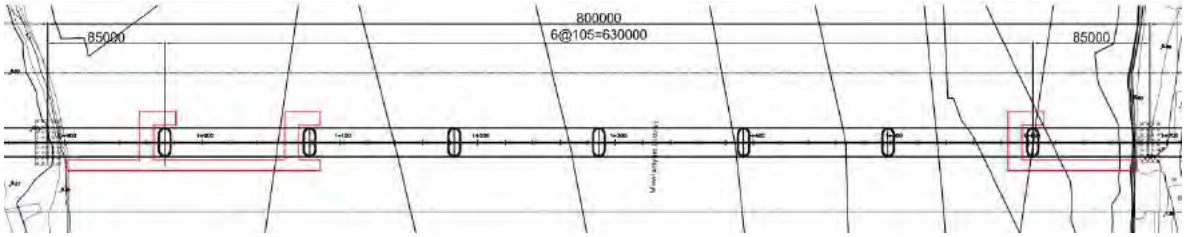
(1) Construction Yards and Temporary Bridge / Jetty

The plan of the construction yards for the main and approach bridges is shown in Figure 3.4.2. The construction yards will be set up in the ROW except for the left bank north side construction yard. The land for a part of the left bank north side construction yard should be leased. As mentioned in Figure 3.4.3, a temporary jetty shall be installed in the shallow area of the river for construction in river section.



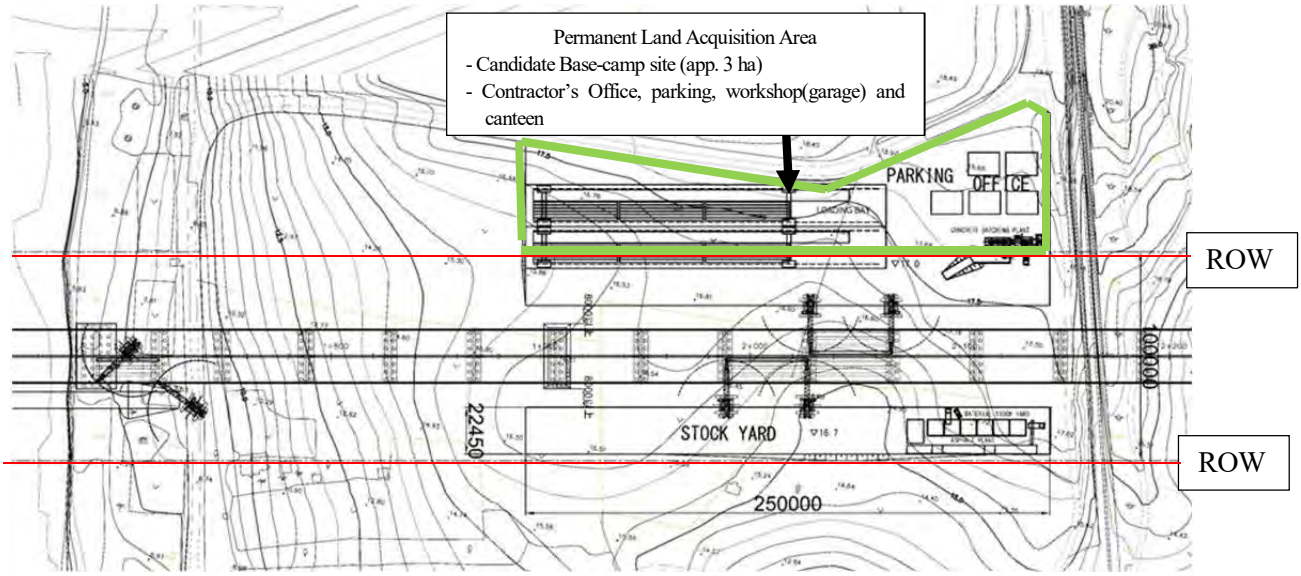
Source: JICA Study Team

Figure 3.4.2 Layout of Construction Yards for New Sittaung Bridge (Reference only)



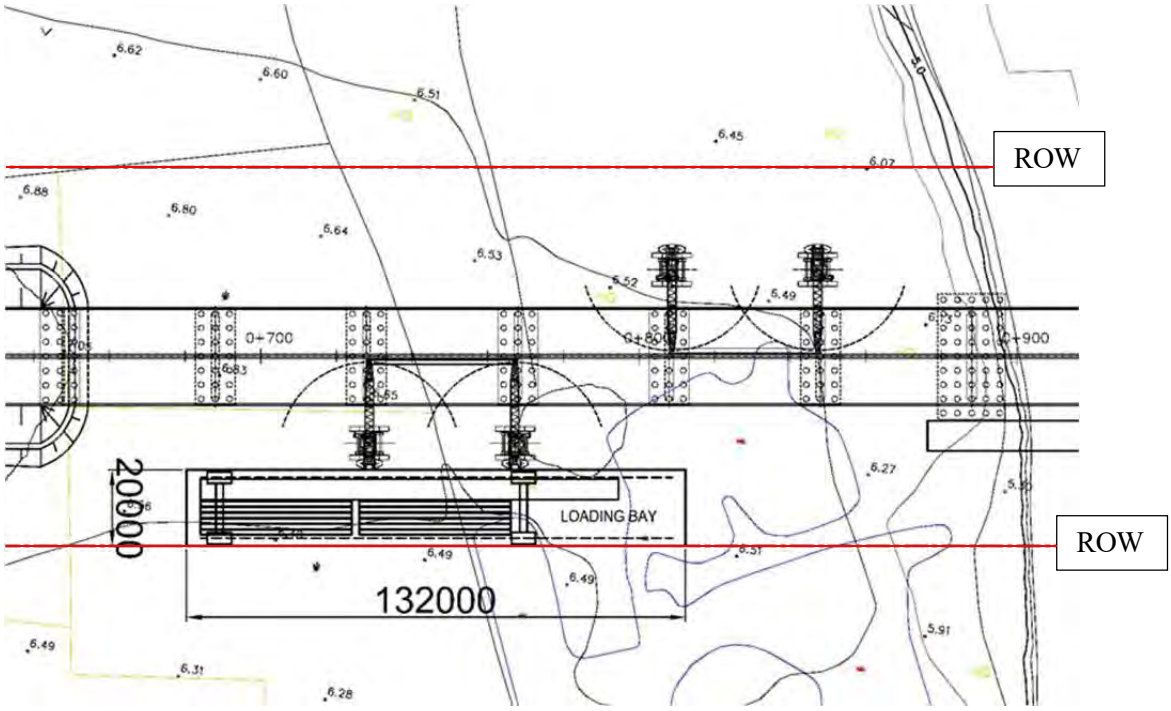
Source: JICA Study Team

Figure 3.4.3 Enlarged View of Temporary Jetty (Reference only)



Source: JICA Study Team

Figure 3.4.4 Enlarged View of Left Bank Side Construction Yards (Reference only)



Source: JICA Study Team

Figure 3.4.5 Enlarged View of Right Bank Side Construction Yards (Reference Only)

(2) Access Roads

To enable the efficient construction works on both bank sides and to shorten the construction period, access roads are necessary for both sides. The plan for the temporary access road for construction is shown in Figure 3.4.6. The existing "A" and/or "B" route has sufficient width of four meters for construction access road and are expected to be utilized as a construction road on the left bank. Widening and installation of lay-by for construction vehicles are necessary on the some portions along the route. On the right bank side, the existing route does not connect to the construction site and passes through the residential area (village). Thus, one half of the route should be newly developed, bypassing the residential area, and the other section should be widened and raised up.

Source: Prepared by JICA Study Team based on Google Earth

Figure 3.4.6 Location and Plan of Temporary Access Road

3.4.3. Bridge Foundation Works

(1) Steel Pipe Sheet Pile (SPSP)

1) Construction yard for SPSP

Considering the river condition, foundation works shall be conducted on a "temporary jetty" in the shallow area, on the other hand, in the deep area it shall be conducted by "barge" as shown in Figure 3.4.7.

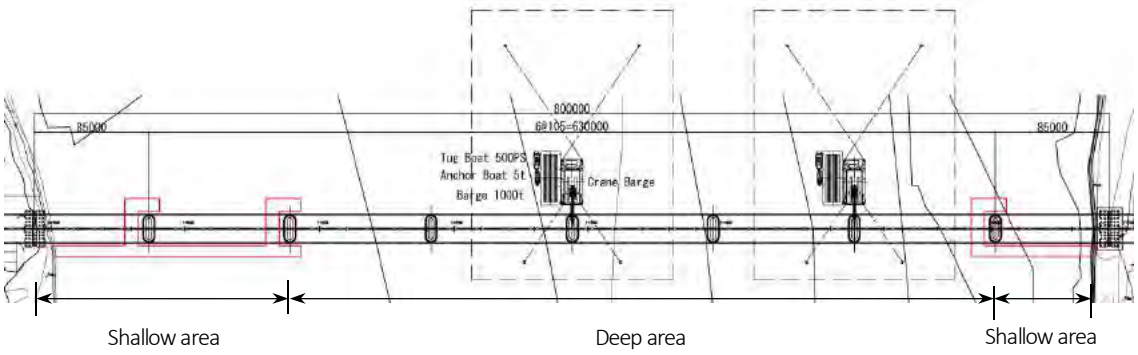
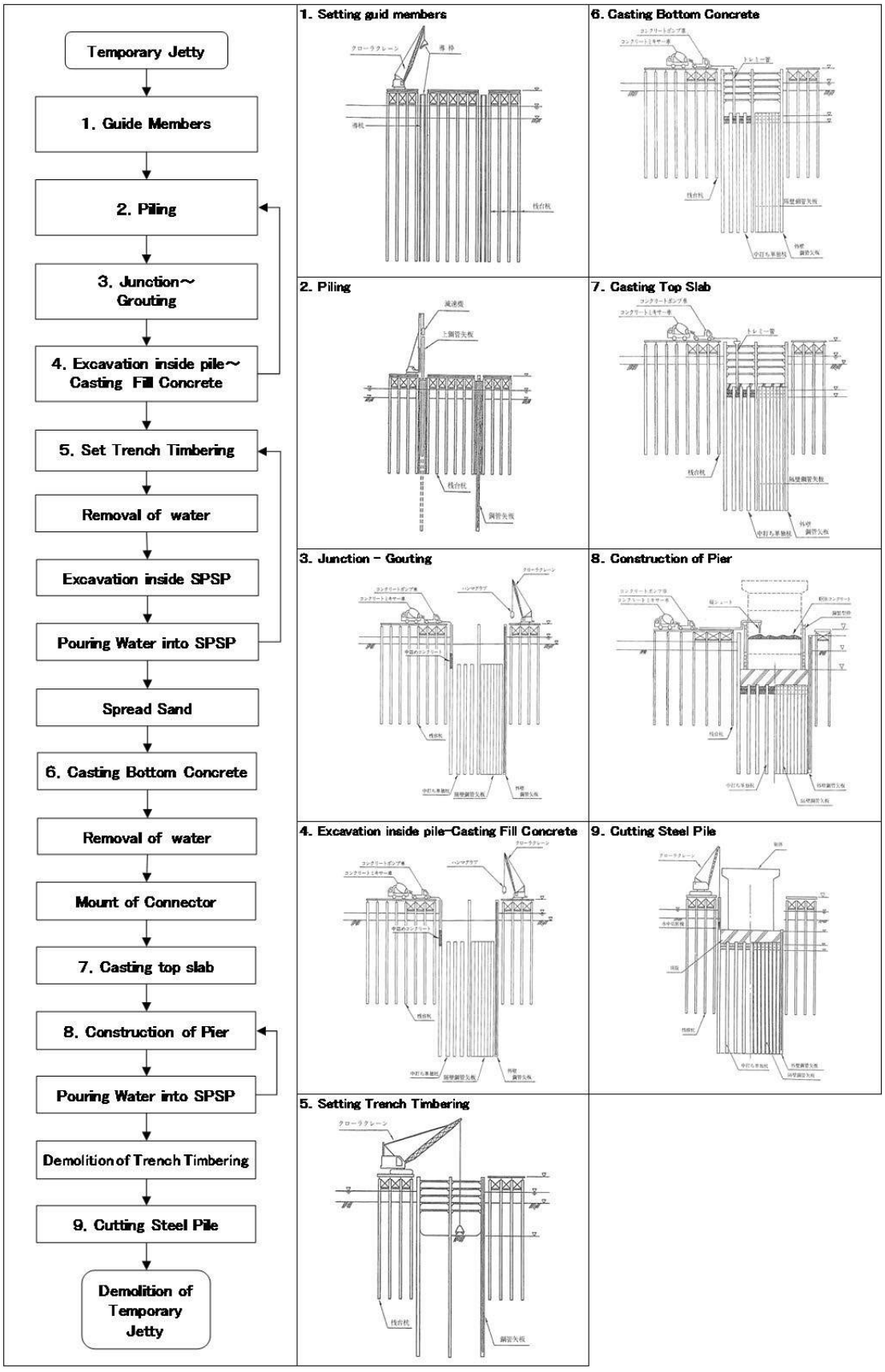


Figure 3.4.7 Typical Layout of Temporary Jetty and Barges during SPSP Construction

2) Construction Method

The SPSP shall be piled by a hydraulic vibro-hammer in consideration of the soil properties at the site. The work procedure for the installation of SPSP is shown in Figure 3.4.8.



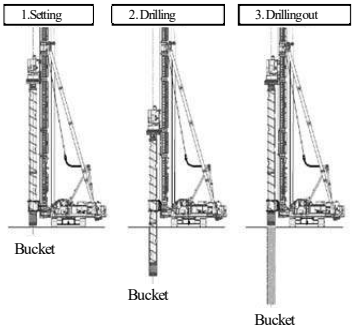
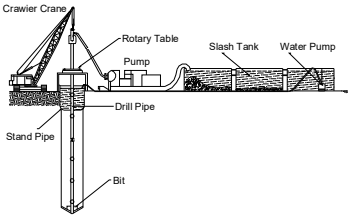
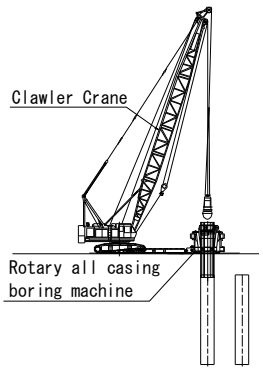
Source: JICA Study Team

Figure 3.4.8 Construction Steps for Steel Pipe Sheet Pile

3) Cast-in-Place RC Pile

Cast in-place RC pile construction methods are introduced in Table 3.4.1. Considering the applicable pile length as well as economic efficiency, the Reverse Circulation Drilling Method is recommended.

Table 3.4.1 Comparison of Piling Methods for Cast-in-Place RC Pile

Work method	Earth Drill Method	Reverse Circulation Drilling Method	All Casing Method (Rotary all casing boring system)
Schematic View			
Applicable diameter	0.8m–3.0m	0.8m–3.0m	1.0m–3.0m
Standard applicable depth	Up to 40m	More than 60m	Up to 60m
Underground water	Applicable	Applicable	Applicable
Very soft surface layer	Applicable	Applicable	Not applicable
Gravel layer in mid layer	Difficult	Not applicable	Applicable for all soil conditions
Direct cost	Reasonable	Tolerable	Higher
Evaluation	Not recommended	**Recommended**	Not recommended

Source: JICA Study Team

3.4.4. Substructure Works

(1) Piers in River

Concrete working, including scaffolding, form work and reinforcement for pier column in river, shall be carried out under a dry-up condition since the SPSP can work as a temporary cofferdam by waterproofing the joints of the steel pipes. All the materials and construction machineries can be hauled through the temporary bridge.

(2) Substructures on Land

Structural excavations for the construction of piers/abutments on land are 3m to 4m deep, and hence can be directly excavated by a backhoe. The water level is high, so countermeasures against water inflow – i.e. sump excavation and drainage pump installation – might be necessary.
The main substructure elements are divided into the footing, column, and pier head. Ready mix concrete can be locally sourced and casted using a concrete pump. Wooden formwork was adopted for the footing and abutment construction, since those elements are composed of

plane surfaces. For pier columns and pier head, metallic formwork shall be adopted to guarantee the constructability and surface quality of the curved/variable sections of those elements.

3.4.5. Superstructure Works

(1) Erection Method of Steel Narrow Box Girder

1) Alternatives

Two alternatives are extracted based on the table below:
Alternative 1 : Launching girder erection method (Erection nose girder)
Alternative 2 : Truck crane with bent method

Table 3.4.2 Applicable Erection Method for Steel Bridge

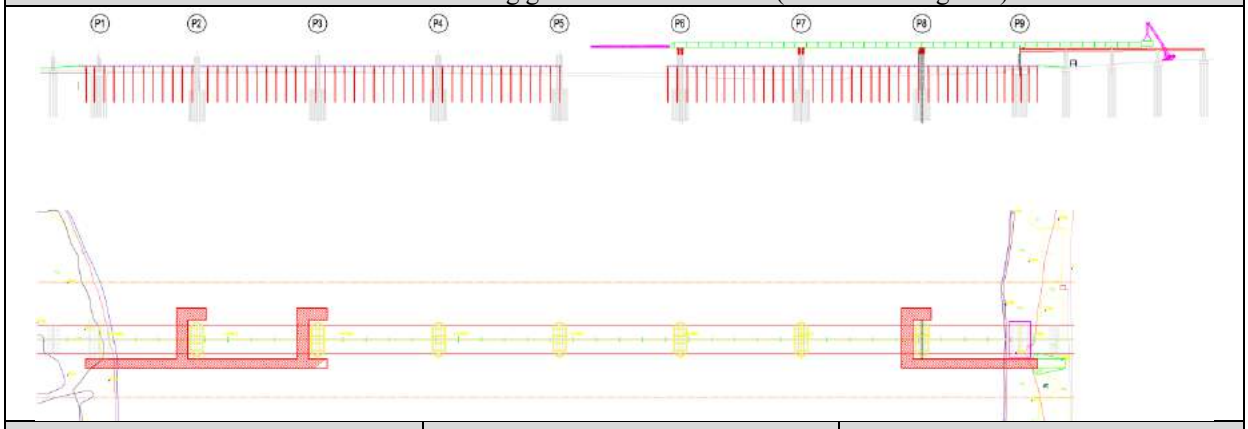
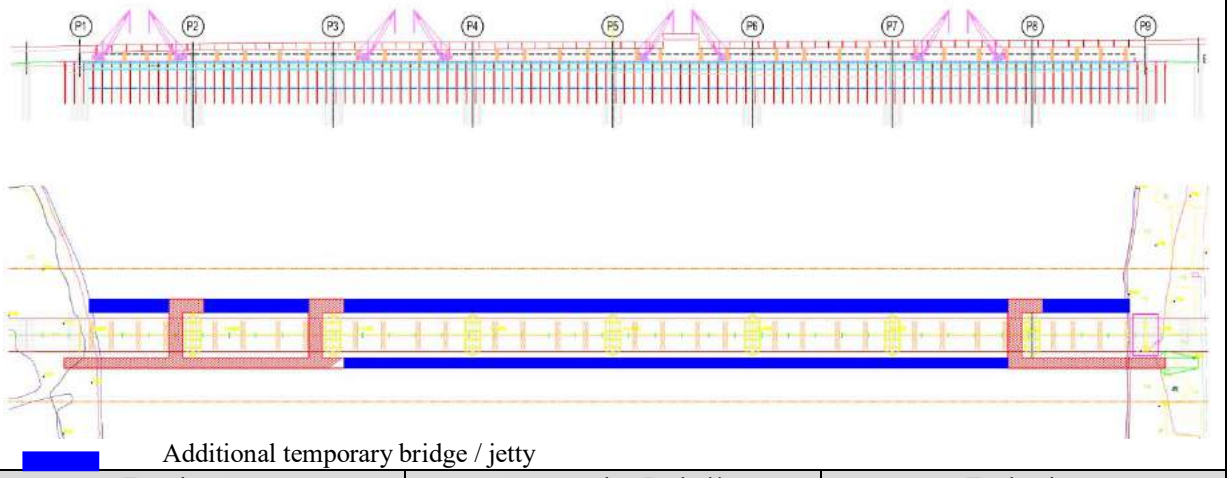
Erection Method / Bridge Type	with Bent (temporary pier)					Cable erection		Launching girder				Cantilever				Large-block erection			
	Truck Crane	Cable Crane	Traveler Crane	Portal-frame Crane	Floating Crane	Straight hanging	Oblique hanging	Erection nose girder	Barge + movable bent	Erection girder		Truck crane	Cable crane	Traveler crane	Floating crane	Truck crane	Floating crane	Barge	Winch
										Straight alignment	Curve alignment								
Simple girder	◎	○	△	○		△		◎	○							◎	○	○	
Continuous girder	◎	○	○	○	○	△		◎		○		○	○	○	○	△	○	○	△
Steel girder (at curve section)	◎	○	○		○						◎	○				△			
Simple truss	○	○	○		○	◎											○	○	
Continuous truss	○	△	◎		○	△						○	○	◎	○		○		△
Steel Arch	△	○				○	◎		○	○	○							○	
Rigid-frame bridge	○	△																	
Cable-stayed	△	○	◎		◎							○	○	◎	○	◎			

Note) ◎ : Often applied ○: Occasionally applied △ can be applied
Source: Prepared by JICA Study Team based on "Guideline for cost estimation of bridge erection (2018), Japan Construction Machinery and Construction Association

2) Evaluation

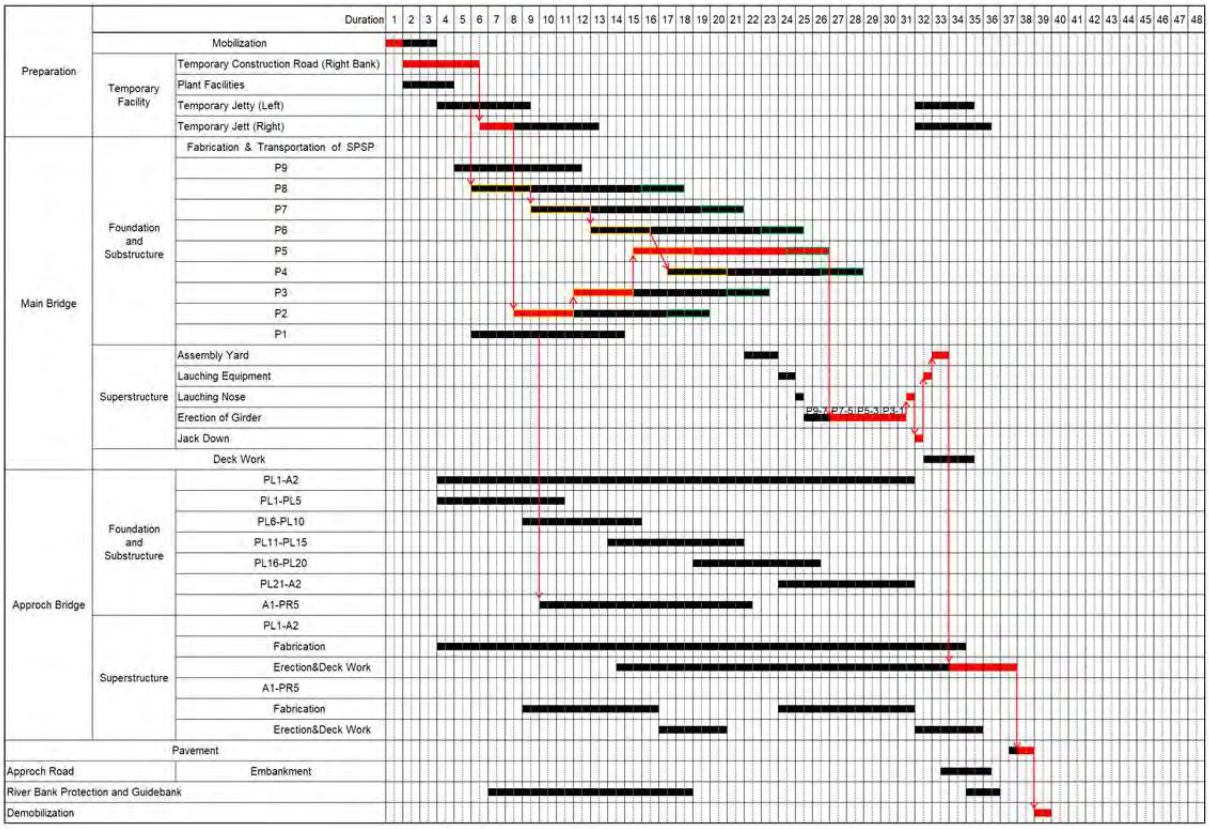
The comparison table is shown in the next table. Alternative-1 is selected for erection method of steel narrow box girder bridge, since Alternative-2 needs higher construction cost and longer construction period due to the additional temporary bridge/jetty which is necessary for girder erection by truck cranes. Construction sequence and schedule for each alternative is shown in Table 3.4.4 and Table 3.4.5, respectively.

Table 3.4.3 Comparative Study on Erection Method for Steel Narrow Box Girder Bridge

Alternative-1 : Launching girder erection method (Erection nose girder)				
				
Erection Cost		Construction Period*		Evaluation
1.00	◎	39 months (1.00)	◎	**Recommended**
Alternative-2 : Truck crane with bent method				
 Additional temporary bridge / jetty				
Erection Cost		Construction Period*		Evaluation
1.13	○	44 months (1.13)	△	Not Recommended

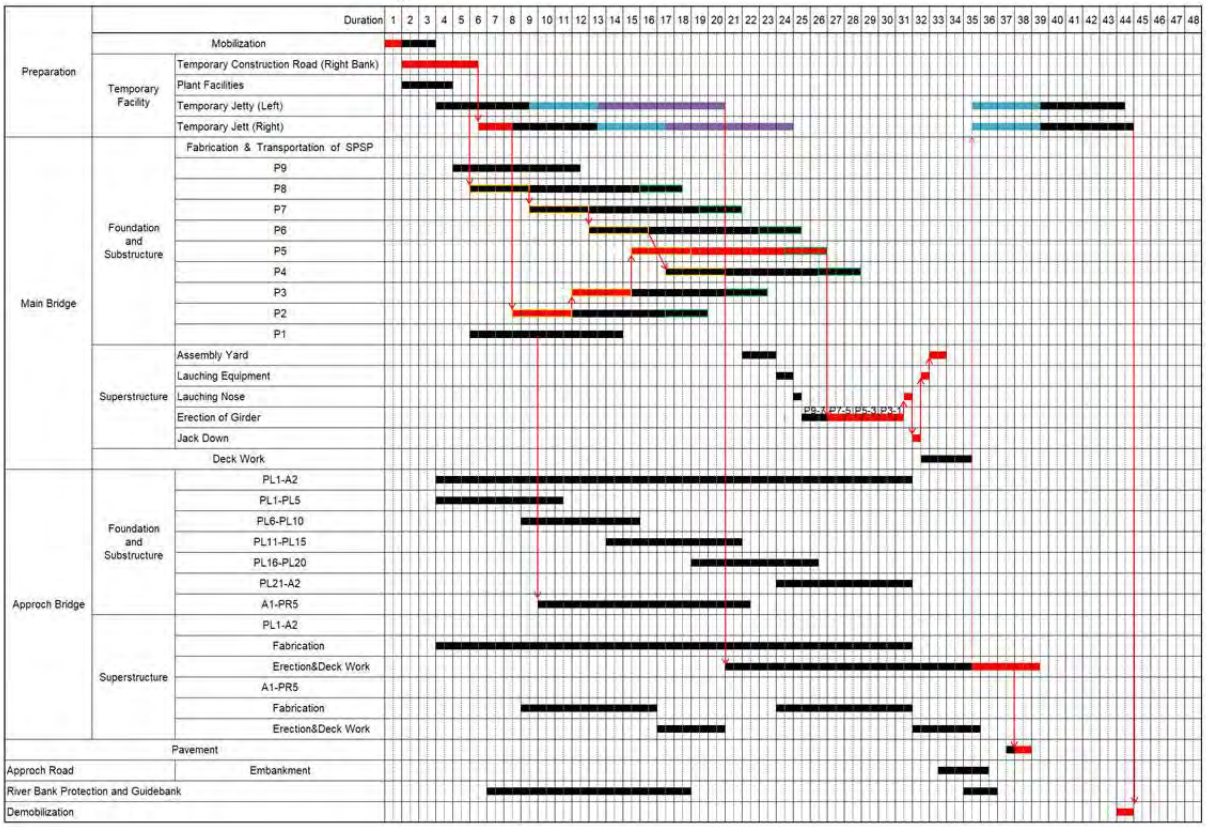
◎ : Excellent ○ : Good △ : Not good
* Construction period in case that work efficiency is 0.83.
Source: JICA Study Team

Table 3.4.4 Comparative Schedule for Alternative 1 (As Reference)



Source: JICA Study Team

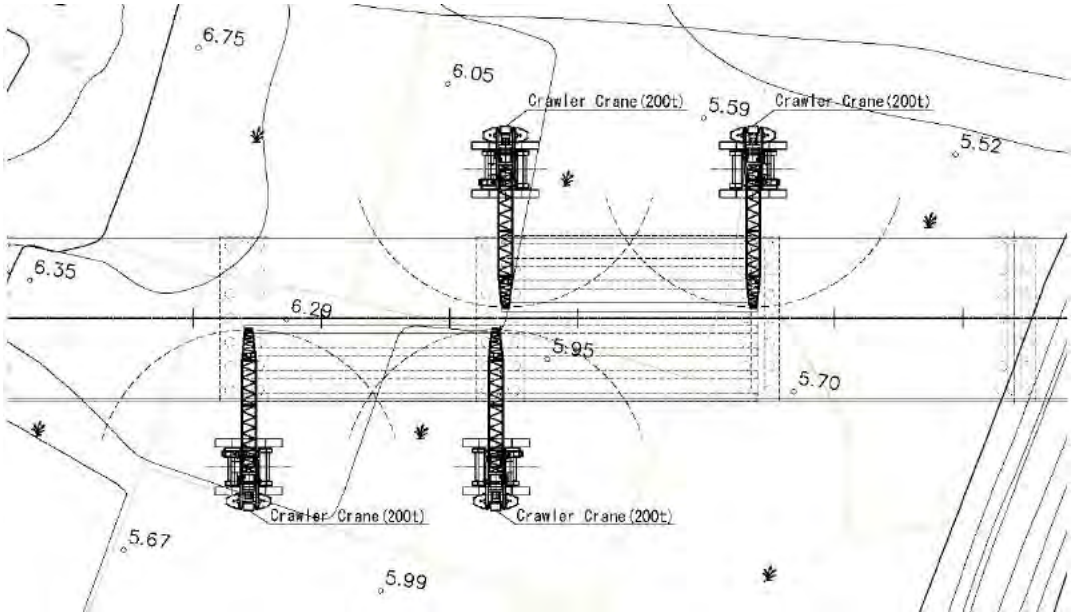
Table 3.4.5 Comparative Schedule for Alternative 2 (As Reference)



Source: JICA Study Team

(2) PC-I Composite Girder

PC-I girder and PC slab panels are fabricated and stored in a temporary yard. Since each girder weighs approximately 120 tons, it is necessary to use two 200-ton crawler cranes as illustrated in Figure 3.4.9. To shorten the construction period, the slab construction is carried out in parallel with the girder erection and the precast panels are set in position using a truck crane.



Source: JICA Study Team

Figure 3.4.9 Erection of PC-I Girder

3.5. Procurement Plan

3.5.1. Procurement Plan for Major Materials and Source of Materials

Cement, aggregate, PC-I girder, PC board and temporary jetty can be procured domestically in Myanmar. Factory-produced steel box girder and steel deck slab for main bridge, bearing and expansion joint will be procured in Japan. Main materials for construction of the bridges and road, and the sources are shown in Table 3.5.1.

Table 3.5.1 Procurement Plan for Main Materials

Material	Country to be Procured	Remarks
Gasoline	Local	
Diesel	Local	
Natural Gravel	Local	
Asphalt Prime Coat	Local	Imported bitumen products
Asphalt Tack Coat	Local	Imported bitumen products
Asphalt Concrete	Local	Imported bitumen products
Cement	Local	
Steel Pipe	Local	Imported steel products
H-Shaped Steel	Local	Imported steel products
Other Shaped Steel	Local	Imported steel products
Reinforcement Bar	Local	Imported steel products
Steel Box Girder	Japan	
Steel Deck Slab	Japan	
PC-I Girder	Local	Imported PC cable products
PC Board	Local	Imported PC cable products
Bearing	Japan	
Expansion Joint	Japan	

Source: JICA Study Team

3.5.2. Procurement Plan for Major Equipment

The construction of the main bridge on the river in Myanmar is planned by special construction method which is the push-out method for steel box girder erection and the steel pipe sheet pile method for foundation. Therefore, equipment for the push-out method and the pile driver for the steel pipe sheet pile method will be procured from Japan.
The other equipment for the construction of bridges and road is possible to procure in Myanmar. The main equipment for construction of the bridge and road are shown in Table 3.5.2.

Table 3.5.2 Procurement Plan for Main Equipment

Equipment	Specification	Country to be Procured
Dump Truck	10t	Local
Dump Truck	2t	Local
Track Crane	4.9t	Local
Track Crane	16t	Local
Track Crane	200t	Local
Rough Terrain Crane	16t	Local
Rough Terrain Crane	25t	Local
Rough Terrain Crane	50t	Local
Crawler Crane	40~45t	Local
Crawler Crane	50~55t	Local
Crawler Crane	60~65t	Local
Crawler Crane	100t	Local
Clamshell	Bucket Struck Capacity 0.8m^3	Local
Back Hoe	Bucket Heaped Capacity 0.8m^3	Local
Back Hoe	Bucket Heaped Capacity 0.45m^3	Local
Bulldozer	21t	Local
Bulldozer	15t	Local
Motor Grader	Blade Length 3.1m	Local
Road Roller	10~12t	Local
Tire Roller	8~20t	Local
Vibration Roller	8~10t	Local
Vibration Roller	Combined Type 3~4t	Local
Tamper	60~80kg	Local
Asphalt Finisher	1.7~3.1m	Local
Concrete Pumping Truck	90~110m^3/h	Local
Vibratory Hammer	60kW	Local or Foreign
Push-Out Devices		Japan
Bent		Local or Foreign
Crawler Pile Driver	Φ rawl	Japan
Generator	250kVA, 300kVA	Local

Source: JICA Study Team

3.5.3. Construction Material, Facilities and Manpower

Type and quantity of the construction material, source of water and electricity and man power is shown below;

Table 3.5.3 Construction Material, Facilities and Manpower

Item	Description
1.Chemical Compounds	Diesel / Gasoline: 1,415 m^3 Note) Generated CO_2 is totally 3,708 CO2t/4 years = 1,415,229 l (Diesel)
2.Construction Material	Concrete: 7,895 m^3
	Asphalt Concrete: 81, 502 m^3
3.Water	Expected Consumption at Construction Office: 3,000 l/day x 39 months (847working days) =2541 m^3 Water Resource: well (underground)
4.Energy	Resources: Generator
5.Man Power (Construction Worker/Labor)	Number of Daily average worker: 100 persons/day x 4 years (39 months) with Approximately 847 working days = 84,700 workers for 4 years

Source: JICA Study Team

3.6. Construction Schedule

In order to establish an eligible construction schedule, two alternatives are nominated in consideration of the following conditions:

- ✓ In principle2, CONSTRUCTION WORKS AT NIGHT SHALL NOT BE CARRIED OUT in order to mitigate the negative impact on birds and ecology around the project area designated as "Important Bird Area"
- ✓ Basic working condition : 5days / week, 9 hours (8:00 – 17:00)

Table 3.6.1 Alternatives for Comparative Study on Construction Schedule

Item	**Alternative-1 : Normal Construction Period**	**Alternative-2 : Shortened Construction Period**
Work Hour	8 hours / day (8:00 – 17:00)	Mar- Sep : 10 hours / day (8:00 – 19:00) Oct – Feb : 8 hours / day (8:00 – 17:00)
Workable Days	207days / year (57%)	285days* /year (78%)

Source: JICA Study Team

Comparison table is shown in Table 3.6.2. Unless the necessary construction period for ADB section is less than 48 months, Alt-1 is recommended in order to minimize the project cost for the New Sittaung Bridge. The construction schedule for each alternative is shown in Figure 3.6.1 and Figure 3.6.2, respectively.

Table 3.6.2 Comparative Study on Construction Schedule

Item	Alt-1 Normal Construction Period		Alt-2 Shortened Construction Period	
Condition	8 hrs / day (8:00 – 17:00) 207days / year (57%)		Mar- Sep : 10 hrs / day (8:00 – 19:00) Oct – Feb : 8 hrs / day (8:00 – 17:00) 285days /year (78%)	
Construction Period	44 months	○	36 months	◎
Project Cost Ratio	1.00	◎	1.04	○
Evaluation	**Recommended**		Less Recommended	

Source: JICA Study Team

Table 3.6.3 Calculation of Workable Days (As Reference)

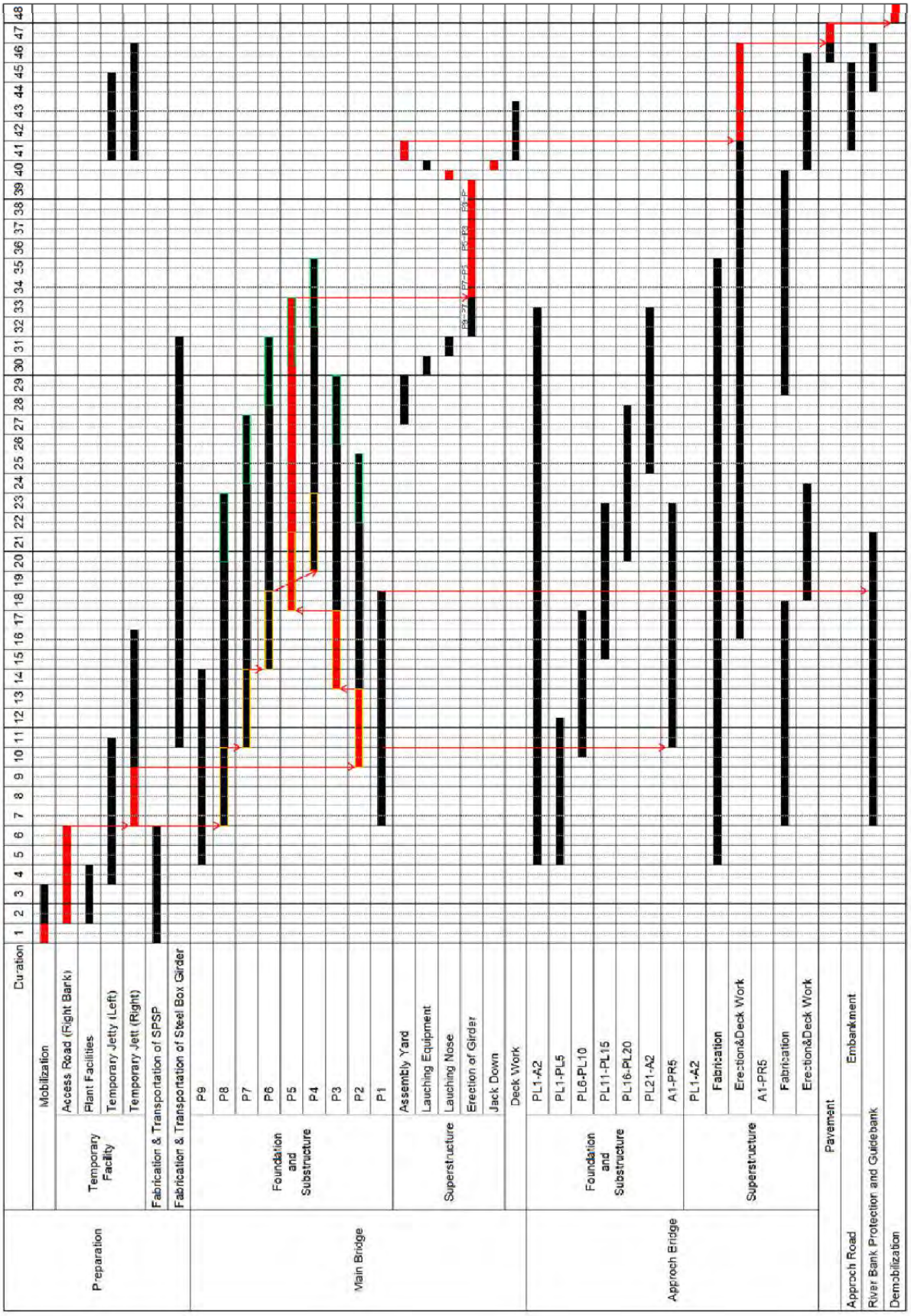
Item	Unit	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
Unworkable day due to heavy rains*	Day	0.25	0.00	0.00	0.25	5.00	12.50	15.25	12.75	9.00	5.25	1.75	0.00	62.0
Weekend	Day	6	6	6.5	4.5	6	6.5	7	6	7.5	6	6	7.5	75.5
Public holidays	Day	2	1	3	6	1	0	2	0	0	3	2	1	21.0
Calendar days	Day	31	28	31	30	31	30	31	31	30	31	30	31	365.0
Unworkable days	Day	8.25	7.00	9.50	10.75	12.00	19.00	24.25	18.75	16.50	14.25	9.75	8.50	158.5
Workable days	Day	22.75	21.00	21.50	19.25	19.00	11.00	6.75	12.25	13.50	16.75	20.25	22.50	206.5
Work efficiency		0.73	0.75	0.69	0.64	0.61	0.37	0.22	0.40	0.45	0.54	0.68	0.73	0.57

Item	Unit	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
Unworkable day due to heavy rains*	日	0.25	0.00	0.00	0.25	5.00	12.50	15.25	12.75	9.00	5.25	1.75	0.00	62.0
Weekend (Only Sunday)	日	4	4	4	3	4	4	5	4	5	4	4	5	50.0
Public holidays	日													0.0
Calendar days	日	31	28	31	30	31	30	31	31	30	31	30	31	365.0
Unworkable days	日	4.25	4	4	3.25	9	16.5	20.25	16.75	14	9.25	5.75	5	112.0
Workable days	日	26.75	24.00	27.00	26.75	22.00	13.50	10.75	14.25	16.00	21.75	24.25	26.00	253.0
Coefficient by overtime		1.00	1.00	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.00	1.00	1.00	
Work efficiency		0.86	0.86	1.09	1.11	0.89	0.56	0.43	0.57	0.67	0.70	0.81	0.84	0.78

*more than 10mm/day

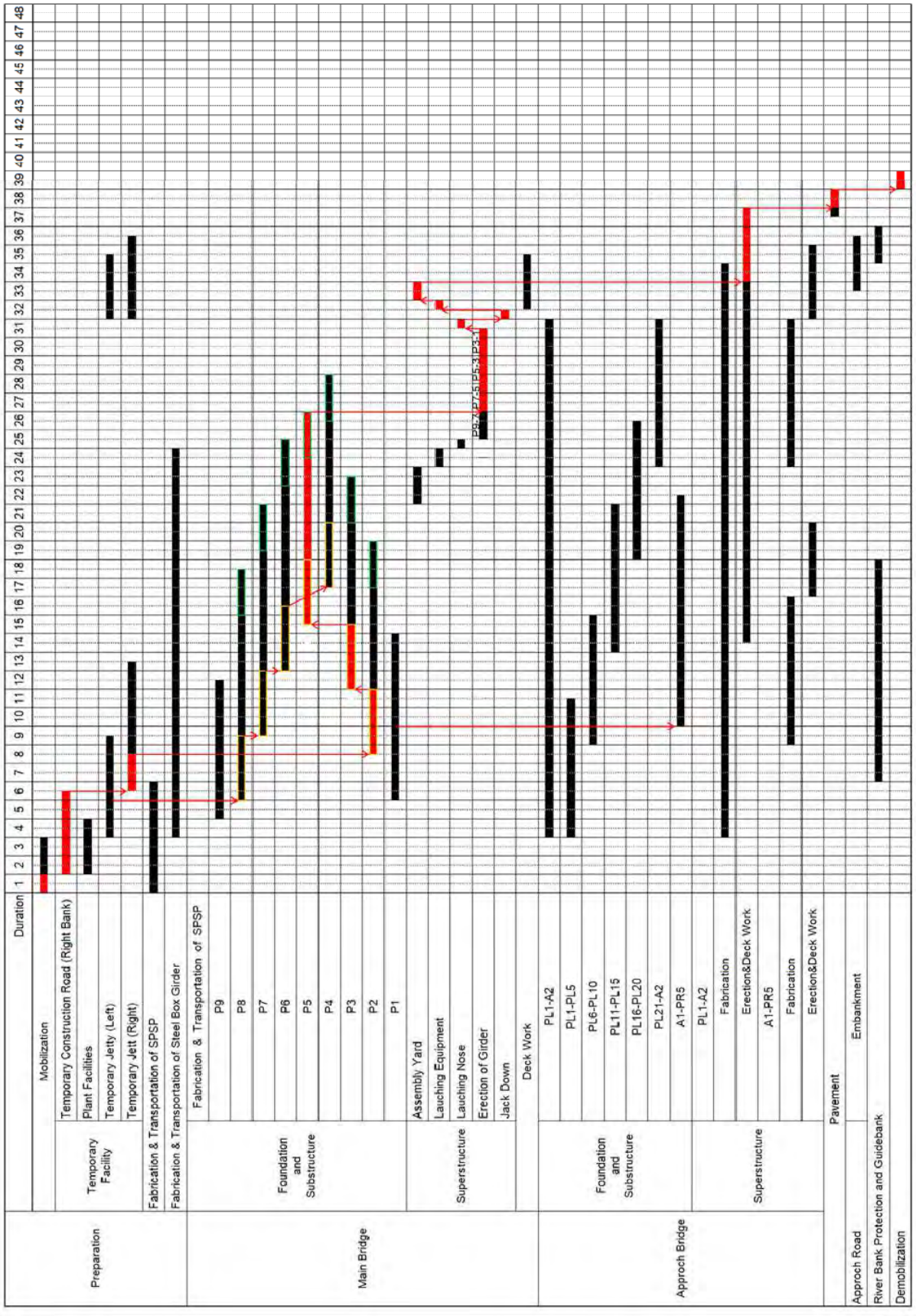
Source: JICA Study Team

[2] For instance, concrete works are necessary to be carried out during nighttime for quality assurance.



Source: JICA Study Team

Figure 3.6.1 Construction Schedule for Alternative-1



Source: JICA Study Team

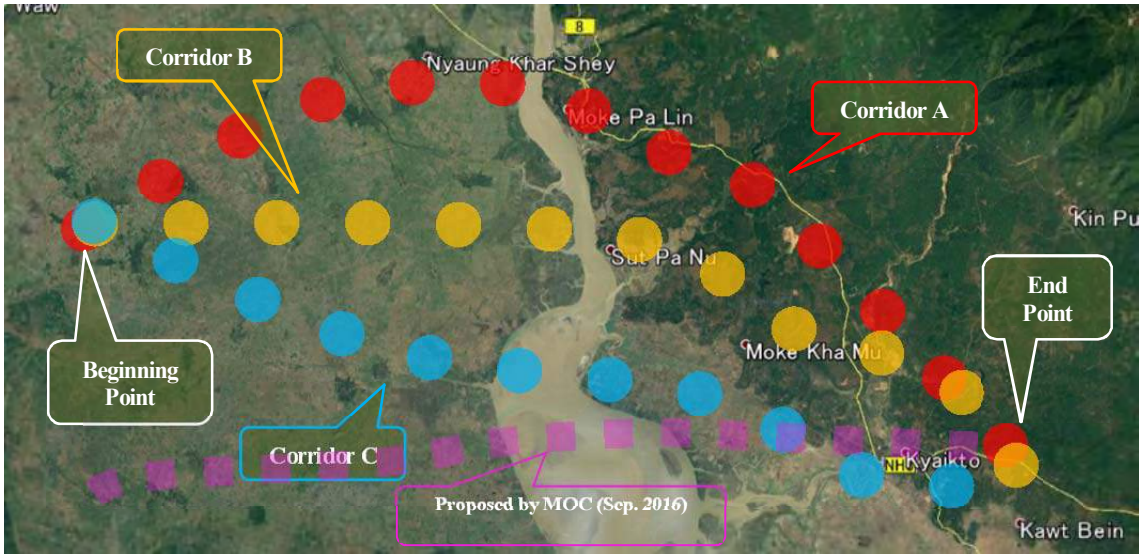
Figure 3.6.2 Construction Schedule for Alternative-2

3.7. Alternative Analysis for Corridor

3.7.1. Extraction of Candidate Corridors

Among the possible corridors passing through the project area studied in the Pre-F/S, three (3) corridors were extracted as possible candidates are given in Figure 3.7.1:

- **Corridor "A",** which runs mostly along the existing National Highway No.8 and crossing the Sittaung River beside the existing Sittaung Bridge;
- **Corridor "B",** which covers the possible alignments proposed in Pre-F/S running through Sut Pa Nu Village and crossing the Sittaung River approximately 7 km downstream side of the existing Sittaung Bridge; and
- **Corridor "C",** which is the shortest connection between New Bago City and Kyaikto City and crossing the Sittaung River approximately 13 km downstream side of the existing Sittaung Bridge.



Source: JICA Study Team

Figure 3.7.1 Plan View for Alternatives of Corridor

Note that the route highlighted in purple color given in Figure 3.7.1 was proposed by MOC in September 2016. The proposed alignment by MOC was consequently turned down due to the unreasonable bridge length (long) and the scoring impact by tidal bore which was already acknowledged by MOC during the Pre-F/S.

3.7.2. Comparative Study for the Selection of Eligible Corridor

The comparative study for the selection of eligible corridor for the East - West Economic Corridor Highway (New Bago – Kyaikto Section) was conducted by multi-criteria analysis shown in Table 3.7.1. Each criteria below are given the classification (A to C) to measure the weight of the performance for each candidate corridor under the comparative assessment as shown in Table 3.7.1.

(1) Riverbank Stability / Influence for Erosion

-A: Relatively stable / minor erosion in the past

-B: Stable with countermeasures / Intermediate erosion in the past

-C: Unstable / Large erosion in the past

(2) Construction Cost

-A: Cheapest option

-B: More than 20% higher than the cheapest option

-C: More than 50% higher than the cheapest option

(3) Environmental Impact (Conservation area or zone)

-A: No impacts on neither Ramsar Site nor IBA/KBA

-B: Has impacts on Ramsar Site or IBA/KBA

-C: Has impacts on Ramsar Site and IBA/KBA

(6) Land Acquisition and Compensation

-A: Almost no residential area in/around the corridor

-B: Some residential areas in/around the corridor

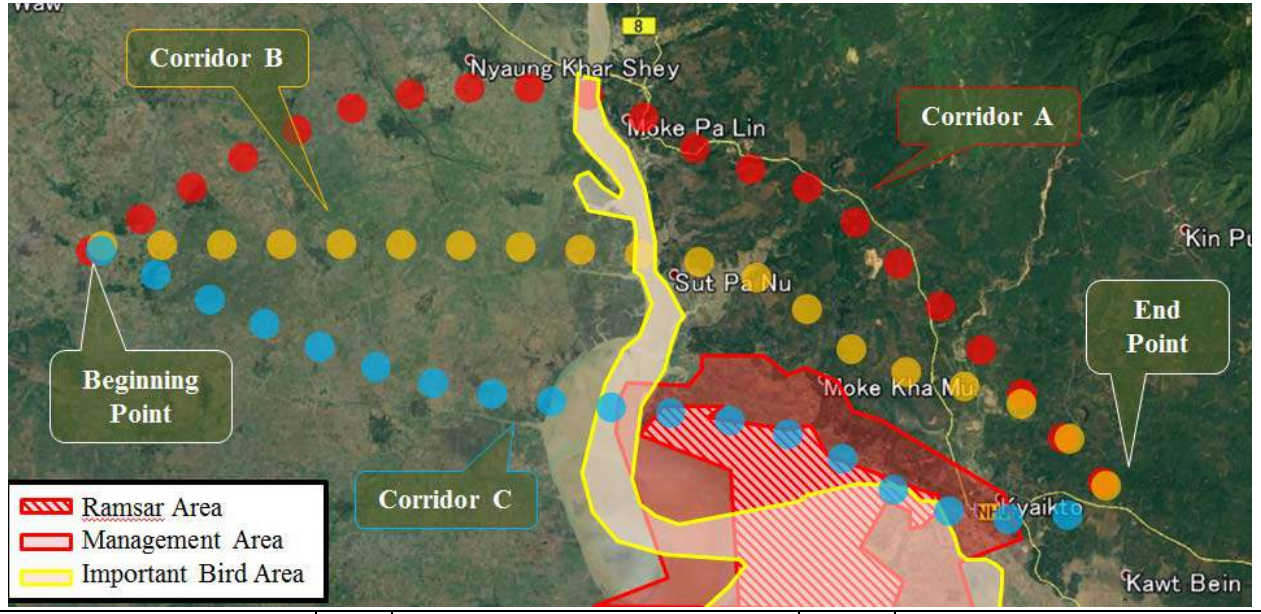
-C: Many residential areas in/around the corridor

The evaluation was made by scoring method based on the following formula. The alternative which has the highest score will be selected as an optimum candidate corridor among the alternatives.

Score = Σ(Criteria (1) x Evaluation (A:20pt, B:10pt, C:0pt) …….. Criteria (6) x Evaluation).

In addition, the alternative corridor, which was ranked "C" in the evaluation, will be disqualified (even for having a single "C" evaluation), because it gives an essential factor to affect the performance of the project road. As a result, Corridor "B" was recommended due to acquiring the highest score of 60/80 points, while the other alternatives were disqualified. Corridor "A" was assessed to have relatively shown a lower performance due to the unreasonable length of the project road and given the potentially high social impact for the large resettlement. Corridor "C" was assessed to have an unreasonable bridge length crossing close to the river mouth and unstable riverbank due to the direct influence of tidal bore while providing a reasonable (short) road length.

Table 3.7.1 Comparison of the Corridor for New Bago – Kyaikto Highway

Alternative	Corridor A		Corridor B		Corridor C	
Summary	✓ Along the existing highway (NH8). ✓ New bridge beside the existing Sittaung Bridge. ✓ Road length : approx. 45km ✓ Crossing river length: approx. 650m		✓ Short road length: approx. 40km. ✓ New bridge at narrow river crossing area: Crossing river length is approx. 750m		✓ Short road length: approx. 40km ✓ Long new bridge: Crossing river length approx. 2.8km	
Alternative Corridors						
Riverbank stability / Influence of tidal bore	✓ "Relatively stable" but scoured by minor tidal wave	A	✓ "Relatively stable" but scoured by minor tidal wave	A	✓ Unstable scored by tidal bore ✓ Large erosion at present	C
Construction cost (Ratio with lowest cost)	✓ "Reasonable" because of shorter bridge length but longer distance of road ✓ (1.03)	A	✓ "Reasonable" because of shorter bridge length ✓ (1.00)	A	✓ "Very High" because of longer bridge length ✓ (1.87)	C
Environmental Impact (Natural Environment)	✓ No impact on Ramsar Site, but has impact on IBA/KBA	B	✓ No impact on Ramsar Site, but has impact on IBA/KBA	B	✓ Impact on Ramsar Site and IBA/KBA	C
Land acquisition and compensation (Social Environment)	✓ 13 residential areas in the corridor	C	✓ 5 residential areas in the corridor	B	✓ 2 residential areas in the corridor	A
Total assessment	Score = 50/80 (Disqualified)		**Recommended** Score = 60/80		Score = 20/80 (Disqualified)	

Source: JICA Study Team

3.8. Selection of Eligible Alignment

3.8.1. Alignment Setting in Suitable Corridor

Based on the results of the comparative study on the corridor selection, it was recommended to find an eligible alignment for new bridge location within the range of Corridor "B". Several alternative alignments can be proposed taking into account the control points including the existing facilities (road, railway and irrigation facilities, etc.) and local communities. The most eligible bridge site should be selected by the criteria considering the suitability of bridge site crossing a river as shown below:

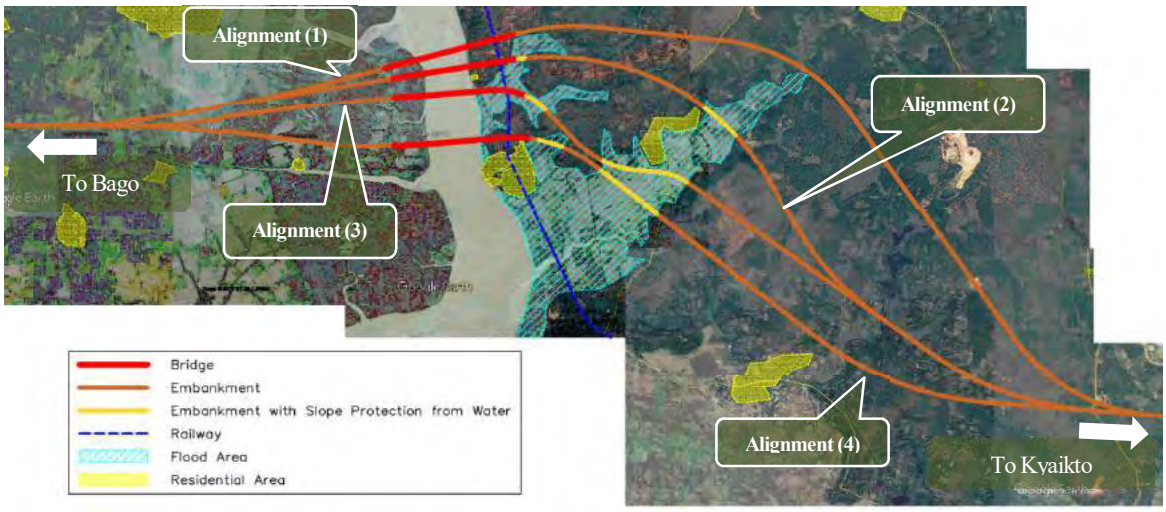
- Steady river flow without cross currents;
- Straight trail of the river;
- Narrow channel with firm banks;
- Suitable high banks above high flood level on each side;
- Rock or other hard soil conditions for slope and river bed;
- Absence of sharp curves in the approaches;
- Absence of expensive river training works;
- Avoidance of excessive underwater construction;
- Economical approaches to danger of floods, free from obstacles, frequent drainage crossings, or place for troublesome in environment assessment, land acquisition and resettlement, etc.

In selecting a suitable site for New Sittaung Bridge, a field reconnaissance was conducted by JICA Study Team to get an impression of the landscape and to extract the possible types of structure for the bridge site. Four (4) probable alternative sites which are likely to satisfy the requirements for a suitable bridge site with reasonable construction cost were selected.

Within certain width of Corridor "B", four (4) possible alternative alignments were proposed as given in Figure 3.8.1. The candidate alignments pass through the area from east to west. Right (west) riverbank is sedimentary flood terrain, while left bank observed stiff hilly terrain and partially paddy field. The elevation of paddy field is rather low, and thus normally flooded during rainy season.

Since there is no critical control point at the right bank side, the route selection was made in consideration of conditions of the left bank side.

- **Alignment (1)**, which stretches mostly on the upstream side amongst the alternatives (700 m apart from Pre-F/S route), becomes the longest route length but can avoid passing through flood areas on the left bank.
- **Alignment (2)**, which runs through secondary upstream side amongst the alternatives (400m upstream side from Pre-F/S route), crosses the narrowest point of river width and passes through mostly hilly areas except some flooded areas on the left bank.
- **Alignment (3)**, which overlays the route proposed by Pre-F/S.
- **Alignment (4)**, which runs through mostly on the downstream side amongst the alternatives (850 m apart from Pre-F/S route), becomes the shortest route length but passes through some flood areas on the left bank.



Source: JICA Study Team

Figure 3.8.1 Plan View for the Route Alternatives

3.8.2. Comparative Study for the Suitable Bridge Site (Alignment)

The selection of alignments was similarly conducted following the selection method of corridor based on multi-criteria analysis. The weighting of evaluation criteria was slightly adjusted to suit the selection of the eligible alignment as below:

(1) Riverbank Erosion (erosion progress ratio for the last 10 years "m/year")

-A: Relatively stable (less than 3m/year)

-B: Tolerably stable (less than 10m/ year)

-C: Unstable (more than 10m /year)

(2) Approach Road

-A: Does not run in flood areas

-B: Runs in small parts of flood areas

-C: Runs in large parts of flood areas

(3) Construction Cost

-A: Lowest/ Reasonable (within 5% higher than lowest option)

-B: Intermediate (More than 5% higher than lowest option)

-C: Unreasonable (More than 10% higher than lowest option)

(4) Land Acquisition and Compensation

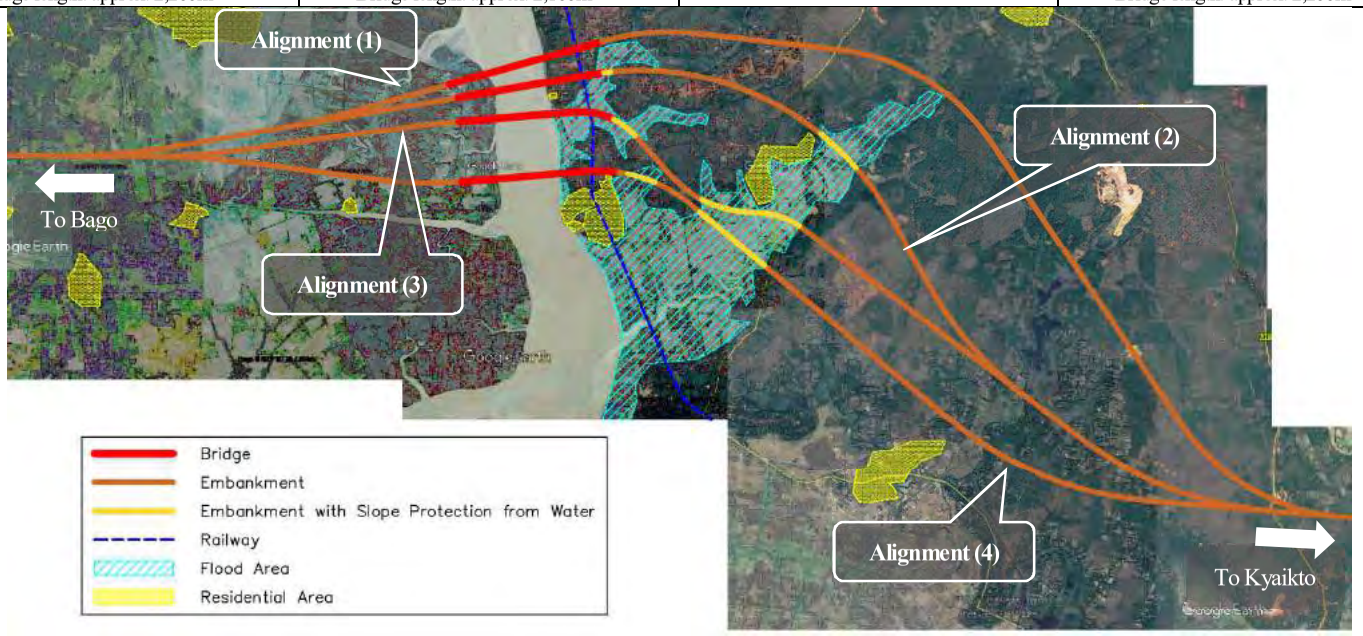
-A: Less than 10 households affected

-B: Less than 50 households affected

-C: More than 50 households affected

The comparative study for the alignment of New Sittaung Bridge is shown in Table 3.8.1 Comparison of the Route for New Sittaung Bridge. As a result, it was recommended that Alignment (2) should be the most eligible alignment for crossing the Sittaung River. The description of the comparisons of alternative alignment should be separately furnished in another chapter of the report along with salient details of each alternative alignment.

Table 3.8.1 Comparison of the Route for New Sittaung Bridge

Alternative	Alignment (1)		Alignment (2)		Alignment (3)		Alignment (4)	
Summary	✓ Avoiding flood area all along the alignment ✓ Road length : approx. 22km ✓ River crossing length : approx. 880m ✓ Bridge length: approx. 2,200m		✓ Avoiding flood area at river crossing point ✓ Road length : approx. 22km ✓ River crossing length : approx. 720m ✓ Bridge length: approx. 2,100m		✓ Pre-F/S Alignment ✓ Road length : approx. 21km ✓ River crossing length : approx. 800m ✓ Bridge length: approx. 2,200m		✓ Avoiding flood area at river crossing point. ✓ Road length : approx. 21km ✓ River crossing length : approx. 870m ✓ Bridge length: approx. 2,200m	
Sketch								
River Bank Erosion (10 years erosion ratio (m/year))	✓ Tolerably stable East (9.0m /year) West (2.1m/year)	B	✓ Relatively stable East (1.8m/year) West (4.8m/ year)	A	✓ Unstable East (0.5m/year) West (20.0m/year)	C	✓ Unstable East (0.6m/year) West (30.3 m/year)	C
Approach Road	✓ No flood area along the alignment.	A	✓ Some flood areas need slope protection.	B	✓ Some flood area needs slope protection.	B	✓ Some flood areas need slope protection.	B
Construction Cost (Ratio)	✓ Intermediate (1.08)	B	✓ Lowest (1.00)	A	✓ Reasonable (1.03)	A	✓ Reasonable (1.06)	A
Natural and Social Environment	✓ 17 households are affected ✓ Passing KBA	B	✓ 26 households are affected ✓ Passing KBA	B	✓ 20 households are affected ✓ Passing KBA	B	✓ 29 households are affected ✓ Passing KBA	B
Evaluation	Score = 50/80		**Recommended** Score = 60/80		Score = 40/80 (Disqualified)		Score = 30/80 (Disqualified)	

Source: JICA Study Team

3.9. Without Project Case

Some adverse natural and social environmental impacts are not caused during construction without project case. However, acceleration of traffic congestion and increasing travel time will give negative impacts on economic activities and generate greenhouse gases. These levels of adverse negative impacts are serious than "with-project" case. In the case of with-project, temporary negative impacts are given during construction. However, since such negative impacts are minimized by appropriate mitigation measures, implementation of project is desirable.

(1) Negative Impacts

- The congested situation must be accelerated due to insufficient capacity of the road and New Sittaung Bridge. This congestion and passing of large cargo trucks will give adverse impacts on pollution and traffic safety.
- The accelerated congestion requires all vehicles to decrease traveling speed, and this increases the volume of greenhouse gases from vehicles.

(2) Positive Impacts

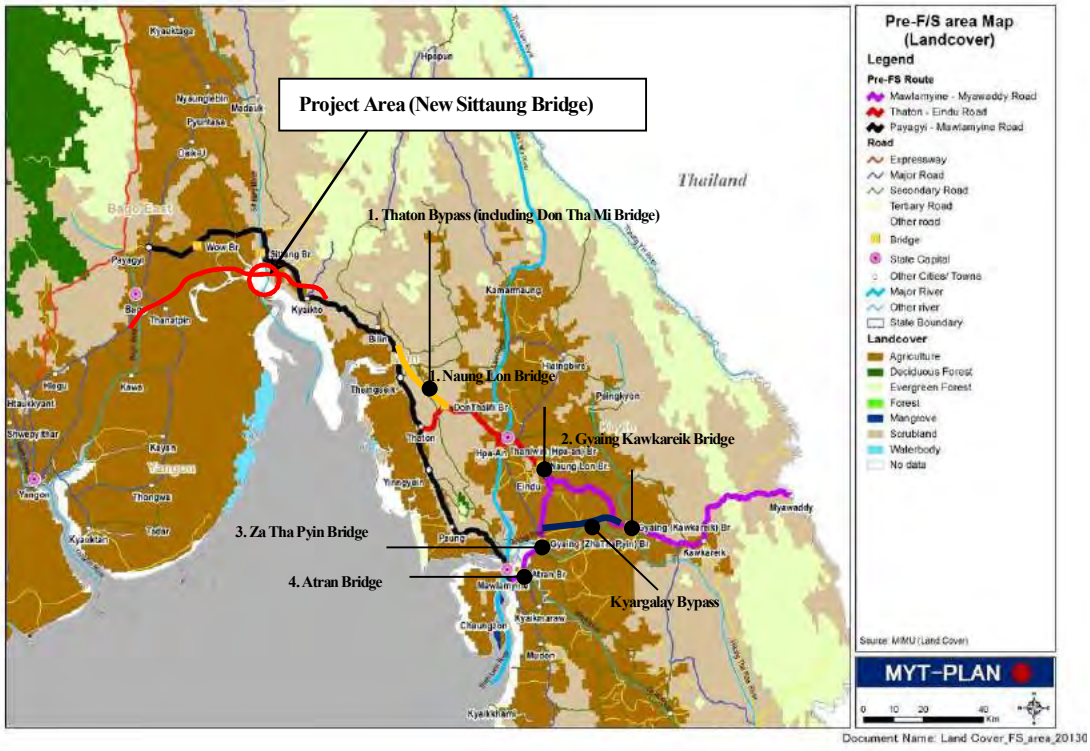
- Resettlement and land acquisition do not occur in the affected area

CHAPTER 4 DESCRIPTION OF THE SURROUNDING ENVIRONMENT

4.1. Natural Environment

4.1.1. Land Use

Aside from towns/villages, the bulk of land use is agricultural, such as rice fields, especially on the west bank and along the Sittaung River. A large number of rubber plantations are also developed in Kyaikto, Mon State.

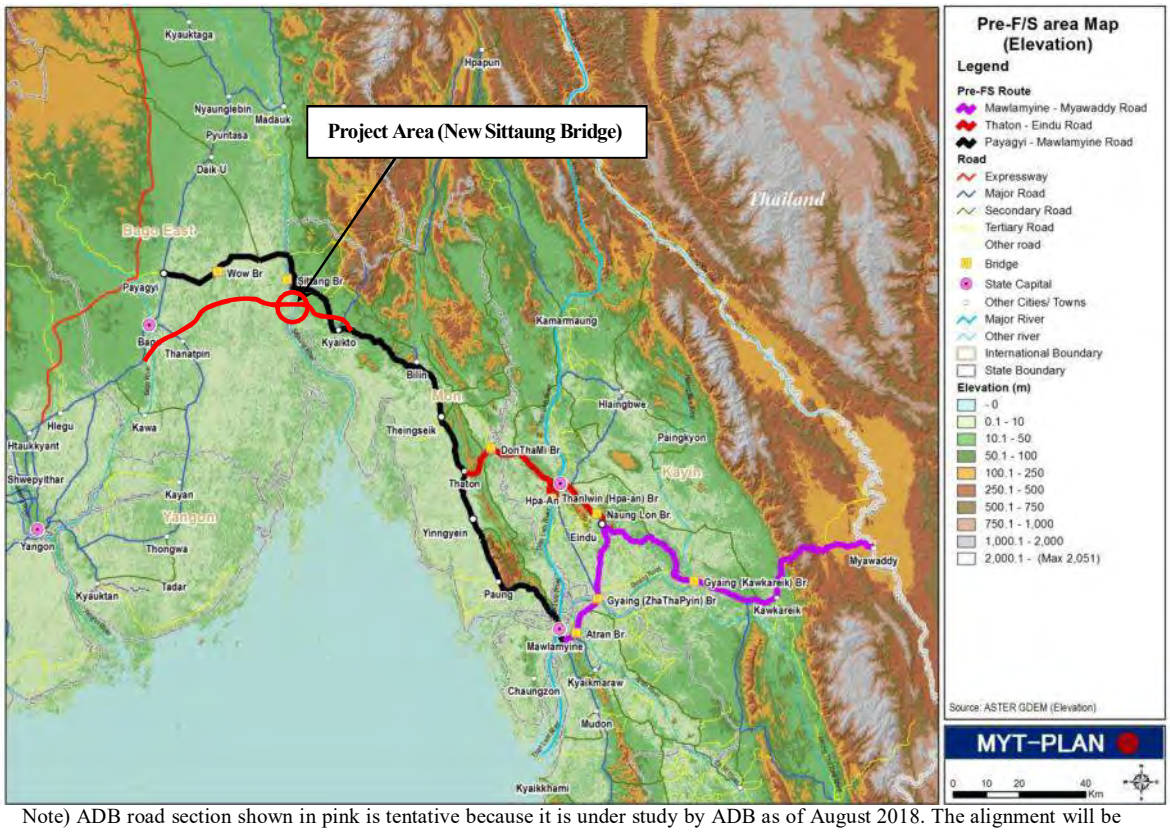


Note) The ADB road section shown in red is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.
Source: MYT-Plan

Figure 4.1.1 Land Use on the East-West Economic Corridor

4.1.2. Topography and Geology

Topographical situation in the project area is shown below. The elevation in Bago Region is 0-10m and passing though only paddy field. On the other hand, elevation varies from 0-50m in paddy field and rubber plantation in Mon State, respectively. With regard to geology in the project area, river sediment is distributed along the Sittaung River, and viscous & sandy soil accumulates under the river sediment.



Note) ADB road section shown in pink is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.

Figure 4.1.2 Topographical and Geological Features in the Project Area

4.1.3. Climate

(1) Temperature

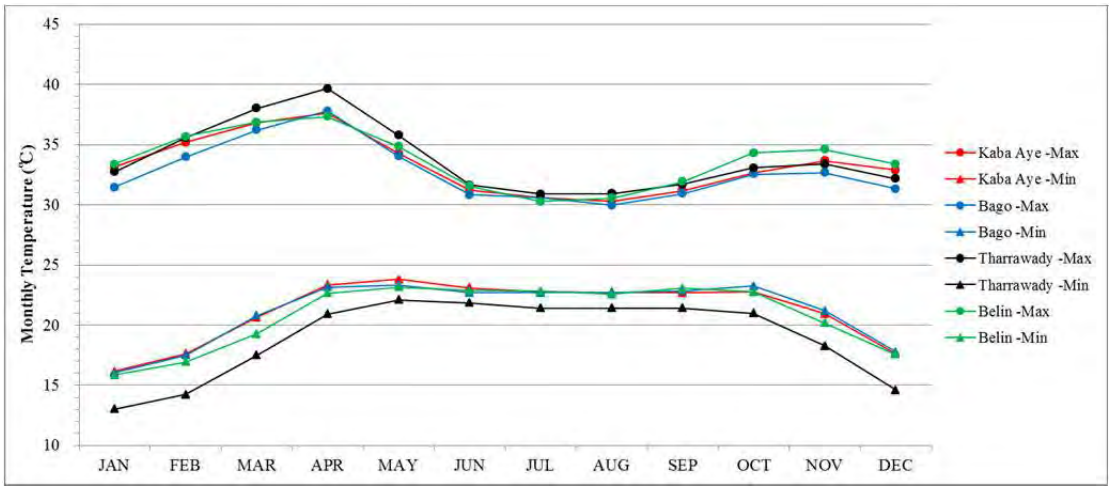
The temperature data at five stations shows almost similar trend. The monthly mean temperature at the south-eastern area in the Myanmar ranges between around 24℃ and 30℃. According to the collected data in this study, the mean monthly maximum temperature 37-40℃ (April) and the mean minimum temperature 13-16℃ (January) at targeted area were recorded respectively during the recent 10 years.

The mean monthly maximum and minimum temperature at related 5 stations are shown in the table below.

Table 4.1.1 Monthly Mean Maximum/Minimum Temperature

Station			Item	Monthly Temperature in ℃												Remarks
				JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average	
1	Kaba Aye	Kaba Aye -Max	Max	33.1	35.2	36.8	37.6	34.3	31.2	30.6	30.3	31.2	32.6	33.7	32.9	37.8	1991-2016
		Kaba Aye -Min	Min	16.2	17.6	20.6	23.4	23.8	23.1	22.8	22.7	22.7	22.7	21.0	17.6	15.9	1991-2016
2	Bago	Bago -Max	Max	31.4	34.0	36.2	37.8	34.0	30.8	30.6	30.0	30.9	32.5	32.7	31.3	38.1	1997-2016
		Bago -Min	Min	16.1	17.5	20.8	23.2	23.3	22.7	22.7	22.7	22.9	23.2	21.2	17.8	15.9	1997-2016
3	Tharrawady	Tharrawady -Max	Max	32.7	35.5	38.0	39.7	35.8	31.6	30.9	30.9	31.7	33.1	33.4	32.2	39.7	1997-2016
		Tharrawady -Min	Min	13.0	14.2	17.5	20.9	22.1	21.8	21.4	21.4	21.4	21.0	18.3	14.6	12.7	1997-2016
4	Shwegyin	Shwegyin -Max	Max	32.9	35.3	37.2	38.4	34.7	31.1	30.0	30.0	31.5	33.7	34.1	32.9	38.5	1997-2016
		Shwegyin -Min	Min	15.4	16.9	20.7	23.7	24.0	23.3	23.0	22.9	23.0	22.5	19.9	16.7	15.0	1997-2016
5	Belin	Belin -Max	Max	33.4	35.7	36.9	37.3	34.8	31.5	30.3	30.5	31.9	34.3	34.6	33.4	37.6	1997-2016
		Belin -Min	Min	15.8	17.0	19.3	22.7	23.1	22.9	22.8	22.6	23.0	22.8	20.2	17.6	15.4	1997-2016
Average				24.0	25.9	28.4	30.5	29.0	27.0	26.5	26.4	27.0	27.8	26.9	24.7	27.0	
Average Max.				32.7	35.1	37.0	38.1	34.7	31.3	30.6	30.4	31.4	33.1	33.6	32.4	33.4	
Average Min.				15.3	16.6	19.6	22.5	23.1	22.6	22.4	22.3	22.5	22.4	20.1	16.9	20.5	

Source: JICA Study Team, DMH (Myanmar Department of Meteorology and Hydrology)



Source: JICA Study Team, DMH (Myanmar Department of Meteorology and Hydrology)

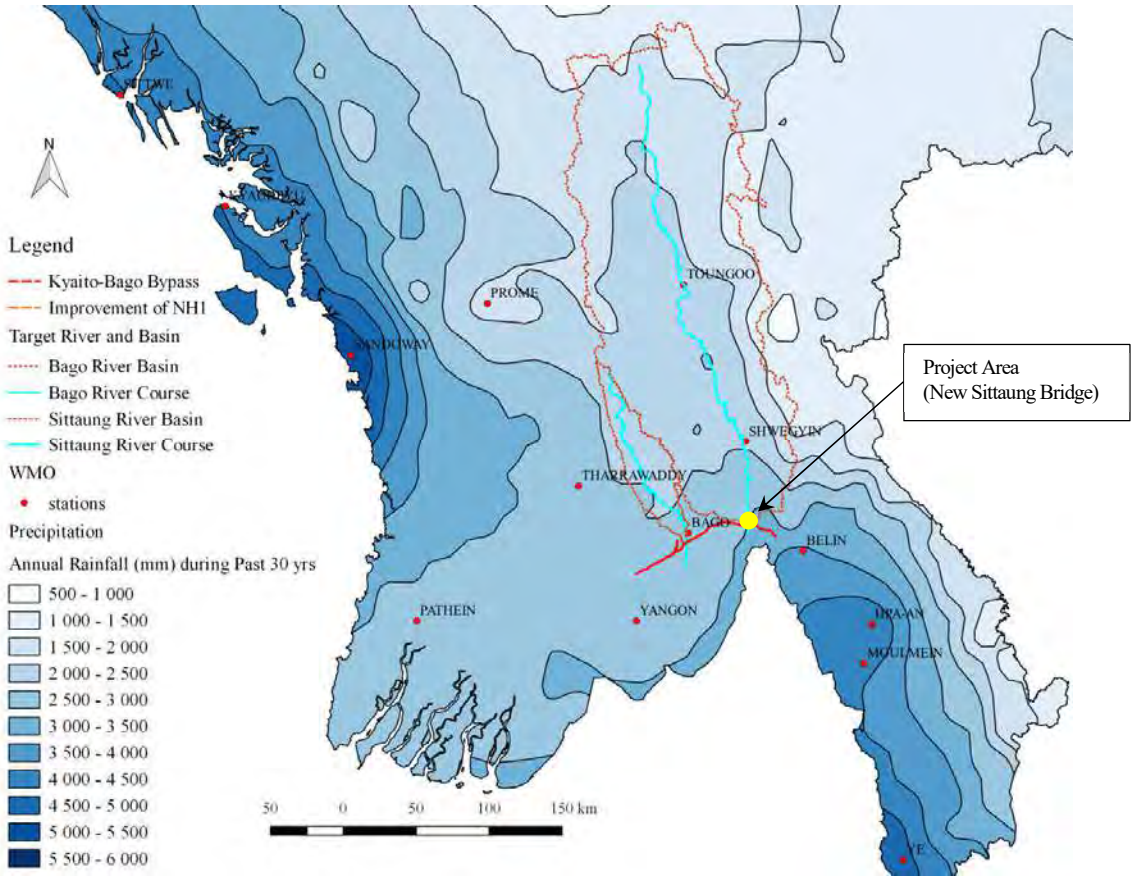
Figure 4.1.3 Monthly Mean Maximum/Minimum Temperature

(2) Rainfall

The targeted area is the area with average to abundant precipitation in Myanmar. (The areal distribution of annual rainfall, which is predicted based on annual rainfalls during the past 10 years or more by observation stations in and around south-eastern Myanmar, is shown in Figure 4.1.4) The annual mean rainfall ranges from 3,481mm at Shwegyin (Madauk) to 5,695mm at Belin. Also the annual rainfall fluctuates between each station significantly. (e.g. between 2,396 and 4,633mm at Shwegyin.)

The seasonal variation of monthly mean precipitation is similar in each station. Regarding the seasonal fluctuations of rainfall, 95% or more of annual rainfall is brought by the rainy season from May to October, with the highest amount of rainfall in July or August.

The mean monthly rainfall at 8 stations is shown in Table 4.1.2 and Figure 4.1.5



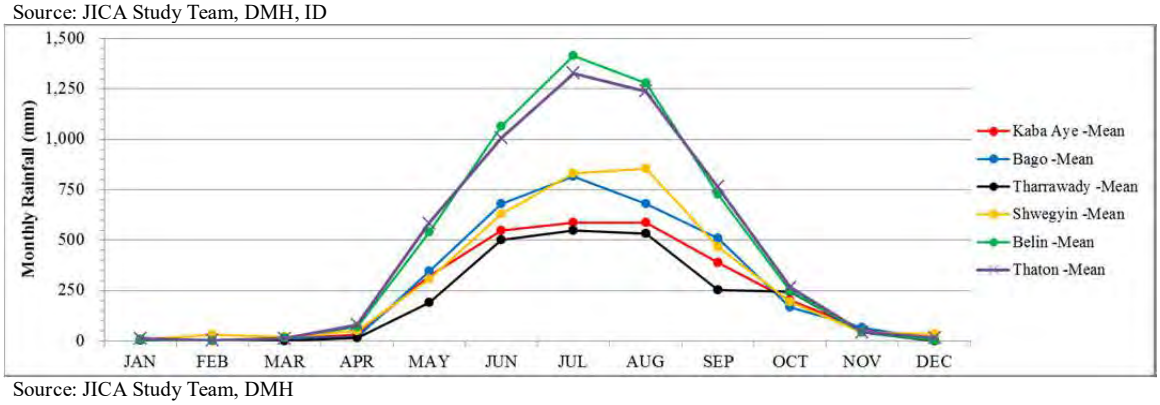
Source: JICA Study Team, Digital Agricultural Atlas (FAO, http://dwms.fao.org/atlases/myanmar/index_en.htm)

Figure 4.1.4 Areal Distribution (Isohyet) of Annual Rainfall in Southern Myanmar

Table 4.1.2 Monthly Mean Rainfall

	Station		Item	Monthly Rainfall in mm													Remarks
				JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total	
1	Kaba Aye	Kaba Aye -Mean	Mean	4	3	13	32	321	550	587	587	390	201	62	6	2,756	1968-2008, 2013-16
2	Bago	Bago -Mean	Mean	5	5	14	22	346	681	818	679	509	167	65	8	3,318	1996-2005, 2013-16
3	Tharrawady	Tharrawady -Mean	Mean	3	1	0	15	191	501	549	534	253	246	43	1	2,335	2013-16
4	Shwegyin	Shwegyin -Mean	Mean	9	32	21	52	306	632	833	857	466	193	45	35	3,481	1996-2016
5	Belin	Belin -Mean	Mean	6	1	16	70	541	1,064	1,417	1,277	725	251	42	6	5,416	2004-2016
6	Thaton	Thaton -Mean	Mean	12	3	14	80	585	1,008	1,328	1,240	765	265	45	17	5,362	2004-2016
7	Myit Kyoe	Myit Kyoe -Mean	Mean					495	520	520	731	656	245	92		3,259	2008-2016
8	Shan Gyaing	Shan Gyaing -Mean	Mean	15	0	0	0	217	609	903	770	497	219	123	0	3,352	2014-16
Average				8	6	11	39	375	696	869	834	533	223	64	10	3,660	

Source: JICA Study Team, DMH, ID



Source: JICA Study Team, DMH

Figure 4.1.5 Monthly Mean Rainfall at 8 Stations

4.1.4. Air Quality

The secondary data of air quality at the nearest point in the project area is shown below. This point is similar with the project area on land use and degree of development. Air quality such as PM10, PM2.5, CO and NO2 is not exceeding Myanmar Standards, IFC and Japanese Standards.

In this EIA, measured and forecasted data is compared with Myanmar Standards and/or IFC Standards in principle. However, other standards, such as Japanese Standards, are adopted when the Myanmar Standards and IFC are nonexistent for a specified item.

Table 4.1.3 Air Quality at the Nearest Point in the Project Area (Kaw Gone Village)

Item Location	Measurement (Standards :[1]Myanmar Guideline [2]IFC Standard, [3] Japanese Standard,)				
	PM_{10} 1(50μg/m^3: 24 hrs.)	$PM_{2.5}$ 1(25μg/m^3: 24hrs)	CO 2(10ppm: 24hrs)	NO_2 1(200μg/m^3: 1hrs)	SO_2 1(20μg/m^3: 24hrs)
Kaw Gone Village	28	17	0.02	180	<100

Source: The Project for Improvement of the East – West Economic Corridor/Sub Project-1/The Project for Construction of Thaton Bypass and 3 Bridges (Don Tha Mi, Naung Lon and Gyaing Kawkareik Bridge)(2014 JICA)

Table 4.1.4 National and International Standards on Air Quality

Standard	PM_{10}	$PM_{2.5}$	CO	NO_2	SO_2
National Environmental Quality (Emission)	50μg/m^3 (24hrs)	25μg/m^3 (24hrs)	-	200μg/m^3 (1 hr)	20 μg/m^3 (24hrs)
IFC (International Finance Corporation)	150 μg/m^3 (24hrs)	75 μg/m^3 (24hrs)	-	200 μg/m^3 (1hr)	20 μg/m^3 (24hrs)
Japanese Standards	SPM 0.10 mg/m3 (24hrs) (converted value 100 μg/m3)	-	10ppm (24hrs)	0.04-0.06ppm Converted value (75.26-110μg/m^3) (24hrs)	0.04ppm Converted value (100μg/m^3) (24hrs)

Source: National Environmental Quality Guidelines (Myanmar 2015), IFC Standards (Environmental, Health, and Safety (EHS) Guidelines 2007), Japanese Standards (Environmental Quality Standards in Japan - Air Quality 1973)

Source: Based on Google Earth and The Project for Improvement of the East – West Economic Corridor/Sub Project-1/The Project for Construction of Thaton Bypass and 3 Bridges (Don Tha Mi, Naung Long and Gyaing Kawkareik Bridge)(2014 JICA)

Figure 4.1.6 Air and Water Quality Survey Point (2014)

4.1.5. Water Quality

The secondary data of water quality at the nearest point in the project area is shown below. This point is located on the branch river of Sittaung as shown in Figure 4.1.6. Myanmar and IFC do not have any standards on river water quality. Thus, the Japanese Standards on river water quality is adopted in this case. The survey results do not satisfy the Japanese Standards except for the SS value.

Table 4.1.5 Water Quality at the Nearest Point in the Project Area (Kyone Eite Chaung River)

Item Location	Condition	Measured Values (Standard Value : IFC Standard)				
		pH (6.5-8.5)	BOD (3 mg/l)	SS (25 mg/l)	EC (No standard)	Temp (No standard)
Kyone Eite Chaung River	River	5.47	10	7.5	25	27.8

Source: The Project for Improvement of the East – West Economic Corridor/Sub Project-1/The Project for Construction of Thaton Bypass and 3 Bridges (Don Tha Mi, Naung Long and Gyaing Kawkareik Bridge)(2014 JICA) (Measured on 9th of September, 2014)

Table 4.1.6 Japanese Standards on River Water Quality

No	Parameters	Unit	Japanese Standards (Category B)
1	pH-value	pH	6.5-8.5
2	COD	-	-
3	BOD	-	3mg/l
4	Total Suspended Solids	mg/l	25 mg/l
5	Turbidity	NTU	-
6	Coliform	No/100ml	5,000 MPN/100ml

Source: Japanese Standards (Environmental Standard for Water , Ministry of Environment 1997)

4.1.6. Natural Protected Areas

No law-based natural protected areas are observed in the project area as shown in Figure 4.1.7.

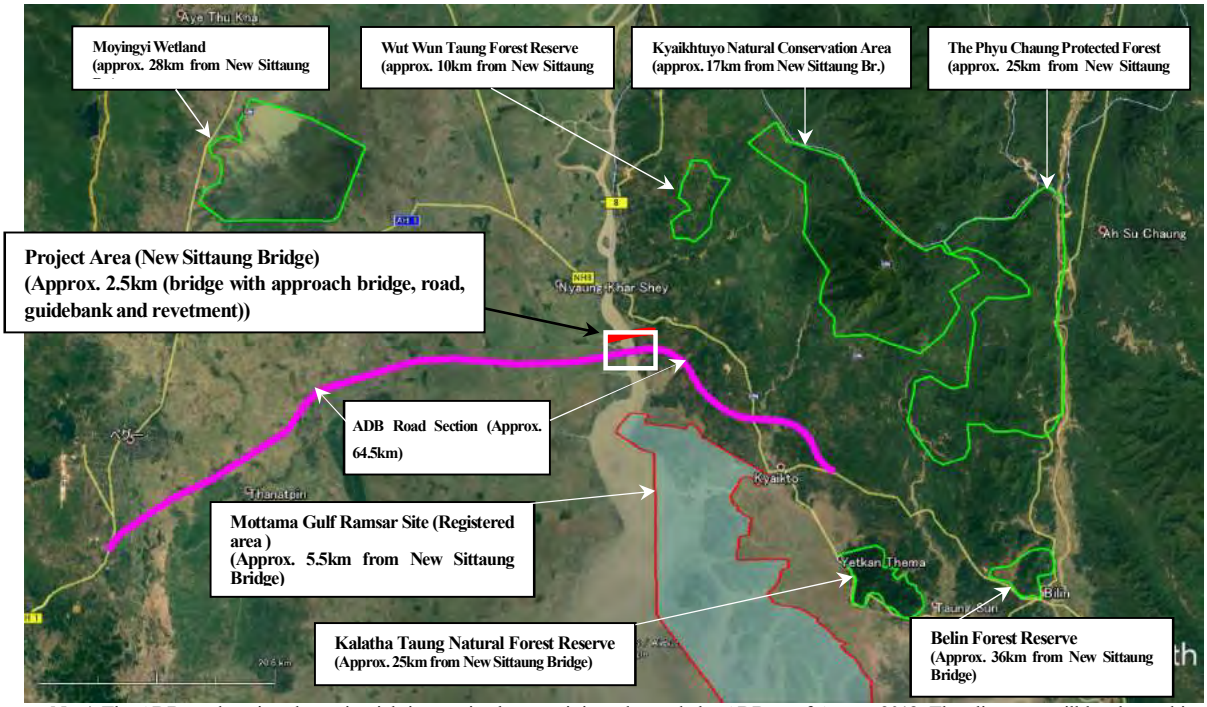
However, the potential management area and the registered Ramsar Site named Gulf of Mottama are located approximately 3.6km and 5.5km away from the planned bridge location, respectively. It is expected the project does not cause serious impacts. However, the degree of adverse impacts on natural environment is analyzed based on site surveys and interview with wildlife specialists.

Table 4.1.7 Natural Protected Areas and Features

Name of Protected Area (Distance from the Site to the Project Area)	Basic Information	Main Purpose and Features (Confirmed Recorded Considerable Species)
Moyingyi Wetland (approx. 28km)	Year Established: 2014 Area: 10,360 ha Relevant Laws: -Forest Law (1992) -Wildlife Conservation Law (1994) -RAMSAR Convention	To protect seasonal migratory birds and conserve wetland ecosystem (migratory birds and resident bird species) Key Resources (133 bird species with a recorded population of 1,8364 which include 1 Vulnerable (VU) and 4 Near Threatened (NT): Source: BANCA (2014)
Wut Wun Taung Forest Reserve (approx. 10km)	Year Established: 1907 Area: 1,502 ha Relevant Laws: Forest Law (1992) -Wildlife Conservation Law (1994)	To ensure sustainable development of forest resources for social environment and economic purposes. Conservation and management of teak and other valuable hardwood species such and Pyinkado on a sustainable basis
Kyaikhtiyo Natural Conservation Area (approx. 17km)	Year Established: 1998 Area: 15,600 ha Relevant Laws: Forest Law (1992) Wildlife Conservation Law (1994)	To protect wildlife species such as leopard, serow, red goral and tiger
The Phyu Chaung Protected	Year Established: 1884	To ensure sustainable development of forest resources for social

Name of Protected Area (Distance from the Site to the Project Area)	Basic Information	Main Purpose and Features (Confirmed Recorded Considerable Species)
Forest (approx. 25km)	Area: 28,617 ha Relevant Laws: - Forest Law (1992) -Wildlife Conservation Law (1994)	environment and economic purposes Conservation and management of teak and other valuable hardwood species such and Pyinkado on a sustainable basis
Kalatha Taung Natural Forest Reserve (approx. 25km)	Year Established: 1947/2016 Area: 2393 ha Relevant Laws: -Forest Law (1992) -Wildlife Conservation Law (1994)	To protect wildlife species such as monkeys, wild cats, pangolin and barking deer
Belin Forest Reserve (approx. 36km)	Year Established: 1908 Area: 208 ha Relevant Laws: -Forest Law (1992) -Wildlife Conservation Law (1994)	To ensure sustainable development of forest resources for social environment and economic purposes Conservation and management of teak and other valuable hardwood species such and Pyinkado on a sustainable basis
Gulf of Mottama Ramsar Site (approx. 5.5km/ registered area)	Year Established: 10th of May 2017 Area: approx. 42,500 ha Relevant Law: Ramsar Convention	To protect seasonal migratory birds and conserve wetland ecosystem (resident migratory birds and resident bird species) Key Resources: (a recorded population of 195,848 which include 1 Critically Endangered (CR spoon-billed sandpiper), 1 Endangered (EN), 1 Vulnerable (VU) and 9 Near Threatened (NT) as well as waders , gulls, terns and other water bird species. Source: BANCA (2017)

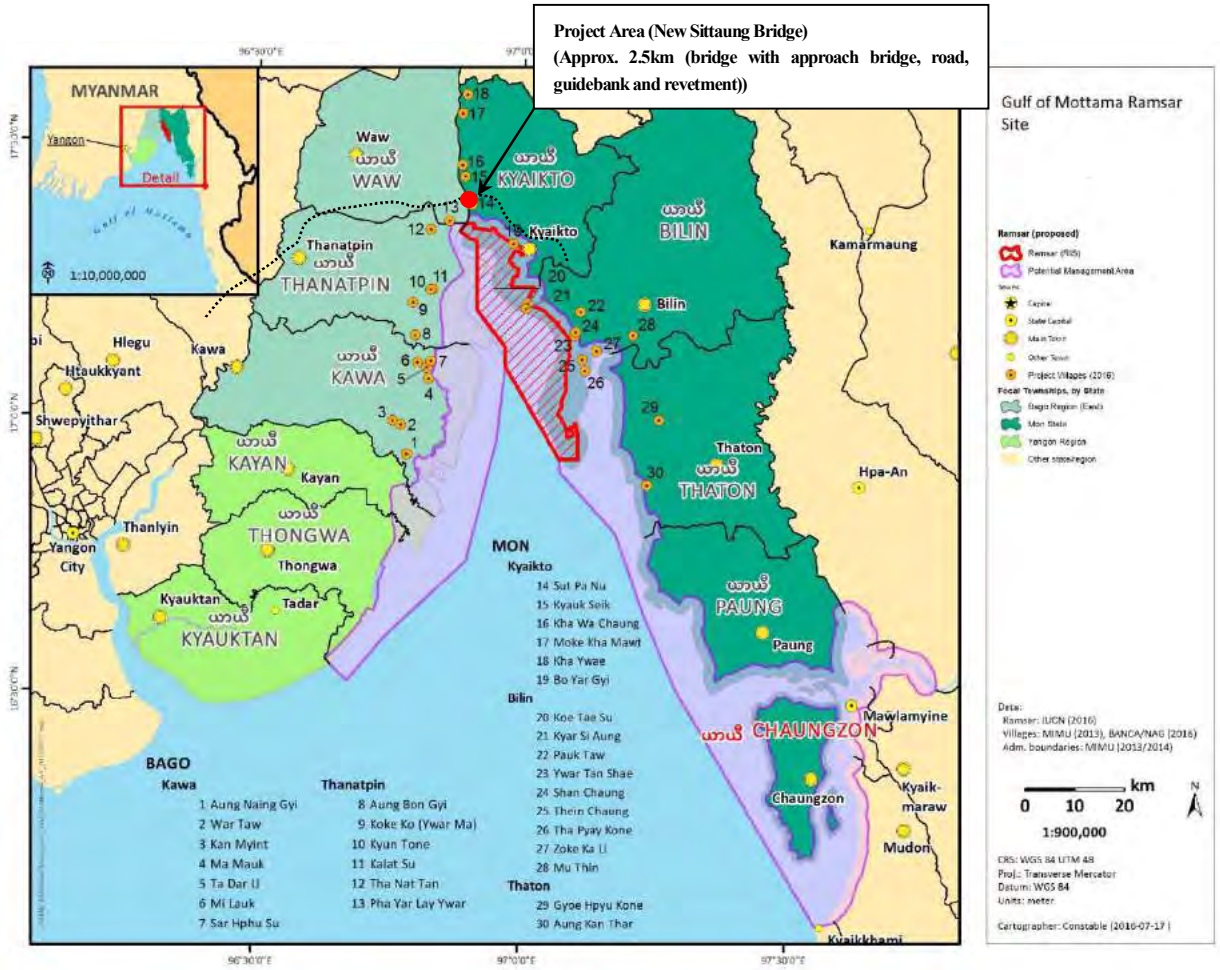
Source: JICA Study Team



Note) The ADB road section shown in pink is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.

Source: JICA Study Team based on Google Earth satellite map (Original sources: Land Records 1944/Forest Department and Ramsar Site (No.2299))

Figure 4.1.7 Natural Protected Area Map in the Project Area and Distance from the Project Area



Source: Myanmar Designates the Gulf of Mottama as a Ramsar Site
(https://www.ramsar.org/news/myanmar-designates-the-gulf-of-mottama-as-a-ramsar-site)

Figure 4.1.8 Location of Registered Gulf of Mottama Ramsar Site and Potential Management Area

Table 4.1.8 Major Birds Species Observed in Mottama Gulf Ramsar Site (Secondary Data)

Phylum	Scientific name	Common name	IUCN Red List	Remarks
AVES	Calidris ferruginea	Curlew Sandpiper	NT	Non-breeding
AVES	Calidris minuta	Little Stint	LC	Non-breeding
AVES	Calidris ruficollis	Red-necked Stint	NT	Non-breeding
AVES	Charadrius alexandrinus	Kentish Plover; Snowy Plover	LC	Non-breeding
AVES	Charadrius mongolus	Lesser Sand Plover; Lesser Sand-Plover	LC	Non-breeding
AVES	Chlidonias leucopterus	White-winged Tern	LC	Non-breeding
AVES	Eurynorhynchus pygmeus	Spoon-billed Sandpiper	CR	The global population estimates of the Critically Endangered Spoon-billed Sandpiper Calidris pygmaeus have been revised downwards several times, owing to the rapid decline of the species. There are now (2014) believed to be 450-500 birds remaining in the wild, including a breeding cohort of 120 pairs (Zöckler et al. 2016). The importance of the Ramsar site as a wintering area has been appreciated only in recent years, and even over this period its proportional importance and critical nature for this bird has been reassessed as even greater than originally thought. Myanmar as a whole hosts more than half of the world population at only two sites, of which the Ramsar site has the majority,
AVES	Limicola falcinellus	Broad-billed Sandpiper		Non-breeding
AVES	Limosa limosa	Black-tailed Godwit	NT	SE Asia Local migrant, breeding in region
AVES	Mycteria leucocephala	Painted Stork	NT	Non-breeding
AVES	Pluvialis fulva	Pacific GoldenPlover; Pacific Golden-Plover	LC	Non-breeding
AVES	Threskiornis melanocephalus	Black-headed Ibis	NT	Non-breeding
AVES	Tringa totanus	Common Redshank	LC	Non-breeding

Source: 3.3 - Animal species whose presence relates to the international importance of the site/ Ramsar Information Sheet, Designation date 24 January 2017, Site number 2299, Coordinates 17°08'55"N 97°00'11"E, Area 42 500,00 ha, Myanmar Gulf of Mottama, https://rsis.ramsar.org/ris/2299, Created by RSIS V.1.6 on - 7 May 2017

4.1.7. Natural Habitat Areas

The Important Birds Area (IBA) and Key Biodiversity Area (KBA) are located on the project area except Mottama Gulf IBA/KBA as shown in Figure 4.1.9.

A detailed map indicating the relationship between the bridge and IBA/KBA and feature is shown in Table 4.1.9 and Figure 4.1.10.

The IBA and KBA are not law-based conservation areas; however, impacts on biodiversity are analyzed in this ESIA.

Table 4.1.9 Outline of Mottama Gulf IBA/KBA

Habitat Name	Basic Information	Impact	Selection Criteria for IBA/KBA
Gulf of Mottama Important Birds Area (IBA) / Key Biodiversity Area (KBA)	Year Established: 2013 Area: Approx. 110,000 ha Category: A1, A4	Project area occupies approx. 25ha in IBA/KBA	Category indicated as follows; A1: Globally threatened species Criterion: The site is known or thought regularly to hold significant numbers of globally threatened species. A4: Congregations Criterion: The site is known or thought to hold congregations of ≥1% of the global population of one or more species on a regular or predictable basis.

Source: IBA: Birdlife International Website (http://datazone.birdlife.org/site/factsheet/gulf-of-mottama-iba-myanmar)

Table 4.1.10 Trigger Species in Mottama Gulf IBA/KAB

Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Painted Stork Mycteria leucocephala	NT	resident	2008-2012	140 individuals	A4i
Black-headed Ibis Threskiornis melanocephalus	NT	resident	2008-2012	150-300 individuals	A4i
Charadrius alexandrinus	NR	non-breeding	2008-2012	10,000-20,000 individuals	A4i
Pacific Golden Plover Pluvialis fulva	LC	non-breeding	2008-2012	8,000-10,000 individuals	A4i
Lesser Sandplover Charadrius mongolus	LC	non-breeding	2008-2012	20,000-40,000 individuals	A4i
Eurasian Curlew Numenius arquata	NT	non-breeding	2008-2012	2,200-4,000 individuals	A4i
Black-tailed Godwit Limosa limosa	NT	non-breeding	2008-2012	3,500-5,000 individuals	A4i
Great Knot Calidris tenuirostris	EN	non-breeding	2009	456 individuals	A1
Broad-billed Sandpiper Calidris falcinellus	LC	non-breeding	2008-2012	4,000-5,000 individuals	A4i
Curlew Sandpiper Calidris ferruginea	NT	non-breeding	2008-2012	7,000-12,000 individuals	A4i
Spoon-billed Sandpiper Calidris pygmaea	CR	non-breeding	2010	74-180 individuals	A1, A4i
Red-necked Stint Calidris ruficollis	NT	non-breeding	2008-2012	7,000-12,000 individuals	A4i
Spotted Redshank Tringa erythropus	LC	non-breeding	2008-2012	1,400-2,000 individuals	A4i
Common Greenshank Tringa nebularia	LC	non-breeding	2008-2012	1,800-3,500 individuals	A4i
Common Redshank Tringa totanus	LC	non-breeding	2008-2012	4,500-8,000 individuals	A4i
Spotted Greenshank Tringa guttifer	EN	non-breeding	2009-2011	117 individuals	A1, A4i

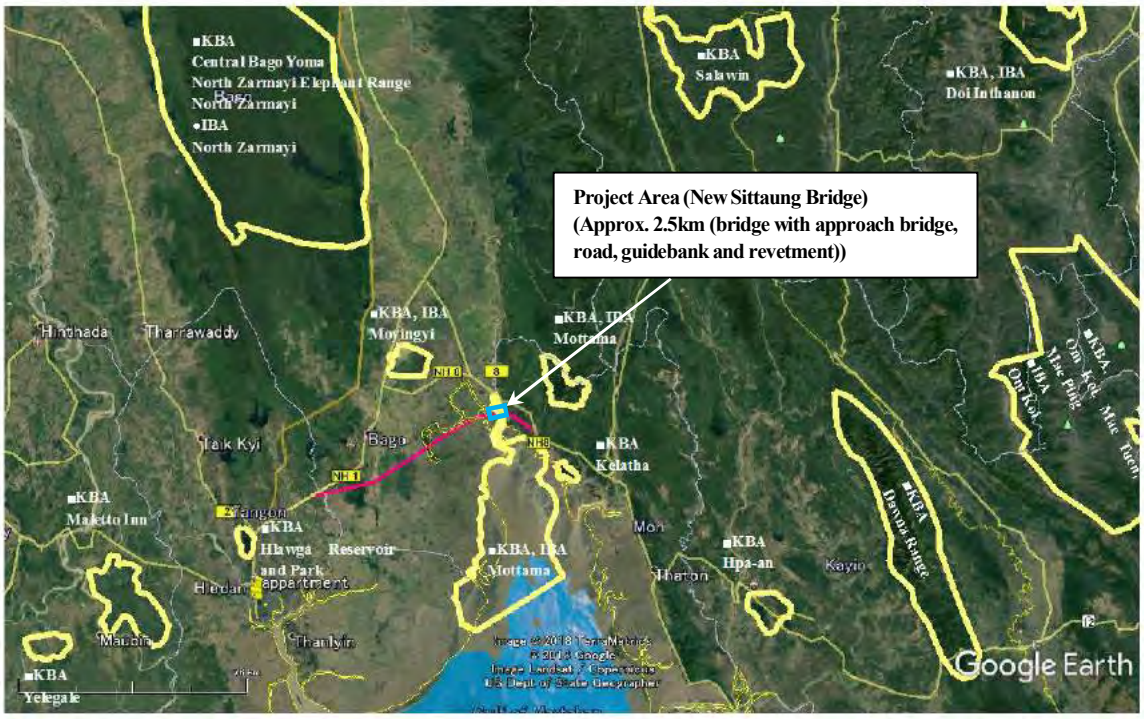
A1. Globally threatened species
Criterion: The site is known or thought regularly to hold significant numbers of a globally threatened species.
Notes: The site qualifies if it is known, estimated or thought to hold a population of a species categorized by the IUCN Red List as Critically Endangered, Endangered or Vulnerable. In general, the regular presence of a Critical or Endangered species, irrespective of population size, at a site may be sufficient for a site to qualify as an IBA. For Vulnerable species, the presence of more than threshold numbers at a site is necessary to trigger selection.

A2. Restricted-range species
Criterion: The site is known or thought to hold a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area (SA).
Notes: This category is for species of Endemic Bird Areas (EBAs). EBAs are defined as places where two or more species of restricted range, i.e. with world distributions of less than 50,000 km2, occur together. More than 70% of such species are also globally threatened. Also included here are species of Secondary Areas. A Secondary Area (SA) supports one or more restricted-range species, but does not qualify as an EBA because less than two species are entirely confined to it. Typical SAs include single restricted-range species which do not overlap in distribution with any other such species, and places where there are widely disjunct records of one or more restricted-range species, which are clearly geographically separate from any of the EBAs.

A3. Biome-restricted species
Criterion: The site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome.
Notes: This category applies to groups of species with largely shared distributions which occur mostly or wholly within all or part of a particular biome and are, therefore, of global importance. As with EBAs, it is necessary that a network of sites be chosen to protect adequately all species confined to each biome and, as necessary, in each range state in which the biome occurs. The 'significant component' term in the Criterion is intended to avoid selecting sites solely on the presence of one or more biome-restricted species that are common and adaptable within the EBA and, therefore, occur at other chosen sites. Additional sites may, however, be chosen for the presence of one or a few species which would, e.g. for reasons of particular habitat requirements, be otherwise under-represented.

A4. Congregations
Criterion: The site is known or thought to hold congregations of ≥1% of the global population of one or more species on a regular or predictable basis.
Notes: This criterion can be applied to seasonal (breeding, wintering or migratory) congregations of any waterbird, seabird or terrestrial bird species. Sites can qualify whether thresholds are exceeded simultaneously or cumulatively, within a limited period. In this way, the criterion covers situations where a rapid turnover of birds takes place (including, for example, for migratory landbirds).

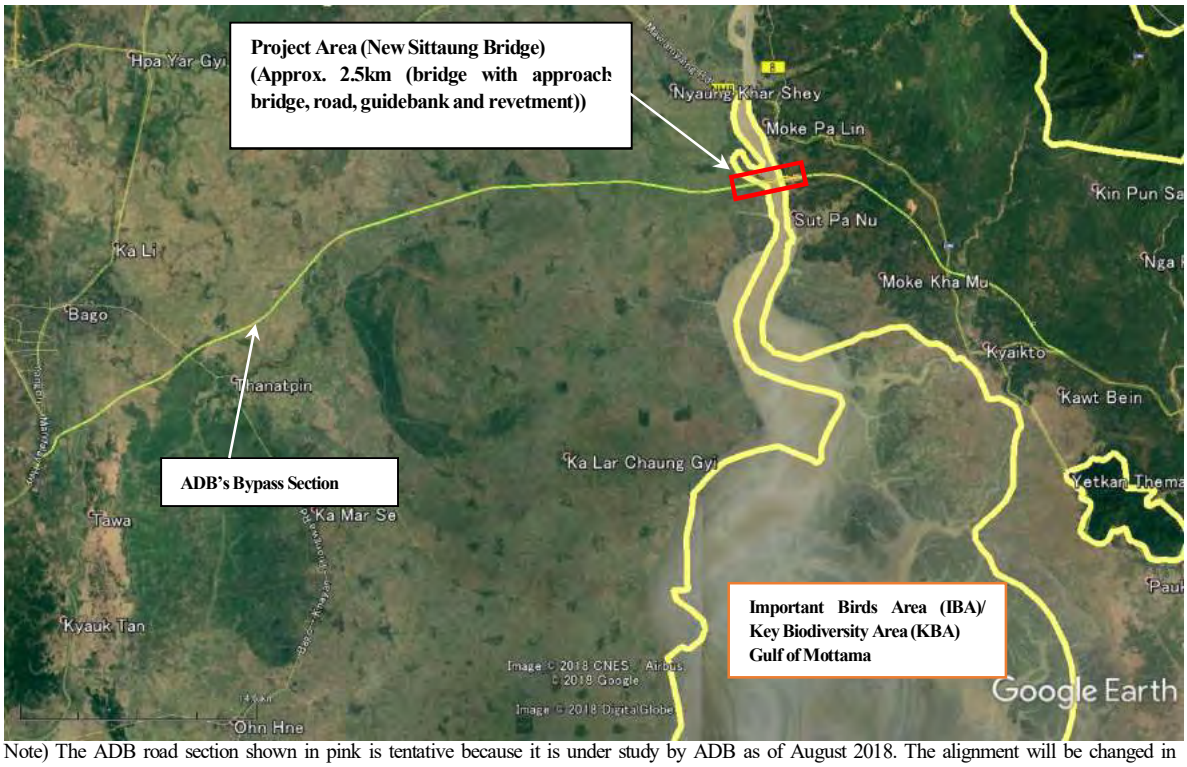
Source: IBA: Birdlife International Website (http://datazone.birdlife.org/site/factsheet/gulf-of-mottama-iba-myanmar/details)



Note) The ADB road section shown in pink is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.

Source: JICA Study Team based on Google Earth satellite map (IBAT Website (https://www.ibat-alliance.org/ibat-conservation/mapviewerol213))

Figure 4.1.9 IBA and KBA Location Map near the Project Area



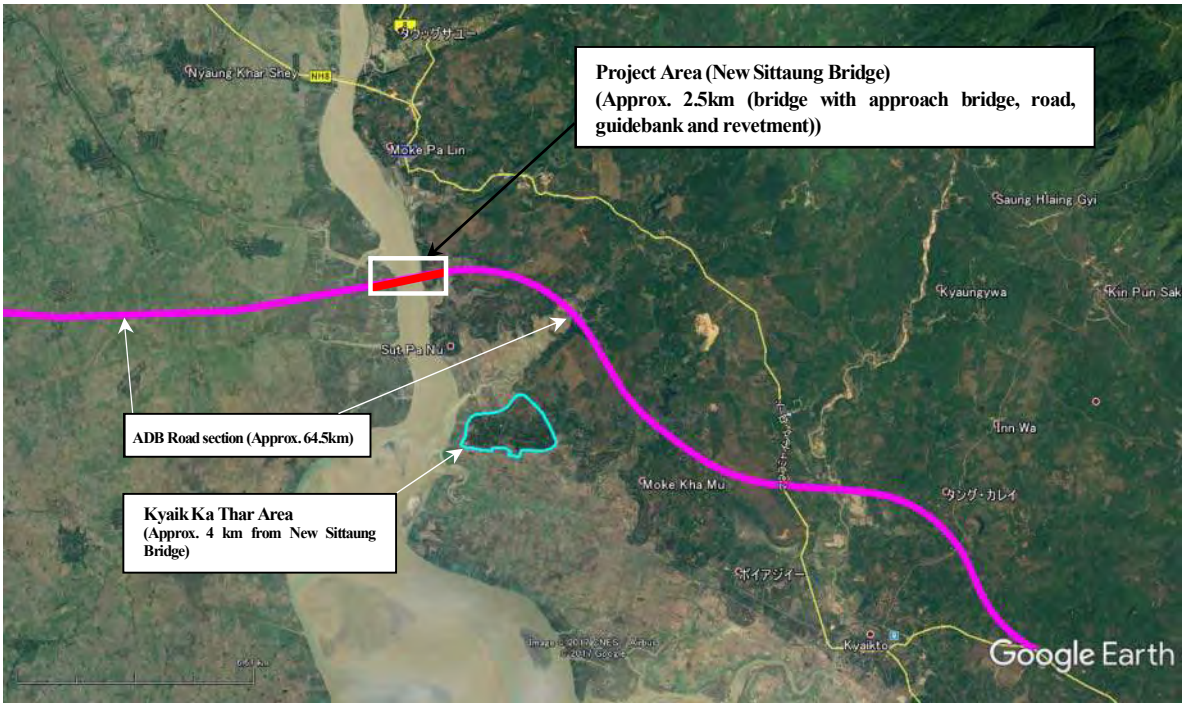
Note) The ADB road section shown in pink is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.

Source: JICA Study Team based on Google Earth satellite map
(IBAT Website (https://www.ibat-alliance.org/ibat-conservation/mapviewerol213))

Figure 4.1.10 Natural Habitat in the Project Area (IBA/KBA)

4.1.8. Cultural Heritage

No registered considerable cultural heritages are observed in the planned bridge location. However, a well-known ancient city named Kyaik Ka Thar is located approximately 4.5km away from the bridge location. This city is not registered as a designated cultural heritage; however, the city is well known in Mon State. However, this village is not a major tourist spot for foreigners, thus there are no viewpoints in this village.



Note) The ADB road section shown in pink is tentative because it is under study by ADB as of August 2018. The alignment will be changed in accordance with the ADB study result.

Source: JICA Study Team based on Google Earth satellite map

Figure 4.1.11 Major Cultural Heritage Site (Kyaik Ka Thar)

4.2. Socio-Economy

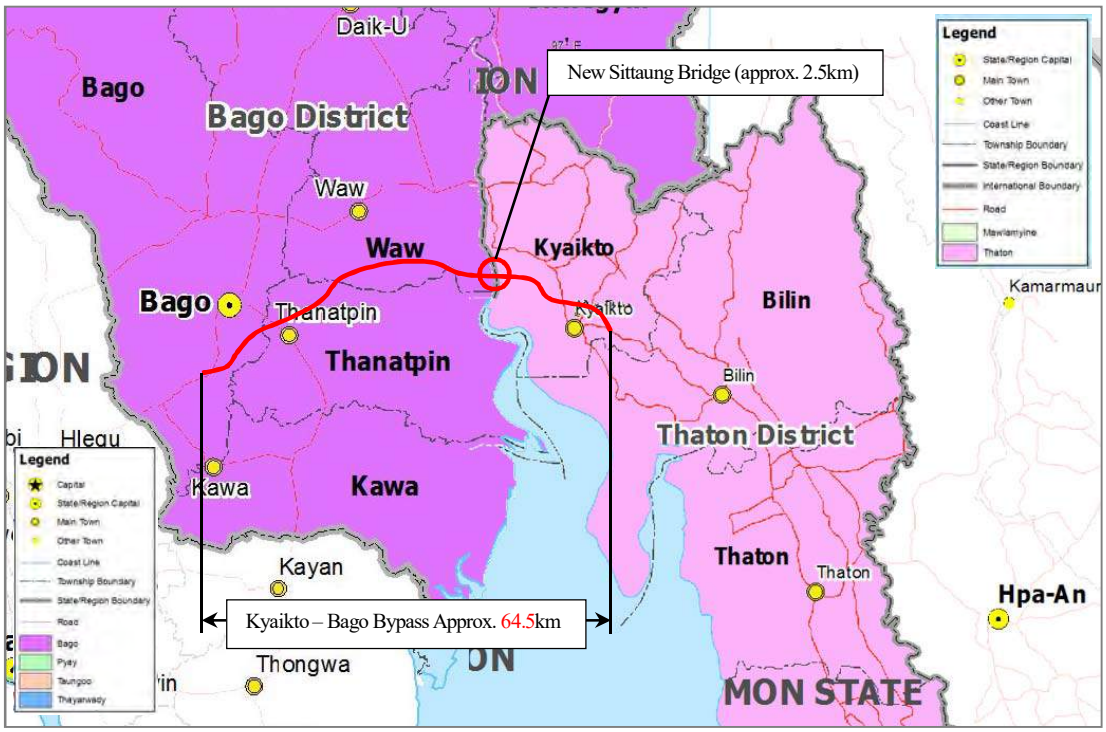
4.2.1. Population

The Socio-Economic characteristics in the Project Area are shown below. The population is 2,054,000 in Mon State and 4,867,000 in Bago Region, totaling 13.4% of Myanmar's population.

Table 4.2.1 Socio-Economic Situation in the Project Area

Item	Year	State	Value	Remarks
Area (km^2)	2015	Mon State	12,297	Total in Myanmar: 676,577
		Bago Region	39,404	
Population (Persons x 1,000)	2014	Mon State	2,054	Total in Myanmar : 51,486
		Bago Region	4,867	
Population Density (Persons/km^2)	2014	Mon State	167	National Average : 76
		Bago Region	124	
		Bago Region [east]	387,785	

Source: 2015 Myanmar Statistical Yearbook/ Central Statistical Organization, Ministry of National Planning and Economic Development



Note) The ADB road section is tentative because it is under study by ADB as of January 5, 2018. The alignment will be changed in accordance with the ADB study result.
Source: JICA Study Team based on Myanmar Information Management Unit

Figure 4.2.1 Administration Map in the Project Area

4.2.2. Education and Literacy

The education system in Myanmar is comprised of five-year, four-year and two- year systems which are one to five grades for primary school, six to nine grades for middle school, and ten to eleven grades for high school. The literacy rate of adults in Myanmar is at 92.7%. The literacy rate of women compared to men is also at high level which is 94% for women compared to 100% for men. The number of primary schools, middle schools and high schools in Bago Region and Mon State where the project area is located are shown in the table below.

Table 4.2.2 Number of Schools and Students in the Project Area

Item / Area	Number of Schools				Number of Students				Number of Student/ School			
	Primary	Middle	High	Total	Primary	Middle	High	Total	Primary	Middle	High	Total
Myanmar	38,017	2,625	1,924	42,566	5,079,135	2,736,252	840,706	8,656,093	133.6	1042.4	437.0	203.4
Bago Region	4,129	253	187	4,569	501,165	268,950	81,268	851,383	121.4	1063.0	434.6	186.3
Mon State	1,239	107	90	1,436	223,371	112,724	33,974	370,069	180.3	1053.5	377.5	257.7

Source: Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development 2016

4.2.3. Health and Sanitation

In Myanmar, major diseases are diarrhea, gastroenteritis, viral infection, head injury, etc., and the major causes of mortality are septicemia, disorders related to short gestation and low birth weight, human immunodeficiency virus (HIV) disease, etc.

As shown in the table below, the number of hospitals and dispensaries in each region are 33 hospitals and 20 dispensaries in Mon State, and 96 hospitals and 44 dispensaries in Bago Region, respectively.

Table 4.2.3 Infectious Diseases and Cause of Deaths in the Project Area

	Infectious Disease	Rate (%)	Cause of Death	Rate (%)
1	Diarrhea / Gastroenteritis	6%	Sepsis	8%
2	Viral Infection	4%	Disorders related to short gestation and low birth weight	6%
3	Head Injury	4%	Human immunodeficiency virus [HIV] disease resulting in infectious and parasitic diseases	4%
4	Gastritis / Duodenitis	3%	Birth asphyxia	4%
5	Cataract	2%	Other and unspecified head injuries	3%

Source: Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development 2016

Table 4.2.4 Number of Hospitals in the Project Area

Area	Number of Hospitals	Number of Clinics※1	Number of Beds	Population per Hospital or Clinic (Person)	Population per bed (Person)
Myanmar	975	576	44,133	33,195	1,167
Mon State	33	20	1,077	38,755	1,907
Bago Region	96	44	2,706	34,764	1,799

Note) Based on survey in 2013-2014

Source: Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development 2016

4.2.4. Employment, Income and Poverty

The GDP per capita (2014 - 2015) in Myanmar is 1,254,582 kyat (1 USD = 1,410 Kyat (Sep. 2018)).

The average monthly household expenditure is 167,434 kyat in Myanmar, 170,223 kyat in Mon State and 160,330 kyat in Bago Region, respectively.

The poverty line is 39,090 kyat per capita per month in Myanmar. On the contrary, poverty line is 28,758 kyat in Mon State and 32,315 kyat in Bago Region.

The status of employment is shown in Table 4.2.5. The labor force participation rate in Mon State is 55.53% and 67.97% in Bago Region, respectively. The unemployment rate is 1.1% in Mon State and 1.0% in Bago Region and the gap between men and women is not significant. Employment to population ratio is 64.2% in Mon State and 67.3% in Bago Region.

Table 4.2.6 Average Expenditure and Poverty Line in the Project Area

Item	Year	State/Region	Value	Remarks
Average Expenditure (kyat/month)	2012	Mon State	170,223	Average in Myanmar : 167,434
		Bago Region	160,330	
Poverty Line Note-1) (kyat/month)	2013/ 2017	Mon State	28,758	Average in Myanmar : 39,090
		Bago Region	32,315	

Note-1) State/ Regional information is referring to "A regional perspective on poverty in Myanmar / UNDP 2013
Country information is referring to "An analysis of poverty in Myanmar / World Bank. 2017"
Note-2) 1 USD = 1,410 Kyat (September, 2018)
Source: 2015 Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development

Table 4.2.7 Employment in the Project Area

Area	Labor force ratio (%) (16 years – 65 years)			Unemployment rate (%)			Employment rate to population (%) (16 years – 65 years)		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Myanmar	64.71	80.20	51.60	0.8	0.7	0.9	64.2	79.7	51.1
Mon State	55.53	74.60	39.89	1.1	1.1	1.3	54.9	73.8	39.4
Bago Region	67.97	82.01	56.19	1.0	0.9	1.1	67.3	81.2	55.6

Source: Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development 2016

CHAPTER 5 SCREENING AND SCOPING

In this Chapter, screening in accordance with Myanmar laws and relevant guidelines and scoping for the prioritized route as a result of alternative analysis are described.

5.1. Screening

The Construction of New Sittaung Bridge project has been classified as EIA project by ECD as of August 21st, 2017 in accordance with EIA Procedure in 2015, Myanmar Law.

Additionally, the EWEC Project including the New Sittaung Bridge Construction Project (JICA Section) has been classified as Category A in accordance with JICA Guidelines.

5.2. Scoping

5.2.1. Scoping Matrix and Reasons

Target activities and main structures to be analyzed are construction of bridge, guidebank and revetment. The impacted items, factors and degree of impacts are shown in Table 5.2.1. This matrix is called "Leopold Matrix" and indicates the relationship between the impacted item and its factor as visually understandable. Additionally, the detailed impacts and reasons are compiled in Table 5.2.2.

During construction, quarry, borrow pit, base camp, construction access road, temporary muck soil storage space and other related facilities are secured by the construction contractor.

Since the location, scale and capacity are not specified during the F/S stage, the general expected impact degree, methodology of baseline survey, and forecast and draft mitigation measures will be prepared in another chapter as "Environmental and Social Considerations for Relevant Facilities Prepared Under Decision-Making by the Construction Contractor".

Table 5.2.1 Scoping Matrix (Bridge, Guidebank and Revetment)

	No	Affected Activities / Impacted Items (JICA)	Overall Rating	Pre/ During Construction Phase: Land acquisition and loss of properties Including demolition of existing bridges	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment and vehicles	Construction of bridges, guidebank, revetment, approach road and other related facilities	Traffic restriction in construction area	Influx of construction workers, construction of base camp including storage	Development and operation of borrow pit and quarry*	Operation Phase: Increase of through traffic and traveling speed	Appearance/Occupancy of roads and related building structures including tunnel and embankment	Increasing influx of settlers
Pollution	1	Air pollution	**B-**	D	D	D	D	D	B-	D	D	D	B-	B-	D	D
	2	Water pollution	**B-**	D	D	D	D	B-	B-	B-	D	B-	B-	C	D	D
	3	Waste	**B-**	D	D	D	B-	B-	D	D	D	B-	D	D	D	D
	4	Soil contamination	**B-**	D	D	D	D	B-	B-	B-	D	B-	B-	D	D	D
	5	Noise and vibration	**B-**	D	D	D	D	D	B-	D	D	D	D	B-	D	D
	6	Ground subsidence	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	7	Odor	**B-**	D	D	D	D	D	D	D	D	B-	D	D	D	D
	8	Sediment quality (soil contamination)	**B-**	D	D	D	D	B-	D	B-	D	B-	B-	D	D	D
Natural Environment	9	Ecosystem	**B-**	D	D	D	B-	B-	D	B-	D	D	C	B-	B-	D
	10	Protected area	**C**	D	D	D	D	C	D	C	D	D	D	C	C	D
	11	Hydrology	**B-**	D	D	D	D	B-	D	B-	D	D	D	D	B-	D

	No	Affected Activities / Impacted Items (JICA)	Overall Rating	Pre/ During Construction Phase: Land acquisition and loss of properties Including demolition of existing bridges	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment and vehicles	Construction of bridges, guidebank, revetment, approach road and other related facilities	Traffic restriction in construction area	Influx of construction workers, construction of base camp including storage	Development and operation of borrow pit and quarry*	Operation Phase: Increase of through traffic and traveling speed	Appearance/Occupancy of roads and related building structures including tunnel and embankment	Increasing influx of settlers
	12	Topography and geology	**B-**	D	D	D	D	B-	D	B-	D	D	B-	D	B-	D
Social Environment	13	Involuntary resettlement	**B-**	B-	D	D	D	D	D	D	D	D	C	D	D	D
	14	The poor	**C**	C	D	D	D	D	D	D	D	D	C	D	D	D
	15	Indigenous and ethnic people	D	D	D	D	D	D	D	D	D	D	C	D	D	D
	16	Local economy such as employment and livelihood	**B-**	B-	D	D	D	D	D	D	D	D	C	B+	D	D
	17	Land use and utilization of local resources	**B-**	B-	D	D	D	D	D	D	D	D	**B-**	D	D	**B-**
	18	Water usage	**B-**	C	D	D	D	B-	D	B-	D	D	C	D	B-	D
	19	Existing social infrastructures and services	**B-**	C	D	D	D	B-	D	B-	B-	D	D	D	B-	D
	20	Social institutions such as local decision-making institutions	**B-**	D	D	D	D	D	D	B-	B-	D	D	D	B-	D
	21	Misdistribution of benefits and damages	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Social Environment	22	Local conflict of interests	**B-**	D	D	D	D	D	D	D	D	B-	D	D	D	D
	23	Cultural heritage	**C**	C	D	D	D	D	D	D	D	D	C	D	D	D
	24	Landscape	**B-**	D	D	D	D	B-	D	B-	D	D	B-	D	B-	D
	25	Gender	**C**	D	D	D	D	D	D	D	D	C	D	D	C	D
	26	Rights of children	**C**	D	D	D	D	D	D	D	D	C	C	D	D	D
	27	Infectious diseases such as HIV/AIDS	**B-**	D	D	D	D	D	D	D	D	B-	C	D	D	B-
	28	Labor environment (including work safety)	**B-**	D	D	D	D	D	D	D	D	B-	C	D	D	D
Others	29	Accidents	**B-**	D	D	D	D	D	B-	D	B-	D	C	B-	D	D
	30	Cross boundary impacts and climate change	**B-**	D	D	D	D	D	B-	B-	D	D	B-	C	D	D

Note) Rating:

A: Serious impact is expected. B: Some impacts are expected. C: Degree and area of impacts are unknown (further surveys and analysis shall be done) D: Few impacts are expected. Thus, baseline surveys and analysis are not necessary. +/- : Positive and Negative Impacts

* Baseline survey, forecast and evaluation for borrow pits, quarry sites, construction roads and other related facilities decided by the Construction Contractor are not the target for this ESIA. Only scoping and general mitigation measures are prepared in Chapter 10.

Source: JICA Study Team

Table 5.2.2 Reasons of Scoping (Bridge, Guidebank and Revetment)

Area	No	Impacted Items on JICA Guidelines	Rating At Scoping Stage: Pre/ During Construction	Rating At Scoping Stage: Operation Phase	Reasons for the Rating
Pollution	1	Air pollution	**B-**	**B-**	**Construction phase:** Temporary negative impacts on air quality are expected due to operation of construction machines and equipment. **Operation phase:** Negative impact is expected due to increase in traffic number.
	2	Water pollution	**B-**	**C**	**Construction phase:** Turbid water may be generated by earthworks and excavation in the river where bridges, guidebank and revetment are planned. Additionally, organic polluted water may be discharged from the base camp. Development and operation of borrow pits and quarries may generate turbid water. Leaking oil from construction machines may cause soil contamination. **Operation phase:** No impacts are expected due to lack of plans regarding service and parking areas along the bridge and approach road. Rain water with chemical substances may run off from

Area	No	Impacted Items on JICA Guidelines	Rating At Scoping Stage		Reasons for the Rating
			Pre/ During Construction	Operation Phase	
					road surface after paving the road.
	3	Waste	**B-**	D	**Construction phase:** Construction waste such as waste soil and cutting trees are expected. Additionally, domestic waste and night soil may be generated from the construction base camp. **Operation phase:** No impacts are expected due to lack of plans regarding service and parking areas along the bridge and approach road.
	4	Soil contamination	**B-**	D	**Construction phase:** Excavated soil on the site may be polluted. Stored construction material such as oil and chemicals may pollute the soil in the base camp. Leaking oil from construction machines may cause soil contamination. **Operation phase:** No impacts are expected due to lack of plan regarding soil contamination.
	5	Noise and vibration	**B-**	**B-**	**Construction phase:** Noise and vibration generation is expected due to operation of construction machines and equipment. **Operation phase:** Noise and vibration generation is expected due to driving of vehicles.
	6	Ground subsidence	D	D	**Construction and operation phase:** No impacts are expected since activities such as large-scale earthworks and pumping water, which causes ground subsidence, are not planned. Additionally, soft ground which causes ground subsident are not observed in the project area.
	7	Odor	**B-**	D	**Construction Phase:** Bad odor may be caused by domestic waste and construction materials in the base camp. **Operation phase:** No impacts are expected due to lack of plans regarding service and parking areas which generate solid and liquid wastes.
	8	Sediment quality (See No. 4 Soil contamination)	**B-**	D	**Construction phase:** If excavated soil in the project site is polluted and taken out to other area, such polluted waste soil may impact the sediment quality of the nearest river. Leaking oil and chemicals from base camps negatively impact the sediment quality of the nearest river. **Operation phase:** Road operation, which causes impacts on sediment quality, is not expected.
Natural environment	9	Ecosystem	**B-**	**B-**	**Construction phase:** The alignment is not passing through any law-based natural protected areas. Potential management area and registered Mottama Gulf Ramsar Site as law-based protected area is located downstream 3.6km and 5.5km away, respectively. Construction activities and construction noise and vibration may give adverse impacts to some species which have feeding areas near the project area. Turbid water, which is generated from the construction area, may negatively impact the ecosystem in the Mottama Ramsar Site. However, construction activities in the river do not give serious impacts if the methodology which does not generate significant turbidity is adopted. Furthermore, the project area is passing through Important Birds Area (IBA) and Key Biodiversity Area (KBA) which are proposed by international NGOs. Although IBA and KBA are not law-based protected areas, project activities may give some impacts. **Operation phase:** An existence of structures such as bridge, approach road and guidebank, and traffic flow with noise and vibration may give adverse impacts to some species which have feeding areas in the project area.
	10	Protected area	**C**	**C**	**Construction phase:** The alignment is not passing through any law-based natural protected areas. As a law-based protected area, Mottama Gulf Ramsar Site is located downstream 3.6km away as management area and 5.5 km as core area, respectively. Construction activities and construction noise and vibration may give adverse impacts to some species which have feeding areas near the project area. Turbid water, which is generated from the construction area, may negatively impact the ecosystem in the Mottama Ramsar Site. However, construction activities in the river do not give serious impacts if the methodology which does not generate significant turbidity is adopted. Furthermore, the project area is passing through Important Birds Area (IBA) and Key Biodiversity Area (KBA) which are proposed by international NGOs. Although IBA and KBA are not law-based protected areas, project activities may give some impacts. **Operation phase:** An existence of bridge and traffic flow with noise and vibration may give adverse impacts to some species which have feeding areas in the project area.
	11	Hydrology	**B-**	**B-**	**Construction and operation phase:** Construction of bridge, guidebank and revetment may change the hydrological situation of the rivers. And earthwork section and construction of structures may cause impacts to small streams in agricultural land.
	12	Topography and geology	**B-**	**B-**	**Construction and operation phase:** Considerable topography and geological sites are not located in the Project Area, thus no impact is expected. However, embankment of the bridge may be caused by slope failure. Additionally, soil erosion and slope failure may be caused by borrow pits and quarry sites.
Social environment	13	Involuntary resettlement	**B-**	D	**Pre-construction phase:** Land acquisition and a few resettlements are expected on the proposed route. However, it is estimated that the number of resettlers does not exceed 200 persons. **Operation phase:** No impact is expected due to lack of plan on resettlement and land acquisition after construction.
	14	The poor	**C**	D	**Pre-construction phase:** The person under poverty line may be impacted by project activities

Area	No	Impacted Items on JICA Guidelines	Rating At Scoping Stage		Reasons for the Rating
			Pre/ During Construction	Operation Phase	
					such as land acquisition. Degree of impacts will be assessed based on the feature of the local society around the project site. **Operation phase:** No impacts are expected due to lack of plan on resettlement and land acquisition after construction.
	15	Indigenous and ethnic people	D	D	**Pre-construction phase:** Any indigenous and ethnic people are not observed at project area including surrounding borrow pits and quarry sites in accordance with WB OP4.10. Thus it is not likely give any adverse impacts on indigenous people. **Operation phase:** No impact is expected due to lack of plan on resettlement and land acquisition after construction.
	16	Local economy such as employment and livelihood	**B-**	**B+**	**Pre-construction phase:** Livelihood of residents, farmers and fishermen may be affected by acquisition of agricultural area and traffic restriction in the river. **Operation phase:** No impact is expected due to lack of plan on resettlement, land acquisition and traffic restriction after construction. However a part of fishermen who is using gill-net method may be impacted due to existence of piers in the river. On the other hand, travelling time to Yangon is shorten due to commencement of new bridge and bypass
	17	Land use and utilization of local resources	**B-**	**B-**	**Pre-construction phase:** Mainly agricultural areas such as paddy fields and rubber plantations will be affected by the project. **Operation phase:** No impact is expected due to lack of plan on resettlement and land acquisition after construction. However, inappropriate land use, such as development of unplanned area, gives impacts to sound urbanization and ecosystem in conservation areas.
	18	Water usage (See No. 11 Hydrology)	**B-**	D	**Construction phase:** Land acquisition may give impact on irrigation system and/or drinking water resources such as wells. Earthwork section and construction of structures may give impacts to irrigation channels and small streams. Land acquisition for development of quarry and borrow pit may cause impacts to wells and small irrigation channels. **Operation phase:** No impact is expected due to lack of plan on resettlement and land acquisition after construction.
	19	Existing social infrastructures and services	**B-**	**B-**	**Pre-construction and Construction phase:** Some schools, meeting places and other public utilities may be affected by land acquisition. Additionally, traffic restriction and existence of structures in the project area will cause impact on commuting and fishermen's activities in the river. **Operation phase:** Existence of structures may cause impact on the approach toward social infrastructures, communication between communities, access to agriculture fields and other services.
	20	Social institutions such as local decision making institutions (See No. 19 Existing social infrastructures and services)	**B-**	**B-**	**Construction and operation phase:** Restriction of the construction area and existence of embankment may cause division of the communities.
	21	Misdistribution of benefit and damage	D	D	**Construction and operation phase:** Misdistribution of benefit and damage caused by the bridge construction is not expected because the construction of bridge provides fair benefits to inhabitants.
	22	Local conflict of interests	**B-**	D	**Construction phase:** Local inhabitants and local authorities may request to ensure fair job opportunities as construction workers. **Operation phase:** No impact is expected (same as No. 21 "Misdistribution of benefit and damage")
	23	Cultural heritage	**C**	D	**Pre-construction and construction phase:** Registered facilities are not affected by the project. However, some religious facilities at community levels such as community pagodas and monasteries may be affected by construction bridges, approach road, revetment and guidebank. **Operation phase:** No impact is expected as there is no land acquisition after construction
	24	Landscape	**B-**	**B-**	**Construction phase:** There are not any law-based protected areas regarding landscape near the project area. However, few impacts are expected during bridge construction. In the quarry and borrow pit sites, alternation of land may have impacts on landscape. **Operation phase:** There are no law-based designated landscape areas around the Project Area. However, changing of usual landscape is expected due to construction of structures. Development of quarry sites and borrow pits may cause impact on landscape.
	25	Gender	**C**	**C**	**Construction and operation phase:** According to interview with the authority regarding gender issues in Myanmar, no issues on gender in infrastructure area are observed. Thus, no impacts are expected on this item.

Area	No	Impacted Items on JICA Guidelines	Rating At Scoping Stage		Reasons for the Rating
			Pre/ During Construction	Operation Phase	
	26	Rights of children	**C**	D	**Construction and operation phase:** Child labor issues regarding infrastructure are not observed in the project area based on interview with the Myanmar Government. However, child laborers may be hired in the construction site. **Operation phase:** No impact is expected because there are no activities regarding children labor.
	27	Infectious diseases such as HIV/AIDS	**B-**	**B-**	**Construction phase:** Infectious diseases, such as STDs, are possible to spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provide habitats for mosquitoes that could possibly transmit malaria and dengue fever. **Operation phase:** Number of influx settlers and tourists increase after construction of the bypass and may distribute infectious diseases such as STDs.
	28	Labor environment	**B-**	D	**Construction phase:** Construction work environment needs to be considered in accordance with relevant laws and regulations. **Operation phase:** No impact is expected as there are no laborers after construction.
Others	29	Accidents	**B-**	**B-**	**Construction phase:** Construction vehicles may use the existing local roads near residential areas, which may increase the number of traffic accidents. **Operation phase:** Risks of traffic accidents on the new road is expected due to increase in traveling speed.
	30	Cross boundary impacts and climate change	**B-**	**C**	**Construction phase:** Operation of construction machines and construction of structures generates GHGs. **Operation phase:** The driving distance between Kyaikto and Bago will be shortened by the construction of the bypass, thus positive impacts are expected in the Project Area. However, converted traffic number may generate additional GHGs. On the other hand, climate change may cause impacts on the increase of sea level and volume of rainfall in the future, thus the design of the bridge shall consider climate change.

Note) Rating:
A: Serious impact is expected. B: Some impacts are expected. C: Degree and area of impacts are unknown (further surveys and analysis shall be done) D: Light impact is expected. Thus, baseline surveys and analysis are not necessary. +/-: Positive and Negative Impacts
* Baseline survey, forecast and evaluation for borrow pits, quarry sites, construction roads and other related facilities are planned by the Construction Contractor and are not the target for this ESIA. Only scoping and general mitigation measures are prepared in Chapter 11.
Source: JICA Study Team

5.2.2. **Baseline Survey and Analysis Methodology**

The expected baseline survey and analysis methodologies are shown below.

Table 5.2.3 Baseline Survey and Analysis Methodology

Category	No (Rating)	Impacted Items on JICA Guidelines	Survey Item and Methodology	Forecast Methodology
Pollution	1 (B-/B-)	Air pollution	(1) Site measurement : 2 points (West bank and East bank) (2) Item: CO, NO2, SO2, TSP (3) Frequency: One time (in dry season, if possible) Note: Collection of secondary data, if any *Instruments: Haz-Scanner Environmental Perimeter Air Station (EPAS)	Quantitative forecast Puff model Or refer other case examples
	2 (B-/C)	Water pollution	(1) Site measurement (2 points at each bridge (up/down stream) x 2 seasons (rainy and dry season) = 4 measurements) (2) Item: BOD, pH, SS, temperature (3) Frequency: Twice (rainy and dry season, if possible) Note: Secondary data collection, if any *Instruments: Multi 3430 - Digital Meter for Digital IDS Sensor HORIBA U-50, Multiparameter Water Quality Meter	Qualitative forecast Or refer other case examples
	3 (B-/D)	Waste	(1) Site survey: Registered land fill site near project site. Interview regarding construction waste management in MOC. (2) Item: Summary of the site (3) Frequency: Once Note: Secondary data collection, if any	Qualitative forecast
	4 (B-/D) 8 (B-/D)	Soil contamination Sedimentation quality	(1) Site Survey: Excavation point (2) Item: cadmium, total cyanide, organic phosphorus, lead, chromium (VI), arsenic, total mercury, alkyl mercury, PCBs, copper, dichloromethane, carbon tetrachloride, 1,2-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, tetrachloroethylene, 1,3-dichloropropene, thiuram, simazine, thiobencarb, benzene and selenium. (3) Frequency: Once Note: Secondary data collection, if any *Instruments: 1) Removing the soil One-Piece Auger 2) Carring the soil EDX 7000/8000 Spectrometer	Qualitative forecast
	5 (B-/B-)	Noise and vibration	(1) Site measurement: 2 points (West bank and East bank) (2) Item Ambient Noise: $L_{Aeq,}$ Continuous 24hr/weekday(1hr average x 24hrs), traffic volume and speed Ambient Vibration (1 hr average x 24hr): 24hr/weekday (3) Frequency: Once (in dry season, if possible) Note: Secondary data collection, if any *Instruments: 1) Noise Sound Pressure Level meters 2) Vibration Vibration Level Meter VM-55	Quantitative forecast (Traffic noise on the boundary and at sensitive receptor / L_{aeq} dB(A))
	7 (B-/D)	Odor	Baseline survey is not required	Qualitative forecast
Natural environment	9 (B-/B-)	Ecosystem	(1)Site survey: 500m each alongside of the bridge guidebank and revetment. Birds' survey area is surveyed within 1km by using telescope. (2) Item: Fauna and flora, ecosystem, considerable species such as listed species on IUCN list Fauna: Mammals, birds, reptiles, amphibians, aquatic life, insects and benthos Flora: Land plants and aquatic plant *basically line transect method is used in this survey (3) Frequency: One time Note: Secondary data collection, if any. Interview with wildlife and bird specialists.	Qualitative forecast
	10 (C/C)	Ecosystem		
	11 (B-/B-)	Hydrology	Refer to hydrology survey by JST (Flooding record survey, Hydrologic analysis)	Qualitative forecast
	12 (B-/B-)	Topography and geology	Refer to topography and geology survey by JST (topographic and geological survey)	Qualitative forecast
Social environ	13 (B-/D)	Involuntary resettlement	Refer to RAP survey by JST (PAPs census, inventory of loss, socio-economic survey, replacement cost study)	Qualitative forecast
	14	The poor	Refer to RAP Survey by JST	Qualitative forecast

Category	No (Rating)	Impacted Items on JICA Guidelines	Survey Item and Methodology	Forecast Methodology
	(C/D)		(PAPs census, socio-economic survey (income))	
	16 (B-/B+)	Local economy such as employment and livelihood	Refer to RAP survey by JST (PAPs census, inventory of loss, socio-economic survey (occupation), replacement cost study)	Qualitative forecast
	17 (B-/D)	Land use and utilization of local resources	Refer to RAP survey by JST (PAPs census, inventory of loss (crops, rubber trees), socio-economic survey)	Qualitative forecast
	18 (B-/D)	Water usage	(1) Site survey: 500m range along the alignment (2) Items: -River water utilization on the site -Underground water (pH, BOD, total coliform, conductivity, temperature and water level of well) (3) Frequency: twice (rainy and dry season, if possible) Note: Secondary data collection, if any	Qualitative forecast
	19 (B-/B-)	Existing social infrastructures and services	(1) Site survey: 1,000m range along the alignment (2) Items: Distribution of hospital, school, religious place, community center and traffic number in the river (3) Frequency: Once Note: Secondary data collection, if any	Qualitative forecast
	20 (B-/B-)	Social institutions such as social infrastructure and local decision-making institutions	Refer to construction plan	Qualitative forecast
	22 (B-/D)	Local conflict of interests	Refer to local stakeholder meetings on EIA or RAP (collection of opinions regarding local conflict)	Qualitative forecast
	23 (C/D)	Cultural heritage	(1) Site survey: 300m range along the alignment (2) Item: Distribution of registered cultural heritage (3) Frequency: Once Note: Secondary data collection, if any	Qualitative forecast
	24 (B-/C)	Landscape	(1) Site survey: Inquire major sightseeing points (2) Item: Taking photographs (3) Frequency: Once (in dry season, if possible)	Photomontage
	25 (C/C)	Gender	(1) Site survey: Interview with relevant organizations in Myanmar	Qualitative forecast
	26 (C/C)	Rights of children	(1) Site survey: Interview with MOC and visual site survey at construction sites	Qualitative forecast
	27 (B-/B-)	Infectious diseases such as HIV/AIDS	Data collection from secondary sources (Interview / Statistical data)	Qualitative forecast
	28 (B-/D)	Labor environment	Confirmation of laws, regulations and IFC standards regarding labors	Qualitative forecast
Others	29 (B-/B-)	Accidents	(1) Site survey: Interview with police station and local government (2) Item: Number of traffic accident and reasons (3) Frequency: Once	Qualitative forecast
	30 (B-/C)	Cross boundary impacts and climate change	Refer to traffic demand forecast done by JST, emission units by car model year, car type, driving speed	Quantitative forecast

Note) Rating:

A: Serious impact is expected. B: Some impacts are expected. C: Degree and area of impacts are unknown (further surveys and analysis shall be done) D: Light impact is expected. Thus, baseline surveys and analysis are not necessary. +/-: Positive and Negative Impacts

* Baseline survey, forecast and evaluation for borrow pits, quarry sites, construction roads and other related facilities are planned by the Construction Contractor and are not the target for this ESIA. Only scoping and general mitigation measures are prepared in Chapter 11.

Source: JICA Study Team

CHAPTER 6 IMPACT AND RISK ASSESSMENT AND MITIGATION MEASURE

6.1. Pollution

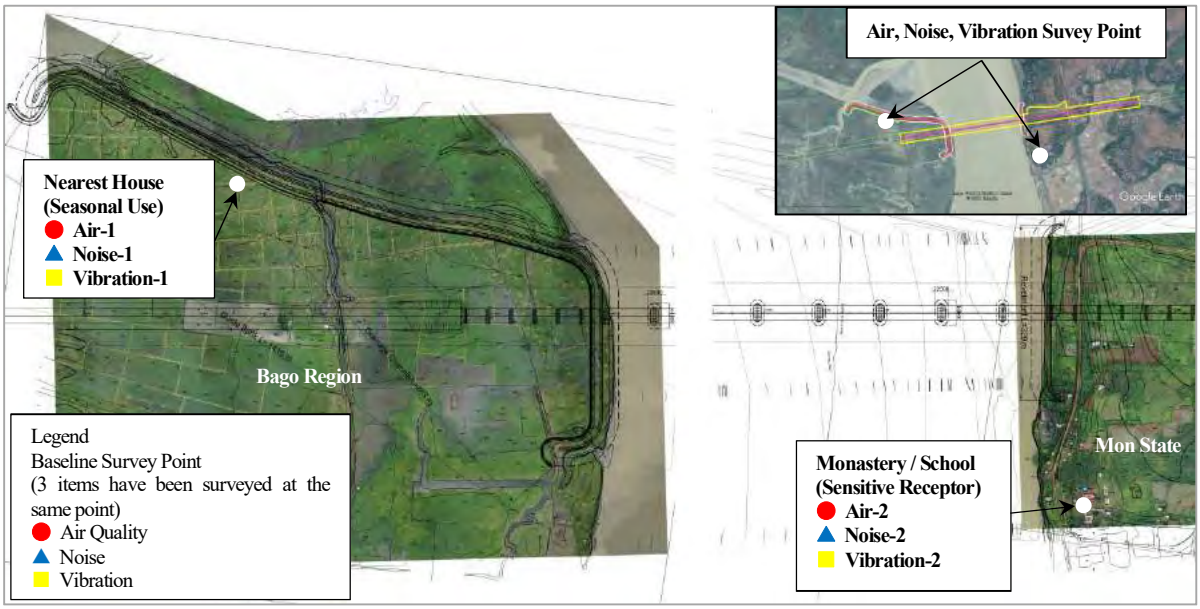
6.1.1. Air Pollution

(1) Result of Baseline Survey

1) Survey Point

Measurement point for air quality, noise and vibration is shown in Figure 6.1.1.

In general, air, noise and vibration measurement is conducted along planned bridge and approach road to grasp the current situation.



Source: JICA Study Team
Note: Air-1: 17°24'15.07"N/ 96°52'54.65"E, Air-2: 17°24'4.80"N/ 96°53'50.01"E
Noise-1: 17°24'15.17"N/ 96°52'54.60"E, Noise-2: 17°24'5.36"N/ 96°53'49.12"E
Vibration-1: 17°24'15.32"N/ 96°52'54.45"E, Vibration-2: 17°24'5.91"N/ 96°53'49.70"E

Figure 6.1.1 Air, Noise and Vibration Measurement Locations

2) Result of Measurement

The measured data for air quality is shown in the next table.

With regard to PM_{10} which is an indicator of dust, all points are exceeding Myanmar standard value due to dry season and agricultural land. Measured values on NO_2, CO and SO_2 satisfied the Myanmar and other country's standards.

Table 6.1.1 Monitoring Date of Air Quality (March 22nd – 23rd, 2018)

Parameter / Location (measured date)		NO_2 (Nitrogen Dioxide) Average for 24hrs [μg/m³]	PM_{10} (particulate matters 10μm) Average for 24hrs [μg/m³]	CO (Carbon Monoxide) Average for 24hrs [ppm]	SO_2 (Sulphur Dioxide) Average for 24hrs [μg/m³]
Air-1 (March 22nd, 2018) Bago Region, Waw Township, Shangai Village (At nearest house (seasonal use))		65.631	**74.820** (exceeding)	0.0873	9.55
Reference ADB data (June 2018) Bago Region (ET#11)		111.84	26.39	0.00015	3.02
Air-2 (March 23rd, 2018) Mon State, Kyaito Township, Sut Pa Nu Village (Monastery / School (Sensitive Receptor))		69.297	**52.150** (exceeding)	0.067	8.21
Reference ADB data (June 2018) Mon State (ET#12)		89.63	37.38	0.00000	2.63
Standard	Myanmar Standards*1	200	**50**	None	**20**
	IFC Standards *2	1year: 40 1 hour: 200	50	None	None
Reference Standard	Japanese Standards	76.53	SPM 100	**10 (24hrs average)** **20 (8hrs average)**	106.65 *converted value
	Thailand Standard	325.3 (1 hr average) 57.4 (1 year average) *converted value	120 (24 hrs average) 40 (1 year average) *converted value	**30 (1 hr average)** **9 (8hrs average)** *converted value	319.8 *converted value

Source: *1: National Environmental Quality (Emission) Guidelines (MONREC, December 29th, 2015)
*2: Environmental, Health, and Safety General Guidelines (IFC, April 30th, 2007)
Note: Air-1: 17°24'15.07"N/ 96°52'54.65"E
Air-2: 17°24'4.80"N/ 96°53'50.01"E

(2) Potential Impacts

1) During Construction

Temporary negative impacts on air quality are expected due to operation of construction machines and equipment.

2) After Construction

Negative impact is expected due to the increase in traffic number.

(3) Impact Forecast

1) During Construction

Exhaust gases, including CO, NO_2, SO_2 and PM, are discharged from construction machines and may cause impact on the nearby residential area. However, this adverse impact is not serious because of the following reasons:

- Operation time is within a limited duration and only at daytime
- Most of the earthworks is limited only to excavation at pillars
- Residential area is not observed near the construction area

2) After Construction

a) Location of Forecast Point and Traffic Volume

Increase of traffic volume will give a degree of adverse impacts on air quality.

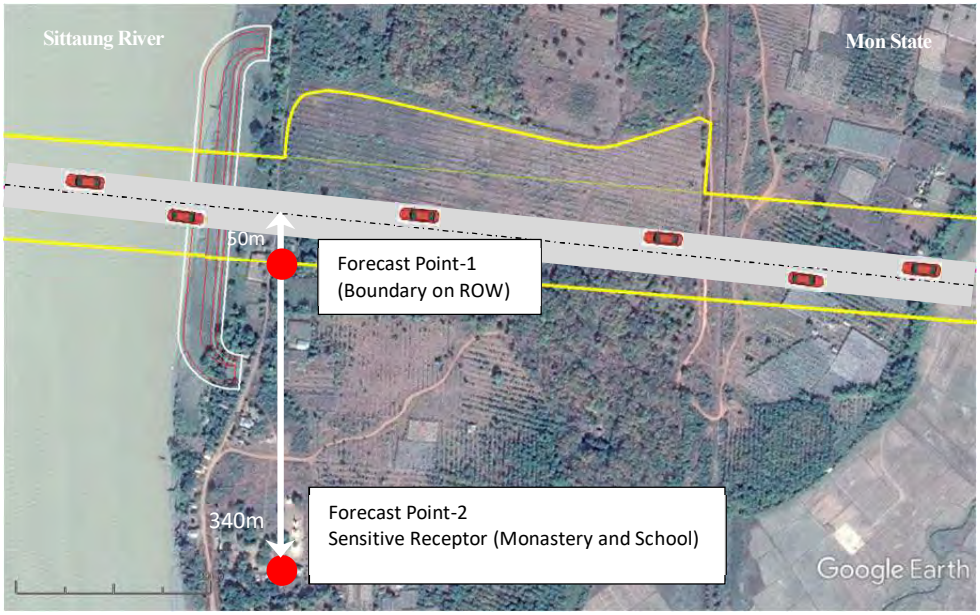
The Puff model, which is widely used in the analysis of air pollution in Japan, is adopted for

quantitative analysis in this case. One point is at the boundary of ROW and another point is selected as the sensitive receptor for the prediction of air pollution. The traffic volumes at each section are shown in Table 6.1.2, and the location of forecasts are shown in Figure 6.1.2 and Figure 6.1.3.

Table 6.1.2 Traffic Volume at Forecasted Points after Construction

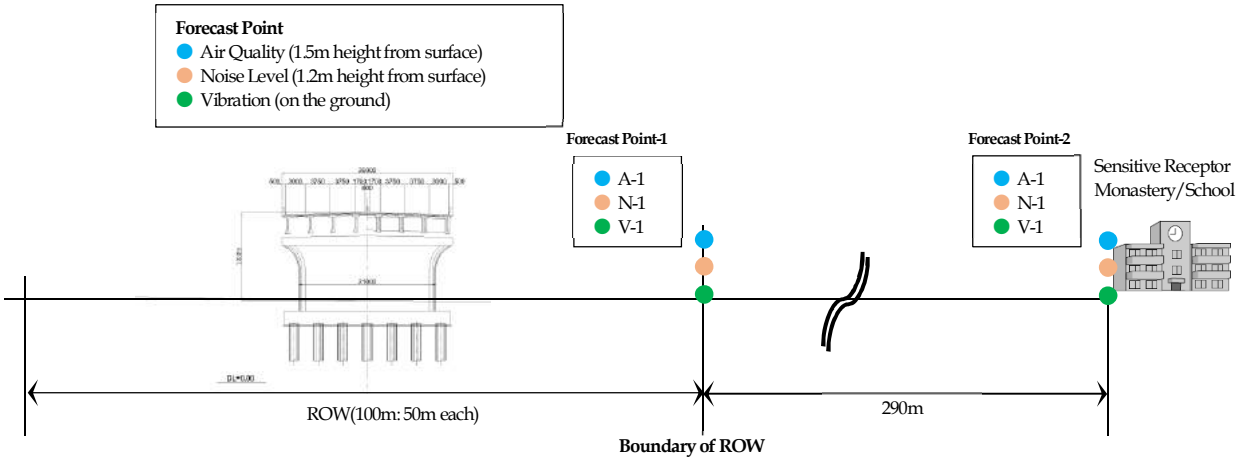
Traffic Volume / Location	Traffic Volume/ Average Speed	Future's Traffic Volume With Project Case (2025) Number a day
Sittaung Bridge Section	Small	9,000
	Big	13,100
	Total	22,100
	Design Speed (km/h)	100 km

Source: JICA Study Team



Source: JICA Study Team based on Google Earth

Figure 6.1.2 Air and Noise and Vibration Forecast Locations (Sensitive Receptor in Sut Pa Nu Village)



Source: JICA Study Team

Figure 6.1.3 Cross Section at Forecast Points (Sensitive Receptor in Sut Pa Nu Village)

b) Result of Forecast

[Methodology of the Air Quality Forecast]

The Puff model is used to predict the road-contributed density. The formulation of the Puff model does not include wind velocity; it means that the baseline data for daily average wind speed with direction for 365 days are not necessary. In the remote area in Myanmar, such statistical data is not available. Additionally in general, the result of analysis by the Puff model is safer side than plume model.

Followings are formulation of puff model methodology. It does not include a parameter regarding wind speed.

$$C(x,y,z)=\frac{Q}{(2\pi)^{3/2}\cdot\alpha^2\cdot\gamma}\left\{\frac{1-\exp\left(-\frac{\ell}{t_0^2}\right)}{2\ell}+\frac{1-\exp\left(-\frac{m}{t_0^2}\right)}{2m}\right\}$$

$$\ell=\frac{1}{2}\cdot\left\{\frac{x^2+y^2}{\alpha^2}+\frac{(z-H)^2}{\gamma^2}\right\},\quad m=\frac{1}{2}\cdot\left\{\frac{x^2+y^2}{\alpha^2}+\frac{(z+H)^2}{\gamma^2}\right\}$$

C (x, y, z) : Forecasted value at the point (x, y, z)
Q : Emission volume from the pollution source (ml/s or mg/s)
H : Height of emission source (m)
$\sigma_{y,z}$: Horizontal and vertical diffusion width (m)
x : Leeward distance (m)
y : Horizontal distance perpendicular to the X axis (m)
z : Vertical distance perpendicular to the X axis (m)
t_0 : Time equivalent to initial diffusion width (s)
α, γ : Coefficient for diffusion width

[Result of Forecast on the Air Quality]

The result of quantitative forecast is shown below. Forecasted values on NO2, CO and SO2 satisfy the adopted standard level. However the value of PM10 is beyond the Myanmar standard value because the current monitored data is already exceeding the standard value. The increase rate is less than 0.1% in 2025, thus the negative impacts of the project are at negligible levels.

Table 6.1.3 Result of Quantitative Forecast on Air Quality after Construction

Point		Forecast Point-1 ROW Boundary (50m from the centerline)		Forecast Point-2 At Sensitive Receptor (Monastery/School) (340m from the centerline)		Standard (□: Adopted standard)		
Parameter		Background (BG)	Forecasted Value with BG (increase rate)	Background (BG)	Forecasted Value with BG (increase rate)	Myanmar	IFC	Japanese
NO_2 ($\mu g/m^3$)	Average for 24hrs	65.631	68.098 (+3.76%)	65.631	66.021 (+0.59%)	**200**	1 year 40 1 hour 200	76.53
PM_{10} ($\mu g/m^3$)	Average for 24hrs	74.820	**74.870 (+0.07%) (exceeding)**	74.820	**74.824 (+0.01%) (exceeding)**	**50**	50	SPM 100
CO (ppm)	Average for 24hrs	0.067	0.077 (+14.93%)	0.067	0.068 (+1.49%)	None	None	**10**
SO_2 ($\mu g/m^3$)	Average for 24hrs	9.55	9.62 (+0.73%)	9.55	9.56 (+0.104%)	**20**	20	106.65

Source: JICA Study Team

(4) Mitigation Measures

1) During Construction

It is expected that the degree of impacts such as dust from construction area is not serious. However, appropriated mitigation measures shall be implemented as shown below:

- ✓ Water sprinkling shall be carried out on earth construction road and construction yard near the residential area. Additionally, surface treatment of the earth road should be considered if required.
- ✓ Periodical cleaning shall be done on paved road used as construction road.

2) After Construction

- ✓ Appropriate land use management should be done along the road. In general, commercial and industrial area shall be designated along the road so as not to cause air pollution directly to the residential area. Such buffer zone can secure diffusion distance and mitigate impacts from exhaust of vehicles.

(5) Evaluation

1) During Construction

Exhaust gases and dusts are generated during construction. However, the adverse impact is not serious because the residential area is far from the construction area. Furthermore, mitigation measures such as sprinkling water and surface treatment is implemented when there is impaction of dust on the nearest residential and commercial areas.

2) After Construction

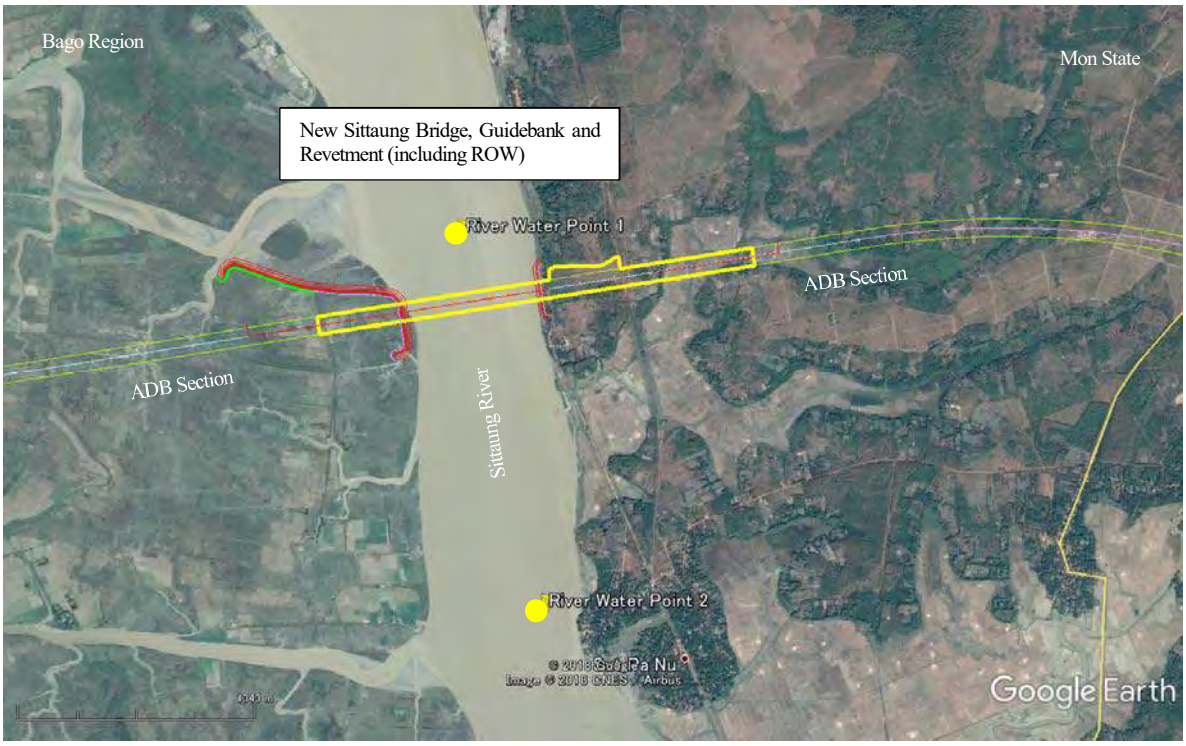
Air quality density will increase after construction due to the existence of road and the driving of vehicles. However, air quality values on NO_2, PM10, CO and SO_2 will increase slightly and these forecasted values satisfy the relevant standards values except for PM10. With regard to PM10, increases are less than 1%. Thus, it is evaluated that the project does not give serious impacts on air quality.

6.1.2. **Water Quality**

(1) Result of Baseline Survey

1) Survey Points

Two (2) measurement points for water quality are shown in Figure 7.1.1.



Source: JICA Study Team (Based on Google Earth satellite image)
Note: River Water-1: 17°24'23.77"N/ 96°53'28.55"E, River Water-2: 17°23'14.89"N/ 96°53'44.61"E

Figure 6.1.4 River Water Quality Sampling Points

2) Result of Measurement

The measured data for air quality is shown in Figure 6.1.4.

Only the pH values in dry and rainy seasons satisfy the standard values. However, BOD and SS values are exceeding Japanese standards. In general, land use takes place along the river in mainly soil surface of agricultural area, thus turbid water of small streams flows into the main Sittaung River. Since sewerage system does not exist in some residential areas along the Sittaung River, SS and BOD values are exceeding standard values.

Table 6.1.4 Monitoring Date of River Water Quality (Dec. 13th – 20th and Feb. 20th)

Location \ Parameter		Temperature [℃]	pH (hydrogen power) [no unit]	BOD (Biochemical Oxygen Demand) [mg/l]	SS (Suspended Solids) [mg/l]
River Water-1 Sittaung River (1.5km downstream from the bridge)	Rainy Season (Sep. 7th, 2017)	25	7.4	**12 (exceeding)**	**212 (exceeding)**
	Dry Season (Mar. 25th, 2018)	25	7.5	**14 (exceeding)**	**62 (exceeding)**
River Water -2 Sittaung River (2.7km downstream from the bridge)	Rainy Season (Sep. 7th, 2017)	25	7.1	**18 (exceeding)**	**296 (exceeding)**
	Dry Season (Mar. 25th, 2018)	25	7.6	**20 (exceeding)**	**86 (exceeding)**
Reference Standard	Japanese Standards	-	**6.5-8.5**	**3 (*3)**	**25**
	National Environmental Quality (Emission) Guidelines [Site Runoff and Wastewater Discharges (construction phase)]	-	6-9	30	50

Source: *1: Ministry of Environment in Japan (River Water Quality / Category B River)
Note: River Water-1: 17°24'23.77"N/ 96°53'28.55"E
River Water-2: 17°23'14.89"N/ 96°53'44.61"E

(2) Potential Impacts

1) During Construction

Turbid water may be generated by earthworks and excavation in the river where bridges, guidebank and revetment are planned. Additionally, organic polluted water may be discharged from the base camp.

2) After Construction

Rain water with oil may run off from the road surface after paving the road.

(3) Impact Forecast

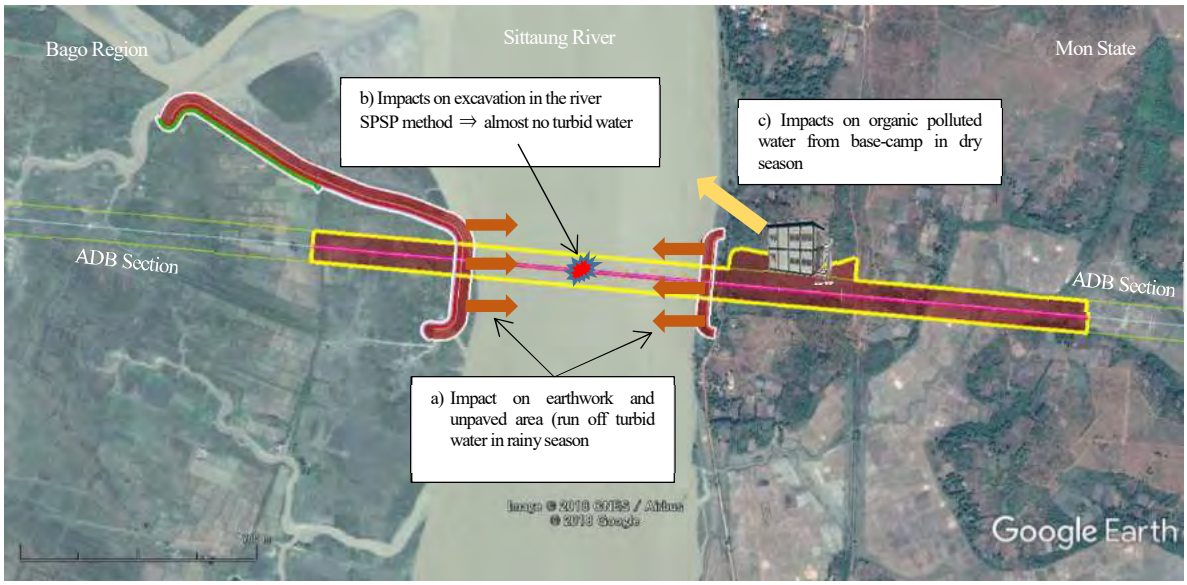
1) During Construction

Image of impacts during construction and forecasted data by source are shown in Table 6.1.5.

Table 6.1.5 Forecasted Impacts Regarding Water Quality During Construction

Impacts \ Parameter		Forecast Condition	Forecasted Impacts
a) Impacts on earthwork and unpaved area	Run off turbid water from unpaved area after raining	Unpaved area max. 250,000 m2	Current SS : 296 mg/l Forecasted SS: 298 mg/l (* 0.97% increase)
b) Impacts on excavation in the river	Excavation at pillars in the river	Steel Pipe Sheet Piles (SPSP) methodology is adopted as piling of foundation works (see mitigation measure)	Turbid water does not come out from excavated point covered with sheet piles, thus negative impacts on turbid water is not caused.
c) Impacts on organic polluted water from the base camp	Discharge of domestic organic polluted water from the base camp	Number of Workers : 50 persons Water consumption: 60 l/person Total discharge water volume: 3,000 l/day Discharge BOD density*1: 30mg/l	Current SS : 14 mg/l Forecasted SS: 14.04 mg/l (* 0.26% increase)

*1: Environmental, Health, and Safety (EHS) Guidelines / General EHS Guidelines: Environmental Wastewater and Ambient Water Quality/ Table 1.3.1 Indicative Values for Treated Sanitary Sewage Discharges



Source: JICA Study Team (Based on Google Earth satellite image)

Figure 6.1.5 Image of Expected Impacts on Water Quality During Construction

Adoption of steel pipe sheet piles (SPSP) methodology can combine basic foundation pile and temporary cofferdam, making it possible to design and construct economically. Additionally, since excavated soil is taken out and transported to other area, turbid water does not generate in the river.

Source: JFE Steel Co., Ltd.

Figure 6.1.6 Image of SPSP (Steel Pipe Sheet Piles) Methodology

2) After Construction

It has been pointed out that road surface water, including exhaust emission and adhesive material of vehicles, may give some adverse impacts on water quality in the Sittaung River. Thus, the degree of impacts is verified based on past analysis and/or researches in Japan.

According to a report which was studied by the National Institute for Land and Infrastructure Management under the Ministry of Land, Infrastructure and Tourism in Japan, 6 chemical substances including Zinc (Zn) and Lead (Pb) have been identified in the drainage water. However, all measured concentration satisfy the Japanese effluent standards.

Table 6.1.6 Water Quality from the Road Surface (2010)

Parameter / Item	Measured Value (all values are satisfied with Standard values)		Standard (Discharged Water Standard Value in Japan)	Pollution Source
Zn	0.069 – 0.15	mg/l	2	Vehicle, Pavement
Hexavalent chromium	0.007 - 0.042	mg/l	0.5	Vehicle
Water-soluble copper salt	0.026 – 0.046	mg/l	3	Vehicle, Pavement
Mn	0.08 – 0.49	mg/l	10	Auto Chemical Products, Pavement and Concrete
Pb	0.013 – 0.075	mg/l	0.1	Vehicle, Pavement
B	0.039 – 0.092	mg/l	10	Vehicle, Auto Chemical Products

Source: Technical Note of National Institute for Land and Infrastructure Management No.596, May 2010

(4) Mitigation Measures

1) During Construction

- ✓ Turbid water from unpaved construction area shall be treated in sedimentation pond and discharged into the river, if required.
- ✓ Waste oil shall be stored and disposed of to a designated site.
- ✓ Sanitation facilities at labor camps and construction yard shall be provided. Also, the location of camps should avoid water sources such as springs and wells.
- ✓ Domestic waste water and night soil from base camp shall be treated and discharged to designated site and facilities.
- ✓ Septic tank for portable toilet and temporary toilet in the construction area and yard shall be used.
- ✓ Steel pipe sheet piles (SPSP) methodology shall be adopted so as not to generate turbid

water at the excavated area in the river.

(5) Evaluation

During construction, turbid water is caused by construction in the area. However, forecasted impact by the project is less than 1%. An appropriate methodology for piling foundation work is adopted so as not to generate turbid water in the river. Thus, it is assumed that such negligible impacts will not cause significant impacts on the mudflats in the downstream.

It is confirmed that the water quality from the road surface does not cause significant impacts based on previous study. Additionally, a wildlife specialist in Japan has commented that significant impacts on water quality were not detected in the case of Bridge Construction Project in Man Lake Ramsar Site in Okinawa Prefecture, Japan.

Therefore, it is unlikely to give significant impacts on water quality during and after construction.

6.1.3. **Waste**

(1) Result of Baseline Survey

According to interviews with villagers, in the project area such as in Kyaikto and Waw townships, domestic waste is either burned, buried or covered with soil in the form of sanitary landfill. Night soil is discharged into excavated hole and covered with soil. With regard to construction waste such as concrete and cut trees, these can be used as construction materials or sold to the village people in general.

On the other hand, construction waste in Myanmar, such as waste soil, is generally disposed of into the river and sea area. Other materials such as trees and waste concrete are generally reused by villagers and/or construction companies as embankment materials.

(2) Potential Impacts

1) During Construction

Construction waste, such as waste soil and cut trees, is expected. Additionally, domestic waste and night soil may be generated from the construction base camp.

2) After Construction

No impacts are expected due to lack of plans regarding service and parking areas along the bridge and approach road.

(3) Impact Forecast

1) During Construction

The estimated waste volume for each item is shown below.

Table 6.1.7 Estimated Waste in the Project Area during Construction

Type of Waste		Estimated Generated Volume
1. Waste soil from earthwork	Land Section	71,482 m^3/ 4 years
	River Section (muck soil)	132,187 m^3/ 4 years
	(Embankment) Reuse Volume	(-59,772) m^3/ 4 years
	Total	143,897 m^3/ 4 years
2. Cut trees Note1)		50,240 m^3 / 4 years
3. Domestic Waste from the Construction Camp	Domestic Solid Waste Note2)	73 ton / 4 years
	Waste Water Note3)	7,300 kl / 4 years
	Night Soil Note4)	321.2 ton / 4 year

Note 1) Number of cut trees is 8,000 rubber trees (DBH (Diameter at Breast Height=0.2m x Height 10m)
Note 2): 0.5 kg waste/person x number of labor 100/day in the camp site x 4 years = 50kg/day 73 ton for 4 years construction. (50kg/day)
Note 3): 50 l waste water /person x number of labor 100/day in the camp site x 4 years = 7,300 kl for 4 years construction. (50,000 l /day)
Note 4): 2.2 kg night soil / person x number of labor 100/day in the camp site x 4 years = 321.2 ton for 4 years construction. (2,200 kg/day)

Excavated soil regarding earthwork, cutting trees in the affected area and domestic waste from camp site are major wastes during construction. Excavated soil at pillars in the land section and rivers section is estimated as app. 71,224 m^3 and 132,187m^3, respectively. 59,772 m^3 out of 71,224 m^3 is used as material for embankment, thus totally 143,897m^3 is generated as waste soil and muck soil.
Cut trees are estimated at approx. 50,240 m^3, and domestic waste and night soil generated at the base camp for workers have an estimated volume of 73 tons / 4 years.

2) After Construction

Since no offices and parking areas are planed for this project, in general, no waste is generated after construction. Thus, it is not likely to give adverse impacts on waste.

(4) Mitigation Measures

1) During Construction

Construction waste (waste soil, cut trees and waste oil, hazardous material)

- ✓ Waste soil from the land section of muck soil from the river section is used in the construction area for temporary earthwork and as embankment material of ADB bypass road section. Muck soil is excavated from the river section and transported, and the necessary process is undertaken for reusing the construction material.
- ✓ Cut trees are sold to villagers as building materials and for other purposes.
- ✓ Waste oil from the construction machines is collected and disposed of through licensed agents
- ✓ Waste chemicals and hazardous materials are stored at base camp site and disposed of through a licensed agent.

Domestic waste and night soil from base camp and offices

- ✓ Domestic solid waste is collected and disposed at the nearest designated disposal site
- ✓ Domestic waste water and night soil shall be treated though septic tank and discharged into the natural stream. Water quality of the effluent shall be confirmed before discharging it into natural water body.

2) After Construction

Any mitigation measures are not required as no impacts are expected

(5) Evaluation

All construction waste and domestic waste generated are reused and/or disposed of following the implementation of mitigation measures. Thus, it is not likely to cause significant impacts on waste management.

6.1.4. Soil Contamination and Sedimentation Quality

(1) Result of Baseline Survey

Soil sampling has been conducted at the point shown in Figure 6.1.7. The point is planed pillar and/or excavated area for revetment and pillars. Because excavated soil may be polluted already.

Based on the result of the analysis shown in Table 6.1.8, all analyzed indicators do not exceed standard values in Thailand and Japan.

Source: JICA Study Team (Based on Google Earth satellite image)

Figure 6.1.7 Soil Quality Sampling Points

Table 6.1.8 Result of Soil Analysis (Sep. 2018)

Item	Unit	Result	Referred Standard	
			Thailand Standard	Japanese Standard
As (Arsenic)	mg/kg	3.67	3.9	15 mg/kg
Cd (Cadmium)	mg/kg	ND	37	0.4 mg/kg
Cr^{6+} (Hexavalent Chromium)	mg/kg	1.44	300	-
Se (Selenium)	mg/kg	0.102	390	-
Cu (Copper)	mg/kg	15.2	-	125 mg/kg
Pb (Lead)	mg/kg	6.74	400	-
Benzene	mg/kg	ND	6.5	-
Carbon Tetrachloride	mg/kg	ND	2.5	-
1,2-Dichloroethane	mg/kg	ND	3.5	-
1,1-Dichloroethylene	mg/kg	ND	0.5	-
Cis-1,2- Dichloroethylene	mg/kg	ND	43	-
Dichloroethylene	mg/kg	ND	89	-
Thetrachloroethylene	mg/kg	ND	57	-

Item	Unit	Result	Referred Standard	
			Thailand Standard	Japanese Standard
Trichloroethylene	mg/kg	ND	28	-
1,1,1-Trichloroethane	mg/kg	ND	630	-
1,1,2-Trichloroethane	mg/kg	ND	8.4	-

Note)
*1: Thailand Standard: Soil Quality Standards for Habitat and Agriculture, Notification of the National Environmental Board, Thailand (No. 25, B.E. 2547/ 2004)
*2: Japanese Standard: Environmental Quality Standards for Soil Pollution, Ministry of Environment/ 1991)
Source: JICA Study Team

(2) Potential Impacts

1) During Construction

Excavated soil on the site may be polluted. Stored construction materials, such as oil and chemicals, may pollute soil in the base camp.

2) After Construction

No impacts are expected as there is no plan regarding soil contamination.

(3) Impact Forecast

1) During Construction

The estimated volume of waste soil from the project area is shown below. A total of 143,897 m^3 of waste soil is generated from the project area. However, this soil is processed and used as earthwork material during construction and embankment of ADB section.
It is expected that excavated soil is not polluted since the current surface soil is not polluted.

Table 6.1.9 Estimated Waste in the Project Area During Construction

Type of Waste		Estimated Generated Volume
1. Waste soil from earthwork	Land Section	71,482 m^3/ 4 years
	River Section (muck soil)	132,187 m^3/ 4 years
	(Embankment) Reuse Volume	(-59,772) m^3/ 4 years
	Total	143,897 m^3/ 4 years

Source: JICA Study Team

On the other hand, risk such as leaking oil from construction machines may occur in the base camp site. Thus, appropriated mitigation measures are required.

2) After Construction

No impacts are expected as there is no plan regarding soil contamination.

(4) Mitigation Measures

1) During Construction

- ✓ Excavated soil on the land and in the river shall be analyzed and it shall be confirmed if the quality is below standard values. Polluted soil shall be treated and used as construction material if excavated soil is polluted.
- ✓ Construction machines shall be maintained so as not to leak oil in the base camp site.
- ✓ Waste oil of the construction machines is collected and disposed of through a licensed agent

- ✓ Waste chemical and hazardous material are stored at the base camp site and disposed of through a licensed agent.

2) After Construction

Any mitigation measures are not required as no impacts are expected.

(5) Evaluation

It is expected that the soil generated in the project area is not polluted based on soil analysis, thus soil contamination is not caused due to construction soil. However, construction soil is tested and confirmed after excavation during construction.

Leaking oil from construction machines and waste oil storage in the base camp may give negative impacts on the surrounding soil. However, appropriate management and implementation of mitigation measures minimize such risks.

6.1.5. Noise and Vibration

(1) Result of Baseline Survey

1) Noise

a) Result of Measurement

Baseline measurements have been conducted at 2 points as shown in Figure 6.1.1.

b) Result of Measurement

The monitored values at 2 points from the nearest house in the project area satisfy the environmental standards in Myanmar.
The range of value is 44 - 45 dB(A) in the daytime and 41 – 45 dB(A) in the night, respectively.

Table 6.1.10 Monitoring Date for Noise (March 22nd – 23rd, 2018)

Location			Survey Date	Daytime 7:00-22:00 dB(A)	Nighttime 22:00-7:00 dB(A)
Noise-1 (March 22nd, 2018) Bago Region, Waw Township, Shangai Village		At the nearest house (seasonal use)	March 22nd – 23rd, 2018	45	41
Noise-2 (March 23rd, 2018) Mon State, Kyaito Township, Sut Pa Nu Village		At monastery / school *(Sensitive Receptor)*	March 23rd – 24th, 2018	44	45
Standard	National Environmental Quality Guidelines (NEQG)	Residential, Institutional, Educational		55	45
		Industrial, Commercial*		70	70
	IFC Standards (International Finance Corporation)	Residential Area		55	45
		Commercial Area		70	70
Reference Standard	Japanese Standards Daytime: 6:00-22:00 Nighttime: 22:00-6:00	Along the trunk road		70	65

Source: JICA Study Team
* The project area is classified as non-residential area due to agricultural land-use
NEQG: National Environmental Quality Guidelines (MONREC, December 2015)
IFC Standard: Environmental, Health, and Safety (EHS) Guidelines Noise Management (April 2007)
Japan: Ministry of Environment (1998) Environmental Standards for Noise
Note: Noise-1: 17°24'15.17"N/ 96°52'54.60"E
Noise-2: 17°24'5.36"N/ 96°53'49.12"E

2) **Vibration**

a) Survey Point

The survey points are same as the noise survey points.

b) Result of Measurement

There are no vibration standard prescripts in Myanmar, thus the Japanese vibration standards along the trunk road have been applied on this ESIA. All monitored vibration levels have met the Japanese standard values.

Table 6.1.11 Monitoring Date for Vibration (March 22nd – 23rd, 2018)

Location			Survey Date	Daytime 7:00-20:00 dB	Nighttime 20:00-7:00 dB
Vibration-1 (March 22nd, 2018) Bago Region, Waw Township, Shangai Village		At the nearest house (seasonal use)	March 22nd – 23rd, 2018	22	29
Vibration-2 (March 23rd, 2018) Mon State, Kyaito Township, Sut Pa Nu Village		At monastery / school *(Sensitive Receptor)*	March 23rd – 24th, 2018	24	27
Standard	National Environmental Quality Guidelines (NEQG)	Residential, Institutional, Educational		-	-
		Industrial, Commercial		-	-
	IFC Standards (International Finance Corporation)	Residential Area		-	-
		Commercial Area		-	-
Reference Standard	Japanese Standards Daytime: 7:00 - 20:00 Nighttime: 20:00 - 7:00	Residential Area		65	60
		Commercial and Industrial Area*		70	65

Source: JICA Study Team

* The project area is classified as non-residential area due to agricultural land-use
NEQG: National Environmental Quality Guidelines (MONREC, December 2015)
IFC Standard: Environmental, Health, and Safety (EHS) Guidelines Noise Management (April 2007)
Japan: Ministry of Environment (1998) Environmental Standards for Noise

Note: Vibration-1: 17°24'15.32"N/ 96°52'54.45"E
Vibration -2: 17°24'5.91"N/ 96°53'49.70"E

(2) **Potential Impacts**

1) **During Construction**

Noise and vibration generation is expected due to operation of construction machines and equipment.

2) **During Operation**

Noise and vibration generation is expected due to driving of vehicles.

(3) **Impact Forecast**

1) **During Construction**

A) Noise

a) Forecast Methodology

The noise during construction is coming from the operation of construction machines. The sound level is measured at 1 meter from the machines, the loudest noise from construction machines is 93 dB(A) for piling work and driving of sheet pile by using a vibrohammer. The noise level assessment during construction will consider the sound level in different distances from the origins. Decay Formula Equation will be used in this assessment, which will be done on a spare basis, as the Equation (1).

$L_{p2} = L_{p1} - 20 \log(r_2/r_1)$……..(1)

When

L_{p1} = Sound level at distance r_1 from the origin

L_{p2} = Sound level at distance r_2 from the origin (forecasted value)

r_1, r_2 = Distance from the origin at sound level L_{p1} and L_{p2}

b) Forecast Point and Forecasted Value

Quantitative forecast is conducted at the boundary of ROW 50m away from the centerline and at monastery and school as sensitive receptors in Sut Pa Nu Village, Mon State as shown in Figure 6.1.2 and Figure 6.1.3, respectively.

The forecasted value is 59 dB(A) at ROW boundary and 47 dB(A) at monastery/school, respectively. These values do not exceed the Japanese standards value for construction noise.

Table 6.1.12 Forecast Results for Construction Noise

Location	Forecast Point	Construction Activities and Related Machines	Sound Level at 1m from the Noise Source dB(A)	Background Level dB(A)	Forecasted Value with BG dB(A)	Standard Value
Noise Forecast -1 Mon State, Kyaito Township, Sut Pa NuVillage	Boundary of ROW (50m from the centerline)	Piling Works (vibrohammer)	93	45	59	Myanmar National Environmental Quality Guidelines does not have any standard for construction noise. Thus Japanese standard has been applied. Japanese Construction Noise Standards 07:00-19:00 85 dB(A)
Noise Forecast -2 Mon State, Kyaito Township, Sut Pa Nu Village	At monastery / school (Sensitive Receptor, 340m from the centerline)	Piling Works (vibrohammer)	93	45	47	

Source: JICA Study Team

B) Vibration

a) Forecast Methodology

The vibration during construction is coming from the operation of construction machines. The vibration level is measured at 1 meter from the machines and the highest vibration from construction machines is 79 dB. The loudest noise from construction machines is 93 dB(A) for piling work and driving of sheet pile by using a vibrohammer. The vibration level assessment during construction will consider vibration level in different distances from the origins. Decay Formula Equation will be used in this assessment, which will be done on a spare basis, as the Equation (1).

$L_{vr} = L_{vr0} - 15\log10(r/r_0) - 8.68\alpha(r-r_0)$…….(1)

When

L_{vr0} = Vibration level at distance r_0 from the origin (vibration at reference point) (dB)

r = Distance from vibration source to forecast point (m)

r_0 = Distance from vibration source to the reference point (m)

α = Friction damping coefficient (0.01-0.04)

b) Forecast Point and Forecasted Value

Quantitative forecast is conducted at the boundary of ROW 50m away from the centerline

and monastery and school as sensitive receptors in Sut Pa Nu Village, Mon State as shown in Figure 6.1.2 and Figure 6.1.3.
The forecasted values are 46 and 24dB, and these values satisfy the Japanese Construction Vibration Standard of 75 dB in the daytime.

Table 6.1.13 Forecast Results for Construction Vibration

Location	Forecast Point	Construction Activities and Related Machines	Sound Level at 1m from the Noise Source dB	Background Level dB	Forecasted value with BG dB	Standard Value
Noise Forecast -1 Mon State, Kyaito Township, Sut Pa Nu Village	Boundary of ROW (50m from the centerline)	Piling Works (vibrohammer)	79	24	46	Myanmar National Environmental Quality Guidelines does not have any standard for construction vibration. Thus Japanese standard has been applied Japanese Construction Vibration Standards 07:00-19:00 75 dB
Noise Forecast -2 Mon State, Kyaito Township, Sut Pa Nu Village	At monastery / School (Sensitive Receptor, 340m from the centerline)	Piling Works (vibrohammer)	79	24	24	

Source: JICA Study Team

2) **After Construction**

A) Noise

a) Methodology and Forecast Points

The ASJ-2013 model in Japan is used for quantitative traffic noise forecast. Traffic number in the future (2025) is shown in Table 6.1.2.

One point is at the boundary of ROW and another point is selected as sensitive receptor for the prediction of air pollution. The locations of forecasts are shown in Figure 6.1.2 and Figure 6.1.3.

b) Result of Forecast

The result of quantitative forecast is shown in Table 6.1.14. The forecasted values at the boundary of ROW and sensitive receptor are 59 dB(A) in the day time / 54 dB(A) in the night time and 57 dB(A) in the day time / 52 dB(A) in the night time respectively.

Based on the results of the forecast, all forecasted values satisfy Myanmar standards.

Table 6.1.14 Forecasted Noise After Construction (2025)

Location		Time Zone	Noise Level dB(A)			Standard Value
			Background Level	Forecasted Value with BG	Adopted Standard (Myanmar Standard)	
Noise Forecast -1 Mon State, Kyaito Township, Sut Pa Nu village	Boundary of ROW (50m from the centerline)	Daytime 7:00-22:00	45	59	70	Myanmar National Environmental Quality Guidelines *1 07:00-22:00 daytime Residential area: 55dB(A) Commercial / Industrial 70 dB(A) 22:00-07:00 Residential area: 55dB(A) Commercial / Industrial 70 dB(A)
		Nighttime 22:00-7:00	42	54	70	
Noise Forecast -2 Mon State, Kyaito Township, Sut Pa Nu village	At monastery / school (Sensitive Receptor, 340m from the centerline)	Daytime 7:00-22:00	45	57	70	
		Nighttime 22:00-7:00	42	52	70	

Note) *1: NEQG: National Environmental Quality Guidelines (MONREC, December 2015)
Source: JICA Study Team

B) Vibration

a) Methodology and Forecast Points

The formulation, which has been developed by the Ministry of Land, Infrastructure, Transport and Tourism in Japan, is used for quantitative traffic vibration forecast. Traffic number in the future (2022) is shown in Table 6.1.2.

One point is at the boundary of ROW and another point is selected as sensitive receptor for the prediction of air pollution. The locations of forecasts are shown in Figure 6.1.2 and Figure 6.1.3.

b) Forecast Point and Forecasted Value

The result of the quantitative forecast is shown in Table 6.1.15. The forecasted values at the boundary of ROW and sensitive receptor are 43 dB in the day time / 40 dB in the night time and 40 dB in the day time / 40 dB in the night time respectively.

With regard to the applied standard value, Japanese traffic vibration standard is adopted since there are no standard values on traffic vibration in Myanmar. Based on the result of the forecast, all forecasted values satisfy Japanese standards.

Table 6.1.15 Forecasted Vibration After Construction (2025)

Location		Time Zone	Vibration Level dB			Standard Value
			Background Level	Forecasted value with BG	Adopted Standard (Japanese Standard)	
Noise Forecast -1 Mon State, Kyaito Township, Sut Pa Nu Village	Boundary of ROW (50m from Centerline)	Daytime 7:00-20:00	33	43	70	MNEQG does not have any standard for vibration, thus Japanese standard has been applied in this EIA. Japanese Standard*1 07:00-20:00 daytime Residential area: 65dB Commercial / Industrial: 70 dB 20:00-07:00 Residential area: 60dB Commercial / Industrial: 65 dB
		Nighttime 20:00-7:00	24	40	65	
Noise Forecast -2 Mon State, Kyaito Township, Sut Pa Nu Village	At monastery / school (Sensitive Receptor, 340m from the centerline)	Daytime 7:00-20:00	33	40	70	
		Nighttime 20:00-7:00	24	40	65	

Note) *1: Article 16 Paragraph 1 Vibration Regulation Law in Japan (1977)
Source: JICA Study Team

(4) Mitigation Measures

1) During Construction

Forecasted values satisfy the standard values, thus mitigation measures are not required in general. However, the following mitigation measures shall be done to minimize forecasted adverse impacts.

- Construction activities and operation of construction machines shall be limited in the daytime and on weekdays.
- Construction machines shall be well-maintained and checked everyday.
- Information disclosures, such as construction schedule and activities, shall be carried out in advance to the surrounding communities.

2) After Construction

Forecasted values satisfy the standard value, thus mitigation measures are not required in general. However, the following mitigation measures shall be implemented to harmonize with the road development and land management along the road.

- Land use along the road shall be designated as commercial and industrial areas, and residential area shall be located behind such commercial area.
- Myanmar government shall control the driving speed on the road (MOC requests to police department regarding strict speed control).

(5) **Evaluation**

1) **During Construction**

As mentioned in the previous article, no standard values for construction noise and vibration have been established in Myanmar at the moment. Thus, it is recommended that other standards such as Japanese standards should be referred to in this ESIA.

The forecasted construction noise and vibration at 2 points are within Japanese standard limits, thus any mitigation measures are not necessary. Additionally, the implementation of mitigation measures minimizes the impacts, and the degree of impacts will be within the acceptable level for inhabitants because of the limited period and time during construction.

2) **After Construction**

As the result of the quantitative analysis on the project case, all forecasted values are not exceeding the present noise and vibration standard levels. Thus, it is unlikely to cause serious impacts on the project area.

6.1.6. **Odor**

(1) Potential Impacts

1) During Construction

Bad odor may be caused by domestic waste and construction materials in the base camp.

2) After Construction

No impacts are expected due to lack of plans regarding service and parking areas which generate solid and liquid wastes.

(2) Impact Forecast

1) During Construction

Putrid odor may be caused by domestic waste and night solid in the construction base camp. Additionally, the smell of oil and chemicals may be generated from workshop and storage if such materials are leaking or not managed appropriately.

(3) Mitigation Measures

1) During Construction

- ✓ Domestic solid waste is collected and disposed at the nearest designated disposal site
- ✓ Domestic waste water and night soil shall be treated though septic tank and discharged into the natural stream. Water quality of the effluent shall be confirmed before discharging into natural water body.

- ✓ Waste oil of the construction machines is collected and disposed through a licensed agent
- ✓ Waste chemical and hazardous material are stored at the base camp site and disposed of through a licensed agent.

2) After Construction

Any mitigation measures are not required as no impacts are expected

(4) Evaluation

All construction waste and domestic waste generated are managed and disposed of following the implementation of mitigation measures, thus they are not likely to cause significant impacts regarding bad odor.

6.2. Natural Environment

6.2.1. Ecosystem and Protected Area

(1) Result of Baseline Survey

1) Surveyed Items and Schedules

Surveyed items and survey dates for mammals, birds, amphibians, reptiles, insects, fishes, phytoplanktons, zooplanktons, benthos and floras are shown in Table 6.2.1. It is noted that bird survey has been conducted during migratory season.

The survey points for terrestrial, aquatic, guidebank and revetment are shown in Figure 6.2.1

Table 6.2.1 Surveyed Items and Survey Dates on Faunas and Floras

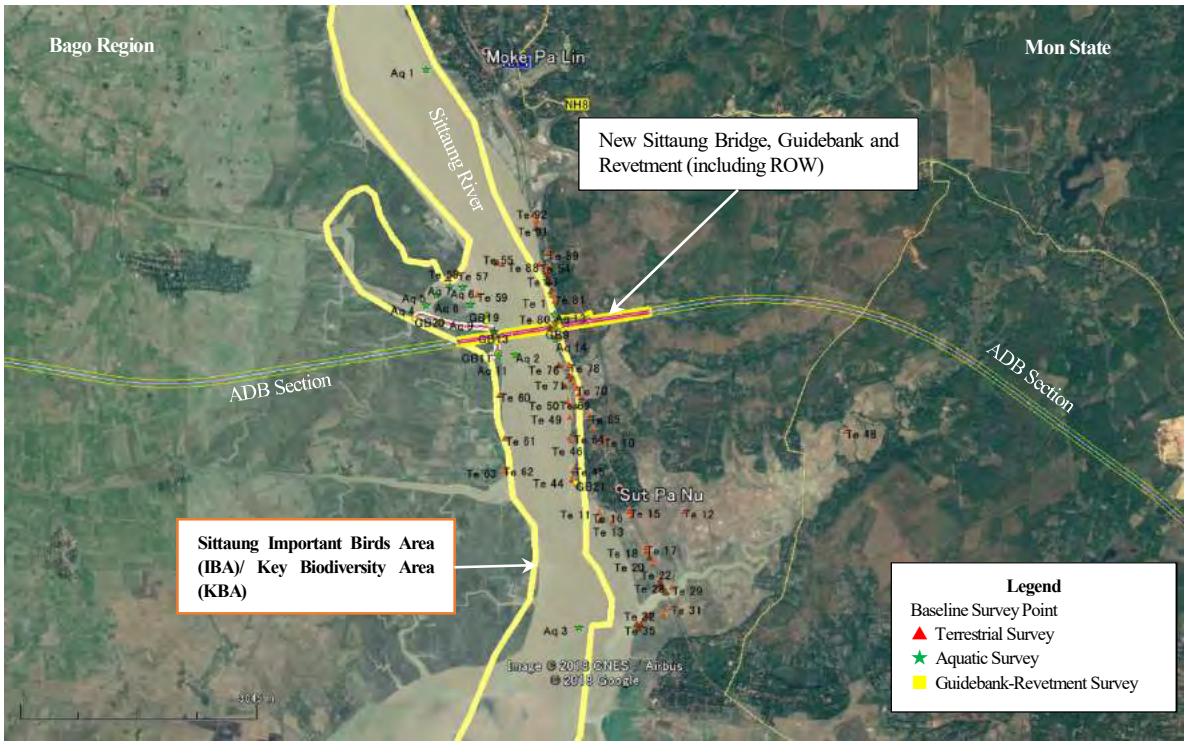
Item			Surveyed Area (Survey Range)	Date	Time	Remarks (Season)
1	Terrestrial Survey	Mammals	East Bank	Feb. 3rd – 4th, 2018	06:00-17:00	Dry Season
			West Bank	Feb. 5th, 2018	06:00-17:00	Dry Season
2		Birds	East Bank (approx.1km)	Feb. 3rd – 4th, 2018	07:00-10:00 15:00-18:00	Dry Season (migration season)
			West Bank (approx.1km)	Feb. 5th, 2018	07:00-10:00 15:00-18:00	Dry Season (migration season)
3		Amphibians	East Bank	Feb. 3rd – 4th, 2018	19:00-23:00	Dry Season
			West Bank	Feb. 5th, 2018	19:00-23:00	Dry Season
4		Reptiles	East Bank	Feb. 3rd – 4th, 2018	19:00-23:00	Dry Season
			West Bank	Feb. 5th, 2018	19:00-23:00	Dry Season
5		Insects (Dragonfly and Butterfly)	East Bank	Feb. 3rd – 4th, 2018	06:00-17:00	Dry Season
			West Bank	Feb. 5th, 2018	06:00-17:00	Dry Season
			West Bank (Guidebank)	May 23rd, 2018	09:00-13:00	Rainy Season
6		Floras	East Bank	Feb. 3rd – 4th, 2018	06:00-17:00	Dry Season
			West Bank	Feb. 5th, 2018	06:00-17:00	Dry Season
			Sittaung River (Embankment)	May 22nd, 2018	10:00-13:30	Rainy Season
			Shangai Creek and Sittaung River (Guidebank)	May 23rd, 2018	09:00-13:00	Rainy Season
7	Aquatic Survey	Fishes	Sittaung River	Feb. 4th, 2018	07:00-17:00	Dry Season
			Sittaung River (Embankment)	May 22nd, 2018	10:00-13:30	Rainy Season
			Shangai Creek and Sittaung River (Guidebank)	May 23rd, 2018	09:00-13:00	Rainy Season
8		Phytoplanktons	Sittaung River	Feb. 2nd, 2018	08:00-11:00	Dry Season
9		Zooplanktons	Sittaung River	Feb. 2nd, 2018	14:00-17:00	Dry Season
10		Benthos	Sittaung River	Feb. 3rd, 2018	08:00-11:00	Dry Season

Source: JICA Study Team

2) Survey Area

The survey points for terrestrial, aquatic, guidebank and revetment are shown in Figure 6.2.1

With regard to bird survey, approximately 1km range from the project area is covered by using a telescope.



Source: JICA Study Team (Based on Google Earth satellite image)

Figure 6.2.1 Fauna and Flora Survey Areas and Points

3) Survey Result

a) Mammals

No species were observed in the project area in this survey since the survey area has been developed as a paddy field and crop area.

However, according to interviews with villagers, small species such as Micromys minutus and Callosciurus erythraeus are observed in the crop field and plantation area.

b) Birds

A total of (27) families of terrestrial and aquatic birds representing (51) species were identified in the survey area as shown in the next table.

All observed species are categorized as Least Concern on the Red List of International Union for Conservation of Nature (IUCN), and no considerable species such as those in categories EX, EW, EN, VU and NT are observed.

Fifteen (15) species are residents and 36 species migrated from other areas. Both resident and migratory species are feeding in the open land, forests and swampy part of the river, and roosting and nesting in the nearest forests and grass area.

It appears that the project area is one of the feeding areas, and the same environment for feeding area is observed in the surrounding area.

Table 6.2.2 Survey Results on Birds

No	Order Name	Family Name	Common Name	Scientific Name	IUCN status	Type	Typical Feeding Target	Feeding Area	Roosting Environment	Nesting Place
1	Falconiformes	Falconidae	Black-Shouldered Kite	*Elanus caeruleus*	LC	Resident	Insects, amphibians, reptiles, small birds	Open land, forest	Forest	Forest
2			Black-Eared Kite	*Milyus lineatus*	LC	Resident	Birds, bats, rodents	Open land, forest	Forest	Japan, India
3			Oriental Honey-buzzard	*Pernis ptilorhynchus*	LC	Migratory	Insects, small mammals, reptiles	Woodland, open areas	Forest	Asia from central Siberia east to Japan
4	Columbiformes	Columbidae	Red-Collared Dove	*Steptopelia tranquebarica*	LC	Migratory	Grass, other seeds, cereals	Cultivation, scrub, deciduous country	Plain	India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam, China, Taiwan, Indonesia and Philippines
5	Psittaciformes	Psittacidae	Rose-Ringed Parakeet	*Psittacula eupatria*	LC	Migratory	Buds, fruits, vegetables, nuts, berries, and seeds	Farmlands and orchards	Forest	South and Southeast Asia, ranging from Pakistan through most of India (including the Andaman Islands and Narcondam Island), Sri Lanka, much of Nepal, Bhutan and Bangladesh (including Cocos Island), into Southern and Central Myanmar, Central Thailand, Southern and Western Laos, much of Cambodia and Southern Vietnam
6	Cuculiformes	Cuculidae	Plaintive Cuckoo	*Cacomantis merulinus*	LC	Resident	Invertebrates	Woodland, scrub, grassland, farmland	Forest edge	Forest edge
7			Greater Coucal	*Centropus sinensis*	LC	Migratory	Insects, caterpillars, bird eggs, nestlings, fruits and seeds	Jungle, cultivation, urban gardens	Forest	Indian Subcontinent and Southeast Asia
8	Strigiformes	Strigidae	Short-Eared Owl	*Asio flammeus*	LC	Resident	Small mammals	Open areas	Grasslands, open areas, low trees	Trees
9	Apodiformes	Apodidae	Asian Palm-Swift	*Cypsiurus balasiensis*	LC	Migratory	Insects	Cultivation	Palm leaf	Tropical Asia from India to the Philippines
10	Coraciformes	Alcedinidae	White-Throated Kingfisher	*Hlacyon smyrnensis*	LC	Migratory	Large crustaceans, insects, earthworms, rodents, snakes, fish and frogs	Bamboo near water	Roadside banks, grassland	Asia, from east Turkey through the Indian subcontinent to the Philippines
11			Black-Capped Kingfisher	*Hlacyon pileata*	LC	Migratory	Fish, large insects	Along estuaries and rivers	Tunnel in an earth bank	India (including the Andaman and Nicobar Islands where they occur even on remote islands like Narcondam), Sri Lanka, Kansu, Shansi, Korea, Malay Peninsula, Thailand, Myanmar, Ryu kyu Islands, Hainan, Philippines
12		Meropidae	Green Bee-Eater	*Merops orientalis*	LC	Resident	Insects	Grassland, thin scrub and forest often quite far from water	Grasslands and in open forests	Grasslands and in open forests
13	Piciformes	Ramphastidae	Coppersmith Barbet	*Megalaima naemacephala*	LC	Resident	Insects	Top branches of tall trees	Inside the trees	Inside the trees
14	Passeriformes	Dicruridae	Black Drongo	*Dicrurus macrocercus*	LC	Resident	Insects, grasslands	Among the branches	Trees	Trees
15		Corvidae	Large-Billed Crow	*Corvus japonensis*	LC	Resident	Wide range of items, anything appearing edible, alive or dead, plant or animal	On the ground or on the trees	In woodland, parks and gardens, cultivated regions	In woodland, parks and gardens, cultivated regions

No	Order Name	Family Name	Common Name	Scientific Name	IUCN status	Type	Typical Feeding Target	Feeding Area	Roosting Environment	Nesting Place
16		Aegithinidae	Common Iora	*Aegithina tiphia*	LC	Resident	Insects	Among the branches	Trees	In the fork of a tree
17		Laniidae	Brown Shrike	*Lanius cristatus*	LC	Migratory	Insects	Grasslands	Trees or bushes	Northern Asia from Mongolia to Siberia
18		Passeridae	House Sparrow	*Passer domesticus*	LC	Resident	Insects and many other foods, seeds of grains and weeds	Agricultural lands	Spiny shrubs and trees less than 7 ft	Trees, urban and rural areas
19	Passeriformes		Eurasian Tree-Sparrow	*Passer montanus*	LC	Resident	Predominantly a seed-eater, preferring smaller seeds of low herbs and grasses, including cultivated cereals	Agricultural lands	Cultivated areas with hedgerow trees, orchards, and gardens	Urban areas, gardens, agricultural lands and rural areas
20		Motacillidae	Paddy field Pipit	*Anthus rufulus*	LC	Resident	Mainly adult and larval insects. Stomach contents included weevils, ants, termites, and bugs	Short grassland and cultivation with open bare ground	Open country, short grassland, paddy-fields, stubble fields and cultivations, also airfields	It builds its nest on the ground under a slight prominence, a tuft of grass, or at the edge of a bush
21			White Wagtail	*Motacilla alba*	LC	Migratory	Beetles, dragonflies, small snails, spiders, worms, crustaceans, to maggots found in carcasses and, most importantly, flies in the order of Diptera	Bare areas and urban areas, especially paved areas such as car parks	Crevices in stone walls and similar natural and man-made structures	Western Europe and the Mediterranean
22			Western Yellow Wagtail	*Motacilla flava*	LC	Migratory	Wide variety of terrestrial and aquatic invertebrates; also some plant material, especially seeds	Near water, such as wet meadows	Damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures	Temperate Europe and Asia
23			Eastern Yellow Wagtail	*Motacilla tschutschensis*	LC	Migratory	Insects	Near water, such as wet meadows	Tussocks	Australia, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, Canada, China, Christmas Island, Hong Kong, India, Indonesia, Lao People's Democratic Republic, Malaysia, Micronesia, Federated States of Mongolia, Myanmar, Nepal, Palau, Philippines, Russian Federation (Central Asian Russia, Eastern Asian Russia), Singapore, Taiwan, Province of China, Thailand; United States, Viet Nam
24		Sturnidae	Jungle Myna	*Acridotheres fuscus*	LC	Migratory	Fruit, grain and insects	Near water or rice fields	Forest and cultivation	Tropical southern Asia from Nepal, Bangladesh, Pakistan, India a nd east Burma to Indonesia.
25			Common Myna	*Acridotheres tristis*	LC	Migratory	Insects, arachnids, crustaceans, reptile s, small mammals, seeds, grain and fruits and discarded waste from human habitation	Grass	Open woodland, cultivation and around habitation	Iran, Pakistan, India, Nepal, Bhutan, Bangladesh, Sri Lanka, Afghanistan, Uzbekistan, Tajikistan, Turkmenistan, Myanmar, Singapore, peninsular Thailand, Indo-China and China
26		Alaudidae	Oriental Skvlark	*Alauda gugula*	LC	Migratory	Seeds and insects	Open grasslands	Open grassland	Southern, central and eastern Asia

No	Order Name	Family Name	Common Name	Scientific Name	IUCN status	Type	Typical Feeding Target	Feeding Area	Roosting Environment	Nesting Place
27		Muscicapidae	Oriental Magpie-Robin	*Copsychus saularis*	LC	Migratory	Insects and other invertebrates	Urban gardens, forests	Urban gardens, forests	Tropical southern Asia from Bangladesh, interior India, Sri Lanka and eastern Pakistan east to Indonesia, Thailand, south China, Malaysia, and Singapore.
28			Eastern Stonechat	*Saxicola maurus*	LC	Migratory	Insects	Grassland and shrubs	Open rough scrubland or rough grassland with scattered shrubs	Temperate Asia and easternmost Europe and winters in the Old World tropics.
29			Taiga Flycather	*Ficedula albicilla*	LC	Migratory	Flying insects and other arthropods, including adult and larval lepidopterans, hymenopterans (including ants) and beetles (Coleoptera)	Open forest, forest edges	Open forest, forest edges, moist woodland, open country with scattered trees	Bangladesh, Bhutan, Cambodia, China, India, Japan, Kazakhstan, Lao People's Democratic Republic, Malaysia, Mongolia, Myanmar, Nepal, Russian Federation (Central Asian Russia, Eastern Asian Russia), Tajikistan, Thailand, Uzbekistan, Viet Nam
30		Pycnonotidae	Red-Vented Bulbul	*Pycnonotus cafer*	LC	Migratory	Fruit, nectar, buds and invertebrates, occasionally vertebrates	Dry scrub, open forest, plains and cultivated lands	Drier deciduous woodland, sparse secondary forest, scrub, orchards and gardens, and mature forests	Tropical southern Asia, Indian subcontinent, including Sri Lanka extending east to Myanmar and parts of Tibet
31			Streak-Eared Bulbul	*Pycnonotus blanfordi*	LC	Migratory	Fruit, berries and many insects	Subtropical or tropical moist lowland forests	Inland and coastal), bamboo, open mixed deciduous woodland, semi-desert, cultivation area	Myanmar, Thailand and Peninsular Malaysia
32		Hirundinidae	Common Sand-Martin	*Riparia riparia*	LC	Migratory	Small insects, mostly gnats and other flies	Near water, coasts, rivers and streams,	Larger bodies of water, such as rivers, lakes or even the ocean, reed beds	The whole of Europe and the Mediterranean countries, part of northern Asia and also North America
33			Dusky Crag-Martin	*Ptyoprogne concolor*	LC	Resident	Insects	Mountainous areas with cliffs and gorges	Mountainous areas with cliffs and gorges	Under a cliff overhang or on a man-made structure
34			Ban Swallow	*Hirundo rustica*	LC	Migratory	Insects	Water source, sheltered ledge	Barns or other outbuildings, Agricultural area	Europe, Asia, Africa and the Americas
35			House Swallow	*Hirundo tahitica*	LC	Resident	Mainly flying ants and Apocrita, beetles, termites	Mangroves, open country, forested hills, and human habitations	Human habitation, urban or rural settings, most parts of the world	Riverbanks, in and around human habitation
36		Timaliidae	White-Throated Babbler	*Turdoides gularis*	LC	Resident	Insects and small trees	Scrub and bushes in semi-desert, borders of cultivation, thorn hedges, thickets, patches of bamboo	Shrub, herb and cultivation area	Bushes and semi-desert region
37		Cisticolidae	Common Tailorbird	*Orthotomus sutorius*	LC	Migratory	Insects, adults and larvae	Open farmland, scrub,	Deciduous forests, scrub	South Asia, from Pakistan and India to South China, and

No	Order Name	Family Name	Common Name	Scientific Name	IUCN status	Type	Typical Feeding Target	Feeding Area	Roosting Environment	Nesting Place
								forest edges and gardens	lands, mangroves, open woodlands, urban parks and gardens	Indonesia
38			Plain Prinia	*Prinia inornata*	LC	Migratory	Small invertebrates, chiefly insects and their larvae	Forest edges and gardens	Wet lowland grassland, open woodland, scrub and sometimes gardens	Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao People's Democratic Republic, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, Province of China, Thailand, Viet Nam
39	Pelecaniformes	Ardeidae	Grey Heron	*Ardea cinea*	LC	Migratory	Insects, and their larvae	Wetlands	Forest	Eurasia, Africa, North America, Greenland, and Australia
40			Indian Pond-Heron	*Ardeola grayii*	LC	Migratory	Crustaceans, aquatic insects, fishes, tadpoles and sometimes leeches, crickets, dragonflies and bees	Marshy wetlands, garbage heaps, edge of ponds, and floating vegetation	Well-watered lawns or even dry grassland, marshy wetlands, edge of ponds	Southern Iran and east to Pakistan, India, Burma, Bangladesh and Sri Lanka
41			Chinese Pond-Heron	*Ardeola bacchus*	LC	Migratory	Insects, Small frogs, worms, aquatic invertebrates, fish, mollusks, worms, some terrestrial insects and even small birds	Paddy fields, swamps, shallow fresh and salt water wetlands and ponds in China	Ponds, riverbanks; also in mangroves and at tidal pools	Russian Far East, NE & E China and Japan SW to NE India (Assam) and N Myanmar. Winters in Andaman Is, Malay Peninsula, Indochina, Borneo and Sumatra, and NE to Ryukyu Is.
42			Eastern Cattle Egret	*Bubulcus coromandus*	LC	Migratory	Small vertebrate, insects, especially grasshoppers, crickets, flies (adults and maggots), and moths, as well as spiders, frogs, and earthworms	Seasonally inundated grasslands, pastures, farmlands, wetlands, cattle or other large mammals and rice paddies	Grass land, near wetlands and bodies of water	Southern and Eastern Asia and Australasia
43			Great Egret	*Ardea alba*	LC	Migratory	Fish, frogs, small mammals, and occasionally small reptiles and insects	Near wetlands and bodies of water in urban and suburban areas.	Tree and reed beds	Asia, Africa, the Americas, and southern Europe
44			Intermediate Egret	*Mesophoyx intermedia*	LC	Migratory	Frogs, snakes, insects, fish	Freshwater swamps, billabongs, floodplains and wet grasslands with dense aquatic vegetation	Freshwater swamps, billabongs, floodplains and wet grasslands with dense aquatic vegetation	Africa, South and Southeast Asia, to China, Japan, New Guinea and Australia
45			Little Egret	*Egretta garzetta*	LC	Migratory	Mainly fish, amphibians, small reptiles, and birds	Shallow water and on land	Shores of lakes, rivers, canals, ponds, lagoons, marshes and flooded land	Temperate regions of Europe, Asia, Africa and Australia
46	Charadriiformes	Vanellidae	Grey-Headed Lapwing	*Vanellus cinereus*	LC	Migratory	Insects, worms and mollusks	shallow water	swamps, near rivers and rice fields	Northeast China and Japan
47		Pluvialidae	Pacific Golden-Plover	*Pluvialis fulva*	LC	Migratory	Insects and crustaceans and some berries.	Urban grasslands, tidal flats, and agricultural fields.	Urban grasslands, tidal flats, and agricultural fields.	Arctic tundra from northernmost Asia into western Alaska
48		Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	LC	Migratory	Insects, spiders, mollusks, crustaceans and annelid worms, tadpoles, adult frogs and toads, small fish and some	Coastal shores, estuaries and salt marshes, to inland	Along river, ponds, or lakes	Eastern Europe across central Asia, to Kamchatka and Sakhalin, Russia, and Japan

No	Order Name	Family Name	Common Name	Scientific Name	IUCN status	Type	Typical Feeding Target	Feeding Area	Roosting Environment	Nesting Place
							plant material, such as seeds	wetlands, riverbanks, pools,		
49			Common Greenshank	*Tringa nebularia*	LC	Migratory	Small invertebrates, small fish and amphibians.	Shallow water, or by sweeping the bill sideways through the water	Taiga zone, in forest clearings, woody moorland, open bogs and marshes, and eutrophic lakes,	Europe and Asia, from northern Scotland and Scandinavia, east through central Asia and Russia, to eastern Siberia
50			Whimbrel	*Numeniua phaeopus*	LC	Migratory	Insects, crustaceans, berries, many crabs, also amphipods and other crustaceans, marine worms, small mollusks.	Mudflats, rocky shores, sandy beaches, salt marshes, flooded agricultural fields, grassy fields near coast	Shores, mudflats, marshes, tundra	Much of subarctic North America, Asia and Europe as far south as Scotland
51		Sternidae	Little Tern	*Sternula albifrons*	LC	Migratory	Fish, insects, annelid worms and molluscs	Shallow waters of channels, estuaries and lagoons, in the surf on beaches,	Sheltered coastal environments	Europe, scattered along the coast and inland in parts of Africa, in much of western, central and the extreme east and south of Asia, and in northern parts of Australia

Note) IUCN Red List Category: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE)
Source: JICA Study Team

c) Amphibians and Reptiles

A total of (10) families of amphibians and reptiles representing (14) species were identified in the survey area as shown in Table 6.2.3.

All observed species are categorized as Least Concern (LC) or Not Evaluated (NE) on the Red List of International Union for Conservation of Nature (IUCN), and no considerable species such as those in categories EX, EW, EN, VU and NT are observed. All these are common species in the project area, and the same feeding, nesting and breeding areas exist not only in the project area, but also outside of the project area.

Table 6.2.3 Survey Results on Amphibians and Reptiles

No	Order Name	Family Name	Common Name	Scientific Name	IUCN status
1	Anura	Dicroglossidae	Long-Legged Cricket Frog	*Zakerana syhadrensis*	LC
2			Paddy Frog	*Zakerana limnocharis*	-
3		Rhacophoridae	White-Lipped Tree Frog	*Polypedates leucomystax*	LC
4		Bufonidae	Black-Spectacled Toad	*Duttaphrynus melanostictus*	LC
5	Squamata	Agamidae	Indo-Chinese Forest Lizard	*Calotes mystaceus*	NE
6			Oriental Garden Lizard	*Calotes versicolor*	-
7		Gekkonidae	Tokay Gecko	*Gekko gecko*	NE
8		Scincidae	Common Sun Skink	*Eutropis multifasciata*	LC
9		Colubridae	Indo-Chinese Rat Snake	*Ptyas korros*	LC
10			Pegu Kukri Snake	*Oligodon cruentatus*	LC
11		Elapidae	Monocled Cobra	*Naja kaouthia*	LC
12			Indian Cobra	*Naja naja*	LC
13		Viperidae	Eastern Russell's Viper	*Doboia russelii*	LC
14		Hydrophiidae	Beaked Sea Snake	*Enhydrina schistose*	LC

Note) IUCN Red List Category: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE)
Source: JICA Study Team

d) Insects

A total of (10) families of dragonflies and butterflies representing (28) species were identified in the survey area as shown in Table 6.2.4

All observed species were categorized as Least Concern (LC) or Not Evaluated (NE) on the Red List of International Union for Conservation of Nature (IUCN), any considerable species such as category EX, EW, EN, VU and NT are not observed. All of these are common species in the project area, and the same feeding and breeding areas exist not only in the project area, but also outside of the project area.

Table 6.2.4 Survey Results on Dragonflies and Butterflies

No		Family	Common name	Scientific name	IUCN Status
1	Dragonfly	Coenagriidae	Orange Marsh Dart	*Ceriagrion rubiae*	-
2			Azure Dartlet	*Enallagma parvum*	-
3			Senegal Golden Dartlet	*Ischnura senegalensis*	LC
4		Platycnemididae	Yellow Bush Dart	*Copera marginipes*	LC
5		Anisoptera/Gomphidaeict	Common Clubtail	*Ictinogomphaus rapax*	-
6		Libellulidae	Ditch Jewel	*Brachythemis contaminate*	LC
7			Ground Skimmer	*Diplacodes trivialis*	LC
8			Ruddy Meadow Skimmer	*Neurothemis intermedia*	LC
9			Pied Paddy Skimmer	*Neurothemis tullia*	LC
10			Green Marsh Hawk	*Orthetrum Sabina*	LC
11			Yellow Tailed Skimmer	*Potamacha congener*	-
12			Marsh Glider	*Rhodothemis Phyllis*	-
1	Butterfly	Papilionidae	Common Mormon	*Papilio polytes Romulus*	-
2		Pieridae	Common Emigrant/Lemon Emigrant	*Catopsilia crocale crocale*	-
3			Common Emigrant/Lemon Emigrant	*Catopsilia pomona Pomona*	-
4			Mottled Emigrant	*Catopsilia pyanthe pyanthe*	-
5			Chocolate Albatross	*Appias lyncida elenosa*	-

No		Family	Common name	Scientific name	IUCN Status
6			Common Crow	*Euploea core godartii*	-
7			Powdered Baron / Malay Baron	*Euthalia monina monina*	-
8				*Euploea hecabe contubernalis*	-
9		Danaidae	Blue Tiger	*Danaus limniace limniace*	-
10		Satyridae	Long-Brand Bushbrown	*Mycalesis visala visala*	-
11		Nymphalidae	Common Sergeant	*Athyma perius perius*	-
12			Common Baron	*Euthalia aconthea gurda*	-
13			Peacock Pansy	*Junonia almana almanac*	-
14			Sailer Butterflies / Sailers	*Neptis zaida putoria*	-
15			Common Tiger	*Danaus genutia*	-
16		Lycaenidae	Common Pierrot	*Castalius rosimon*	-

Note) IUCN Red List Category: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE), "-" Not identified
Source: JICA Study Team

e) Fishes

30 species were identified on the site survey and 12 species were listed based on interview with fishermen. Most of the identified species are categorized as NE, LC and DD except for "Butter Catfish" categorized as NT(Near Threatened). According to information on the IUCN website, original distributed area is in South Asia such as Bangladesh, India, Pakistan and Sri Lanka. Thus it is supposed that this species may stay in the Sittaung River seasonally.

This species is common food fish in South Asia such as Bangladesh, India, Pakistan and Sri Lanka, thus population is decreasing due to this overexploitation. According to IUCN information, This species is considered an esteemed food fish in the Indian subcontinent and is the subject of targeted fisheries. It is occasionally caught and exported as an ornamental fish.

Table 6.2.5 Survey Results on Fishes

	Order	Family	Common Name	Scientific Name	Local name	IUCN Red List Status	Identification
1	*Clupeiformes*	Clupeidae	Hilsa shad	*Tenualosa ilisha**	Nga-tha-lauk	NE	On site
2			Toli shad	*Tenualosa toil**	Nga-tha-lauk-yout-pha	NE	On site
3			Rohtee	*Osteobrama alfredianus*		NE	On site
4		Engraulididae	Common hairfin anchovy	*Setipinna tenuifilis**	Nga-byar	NE	On site
5			Burma hairfin anchovy	*Setipinna wheeleri**	Nga-byar	NE	On site
6	*Siluriformes*	Ariidae	Soldier catfish	*Osteogeneiosus militaris**	Nga-yaung	NE	On site
7		Siluridae	Butter catfish	*Ompok bimaculatus*	Nga-nu-than	**NT**	On site
8		Bagridae	Gangetic mystus	*Mystus cavasius**	Nga-zin-yine	LC	On site
9			Kerala mystus	*M. armatus**	Nga-zin-yine	LC	On site
10			Long whiskers catfish	*M. gulio**	Nga-zin-yine	LC	On site
11			Striped dwarf catfish	*Mystus vittatus*		LC	On site
12		Clarridae	Philippine catfish	*Clarias batrachus*	Nga-khu	LC	On site
13	*Mugiliformes*	Mugilidae	Corsula	*Rhinomugil corsula**	Nga-zinn	LC	On site
14			Squaretail mullet	*Ellochelon vaigiensis**	Ka-ba-lu	NE	On site
15	*Perciformes*	Polynemidae	Fourfinger threadfin	*Eleutheronema tetradactylum**	Ka-ku-yan	NE	On site
16		Sillagoginidae	Flathead solliago	*Sillaginopsis panijus**	Nga-pa-lwe	NE	On site
17		Trichiuridae	Largehead hairtail	*Trichiurus lepturus*	Nga-da-gon	NE	On site
18		Gobiidae	Tank goby	*Glossogobius giuris*	Ka-tha-poe	LC	On site
19			-	*Odontamblyopus rubicundus*	Nga-phyan-ni	NE	On site
20		Gobiidae	-	*Apocryptes bato*	Nga-phyan	NE	On site
21		Osphronemidae	Thick lipped gourami	*Trichogaster labiosa*	Nga-pyin-tha-let-khout	LC	On site
22		Ambassidae	Indian glassy fish	*Parambassis ranga*	Nga-zin-set	LC	On site
23		Channidae	Striped snakehead	*Channa striata*	Nga-pa-naw	LC	On site
24		Sciaenidae	Pama croaker	*Otolithoides pama**	Nga-poke-thin	NE	On site
25			Belanger's croaker	*Johnius belangerii**	Nga-poke-khone	NE	On site
26	*Scorpaeniformes*	Platycephalidae	Bartail flathead	*Platycephalus indicus*	Nga-kyauk-pharr	DD	On site
27	*Tetraodontiformes*	Tetraodontidae		*Chonerhinos naritus*	Nga-pu-tinn	NE	On site
28	*Cypriniformes*	Cyprinidae	Large razorbelly minnow	*Salmophasia bacaila*	Nga daung shay	LC	On site
29			Swamp barb	*Puntius chola*	Nga-Khone-ma	LC	On site
30	*Pleuronectiformes*	Cynoglossidae	Bengal tongue sole	*Cynoglossus cynoglosssus*	Nga-khway-shar	NE	On site
31	*Decapoda*	Palaemonidae		*Exopalaemon stylifera*	Pa-zun-pyaw		On site
32			Gaint perch/ Baramundi	*Lates sp.*			Interview
33			Bronze featherback	*Notopterus sp.*			Interview
34			Pangas catfish	*Pangasius sp.*			Interview

	Order	Family	Common Name	Scientific Name	Local name	IUCN Red List Status	Identification
35			Paradise threadfin	*Polynemus sp.*			Interview
36			Spottail needlefish	*Strongylura sp.*			Interview
37				*Osteobrama sp.*			Interview
38			Wallago	*Wallago sp.*			Interview
39			Burmese carplet	*Amblypharyngodon sp.*			Interview
40			Catfish	*Arius sp.*			Interview
41			Spotted scat	*Scatophagus sp.*			Interview

Note) IUCN Red List Category: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE) "-" Not identified
*: Commercial species
Source: JICA Study Team

f) Planktons and Benthos

Found in lakes, streams, and oceans, phytoplanktons are single-celled organisms that make their own food from sunlight through photosynthesis. Phytoplanktons occur almost anywhere where water and sunlight are available. While there are thousands of different types of phytoplanktons, there are several main categories that make up the most commonly occurring organisms. They are the primary producer and essential in the food chain and food web. According to the result of the present survey, species composition of phytoplanktons were low (35 species) due to the effect of high turbidity of the Sittaung River.

A type of plankton, zooplanktons consist of tiny, free-floating animals that can be found in the streams, rivers, and seas. Hundreds of thousands of different species of animals are part of the zooplanktons. They are usually located near the surface of the water, or rarely on a depth of 1,000 feet. The diet of zooplanktons is based on algae and bacteria and tiny animals in the form of phytoplanktons. The number of zooplanktons was low in the survey area, as they feed on phytoplanktons which were relatively quite low in the survey area.

Benthic organisms live on or just beneath the bottom of the lagoon or in the intertidal zone (mainly mudflats). They crawl over, burrow into, or are attached to the sediments or anything else on the bottom. Benthic organisms are important links in the estuarine food chains, providing an important food source for fishes, birds, and mammals. Without benthic organisms, these larger animals would not be able to survive. It is quite logical that the presence of only 5 species of benthos is probably due to the absence of mudflats in the project area and the area does not belong to the intertidal zone.

Table 6.2.6 Survey Results on Planktons

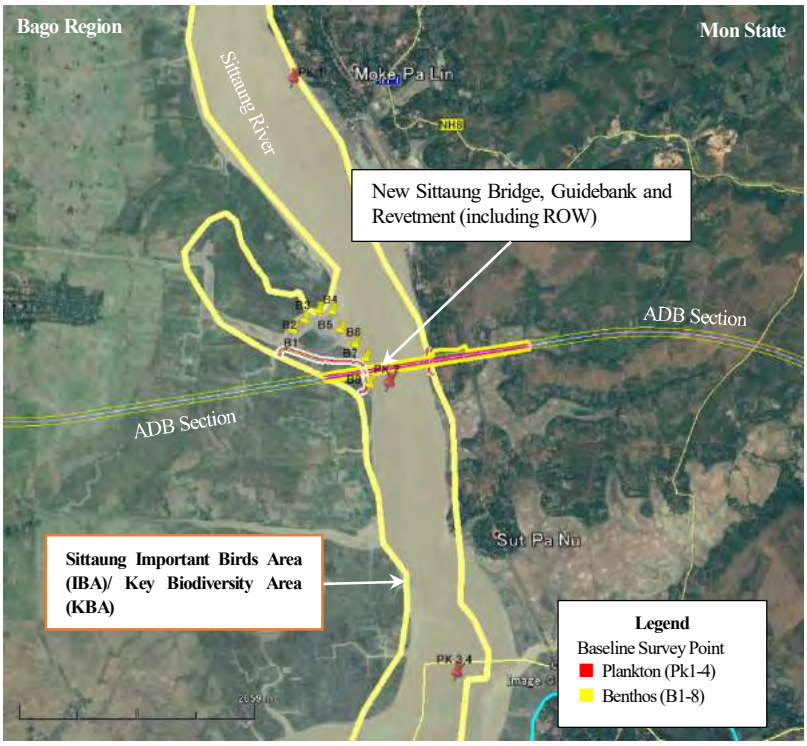
No	Type	Phylum	Class	Order	Family	Genus	Scientific name	Sampling Point			
								1	2	3	4
1	Phytoplankton	Cyanophyta	Cyanophyceae	Nostocalrs	Nostocaceae		Nostoc commune Vaucher.		+	+	
2				Oscillatoriaceales	Oscillatoriaceae		Lyngbya sp. Agardh *ex* Gomont			+	
3							Oscillatoria limosa		+	+	
4					Allacoseiraceae		Aulacoseira granulate (Ehrenberg) Simonsen	+	+	+	
5				Allacoseirales							
6		Bacillariophyta	Coscinodiscophyceae				Aulacoseira muzzanensis (Meister) Krammer		+		
7				Biddulphiineae	Hemiaulaceae		Cerataulina bicornis		+		
8				Thalassiosirales	Thilassiosiraceae		Thalassiosira oestrupii (Ostenfeld) Hasle	+		+	
9					Skeletonemataceae		Skeletonema costatum (Greville) Cleve	+		+	
10					Leptocylindriaceae		Leptocylindrus minimus			+	
11				Coscinodiscales	Coscinodisceae		Coscinodiscus centralis Ehrenberg	+	+	+	
12							Coscinodiscus granii Gough	+	+	+	
13							Coscinodiscus radiatus Ehrenberg	+	+	+	
14							Coscinodiscus oculus-iridis var. borealis		+	+	
15							Coscinodiscus perforatus var. *cellulosa* Grunow		+	+	
16							Coscinodiscus oculus-iridis Ehrenberg			+	
17							Coscinodiscus wailesii Gran and Angst			+	
18				Hemiaulales	Bellerocheaceae		Bellerochea malleus (Brightwell) Van Heurck	+			
19				Lithodesmiales	Lithodesmiaceae		Syringodium americanum Ehrenberg			+	
20											
21		Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae		Synedra sp.1			+	
22							Synedra ulna Ehrenberg		+	+	
23			Bacillariophyceae	Bacillanales	Bacillariaceae		Cylindrothica closterium Lewin & Reimann			+	
24							Nitzschia filiformis (Smith) Hust			+	
25							Nitzschia delicatissima Cleve		+	+	
26							Nitzschia sigma (Kützing) Smith		+	+	
27							Nitzschia			+	
28				Surirellales	Entomoneidaceae		Surirella terryi Terry		+	+	
29				Naviculales	Naviculaceae		Trachyneis aspera (Ehrenberg) Cleve			+	
30							Craticula cuspidate (Kützing) Mann			+	
31							Gyrosigma spencerii (Quekett) Cleve			+	
32			Dinophyceae	Prorocentrales	Prorocentraceae		Prorocentrum gracile Schütt			+	
33				Gonyaulacales	Ceratiaceae		Ceratium dens Ostenfeld and Schumidt			+	
34			Zygnematophyceae				Ceratium furcoides (Levander) Langhans		+	+	
35				Zygnematales	Zygnemataceae		Spirogyra borgenana Transeau		+	+	
36			Chlorophyceae				Spirogyra protecta	+		+	
37				Sphaeropleales	Hydrodictyaceae		Pediastrum simplex		+	+	
38	Zooplankton	Rotifera	Monogononta	Plioma	Brachionidae	*Brachionus*	Brachionus falcatus	+	+	+	
39		Chaetognatha	Sagittoidea	Aphragmophora	Sagittidae	*Sagitta*	Sagitta sp.			+	
40		Arthopoda	Branchiopoda	Cladocera	Bosminidae	*Bosmina*	Bosmina longirostris	+	+	+	+
41							Bosmina longirostris var. *cornuta*	+	+	+	+
42					Chydoridae	*Allona*	Allona sp.	+			
43					Daphnidae	*Ceriodaphnia*	Ceriodaphnia sp.		+		
44						*Moina*	Moina sp.	+	+	+	+
45			Crustacea	Calanoida	Paracalanidae	*Acrocalanus*	Acrocalanus gibber	+	+	+	+
46							Acrocalanus longicornis	+	+	+	+
47						*Bestiolina*	Bestiolina sp.	+	+	+	+
48							Pseudodiaptomus sp.	+	+	+	+
49					Pontellidae	Labidocera	Labidocera euchaeta	+	+	+	+
50					Acartiidae	Acartiella	Acartiella sp.	+	+	+	
51				Cyclopoida	Oithonidae	Oithona	Oithona nana	+	+	+	+
52							Oithona rigida	+	+	+	+
53		Arthopoda	Crustacea	Harpacticoida	Euterpinidae	Euterpina	Euterpina acutifrons	+	+	+	+
54					Ectinosomatidae	Microsetella	Microsetella norvegica	+			
55				Mysidacea	Mysidae		Young mysid	+	+	+	+
56				Decapoda			Megalopa larvae of crab	+	+	+	+
57		Chordata	-	-	-	-	Fish larvae	+	+	+	+

Source: JICA Study Team

Table 6.2.7 Survey Results on Benthos

No	Phylum	Class	Order	Family	Scientific name	Sampling Point							
						1	2	3	4	5	6	7	8
1	Annelida	Polychaeta	Errantia	Glyceride	*Glycera sp.*				+				
2	Mollusca	Gastropoda	Mesogastropoda	Littorinidae	*Litorina planaxis*				+		+		
3			Neogastropoda	Ranellidae	*Cymatium pteifferianum*	+							
4	Arthropoda	Crustacea	Decapoda	Ocypodidae	*Ilyoplax pusillus*			+	+	+			
5		Insecta	Diptera	Dolichopodiae	*Diptera sp.*	+		+		+			+

Source: JICA Study Team



Source: JICA Study Team (Based on Google Earth satellite image)

Figure 6.2.2 Planktons and Benthos Survey Areas and Points

g) Flora

A total of 170 species have been identified in the survey area. In these species, "Borassus flabellifer" is categorized as EN, while "Shorea cinerea", "Abarema bigemina" and "Santalum album" are categorized as VU, respectively, as shown in the table below.

Table 6.2.8 Survey Results on Flora

No	Family	Scientific name	Common Name	Type	Red List Status
1	Arecaceae	*Borassus flabellifer*	Htan	Tree	**EN**
2		*Cocos nucifera*	Ohn	Tree	NE
3	Aloaceae	*Aloe vera*	Shazaung-let-pet	Herb	NE
4	Acanthaceae	*Acanthus ebracteatus*	Khaya	Shrub	LC
5		*Hygrophila phlomoides*	Migyaung kunbat	Herb	NE
6		*Hygrophila phlomoides Nees*	Myanmar Linseed	Herb	-
7		*Justicia gendarussa*	Willow-leaved justicia	Shrub	-
8	Amaranthaceae	*Aerva javanica*	On-hnye	Herb	NE
9		*Alternanthera sessilis*	Sessile joyweed	Small tree	LC
10	Anacardiaceae	*Bouea burmanica*	Mayan	Tree	-
11		*Linnea coromandelica*	Nebe	Tree	LC
12		*Mangifera calonrura*	Taw-tha-yet	Tree	DD
13		*Mangifera indica*	Tha-yet	Tree	NE
14		*Spondias pinnata*	Gwe	Tree	DD
15	Annonaceae	*Annona muricata*	Duyin –awza	Small tree	NE
16	Apocynaceae	*Alstonia scholaris*	Taung-mayo	Tree	LC
17	Aquifoliaceae	*Ilex sulcala*	Sauk yo	Tree	NE
18	Asclepiadaceae	*Sarcolobus carinatus*	Ka-yu	Climber	LC
19		*Sarcolobus globosus*		Climber	LC
20	Asteraceae	*Chromolaena odorata*	Bezat	Shrub	LC
21		*Eclipta alba*	Kyeit- hmon	Herb	LC
22	Bignoniaceae	*Heteropharagma adnophylla*	Phat than	Tree	-
23		*Markhamia stipulata*	Ma-hlwa	Tree	-
24		*Oroxylum indicum*	Kyaung –sha	Tree	-
25	Bombacaceae	*Bombax ceiba*	Letpan	Tree	NE
26		*Ceiba pentandra*	Le-moh-pin	Tree	LC
27	Caeasalpiniaceae	*Bauhina ornada*	Swe-daw –new	Climber	LC
28	Caeasalpiniaceae	*Bauhina pottsii*	Swe-daw	Small tree	LC
29		*Bauhina sulphurea*	Swe-daw	Tree	-
30		*Caesalpinia pulcherrima*	Sein-pan –galay	Small tree	-
31		*Cassia angustifolia*	Pwegaing	Shrub	LC
32		*Cassia bicapsularis*	Dan-kywe	Shrub	LC
33		*Cassia fistula*	Ngu	Tree	LC
34		*Cassia mimosoides*	Mezali	Shrub	-
35		*Cassia Multijuga*	Thiho-ngu	Small tree	-
36		*Delonix regia*	Sein-pan	Tree	LC
37		*Senna siamea*	Taw-mezali	Tree	NE
38		*Tamarindus indica*	Magyi	Tree	LC
39	Caricaceae	*Bhesa robusta*	Gwe-dauk	Tree	LC
40		*Carica papaya*	Thin-baw	Small tree	DD
41	Combretaceae	*Combretum acuminatum*	Nabu-new	Climber	NE
42		*Terminalia bellerica*	Thit-seint	Tree	NE
43		*Terminalia catappa*	Banda	Tree	NE
44	Convolvulaceae	*Erycibe citriniflora*	Eikhmwe	Small tree	LC
45		*Ipomaea bona*	Kyan-hin –nyunt	Climber	LC
46		*Ipomaea reptans*	Ye-kanzun	Climber	LC
47	Cucurbitaceae	*Citrullus lanatus*	Hpaye	Climber	LC
48		*Cucumis saativus*	Thakha	Climber	-
49		*Cucurbita moschata*	Hpayan	Climber	-
50		*Trichosanthes cucurmerina*	Thabut kha	Climber	-
51	Dipteracarpaceae	*Parashorea dussoudii*	Kaduk	Tree	-
52		*Shorea cinerea*	Kadut-n	Tree	**VU**
53	Dipteracarpaceae	*Shorea entic*	Thit-ya	Tree	-
54	Elaeacarpaceae	*Elaeocarpus griffithis*	Kalaminkye	Tree	NE
55	Euphorbiaceae	*Aporusa willosula*	Thit-khauk	Small tree	NE
56		*Baccaurea parviflora*	Kanaso	Small tree	NE
57		*Croton joufra*	Thet-yin –gyi	Tree	LC
58		*Emblica officinalis*	Zibyu	Tree	NE
59		*Euphorbia antiquorum*	Kun	Small tree	NE
60		*Macaranga senticulate*	Phet-Wun	Small tree	NE

No	Family	Scientific name	Common Name	Type	Red List Status
61		*Macaranga albus*	Phet-waing	Tree	-
62		*Ricinus communis*	Kyet-su	Small tree	-
63		*Euphorbia neriifolia L.*	Indian Spurge Tree	Small tree	-
64	Fabaceae	*Butea superba*	Pauk-new	Climber	-
65		*Desmodium oblongum*	Kyu	Shrub	LC
66		*Dilochos uniflorus*	Pe-bi-zat	Climber	LC
67		*Millettia pachycarpa*	Mi-gyaung new	Climber	-
68		*Ptcrocarpus macrocarpus*	Thit padauk	Tree	NE
69		*Albizia lebbeck*	Siris tree	Tree	-
70		*Mimosa pudica L*	Sensitive Plant	Herb	LC
71		*Mimosa pigra L.*	Giant sensitive tree	Herb	-
72		*Erythrina indica*	Coral tree	Tree	LC
73		*Rhynchosia minima*	Least snout-bean	Herb	-
74		*Sesbania bispinosa*	Sesbania Pea	Herb	LC
75	Flacauritiaceae	*Hydnocarpus heterophyllus*	Kalaw-so	Tree	-
76	Hypericaceae	*Calophyllun amoenum*	Tharipii	Tree	-
77		*Cratoxylum nexiifolium*	Bebya	Tree	-
78		*Mesua ferrea*	Gangaw	Tree	-
79	Lamiaceae	*Ocimum americanum*	Pin-sein	Herb	LC
80		*Clerodendrum speciosissimum Van Geert ex C.Morren*	Japanese Glorybower	Shrub	-
81		*Mentha arvensis L.*	Field mint	Herb	LC
82	Lauraceae	*Litiea monapetala*	Ondon	Small tree	NE
83	Lythraceae	*Lagerstroemia floribunda*	Pyinma	Tree	LC
84		*Lawsonia alba*	Dan	Shrub	LC
85	Mimosaceae	*Abarema bigemina*	Danyin	Tree	**VU**
86	Mimosaceae	*Acacia concinna*	Kinmun-gin	Climber/Creeper	NE
87	Oxalidaceae	*Auerrhoa carambola*	Zaung-yar	Small tree	NE
88	Poaceae	*Bambusa polymorpho*	Kyathaung-wa	Bamboo	NE
89		*Gigantochloa auriculata*	Thaik-wa	Bamboo	NE
90		*Gigantochloa nigrociliata*	Wa-ya	Bamboo	NE
91		*Gigantochloa wanat E.G.Camus*	Wa-net	Bamboo	NE
92		*Pseudoraphis brunoniana*	Myet	Grass	NE
93		*Saccharum spontanensis*	Kaing	Grass	NE
94		*Thyrsostachys siamensis*	Hti-Yo –wa	Bamboo	NE
95	Papilionaceae	*Erythrina crista*	Kathit	Small tree	NE
96	Passifloraceae	*Adenia caediophylla*	Kyet-hin-kha-nwe	Climber/Creeper	NE
97	Piperaceae	*Piper bettle*	Kun	Climber/Creeper	NE
98		*Piper betle L.*	Betelvine	Climber	-
99		*Piper longum*	Nga yoke kaung	Climber/Creeper	NE
100		*Piper nigrum*	Sayo	Climber/Creeper	NE
101	Rhamnaceae	*Ziziphus oenopila*	Supauk-pin	Shrub	NE
102		*Ziziphus rugosa*	Taw-zi	Small tree	NE
103	Rhizophoraceae	*Carallia brachiata*	Mani –awga	Tree	NE
104	Rubiaceae	*Morinda angustifolia*	Yeyo	Small tree	NE
105	Rutaceae	*Aegle marmelos*	Okshit	Tree	NE
106		*Citus hystrix*	Shauk- cho	Small tree	NE
107		*Citus maxima*	Kywe-gaw	Small tree	NE
108		*Murraya koenigii*	Pyindawthein	Small tree	NE
109	Santalaceae	*Santalum album*	Nant-thar-phyu	Small tree	**VU**
110	Mimosaceae	*Acacia concinna*	Kinmun-gin	Climber/Creeper	NE
111	Mimosaceae	*Acacia pennata*	Suboke	Climber/Creeper	M
112		*Adenanthera pavonia*	Ywe	Tree	NE
113		*Albizia chinensis*	Kayan	Tree	-
114		*Albizia lebbek*	Kokko	Tree	NE
115		*Albizia procera*	Sit-pin	Tree	LC
116		*Leucaena glauea*	Bawzagaing	Tree	-
117		*Pithecellobium dulce*	Kala-magyi	Tree	NE
118	Moraceae	*Artocarpus heterophyllus*	Peinne	Tree	-
119		*Ficus altissima*	Naung-peinne	Tree	-

No	Family	Scientific name	Common Name	Type	Red List Status
120		*Ficus annulata*	Naung-tha-phan	Tree	-
121		*Ficus glabella*	Naung-tha-bye	Tree	-
122		*Ficus glomerata*	Naung-tha-phan	Tree	-
123		*Ficus indica*	Naung-tha-bye	Tree	DD
124		*Ficus virens*	Naung-gyin	Tree	-
125		*Ficus chartacea*	Tha-phan	Tree	-
126		*Ficus religiosa*	Pipal	Tree	-
127		*Ficus hispida L.f.*	Hairy fig	Tree	-
128	Moringaceae	*Moringa oleifera*	Dan-da-lum	Tree	NE
129	Myrtaceae	*Eucalyptus comaldulensis*	U-ca-lit	Tree	NE
130		*Eugenia amplexicaulis*	Thabya-ge	Tree	NE
131		*Syzygium attenuatum*	Thabye	Tree	NE
132		*Syzygium grande*	Thabye-gyi	Tree	NE
133		*Syzygium oblatum*	Thabye-ni	Tree	NE
134		*Syzygium polyanthum*	Malaga	Tree	NE
135		*Psidium guajava*	Malaka	Small tree	NE
136	Nyetaginaceae	*Bougainvillea glabra*	Sekku pan	Climber/Creeper	LC
137	Oleaceae	*Jasminium scandens*	Taw-Sabe	Shrub	-
138	Oxalidaceae	*Auerrhoa carambola*	Zaung-yar	Small tree	NE
139	Poaceae	*Bambusa polymorpho*	Kyathaung-wa	Bamboo	NE
140		*Gigantochloa auriculata*	Thaik-wa	Bamboo	NE
141		*Gigantochloa nigrociliata*	Wa-ya	Bamboo	NE
142		*Gigantochloa wanat E.G.Camus*	Wa-net	Bamboo	NE
143		*Pseudoraphis brunoniana*	Myet	Grass	NE
144		*Saccharum spontanensis*	Kaing	Grass	NE
145		*Thyrsostachys siamensis*	Hti-Yo –wa	Bamboo	NE
146	Passifloraceae	*Adenia caediophylla*	Kyet-hin-kha-nwe	Climber/Creeper	NE
147	Piperaceae	*Piper bettle*	Kun	Climber/Creeper	NE
148		*Piper longum*	Nga yoke kaung	Climber/Creeper	NE
149		*Piper nigrum*	Sayo	Climber/Creeper	NE
150	Rhamnaceae	*Ziziphus oenopila*	Supauk-pin	Shrub	NE
151		*Ziziphus rugosa*	Taw-zi	Small tree	NE
152	Rhizophoraceae	*Carallia brachiata*	Mani –awga	Tree	NE
153	Rubiaceae	*Morinda angustifolia*	Yeyo	Small tree	NE
154	Rutaceae	*Aegle marmelos*	Okshit	Tree	NE
155		*Citus hystrix*	Shauk- cho	Small tree	NE
156		*Citus maxima*	Kywe-gaw	Small tree	NE
157		*Murraya koenigii*	Pyindawthein	Small tree	NE
158	Tiliaceae	*Microcos paniculata*	Mya-yar	Small tree	-
159	Verbenaceae	*Clerodendrum patasites*	Phet –kha	Small tree	-
160	Verbenaceae	*Gmelina arborea*	Ya ma nay	Tree	NE
161		*Tectona grandis*	Kyun	Tree	NE
162	Vitaceae	*Vitex trifolia*	Kyaung- ban	Small tree	-
163	Urticaceae	*Bochmeria hamiltoniana*	Kya-sha	Shrub	-
164	Zingiberaceae	*Curcuma caesia Roxb.*	Black turmeric / Hta-min-sok	Herb	-
165	Capparaceae	*Crateva religiosa*	Three-leaved caper	Tree	-
166	Boraginaceae	*Heliotropium indicum*	Indian heliotrope	Herb	LC
167	Malvaceae	*Hibiscus lunarifolius*	Chinbaung-yaing	Shrub	-
168	Meliaceae	*Sandoricum koetjape*	Santol	Tree	-
169	Cyperaceae	*Cyperus compressus L.*	Poorland flatsedge	Herb	LC
170	Solanaceae	*Physalis minima*	Wild gooseberry	Herb	LC
171	Onagraceae	*Ludwigia adscendens*	Water primrose	Herb	-

Note: Extinct(EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE), "-" Not identified
Source: JICA Study Team

The features of considerable species categorized as EN and VU in the IUCN Red List are shown below.

Only "Shorea cinerea" is a native species which has been identified out of 100m range (right of way:ROW). However, based on IUCN information, original distributed area is hilly and mountainous area with elevation 400-1200m of southern part of Myanmar such as Tanintharyi Region. Thus it is supposed that this individual may be planted by villager or prominence individual.

Additionally the other 3 species are not native species, they may also prominence individual or planted by villager.

Table 6.2.9 Features of Considerable Flora Species

Name of Species	IUCN Status	Countries Distributed	Major Threat (based on IUCN)	Situation on Site	Identified Location
Borassus flabellifer 	EN	Madagascar	There is loss of habitat due to expanding agriculture and increasing fire frequency **in Madagascar.**	Identified individual is cultivated, not natural	Out of the project area (ROW)
Shorea cinerea	VU	Lao People's Democratic Republic, Malaysia, **Myanmar (only Shan State and Tanintharyi Region)**, Thailand, Viet Nam	This is a woody plant used for timber in general. This species has had a 30–50% population reduction in the past three generations (300 years) due to loss of habitat for expanding agriculture, exploitation of the species and forest clear cutting. Decline is likely to continue into the future.	This species was recorded out of ROW, however, based on IUCN information, original distributed area is hilly and mountainous area (elevation 400-1200m) of southern part of Myanmar. Thus this individual may be planted by villager or prominence individual.	Out of the project area (ROW)
Abarema bigemina	VU	Sri Lanka	No description However, native is in Sri Lanka and the number of individuals has decreased.	Recorded individual is not natural.	Out of the project area (ROW)
Santalum album 	VU	China, India (Karnataka, Tamil Nadu), Indonesia (Lesser Sunda Is.), Philippines	Fire, grazing and most importantly, exploitation of the wood for fine furniture and carving and also for oil are threatening the species. Smuggling is assumed to have reached alarming proportions.	Recorded individual is not natural.	Out of the project area (ROW)

Source: IUCN Red List (http://www.iucnredlist.org as of Oct. 2018)

4) Evaluation Regarding Critical Natural Habitat

As explained in the previous article on "3.1.7 Natural Habitat Areas", the planned bridge is passing through a part of IBA/ KBA. Based on the result of fauna-flora surveys, the project area including a part of IBA/KBA is evaluated whether it is categorized as important natural habitat in accordance with the JICA Guidelines for Environmental and Social Considerations (2010) as shown below.

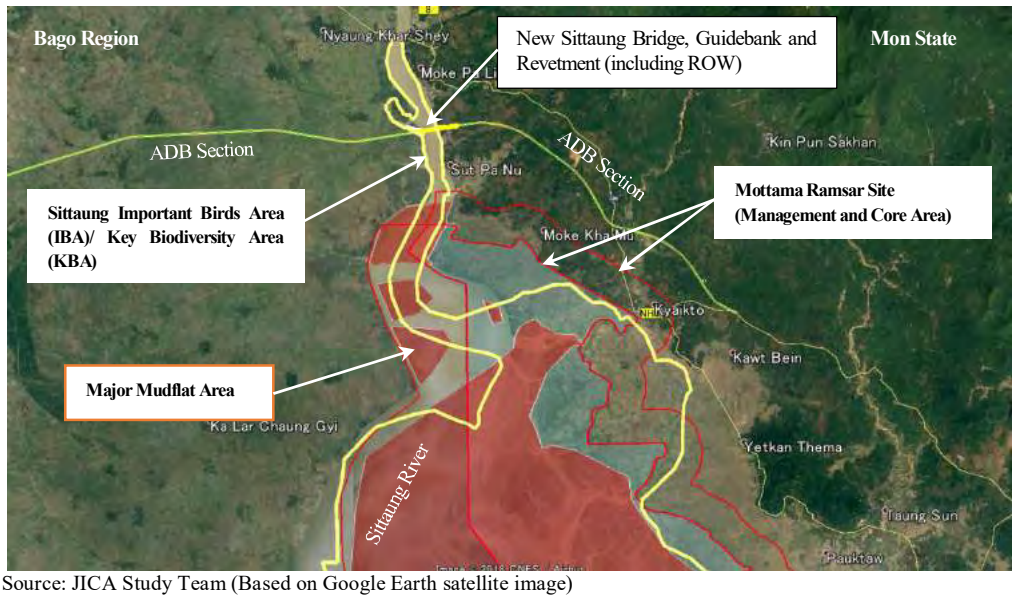
As a result of the analysis regarding critically natural habitat as shown in Table 6.2.10, it is evaluated that the project site as a part of IBA/KBA is NOT categorized as critically natural habitat in accordance with JICA Guidelines.

Table 6.2.10 Assessment Regarding Critical Natural Habitat

Criteria under JICA Guideline[*1]	Fact and Evaluation	Applicability
Criteria-1 Habitats important for the species that are classified into "Critically Endangered (CR), "Endangered (EN)", "Vulnerable (VU)", and "Near Threatened (NT)" under the	According to secondly data for IBA/KBA, some considerable species categorized as CR, EN and NT are listed up as shown in Table 4.1.8 and 4.1.10. However such considerable bird species have not been observed in the bird survey during migratory season in 2018. Additionally 1 fish species and 3 flora species have been recorded out of	Criteria is not applicable for the project area in the part of Gulf of Mottama IBA/KBA

Criteria under JICA Guideline*1	Fact and Evaluation	Applicability
International Union for Conservation of Nature (IUCN) Red List of Threatened Species	ROW, however, native and main distribution area is not project area. The project area is developed as an agricultural and paddy area without any natural vegetation forests. Thus it is speculated that any desirable nesting and roosting areas are not existing in the project area. In the river area, there are no main mudflat areas as feeding area for migratory birds and other fauna-flora species. (See main mud-flat area in Figure 6.2.3) Thus although some considerable species have been observed out of ROW and Sittaung River, the project area is not main distributed area nor/or important area as feeding and nesting.	
Criteria-2 Habitats important for endemic species and/or limitedly distributed species	In the fauna-flora surveys, such endemic and/or limitedly distributed species have not been observed.	Criteria is not applicable for the project area in the part of Gulf of Mottama IBA/KBA
Criteria-3 Internationally important habitats that support migratory species and/or flock-forming species	The most important function for bird's wintering spot is securing of feeding. Considerable migratory birds can find their targets in mudflat area. In the project area, no major mudflat is observed. The main mudflat exists in the Potential Management area and registered area of the Ramsar Site.	Criteria is not applicable for the project area in the part of Gulf of Mottama IBA/KBA
Criteria-4 Critically endangered ecosystems and/or unique ecosystems	Since the project area is developed as an agricultural area, such critically endangered ecosystem and/or unique ecosystem is not observed.	Criteria is not applicable for the project area in the part of Gulf of Mottama IBA/KBA
Criteria-5 Areas related to important evolutionary processes	Past study regarding important evolutionary processes is not reported in this area.	Criteria is not applicable for the project area in the part of Gulf of Mottama IBA/KBA

Source: *1: Answers to Frequently Asked Questions about Japan International Cooperation Agency (JICA)'S Guidelines for Environmental and Social Considerations (July 20, 2011, revised on February 5, 2016)



Source: JICA Study Team (Based on Google Earth satellite image)

Figure 6.2.3 Major Mudflat Distribution in IBA/KBA and Ramsar Site

(2) Potential Impacts

1) During Construction

The project area is almost a developed area such as paddy field and rubber tree plantation. However, construction activities with noise and vibration and the generation of turbid water in the river may give some impacts on the surrounding ecosystem. Additionally, the cutting of rubber trees in the forest may cause impact on its ecosystem.

The alignment is not passing through any law-based natural protected areas. Potential management area is located 3.6 km away downstream and the registered Mottama Gulf Ramsar Site as a law-based protected area is located downstream 5.5 km away from the project area. Construction activities and construction noise and vibration may give impacts

on some species which have feeding areas near project area, and turbid water which is generated from construction area may give impacts on the ecosystem in the Gulf of Mottama Ramsar Site.

Furthermore, the project area is passing through Sittaung Important Birds Area (IBA) and Key Biodiversity Area (KBA), which are proposed by international NGOs. Although IBA and KBA are not law-based protected areas, it is expected that project activities may give some impacts.

2) **After Construction**

An existence of structures such as bridge, approach road and guidebank, and the traffic flow with noise and vibration may give adverse impacts to some species which have feeding areas in the project area

(3) **Impact Forecast**

1) **During Construction**

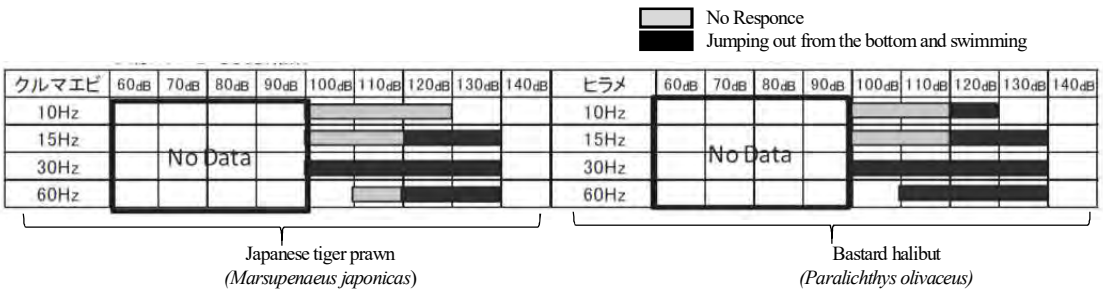
Expected impact factor and degrees in the project area, IBA and Mottama Ramsar site during construction are shown below:

Table 6.2.11 Impact Item and Factor on Fauna and Flora During Construction

Impact Area and Degree / Impacted Factor	Affected Area	
	Project Area and surrounding area within 500m / IBA-KBA	Ramsar Site Potential Management Area: Approx. 3.6km away Ramsar Registered Area: Approx. 5.5km away
1.Alternation of land due to earthwork and cutting trees	1) Land Area Paddy field and rubber trees are alternated by earthwork in the affected area. Most of fauna species avoid this area and stay in the same habitats outside of the project area. With regard to flora, since the main land is used as a paddy field, there are no considerable adverse effects on the ecosystem, and the impacts on the ecosystem are not serious. 2) River Area Excavation at planned pillars may give adverse impacts on aquatic life such as fishes, benthos and plants. Some considerable fauna-flora species have been recorded in the survey. General species living in the affected area may be impacted, but the same habitats are distributed in the surrounding area.	No impacts are expected because direct alternation in Ramsar Site is not planned.
2.Human activities	1) Land Area Mammal species and birds avoid feeding and roosting in ROW; however, the same condition exists outside of ROW. 2) River Area Birds and fishes avoid feeding in ROW; however, such species exhibit the same condition outside of ROW.	No impacts are expected because human activities in the project area are not confirmed in Ramsar Site.
3.Construction noise and vibration	1) Land Area Mammal species and birds avoid feeding and roosting in ROW; however, the same condition exists outside of ROW. The estimated noise and vibration level on the boundary of ROW is 59 dB(A) noise and 46 dB vibration, respectively. It is not likely to give significant impact on feeding area and roosting area. However, mitigation measures for the minimization of construction of noise and vibration should be in place. 2) River Area Birds and fishes avoid feeding in ROW and exhibit the same condition outside of ROW. It is predicted that a steady source of noise such as operation of construction machines does not give serious impacts on birds; however, unsteady noise such as piling by drop hammer may pose a threat to birds and keep them away from the construction area. However, the	[Estimated noise level] · Background Level: 45 dB(A) · Forested level: 45 dB(A) at Management and Core Area [Estimated vibration level] · Background Level: 24 dB · Forested level: 24 dB at Management and Core Area Construction noise and vibration do not give any impact on Ramsar Site.

Impact Area and Degree / Impacted Factor	Affected Area	
	Project Area and surrounding area within 500m / IBA-KBA	Ramsar Site Potential Management Area: Approx. 3.6km away Ramsar Registered Area: Approx. 5.5km away
	surrounding area has same environment for feeding and roosting. With regard to vibration impact on fishes in the water, according to the reference, it is observed that more than 100 dB vibration give impacts on fishes and shellfishes. However, the vibration level of vibrohammer is approx. 80 dB, thus it is expected that the given impact is not serious. (See Figure 6.2.4.)	
4.Generation of Turbid water in the river and organic polluted water	1) Impact from Excavation of Pillars in the River Steel pipe sheet piles (SPSP) methodology is adopted so as not to generate turbid water at excavated area in the river, thus the impact is at negligible level. 2) Impact from the Construction Area (Turbid Water) Developed and opened area as a construction area may generate turbid water during rainy season. Forecasted data is shown below: ・ Current SS: 296 mg/l (Rainy Season) ・ Forecasted SS: 298 mg/l (Rainy Season) Increase rate is less than 1% and does not cause significant impact 3) Impact from Organic Polluted Water Organic polluted water may be generated from the base camp. Forecasted density of BOD is show below: ・ Current BOD: 14 mg/l (Dry Season) ・ Forecasted BOD: 14.04 mg/l (Dry Season) Increase rate is less than 0.3% and does not cause significant impact	←Ditto
5.Changing hydrological situation	Construction of pillars in the river may change the hydrological situation and give impact on the surrounding feeding area such as mudflat for birds and other fauna species. According to hydrological simulation, the height of water surface may change in the range of approx. 120 m to downstream side. In this area, no mudflat is observed. Thus, it is not likely to give any impacts on the ecosystem, especially for birds.	←Ditto The Potential Management Area and registered Ramsar Site are located more than 3.6km and 5.5km away from the project area, respectively. Thus, no impact is predicted for the project during construction.

Source: JICA Study Team



Source: The Influence That Vibration To Occur By Marine Construction Gives To The Benthos Of The Peripheral Sea Area (July 2008/ Kana UEDA)

Figure 6.2.4 Impact of Vibration Level on Aquatic Fauna Based on Other Study

With regard to bird species, no considerable species such as those in categories EX, EW, EN, VU and NT are observed. Any considerable species in the secondary data IBA/KBA as shown in Table 4.1.10 have not been observed in the baseline survey because the survey area is quite a small area outside of the IBA / KBA area, which has a distribution of approx. 110,000 ha. Also, the main feeding and roosting area for the considerable migratory birds is the mudflat area located at least 3.6km away from the project area. Thus, the project does not give any significant impact on such species. Additionally, some considerable fishes and flora species have been identified. However, according to the description of IUCN, the reasons why species are threatened are described mainly in the native area and not in all identified areas. Thus, the project activities do not give serious impacts to such species.

2) After Construction

The expected impact factors and degrees in the project area, IBA and Mottama Ramsar Site after construction are shown below:

Table 6.2.12 Impact Items and Factors on Fauna and Flora After Construction

<table>
<tr><th>Impact Area and Degree / Impacted Factor</th><th>Affected Area</th><th>Ramsar Site
Potential Management Area: Approx. 3.6km away
Ramsar Registered Area: Approx. 5.5km away</th></tr>
<tr><td>1. Road kill</td><td>Road kill of mammals and birds are expected, thus following mitigation measures are required for minimization of impacts:
· Setting up of fence at the boundary of ROW for road kill prevention
· Setting up of LED handrail light in the bridge section so as not to attract insects and bats (under consideration: See Figure 6.2.5)
· Setting up of pole more than 4m in height so that moving vehicles will not get hit by flying birds (under consideration: See Figure 6.2.6)</td><td>Some birds may come to the project area for feeding. Thus, mitigation measures are required.
. Ditto</td></tr>
<tr><td>3.Traffic noise and vibration</td><td>Forecasted noise and vibration level at the boundary of ROW and 250m in KBA/IBA is shown below:

[Noise] Project Area 100-500 m range (KBA/IBA)<table><tr><th rowspan="2">Point
From the centerline</th><th rowspan="2">Time</th><th colspan="2">Noise Level dB(A)</th></tr><tr><th>BG</th><th>Forecast</th></tr><tr><td rowspan="2">ROW
(50m away)</td><td>Daytime</td><td>45</td><td>59</td></tr><tr><td>Nighttime</td><td>42</td><td>54</td></tr><tr><td rowspan="2">250m away</td><td>Daytime</td><td>45</td><td>58</td></tr><tr><td>Nighttime</td><td>42</td><td>53</td></tr></table>Note) Day 7-22hrs, Night 22-7hrs, BG:Background

[Vibration] 100-500m range (KBA/IBA)<table><tr><th rowspan="2">Point
From the centerline</th><th rowspan="2">Time</th><th colspan="2">Vibration Level dB</th></tr><tr><th>BG</th><th>Forecast</th></tr><tr><td rowspan="2">ROW
(50m away)</td><td>Daytime</td><td>33</td><td>43</td></tr><tr><td>Nighttime</td><td>24</td><td>40</td></tr><tr><td rowspan="2">250m away</td><td>Daytime</td><td>33</td><td>41</td></tr><tr><td>Nighttime</td><td>24</td><td>40</td></tr></table>Note) Day 7-20hrs, Night 20-7hrs, BG:Background

Mammals and bird species which are feeding and roosting on the boundary of ROW may be led to avoid the project area after the opening of the new bridge. However, some bird species such as helons are observed near current Sittaung Bridge. The species is not likely to cause significant impact on the birds' feeding and roosting areas.</td><td>Forecasted noise and vibration levels at the boundary of Potential Management Area and Registered Ramsar Site are shown below:

[Noise] Ramsar Site (3.6km – 5.5km)<table><tr><th rowspan="2">Point
From the centerline</th><th rowspan="2">Time</th><th colspan="2">Noise Level dB(A)</th></tr><tr><th>BG</th><th>Forecast</th></tr><tr><td rowspan="2">Management Area (3.6km)</td><td>Daytime</td><td>45</td><td>49</td></tr><tr><td>Nighttime</td><td>42</td><td>45</td></tr><tr><td rowspan="2">Registered Area (5.5km)</td><td>Daytime</td><td>45</td><td>49</td></tr><tr><td>Nighttime</td><td>42</td><td>44</td></tr></table>Note) Day 7-22hrs, Night 22-7hrs, BG:Background

[Vibration] Ramsar Site (3.6km – 5.5km)<table><tr><th rowspan="2">Point
From the centerline</th><th rowspan="2">Time</th><th colspan="2">Vibration Level dB</th></tr><tr><th>BG</th><th>Forecast</th></tr><tr><td rowspan="2">Management Area 3.6km)</td><td>Daytime</td><td>33</td><td>38</td></tr><tr><td>Nighttime</td><td>24</td><td>36</td></tr><tr><td rowspan="2">Core Area (5.5km)</td><td>Daytime</td><td>33</td><td>37</td></tr><tr><td>Nighttime</td><td>24</td><td>35</td></tr></table>Note) Day 7-20hrs, Night 20-7hrs, BG:Background

Forecasted noise and vibration levels decay according to distance from the bridge, and these forecasted values are not at significant levels.
Thus it is not likely to give significant impact on the birds' feeding and roosting areas in Ramsar Site.</td></tr>
<tr><td>4. Lightning along the bridge and road</td><td>Lighting may give adverse impacts to birds' roosting area in the grass and fishes in the river.
Thus, leaking light should be minimized through the implementation of mitigation measures as follows:
· Setting up of light with cover not to irradiate the river surface and outside of the road (see Figure 6.2.5)</td><td>In general, illuminance is inversely proportional to the square of the distance, thus the illumination level at 3.6km from the bridge is approx. 0.02% of ROW boundary.
The project gives few impacts on lighting.</td></tr>
<tr><td>5. Impact on the Water Quality</td><td>• No turbid water is generated by the project
• No organic polluted water is generated by the project
• With regard to surface water quality from carriage way, it does not give serious impacts on Zn and Pb in accordance with case study in Japan*Note-1
*Note-1 See Article 10.7.2 Water Quality (3) Impact forecast, 2) After Construction
Technical Note of National Institute for Land and Infrastructure Management No.596 May 2010</td><td>←Ditto</td></tr>
<tr><td>6. Expansion of development</td><td>The land along the road and bridge may be developed without any regulation. Such development may give adverse impacts on KBA/IBA. Thus following mitigation measures are necessary:</td><td>The land along the road and bridge may be developed without any regulation. Such development may give adverse impacts on Ramsar Site. Thus following mitigation measures are necessary:</td></tr>
</table>

Impact Area and Degree / Impacted Factor	Affected Area	
	Project area and surrounding area within 500m / IBA-KBA	Ramsar Site Potential Management Area: Approx. 3.6km away Ramsar Registered Area: Approx. 5.5km away
	· Establish land use plan in the project area and KBA/IBA and implement appropriate land use management so as not to cause unplanned development.	· Establish land use plan in Ramsar Site and implement appropriate land use management so as not to cause unplanned development

Note*1: The Influence That Vibration To Occur By Marine Construction Gives To The Benthos Of The Peripheral Sea Area (July, 2008/ Kana UEDA)

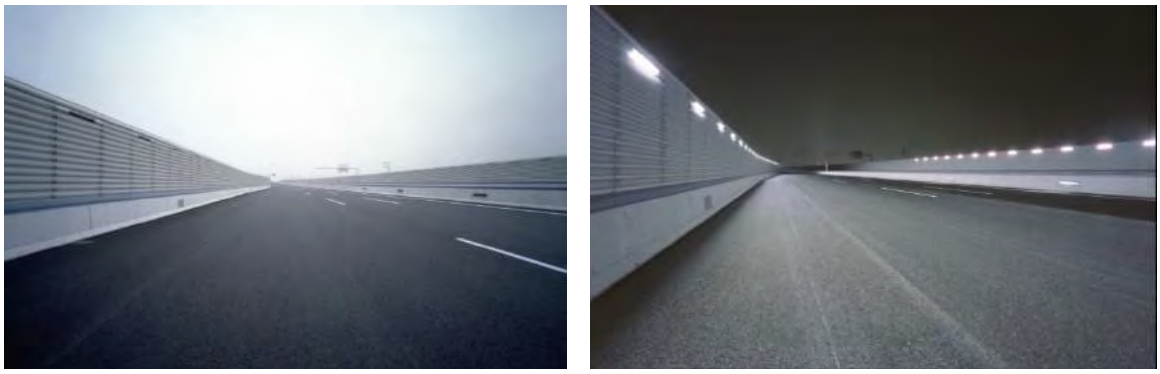
(4) Mitigation Measures

1) During Construction

- ✓ ROW shall be marked and all relevant construction workers should be informed not to conduct development outside of the project area
- ✓ Waste oil shall be stored and disposed of into a designated site so as not to leak into the water body
- ✓ Adoption of steel pipe sheet piles (SPSP) methodology so as not to generate significant turbid water at the excavated area in the river
- ✓ Adoption of lower noise and vibration construction method and machines
- ✓ Lighting in the river shall be minimized at nighttime so as not to cause adverse impacts on the fishes' lifecycle
- ✓ Implementation of detailed comprehensive fauna-flora monitoring during detailed design and construction (See special ecosystem survey in the article on EMP)

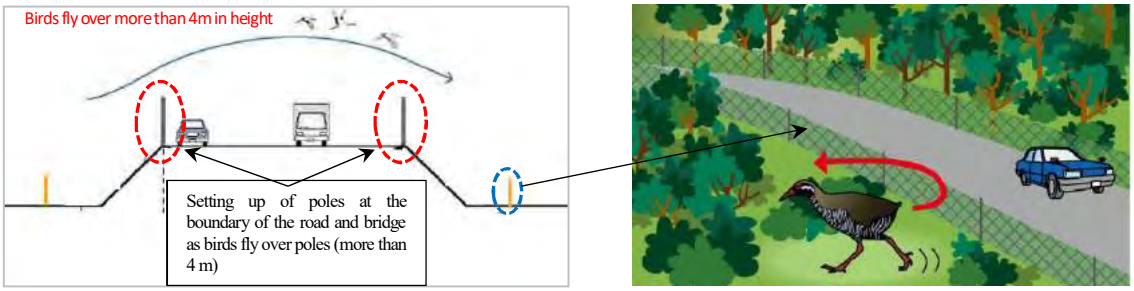
2) After Construction

- ✓ Setting up of fence at boundary of ROW for road kill prevention
- ✓ Setting up of pole more than 4m in height so that moving vehicles will not get hit by flying birds (under consideration)
- ✓ Setting up of LED handrail light in the bridge section so as not to attract insects and bats (under consideration)
- ✓ Setting up of light with cover so as not to irradiate the river surface and outside of the road in keeping with sound lifecycle of fishes
- ✓ Establishment of a land use plan in the project area, KBA/IBA and Ramsar Site and implementation of appropriate land use management so as not to cause unplanned development
- ✓ Implementation of detailed comprehensive fauna-flora monitoring after construction (See special ecosystem survey in the article on EMP.)



Source: Panasonic Eco-solutions (Project name: Shin Meishin Expressway Asuka IC- Nabeta IC in Japan)

Figure 6.2.5 Handrail Lighting System



Source: National Institute for Land and Infrastructure Management (NILIM)

Figure 6.2.6 Mitigation Measures for Road Kill Prevention

(5) Evaluation

1) Project Area Including KBA/IBA

The project area is developed as paddy field and rubber tree plantation with human activities. Thus, considerable habitats such as natural forests and mudflat for mammal and bird species in the project area are not observed. Although some considerable species have been observed out of ROW and Sittaung River, the project area is not main distributed area nor/or important area as feeding and nesting.

Furthermore, according to the result of planktons and benthos survey, the number of observed species is quite low, and it is evaluated that the level of natural diversity is not rich due to the effect of high turbidity in the Sittaung River.

During construction, noise and vibration from construction activities may give impacts on feeding and roosting areas of birds and fishes near the project area. However, similar habitats exist outside of the project area, and such species can avoid the impacted area during the impacted period.

After construction, some impacts such as road kill, traffic noise, lighting and human activities due to new development are expected. However, the implementation of mitigation measures minimizes these expected adverse impacts. Thus, it is not likely to give serious impacts on the ecosystem in the project area and KBA/IBA.

With regard to the result of the analysis on critically natural habitats, it is evaluated that the project area in the part of Sittaung KBA/IBA is not a critically natural habitat in accordance with criteria under JICA Guidelines.

2) Mottama Gulf Ramsar Site

According to information regarding Mottama Gulf Ramsar Site, some considerable species such as "spoon-billed sandpiper", categorized as CR on the IUCN Red List, migrated from the northern area and uses the Ramsar Site as wintering spot. Especially, most of the migratory aquatic birds use the mudflat as feeding and roosting areas during migratory season.

Critical habitats for fauna species such as Potential Management Area and the registered Ramsar Site are located more than 3.6km and 5.5 km away downstream from the project area, respectively.

According to wildlife specialists in Myanmar and Japan, the following opinions, discussion and conclusions have been given:

Table 6.2.13 Impact Items and Factors on Fauna and Flora After Construction

No	Discussions and Conclusions		
	Expected Impacts and Opinions (Name of Specialist)	Answers from JST Based on Forecast Results	Conclusion
1	Noise, vibration and lighting may give impacts on Ramsar Site. (Dr. Aye and Dr. Murata)	Distance from the project area to buffer zone and core area is approx. 3.6km and 5.5 km, respectively. Noise, vibration and lightning are sufficiently weak and small at Ramsar Site. JST has indicated the quantitative forecasts of the specialist.	Project does not give significant impacts
2	Hydrological situation may change, and mudflat for feeding and roosting decreases. Hence, the project may give significant impacts. (Dr. Aye and Dr. Murata)	The most important factor for the creation of mudflat is the hydrological situation and accumulated soil from the upstream and downstream by breaking bore. According to hydrological analysis, the project gives only approx. 100m range from the bridge downstream. Additionally, project activities do not give significant impacts on accumulated mudflat soil. Thus, the project does not give significant impacts on mudflats as the birds' feeding and roosting areas.	Project does not give significant impacts
3	Expansion of land development may give significant impacts on KBA/IBA and Ramsar Site in the future (Dr. Murata)	The project implementation agency is MOC and controls only the project area, thus MOC can manage land use in ROW. However, other areas belong to private owners and the local government, thus the local government shall manage such land near the Ramsar Site and IBA/KBA so as not to give significant impacts on natural habitats.	In the project area, MOC can manage land use appropriately. However, the local government should control other land use and pollution.

Note: The JICA Study Team has explained the project outline based on Appendix 4 – Presentation Material for Public Consultation Meetings and discussed about the major impacts item, degree and necessary mitigation measures.
Date of interview:
Dr. Aye Thant Zin (Professor, Zoology Department, Mawlamyine University) / Aug. 10th, 2018.
Dr. Koichi MURATA (Professor, College of Bioresource Sciences, Nihon University, Japan / Representative of Zoorasia in Kanagawa Prefecture, Japan) / October 18th, 2018

As shown in the result of discussions with wildlife specialists, noise, vibration, lighting and changing hydrological situation do not give significant impacts on Ramsar Site.

Thus, at the moment, they are not likely to give serious impacts on Ramsar Site if such mitigation measures are conducted appropriately.

However, with regard to land use management in the future, Mon State and Bago Region need to establish a land use plan in KBA/IBA and Ramsar Site not to conduct development activities without proper management. Furthermore, adequate pollution control for waste water and solid waste should be done.

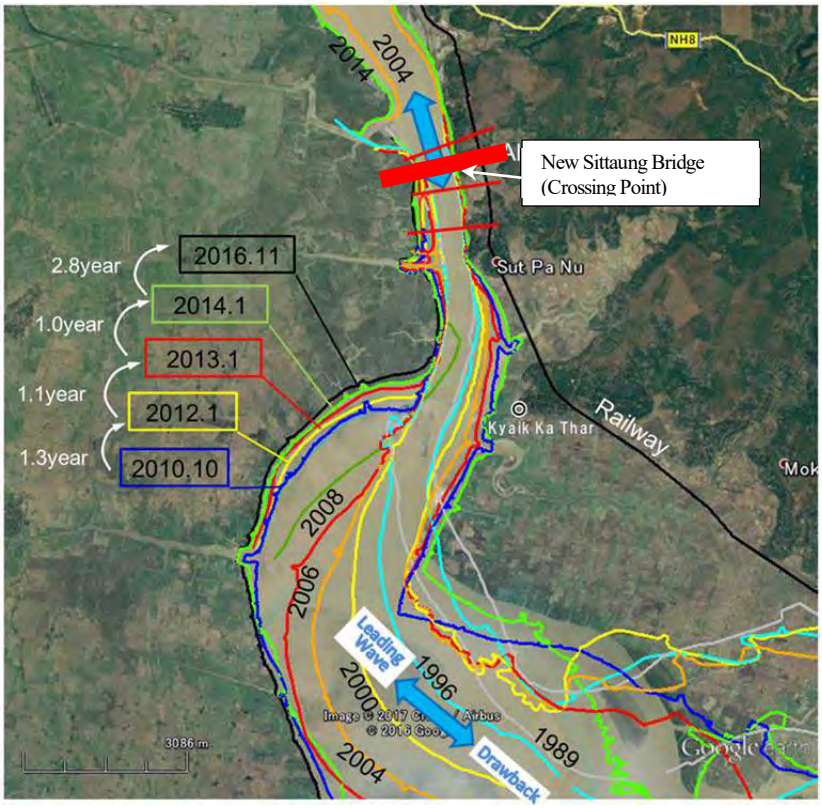
6.2.3. Hydrology and Disaster (Flooding Situation)

(1) Result of Baseline Survey

1) River Channel and Tidal Bore

Sittaung River is a part of the area which is affected by tidal bore once in two weeks. Thus, the river route has been shifting due to tidal bore and flooding as shown in Figure 6.2.7. It shows that the proposed bridge location is the most stable in the past 30 years.

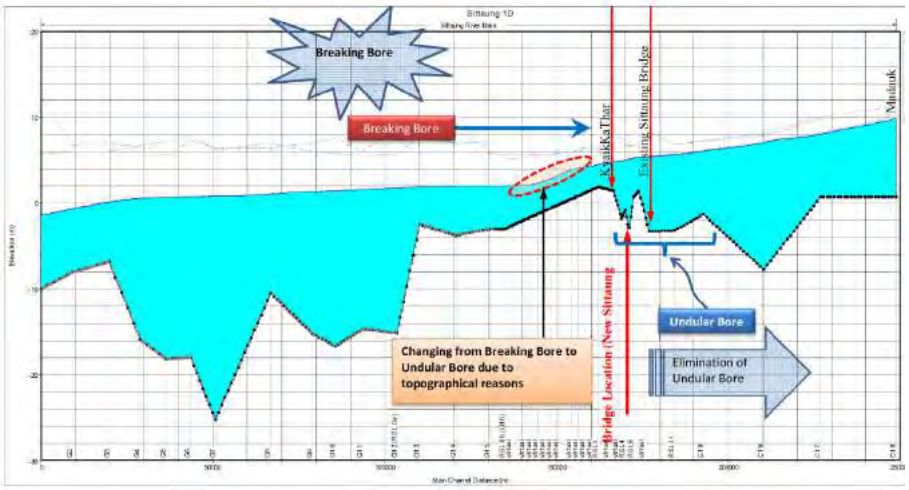
The highest water level by flooding and breaking bore recorded did not reach the existing village road in the East Bank, Kyaito Township. The highest flooding level was approx. 9 m from mean sea level in 1996.



Source: JICA Study Team based on Google Earth and NASA (Landsat TM)

Figure 6.2.7 Shifting of Bank Lines Around the Proposed Bridges

In the Sittaung River, tidal bore generates breaking bore and gives impacts on the shifting of the river. The distance from Sittaung River mouth to Kyaik Ka Thar Village is approximately 63km, and this area is affected by breaking bore. However, this breaking bore changes to undular bore after Kyaik Ka Thar due to topographic condition as shown in Figure 6.2.8. Thus, the area of planned bridge is not impacted by breaking bore and is more stable than southern downstream from Kyaik Ka Thar Village.



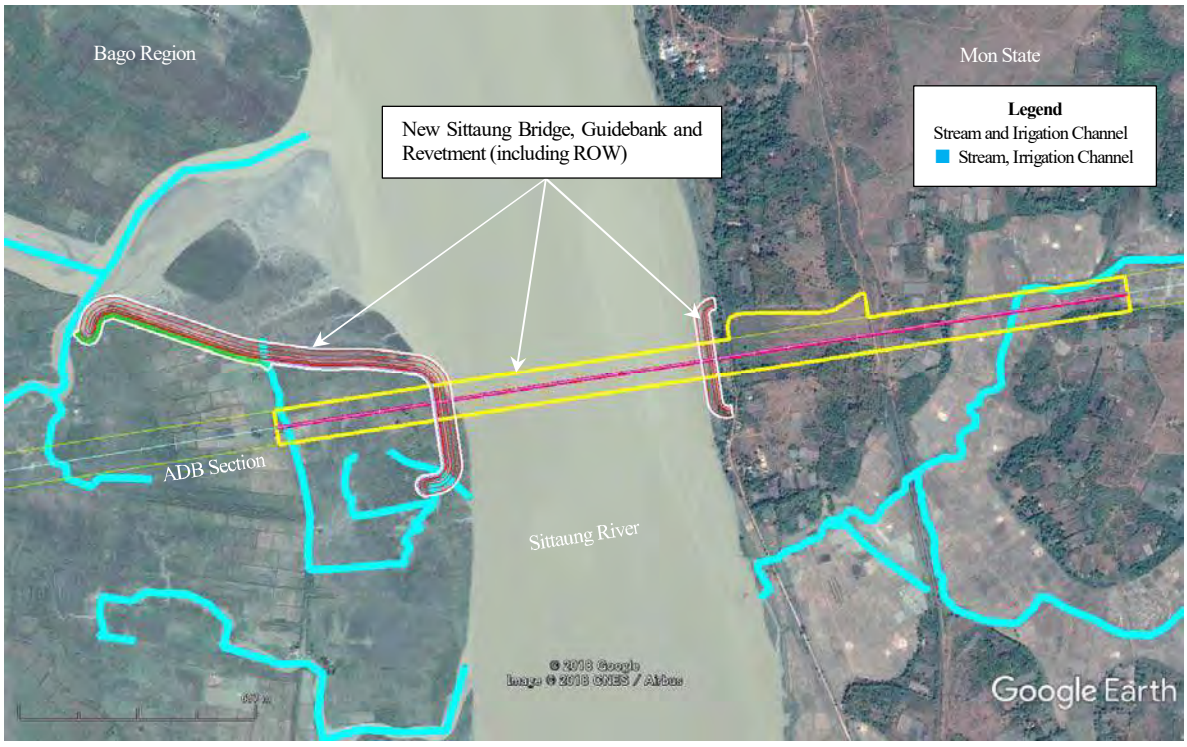
Source: JICA Study Team

Figure 6.2.8 Longitudinal Section of Sittaung River and Mechanism of Tidal Bore

2) Distribution of Small Stream

The distribution of small streams and creeks in the project area are shown in Figure 6.2.13.

On the west bank in Bago Region, a couple of irrigation streams are passing through the approach road and guidebank. On the other hand, only one irrigation river is crossing the approach road on the east bank in Mon State.



Source: JICA Study Team (based on Google Earth satellite map)

Figure 6.2.9 Location of Small Streams and Creeks in the Project Area

(2) Potential Impacts

1) During and After Construction

Construction of bridge, guidebank and revetment may change the hydrological situation of the rivers.

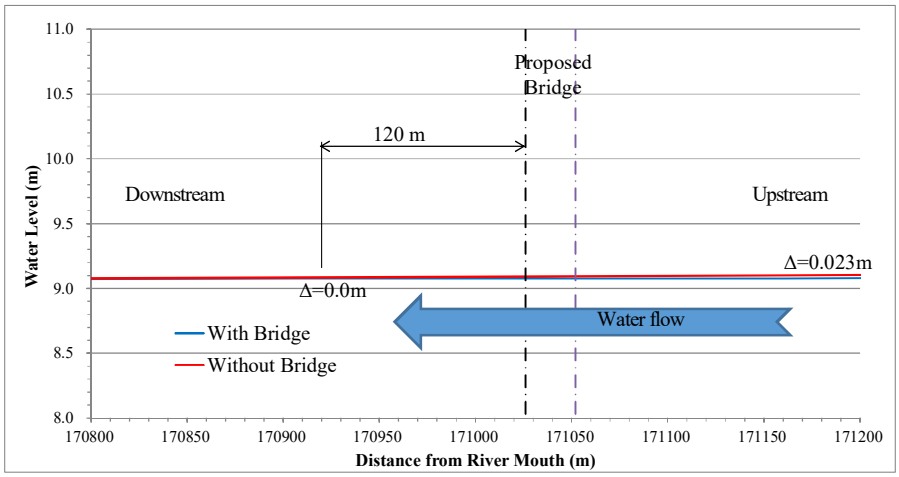
As the result of changing hydrological situation, siltation may be caused downstream. Such narrowing of water course due to siltation makes dangerous situation when tidal bore comes for fishermen and people living along the Sittaung River.

Earthwork section and construction of structures may cause impacts on small streams in agricultural land.

(3) Impact Forecast

1) During and After Construction

As mentioned in the article, "(1) Result of Baseline Survey", the selected bridge crossing point is the most stable location based on past flooding record and the shifting of river channel in the past 30 years. According to hydrological simulation by the construction of piers in the Sittaung River, it is estimated that the surface water level may change to a maximum of 2-3 cm in the range of 100m downstream. However, this impact does not reach more than approx. 100m away downstream as shown in the next figure.



Source: JICA Study Team (based on Google earth satellite map)

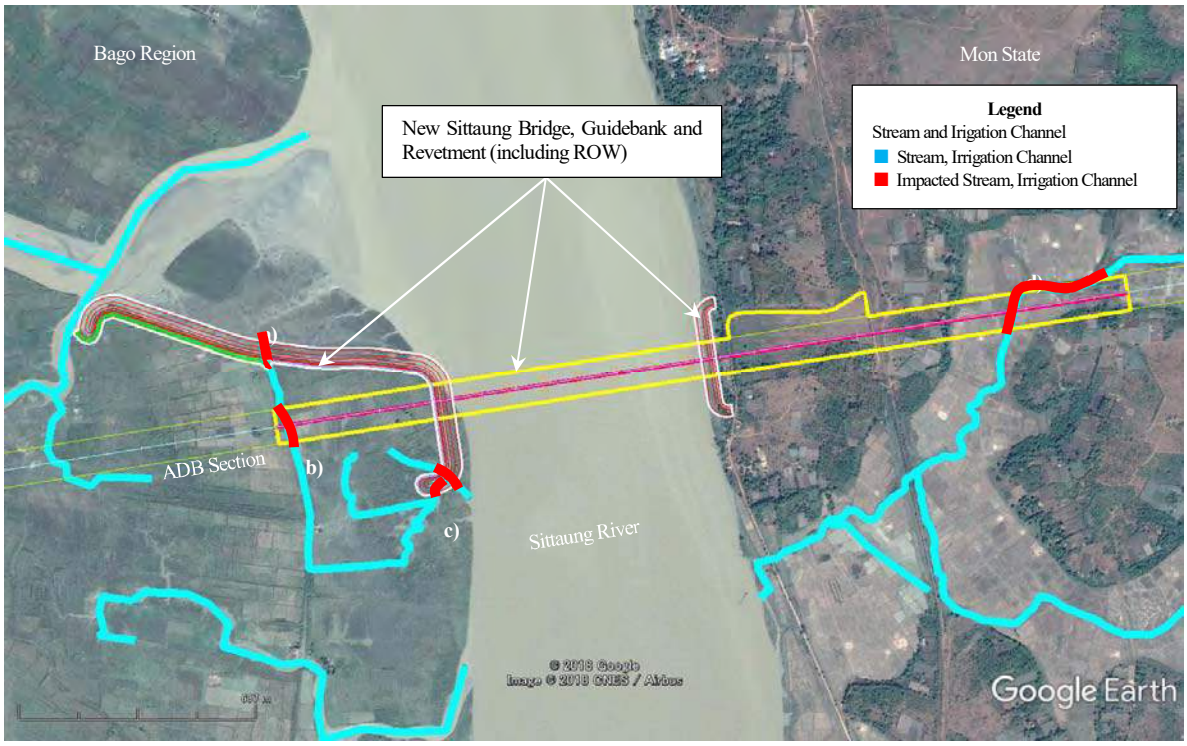
Figure 6.2.10 Degree of Water Level Changes After Construction

Thus it is expected that the existence of bridge does not give significant impacts on the hydrological situation. However small scale siltation may be caused within 100m range downstream.

Furthermore, the construction of guidebank and revetment keeps the river channel stabilized in the project area. The guidebank does not give significant impacts to surrounding flooding situations such as Shangai Creek and surrounding villages.

With regard to impacts on streams and irrigation channel, a total of approximately 600m of streams and irrigation channels are affected by the project as shown in Figure 6.2.11 and Table 6.2.14.

Streams and irrigation channels are indispensable for agricultural field in the project area, thus mitigation measures are necessary so as not to affect agricultural activities.



Source: JICA Study Team (based on Google Earth satellite map)

Figure 6.2.11 Impacted Streams and Creeks in the Project Area

Impacted streams and channels are shown below:

Table 6.2.14 Impacted Streams and Irrigation Channels

Impacted Stream and Irrigation			Length of Affected Stream
	Affected Structure	Location	
a)	Guidebank	Bago Region	80 m
b)	Approach Road	Bago Region	100 m
c)	Guidebank	Bago Region	100 m
d)	Approach Road	Mon State	350 m
	Total		630 m

Source: JICA Study Team

(4) Mitigation Measures

1) During and After Construction

- ✓ Construction of guidebank and revetment to stabilize hydrological situation in the project area
- ✓ Implementation of periodical dredging and river training when unexpected siltation is caused in the river and surrounding streams and creek
- ✓ Diversion of irrigation channels and/or streams shall be set up if the project activities give impacts on such streams

(5) Evaluation

According to hydrological analysis, the existence of bridge pillars in the Sittaung River does not give significant impacts on hydrological situation of the current Sittaung River.
and mudflat in Ramsar Site.

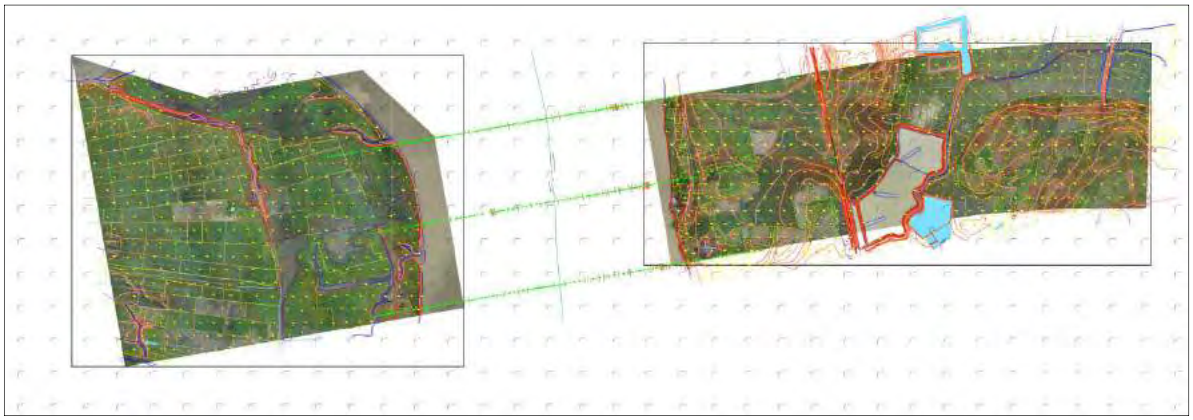
In the land area, construction of structures such as approach road and guidebank may cause impacts on streams and irrigation channels. However, diversion channels such as alternative open irrigation channels, crossing water pipe and culvert are constructed as mitigation measures. Thus, it is not likely to give significant impacts on hydrological situation in the project area.

6.2.4. Topography and Geology

(1) Result of Baseline Survey

1) Topographical Survey

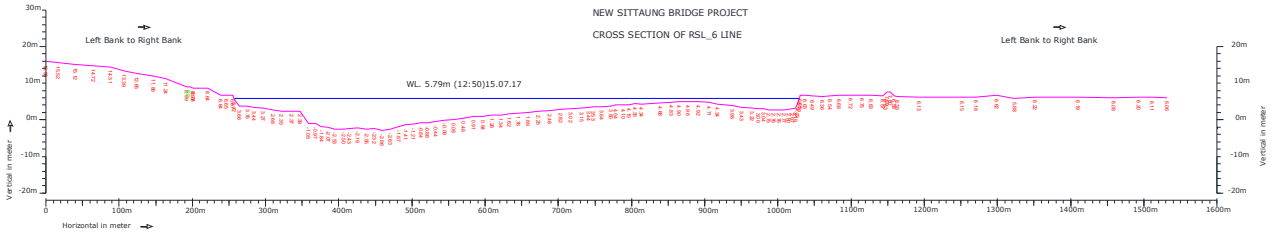
The aerial photo image is obtained by converting the aerial photograph of the central projection using Digital Terrain Model (hereinafter refer to as "DTM"), Exterior Orientation (hereinafter refer to as "EO") parameter and the aerial photograph. The exterior orientation of photo center was calculated using GCP from the GPS base station. Also, all natural and artificial terrain features such as rivers, streams, forests, paddy fields, farms, plantations, roads, paths, houses, schools, public buildings, cemeteries, etc. are shown in Figure 6.2.12.



Source: JICA Study Team

Figure 6.2.12 Topographic Map in the Project Area

The river bed height was determined by subtracting the depth from the water level of simultaneous observation. The river cross sectional data near the bridge crossing section is shown in Figure 6.2.13. The depth of the river is between 7 to 9 m from the river surface in May 2017.

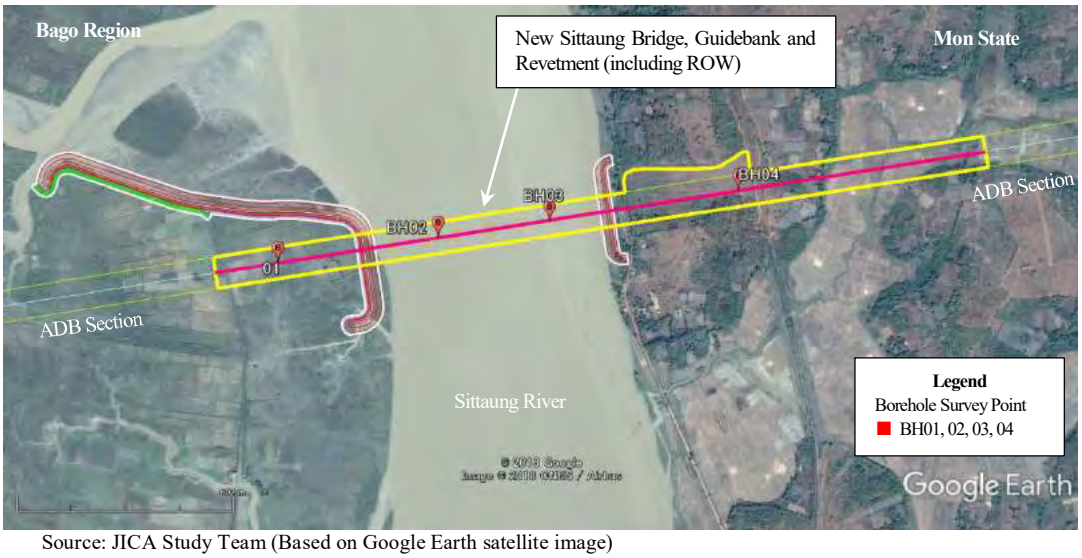


Source: JICA Study Team

Figure 6.2.13 River Cross Section at Bridge Crossing Section

2) Geological Survey

A geological survey has been conducted at 4 points in the project area as shown in Figure 6.2.14.



Source: JICA Study Team (Based on Google Earth satellite image)

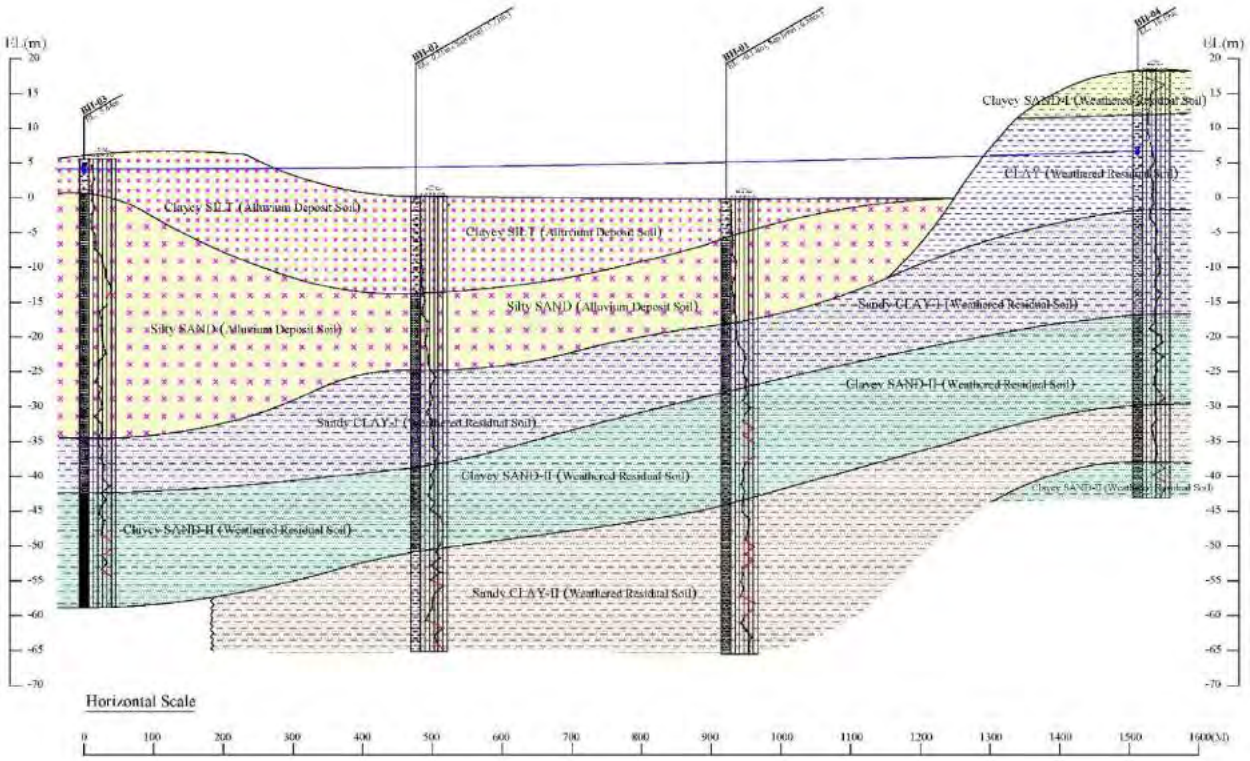
Figure 6.2.14 Location of Borehole Survey in the Project Area

According to the survey, soft ground has not been observed from survey points. The original target depth of boring was to confirm 5.0 m of N-value of more than 50. However, only BH-3 was confirmed at 5 continuous times of N-value ≥ 50 from the depth of 60 m.

Based on the results of four (4) borehole investigations, soil profile for the alignment of new bridge can be formulated as shown in Figure 6.2.15. The soil layers are divided in two (2) layers depending on soil produced condition, alluvium soil deposit layer and weathered residual soil layer, and a total of seven (7) numbers of different layers have been recognized. The soil layers are classified in accordance with their physical properties and/or their relative density. The seven (7) different layers observed in the project area are described from top to bottom as follows.

The area from BH-01 to BH-03 is covered by transported soils which are derived from flood plain deposits, Silt and Sand (alluvium soil deposit). Under the alluvium soil layer, residual soil layer are confirmed as cohesive and granular alternatively (weathered residual soil). For only BH-04, the residual soil layer is confirmed from the surface ground.

i. Clayey SAND-I (Weathered Residual Soil)
ii. CLAY (Weathered Residual Soil)
iii. Clayey SILT (Alluvium Soil Deposit)
iv. Silty SAND (Alluvium Soil Deposit)
v. Sandy CLAY-I (Weathered Residual Soil)
vi. Clayey SAND-II (Weathered Residual Soil)
vii. Sandy CLAY-II (Weathered Residual Soil)



Source: JICA Study Team

Figure 6.2.15 Soil Profile Based on 4 Borehole Investigations

(2) Potential Impacts

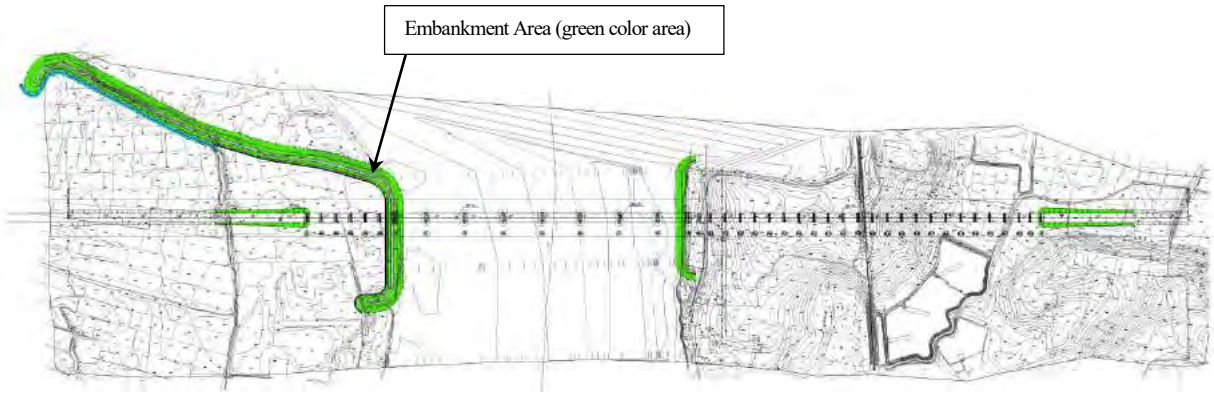
1) During Construction and After Construction,

Considerable topography and geological sites are not located in the Project Area, thus no impact is expected. However, embankment of the bridge may have slope failure.

(3) Impact Forecast

1) During Construction and After Construction

The embankment is constructed in a part of the bridge and approach road as shown in Figure 6.2.16.



Source: JICA Study Team

Figure 6.2.16 Embankment in the Project Area (Approach Road, Guidebank and Revetment)

These embankment sections have risks of soil erosion, slope failure and landslide. Thus,

the following mitigation measures are taken in general.

(4) Mitigation Measures

1) During Construction and After Construction

- ✓ The slope gradient for embankment is adopted 1:2 in accordance with Guideline of Earthwork (Japan Road Association)
- ✓ Implementation of slope protection such as turf work, planting treatment, concrete block retaining wall and retaining wall

(Turf work)

(Concrete block retaining wall)

(Retaining wall)

Source: JICA Study Team

Figure 6.2.17 Methodology of Slope Protection

(5) Evaluation

Implementation of appropriate design and mitigation measures such as slope protection and periodical monitoring and maintenance will mitigate the expected impacts. Thus, it is not likely to give significant impacts on the stability of earthwork section.

6.3. Social Environment

6.3.1. Involuntary Resettlement

(1) Result of Baseline Survey

The project area is developed as an agricultural area such as paddy field and rubber tree plantation, thus most of the affected lands are basically large-scale plots of farming lands.

A total 20 Project Affected Households (PAHs), including 24 resettlers, are recorded in this project site, and the total area of land acquisition is 25.3 ha (62.53 acre).

A category-wise outline of affected structures and impact area on land are shown below:

Table 6.3.1 Total Project Affected Units and Land Acquisition Area

No	Region / Item	Bago Region	Mon State	Total
1	No. of PAH (Project Affected Household affected on land, structure and crops/trees)	8	12	20
2	Affected Land (Acre)	39.68 (16.06ha)	22.85 (9.25ha)	62.53 (25.3ha)
3	Displaced Persons	3	21	24

Note): PAHs : Project Affected Households, 1 Acre = 4,046.86 m^2
Source: JICA Study Team

(2) Potential Impacts

1) During Construction

As shown in Table 6.3.1, 24 resettlers and 20 PAHs are impacted by the construction of bridge and approach road.

2) After Construction

No impacts are expected.

(3) Impact Forecast

1) During Construction

As shown in Table 6.3.1, it is identified that 24 resettlers shall be displaced, and 20 PAHs of owners of land, structure and crops/ trees are affected. The affected land area by the project is 25.3 ha.

(4) Mitigation Measures

1) During Construction

Major mitigation measures are as follows:

- ✓ Holding of consultation meetings for understanding of compensation policy
- ✓ Appropriate compensation and implementation of livelihood restoration program in accordance with approved RAP by Myanmar Government
- ✓ Monitoring and assessment shall be conducted regarding the livelihood of PAPs, and appropriate restoration and enhancement of living standards will be considered in accordance with JICA's Guidelines and related laws and regulations in Myanmar.

(5) Evaluation

1) During Construction

Although 20 PAHs and 24 resettlers are caused by the project, implementation of appropriate compensation, livelihood restoration program will mitigate expected adverse impacts, thus it is not likely to give serious impacts on this item. These impacts and detailed compensation policy shall be updated during detailed design.

6.3.2. The Poverty

(1) Result of Baseline Survey

According to the statistical data, the average monthly household expenditure is 167,434 kyat in Myanmar, 170,223 kyat in Mon State and 160,330 kyat in Bago Region, respectively.

The poverty line is 39,090 kyat per capita per month in Myanmar. On the contrary, poverty line is 28,758 kyat in Mon State and 32,315 kyat in Bago Region.

Table 6.3.2 Number of Persons under Poverty Line

Item	Year	State/Region	Value	Remarks
Average Expenditure (kyat/month)	2012	Mon State	170,223	Average in Myanmar : 167,434
		Bago Region	160,330	
Poverty line Note-1) (kyat/month)	2013/ 2017	Mon State	28,758	Average in Myanmar : 39,090
		Bago Region	32,315	

Note-1) State/ Regional information is referring to "A regional perspective on poverty in Myanmar / UNDP 2013
Country information is referring to "An analysis of poverty in Myanmar / World Bank. 2017"
Source: 2015 Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development

(2) Potential Impacts

1) During Construction

The person under poverty line may be impacted by the project activities such as land acquisition. The degree of impacts will be assessed based on the feature of the local society around the project site.

2) After Construction

No impacts are expected.

(3) Impact Forecast

1) During Construction

According to surveys regarding land acquisition, any persons under the poverty line have not been identified. Thus, the project does not give any adverse impacts on persons under the poverty line during construction.

(4) Mitigation Measures

The implementation of mitigation measures is not required because persons under poverty line have not been identified in the project area.

(5) Evaluation

No person under poverty line is observed, thus mitigation measure is not necessary. The project does not cause any impacts on poverty.

6.3.3. Local Economy Such as Employment and Livelihood

(1) Result of Baseline Survey

1) Occupation of Project Affected Household (PAHs)

Project Affected Household are defined as those who has direct impact to their residences, assets or their income source caused by land acquisition. They are regarded as PAPs in RAP survey and the Socio-Economic Survey to them were conducted. With regard to their occupation, the survey results are shown in Table 6.3.3. Most of the PAPs are farming rice and other crops and orchard.

Table 6.3.3 Occupations of Project Affected Unit Heads

Intersection / Occupation	Bago Side		Mon Side		Total	
	No.	%	No.	%	No.	%
(1) Dependent	1	12.5	0	0.0	1	5.3
(2) Student	0	0.0	0	0.0	0	0.0
(3) Casual Employee	0	0.0	1	9.1	1	5.3
(4) Wage Worker (Long-Term Contract)	0	0.0	1	9.1	1	5.3
(5) Farming Rice and Other Crops	6	75.0	1	9.1	7	36.8
(6) Farming Vegetables	0	0.0	0	0.0	0	0.0
(7) Orchard	0	0.0	7	63.6	7	36.8
(8) Livestock	0	0.0	1	9.1	1	5.3
(9) Fishery	0	0.0	0	0.0	0	0.0
(10) Handicraft	0	0.0	0	0.0	0	0.0
(11) Government Employee	0	0.0	0	0.0	0	0.0
(12) Shop Owner	1	12.5	0	0.0	1	5.3
(13) Retired or Over Working Age	0	0.0	0	0.0	0	0.0
(14) Others	0	0.0	0	0.0	0	0.0
Total	8	100.0	11	100.0	**19**	**100.0**

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

2) Fishery in the Project Area

While those who have direct impact by land acquisition are covered in RAP as shown above, it was suggested that the fishermen in the Sittaung river may have indirect impact by the Project during public consultation and RAP socialization. Therefore, the assessment of the impact to the fishermen is presented below.

a) Number of Fishermen and Boat

Interviews were conducted to the village leader and leader of fisherman's group of 16 villages/ communities (1) Su Pa Nu, 2) Mo Pa Lin, 3) Shan Kaing, 4) Taung Tha Pyay Kan, 5) Sit taung, 6) Saike Kan Thar Hamlet (Thein Za Yat Village), 7) Ywar Ma Hamlet (Thein Za Yat Village), 8) Ta Naw Kyun, 9) Ywa Lay Hamlet (Thein Za Yat Village), 10) Kyauk Ka Lak Village, 11) Thaton zu Hamlet (Thein Za Yat Village), 12) Kyaikto south, 13) Boyargi, 14) Kawt Htin, 15) Moke Kha Mu, 16) Kyaik Ka Thar) nearest to the location of New Sittaung Bridge alongside of the Sittaung river. Since Fisheries Cooperative Associations are not established in these areas, fishermen who have main income from fishing have been identified by village leader and leader of fisherman's group. As a result of the interview, some fishermen in 5 villages out of 16 villages are identified to be using project area for fishing. The identified fishermen in the 5 villages are totally 219.

The identified villages and the number of identified fishermen are shown in Table 6.3.4.

Table 6.3.4 Number of Recognized Fishermen

No.	Village	Township	State/Region	Number of Fishermen (Full-Time)
1	Sut Pa Nu	Kyaikto	Mon	72
2	Mopalin	Kyaikto	Mon	45
3	Shan Kaing	Waw	Bago	1
4	Sittaung	Kyaikto	Mon	100
5	Kyauk Ka Lat	Kyaikto	Mon	1
			Total	219

Source: JICA Study Team

Total estimated fishing boat is approximately 240 / day round trip in the Sittaung River in accordance with village leader.

Table 6.3.5 Traffic Number in the Sittaung River

No.	Name	Estimated Number Number / day (round trip)
1	Fishing Boat	240
2	Cargo ship	20
3	Ferry boat (between East-West bank)	8
	Total	268

Source: JICA Study Team(interview with village leader of Su Pa Nu village)

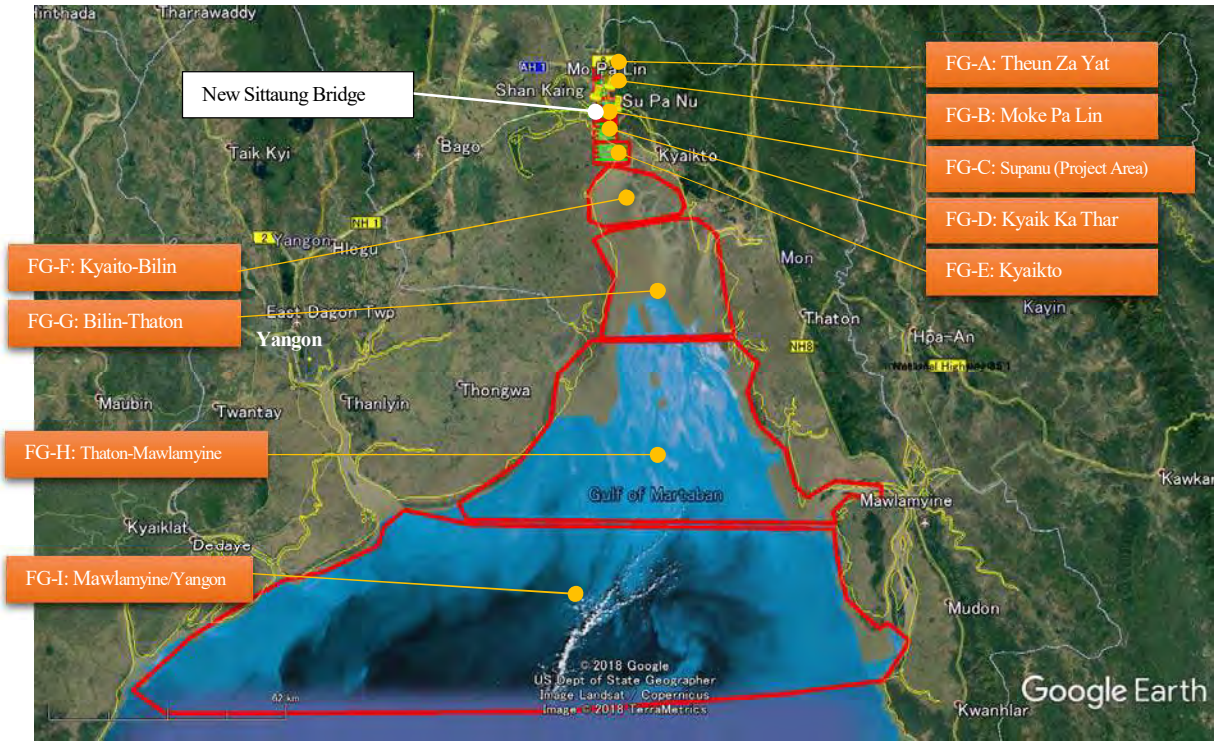
b) Main Fishing Ground

Main fishing ground(s) have been identified based on the interview survey. In this interview survey, fishermen were interviewed on main fishing ground(s).

The major fishing ground for fishermen in the 16 villages can be classified into 9 areas from FG-A to FG-I. The project site falls under FG-C: Su Pa Nu (Project Area). The area of FG-C is 6.44 km2 which accounts for 0.06% of total area of app. 10,500 km2 covering FG-A to FG-I.

As described in i), it was found out that fishermen living in the above 5 villages are using the FG-C as a fishing ground, however their fishing ground is not limited to FG-C and they also use other area other than the project site.

In the Project area, Hilsa Shad and Soldier croaker are major fish type. Major fishing method used in the project area is Drift gill net method.



Source: JICA Study Team Based on Google Earth Map

Figure 6.3.1 Nine (9) Main Fishing Grounds for Five (5) Target Fishermen Villages

(2) Potential Impacts

1) During Construction

Livelihood of residents, farmers and fishermen may be affected by acquisition of agricultural land and traffic restriction in the river.

2) After Construction

No impact is expected due to lack of resettlement, land acquisition and traffic restriction plans after construction. However, a group of fishermen using the gill net method may be impacted due to the existence of piers in the river.

On the other hand, traveling time to Yangon is shortened due to the commencement of new bridge and bypass.

(3) Impact Forecast

1) During Construction

a) Impacts on Agricultural Area

As shown in Table 6.3.1, approximately 25 ha of agricultural area such as paddy field, farming land and rubber plantation is affected by the project.

b) Impacts on Fishery

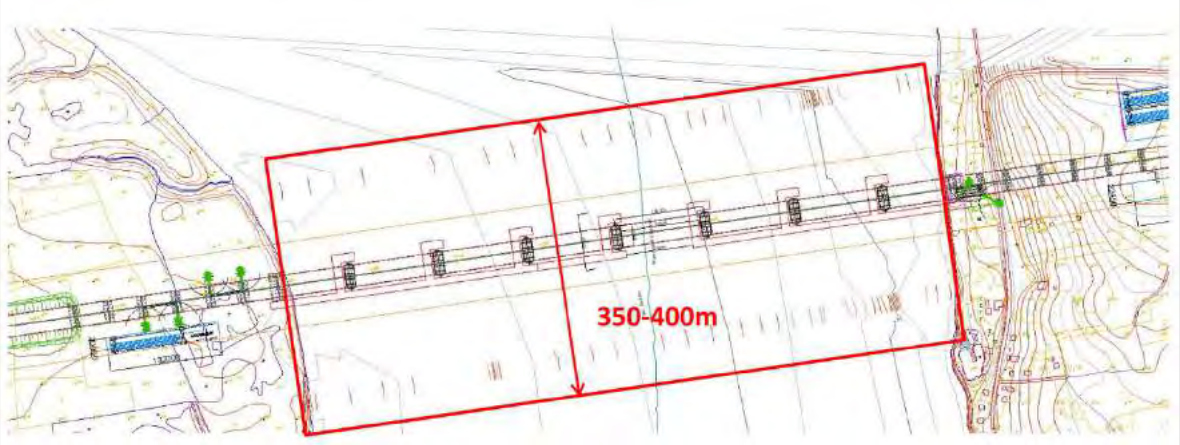
During construction, some impacts are expected as shown in Table 6.3.6.

Table 6.3.6 Impact Items on Fishery During Construction

Impact Item and Potential	Impact Forecast
(1) Impacts on fishes and aquatic species Generation of turbid water and construction noise and vibration may give impacts on fishes and habitats of aquatic species	Turbid water is not generated because the steel pipe sheet piles method is adopted for foundation works. Fishes and aquatic species may be led to avoid the construction area temporarily within 200 m range updownstream during construction as shown in the following figure (Figure 6.3.2). However, according to a study in Japan, more than 100 dB [note-1)] vibration gives impacts on fishes. In these construction activities, since vibrohammer with less than 80 dB vibration is adopted, the degree of impact is not significant.
(2) Impacts on fishing activities and fishing area Construction restricted area is established and may give impacts on fishing activities and fishing ground	Traffic restriction and setting up of prohibited fishing area from the view of safety may give impacts on fishing activities and fishing ground. For the interviewed 16 villages, 9 fishing ground s are identified as shown in Figure 6.3.1 and its total area of the 9 fishing ground is approximately 10,500 km2. On the other hand, the project site falls under FG-C and its area is 6.44 km2 (0.06% of total area of 9 fishing grounds). Moreover, within the FG-C, the prohibited fishing area during construction will be not the whole area of the FG-C but limited to the 400m range of the upstream and downstream side of the bridge location (see Figure 6.3.2), which area is 0.42 km2 (6.5% of FG-C and 0.004% of total area of 9 fishing grounds). Regarding with the prohibited fishing area during construction, navigation channel (NC) will be secured therefore fishermen can move to upstream or downstream of the project site through NC. Although identified fishermen in 5 villages presented in Figure 6.3.1 use FG-C as a fishing ground, those fishermen use not only FG-C but also other area as a fishing ground. Furthermore, it was mentioned that any fishermen have right to use any fishing ground, and some similar fishing grounds are distributed near project area according to the interview with department of fishery in Kyaito Township. Therefore fishermen using in the project area can shift to another fishing area during construction phase and accordingly the degree of the impact to fishery is not significant.

Note-1: Reference *1: The Influence That Vibration To Occur By Marine Construction Gives To The Benthos Of The Peripheral Sea Area (July, 2008/ Kana UEDA) See Figure 6.2.4

Source: JICA Study Team



Source: JICA Study Team

Figure 6.3.2 Construction-Restricted Area (Prohibited Fishing Area) During Construction

2) After Construction

a) Impacts on Fishery

During construction, some impacts are expected as shown in the next table.

.

Table 6.3.7 Impacted Items on Fishery After Construction

Impact Item and potential	Impact Forecast
(1) Impacts on fishes and aquatic species Generation of turbid water from road surface and traffic noise and vibration may give impacts on fishes and habitats of aquatic species	Road surface water does not give any impacts on aquatic species because the water quality does not exceed standard values under general circumstances. Fishes and aquatic species may be led to avoid the area when the bypass and bridge opens. However, such species come back under the bridge because desirable habitats are created due to setting up of riprap for the prevention of scouring at piers. (See Figure 6.3.4.)
(2) Impacts on fishing activities and fishing area Existence of piers may give impact on fishing activities	Fishermen using the gill net method may be impacted by the existence of bridge piers after construction. However, according to an interview with the fishery department in Kyaikto Township, fishermen can avoid piers and use other fishing grounds. On the other hand, traveling time to Yangon is shortened due to commencement of new bridge and bypass, thus fishermen and/or traders can access the nearest markets and sell at a higher price.

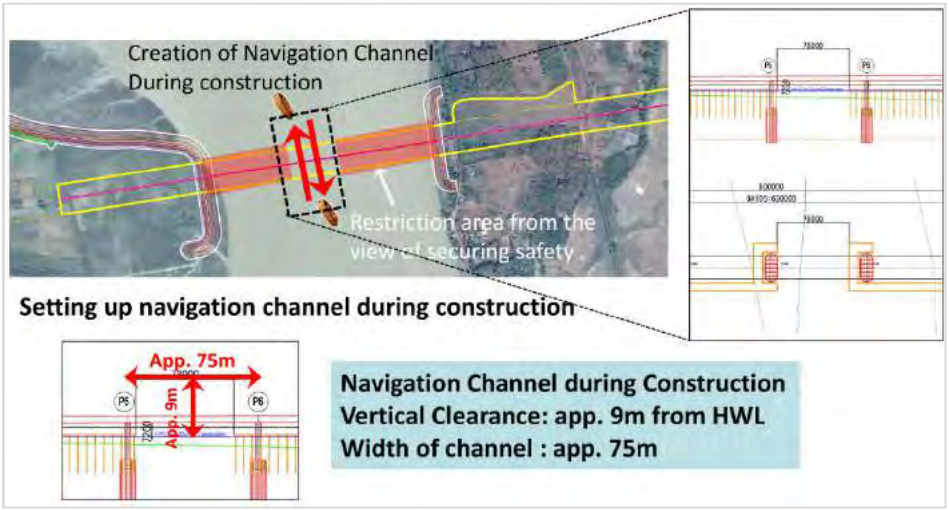
Source: JICA Study Team

(4) Mitigation Measures

1) During Construction

Major mitigation measures are as follows:

- ✓ Holding of consultation meetings for understanding of compensation policy and livelihood restoration programs for project affected persons who lose agricultural lands such as paddy field and rubber plantation.
- ✓ Implementation of adequate compensation in accordance with approved RAP.
- ✓ Appropriate methodology for foundation work, such as steel pipe sheet piles method, for minimization of turbid water shall be taken so as not to give serious impacts on the habitats of fishes (see Figure 6.1.6).
- ✓ Appropriate methodology and machines shall be selected for minimization of noise and vibration impacts so as not to give serious impacts on the habitats of fishes.
- ✓ Setting up of navigation channel with necessary vertical clearance during construction as shown in Figure 6.3.3.
- ✓ Establishment of grievance redress mechanism for the solution of issues involving farmers and fishermen.



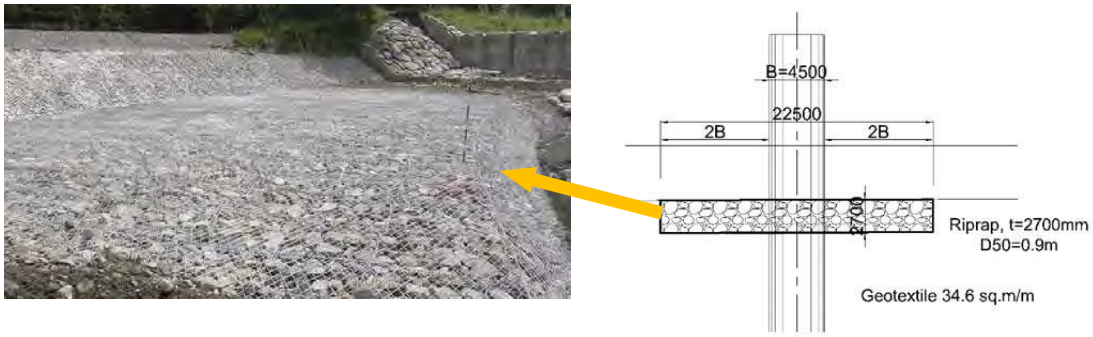
Source: JICA Study Team

Figure 6.3.3 Image of Navigation Channel

2) After Construction

Major mitigation measures are as follows:

- ✓ Construction of riprap – which aquatic species can use as habitat – for the prevention of scouring at piers
- ✓ Establishment of grievance redress mechanism for the solution of issues involving farmers and fishermen



Source: JICA Study Team

Figure 6.3.4 Image of Riprap at Piers (As Habitat for Aquatic Species)

(5) Evaluation

1) During Construction

Although around approx. 25 ha of agricultural land is acquired due to construction of bridge and approach road, appropriate compensation policy in accordance with Myanmar laws and JICA Guidelines is established and implemented by the Myanmar Government.

Impacts on turbid water, noise and vibration is minimized by various mitigation measures, thus it is not likely to give serious impacts on fishes and other aquatic species.

On the other hand, the establishment of restriction area within 400m range from the construction area gives a certain degree of impact on fishermen who use the restricted area as main fishing ground. However, such fishermen have some alternative fishing grounds, and they can shift to these fishing grounds. Thus, the project does not give significant impacts on fishermen's livelihood.

2) After Construction

Expected impacts by road noise and vibration are not serious. There are no restricted fishing areas after construction. Thus, the livelihood of fishermen is not impacted by the project.

Furthermore, the shortening of traveling time from the project area to Yangon area gives positive impacts on trading and transportation of fresh fishes. Thus, the project does not cause serious negative impacts and brings positive impacts on the local economy.

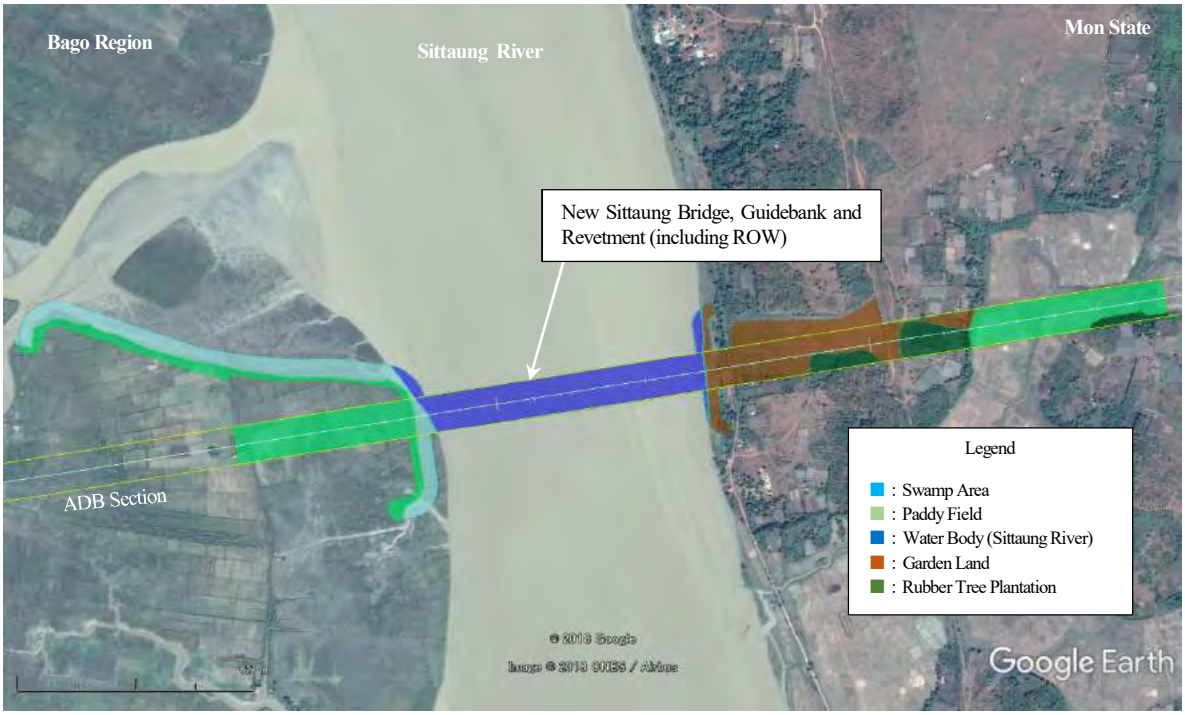
6.3.4. Land Use and Utilization of Local Resources

(1) Result of Baseline Survey

Land use of the project is categorized into 5 types such as swamp area, paddy field, water body, garden land and rubber plantation as shown in Figure 6.3.5 and Table 6.3.8.

More than 50% of land use is allocated for farming such as paddy field and garden land, and

swampy area and rubber plantation comprise approximately 16% and 7%, respectively.



Source: JICA Study Team (based on Google Earth satellite map)

Figure 6.3.5 Land Use Map in the Project Area

Table 6.3.8 Land Use and Area by Type in the Project Area

Land Use	Area (ha)	%	Remarks
1.Swamp Area	5.9	16.0	Including seasonal farming land
2.Paddy Field	12.4	33.7	Including seasonal garden land
3.Water Body	8.2	22.3	Sittaung River
4.Garden Land	7.7	20.9	Cash crop area
5.Rubber Plantation	2.6	7.1	-
Total	36.8	100.0	

Source: JICA Study Team

(2) Potential Impacts

1) During Construction

Mainly agricultural areas, such as paddy fields and rubber plantations, will be affected by the project.

2) After Construction

No impact is expected due to lack of plans regarding resettlement and land acquisition after construction. However inappropriate land use such as development of unplanned area gives impacts to sound urbanization and ecosystem in conservation areas.

(3) Impact forecast

1) During Construction

During and before construction stage, app. 12.4 ha of paddy field, 7.7 ha of garden land and 2.6 ha of rubber tree plantation is impacted and occupied by the bridge and approach road as shown in Table 6.3.8

2) After Construction

Construction of bridge and bypass improves accessibility from the project area in Kyaikto and Waw Township to Yangon area, thus it is expected that industrial area and related commercial area may be developed along the road.

Since there is lack of law-based land use plan in the project area, unplanned development may occur along the bypass and bridge area. Such unplanned development leads to pollution and gives adverse impacts on natural conservation areas such as KBA/IBA and Ramsar Site. Thus, adequate land-use plan shall be established and managed by the government.

(4) Mitigation Measures

1) During Construction

The following mitigation measures shall be implemented:

- ✓ Implementation of consultation with affected landowners and formulation of basic compensation policy before the actual land acquisition

2) After Construction

The following mitigation measures shall be implemented:

- ✓ Establishment of land use plan and management plan in the project area so as not to cause unplanned development
- ✓ Pollution control shall be done by the Myanmar Government when an industrial zone is located in the project area

(5) Evaluation

During construction, land acquisition of agricultural area is compensated appropriately in accordance with Myanmar laws and JICA Guidelines.

After construction, the establishment of appropriate land use plan, implementation of land use management and pollution control by the local government can create sound development harmonized with the natural environment.

6.3.5. **Water Usage**

(1) Result of Baseline Survey

No wells have been identified in the project affected area. However, only one well is identified which is located approximately 70 m away from project area as shown in Figure 6.3.6.

The water quality in the well is shown in Table 6.3.9, measured values on pH, color and turbidity are exceeding WHO guideline values.

Irrigation channel and streams in the project area is show in Figure 6.2.9 in the article under “Hydrology”.

Source: JICA Study Team (based on Google Earth satellite map)

Figure 6.3.6 Location Map of the Well Nearest to the Project Area

Table 6.3.9 Water Quality at the Nearest Well (March 25th, 2018)

Location \ Parameter		Temperature [℃]	pH [-]	Conductivity [μS/cm]	BOD [mg/l]	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	Turbidity [TCU]	Color [TCU]	Depth [m]
Sut Pa Nu Village (Kyaito Township, Mon State)	Dry Season (March 25, 2018)	25	5.4	89	10	10	Not detected (<1)	58	30	4.5m
Reference Standard	Guidelines for drinking water quality (WHO, 2012)	-	6.5-8.5	-	-	Not Detected	Not Detected	5	15	-

Source: JICA Study Team

(2) Potential Impacts

1) During Construction

Land acquisition may give impact on irrigation system and/or drinking water resources such as wells. Earthwork section and construction of structures may give impacts on irrigation channels and small streams.

2) After Construction

No impact is expected due to lack of resettlement and land acquisition plans after construction

(3) Impact Forecast

1) During Construction

Since no wells are identified in the project area, land acquisition does not give any impacts on wells.

On the other hand, some irrigation channels and small stream are cut off due to occupation of bridge and approach road as shown in Figure 6.2.11 and Table 6.2.14. A total of approximately 630m of irrigation channel and stream are impacted by the project. Thus, the

implementation of mitigation measures is necessary.

(4) Mitigation Measures

1) During Construction

The following mitigation measures shall be implemented:

- ✓ Alternative measures for water provision shall be prepared if water level and water quality at the nearest well changes during construction.
- ✓ Diversion of irrigation channels and/or streams shall be set up if the project activities give impacts to such streams.

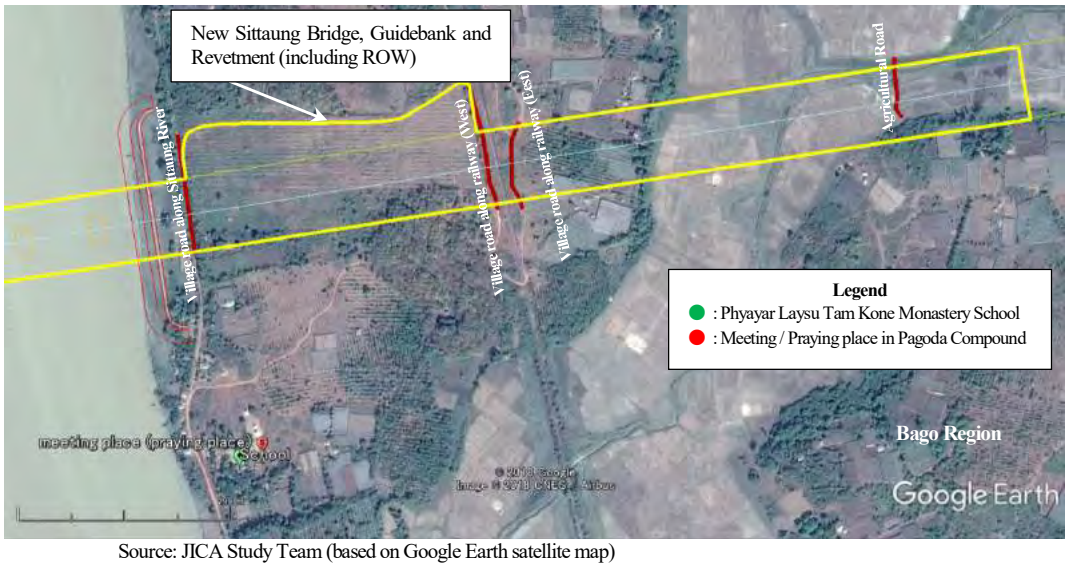
(5) Evaluation

Drinking water sources such as wells are not impacted by the project. On the other hand, construction of structures such as bridge and approach road and their existence may cut streams and irrigation channels. However, diversion channels such as alternative open irrigation channels, crossing water pipe and culvert are constructed as mitigation measures. Thus, they are not likely to give significant impacts on the hydrological situation in the project area.

6.3.6. Existing Social Infrastructure and Services, Social Institutions Such as Local Decision-Making Institutions

(1) Result of Baseline Survey

In the project area, the meeting place and school are located outside of ROW, and community roads and agricultural road are crossing through the project area on the east bank in Mon State as shown in Figure 6.3.7.



Source: JICA Study Team (based on Google Earth satellite map)

Figure 6.3.7 Location of Infrastructure (Village Road) in the Project Area

(2) Potential Impacts

1) During and After Construction

Some schools, meeting places and other public utilities may be affected by land acquisition. Additionally, traffic restriction and existence of structures in the project area will give impact

on commuting and access route. In the river section, construction and existence of the bridge may cause impact on fishermen's activities. With regard to impacts on fishermen, the degree of impacts and necessary mitigation measures are described in "7.3.3 Local Economy".

(3) Impact Forecast

1) During and After Construction

During and after construction of the bridge and approach road, the following community roads are impacted as shown in Figure 6.3.7.

A total of approximately 460 m of 3 village roads and 100m agricultural road are impacted by the construction and existence of structures. Thus, these roads should be secured during and after construction.

Any other utilities such as power lines and communication cables do not exist in the project affected area. Affected streams and irrigation channels are discussed in the article "7.2.2 Hydrology".

Table 6.3.10 Affected Social Infrastructure Item and Quantity

Impacted Road	Impacted Road Length (m)	Impacted Structure
1.Village road along the Sittaung River	160	Bridge
2.Village road along the railway (west side)	180	Bridge
3.Village road along the railway (east side)	120	Bridge
4.Agricultural road	100	Embankment (Approach road)
Total	560	-

Source: JICA Study Team

(4) Mitigation Measures

1) During and After Construction

The following mitigation measures shall be implemented:

- ✓ Detour and access road to social infrastructure such as school and meeting place for commuters and users shall be provided, if required. In general, such access road should be secured at same the place from the view of connecting the communities.
- ✓ This detailed detour plan shall be prepared by the construction contractor during mobilization and inspected by the consultant before construction activities.

(5) Evaluation

Construction activities may give adverse impact on access route to public facilities and/or commuting route. Additionally, the appearance of structures on the existing road may give adverse impact on the separation of the communities and it may lead to inconvenience in commuting and accessing the social infrastructures.

However, the implementation of mitigation measures will minimize the impacts. Thus, they are not likely to give serious impacts on this item.

A detailed construction restriction plan and detour plan shall be prepared by the construction contractor and inspected by the consultant during construction.

6.3.7. **Local Conflict of interests**

(1) Result of Baseline Survey

In general, provision of job opportunities as construction workers is a common opinion raised by local inhabitants and local authorities. In this public consultation, the local people have requested for job opportunities such as construction work during construction.

(2) Potential Impacts

1) During Construction

Conflicts or disputes between communities may arise if there is imbalance in the hiring of workers.

2) After Construction

No adverse impacts are expected.

(3) Impact Forecast

1) During Construction

Conflicts or disputes between communities may arise caused by imbalance in the hiring of workers.

(4) Mitigation Measures

1) During Construction

The following are the proposed mitigation measures:

- ✓ Local workforce is prioritized for the construction of bridge and other structures
- ✓ Implementation of appropriate education for hired workers from other area, if required

(5) Evaluation

1) During Construction

Hired workers from other areas may have conflicts with the local inhabitants. However, the implementation of mitigation measures will minimize the impacts. Thus, it is not likely to give serious impacts on this item.

6.3.8. **Cultural Heritage**

(1) Result of Baseline Survey

No cultural heritage including law registered sites, buried cultural objects and pagoda are observed in the project area.

The nearest pagoda is approximately 300m away from the boundary of ROW as shown in Figure 6.3.7.

(2) Potential Impacts

1) During Construction

Community-level religious facilities, such as community pagodas and monasteries, may be

affected by construction bridges, approach road, revetment and guidebank.

2) After Construction

No impact is expected due to lack of land acquisition plan after construction.

(3) Impact Forecast

No impacts on cultural heritage are expected as there are no such sites in the project affected area. Thus, mitigation measures are not necessary in this project.

6.3.9. Landscape

(1) Result of Baseline Survey

There are no law-based protected view points in the project area and its surrounding area. The project area is already a developed area as agricultural land, and no natural parks and historical parks are located as shown in Figure 6.3.8 and Figure 6.3.9.

The landscape elements from the bridge crossing point are the river and the bank of the river.

Source: JICA Study Team

Figure 6.3.8 Landscape at Bridge Crossing Point (Sittaung River)

Source: JICA Study Team

Figure 6.3.9 Landscape at Bridge Crossing Point (Mon State)

(2) Potential Impacts

1) During and After Construction

There are no law-based designated landscape areas around the project area. However, the changing of usual landscape is expected due to construction of structures.

(3) Impact Forecast

Simulated computer graphic (CG) images are shown in Figure 6.3.10 - Figure 6.3.11. The landscape elements are structure of the bridge, carriageway and relevant road structures such as embankment and guidebank. According to the CGs, the sky landscape is reduced by the construction of the flyover. On the other hand, the installation of a modern design structure such as bridge creates a sophisticated symbolic landscape in the project area.

Although the Kyaik Ka Tar Village is well-known by the local people as an ancient town, a considerable natural landscape in the village is not observed, thus adverse impact is not expected in the village.

Source: JICA Study Team

Figure 6.3.10 CG Landscape from Sut Pa Nu Village in Mon State

Source: JICA Study Team

Figure 6.3.11 CG Landscape From Various Angles

(4) **Mitigation Measures**

To mitigate the adverse impacts, a monotone color harmonized with the surrounding current landscape has been adopted as shown in Figure 6.3.10-Figure 6.3.11.

(5) **Evaluation**

The changes before and after the construction of bridge and related structures are unavoidable. Although the sky factor has decreased due to the existence of bridge, a sophisticated and symbolic landscape is created. Furthermore, the color of the structure harmonizes with the agricultural land. Thus, it is evaluated that the project does not give serious impacts on this item.

6.3.10. **Gender**

(1) Result of Baseline Survey

According to an interview with Women Development Division under the Ministry of Social Welfare, Relief and Resettlement, the Myanmar National Committee for Women's Affairs was established in 1996, and this organization is cooperating with the Ministry of Education and the Ministry of Health and Sports.

A National Strategic Plan for Advancement of Women (NSPAW) 2013-2022 was established in 2013, and it has various activities on 13 areas such as poverty, education and training, health, violence against women and etc. However, women's issues in the infrastructure sector have not been recognized until now.

Thus, the Women Development Division suggested that there are no women's issues in infrastructure at the moment.

On the other hand, in the Public Consultations and RAP meetings, since female participants

have attended and expressed their opinions in front of others, females do not have any disadvantage in the process of decision-making.

(2) Potential Impacts

1) During and After Construction

According to an interview with the authority regarding gender issues in Myanmar, no issues on gender in infrastructure area are observed. Thus, no impacts are expected on this item.

(3) Impact Forecast

There are no impacts on gender in this project. However, some preventive measures should be conducted. Gender equality/women's participation should be promoted under National Strategic Plan for the Advancement of Women (2013-2022), Minimum Wages in Myanmar (2013) and international recognition

(4) Mitigation Measures

1) During Construction

The following are the proposed mitigation measures:

- ✓ Installation of security light in the crossing road under the bridge and approach road;
- ✓ Provision of job opportunities and fair salary between genders; and
- ✓ At least 10% of female workers should be hired as simple workers

6.3.11. **Rights of Children**

(1) Result of Baseline Survey

According to information from the 2015 Labor Force Survey Report, International Labor Organization (ILO), the following are the features of child labor in Myanmar:

a) 1.13 million children aged 5 to 17 years – or 9.3% of the child population – are in child labor;

b) 8.5% are girls and 10% are boys;

c) Over half of the child laborers – 616,815 or 5.1% of the child population – are trapped in hazardous work likely to harm their physical, mental or moral development;

d) Most of the children in hazardous work are between 12-14 years old at 24.1%, and 74.6 % are between 15-17 years old;

e) The 12-14 years age group tends to work very long hours. Thus, 25.8% of the 12-14 years old age group and 24.3% of the 15-17 years old age group have worked 60 hours or more;

f) The key sectors where child labor occurs are agriculture (60.5%), manufacturing (12%) and wholesale and retail trade, repair of motor vehicles and others (11%).

(2) Potential Impacts

1) During Construction

Child labor issues regarding infrastructure are not observed in the project area based on interview with the Myanmar Government. However, child labor may occur in the

construction site.

2) After Construction

No impact is expected because no activities regarding children labor were observed.

(3) Impact forecast

Children laborers may be hired as simple workers in the construction site and/or laborers atthe quarry site. Thus, appropriate rules which prohibit the hiring of child laborers under 18 years old shall be established for the project.

(4) Mitigation Measures

✓ In Article 6.21 " Child Labor" under Conditions Of Contract for Construction For Building And Engineering Works Designed by the Employer Multilateral Development Bank Harmonized Edition (June 2010) General Conditions/ International Federation Of Consulting Engineers (FIDIC) shall be followed:

> **6.21 Child labour**
> The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Where the relevant labour laws of the Country have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.

(5) **Evaluation**

In the project area, no children laborers have been observed during surveys. However, international organization such as IOL has reported the existence of child labor in Myanmar. Thus, preventive measures shall be strictly implemented during construction. The implementation of such measures eases the risks of hiring children laborers.

The changes before and after construction of bridge and related structures are unavoidable. Although the sky factor has decreased due to the existence of bridge, a sophisticated and symbolic landscape is created. Furthermore, the color of the structure harmonizes with the agricultural land. Thus, it is evaluated that the project does not give serious impacts on this item.

6.3.12. Infectious Disease and Occupational Health

(1) Result of Baseline Survey

According to literature survey, major infectious diseases are lower respiratory infections, tuberculosis and STDs such as HIV/AIDS. HIV/AIDS was the leading cause of death, killing 11.4 thousand people in 2012.

Table 6.3.11 Top 10 Causes of Death

Causes of Mortality * Infectious Disease	Rate in Top 10 (%)	Number of Mortality(2012)
1. Stroke	12.7	56,200
*2. Lower respiratory infections	9.2	40,500
3. Ischemic heart disease	6.8	30,000
*4. Tuberculosis	5.8	25,500
5. Chronic obstructive pulmonary disease	4.4	19,200
6. Cirrhosis of the liver	3.5	15,500
7. Diabetes mellitus	3.3	14,400
8. Asthma	3.0	13,300
9. Diarrheal diseases	2.6	11,400

Causes of Mortality * Infectious Disease	Rate in Top 10 (%)	Number of Mortality(2012)
*10. HIV/AIDS	2.6	11,400

Source: Myanmar WHO statistical profile (WHO 2012)

Additionally statistical data regarding infection diseases such as Malaria and Influenza on the Public Health Statistical Year Book (2014-2016) is shown below.

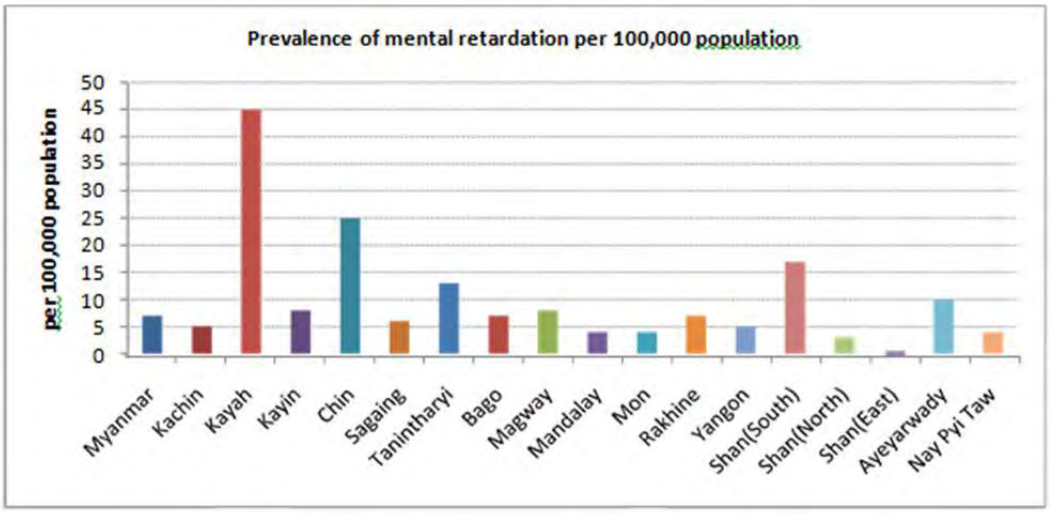
In 2016, number of approved Malaria case is 546 in Bago and 275 in Mon respectively. With regard to Influenza, the approved case number is 43 in Bago and 13 in Mon from 1st of January 2019 to 2nd of September 2019 respectively.

Table 6.3.12 Number of Cases of Major Infection Disease in the Project Area

Region/State	Number of Affected Person (Persons/Year)		Fatal Case Rate (Cases)	
	Malaria (2016)	Influenza (1st of Jan-2nd of Sep. 2019)	Malaria (2016)	Influenza (1st of Jan-2nd of Sep. 2019)
Bago	546	43	4 (0.67%)	10
Mon	275	13	0	3

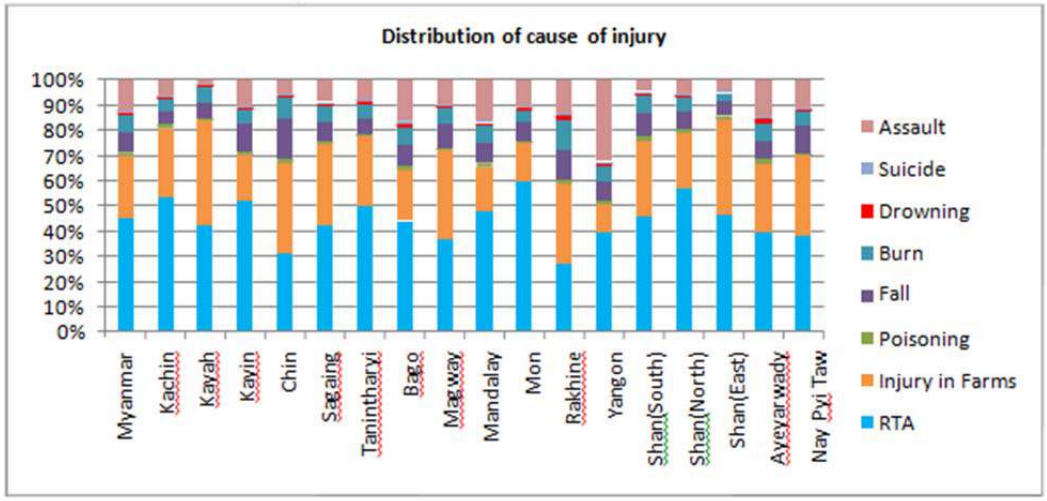
Source: Malaria: Public Health Statistical Year Book (2014-2016)/ Ministry of Health and Sports

Other related statistical data is shown below;



Source: Public Health Statistical Year Book (2014-2016)/ Ministry of Health and Sports

Figure 6.3.12 Number of Mental Helth Case



Source: Public Health Statistical Year Book (2014-2016)/ Ministry of Health and Sports

Figure 6.3.13 Number of Injury Case

(2) Potential Impacts

1) During Construction

Infectious diseases such as STDs are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provide habitats for mosquitoes that could possibly transmit dengue.

Additionally project during construction may give some adverse impacts to surrounding villagers, each item such as air, water, noise, vibration

2) After Construction

Insufficient maintenance drainage along the approach road may provide habitats for mosquito and cause infectious diseases such as dengue.

(3) Impact Forecast

1) During and After Construction

Hired construction workers and skilled equipment operators who are coming from other areas and foreign countries may establish contact with inhabitants and spread infectious diseases. On the other hand, such workers have risks of infection diseases such as dengue fever and waterborne diarrhea, if the contractor does not provide hygienic accommodation nor foods. The environmental, social and health impacts during and after construction is shown below;

Table 6.3.13 Environmental, Social and Health Impact during Construction

Impacts Item	General Impact	Degree of Impact	
		Construction Worker	Surrounding Villager
1.Air	Inhalation of dust over a long period of time can cause respiratory related disease	Workers at the borrow pits and quarry site and security guard	Villager living near borrow pits, quarry sites and construction road
2.Noise	Person exposed to noise above 100 dB(A) for long periods can be deaf	Workers at the borrow pits and quarry site and operator of construction machines	No affected persons
3.Infection Disease	a)Bitten of mosquito has risk of infection diseases such as dengue fever. b)Taking of unsanitary food and water has risk of the infection diseases such as waterborne diarrhea c)Contacting between construction workers and local people may spread infection disease such as STDs	a), b), c) and d) All construction workers have risks	a) All Villagers c) All Villagers All villager have risks of getting infection diseases from workers coming from out of project area
4. Safety	a) Working without considering labor laws and regulations in the construction area may cause accidents. b) Traffic accident may be caused on the construction access road	a) and b) All workers on site	b) All villagers using the construction road(s)

Source: JICA Study Team

Table 6.3.14 Environmental, Social and Health Impact after Construction

Impacts Item	General Impact	Degree of Impact to Surrounding Villager
1.Air	Inhalation of high density NO2, SO2, PM and CO over a long period of time can cause respiratory related disease	No affected persons (According to quantitative forecast in the Chapter 6.1.1, the impact is under standard or negligible, thus health damage is not expected)
2.Noise	Person exposed to noise above 100 dB(A) for long periods can be deaf	No affected persons (According to quantitative forecast in the Chapter 6.1.5, the impact is under standard, thus health damage is not expected)
3.Infection Disease	Inappropriate maintained drainage may provide habitats for mosquitoes	No affected persons (There are not drainage in the bridge section)

Impacts Item	General Impact	Degree of Impact to Surrounding Villager
	that could possibly transmit dengue	
4. Safety	The bridge and approach road is	Drivers and passengers may have risks of traffic accident on the constructed bridge and bypass. If villagers who are entering or passing the road/bridge may have risks of traffic accident. However since this bridge a part of full-controlled access expressway, it is not likely to cause such situation.

Source: JICA Study Team

Additionally, puddles in the construction area and insufficient drainage will provide a habitat for dengue carrier mosquitoes.

(4) Mitigation Measures

1) During Construction

The following are the proposed mitigation measures:

- ✓ Installation of sufficient drainage facilities so as not to provide habitat for vector mosquitoes;
- ✓ Installation of appropriate precautionary measures such as mosquito nets and provision of purified water for the workers in accordance with FIDIC General Conditions (6.15 Measures against Insect and Pest Nuisance)
- ✓ Provision of adequate temporary sanitation facilities;
- ✓ Enforcement of medical screening and periodical medical check-up for workers; and
- ✓ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness-raising among the laborers is promoted during construction.

2) After Construction

The following are the proposed mitigation measures:

- ✓ Installation of sufficient drainage facilities so as not to provide habitat for vector mosquitoes;
- ✓ Implementation of periodical maintenance for drainages; and
- ✓ Article 6.7 “Health and Safety” under Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer Multilateral Development Bank Harmonized Edition (June 2010) General Conditions/ International Federation of Consulting Engineers (FIDIC) shall be followed.

6.7 Health and Safety
The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics. The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority. The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require. HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals. The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Subcontractors and any other Contractor's or Employer's personnel, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behaviour with respect to, of Sexually Transmitted Diseases (STD) - or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labour as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counselling and referral to a dedicated national STI and HIV/AIDS programme, (unless otherwise agreed) of all Site staff and labour. The Contractor shall include in the programme to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation programme for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation programme shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the programme shall detail the resources to be provided or utilised and any related sub-contracting proposed. The programme shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this programme shall not exceed the Provisional Sum dedicated for this purpose.

(5) Evaluation

Inflow of workers during construction may provide opportunity for spreading infectious diseases. Additionally, insufficient and inappropriate drainage and maintenance during construction may also provide habitats for mosquito larvae. However, the implementation of mitigation measures will prevent and minimize these adverse impacts. Thus, it is not likely to give serious impacts on them.

6.3.13. Labor Environment

(1) Result of Baseline Survey

In the 1960's, the Law Prescribing the Fundamental Rights and Duties of People's Workers (1964) had been effective as a comprehensive law regarding the rights of laborers. However this law has been abolished in 2011, and the following 14 laws are applicable in Myanmar.

Labor conditions, safety of facilities and equipment are not prescribed in the following 14 laws. However, the same level shall be secured under the Factories Act 1951.

Table 6.3.15 Major Laws regarding Rights of Labor in Myanmar

Name of Law	Year Established	Summary	Applicable for the Project
1. The Workmen's Compensation Act	1923	The employer shall compensate occupational injury	Applicable
2. The Employment Statistics Act	1948	The employer shall submit statistical data for employees	-
3. The Factories Act	1951	The laws prescripts mandated facilities in factory and labor conditions in factory	To be applied in the construction site
4. The Leave and Holidays Act	1951	The law prescripts holidays, paid leave, medical leave and maternity leave for employees	Applicable
5. The Oilfields (Labor and Welfare) Act	1951	The law prescript rights of employees in the oil fields	
6. The Employment Restriction Act	1951	The employer shall inform the vacancies to the Labor Exchange Office in Township	
7. The Law Relating to Overseas Employment	1999	The law prescript rights of employees who are working in foreign countries	Applicable
8. The Labor Organization Law	2011	The law prescript rights of employees such as establishment of labor unions and going on strikes	Applicable
9. The Settlement of Labor Dispute Law	2012	The law prescripts solution and processing of dispute cases between employer and employees	Applicable
10. The Social Security Law	2012	The law prescripts that a company which has regulated number of employees shall join social insurance	Applicable
11. The Minimum Wages Law	2013	The law prescript the process of making decision for setting minimum wages (4,800 kyat/day as of March 2018)	Applicable
12. The Employment and Skill Development Law	2013	The law prescripts that the employer shall sign a contract with the employees within 30 days	Applicable
13. The Payment of Wages Law	2016	The law prescripts deduction, payment date and payment measures	-
14. The Shops and Establishments Law	2016	The law prescripts labor time, wages, securing safety and health in the shops and commercial facility	-

Source: Labor Guide Book (JETRO: March 2017)

(2) Potential Impacts

1) During Construction

Construction work environment needs to be considered in accordance with relevant laws and regulations. Additionally project activities may give some impacts on occupational health.

2) After Construction

No impacts are expected.

(3) Impact Forecast

1) During Construction

Working without considering labor laws and regulations in the construction area may cause accidents. For instance, working without using helmets and working boots increase the risks of head and foot injuries. Additionally infection diseases may be spread if the contractor does not provided nor take appropriate perceptional measures as shown below;

Table 6.3.16 Environmental, Social and Health Impact for Workers

Impacts Item	General Impact	Possibility in the Project
1.Air	Inhalation of dust over a long period of time can cause respiratory related disease	Workers at the borrow pits and quarry site and security guard
2.Noise	Person exposed to noise above 100 dB(A) for long periods can be deaf	Workers at the borrow pits and quarry site and operator of construction machines
3.Infection Disease	Bitten of mosquito has risk of infection diseases such as dengue fever. Taking of unsanitary food and water has risk of the infection diseases such as waterborne diarrhea	All workers who have food and water at base camp, offices and accommodation
4. Safety	Working without considering labor laws and regulations in the construction area may cause accidents.	All workers on site

Source: JICA Study Team

(4) Mitigation Measures

1) During Construction

The following relevant laws and regulations shall be followed by the contractor and workers:

- ✓ Relevant laws in Myanmar such as "the Workmen's Compensation Act", "the Factories Act", "the Leave and Holidays Act", "the Law Relating to Overseas Employment", "the Labor Organization Law", "the Settlement of Labor Dispute Law", "the Social Security Law" and "the Minimum Wages Law" shall be followed
- ✓ Additionally, Article 23 of Occupational Health and Safety, Labor and Working Conditions in IFC Performance Standard 2 shall be applied.

> **Occupational Health and Safety**
> 23. The client will provide a safe and healthy work environment, taking into account inherent risks in its particular sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women. The client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, as far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice,14 as reflected in various internationally recognized sources including the World Bank Group Environmental, Health and Safety Guidelines, the client will address areas that include the (i) identification of potential hazards to workers, particularly those that may be life-threatening; (ii) provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) training of workers; (iv) documentation and reporting of occupational accidents, diseases, and incidents; and (v) emergency prevention, preparedness, and response arrangements.
> ***Source: IFC Performance Standard 2 (2012): Labor and Working Conditions / Article 23 Occupational Health and Safety***

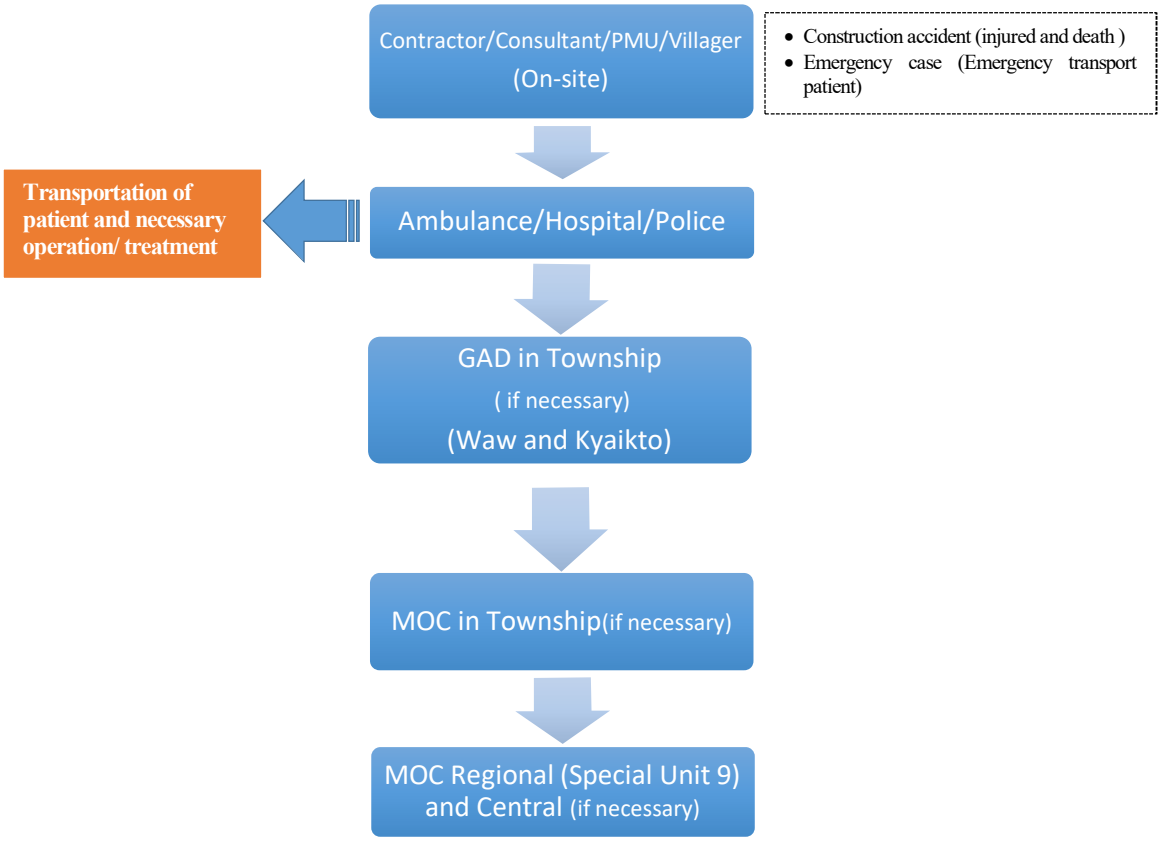
- ✓ Chapter 6 of Staff and Labor, including "6.6 Facilities for Staff", "6.7 Health and Safety" and "6.15 Measures against Insect and Pest Nuisance" under Conditions Of Contract For Construction For Building And Engineering Works Designed by the Employer Multilateral Development Bank Harmonized Edition (June 2010) General Conditions by the International Federation Of Consulting Engineers (FIDIC), shall be followed.

> **6.6 Facilities of Staff**
> Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification. The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

6.7 Health and Safety
The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics. The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

6.15 Measures against Insect and Pest Nuisance
The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

✓ Preparation of emergency response system for emergency cases such as construction accident and patient transportation. This response system and procedure shall be proposed by the Contractor during construction. Sample response procedure is shown below;



Source: JICA Study Team

Figure 6.3.14 Proposed Response Process in Emergency Case (First Aid Plan/Accident)

Additionally contractor shall follow general conditions for workers shown below;

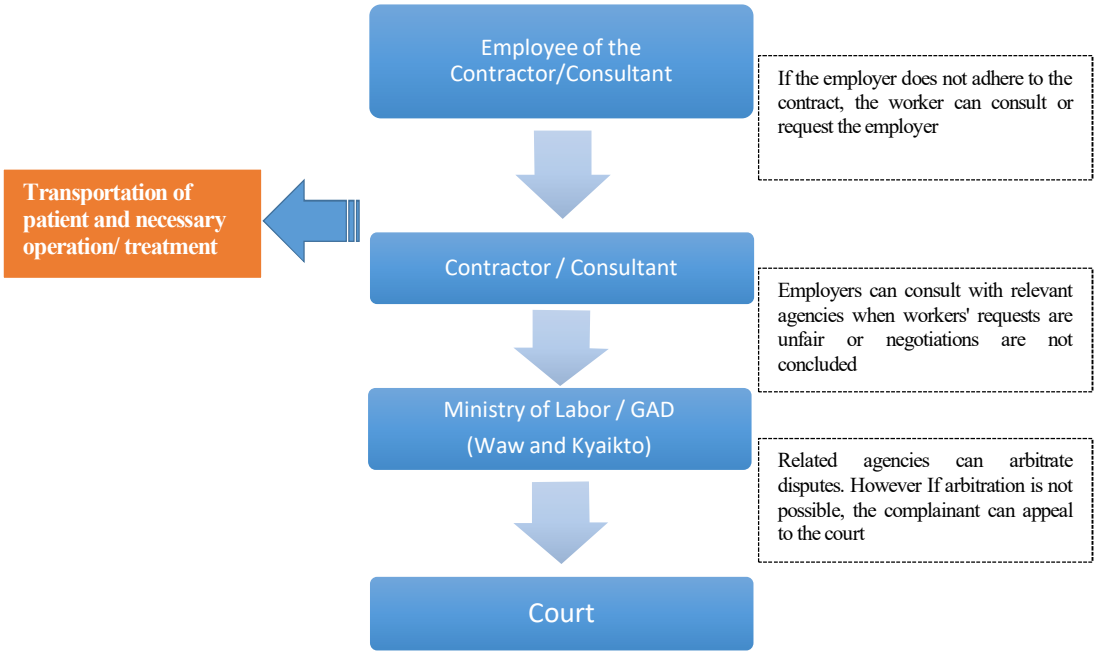
Table 6.3.17 Contractor's Duties including Social Security for Construction Labors

FIDC Article	Conditions
6.4 Labour Laws	The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights. The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.
6.5 Working Hours	No work shall be carried out on the Site on locally recognized days of rest, or outside the normal working hours stated in the Contract Data, unless: (a) otherwise stated in the Contract, (b) the Engineer gives consent, or (c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.
6.6 Facilities for Staff and Labour	Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification. The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.
6.7 Health and Safety	The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics. The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority. The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require. HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals. The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Subcontractors and any other Contractor's or Employer's personnel, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behaviour with respect to, of Sexually Transmitted Diseases (STD) - or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labour as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counselling and referral to a dedicated national STI and HIV/AIDS programme, (unless otherwise agreed) of all Site staff and labour. The Contractor shall include in the programme to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation programme for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation programme shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the programme shall detail the resources to be provided or utilised and any related sub-contracting proposed. The programme shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this programme shall not exceed the Provisional Sum dedicated for this purpose.
6.11 Disorderly Conduct	The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.
6.13 Supply of Foodstuffs	The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.
6.14 Supply of Water	The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.
6.15 Measures against Insect and Pest Nuisance	The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce the danger to their health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.
6.16 Alcoholic Liquor or Drugs	The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal thereto by Contractor's Personnel.
6.17 Arms and	The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of

FIDC Article	Conditions
Ammunition	any kind, or allow Contractor's Personnel to do so.
6.18 Festivals and Religious Customs	The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.
6.19 Funeral Arrangements	The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.
6.20 Forced Labour	The Contractor shall not employ forced labour, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
6.21 Child Labour	The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Where the relevant labour laws of the Country have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.
6.24 Non-Discrimination and Equal Opportunity	The Contractor shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where the relevant labour laws provide for non-discrimination in employment, the Contractor shall comply with such laws. When the relevant labour laws are silent on nondiscrimination in employment, the Contractor shall meet this Sub-Clause's requirements. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination.

Source: Conditions Of Contract For CONSTRUCTION FOR BUILDING AND ENGINEERING WORKS DESIGNED BY THE EMPLOYER/ Multilateral Development Bank Harmonised Edition / June 2010/ General Conditions

When some disputes between the contractor and the worker are caused, it may be possible to resolve it using the following grievance redress mechanism



Source: JICA Study Team

Figure 6.3.15 Draft Redress Grievance Mechanism for Employee(s) during Construction

(5) Evaluation

Relevant laws in Myanmar and IFC standards shall be applied for the employees during the construction period. The labor environment and safety will be secured in accordance with the above laws and international standards.

6.3.14. **Accident**

(1) Result of Baseline Survey

According to some reports, a total of 116 people died due to accident on the country's Yangon-Mandalay highway in connection with 555 traffic accident cases, with 863 injured in 2017. Majority of the reasons for such traffic accidents are overspeeding, reckless driving, defective vehicles and flat tire.

On the hand, the number of fatal accidents involving drivers, passengers, pedestrian and motor cyclists were 392 persons in Bago Region and 254 persons in Mon State, respectively. These accidents have been caused by overspeeding, overtaking and reckless driving. Additionally, insufficient road safety facilities such as traffic lights, street lights and sign boards are very limited, and such road environment accelerates the increase of traffic accidents.

Table 6.3.18 Number of Traffic Accidents in Bago Region and Mon State (2016)

States and Regions	Road User Class	Degree of fatalities (2016)			
		Killed	Seriously injured	Moderately injured	Minor/Other injuries
Bago Region	Drivers and Passengers	215	804	316	371
	Pedestrians	8	3	1	2
	Motorcyclists	169	421	451	276
	Total	392	1,228	768	649
Mon State	Drivers and Passengers	145	338	140	125
	Pedestrians	2	5	2	0
	Motorcyclists	107	223	138	159
	Total	254	566	280	284
Grand Total		646	1,794	1,048	933

Source: Myanmar Statistical Yearbook/Central Statistical Organization, Ministry of National Planning and Economic Development 2016

(2) Potential Impacts

1) During Construction

Construction vehicles may use the existing local roads near residential areas, thus the number of traffic accident may increase. The Construction workers and surrounding villagers may have accidents in the project area.

2) After Construction

Risks of traffic accidents on the new road are expected due to increase in traveling speed.

(3) Impact Forecast

1) During Construction

According to construction plan, construction machines and trucks will be operated for approximately 4 years. Thus, the risks of traffic accidents and construction accidents increase in the project area and surrounding connected roads, and mitigation measures shall be prepared.

2) After Construction

Since only vehicles are allowed to pass through the bridge and approach road, it is expected that the number of traffic accidents between vehicles and local people will decrease. However, since the driving speed of vehicles has increased from 60km/h to 100km/h due to expressway, the number of traffic accidents may increase if adequate traffic safety facilities are not installed. Thus, the setting up of mitigation measures is indispensable.

(4) Mitigation Measures

1) During Construction

The following are the proposed mitigation measures:

- ✓ Deployment of a flagman at the gate of construction area and intersections for traffic management
- ✓ Installation of safety sign boards such as speed limit and residential area in the project area
- ✓ Installation of fence around the construction site to keep out the local people such as children
- ✓ Installation of lightning facility at nighttime in the construction area
- ✓ Restriction of mobilization speed to less than 20km/h in the construction site
- ✓ Implementation of safety training for the workers
- ✓ Securing of temporary diversion roads for villagers if construction activities give adverse impacts on current roads in the project area
- ✓ Preparation of emergency response system for emergency cases such as construction accident and patient transportation. This response system and procedure shall be proposed by the Contractor during construction.(see the sample: Figure 6.3.14)

2) After Construction

The following are the proposed mitigation measures:

- ✓ Installation of sign board for safety (speed limit)
- ✓ Installation of crosswalk and pedestrian bridge at appropriate points
- ✓ Implementation of traffic safety campaign for citizens
- ✓ Strengthening of speed control by the police department

(5) Evaluation

Operation of construction machines and vehicles may increase the number of accidents in the construction area and on the road where construction machines are used, and construction vehicles may use the existing local road near residential and commercial areas. Thus, the number of traffic accidents increase during construction.

After the construction of bridge and approach road, accidents between vehicles and pedestrians may decrease. However, accidents between vehicles may increase due to overspeeding.

However, the implementation of mitigation measures during and after construction must prevent and minimize these adverse impacts. Thus, it is not likely to give serious impacts on these accidents.

6.3.15. **Cross Boundary Impacts and Climate Change**

(1) Potential Impacts

1) During Construction

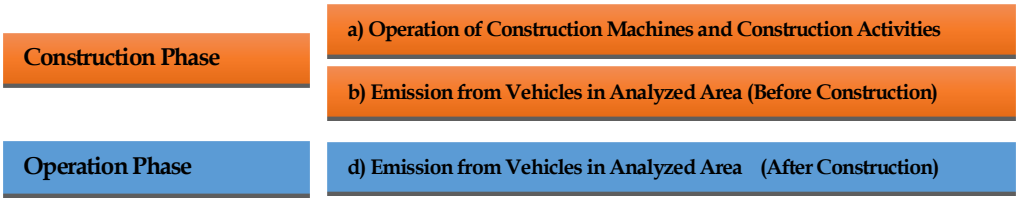
Operation of construction machines and construction activities generate CO2 as shown in Figure 6.3.16.

2) After Construction

a) GHGs Generation

The driving distance between Kyaikto and Bago will be shortened by the construction of the bypass, thus positive impacts are expected in the project area. However, the converted traffic number may generate additional GHGs.

The construction of bridge and bypass does not generate additional traffic in the project area. However, the construction of bridge and bypass ease traffic congestion in Myanmar, which means that traveling speed will increase in Myanmar. Thus, the generated volume of CO2 is forecasted quantitatively in "With" and "Without" project case.



Source: JICA Study Team

Figure 6.3.16 Analyzed Item on CO2 Generation

b) Climate Change

On the other hand, climate change may cause impacts on sea level rise and increase of rainfall volume in the future. Thus, the design of the bridge shall consider climate change.

(2) Impact Forecast

a) GHGs Generation

The generated CO2 volume during construction and operation stage from 2017 to 2045 is shown in Table 6.3.19.

During construction, a total of approximately 180,000 tons of CO2 is generated for 4 years. After construction, the average traveling speed in the analyzed area will increase from approximately 50 km/h without project case to 50.4 km/h with project case, and emission factor decrease in conjunction with traveling speed inversely. Thus, generated CO2 from traffic decrease after construction of bridge and connected bypass due to increase of traveling speed.

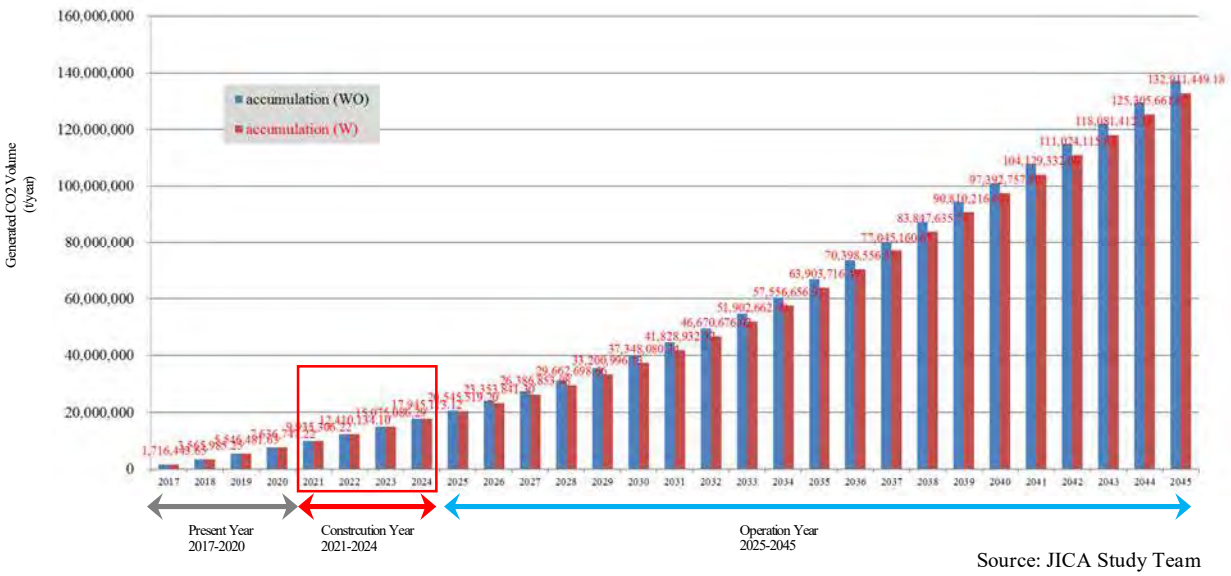
Quantitative forecast during and after construction (2017-2045) is shown in Table 6.3.19 and Figure 6.3.17.

Total accumulated CO2 volume in the case of "Without Project" beyond "With Project" case after the operation year 2025. This means that the project gives positive impacts on CO2 during the operation stage.

Table 6.3.19 Estimated Generated CO2(t/year) From Vehicles in Myanmar (2017-2045)

Phase	Year	Without Project			With Project			Differences	accumulation (WO)	accumulation (W)	Differences accumulation (WO-W)
		Traffic	Construction	Total	Traffic	Construction	Total				
Current	2017	1,716,443.65	0.00	1,716,443.65	1,716,443.65	0.00	1,716,443.65	0.00	1,716,443.65	1,716,443.65	0.00
	2018	1,849,541.60	0.00	1,849,541.60	1,849,541.60	0.00	1,849,541.60	0.00	3,565,985.25	3,565,985.25	0.00
	2019	1,980,496.39	0.00	1,980,496.39	1,980,496.39	0.00	1,980,496.39	0.00	5,546,481.63	5,546,481.63	0.00
	2020	2,090,265.59	0.00	2,090,265.59	2,090,265.59	0.00	2,090,265.59	0.00	7,636,747.22	7,636,747.22	0.00
Construction	2021	2,253,693.40	0.00	2,253,693.40	2,253,693.40	44,865.60	2,298,559.00	-44,865.60	9,890,440.62	9,935,306.22	-44,865.60
	2022	2,429,962.28	0.00	2,429,962.28	2,429,962.28	44,865.60	2,474,827.88	-44,865.60	12,320,402.90	12,410,134.10	-89,731.20
	2023	2,620,086.58	0.00	2,620,086.58	2,620,086.58	44,865.60	2,664,952.18	-44,865.60	14,940,489.49	15,075,086.29	-134,596.80
	2024	2,825,161.23	0.00	2,825,161.23	2,825,161.23	44,865.60	2,870,026.83	-44,865.60	17,765,650.72	17,945,113.12	-179,462.40
Operation	2025	3,024,168.25	0.00	3,024,168.25	2,600,406.08	0.00	2,600,406.08	423,762.17	20,789,818.97	20,545,519.20	244,299.77
	2026	3,268,201.20	0.00	3,268,201.20	2,808,322.10	0.00	2,808,322.10	459,879.10	24,058,020.17	23,353,841.30	704,178.87
	2027	3,532,109.36	0.00	3,532,109.36	3,033,012.69	0.00	3,033,012.69	499,096.67	27,590,129.53	26,386,853.98	1,203,275.55
	2028	3,817,527.81	0.00	3,817,527.81	3,275,844.67	0.00	3,275,844.67	541,683.14	31,407,657.34	29,662,698.66	1,744,958.69
	2029	4,126,227.61	0.00	4,126,227.61	3,538,297.48	0.00	3,538,297.48	587,930.14	35,533,884.95	33,200,996.13	2,332,888.82
	2030	4,460,127.21	0.00	4,460,127.21	4,147,084.21	0.00	4,147,084.21	313,043.00	39,994,012.16	37,348,080.34	2,645,931.82
	2031	4,541,802.35	0.00	4,541,802.35	4,480,851.98	0.00	4,480,851.98	60,950.38	44,535,814.51	41,828,932.32	2,706,882.20
	2032	4,908,977.47	0.00	4,908,977.47	4,841,743.70	0.00	4,841,743.70	67,233.77	49,444,791.98	46,670,676.02	2,774,115.97
	2033	5,306,117.61	0.00	5,306,117.61	5,231,986.88	0.00	5,231,986.88	74,130.73	54,750,909.59	51,902,662.90	2,848,246.69
	2034	5,735,693.31	0.00	5,735,693.31	5,653,994.01	0.00	5,653,994.01	81,699.29	60,486,602.90	57,556,656.91	2,929,945.99
	2035	6,470,631.97	0.00	6,470,631.97	6,347,059.58	0.00	6,347,059.58	123,572.39	66,957,234.87	63,903,716.49	3,053,518.38
	2036	6,621,519.89	0.00	6,621,519.89	6,494,840.06	0.00	6,494,840.06	126,679.83	73,578,754.76	70,398,556.55	3,180,198.21
	2037	6,776,469.90	0.00	6,776,469.90	6,646,604.10	0.00	6,646,604.10	129,865.80	80,355,224.66	77,045,160.65	3,310,064.01
	2038	6,935,607.51	0.00	6,935,607.51	6,802,475.14	0.00	6,802,475.14	133,132.37	87,290,832.17	83,847,635.79	3,443,196.38
	2039	7,099,062.48	0.00	7,099,062.48	6,962,580.82	0.00	6,962,580.82	136,481.67	94,389,894.65	90,810,216.60	3,579,678.04
	2040	6,712,919.82	0.00	6,712,919.82	6,582,541.20	0.00	6,582,541.20	130,378.62	101,102,814.47	97,392,757.80	3,710,056.67
	2041	6,870,221.15	1.00	6,870,222.15	6,736,573.80	1.00	6,736,574.80	133,646.35	107,973,036.62	104,129,332.60	3,843,704.02
	2042	7,031,779.89	2.00	7,031,781.89	6,894,781.23	2.00	6,894,783.23	136,996.66	115,004,818.51	111,024,115.83	3,980,702.68
	2043	7,197,728.16	3.00	7,197,731.16	7,057,293.42	3.00	7,057,296.42	140,431.74	122,202,549.67	118,081,412.25	4,121,137.42
	2044	7,368,202.61	4.00	7,368,206.61	7,224,244.77	4.00	7,224,248.77	143,953.84	129,570,756.28	125,305,661.02	4,265,095.26
	2045	7,767,395.39	5.00	7,767,400.39	7,605,783.16	5.00	7,605,788.16	161,607.23	137,338,156.67	132,911,449.18	4,426,707.50
	Total	137,338,141.67	15.00	137,338,156.67	132,731,971.78	179,477.40	132,911,449.18	4,426,692.50	1,577,738,356.91	1,517,138,229.98	60,600,126.93

Source: JICA Study Team



Source: JICA Study Team

Figure 6.3.17 Analyzed Item on CO2 Generation (2017-2045)

b) Climate Change

According to the Myanmar Climate Change Strategy and Action Plan (MCCSAP) Version 19 January 2017 by the Ministry of Natural Resources and Environmental Conservation (MoNREC), the sea level rise in Myanmar seas is estimated to be 83 cm (2080's) at most.

(3) Mitigation Measures

According to quantitative forecast on CO2, the project gives positive impact. However implementation of mitigation measures can minimize adverse impacts._

1) During Construction

With regard to the operation of construction machines, the following manner shall be observed during construction:

- ✓ Prohibition of unnecessary operation of construction machines
- ✓ Periodical (daily, weekly and monthly) checking and maintenance of construction machines shall be done.

2) After Construction

- ✓ Strengthening of speed control by the police department (MOC requests to police department regarding strict speed control)
- ✓ Strengthening of car inspection mechanisms to restrict vehicles from discharging high emissions (MOC requests to Ministry of Transportation and Communication, Road Transport Administration Department regarding appropriate implementation of car inspection)
- ✓ A margin of vertical clearance shall be secured by at least 2m so as not to cause impacts on climate change influences.

(4) Evaluation

Negative impacts are forecasted during construction due to construction activities such as operation of construction machines. However, traffic in the analyzed area will be improved by easing of traffic congestion due to construction of flyover. Thus, the total generated CO2 will be improved after 2025, and the project gives positive impacts after 2025.

Additionally, the rise in sea level is estimated at a maximum of 83cm in accordance with MCCSAP. However, bridge design with vertical clearance covers the impacts of climate change. Thus, it is likely to give positive impacts on this item.

6.4. Risk Assessment and Disaster Management Plan

6.4.1. Objective of Disaster Management Plan

New Sittaung Bridge with 4-lanes, 2.5 km long will be connecting with 64.5 km - Kyaikto – Bago Bypass with a design speed of 100 kmph financed by ADB. Provision and plan for risks has been made at various stages. The risk may be due to accident, falling of vehicle in to the Sittaung river, fire, earthquake, collision of ship with the bridge or spillage of oil and chemicals on the bridge and river. This would, depending upon the type and intensity, involve disasters in terms of loss of life and damage to the bridge apart from disruption of traffic. Therefore to avoid and minimize this, disaster and emergency management plays a very important role.

The purpose of the DMP (Disaster Management Plan) is to identify the roles, responsibilities, and tasks/functions to be performed in all disaster recovery operations. Thus objective is

- To increase awareness among of officials of the project on the issues involved in disaster recovery,
- To provide explanations of roles and responsibilities, and
- To provide guidelines for disaster recovery operations.
- To localize the emergency and, if possible eliminate it; and
- To minimize the effects of the accidents on people and property.

Elimination will require prompt action by operators and works emergency staff using, for example, fire-fighting equipment, emergency due to collision and submergence etc.

Minimizing the effects may include rescue, first aid, evacuation, rehabilitation and giving information promptly to people living nearby.

6.4.2. Risks and Disasters

The project consists of bridge and new road in river and terrestrial settings respectively. Large no. of vehicles will ply across the bridge. In this scenario of vehicular movement, few risks and disasters are involved. This disaster could be natural as well as related to other sources.

6.4.3. Risk Analysis

Risk may be defined as the potential realization of unwanted consequences of an event (i.e. the product of the probability of an event and the consequences of the event). Both the probability of occurrence of an event and the magnitude of its consequences are thus involved. Acceptance criteria can be established either in the form of a predefined set of "Risk Acceptance Criteria" or in the form of "Optimum cost criteria".

The Risk acceptance criteria are normally imposed by the authorities to reflect the willingness of people and society to accept risks. Optimum cost criteria are Acceptance Criteria based on cost effectiveness analysis comparing the cost of the bridge strengthening and protection measures against the benefits of risk reduction.

The analysis should take into account consequence of collision, such as

- Damage to bridge
- Damage to the users of the bridge
- Damage to vessel and cargo, if any
- Inconvenience cost of society and business
- Social losses
- Damages to the environment (river, IBA/KBA, Ramsar site)

The risk acceptance criteria are intended to cover the aggregate probability of accident due to several types of causes such as fire and explosion, train accidents, etc. in addition of vessel collision.

For this project it is recommended that specific evaluation should be carried out for:

- Importance of the bridge connection to the public and society, to business and industry, to the national defense etc.
- fatality risk in the case of high traffic volume
- cost effectiveness of improving the safety for the bridge.

(1) Fatality Acceptance Criteria

The risk categories are

- Individual fatality risk
- Societal risk (i.e. number of fatalities in an accident and the number of events per year)
- To achieve low fatality risk

- Ensure a low probability of bride disruption
- Introduce bridge use warning systems on the bridge (if required)

(2) Optimum and acceptance criteria

1) Damage to the bridge – direction consequences to the bridge owner are:
   - Cost of the salvaging the wrecked part of the bridge
   - Cost of repair/replacement of the bridge
   - Loss of revenue during repair/replacement of the bridge
   - Additional costs of repair/replacement due to more strict requirements of the Authorities after the accident
2) Damage to the users of the bridge
   - Injuries and loss of lives – cost values for fatalities
   - Damage to vehicles and goods
3) Inconvenience costs to Society and Business
   - Road and rail inconvenience costs, strategic importance of the bridge, Alternative routes available.
   - Port interruption cost – blocking of navigation channel
   - Business and social loss
4) Damage to environment
   - Cost of repair/replacement of the bridge
   - Cost of physical restoration
   - Ecological problems – immediate/long term.

6.4.4. **Anticipated Emergencies or Disasters**

The disasters can be classifieds manmade or artificial and natural. Both type of disasters causes' loss of life as well as properties. The anticipated disasters are:

- Accidents Or Medical Emergencies
- Fire
- Sabotage
- Collision of Ship with bridge
- Explosion
- Bomb Threat
- Chemical Spill
- Local/Civil Disturbance
- Utility Failure
- Violent Crime Or Behaviour
- Health Emergency (Epidemic)

- Weather – Monsoon and flooding

6.4.5. Components of DMP (Disaster Management Plan)

The efficient and effective Disaster Management System should have following components

- Emergency Response Team
- Public Affairs
- Telephone Services
- Dining Services
- Financial Services
- Planning Section

6.4.6. Various Scenarios of Risks and Disaster in the Project

(1) Evacuation of passengers

Risk is involved by way of collision and falling of vehicle into the river. Communication system plays an important role which will be available on the bridge. Early response such as rescue and relief by the rescue team by means of life saving boat will be planned. These rescued passengers will be brought from nearest port and given first aid by paramedics and taken to nearby hospital.

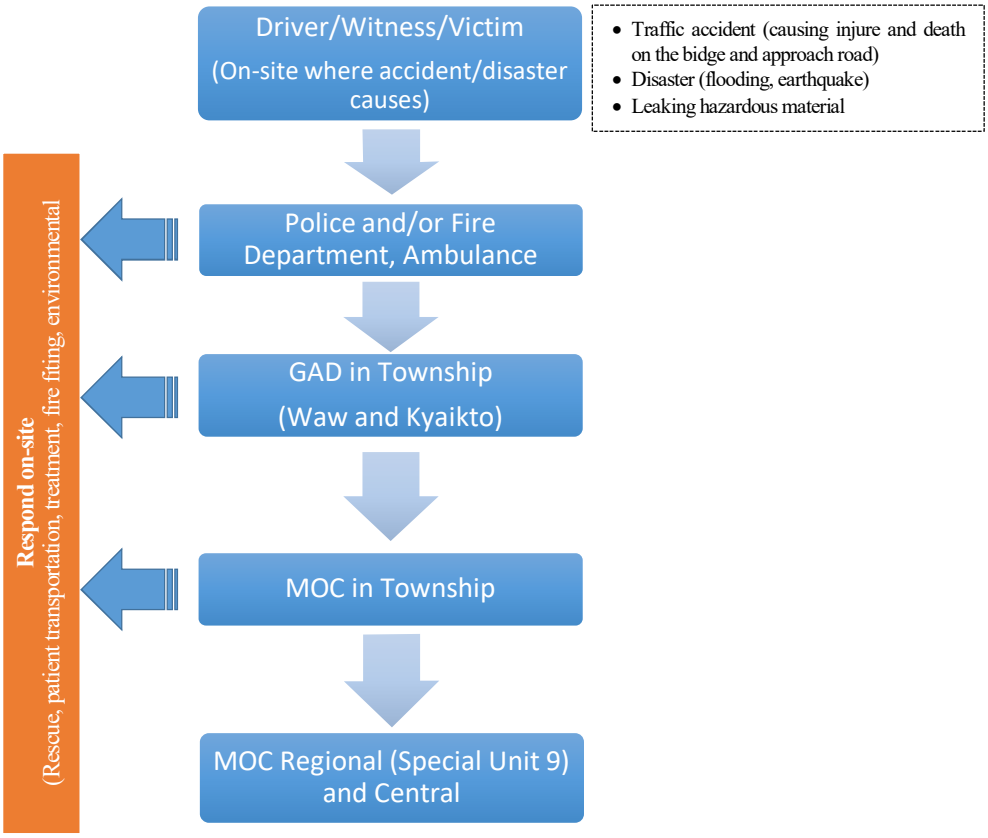
(2) Head-on collision/ vehicle accidents on the bridge

The major risk involved in this type of Disaster is fatal or high degree of injury. Early response will be in terms of well equipped ambulance with paramedical team reaching on the site. This will help in rescue of passengers from the accident site and will be taken to the nearest hospital. If need arises the patient can be taken to one of the major and super-specialty hospital in the area.

(3) Spillage and leakages of oil / hazardous materials on the bridge

This Disaster can occur during a leak or spillages of oil met with an accident on the bridge. The various risks involved in this includes spillages of oil and fuel into the river thereby causing marine pollution, danger of skidding of other vehicles due to spillages. Risk of catching fire depends upon the flash point of the material. The early response in this case will be stoppage of vehicular movement immediately by using communication system on the bridge and towing the damaged vehicle in order to make traffic easier. Mopping operations through specialized agencies will be taken to collect oil spilled on the road as well as floating on the river surface.

Proposed contact and response process is shown in the next figure.



Source: JICA Study Team

Figure 6.4.1 Proposed Response Process in Emergency Case

6.4.7. Emergency Services needed to meet the disaster

(1) Emergency Services needed to meet the disaster

a) Fire fighting – Fire services available in Kyaikto and Waw Township (Township)

b) Search and rescue – Fire services / Ambulance in Township

c) Medical emergency care –Ambulance in Kyaikto and Was Township

d) Facilities Services (public works) – damage prevention, debris, shoring up buildings, custodial, maintenance, and support to other agencies.

e) Scene security and traffic control – Police department and MOC in Township

f) Hazardous materials operations – Fire Deparment in Township

g) Communications Unit – information systems for tactical, regional and national information. Telecommunications, Main Control Centre, Human Resources, etc.

In addition to above following equipments are proposed to be stationed at the nearest MOC regional (Kyikto and Was Township MOC) for disaster management during Fire Fighting

- Foam cum water tender
- Portable fire fighting pumps
- Fire jeeps / vehicles

- Foam fire extinguishers
- Dry chemical powder extinguishers
- CO2 extinguishers
- Fire protections suits
- Full face and half face mask respirators
- Light water foam AFFF
- Spark proof torch
- Fire alarm system
- Gas measuring meter
- Fire tugs (in the water)

CHAPTER 7 CUMULATIVE IMPACT ASSESSMENT

In the project area for the East-West Economic Corridor Improvement Project (New Sittaung Bridge), any other large-scale projects have not been confirmed except Kyaikto – Bago Bypass Project.

Environmental and social impacts are discussed in ADB EIA. The result of review of ADB is shown below;

The final EIA for the ADB section (the construction of 64.5 km bypass) has prepared by ADB Technical Assistance Team in accordance with ADB Safeguard Policy Statement 2009 and relevant Myanmar Laws, and has submitted from ADB to MOC in the middle of July 2019.

The final ADB-EIA has shared with JICA side, and then the EIA has reviewed by JST in August 2019.

It has been confirmed that following requirements are satisfied in accordance with relevant EIA laws in Myanmar, JICA Guidelines and Operational Policies of World Bank/IFC basically. Hence it is evaluated that an implementation of the bypass road does not have any significant adverse impacts on pollution, natural and social environment.

- ✓ Analysis items (Pollution items, natural environment items and social items)
- ✓ Quantitative forecasts and evaluation in accordance with environmental standards (air quality and noise level along the bypass section)
- ✓ Timing and number of local stakeholder meeting (Scoping and draft EIA stage)
- ✓ Preparation of appropriate mitigation measures and monitoring plan

Although the ADB-EIA has well-prepared in accordance relevant guidelines and laws, however following collaboration between JICA and ADB during detailed design and construction stage might maximize the effectiveness of the both projects and minimize negative impacts.

- ✓ Sharing information regarding special ecosystem monitoring for preparation of appropriate mitigation measures during detailed design
- ✓ Sharing the updated environmental management plan (EMP) for mutual confirmation during detailed design
- ✓ Holding periodical meetings with PMUs, contractors and supervision consultants for the bypass and bridge section respectively for solution of common issues

CHAPTER 8 ENVIRONMENTAL MANAGEMENT PLAN

8.1. Mitigation Measures

The Environmental Management Plan (hereinafter referred to as "EMP") consists of mitigation measures and environmental monitoring plan in general.

Mitigation measures are prepared for minimizing the adverse negative impacts during and after construction. Necessary mitigation measures based on the result of impact forecasts are shown in Table 8.1.1.

Implementation of mitigation measures shall be monitored during construction, and the effectiveness of mitigation measures shall be verified based on the result of quantitative forecasts. Furthermore, the accumulation of monitoring data might lead to the implementation of adequate mitigation measures in the future.

In general, the cost of mitigation measures during construction are included as construction cost except for special mitigation measures. With regard to special mitigation measures for ecosystem, the items and expected cost are shown in Table 8.1.2.

Table 8.1.1 Environmental and Social Mitigation Measures

Area	No.	Item	Draft Mitigation Measures		Responsibility	
			During Construction	After Construction	Implementation Agency	Responsible Agency
Pollution	1	Air pollution	☐ Water sprinkling shall be carried out on earth construction road and construction yard near the residential area. Additionally, surface treatment of the earth road should be considered, if required. ☐ Periodical cleaning shall be done on paved road used as construction road.	☐ Appropriate land use management should be done along the road. In general, commercial and industrial area shall be designated along the road so that the residential area will not be directly affected by air pollution.	[During Const.] Contractor (Construction Company) [After Const.] MOC and local authority (Bago Region and Mon State)	[During Const.] MOC [After Const.] MOC and Local Authority
	2	Water pollution	☐ Turbid water from unpaved construction area shall be treated in sedimentation pond and discharged into the river, if required. ☐ Waste oil of construction machines shall be stored and disposed of into a designated site. ☐ Construction machines shall be maintained so as not to leak oil in the base camp site. ☐ Provision of sanitation facilities at the labor camps and construction yard. Also, the location of camps should be at least 200 m away from water sources. ☐ Domestic wastewater and night soil from base camp shall be treated and discharged of at designated sites and facilities. ☐ Use septic tank for portable toilet and temporary toilet in the construction area and yard ☐ Adoption of steel pipe sheet piles (SPSP) methodology so as not to generate turbid water at excavated area in the river.	Not required	[During Const.] Contractor	[During Const.] MOC
	3	Waste	[Construction waste (Waste soil, cut trees, waste oil and hazardous materials)] ☐ Waste soil from the land section of muck soil from the river section is used in the	Not required	[During Const] Contractor	[During Const] MOC

Area	No.	Item	Draft Mitigation Measures		Responsibility	
			During Construction	After Construction	Implementation Agency	Responsible Agency
			construction area for temporary earthwork and as embankment material of ADB bypass road section. Muck soil is excavated from the river section and transported, and the necessary process is taken for reusing it as construction material. ☐ Cut trees are sold to villagers as building materials and for other purposes. ☐ Waste oil of the construction machines is collected and disposed of through a licensed agent such as fuel station. ☐ Waste chemical and hazardous material are stored at the base camp site and disposed of through a licensed agent. [Domestic waste and night soil from base camp and offices] ☐ Domestic solid waste is collected and disposed at the nearest designated disposal site ☐ Domestic wastewater and night soil shall be treated though septic tank and discharged of into the natural stream. Water quality of the effluent shall be confirmed before discharging into the natural water body.			
	4	Soil contamination and sediment	☐ Excavated soil on the land and in the river shall be analyzed and quality shall be confirmed if it is under standard values. Polluted soil shall be treated and used as construction material if excavated soil is polluted. ☐ Construction machines shall be maintained so as not to leak oil in the base camp site. ☐ Waste oil of the construction machines is collected and disposed of through a licensed agent ☐ Waste chemical and hazardous material are stored at the base camp site and disposed of through a licensed agent.	Not required	[During Const] Contractor	[During Const] MOC
	5	Noise and vibration	[Construction noise and vibration] ☐ Construction activities and operation of construction machines shall be limited in the daytime and on weekdays. ☐ Construction machines shall be well-maintained and checked everyday. ☐ Information disclosures, such as construction schedule and activities, shall be carried out in advance to the surrounding community.	☐ Land use along the road shall be designated as commercial and industrial areas, and residential area shall be located behind such commercial area ☐ Myanmar government shall control the driving speed on the road (MOC requests to police department regarding strict speed control)	[During Const] Contractor [After Const] MOC and Local Authorities	[During Const] [After Const] MOC and Local Authorities
	6	Odor	☐ Domestic solid waste is collected and disposed at the nearest designated disposal site ☐ Domestic waste water and night soil shall be treated though septic tank and discharged of into the natural stream. Water quality of the effluent shall be	Not required	[During Const] Contractor	[During Const] MOC

Area	No.	Item	Draft Mitigation Measures		Responsibility	
			During Construction	After Construction	Implementation Agency	Responsible Agency
			confirmed before discharging it into the natural water body. ☐ Waste oil of the construction machines is collected and disposed of through a licensed agent ☐ Waste chemical and hazardous material are stored at the base camp site and disposed of through a licensed agent			
Natural Environment	7	Protected area and ecosystem	☐ ROW shall be marked and all relevant construction workers and communities shall be informed not to conduct development outside of the project area. ☐ Waste oil shall be stored and disposed of to designated site so as not to leak into the water body and on land ☐ Adoption of steel pipe sheet piles (SPSP) methodology so as not to generate significant turbid water at excavated area in the river. ☐ Adoption of lower noise and vibration construction method and machines ☐ Lighting in the river shall be minimized at nighttime so as not to cause adverse impacts on the fishes' lifecycle. ☐ Implementation of detailed comprehensive fauna-flora monitoring during mobilization and construction (See special ecosystem survey in the article on EMP)	☐ Setting up of fence at the boundary of ROW for road kill prevention ☐ Setting up of pole more than 4m in height so that moving vehicles will not get hit by flying birds (under consideration) ☐ Setting up of LED handrail light in the bridge section so as not to attract insects and bats (under consideration) ☐ Setting up of light with cover so as not to irradiate the river surface and outside of the road in keeping with sound lifecycle of fishes ☐ Implementation of detailed comprehensive fauna-flora monitoring after construction (See special ecosystem survey in the article on EMP) ☐ Establishment of land use plan in the project area, KBA/IBA and Ramsar Site and implementation of appropriate land use management so as not to cause unplanned development	[During Const] Contractor [After Const] Contractor *Management of KBA shall be done by MOC, MONREC and local authorities	[During Const] MOC [After Const] MOC, MONREC and local authorities
	8	Hydrology	☐ Construction of guidebank and revetment to stabilize hydrological situation north wide of the project area ☐ Implementation of periodical dredging and river training when unexpected silatation is caused in the river and surrounding streams and creek. ☐ Diversion of irrigation channels and/or streams shall be set up if the project activities give impacts on such streams	☐ Implementation of periodical dredging and river training when unexpected silatation is caused in the river and surrounding streams and creek.	[During Const] Contractor	[During Const] MOC
	9	Topography and geology	☐ The slope gradient for embankment is adopted 1:2 in accordance with the Guideline of Earthwork (Japan Road Association) ☐ Implementation of slope protection such as turf work, planting treatment, concrete block retaining wall and retaining wall	Not required	[During Const] Contractor	[During Const] MOC
n v	10	Resettlement	[Before Const.]	Not required	[Before Const]	[Before

Area	No.	Item	Draft Mitigation Measures		Responsibility	
			During Construction	After Construction	Implementation Agency	Responsible Agency
			☐ Holding of consultation meetings for understanding of compensation policy ☐ Appropriate compensation and implementation of livelihood restoration program in accordance with approved RAP by Myanmar Government ☐ Monitoring and assessment regarding the livelihood of PAPs shall be conducted and appropriate restoration and enhancement of living standards shall be considered in accordance with JICA's Guidelines and related laws and regulation in Myanmar.		MOC and Local Authorities	Const.] MOC and Local Authorities
	11	Local economy such as employment and livelihood	[Before Const.] ☐ Holding of consultation meetings for understanding of compensation policy and livelihood restoration programs for project affected persons who lose agricultural land such as paddy field and rubber plantation ☐ Implementation of adequate compensation in accordance with approved RAP [During Construction] ☐ Appropriate methodology for foundation work such as steel pipe sheet piles method for minimization of turbid water shall be taken so as not to give serious impacts on habitats of fishes. ☐ Appropriate methodology and machines shall be selected for minimization of noise and vibration impacts so as not to give serious impacts on the habitats of fishes. ☐ Setting up of navigation channel with necessary vertical clearance during construction ☐ Establishment of grievance redress mechanism for the solution of issues involving farmers and fishermen	☐ Construction of riprap – which aquatic species can use as habitat – for the prevention of scouring at piers ☐ Establishment of grievance redress mechanism for the solution of issues involving farmers and fishermen	[Before Const] MOC and local authorities [During Const] Contractor [After Const] Contractor	[Before Const] MOC and local authorities [During Const] [After Const] MOC
	12	Land use and utilization of local resources	[Before Const] ☐ Implementation of consultation with affected landowners and formulation of basic compensation policy before actual land acquisition.	☐ Establishment of land use plan and management plan in the project area so as not to cause unplanned development ☐ Pollution control shall be done by Myanmar Government when industrial zone is located in the project area	[Before Const] MOC and local authorities [After Const] MOC and Local Authorities	[Before Const] MOC and local authorities [After Const] MOC and Local Authorities
	13	Water usage	☐ Alternative measures for water provision shall be prepared if water level and water quality at the nearest well change during construction. ☐ Diversion of irrigation channels and/or streams shall be set up if the project activities give impacts on such streams	☐ Alternative measures for water provision shall be prepared if water level and water quality at the nearest well change	[During Const] Contractor [After Const] MOC	[During Const] [After Const] MOC

Area	No.	Item	Draft Mitigation Measures		Responsibility	
			During Construction	After Construction	Implementation Agency	Responsible Agency
	14	Existing social infrastructures and services	☐ Detour and access road to social infrastructures such as school and meeting place for commuters and users shall be provided, if required. Such access road should be secured in the same place from the view of connecting the communities.	Not required	[During Const] Contractor	[During Const] MOC
	15	Social institutions such as local decision-making institutions	↑ Ditto	Not required	[During Const] Contractor	[During Const] MOC
	16	Local conflict of interests	☐ Local workforce is prioritized for the construction of bridge and other structures ☐ Implementation of appropriate education for hired workers from other areas, if any	Not required	[During Const] Contractor	[During Const] MOC
	17	Landscape	☐ Adoption of monotone color harmonized with the surrounding current landscape	Not required	[During Const] Contractor	[During Const] MOC
	18	Gender	There are not any impacts on gender in this project; however, some prevention measures such as "Equal Opportunities for Employment" should be conducted. Gender equality/women's participation should be promoted under National Strategic Plan for the Advancement of Women (2013-2022), Minimum Wages in Myanmar (2013) and international recognition ☐ Installation of security light in the crossing road under the bridge and on the approach road ☐ Provision of job opportunities and fair salary between genders ☐ At least 10% of female workers should be hired as simple workers	Not required	[During Const] Contractor	[During Const] MOC
	19	Rights of children	☐ No employment under the age of 18	Not required	[During Const] Contractor	[During Const] MOC
	20	Infectious diseases such as HIV/AIDS	☐ Installation of sufficient drainage facilities so as not to provide habitats for vector mosquitoes ☐ Installation of appropriate precautionary measures such as mosquito nets and provision of purified water for the workers in accordance with FIDIC General Conditions (6.15 Measures against Insect and Pest Nuisance) ☐ Provision of adequate temporary sanitation facilities ☐ Enforcement of medical screening and periodical medical check-up for workers ☐ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness-raising among the laborers is promoted during construction	☐ Implementation of periodical maintenance for drainages	[During Const] Contractor [After Const] MOC	[During Const] [After Const] MOC
	21	Labor Environment and Safety	☐ Relevant laws in Myanmar such as "the Workmen's Compensation Act", "the Factories Act", "the Leave and Holidays Act", "the Law relating to Overseas Employment", "the Labor Organization	Not required	[During Const] Contractor	[During Const] MOC and Local Authorities

Area	No.	Item	Draft Mitigation Measures		Responsibility	
			During Construction	After Construction	Implementation Agency	Responsible Agency
			Law", "the Settlement of Labor Dispute Law", "the Social Security Law" and "the Minimum Wages Law" shall be followed. ☐ Additionally, Article 23 on Occupational Health and Safety, Labor and Working Conditions in IFC Performance Standard 2 shall be applied. ☐ Preparation of emargency response system for emergency cases such as construction accident and patient transportation. This response system and procedure shall be proposed by the Contractor during construction.			
Others	22	Accident	☐ Deployment of flagman at the gate of construction area and intersections for traffic management ☐ Installation of safety sign boards such as speed limit and residential area in the project area ☐ Installation of fence around the construction site to keep out the local people such as children ☐ Installation of lighting facility at nighttime in the construction area ☐ Restriction of mobilization speed to less than 20km/h in the construction site ☐ Implementation of safety training for the workers ☐ Securing of temporary diversion roads for villagers, if construction activities give adverse impacts on current roads in the project area ☐ Preparation of emargency response system for emergency cases such as construction accident and patient transportation. This response system and procedure shall be proposed by the Contractor during construction.	☐ Installation of sign board for safety (speed limit) ☐ Installation of crosswalk and pedestrian bridge at appropriate points ☐ Implementation of traffic safety campaign for citizen ☐ Enforcement of traffic control by police	[During Const] Contractor [After Const] Installation of facilities and sign boards, safety campaign: Contractor Traffic Control: Police department in Bago and Mon State	[During Const] MOC [After Const] MOC and Local Authorities
	23	Cross Boundary Impacts and Climate Change (Green House Gases (CO2))	According to quantitative forecast on CO2, the project gives positive impact. However implementation of mitigation measures can minimize adverse impacts. ☐ Prohibition of unnecessary operation of construction machines ☐ Periodical (daily, weekly and monthly) checking and maintenance of construction machines shall be done.	According to quantitative forecast on CO2, the project gives positive impact. However implementation of mitigation measures can minimize adverse impacts. ☐ Strengthening of speed control by the police department ☐ Strengthening of car inspection mechanisms to restrict vehicles from discharging high emissions	[During Const] Contractor [After Const] MOC and Local Authorities	[During Const] MOC [After Const] MOC and Local Authorities

Note) Rating: A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

Table 8.1.2 Cost of Special Mitigation Measures

Mitigation Measures	Cost (USD)
1. Setting up of LED handrail light in the bridge section	2.7 Million
2. Setting up of pole more than 4m in height so that moving vehicles will not get hit by flying birds	0.8 Million
Total	3.5 Million

Source: JICA Study Team

8.2. Environmental Monitoring Plan

The environmental monitoring plan has established based on the impacted items and the degree of impacts. These monitoring results and implementation of mitigation measures shall be observed and managed by the project proponent, contractor, supervision consultant, environmental authorized agency, local governments and relevant ministries.

The direct cost of monitoring during and after construction are 425,400 (USD) and 177,600 (USD), respectively. Additionally cost of special ecosystem during detailed design and construction stage by MOC in cooperation with detailed design consultant and supervision consultant is 250,000 (USD) as shown below;

Table 8.2.1 Estimated Monitoring Cost

Cost	Cost (USD)	Remarks
1. Monitoring Cost during Construction (4 years)	425,400	Monitoring is conducted by the Contractor
2. Special Ecosystem Monitoring (Detailed design stage (1 year) and construction stage (4 years)	250,000	Monitoring is conducted by MOC and the detailed design consultant
3. Monitoring Cost after Construction (3 years)	177,600	Monitoring is conducted by MOC (including special ecosystem monitoring)
Total	853,000	

Source: JICA Study Team

During construction, the Construction Contractor shall prepare the Environmental Management Plan for Construction (CEMP) and obtain permission from PMU, and carry out the task under the supervision of the Consultant.

Table 8.2.2 Environmental Monitoring Plan Pre- and During Construction Phase (4 years)

Area	No.	Item	Parameter	Method	Location	Frequency per Year	Direct Cost (in thousand USD)	Conservation Target[*3]
Natural Environment	1	Air pollution	NO_2, $PM_{2.5}$,PM_{10}, SO_2, CO and Ozone	Based on the National Environmental Quality (Emission) Guidelines and / or the same methodology of baseline surveys	**2 Locations** Where baseline monitoring was carried out *Coordinate Air-1: 17°24'15.07"N/ 96°52'54.65"E Air-2: 17°24'4.80"N/ 96°53'50.01"E	**4 times / year x 4 years** (2 times / Dry and Rainy Season)	**16.0** (4 times /year x 500 USD / point x 2 points x 4years)	**National Environmental Quality (Emission) Guidelines** **[Air Emissions]** **Maximum limit values of ambient air quality parameters** 1. Nitrogen Dioxide (NO^2) · 1 year: 40 $\mu g/m^3$ · 1 hour: 200 $\mu g/m^3$ 2. Ozone · 8-hour daily max.: 100 $\mu g/m^3$ 3. PM_{10} (Ø< 10µm) · 1 year: 20 $\mu g/m^3$ · 24 hours: 50 $\mu g/m^3$ 4. $PM_{2.5}$ (Ø< 2.5µm) · 1 year: 10 $\mu g/m^3$ · 24 hours: 25 $\mu g/m^3$ 5. Sulphur Dioxide (SO_2) · 24 hours: 20 $\mu g/m^3$ · 10 minutes: 500 $\mu g/m^3$ **Japanese Standard** 6. Carbon Monoxide (CO) · 24 hours: 10 ppm · 8 hours: 20ppm
	2	Water quality	BOD, COD, Oil & Grease, pH, Total Coliform, T-N, T-P and TSS	Based on the National Environmental Quality (Emission) Guidelines and/or same methodology of baseline surveys	**2 Locations** Upstream of construction area and downstream of construction area *Coordinates River Water-1: 17°24'23.77"N/ 96°53'28.55"E, River Water-2: 17°23'14.89"N/ 96°53'44.61"E	**2 times / year x 4 years** (2 times / Dry and Rainy Season)	**6.4** (4 times /year x 200 USD / point x 2 points x 4 years)	**National Environmental Quality (Emission) Guidelines** **[Site Runoff and Wastewater Discharges (Construction Phase)]** 1. BOD : 30 mg/l 2. COD : 125 mg/l 3. Oil and Grease : 10 mg/l 4. pH : 6-9 5. Total coliform bacteria[4]: 400 count/100ml 6. T-N : 10 mg/l 7. T-P : 2 mg/l 8. TSS : 50 mg/l
	3	Waste	Volume of waste soil, cut trees and domestic garbage	Record volume of generated waste in the project area	**Waste storage and collection points**	**4 times / year x 4 years**	**3.2** (4 times /year x 200 USD/time x 4 years)	Generated construction waste and domestic shall be reused or disposed of at designated site.
	4	Soil contamination and sedimentation quality	As, Cd, Cr6, Se Cu, Pb, Benzene, Carbon Tetrachloride, 1,2-Dichloroethane, 1,1-Dichloroethylene, Cis-1,2-Dichloroethylene, Dichloroethylene, Thetrachloroethylene, Trichloroethylene 1,1,1-Trichloroethane 1,1,2-Trichloroethane	Same methodology of baseline surveys	**3 Locations** Station-1 and 2: Excavated point at piers on the land in Bago Region and Mon State Station-3: Excavated point in the river *Coordinates Soil-1: 17°24'10.82"N/ 96°53'17.20"E Soil-2: 17°24'15.08"N/ 96°53'45.60"E Soil-3: 17°24'12.96"N/	**1 time (before excavation)**	**3.0** (1 time x 1,000 USD / point x 3 points)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target 1. Thailand Standard Soil Quality Standards for Habitat and Agriculture, Notification of the National Environmental Board, Thailand (No. 25, B.E. 2547/ 2004) 2: Japanese Standard: Environmental Quality Standards for Soil Pollution, Ministry of Environment/ 1991)

Area	No.	Item	Parameter	Method	Location	Frequency per Year	Direct Cost (in thousand USD)	Conservation Target[*3]
					96°53'31.73"E			
	5	Noise and vibration	Construction noise ($dB(A)L_{Aeq}$)	Noise: 24hrs of continuous measurement (at least 10min in an hour x 24hours)	2 Locations (same as forecasted points during construction) *Coordinates St-1: 17°24'15.17"N/ 96°52'54.60"E St-2: 17°24'5.36"N/ 96°53'49.12"E	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**32.0** (Noise and Vibration 2 Items (noise/vibration) x 500 USD /point x 2 locations x 4 times / year x 4 year)	There are neither law-based criteria nor international guidelines to be followed, thus the following is established as conservation target: Japanese Standard during construction [Noise] dB(A) Reference standard in Japan 07:00-19:00: 85 dB(A)
			Construction Vibration (mm/sec) *Unit shall be converted from mm/s to dB	Vibration 24hrs continuous measurement (at least 10min in an hour x 24hours)		**4 times / year x 4 years** (2 times / Rainy and Dry Season)		[Vibration] dB Reference standard in Japan 07:00-19:00 : 75 dB
Natural Environment	6	Odor	Oil, chemicals and garbage odor	Sensory evaluation	Base camp site and storage	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**1.6** (4 times /year x 100 USD/time x 1 point x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target No significant impact
	7	Protected area and ecosystem	General flora – fauna survey	Visual survey	Project Area	**4 times / year x 4 years** (2 time / Rainy and Dry Season)	**32.0** (4 times /year x 20,000 USD/time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Observed species do not change before and during construction
	8	Hydrology, Topography and geology	Condition of embankment and Siltation & hydrology of Sittaung River and Shangai Creek	Visual survey (taking picture)	Project Area (approach road, guidebank, revetment, Sittaung River and Shangai Creek)	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**1.6** (4 times /year x 100 USD/time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Soil erosion, slope failure and landslide are not observed.
Social Environment	9	Involuntary resettlement	Payment and implementation of social assistance in accordance with RAP	Consultation meeting with and / or survey of the project affected persons (PAPs)	Affected area	Refer to RAP monitoring plan	Refer to RAP monitoring plan	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target JICA Guidelines: Compensation shall be completed prior to actual construction activities and securing of livelihood standards Note) If compensation regarding land acquisition before construction is implemented, monitoring shall be done by internal and external monitoring body
	10	Local economy such as employment and livelihood	Impacts on fishery (fishing ground, income and comments)	Identification based on interviews with fishermen and site survey	Project area	**3 times / year x 4 years** (1 time / Rainy season, 2 times /Dry Season)	**12.0** (3 times /year x 1,000 USD/time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Impacts on fishery shall be minimized based on implementation of mitigation measures such as construction of navigation channel
	11	Water usage	Impacts on irrigation and stream	Visual survey (taking picture)	Irrigation channels and stream in the project area	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**1.6** (4 times /year x 100 USD / time x 4 years)	There are neither law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Impacts on irrigation shall be minimize and

Area	No.	Item	Parameter	Method	Location	Frequency per Year	Direct Cost (in thousand USD)	Conservation Target[*3]
								or alternative routes shall be secured as mitigation measures
	12	Existing social infrastructures and services	Impacts on public infrastructures such as road crossing project area	Visual survey (taking picture)	Crossing roads under the bridge and approach road in the project area	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**3.2** (4 times /year x 200 USD / time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Access route, community & agricultural road shall be secured
	13	Local conflict of interests	Construction workers from the community	Confirmation of workers' list from thecontractor	Project area (base camp site)	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**8.0** (4 times /year x 500 USD / time x 4 years) Including "Gender" , "Light of children" and "Infectious Disease"	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Employment opportunity shall be provided fairly for each village
	14	Landscape	Condition of landscape (color of structure)	Visual inspection and taking photo	Project area (structure color)	**2 times / year x 4 years** (1 time / Dry and rainy season)	**0.8** (2 times /year x 100 USD / time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Color of structure shall adopt a monotone color harmonized with the surrounding landscape
	15	Gender	Construction workers (gender)	Confirmation of workers' list from thecontractor	Project area	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	Including Local Conflict of interest	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Employment opportunity shall be provided fairly from the view of gender
	16	Rights of children	Construction workers	Confirmation of workers list from contractor	Project area	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	Including Local Conflict of interest	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target FIDIC 2010 (General Condition) No employment under the age of 18
	17	Infectious diseases such as HIV/AIDS	Number of infected patients	Confirmation of health check list from the contractor	Project area (base camp site)	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	Including Local Conflict of interest	There are neither law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Infectious diseases are not caused by the project
	18	Labor environment	Construction workers' conditions	Confirmation of safety devices and conditions via interviews	Project area (base camp site)	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**3.2** (4 times /year x 200 USD / time x 4 years)	The following laws and guidelines shall be followed 1. The Factories Act 1951 2. IFC Performance Standard 2 Labor and Working Conditions 3.FIDIC 2010
Other	19	Accident	Number of accidents	Confirmation of list of accidents from local government/ police department	Project area	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**3.2** (4 times /year x 200 USD / time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target No accidents are caused by construction activities
	20	Cross boundary impacts and climate change	Frequency of maintenance of construction machines	Confirm record of maintenance of construction machines	Project area	**4 times / year x 4 years** (2 times / Rainy and Dry Season)	**1.6** (2 times /year x 200 USD / time x 4 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Construction machines shall be well-maintained so as not to generate much

Area	No.	Item	Parameter	Method	Location	Frequency per Year	Direct Cost (in thousand USD)	Conservation Target*3
								GHGs such as CO2
Total Cost During Construction : *425,400 (USD)* for 4 years (During Construction)								

Remarks
*1: Frequency and timing of monitoring shall be modifies during the detailed design stage
*2: The cost indicates direct cost, not including consultant fee, overhead and personal expense
*3: Conservation Target: If quantitative values exis such values are prioritized as target based on Myanmar Laws, International Guidelines and other references. If quantitative values do not existi, qualitative target is established as project base.

Source: JICA Study Team

Environmental monitoring survey plan during the operation phase is proposed as follows. Proposed monitoring period is at least three (3) years.

Table 8.2.3 Environmental Monitoring Plan After Construction Phase (3 Years)

Area	No.	Item	Parameter	Method	Location	Frequency a year	Direct Cost (Thousands USD)	Conservation Target*3
Natural Environment	1	Air pollution	NO_2, $PM_{2.5}$,PM_{10}, SO_2, CO and Ozone	Base on the National Environmental Quality (Emission) Guidelines and / or the same methodology of baseline surveys	**2 Locations** Same as forecasted points *Coordinate Air-1: 17°24'15.07"N/ 96°52'54.65"E Air-2: 17°24'4.80"N/ 96°53'50.01"E	**2 times / year x 3 years** (1 time / Dry and Rainy Season)	**6.0** (2 times /year x 500 USD / point x 2 points x 3years)	**National Environmental Quality (Emission) Guidelines** **[Air Emissions]** **Maximum limit values of ambient air quality parameters** 1. Nitrogen Dioxide (NO_2) · 1 year: 40 $\mu g/m^3$ · 1 hour: 200 $\mu g/m^3$ 2. Ozone · 8-hour daily max.: 100 $\mu g/m^3$ 3. PM_{10} (Ø< 10µm) · 1 year: 20 $\mu g/m^3$ · 24 hours: 50 $\mu g/m^3$ 4. $PM_{2.5}$ (Ø< 2.5µm) · 1 year: 10 $\mu g/m^3$ · 24 hours: 25 $\mu g/m^3$ 5. Sulphur Dioxide (SO_2) · 24 hours: 20 $\mu g/m^3$ · 10-minutes: 500 $\mu g/m^3$ **Japanese Standard** 6. Carbon Monoxide (CO) · 24 hours: 10 ppm · 8 hours: 20ppm
	2	Noise and vibration	Traffic Noise (dB(A)L_{Aeq})	Noise: 24hrs continuous measurement (at least 10min in an hour x 24hours)	2 Locations (same as forecasted points during construction) *Coordinates St-1: 17°24'15.17"N/ 96°52'54.60"E St-2: 17°24'5.36"N/ 96°53'49.12"E	**2 times / year x 3 years** (1 time / Rainy and Dry Season)	**12.0** (Noise and Vibration 2 Items (noise/vibration) x 500 USD /point x 2 locations x 2 times / year x 3 year)	Myanmar National Environmental Quality Guidelines [Noise] dB(A)/ Commercial and industrial Area 07:00-22:00: 70 dB(A) 22:00-07:00 70dB(A)
			Traffic Vibration (mm/sec) *Unit shall be converted from mm/s to dB	Vibration 24hrs of continuous measurement (at least 10min in an hour x 24hours)		**2 times / year x 3 years** (1 time / Rainy and Dry Season)		There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target -Japanese Standard [Vibration] dB 07:00-20:00 : 70 dB 20:00-07:00: 65 dB

Area	No.	Item	Parameter	Method	Location	Frequency a year	Direct Cost (Thousands USD)	Conservation Target*3
Natural Environment	3	Protected area and ecosystem	Fauna and flora	Same as baseline surveys	Project Area and Ramsar Site	**3 years**	**150.0** (50,000 USD/year x 3 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Observed species do not change after construction
	4	Hydrology, Topography and geology	Condition of embankment and Siltation & hydrology of Sittaung River and Shangai Creek	Visual survey (taking picture)	Project Area (approach road, guidebank, revetment, Sittaung River and Shangai Creek)	**2 times / year x 3 years** (1 time / Rainy and Dry Season)	**0.6** (2 times /year x 100 USD/time x 3years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Soil erosion, slope failure and landslide are not observed.
Social Environment	5	Local economy such as employment and livelihood	Impacts on fishery (fishing ground, income and comments)	Identification based on interviews with fishermen and site survey	Project area	**2 times / year x 3 years** (1 time / Rainy and Dry Season)	**6.0** (2 times /year x 1,000 USD/time x 3 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target The project does not give significant impacts on fishing ground
	6	Land use and utilization of local resources	Condition of land use	Visual survey (taking picture) Interview with local government	Project area (along the approach road and bridge)	**2 times / year x 3 years** (1 time / Rainy and Dry Season)	**1.2** (2 times /year x 200 USD/time x 3years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Appropriate land use shall be established and managed by local government
	7	Water usage	Impacts on irrigation and stream	Visual survey (taking picture)	Irrigation channels and stream in the project area	**2 times / year x 3 years** (1 time / Rainy and Dry Season)	**0.6** (2 times /year x 100 USD / time x 3years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target Impacts on irrigation shall be minimized and / or alternative routes shall be secured as mitigation measures
	8	Landscape	Condition of landscape (color of structure)	Visual inspection and taking photo	Project area (structure color)	**1 time / year x 3 years** (1 time / Dry season)	**0.3** (1 time /year x 100 USD / time x 3 years)	There are no law-based criteria nor international guidelines to be followed, thus the following is established as conservation target For the color of structure, a monotone color harmonized with the surrounding landscape shall be adopted.
Other	9	Accident	Number of accidents	Confirmation of accidents list from local government/ police department	Project area	**1 time / year x 3 years**	**0.9** (1 time /year x 300 USD / time x 3 years)	There are not law-based criteria nor international guidelines to be followed, thus following is established as conservation target There is no significant occurrence of traffic accidents.

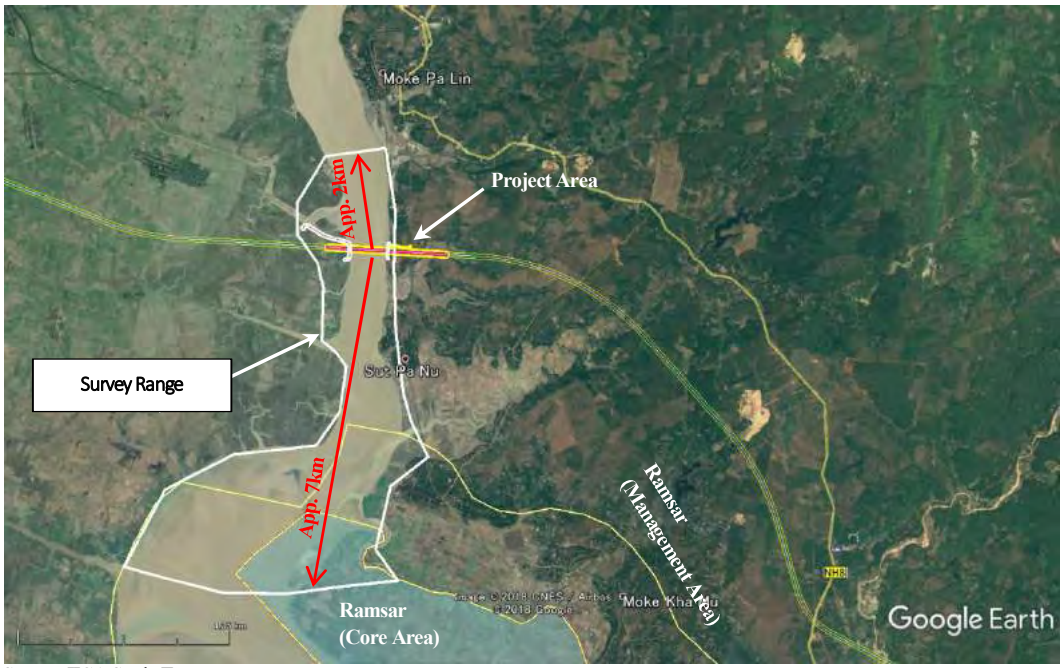
Total Cost During Construction : *177,600 (USD)* for 3 years (After Construction)

Remarks
*1: Frequency and timing of monitoring shall be modified at detailed design stage
*2: The cost indicates direct cost, not including consultant fee, overhead and personal expense
*3: Conservation Target: If quantitative values exist such values prioritized as target based on Myanmar Laws, International Guidelines and other references. If quantitative values do not exist, qualitative target is established as project base.

Table 8.2.4 Special Ecosystem Monitoring Plan During Construction and After Construction

Survey Item / Survey Period			Survey Season: Dry Season (Migratory Season)	Survey Season: Rainy Season (Not Migratory Season)	Number of Survey Days	Remarks (Number of survey points and area)
Birds Survey	Migratory Birds Survey	Birds Species Survey	Nov-Dec	Jul-Aug	Continuous for 3 days	7-point census
			Jan-Feb	No need	Continuous for 3 days	Line census
Physical Habitat Survey	Mudflat Survey	Record mudflat area	Nov-Dec	No need	One day	Survey Area 2km upstream of the bridge to 7km downstream
	Noise Survey	Ambient noise for 24hrs	Nov-Dec	No need	4 points / 24 hours	1 point: upstream of bridge area 2 points: bridge area 3 points: management area 4 points: core area
Fauna-Flora Survey	Flora Survey	Fauna Species Survey	Nov-Dec	Jul-Aug	3 days	Survey Area (both banks) 2km upstream of the bridge to 7km downstream
	Fauna Survey	Fishes Species Survey Benthos Survey Zooplanktons and Phytoplanktons	Nov-Dec	Jul-Aug	4 points	1 point : up stream of bridge area 2 points: bridge area 3 points: management area 4 points: core area
Cost/ Year						50,000 USD/ year
Detailed Design Stage : 1 year (supported by the Detailed Design Consultant)						50,000 USD / year
Construction Stage: 4 years (supported by the Consultant for Construction Supervision)						200,000 USD / 4 years
Post Construction: 3 years (Conducted by MOC)						150,000 USD/ 3 years (this cost is included monitoring cost post construction)

Source: JICA Study Team



Source: JICA Study Team

Figure 8.2.1 Area of Special Ecosystem Survey During and After Construction

8.3. Monitoring Organization

8.3.1. During Construction

The objectives and design of the EMP and Environmental Monitoring Plan are described in

the earlier sections of this chapter. There is a necessity to form a proper 'Institutional Framework' for the effective implementation of the formulated environmental management and monitoring plan. The elements of this 'Institutional Framework' will coordinate and work with each other throughout the project, i.e. during pre-construction, construction and operation stages.

The implementation of formulated environmental mitigation measures comes with a cost, so the budgeting of EMP is necessary and also the financial source that will provide this budget are discussed in this section.

The suggested elements of 'Institutional Framework' for implementing EMP during construction will be as follows:

a) Project Management Unit (PMU) under Ministry of Construction

b) Construction Supervision Consultant (CSC)

- Project Management Consultant (PMC)
- Environmental Consultant (EC)

c) Project Construction Contractor - Construction Company (PCC)

d) Authorized Environmental Agency

- Environmental Conservation Department (ECD) under Ministry of Natural Resources and Environmental Conservation (MONREC)

e) Local Government – Bago Region and Mon State

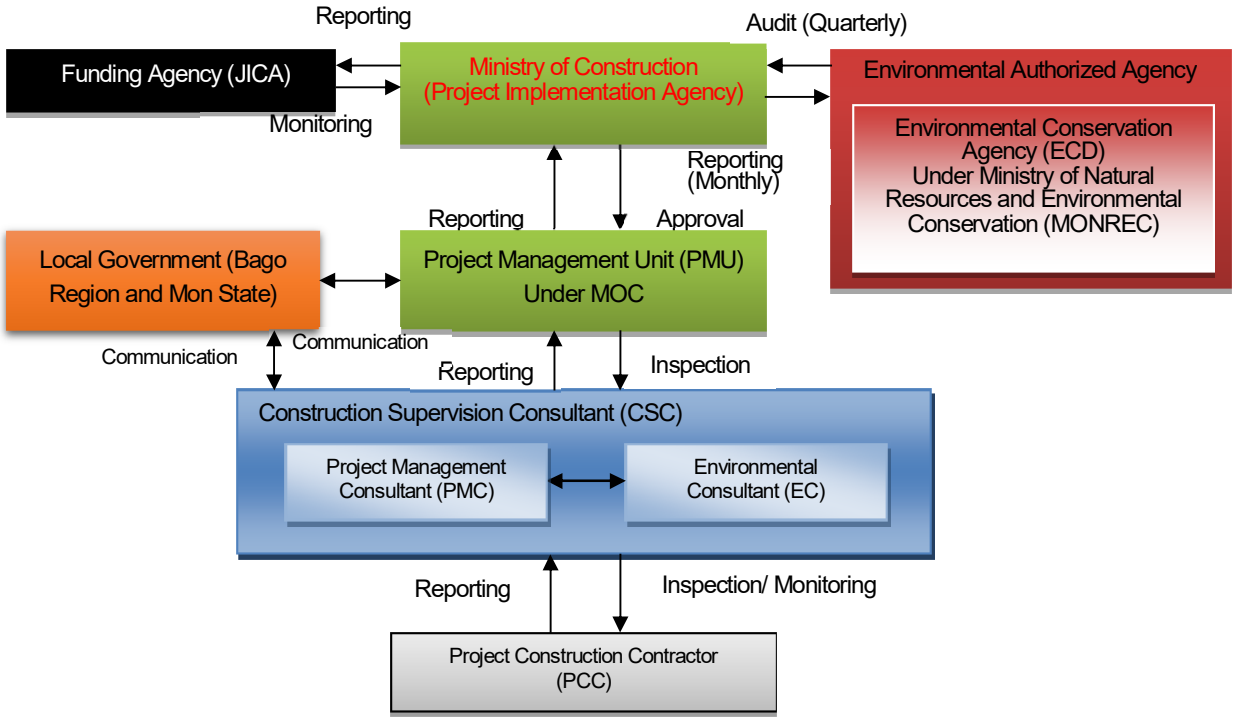
f) Funding Agency – JICA

The above stated elements are part of the 'Institutional Framework' that will work together to effectively implement the formulated 'Environmental Management Plan'. The roles and responsibilities of these elements are given in Table 8.3.1.

Table 8.3.1 Environmental Management Organization during Construction

Name of Organization	Roles and Responsibilities
a) Project Management Unit under MOC (PMU)	· Initiate the coordination process among the concerned organizations (Elements of Institutional Framework) for EMP implementation. · Oversee the implementation of the EMP by PMU and CSC · Review and approve monthly Environmental Report from CSC and sending the report to ECD, MONREC
b) Construction Supervision Consultant (CSC)	· CSC works in association with Project Construction Contractor (PCC) & the Environmental Consultant (EC) on a full-time basis at the project site office. · PMC mainly looks after managing engineering and construction-related activities.
Environmental Consultant (EC)	· EC inspects implementation of mitigation measures and environmental monitoring conducted by PCC · EC reviews and corrects Environmental Monitoring Report (EMR) submitted by PCC and then submit it to PMU after inspection.
c) Project Construction Company (PCC)	· PCC implements approved EMP (mitigation measures) under observation of PMC & EC. · PCC submits EMR for all conducted mitigation measures on site to the EC on weekly and/or monthly basis.
d) Authorized Environmental Agency (ECD/MONREC)	· Inspect and audit periodical environmental monitoring report · Inspect the implementation of mitigation measures on site, as required · Request for necessary action and additional surveys and implementation of mitigation measures, if required
e) Local Government Bago Region and Mon State	· Monitor construction activities · Request for necessary action and additional surveys and implementation of mitigation measures, if required
f) Funding Agency (JICA)	· Review periodical environmental monitoring report · Request for necessary action and additional surveys and implementation of mitigation measures, if required

Source: JICA Study Team



Source: JICA Study Team

Figure 8.3.1 Environmental Management Implementation Organizations During Construction

8.3.2. Completion of Construction

The Contractor shall appropriate demobilization procedure after completion of construction.

Following process shall be taken when the construction activities are completed.

1) The constructed structures are inspected by the supervision consultant and PMU
2) Demobilization activities are done by the Contractor
3) Construction area is monitored and inspected by the supervision consultant and PMU

It is a fundamental principle that the Contractor shall restore the project site to the original conditions.

Especially following considerations shall be conducted and monitored by the PMU and supervision consultants when the demobilization is completed.

Table 8.3.2 Items to be Monitored at the Completion of Construction

Point to be monitored	Roles and Responsibilities
a) Removal of Wastes	· All wastes such as waste soil, cut trees, domestic waste and night soil from construction yard/offices shall be removed from the project site.
b) Backfilling and alternation	· Excavated holes shall be backfilled not to cause accidents
c) Replanting	· The area where removal of grass and tress shall be replanted
d) Maintain of public facilities	· Damaged public facilities such as public road, streams and irrigation facilities shall be maintained to the original condition.

8.3.3. After Construction

The major authorities for implementing the EMP after construction are as follows:

a) Ministry of Construction (MOC)

b) Local Government – Bago Region and Mon State

c) Authorized Environmental Agency

- Environmental Conservation Department (ECD) under the Ministry of Natural Resources and Environmental Conservation (MONREC)

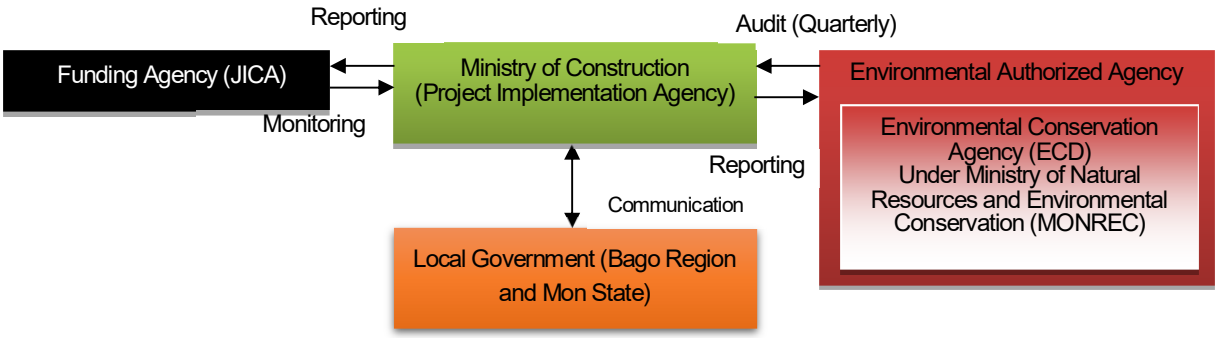
d) Funding Agency – JICA

The roles and responsibilities of each organization are shown below:

Table 8.3.3 Environmental Management Organizations After Construction

Name of Organization	Roles and Responsibilities
a) Ministry of Construction (MOC)	· Initiate the coordination process among the concerned organizations (Elements of Institutional Framework) for EMP implementation. · Oversee the implementation of the EMP by PMU and CSC · Review and approve monthly Environmental Report from CSC and sending the report to ECD, MONREC
b) Local Government Bago Region and Mon State	· Monitor construction activities · Request for necessary action and additional surveys and implementation of mitigation measures, if required
c) Authorized Environmental Agency (ECD/MONREC)	· Inspect and audit the periodical environmental monitoring report · Inspect the implementation of mitigation measures on site, as required · Request for necessary action and additional surveys and implementation of mitigation measures, if required
d) Funding Agency (JICA)	· Review the periodical environmental monitoring report · Request for necessary action and additional surveys and implementation of mitigation measures, if required

Source: JICA Study Team



Source: JICA Study Team

Figure 8.3.2 Environmental Management Implementation Organizations After Construction

8.4. Grievance Redress Mechanism

Complaints and conflicts may arise during construction, land acquisition and compensation process. These complaints and conflicts can be of many kinds. It could be:

I. EIA

i) Unexpected natural and social adverse impacts by the project construction activities

II. Land Acquisition and Compensation

ii) Errors in the identification of people and property affected by the project;

iii) Disagreement on land, either between the affected person and the expropriation agency, or between two neighbors;

iv) Conflict over the ownership of a property between two affected persons;

v) Disagreement over the assessment of property;

vi) Family problems (estates, divorces) that raise disputes between heirs or members of the same family regarding a property, parts of a property or other property;

vii) Disagreements about resettlement measures, location of a resettlement site, type of compensation or habitat proposed, characteristics of the parcel, quality of the new areas of use, etc.

The aim of the Grievance Redress Mechanisms (GRM) is to ensure that grievances and concerns raised by PAPs or other people within the communities can be effectively dealt with in a timely and satisfactory manner. Given the potential for quick and effective resolution on the ground, utilizing local dispute mechanisms as a first step in line with current traditional practices makes the mechanism more effective. Normally, a grievance redress mechanism is developed to ensure that:

i) All complaints related to natural and social impacts by the project, resettlement, compensation and others assistances are appropriately dealt with;

ii) It can be easily access by those who have complaints related to resettlement and other assistance; and

iii) Adequate measures are taken to resolve the issues raised.

Grievance related to any aspect of the project or sub-project shall be handled through a consultative manner appropriately, easily and speedily. The Grievance Redress Committee (GRC) is suited as the main entity that takes care of the issues. The composition of the GRC includes the following members:

i) Representatives from PMU/DOB and regional DOB;

ii) Representatives from DOH;

iii) Village Tract leader/ Representatives from the relevant community;

iv) Township GAD, MOHA;

v) Township officer of DALMS, MOALI;

vi) Ministry of Natural Resources and Environmental Conservation;

vii) Ministry of Agriculture, Livestock and Irrigation;

viii) Other relevant organization, if any.

The GRC member are mainly composed of relevant officials at township level. However, depending on the type of the complaint or the situation, the GRC may also ask representatives of the relevant organization to take part in the procedure of grievance resolution, such as state/ regional government, contractor and consultants.

A possible scheme for grievance redress mechanism is illustrated in Figure 8.3 and its process is as follows:

1) PAPs can lodge claims or complaints on natural and social impacts, resettlement and compensation directly to the GRC or indirectly through the village tract. A Grievance Redress Officer (GRO) at the corresponding township in GRC is responsible for the contact;

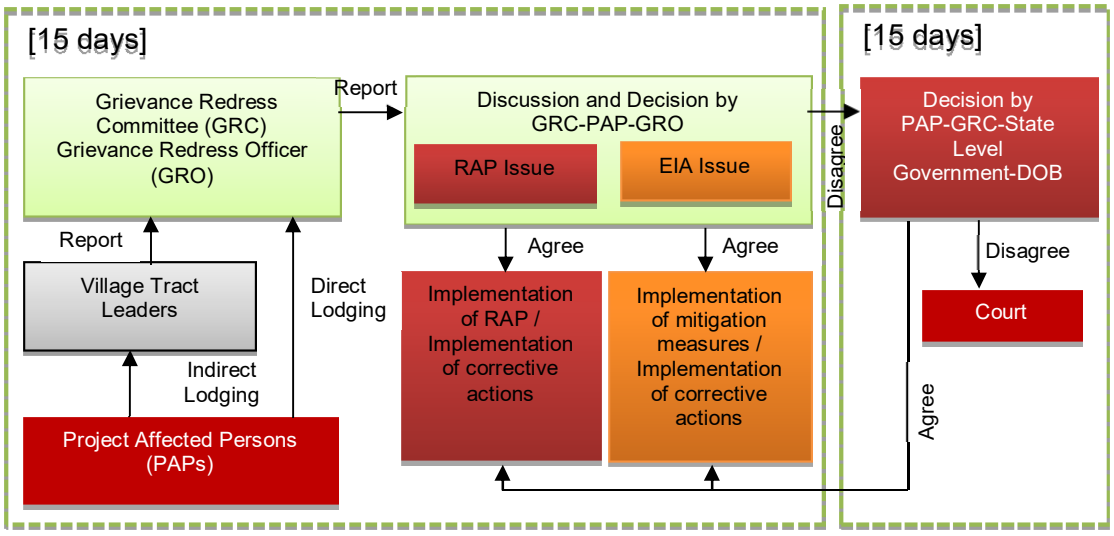
2) The chairperson of the GRC/GRO assigns an officer-in-charge from the RIC members in accordance with the nature of the lodged complaint in order to interview the PAP concerned who raised the issue; **[5 days]**

3) The GRC holds discussions based on the evidences obtained, takes an approach and makes an initial decision. The appointed officer starts negotiation with the PAP in consultation with the RIEC; **[10 days]**

4) In case an agreement is not achieved between the concerned PAP and the GRM within 15 working days from the day the complaint is lodged, the case is to be forwarded to the DoB and the corresponding State government in addition to the GRC. The relevant section in DoB reviews the documents and discusses with the PAP until an agreement is obtained; and **[15 days]**

5) If, however, the agreement is not reached within 15 days at this stage, the case may to be sent to the court for legal steps.

Once grievance are raised in the GRC, the contents of the grievances, status of the resolution process shall be recorded until closure of complaint.



Source: JICA Study Team

Figure 8.3 Scheme for Grievance Redress Procedure

This GRM will be separately established from the one to be established for ADB road section since the project proponent will be different organization. However, the proposed GRM of ADB are almost same mechanism with GRM of JICA Bride section. Any issues related to the project such as RAP matter or EIA matter can be raised to the GRC. The component of the GRC are almost same in both GRM. Also, the same steps to be followed both in JICA GRM and ADB GRM as both GRM propose to discuss firstly in the township level and secondly in the state/regional level if not resolved in the first step.

It is also noted that GRM procedures will have to be disclosed and discussed with PAPs and communities to ensure that they agree and understand the process. The mechanism is usually established just after the public consultation meeting by re-investigating the RAP contents during the detailed design stage. A plaintiff (PAP) will not need to bear the cost in case the case could be finalized within the committee. The management cost is enough within the total RAP implementation cost. However, the plaintiff is to bear the relevant cost which the domestic legal system defines in case a suit at law would be filed.

CHAPTER 9 PUBLIC CONSULTATION AND DISCLOSURE

9.1. Summary of Public Consultation

9.1.1. Legal Background and Objectives

The EIA Procedure 2015 prescripts necessity of public consultation as follows;

The Project Proponent shall conduct the following:

a) Arrange for appropriate public consultation through all phases of the IEE and EIA process as required by Articles 34, 50, and 61; and

b) Disclose to the public in a timely manner all relevant project-related information in accordance with this Procedure, except for those which may be related to national security concerns as informed by the Ministry.

In case of EIA project, the proponent shall conduct public consultation meetings twice at scoping and EIA survey stages, respectively, as EIA Procedure 2015 indicates.

[Article 50] (Onlu relevant articles)

As part of the scoping stage, the Project Proponent shall ensure that the following public consultation and participation process is carried out:

b) Arrange the required complement of consultation meetings as advised by the Ministry, with local communities, potential PAPs, local authorities, community-based organizations and civil society, and provide appropriate and timely explanations in press conferences and media interviews.

[Article 61]

As part of the EIA investigations, the Project Proponent shall undertake the following consultation process:

b) Arrange consultation meetings at national, regional, state, Nay Pyi Taw Union Territory and local levels, with PAPs, authorities, community-based organizations and civil society.

On the other hand, JICA Guidelines also prescripts that public consultation meetings shall be done twice for Category A project – which is required by EIA – at scoping and draft EIA stages, respectively.

9.1.2. Overview of Public Consultation

The public consultation meetings for EIA have been held twice at scoping and preparation of draft EIA, respectively. The overview such as date and venue for the meetings are shown below.

Table 9.1.1 Overview of the Public Consultation

Objectives of the Meeting (Date and Venue)	Agenda	Major Attendee	Methodology
1st Public Consultation in Bago Region Scoping Stage PC (June 15th, 2017 13:00~14:00 Ammata-yama Monastery (east monastery), Shan Kaing Village, Waw Township, Bago Region)	1. Project outline 2. Expected positive and negative impacts 3. Alternative analysis 4. Tentative schedule of the Study 5. Exchange of opinions	Total: 174 (Male: 103, Female: 51) Government: 8, Parliament: 1, PAPs: 155, NGOs and Community Specific Group: 6, Media: 1, JICA Study Team: 3	1) Information Disclosure 2 newspapers disclosure 2) Language English and Burmese
1st Public Consultation in Mon State Scoping Stage PC (June 16th, 2017 13:00~14:00 Shin Uppaghotta Pavillion, Sut Pa Nu Village, Kyaikto Township, Mon State)	1. Project outline 2. Expected positive and negative impacts 3. Alternative analysis 4. Tentative schedule of the Study 5. Exchange of opinions	Total: 176 (Male:75, Female: 91) Government: 2, , PAPs: 165, NGOs and Community Specific Group: 9 , JICA Study Team: 3	

Objectives of the Meeting (Date and Venue)	Agenda	Major Attendee	Methodology
2nd Public Consultation in Mon State Draft EIA Stage PC (August 28th, 2018: 09:46 ~ 11:18am at Sin U Pa Gote Ta Monastery, Sut Pa Nu Village, Kyaikto Township, Mon State)	1. Project outline 2. Result of impact forecast 3. Mitigation measures 4. Environmental management plan 5. Tentative construction schedule 6. Exchange of opinions	Total: 96 (Male: 67, Female: 29) Government: 21, Local Stakeholders: 53, PAPs: 7, NGOs and Community Specific Group: 2 , Media: 3, JICA Study Team: 3, E Guard Environmental Services: 7	
2nd Public Consultation in Bago Region Draft EIA Stage PC (August 29th, 2018: 09:37 ~ 10:48am at Village Administrator Office, Shan Kaing Village, Waw Township, Bago Region)	1. Project outline 2. Result of impact forecast 3. Mitigation measures 4. Environmental management plan 5. Tentative construction schedule 6. Exchange of opinions	Total: 96 (Male: 67, Female: 29) Government: 21, Local Stakeholders: 53, PAPs: 7, NGOs and Community Specific Group: 2 , Media: 3, JICA Study Team: 3, E Guard Environmental Services: 7	

Source: JICA Study Team

9.2. Opinions in the Public Consultation

9.2.1. 1st Public Consultation on Scoping Stage

The opinions, questions and answers during the discussion session are shown below:

Table 9.2.1 Opinions in the 1st Public Consultation for Bago Region (June 15th, 2017)

No	Major Opinions and Answers				
	Questions / Comments		Answers		Reaction of the Questioner
	Name / Position	Questions / Comments	Name / Position	Answer	
1	Parliament Member (Male)	On behalf of the villagers, a parliament member inquired how much of the agricultural and residential land would be affected and which places that would be affected were still unknown at this time. The villagers would ask again during the next meeting. All the villagers agreed. (Comment)	JICA Study Team	Comments were confirmed	-
2	Villager (Male)	This was a big chance that their village would be developed, so all the villagers agreed to and were happy to hear about the new bridge project. During the first meeting, they did not have any questions at all. (Comment)	JICA Study Team	Comments were confirmed	-

Source: JICA Study Team

Table 9.2.2 Opinions in the 1st Public Consultation for Mon State (June 16th, 2017)

No	Major Opinions and Answers				
	Questions / Comments		Answer		Reaction of the Questioner
	Name / Position	Questions	Name / Position	Answer	
1	Head Administrative of the Village (Male)	Regarding the names of the two existing Sittaung bridges (Sittaung-Thein Zayat Bridge and Sittaung - Mokepalin Bridge), a Sut Pa Nu villager wanted to give the bridge name "Sittaung Bridge – Sut Pa Nu", and all the villagers from Sut Pa Nu Village agreed.	JICA Study Team	JICA Study Team would consider and inform the government	Accepted the answer
2	Villager (Male)	Regarding the consideration for the construction area, the villagers felt that the land and the residential area would not be affected too much and that the area was a suitable place.	JICA Study Team	JICA Study Team continued considering this point in the study	Accepted the answer
3	Villager	They were worrying about their income	JICA Study Team	JICA Study Team would	Accepted the

	(Female)	from fishing during the construction period because over 60 houses were owned by fishermen.		consider this in the study and inform the government	answer
4	Villager (Female)	If the bridge implementation was confirmed, they would be happy because they could probably get jobs during the construction period.	JICA Study Team	JICA Study Team would consider this request and inform the government	Accepted the answer
5	Villager (Male)	As per information from Sut Pa Nu Village, there was one ancient pagoda near the bank of Shan Kaing Village and it was sunk underwater.	JICA Study Team	JICA Study Team would consider this request and inform the government. (Based on the interview, it was confirmed that it was located outside of the construction area.)	Accepted the answer
6	Villager (Male)	Along with the trunk road/bridge development, the villagers wanted to have access road and regional development such as school construction.	JICA Study Team	JICA Study Team would inform the Myanmar government and JICA.	Accepted the answer

Source: JICA Study Team

9.2.2. 2nd Public Consultation on the Draft EIA during EIA Study)

The opinions, questions and answers during discussion session are shown below:

Table 9.2.3 Opinions in the 2nd Public Consultation Mon State (August 28th, 2018)

No	Major Opinions and Answers				
	Questions / Comments		Answer		Reaction of the Questioner
	Name/Position	Question/Comment	Name/Position	Answer	
1	Villager (Fisherman) (Male)	He asked impacts on fishing areas and fishes due to the using of heavy machinery and the existence of laborers during the construction.	MOC	During the construction stage, an 8-meter wide and 9-meter enough navigation channel would be opened to move along the river. The construction area is prohibited to be used as fishing ground from the view of avoiding accident, but construction activities do not give any impacts on fishes. After construction, fishermen can use the same fishing ground without any restriction.	Accepted the answer
2.	Leader of fishermen (Male)	He heard that the limit would be 5 miles upstream to 5 miles downstream from the bridge construction site. Moreover, it could affect their livelihood because it is the main fishing area for local fishers.	MOC and JICA Study Team	Only construction area will be restricted during construction for safety reason, however there is no limitation for fisheries after construction of the bridge.	Accepted the answer
3.	Village Administrator (Male)	He wanted to conclude the opinions of villagers. Basically, all villagers welcomed the project. Although there were some misunderstandings during the discussions, most of villagers understood the conclusions.	MOC	Questions from betel leaf growers and farmers were warmly welcomed. The MOC came after explaining about the project to the Chief Minister of Mon State and having to await the higher authorities for final decision.	Comments are confirmed.
			JICA Study Team	The Chief Minister of Mon State would come again to negotiate with the local fisherfolks and to collect survey data on fishers.	-

Source: JICA Study Team

Table 9.2.4 Opinions in the 2nd Public Consultation for Bago Region (August 29th, 2018)

No	Major Opinions and Answers				
	Questions / Comments		Answer		Reaction of the Questioner
	Name / Position	Questions / Comments	Name / Position	Answer	
1.	Policeman of Waw Township (Male)	He said that they had to settle the cases of encroachment under section (476). Form (7) is very important for farmers. In order to prevent undesirable encroachments and conflicts on land ownership, legal agreements should be carefully read so as not to leave any blanks before signing up. (Comment)	JICA Study Team	Comments were confirmed	-
2.	Villager (Male)	He wanted to know whether the entitlement of the villagers would be affected after 2023.	JICA Study Team	If both Japanese and Myanmar governments agreed to the findings, the construction of bridge would materialize.	Accepted the answer
3.	Township Officer, Waw Agriculture Department (Male)	He asked which extent of paddy fields in Bago Region would be affected and how this would impact the Right of Way of the road passing through these fields.	JICA Study Team	The boundary of the road is measured by ADB. Thus, they will come and explain about the road.	Accepted the answer
4.	Villager (Female)	She wanted to know about the compensation for the paddy fields beside the embankment after the termination of the project.	JICA Study Team	It was not considered yet, but if the rest of the paddy field beside the embankment would be difficult to cultivate, then they would be compensated.	Accepted the answer
5.	Villager (Male)	He asked whether the flow of Sittaung River and erosion of banks would be changed or not due to the construction of the bridge.	JICA Study Team	According to the project, the embankments would be built on both sides so that erosion could be minimized. The flow of water could change within 100 meters downstream from the base of the bridge but flow would become normal at over 100 meters from the base of the bridge.	Accepted the answer
6	Member of Parliament (Male)	He stated that the attitude of the public was very important. The local people needed to attend public consultation meetings so that they could express their attitudes, needs and discuss openly in a transparent manner. He added that in Myanmar, EIA was not carried out in the past but had become mandatory nowadays for development projects such as the Sittaung Bridge Project. The EIA results of this project were satisfactory based on the data presented. If there were any serious impacts, the Myanmar Government would arrange for compensation. The arrangement would be done based on the policy of the Ministry of Agriculture, Livestock, and Irrigation. The budget of the Myanmar Government would be used for compensation.	JICA Study Team	Comments were confirmed	

Source: JICA Study Team

CHAPTER 10 SCHEDULE TOWARD PROJECT IMPLEMENTATION

10.1. Necessary Environmental Activities and Expected Schedule

As of November 2018, it is expected that Japan International Cooperation Agency (JICA) is the funding agency and MOC is the implementation agency for the New Sittaung Bridge.

The expected process for the implementation of the project after submission of the draft EIA to ECD is shown below.

With regard to ECD's duration of review of the draft EIA, Article 68 of EIA Procedure 2015 mentions as follows:

> Article 68
> If it is determined by the Ministry that the EIA Report does not satisfy requirements, then the Project Proponent shall be called upon by the Department to undertake the necessary amendments as directed by the Ministry. The Ministry shall deliver its final decision within ninety (90) working days of receipt of the EIA Report. In case of Complex Projects, or if the Ministry requires the EIA Report to be amended, then the timeline will be extended accordingly.
>
> Source: EIA Procedure 2015

MONREC shall respond whether an amendment is required or not within 90 days after receiving the draft EIA report. The points to be revised are directed by ECD within 90 days, and the proponent shall submit the amended final EIA Report to ECD.

Table 10.1.1 Expected Process for the Implementation of the Project (as of November 2018)

Step	Items	Expected Period (Duration)	Related Organization
Step-1	Submission of draft EIA from MOC (Ministry of Construction) to MONREC (Ministry of Natural Resources and Environmental Conservation)	January 2019	MOC, ECD (Environmental Conservation Department) under MONREC
Step-2	Reviewing by ECD	Feb-June 2019 (prescript duration is minimum of 90 working days)	ECD and related ministries
Step-3	EIA approval from MONREC	November 2019	ECD under MONREC

Source: JICA Study Team

Table 10.1.2 Expected Environmental Schedule

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Source: JICA Study Team

CHAPTER 11 OTHER ITEMS AND ACTIVITIES TO BE CONSIDERED

11.1. Activities to be Conducted under the Responsibility of Construction Contractor

In general, the following activities such as development of quarry and borrow pit, construction of road and construction yard are planned and operated under the responsibility of the contractor after getting permit from the Project Management Unit (PMU) and relevant organizations.

Since these activities are planned and operated by the Contractor, specific locations are not fixed yet. Thus, the expected impacted items, degree of impacts and mitigation measures are proposed in this chapter.

The Contractor shall prepare a draft environmental management plan (EMP) for using quarry sites, borrow pits, camp site and construction access roads and implement all mitigation measures and monitoring appropriately.

Table 11.1.1 Necessary Process and Permissions to be Obtained during Construction

Item	Necessary Action by the Contractor	Remarks
1. Development and/or use of quarry and borrow pit	1-1: Licensed quarry should be selected and contracted	See candidate quarry site (Figure 11.2.1Figure 11.2.2)
	1-2: Obtain environmental approval from ECD under MONREC (if ECD requests for EMP, IEE or EIA)	The following durations are necessary after submission of the required report (1) EMP: 30 working days (2) IEE: 60 working days (3) EIA: 90 working days
	1-3: Obtain development permission from the General Administration Department of township and district	The Contractor shall submit the plan and EMP to GAD township and district 6-12 months are necessary for the issuance of permit.
	1-4: Negotiate with the landowner regarding the development of quarry in accordance with the approved RAP in this project	The Contractor, together with MOC, shall negotiate with the landowner in accordance with the approved RAP.
2. Development of construction road	2-1: The Contractor shall submit the traffic and access road plan upon discussion with the Consultant and the local government (See tentative construction road: Figure 11.2.4)	MOC shall discuss with the local government about the preference for road condition after construction, whether for temporary use or permanent occupation.
	2-2: In the case of temporary use, the contractor shall negotiate with the landowner and/or property owner and set the appropriate cost in accordance with the approved RAP	In the case of permanent occupation, Myanmar government shall compensate for the appropriate replacement cost in accordance with the approved RAP.
3. Development of the Construction Yard	3-1: The Contractor shall submit the activities and facilities plan such as office, workshop, concrete plant, asphalt plant and stock yard. (See Figure 11.2.5 for tentative construction yard.	If the Contractor constructs the construction yard outside of the project area, the Contractor shall incur the expense of securing the compound. The Contractor shall pay the appropriate price in accordance with the approved RAP.
	3-2: The Contractor shall submit the EMP for the facilities in the construction yard.	-

Note: Cutting tree permission is required if the trees are located in the government land. Private trees shall be obtained from the owner after appropriate compensation has been made.
Source: JICA Study Team

11.2. Predicted Impacts and Mitigation Measures

11.2.1. Development and / or Use of Quarry and Borrow Pit

(1) Necessary Volume of Quarry and Soil

The necessary volume of quarry and borrow for construction of approach road and construction road

are shown below (see Figure 11.2.1 and Figure 11.2.2).

Required materials such as soil and crushed stone are secured from the existing quarry and borrow pits around the project area as shown in Table 11.2.2, Figure 11.2.1 and Figure 11.2.2.

The Contractor shall consider the environmental and social impacts and takes the necessary process when the Contractor needs to open new quarry and borrow pits. Predicted impact items and general mitigation measures are shown in the next article.

Table 11.2.1 Necessary Volume of Quarry and Soil

Item	Necessary Volume	Secured Volume from existing sites
1. Soil (Borrow)	149,752 m^3	534,200 m^3
2. Crusher Run	214,802 m^3	323,800 m^3

Source: JICA Study Team

Table 11.2.2 Existing Quarry and Borrow Pit

No	Name of Quarry/ Borrow Pit [Distance from the Project Area]	Coordinate		Owner	License		Remaining Area (Capacity *1,000m3)	Productivity
		Latitude(S)	Longitude(E)		Validity	Size		
1	Sein TharaPhu (Quarry-1)[10km]	17.497768	96.907478	U Chit Sein	Valid	Large	11.33 ha (226.6)	700 t/day
2	Kan Pwint Oo Co. Ltd. (Quarry-2)[9.5km]	17.489210	96.909706	(not identify)	Under Renewal	Large	4.86 ha (97.2)	600 t/day
	Total remaining capacity (Quarry)						**323.8**	-
3	U Ye' Win (Borrow pit-1) [3.5km]	17.427771	96.931709	U Ye' Win	No License	-	1.62 ha (32.4)	No info
4	U Thaung Htay (Borrow pit-2) [3.5m]	17.413479	96.938861	Ko Thaung Htay Family	Still applying	Small	7.28 ha (145.6)	700 t/day
5	No name (Borrow pit-3) [48km]	17.476204	96.444740	(Not identified)	No License	-	0.81 ha (16.2)	No info
6	No name (Borrow pit-4) [48km]	17.479589	96.434074	(Not identified)	No License	-	16.19 ha (323.8)	No info
7	No name (Borrow pit-5) [5.5km]	17.451345	96.888039	(Not identified)	No License	-	0.81 ha (16.2)	No info
	Total remaining capacity (Borrow Pit)						**534.2**	

Note) Remaining capacity : remaining area (m2) x 2 m depth
Source: JICA Study Team

Source: JICA Study Team based on Google Earth

Figure 11.2.1 Existing Quarry and Borrow Pits in Mon State

Source: JICA Study Team based on Google earth

Figure 11.2.2 Existing Quarry and Borrow Pits in Bago Region

(2) Expected Adverse Impacts Due to New Development of Quarry and Borrow Pit

As mentioned in the previous article (Table 11.1.1), the Contractor shall take the necessary and appropriate process to obtain an environment and development permit if new quarry and/or borrow pits are required.

In this article, the typical impacted items and reasons are analyzed based on scoping matrix, and general mitigation measures are indicated.

The Contractor shall refer to the following scoping and mitigation measures and obtain the necessary environmental permission from ECD, if required.

Table 11.2.3 Scoping Matrix for the New Development of Quarry and Borrow Pits

	No	Factor / Impacted Item	Rating During Construction	Pre / During Construction									
				Land acquisition and loss of properties	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation and cutting trees	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment and vehicles in the compound	Influx of construction workers and staying in the construction yard and offices	Establishment and operation of crusher plant, concrete plant and asphalt plant	Blasting of rock	Transportation of materials (soil and crushed stone)
Pollution	1	Air pollution	B-					B-	B-		B-	B-	
	2	Water pollution	B-					B-		B-	B-		
	3	Waste	B-				B-			B-			
	4	Soil contamination	B-								B-		B-
	5	Noise and vibration	A-						B-		B-	A-	
	6	Ground subsidence	D										
	7	Odor	B-							B-	B-		
	8	Sediment quality (same as soil contamination)	B-								B-		B-
Natural	9	Protected area	D										
	10	Ecosystem	B-			B-	B-	B-	B-			B-	
	11	Hydrology	D										
	12	Topography and geology	B-					B-					
Social	13	Involuntary resettlement	C	C									
	14	The poor	C	C									
	15	Indigenous and ethnic people	D										
	16	Local economy such as employment and livelihood	C	C									
	17	Land use and utilization of local resources	C		C		C						
	18	Waste usage	C					C					
	19	Existing social infrastructures and services	C					C					
	20	Social institutions such as local decision-making institutions	D										
	21	Misdistribution of benefits and damage	D										
	22	Local conflict of interests	D										
	23	Cultural heritage	D										

	No	Factor / Impacted Item	Rating During Construction	Pre / During Construction									
				Land acquisition and loss of properties	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation and cutting trees	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment and vehicles in the compound	Influx of construction workers and staying in the construction yard and offices	Establishment and operation of crusher plant, concrete plant and asphalt plant	Blasting of rock	Transportation of materials (soil and crushed stone)
	24	Landscape	C					C					
	25	Gender	D										
	26	Rights of children	C							C			
	27	Infectious diseases such as HIV/AIDS	C							C			
	28	Labor environment (including work safety)	B-						B-	B-		B-	
Other	29	Accidents	B-						B-	B-		B-	B-
	30	Cross boundary impacts and climate change	B-						B-				

Note) Rating: A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done) No mark or D: Light impact is expected. Detailed quantitative survey is not necessary. + : Positive Impacts, -: Negative Impacts

Source: JICA Study Team

Table 11.2.4 Scoping Matrix and Reasons for Development of Quarry and Borrow Pit

Area	No	Impacted Item on JICA Guidelines	Rating	Reasons for the Rating (Only During Construction Phase)
Pollution	1	Air pollution	B-	Temporary negative impacts are expected due to cutting and excavation, blasting, operation of construction machines, equipment and relevant plants.
	2	Water pollution	B-	Cutting and rock and soil extraction do not generate wastewater. However, run-off water by rain includes high density turbid water. Additionally, domestic organic polluted water and night soil from the offices are expected. Additionally, chemical polluted water may be discharged from plant and material storage if the facilities are not managed properly. Thus, mitigation measures shall be carried out.
	3	Waste	B-	Domestic waste and night soil from offices are expected. Additionally construction waste may be generated from plant.
	4	Soil contamination	B-	Chemicals such as oil at facilities may pollute surface and underground soil in the compound. If quarry and soil are contaminated, adverse impacts are expected in the project area.
	5	Noise and vibration	A-	Generation of noise and vibration is expected due to works of construction machines, equipment and related plants. A significant impact is predicted if blasting method is used at quarry.
	6	Ground subsidence	D	No impacts are expected since activities which cause ground subsidence are not expected.
	7	Odor	B-	Domestic waste from offices and operation of plants may cause bad smell
	8	Sediment quality (see No 4 Soil contamination)	B-	Chemicals such as oil at facilities may pollute the surface and underground soil in the compound. If quarry and soil are contaminated, adverse impacts are given in the project area.
Natural Environment	9	Protected area	D	Protected area and its surrounding area shall not be selected as quarry and borrow pit.
	10	Ecosystem	B-	Reclamation of wetland, cutting trees, cutting ground, operation of machines and blasting give adverse impacts on the ecosystem.
	11	Hydrology	D	No impacts are expected since there are no permanent natural rivers around the project site. However, general mitigation measures shall be done.
	12	Topography and geology	B-	Slope failure and soil erosion may be caused by cutting land and extraction of materials.
Social Environment	13	Involuntary resettlement	C	Resettlement and land acquisition may be caused by the new development of quarry and borrow pits
	14	The poor	C	Inhabitants and shop owners in the developed area who are under the poverty line may be affected by the development of quarry and borrow pits.
	15	Indigenous and ethnic people	D	No indigenous and ethnic people were observed in this area in accordance with WB OP4.10.
	16	Local economy such as employment and livelihood	C	Economic activities such as shops, cultivation of crops and commercial forests existing in the developed area may be impacted due to the development of quarry and borrow pits.
	17	Land use and utilization of local resources	C	Land use such as agricultural land and/or commercial forests existing in the developed area may be impacted due to the development of quarry and borrow pits.
	18	Water usage	C	Land acquisition may give impacts on irrigation facilities and drinking water resources, such as wells, if they exist in the developed area.
Social Environment	19	Existing social infrastructures and services	C	Schools, hospitals, religious facilities and public utilities may be impacted if they exist in the developed area.
	20	Social institutions such as local decision-making	D	No impacts are expected because there are no activities which give adverse impacts

Area	No	Impacted Item on JICA Guidelines	Rating	Reasons for the Rating (Only During Construction Phase)
		institutions		on this item.
	21	Misdistribution of benefit and damage	D	No impacts are expected because there are no activities which give adverse impacts on this item.
	22	Local conflict of interests	D	Only qualified quarry and borrow pits are used, thus it is expected that there would be no conflicts among quarry and land owners.
	23	Cultural heritage	D	The area which is located in a cultural heritage site shall not be selected as quarry and borrow pits site.
	24	Landscape	C	Cutting trees, hill and rock may change the topographic feature.
	25	Gender	D	According to interview with the authority regarding gender in Myanmar, no issues on gender in infrastructure area are observed. Thus, no impacts are expected on this item.
	26	Rights of children	C	Child laborers may be hired in quarry and borrow pit site
	27	Infectious diseases such as HIV/AIDS	C	Infectious diseases such as STDs are possible to be spread due to inflow of construction workers. Furthermore, alteration on the ground by cut land and filling may trigger the formation of habitats for mosquitoes that could possibly transmit malaria and dengue fever.
	28	Labor environment	B-	Construction work environment needs to be considered in accordance with relevant laws and regulations.
Other	29	Accidents	B-	Construction vehicles may use the existing local roads near residential areas, thus the number of traffic accident may increase.
	30	Cross boundary impacts and climate change	B-	Operation of construction machines generate GHGs.

Note) Rating:
A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done) D: Light impact is expected. Detailed quantitative survey is not necessary.
+ : Positive Impacts, -: Negative Impacts
Source: JICA Study Team

(3) Recommended Mitigation Measures

Recommended mitigation measures for the development of quarry and borrow pits are shown in Table 11.2.5.

Table 11.2.5 Recommended Mitigation Measures for the Development of Quarry and Borrow Pit

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
Pollution	1	Air pollution	☐ Water sprinkling shall be carried out in the compound so as not to give dust impacts on the nearest residential area ☐ Periodical maintenance for facilities and machines shall be done ☐ Periodical cleaning shall be done on paved road used as construction road	Contractor (Construction Company)	MOC
	2	Water pollution	☐ Turbid water from unpaved construction area shall be treated in sedimentation pond and discharged into the nearest stream, if required ☐ Waste oil shall be stored and disposed of into the designated site ☐ Provision of sanitation facilities on site ☐ Domestic waste water and night soil from site shall be treated and discharged into the designated site and facilities. ☐ Use of septic tank for portable toilet and temporary toilet in the site	Contractor	MOC
	3	Waste	☐ Waste oil of the facilities and machines shall be collected and disposed of through a licensed agent such as fuel station. ☐ Waste chemical and hazardous material shall be stored on site and disposed	Contractor	MOC

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
			of through a licensed agent ☐ Domestic solid waste is collected and disposed at the nearest designated disposal site ☐ Domestic wastewater and night soil shall be treated though septic tank and discharged to natural stream. Water quality of the effluent shall be confirmed before discharging into the natural water body.		
	4	Soil contamination and sediment	☐ Excavated borrow soil shall be analyzed and confirmed if the quality is under standard values. Polluted soil shall not be used. ☐ Facilities and construction machines shall be maintained so as not to leak oil and chemicals. ☐ Waste oil of facilities and machines shall be collected and disposed of through a licensed agent ☐ Waste chemical and hazardous material shall be stored on site and disposed of by a licensed agent	Contractor	MOC
	5	Noise and vibration	☐ Activities in quarry and borrow pits shall be limited in the daytime and on weekdays. ☐ Facilities and machines shall be well maintained and checked everyday ☐ Information disclosure such as blasting schedule shall be conducted in advance to the surrounding community.	Contractor	MOC
	6	Odor	☐ Domestic solid waste is collected and disposed at the nearest designated disposal site ☐ Domestic wastewater and night soil shall be treated though septic tank and discharged to natural stream. Water quality of the effluent shall be confirmed before discharging it into the natural water body. ☐ Waste oil of facilities and machines are collected and disposed of through a licensed agent ☐ Waste chemical and hazardous material are stored on site and disposed of through a licensed agent	Contractor	MOC
Natural Environment	7	Ecosystem	☐ Boundary of quarry and borrow pit shall be marked and all relevant workers and communities shall be informed not to conduct development activities outside of the boundary ☐ Waste oil shall be stored and disposed of into the designated site so as not to leak into the water body	Contractor	MOC
	8	Topography and geology	☐ Implementation of slope protection such as turf work, planting treatment, concrete block retaining wall and retaining wall at the end of construction period	Contractor	MOC
Social Environment	9	Resettlement	☐ Holding of consultation meetings with landowner(s) for understanding of compensation policy ☐ Appropriate compensation and implementation of livelihood restoration program in accordance with approved RAP by Myanmar Government	Contractor and Local Authorities	MOC and Local Authorities
	10	The poor	☐ Appropriate livelihood restriction program shall be considered in accordance with approved RAP	Contractor	MOC
	11	Local economy such as employment and livelihood	☐ Holding of consultation meetings for understanding of compensation policy and livelihood restoration programs for project affected persons who lose agricultural lands such as paddy field and rubber plantation ☐ Implementation of adequate compensation in accordance with approved RAP	Contractor	MOC
	13	Land use and utilization of local resources	☐ Implementation of consultation with affected landowners and formulation of basic compensation policy before actual land acquisition.	Contractor	MOC
	12	Water usage	☐ Appropriate compensation shall be done in accordance with approved RAP if water usage facilities area such as wells are affected ☐ Alternative measures for water provision shall be prepared if water level and water quality at the nearest well change during operation of quarry and borrow pits ☐ Diversion of irrigation channels and/or streams shall be set up if the activities give impacts on such streams	Contractor	MOC

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
	13	Existing social infrastructures and services	☐ Developing of quarry and borrow pits shall avoid areas adjacent to school, hospital, religious facilities and other public facilities ☐ Detour and access road to social infrastructure such as school and meeting place for commuters and users shall be provided, if required. Such access road should be secured at the same place from the view of connecting the communities	Contractor	MOC
	14	Landscape	☐ Adoption of monotone color for the construction of facilities harmonized with the surrounding current landscape ☐ Replanting shall be done at the end of construction period	Contractor	MOC
	15	Gender	☐ Provision of job opportunities and fair salary between genders. ☐ At least 10% of female workers should be hired as simple workers	Contractor	MOC
	16	Rights of children	☐ No employment under the age of 18	Contractor	MOC
	17	Infectious diseases such as HIV/AIDS	☐ Installation of sufficient drainage facilities so as not to provide habitat for vector mosquitoes ☐ Enforcement of medical screening and periodical medical check-up for workers ☐ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness-raising among the laborers is promoted during construction	Contractor	MOC
	18	Labor environment and safety	☐ Relevant laws in Myanmar such as "the Workmen's Compensation Act", "the Factories Act", "the Leave and Holidays Act", "the Law relating to Overseas Employment", "the Labor Organization Law", "the Settlement of Labor Dispute Law", "the Social Security Law" and "the Minimum Wages Law" shall be followed ☐ Additionally, Article 23 of Occupational Health and Safety, Labor and Working Conditions in IFC Performance Standard 2 shall be applied	Contractor	MOC
Others	19	Accident	☐ Deployment of flagman at the gate for traffic management ☐ Installation of safety sign board such as speed limit and residential area near the site ☐ Installation of fence around the construction site to keep out the local people such as children ☐ Installation of lighting facility at nighttime on site ☐ Restriction of mobilization speed to less than 20km/h in the construction site ☐ Implementation of safety training for the workers (especially blasting methodology and standard operation procedure)	Contractor	MOC
	20	Cross boundary impacts and climate change	☐ Prohibition of unnecessary operation of facilities and machines ☐ Periodical (daily, weekly and monthly) checking and maintenance of facilities and machines shall be done	Contractor	MOC

Source: JICA Study Team

11.2.2. **Development of Construction Road**

(1) Location of Construction Road

To enable the efficient construction works on both bank sides and shorten the construction period, access roads are necessary for both sides. The typical cross section and route of the access road is shown in Figure 11.2.3 and Figure 11.2.4, respectively.

The existing route A on the east bank in Mon State has sufficient width of four (4) meters for the construction of access road and is expected to be utilized as a construction road. Widening and installation of lay-by for construction vehicles are necessary on some portions along the route.

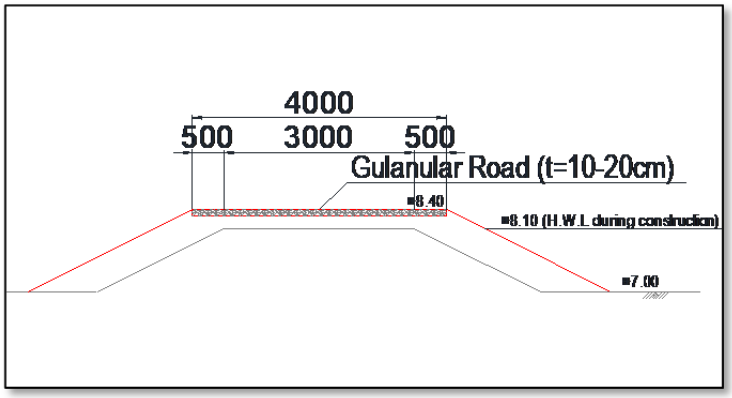
On the east bank in Bago Region, the existing route does not connect to the construction site and passes through the residential area (village). Thus, half of the route bypassing the residential area should be newly developed and the other section should be widened and raised up.

The total length of the access road is 23.8 km, and the cost of land acquisition is estimated at approximately 45,000 USD. The contractor shall negotiate with the landowner and compensate in accordance with approved the RAP.

Table 11.2.6 Length and Cost of Access Road During Construction

Area \ Road Type		Existing Road	Widening and Elevated	New Road	Total
1. East Bank (Mon State)	Road Length	12.3km	0	0	12.3km
	Acquired Land (estimated cost)	0	0	0	0
2. West Bank (Bago Region)	Road Length	0	5.0km	6.5km	11.5km
	Acquired Land (estimated cost)	0	2.5 ha (12,500 USD)	6.5 ha (32,500 USD)	9.0 ha (45,000 USD)
Total		12.3km	5.0km	6.5km	23.8km

Estimated land cost: approximately 5 USD/m2 (based on replacement cost in RAP Survey)
Source: JICA Study Team



Source: JICA Study Team based on Google Earth

Figure 11.2.3 Typical Cross Section of Access Road During Construction

Source: JICA Study Team based on Google earth

Figure 11.2.4 Access Road Plan during Construction

(2) Expected Adverse Impacts Due to Construction of Access Road (In the Case of New Construction and Widening of Road)

As mentioned in Table 11.1.1, the Contractor shall take the necessary and appropriate process in securing the environment and development permission for the construction of access road.

According to opinions from the community, the widening of existing road and/or new construction of access road is desirable for the community because the current community road is not in good condition especially during rainy season. Thus, it is recommended that the Contractor shall discuss with MOC and the local government about the necessity of leaving the access road after construction period.

In this article, typical impacted items and reasons are analyzed based on scoping matrix, and then general mitigation measures are indicated.

The Contractor shall refer to following scoping and mitigation measures and obtain the necessary environmental permission from ECD, if required. According to EIA Procedure 2015, since the total road length for new development is less than 50km, IEE and EIA are not required. However, the Contractor shall confirm with MONREC about the necessary action.

Table 11.2.7 Scoping Matrix for the New Development of Construction Access Road

	No	Factor / Impact Item	Rating During Construction	During Construction						
				Land acquisition and loss of properties	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation and cutting trees	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment, machines and vehicles	Influx of construction workers (construction yard is not necessary)
Pollution	1	Air pollution	B-					B-	B-	
	2	Water pollution	B-					B-		
	3	Waste	B-				B-			
	4	Soil contamination	B-					B-		
	5	Noise and vibration	B-						B-	
	6	Ground subsidence	B-					B-		
	7	Odor	D							
	8	Sediment quality (same as soil contamination)	B-					B-		
Natural	9	Protected area	D							
	10	Ecosystem	B-			B-	B-	B-	B-	
	11	Hydrology	B-					B-		
	12	Topography and geology	B-					B-		
Social	13	Involuntary resettlement	B-	B-						
	14	The poor	C	C						
	15	Indigenous and ethnic people	D							
	16	Local economy such as employment and livelihood	C	C						
	17	Land use and utilization of local resources	C		C		C			
	18	Waste usage	C					C		

	No	Factor / Impact Item	Rating During Construction	During Construction						
				Land acquisition and loss of properties	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation and cutting trees	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment, machines and vehicles	Influx of construction workers (construction yard is not necessary)
	19	Existing social infrastructures and services	B-					C	B-	
	20	Social institutions such as local decision-making institutions	D							
	21	Misdistribution of benefits and damage	D							
	22	Local conflict of interests	B-							B-
	23	Cultural heritage	C					C		
	24	Landscape	D							
	25	Gender	D							
	26	Rights of children	C							C
	27	Infectious diseases such as HIV/AIDS	C							C
	28	Labor environment (including work safety)	B-						B-	B-
Other	29	Accidents	B-						B-	B-
	30	Cross boundary impacts and climate change	B-						B-	

Note) Rating: A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done) No mark or D: Light impact is expected. Detailed quantitative survey is not necessary. + : Positive Impacts, -: Negative Impacts
Source: JICA Study Team

Table 11.2.8 Scoping Matrix and Reasons for Access Road

Area	No	Impacted Item on JICA Guidelines	Rating	Reasons for the Rating (Only During Construction Phase)
Pollution	1	Air pollution	B-	Temporary negative impacts are expected due to earthwork and operation of construction machines.
	2	Water pollution	B-	Earthwork activities in the paddy field and nearby stream may cause turbid water.
	3	Waste	B-	Cut trees and waste soil may occur in the affected area.
	4	Soil contamination	B-	Materials from quarry and borrow pit may cause pollution near the access road
	5	Noise and vibration	B-	Generation of noise and vibration is expected due to the operation of construction machines.
	6	Ground subsidence	B-	Construction of the road may cause ground subsidence adjacent to the embankment especially in the paddy field
	7	Odor	D	No adverse impacts are expected due to lack of base camp site for these activities
	8	Sediment quality (See No 4 Soil contamination)	B-	Materials from quarry and borrow pit near the access road may be polluted
Envir	9	Protected area	D	Protected area and its surrounding area shall not be selected as quarry and borrow pit.
	10	Ecosystem	B-	Reclamation of wetland, cutting trees and operation machines may give adverse

Area	No	Impacted Item on JICA Guidelines	Rating	Reasons for the Rating (Only During Construction Phase)
				impacts on the ecosystem.
	11	Hydrology	B-	Construction of the access road may give impact on existing streams
	12	Topography and geology	B-	Slope failure and soil erosion may be caused by the embankment
Social Environment	13	Involuntary resettlement	B-	Land acquisition is caused due to widening of existing road and construction of new access road
	14	The poor	C	Land owner who is under poverty line may be affected by land acquisition
	15	Indigenous and ethnic people	D	No indigenous and ethnic people were observed in this area in accordance with WB OP4.10
	16	Local economy such as employment and livelihood	C	Economic activities such as cultivation of crops and commercial forests may be impacted due to development of access road
	17	Land use and utilization of local resources	C	Land use such as agricultural land and/or commercial forests may be impacted due to development of access road
	18	Water usage	C	Land acquisition may give impacts on irrigation facilities and drinking water resources such as wells if they exist in the developed area.
Social Environment	19	Existing social infrastructures and services	B-	Schools, hospitals, religious facilities and public utilities may be impacted if they exist in the developed area. Additionally construction machines may give damages on the existing road.
	20	Social institutions such as local decision-making institutions	D	No impacts are expected because there are no activities which give adverse impacts on this item.
	21	Misdistribution of benefit and damage	D	No impacts are expected because there are no activities which give adverse impacts on this item.
	22	Local conflict of interests	B-	Local inhabitants and local authorities may request to ensure job opportunities as construction workers fairly.
	23	Cultural heritage	C	Cultural heritage such as pagoda may be located in the affected area
	24	Landscape	D	Construction of access road does not give significant impacts to current landscape
	25	Gender	D	According to interview with authority regarding gender in Myanmar, no issues on gender in infrastructure area are observed. Thus no impacts are expected on this item.
	26	Right of children	C	Child laborers may be hired as simple workers in the project area
	27	Infectious diseases such as HIV/AIDS	C	Infectious diseases such as STDs are possible to be spread due to inflow of construction workers. Furthermore, alteration to the ground by filling may trigger the formation of habitats for mosquitoes that could possibly transmit malaria and dengue fever.
	28	Labor environment	B-	Construction work environment needs to be considered in accordance with relevant laws and regulations.
Other	29	Accidents	B-	Construction vehicles use existing local roads near residential areas, thus the number of traffic accidents may increase.
	30	Cross boundary impacts and climate change	B-	Operation of construction machines generate GHGs.

Note) Rating:
A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done) D: Light impact is expected. Detailed quantitative survey is not necessary.
+ : Positive Impacts, -: Negative Impacts
Source: JICA Study Team

(3) Recommended Mitigation Measures

Recommended mitigation measures for the development and/or expansion of access road during construction are shown in Table 11.2.5.

Table 11.2.9 Recommended Mitigation Measures for the Development of The Access Road

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
Pollution	1	Air pollution	☐ Water sprinkling shall be carried out in the construction area so as not to give dust impacts on the nearest residential area. Surface treatment should be considered if required. ☐ Periodical maintenance for facilities and machines shall be done	Contractor (Construction Company)	MOC
	2	Water pollution	☐ Turbid water shall be minimized at river and stream ☐ Waste oil shall be stored and disposed of into the designated site	Contractor	MOC
	3	Waste	☐ Waste oil of facilities and machines shall be collected and disposed through a licensed agent ☐ Cut trees shall be reused or disposed of at a designated place	Contractor	MOC
	4	Soil contamination and sediment	☐ Excavated borrow soil shall be analyzed and confirmed if the quality is under standard values. Polluted soil shall not be used. ☐ Facilities and construction machines shall be maintained so as not to leak oil and chemicals. ☐ Waste oil of facilities and machines shall be collected and disposed through a licensed agent	Contractor	MOC
	5	Noise and vibration	☐ Activities in quarry and borrow pits shall be limited in the daytime and on weekdays ☐ Facilities and machines shall be well maintained and checked everyday ☐ Information disclosure of construction schedule shall be carried out in advance to the surrounding community.	Contractor	MOC
	6	Ground subsidence	☐ Ground condition shall be monitored during construction and appropriate countermeasure shall be taken if ground subsidence is found	Contractor	MOC
Natural Environment	7	Ecosystem	☐ Boundary of quarry and borrow pit shall be marked and all relevant workers and communities shall be informed not to conduct development activities outside of the boundary ☐ Waste oil shall be stored and disposed of into the designated site so as not to leak water body	Contractor	MOC
	8	Topography and geology	☐ Implementation of slope protection such as turf work, planting treatment, concrete block retaining wall and retaining wall at the end of construction period	Contractor	MOC
Social Environment	9	Resettlement	☐ Holding of consultation meetings with landowner(s) for understanding of compensation policy ☐ Appropriate compensation and implementation of livelihood restoration program in accordance with approved RAP by Myanmar Government	Contractor and Local Authorities	MOC and Local Authorities
	10	The poor	☐ Appropriate livelihood restriction program shall be considered in accordance with the approved RAP	Contractor	MOC
	11	Local economy such as employment and livelihood	☐ Holding of consultation meetings for understanding of compensation policy and livelihood restoration programs for project affected persons who lose agricultural lands such as paddy field and rubber plantation ☐ Implementation of adequate compensation in accordance with approved RAP	Contractor	MOC
	12	Land use and utilization of local resources	☐ Implementation of consultation with affected landowners and formulation of basic compensation policy before the actual land acquisition.	Contractor	MOC
	13	Water usage	☐ Appropriate compensation shall be done in accordance with approved RAP, if water usage facilities area affected such as wells ☐ Alternative measures for water provision shall be prepared if water level and water quality at the nearest well change during the operation of quarry and borrow pits. ☐ Diversion of irrigation channels and/or streams shall be set up if the activities	Contractor	MOC

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
			give impacts on such streams		
	14	Existing social infrastructures and services	☐ Detour and access road to social infrastructure such as school and meeting place for commuters and users shall be provided, if required. Such access road should be secured in same place from the view of connecting the communities. ☐ All construction roads and related access roads shall be maintained during construction	Contractor	MOC
	15	Gender	☐ Provision of job opportunities and fair salary between genders. ☐ At least 10% of female workers should be hired as simple workers	Contractor	MOC
	16	Rights of children	☐ No employment under the age of 18	Contractor	MOC
	17	Infectious diseases such as HIV/AIDS	☐ Installation of sufficient drainage facilities so as not to provide habitats for vector mosquitoes ☐ Enforcement of medical screening and periodical medical check-up for workers ☐ In order to prevent the spread of infectious diseases such as HIV/AIDS, awareness-raising among the laborers is promoted during construction	Contractor	MOC
	18	Labor environment and safety	☐ Relevant laws in Myanmar such as “the Workmen’s Compensation Act”, “the Factories Act”, “the Leave and Holidays Act”, “the Law relating to Overseas Employment”, “the Labor Organization Law”, “the Settlement of Labor Dispute Law”, “the Social Security Law” and “the Minimum Wages Law” shall be followed ☐ Additionally, Article 23 of Occupational Health and Safety, Labor and Working Conditions in IFC Performance Standard 2 shall be applied.	Contractor	MOC
Others	19	Accident	☐ Deployment of a flagman at the gate for traffic management ☐ Installation of safety sign board such as speed limit and residential area near the site ☐ Installation of fence around the construction site to keep out the local people such as children ☐ Installation of lighting facility on site at nighttime ☐ Restriction of mobilization speed to less than 20km/h in the construction site ☐ Implementation of safety training for the workers (especially blasting methodology and standard operation procedure)	Contractor	MOC
	20	Cross boundary impacts and climate change	☐ Prohibition of unnecessary operation of facilities and machines ☐ Periodical (daily, weekly and monthly) checking and maintenance of facilities and machines shall be done	Contractor	MOC

Source: JICA Study Team

11.2.3. **Construction Yard and Camp Site**

(1) Candidate Location of Construction Yard

Candidate locations of the construction yards and installed facilities are shown in Figure 11.2.5 and Table 11.2.10.

Source: JICA Study Team based on Google earth

Figure 11.2.5 Candidate Location of the Construction Yard

Table 11.2.10 Expected Facilities in the Construction Yard

Item	Description
Location	Sut Pa Nu Village, Kyaikto Township, Thaton District, Mon State
Current Land use	Agricultural Area
Estimated Area	Approx. 2 ha
Expected installed facilities	Office, work shop, concrete plant, accommodation for workers, storage and parking space
Number of Workers	Approx. 100 workers (including skilled workers)

Source: JICA Study Team

(2) Expected Adverse Impacts of the Construction Yard Including Activities such as Operation of Plants

These candidate locations of the construction yard have been identified during feasibility study as part of cost estimation of the project. However, the candidate location is proposed by the construction contractor and approved by the project proponent before the actual construction activities.

The contractor shall refer to the following predicted adverse impacts and mitigation measures, take the necessary process and obtain approval in accordance with relevant EIA laws and JICA Guidelines during mobilization.

Expected adverse impacts during construction and their reasons are shown below:

Table 11.2.11 Scoping Matrix for Construction Yard

	No	Factor / Impact Item	Rating During Construction	Pre / During Construction							
				Land acquisition and loss of properties	Change of land use plan, control of various activities by regulations for the construction	Reclamation of wetland, etc.	Deforestation and cutting trees	Alteration of the ground by cut land, filling, drilling, tunnel, etc.	Operation of construction equipment and vehicles	Influx of construction workers and staying in construction yard and offices	Establishment and operation of plants and material storage (asphalt plant, etc.)
Pollution	1	Air pollution	B-					B-	B-		
	2	Water pollution	B-						B-	B-	
	3	Waste	B-				B-			B-	
	4	Soil contamination	B-					B-			B-
	5	Noise and vibration	B-						B-		B-
	6	Ground subsidence	D								
	7	Odor	B-							B-	
	8	Sediment quality	B-						B-		
Natural	9	Protected area	D								
	10	Ecosystem	B-							B-	
	11	Hydrology	D								
	12	Topography and geology	D								
Social	13	Involuntary resettlement	D								
	14	The poor	D								
	15	Indigenous and ethnic people	D								
	16	Local economy such as employment and livelihood	D								
	17	Land use and utilization of local resources	D								
	18	Waste usage	D								
	19	Existing social infrastructures and services	D								
	20	Social institutions such as local decision-making institutions	D								
	21	Misdistribution of benefits and damage	D								
	22	Local conflict of interests	B-							B-	
	23	Cultural heritage	D								
	24	Landscape	D								
	25	Gender	D								
	26	Rights of children	C							C	
	27	Infectious diseases such as HIV/AIDS	C							C	
	28	Labor environment (including work safety)	B-						B-	B-	B-
Other	29	Accidents	B-						B-	B-	
	30	Cross boundary impacts and climate change	B-						B-		B-

Note) Rating: A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done) No mark or D: Light impact is expected. Detailed quantitative survey is not necessary. + : Positive Impacts, -: Negative Impacts

Source: JICA Study Team

Table 11.2.12 Scoping Matrix and Reasons for Construction Yard

Area	No	Impacted Item on JICA Guidelines	Rating	Reasons of the Rating (Only Construction Phase)
Pollution	1	Air pollution	B-	Temporary negative impacts are expected due to operation of construction machines, plants and equipment.
	2	Water pollution	B-	Domestic organic polluted water and night soil from offices are expected. Additionally, chemical polluted water may be discharged from plant and material storage, if the facilities are not managed properly.
	3	Waste	B-	Domestic waste and night soil from offices are expected. Additionally, construction waste may be generated from the plant.
	4	Soil contamination	B-	Materials for facilities and chemicals such as oil may pollute the surface and underground soil in the compound.
	5	Noise and vibration	B-	Generation of noise and vibration is expected due to operation of construction machines, equipment and plants.
	6	Ground subsidence	D	No impacts are expected since activities which cause ground subsidence are not expected.
	7	Odor	B-	Domestic waste from offices and operation of plants may cause bad smell
	8	Sediment quality (see No. 4 Soil contamination)	B-	Materials for facilities and chemicals such as oil may pollute the surface and underground soil in the compound, and such polluted soil comes out to the nearest steam and/or water body.
Natural Environment	9	Protected area	D	No impacts are expected since there are no national parks, natural protected and critical habitats area near the project site.
	10	Ecosystem	B-	Operation of construction machines, plants, discharging domestic polluted water may give impacts on the surrounding area
	11	Hydrology	D	No impacts are expected since there are no streams in the candidate location. Furthermore, activities in the construction yard do not give any impacts on the hydrological situation of the Sittaung River.
	12	Topography and geology	D	Considerable topography and geological sites are not located in the Project Area, thus no impact is expected. Furthermore, any plans of construction embankment do not exist in the compound.
Social Environment	13	Involuntary resettlement	D	No resettlement and land acquisition are caused (Land acquisition is done by Myanmar Government before construction stage)
	14	The poor	D	Since land acquisition is done by Myanmar government before construction, there are no issues during construction
	15	Indigenous and ethnic people	D	No indigenous and ethnic people were observed in accordance with WB OP4.10
	16	Local economy such as employment and livelihood	D	Since land acquisition is done by Myanmar government before construction, there are no issues during construction
	17	Land use and utilization of local resources	D	Since land acquisition is done by Myanmar government before construction, there are no issues during construction
	18	Water usage	D	There are no irrigation system and streams in the compound
Social Environment	19	Existing social infrastructures and services	D	No impacts are expected in the affected area because there are no schools, clinics, meeting places and religious facilities in the affected area.
	20	Social institutions such as local decision making institutions	D	No impacts are expected because there are no activities which give adverse impacts on this item.
	21	Misdistribution of benefit and damage	D	No impacts are expected because there are no activities which give adverse impacts on this item.

Area	No	Impacted Item on JICA Guidelines	Rating	Reasons of the Rating (Only Construction Phase)
	22	Local conflict of interests	B-	Local inhabitants and local authorities may request to ensure job opportunities for construction workers fairly.
	23	Cultural heritage	D	No impacts are expected because there is no law-based registered cultural heritage in the candidate location
	24	Landscape	D	Construction of construction yard does not give significant impacts on the current landscape
	25	Gender	D	According to interview with authority regarding gender in Myanmar, no issues on gender in infrastructure area are observed. Thus, no impacts are expected on this item
	26	Rights of children	C	Child labor may be hired as simple workers in the project area
	27	Infectious diseases such as HIV/AIDS	C	Infectious diseases such as STDs are possible to be spread due to inflow of construction workers. Furthermore, alteration to the ground by filling may trigger the formation of habitats for mosquitoes that possibly transmit malaria and dengue fever.
	28	Labor environment	B-	Construction work environment needs to be considered in accordance with relevant laws and regulations.
Other	29	Accidents	B-	Construction vehicles use existing local roads near residential areas, thus the number of traffic accident may increase.
	30	Cross boundary impacts and climate change	B-	Operation of construction machines generate GHGs.

Note) Rating:
A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impact is not expected, but survey and analysis shall be done) No mark: Light impact is expected. Detailed quantitative survey is not necessary.
+ : Positive Impacts, -: Negative Impacts
Source: JICA Study Team

(3) Recommended Mitigation Measures

Recommended mitigation measures are shown in Table 11.2.13.

Table 11.2.13 Recommended Mitigation Measures for Construction Yard

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
Pollution	1	Air pollution	☐ Water sprinkling shall be carried out in the construction area so as not to give dust impacts on the nearest residential area. Surface treatment should be considered if required. ☐ Periodical maintenance for facilities and machines shall be done	Contractor (Construction Company)	MOC
	2	Water pollution	☐ Turbid water shall be minimized at river and stream ☐ Waste oil shall be stored and disposed of into the designated site	Contractor	MOC
	3	Waste	☐ Waste oil of facilities and machines shall be collected and disposed through a licensed agent ☐ Cut trees shall be reused or disposed of at a designated place	Contractor	MOC
	4	Soil contamination and sediment	☐ Excavated borrow soil shall be analyzed and confirmed if the quality is under standard values. Polluted soil shall not be used. ☐ Facilities and construction machines shall be maintained so as not to leak oil and chemicals. ☐ Waste oil of facilities and machines shall be collected and disposed through a licensed agent	Contractor	MOC
	5	Noise and vibration	☐ Activities in quarry and borrow pits shall be limited in the daytime and on weekdays ☐ Facilities and machines shall be well maintained and checked everyday ☐ Information disclosure of construction schedule shall be carried out in advance to the surrounding community.	Contractor	MOC

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
	6	Ground subsidence	☐ Ground condition shall be monitored during construction and appropriate counter measure shall be taken if ground subsidence is found	Contractor	MOC
Natural Environment	7	Ecosystem	☐ Boundary of quarry and borrow pit shall be marked and all relevant workers and communities shall be informed not to develop outside of the boundary ☐ Waste oil shall be stored and disposed of into the designated site so as not to leak water body	Contractor	MOC
	8	Topography and Geology	☐ Implementation of slope protection such as turf work, planting treatment, concrete block retaining wall and retaining wall at the end of construction period	Contractor	MOC
Social Environment	9	Resettlement	☐ Holding of consultation meetings with the landowner(s) for understanding of compensation policy ☐ Appropriate compensation and implementation of livelihood restoration program in accordance with approved RAP by Myanmar Government	Contractor and Local Authorities	MOC and Local Authorities
	10	The poor	☐ Appropriate livelihood restriction program shall be considered in accordance with approved RAP	Contractor	MOC
	11	Local economy such as employment and livelihood	☐ Holding of consultation meetings for understanding of compensation policy and livelihood restoration programs for project affected persons who lose agricultural lands such as paddy field and rubber plantation ☐ Implementation of adequate compensation in accordance with approved RAP	Contractor	MOC
	12	Land use and utilization of local resources	☐ Implementation of consultation with affected landowners and formulation of basic compensation policy before actual land acquisition.	Contractor	MOC
	13	Water usage	☐ Appropriate compensation shall be done in accordance with approved RAP if water usage facilities area such as wells are affected ☐ Alternative measures for water provision shall be prepared if water level and water quality at the nearest well change during the operation of quarry and borrow pits. ☐ Diversion of irrigation channels and/or streams shall be set up if the activities give impacts on such streams	Contractor	MOC
	14	Existing social infrastructures and services	☐ Detour and access road to social infrastructure such as school and meeting place for commuters and users shall be provided, if required. Such access road should be secured at same place basically from the view of connecting the communities.	Contractor	MOC
	15	Gender	☐ Provision of job opportunities and fair salary for between genders ☐ At least 10% of female workers should be hired as simple workers	Contractor	MOC
	16	Rights of children	☐ No employment under the age of 18	Contractor	MOC
	17	Infectious diseases such as HIV/AIDS	☐ Installation of sufficient drainage facilities so as not to provide habitats for vector mosquitoes ☐ Enforcement of medical screening and periodical medical check-up for workers ☐ In order to prevent the spread of infectious diseases such as HIV/AIDS, awareness-raising among the laborers is promoted during construction	Contractor	MOC
	18	Labor environment and safety	☐ Relevant laws in Myanmar such as “the Workmen’s Compensation Act”, “the Factories Act”, “the Leave and Holidays Act”, “the Law relating to Overseas Employment”, “the Labor Organization Law”, “the Settlement of Labor Dispute Law”, “the Social Security Law” and “the Minimum Wages Law” shall be followed ☐ Additionally, Article 23 of Occupational Health and Safety, Labor and Working Conditions in IFC Performance Standard 2 shall be applied.	Contractor	MOC
Others	19	Accident	☐ Deployment of a flagman at the gate for traffic management ☐ Installation of safety sign board such as speed limit and residential area near the site ☐ Installation of fence around the construction site to keep out local people	Contractor	MOC

Area	No.	Item	Draft Mitigation Measures	Responsibility	
			During Construction	Implementation Agency	Responsible Agency
			such as children ☐ Installation of lightning facility at nighttime on site ☐ Restriction of mobilization speed to less than 20km/h in the construction site ☐ Implementation of safety training for the workers (especially blasting methodology and standard operation procedure)		
	20	Cross boundary impacts and climate change	☐ Prohibition of unnecessary operation of facilities and machines ☐ Periodical (daily, weekly and monthly) checking and maintenance of facilities and machines shall be done	Contractor	MOC

Note) Rating: A: Serious impact is expected. B: Some impacts are expected. C: Extent of impact is unknown (serious impacts are not expected, but survey and analysis shall be done) No mark and D: Few impacts are expected. Detailed quantitative survey is not necessary. (+: Positive impacts, - : Negative impacts)
Source: JICA Study Team

CHAPTER 12 Comprehensive Evaluation and Recommendations

12.1. Comprehensive Evaluation

This EIA has prepared in accordance with relevant EIA laws in Myanmar and JICA Guidelines for Environmental and Social Considerations 2010.

The project proposal report for screening has submitted from MOC to ECD in July 2017, and then ECD has classified as an EIA project due to bridge length with more than 2km in August 2017. MOC has prepared a scoping report and submitted it to ECD in October 2017 and approved in June 2018 after exchanging comments between MOC and ECD. MOC in cooperation with JICA has conducted a series of site surveys and analysis, and then prepared draft EIA report and submitted it to ECD in January 2019.

According to analysis in the EIA report, a degree of adverse impacts are expected on pollution items such as air, water, noise & vibration, ecosystem and social items such as land acquisition and local economy. However these impacts are not serious and minimized by the prepared appropriate mitigation measures.

Furthermore it has been confirmed that following requirements are satisfied in accordance with relevant EIA laws in Myanmar and JICA Guidelines. Hence it is evaluated that a construction of the New Sittaung Bridge does not give any significant adverse impacts on pollution, natural and social environment.

- ✓ Analysis items (Pollution items, natural environment items and social items)
- ✓ Quantitative forecasts and evaluation in accordance with environmental standards (air quality and noise level along the bypass section)
- ✓ Timing and number of local stakeholder meeting (Scoping and draft EIA stage)
- ✓ Preparation of appropriate mitigation measures and monitoring plan

12.1.1. Recommendations for Harmonization of both Projects

Although the ADB-EIA for the bypass section (64.5km) connected with New Sittaung Bridge has well-prepared in accordance relevant guidelines and laws, however following collaboration between JICA and ADB during detailed design and construction stage might maximize the effectiveness of the both projects and minimize negative impacts.

- ✓ Sharing information regarding special ecosystem monitoring for preparation of appropriate mitigation measures during detailed design
- ✓ Sharing the updated environmental management plan (EMP) for mutual confirmation during detailed design
- ✓ Holding periodical meetings with PMUs, contractors and supervision consultants for the bypass and bridge section respectively for solution of common issues

付録 - 6

RAP 報告書

Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section)

The Project for Construction of New Sittaung Bridge

Resettlement Action Plan

(January 2020)

Department of Bridge (DOB),
Ministry of Construction (MOC)

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Currency Equivalents

(As of January 2020)

Currency Unit	-	Myanmar Kyat (MMK)
MMK 1.00	=	US$ 0.00067
US$ 1.00	=	MMK 1,500

Abbreviations

ADB	Asian Development Bank
COD	Cut-off Date
COI	Corridor of Impact
DALMS	Department of Agricultural Land Management and Statistics
D/D	Detailed Design
DICD	Department of Industrial Crops Development
DMS	Detailed Measurement Survey
DOB	Department of Bridges
DOH	Department of Highways
DPs	Displaced Persons
EIA	Environmental Impact Assessment
EWEC	East-West Economic Corridor
EMA	External Monitoring Agent
F/S	Feasibility Study
GAD	General Administration Department
GL	Guideline
GoM	Government of Myanmar
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
GRO	Grievance Redress Officer
HH	Household
IRP	Income Restoration Program
IMA	Internal Monitoring Agent
IOL	Inventory of Loss Assets
JICA	Japan International Cooperation Agency
JST	JICA Study Team
MMK	Myanmar Kyat
MOALI	Ministry of Agriculture, Livestock and Irrigation
MOC	Ministry of Construction
MOHA	Ministry of Home Affairs
MONREC	Ministry of Natural Resources and Environmental Conservation
MOPF	Ministry of Finance & Planning
MSWRR	Ministry of Social Welfare, Relief and Resettlement
NGO	Non-governmental Organization
ODA	Official Development Assistance
PAHs	Project Affected Households
PAPs	Project Affected Persons
PIB	Project Information Booklet
PMU	Project Management Unit
RAP	Resettlement Action Plan
RCS	Replacement Cost Survey
RIC	Resettlement Implementation Committee
RIEC	Resettlement Implementation and Environmental Committee
ROW	Right of Way

RP	Resettlement Plan
SAHs	Severely Affected Households
SES	Socio-Economic Survey
SPS	Safeguard Policy Statement
TOR	Terms of Reference
URAP	Updated RAP
USD	United States Doller
VAHs	Vulnerable Affected Households
WB OP	World Bank Operational Policy

CHAPTER 1 Introduction

1.1. Background of the Project

Republic of the Union of Myanmar (hereinafter referred to as “Myanmar”) has been continuing high economic growth for the shift to democratization (March 2011). There is active trade with neighboring Thailand in the background. Trade between the two countries is expected to further expand in the future, but current maritime transport via the Malay Peninsula is very inefficient. As an alternative means of transportation to the sea, it is expected that the East-West Economic Corridor (hereinafter referred to as “EWEC”) connecting the two countries by land will be developed early. The Thai side section of EWEC has been improved with international standard that can correspond to international logistics. On the other hand, there are many bottleneck sections that impede smooth land transportation, such as weight limitation due to aging of bridges, incorrect alignment and profile such as steep and sharp curves, passage through dense urban areas, etc. Therefore, the government of Myanmar has put the development of the route as a priority issue, and has promoted improvement through the support of international organizations and Thai government.

As a result, from Thai border to Thaton and Mawlamyine section, it has been improved to a two-lane paved road corresponding to international standard, thereby domestic and international logistics are expected to be activated. Meanwhile, the issues such as traffic congestion and deterioration of safety are beginning to surface. Especially, the traffic congestion is predicted to occur due to the mixture of regional traffic and transit traffic because the existing road passes through the urban area from Kyaikto to Bago section about 100 km from Thaton to Yangon. Therefore, in order to separate regional traffic and transit traffic to ensure safety, it is necessary to build alternative highway that can divert the traffic from urban areas in the section.

Under these circumstances, Japan International Cooperation Agency (hereinafter referred to as “JICA”) and Asian Development Bank (hereinafter referred to as “ADB”) cooperated to agree for the implementation of the Feasibility Study (F/S) necessary for the development of the new arterial road in this section. JICA implements F/S related to the construction of the New Sittaung Bridge (hereinafter referred to as “the Study”), and ADB implements F/S related to road from Kyaikto to Bago section, respectively. The Study is mainly concerned for the “construction of the New Sittaung Bridge” (hereinafter referred to as “the Project”), which is the objective to implement the Project by JICA's Official Development Assistance (hereinafter referred to as “ODA”) loan, and is required to assess the validity of the implementation by Japan's ODA loan cooperation project, including justification of project cost, project implementation system, environmental and social considerations for the purpose of the construction of the New Sittaung Bridge.

1.2. Outline of the EWEC Project

The objective of the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) (hereinafter referred to as “the EWEC Project”) is the development of a new arterial road of about 61.4 km connecting Bago from Kyaikto. And the subject of the Study is for the New Sittaung Bridge section of about 2.5 km total length, in which JICA's loan is studied. The outline of the EWEC Project is shown in Table 1.1.

Table 1.1 Outline of the EWEC Project

Project Name	East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section)
Project Purpose	To improve the efficiency of international and domestic logistics by responding to the increasing traffic demand of the section by improving the new arterial road from the Bago to Kyaikto section of the EWEC, thereby contributing to the revitalization of Myanmar's trade.
Project Outline	・Construction of New Sittaung Bridge (total length of 2.5 km) (study object of JICA's loan) ・Development of new arterial road (total length of 61.4 km) (study object of ADB's loan) ・Consulting service (Detailed design, tender assistance)
Project Area	Mon State and Bago Region
Related government	Ministry of Construction(MOC), Department of Bridges (DOB) and Department of Highways (DOH)

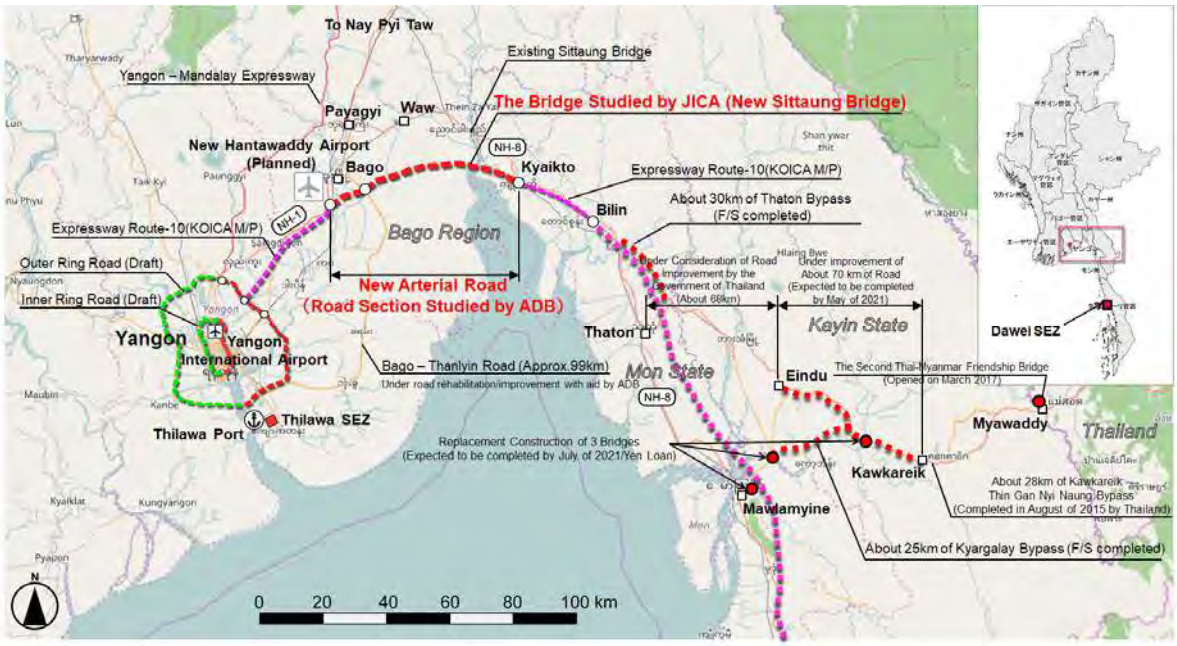
Source: JICA Study Team

1.3. Objective of the Study

The objective of the Study is to conduct a necessary survey, such as objectives, outline, project cost, implementation schedule, implementation method (procurement, construction), project implementation organization, operation and maintenance system, environmental and social considerations, etc., for the examination for implementation of the New Sittaung Bridge construction project in the EWEC Project as Japan's loan cooperation.

1.4. Study Area

The details of the EWEC Project area is shown in Figure 1.1.



Source: JICA Study Team

Figure 1.1 Project Location Map

1.5. Screening on JICA Guidelines

Kyaikto-Bago Bypass project is divided into two (2) sections as ADB section (Kyaikto –Bago Bypass Road) and JICA Section (New Sittaung Bridge), and it is informed the loan process will be separated respectively. Since these two projects are recognized as one project and it falls under the list of sensitive sectors and sensitive characteristics in terms of road and bridge sector and large-scale involuntary resettlement, thus the entire of project is classified as "Category A" in accordance with JICA Guidelines for Environmental and Social Considerations (April, 2010) (hereinafter referred to as "JICA Guidelines"). As part of the New Sittaung Bridge construction, the project for JICA section will also consist of guide bank and revetment, which will be done in parallel with bridge component. This RAP will cover all these components of JICA section.

CHAPTER 2 Land Acquisition and Resettlement Scope

2.1. Project Component and activities

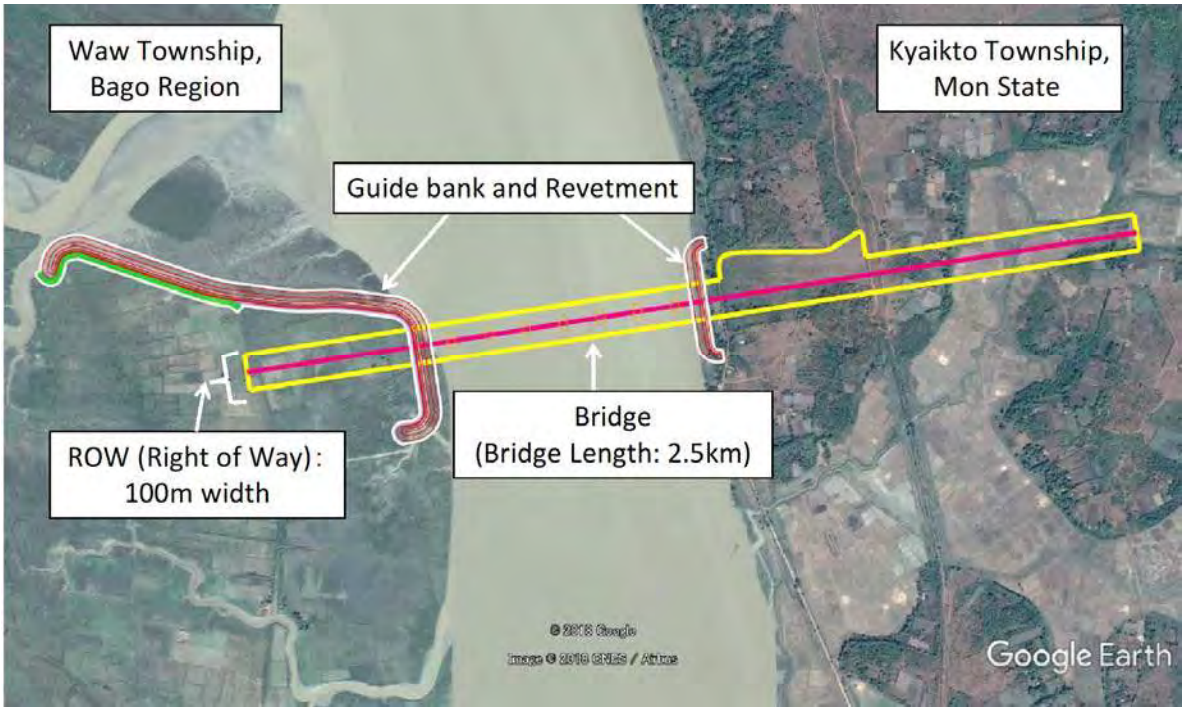
2.1.1. Project outline

The subject of the study for this RAP is the New Sittaung Bridge of about 2.5km total length. The component of the New Sittaung Bridge consists of the bridge part and the guidebank and revetment. The outline of the project components are shown Table 2.1. Figure 2.1 shows the detailed location of the project.

Table 2.1 Project Outline and Main Component

Component	Structure Specification	Location
1. Main Bridge with Approach Bridge and Approach Road	Main Bridge: L=800m, W=22.0 m, Right of Way (ROW)=100m	East Bank: Kyaito Township, Thaton District, Mon State West Bank: Waw Township, Bago District, Bago Region
	Approach Bridge: L=240m (right), L=960m (left) , W=22.0 m, ROW=100m	
	Approach Road: L = 248m (right), L = 252m (left), W=23.5 m, ROW=100m	
2. Guidebank and Revetment	Guidebank Length L = app. 1.5km, (West side bank)	Guidebank: Waw Township, Bago District, Bago Region
	Revetment Length = app. 0.3km (East side bank)	Revetment : Kyaito Township, Thaton District, Mon State

Note) Other facilities such as quarry, borrow pit, construction road and storage space of excavated soil in the river which will be decided by construction contractor during construction stage are not included for this RAP
Source: JICA Study Team



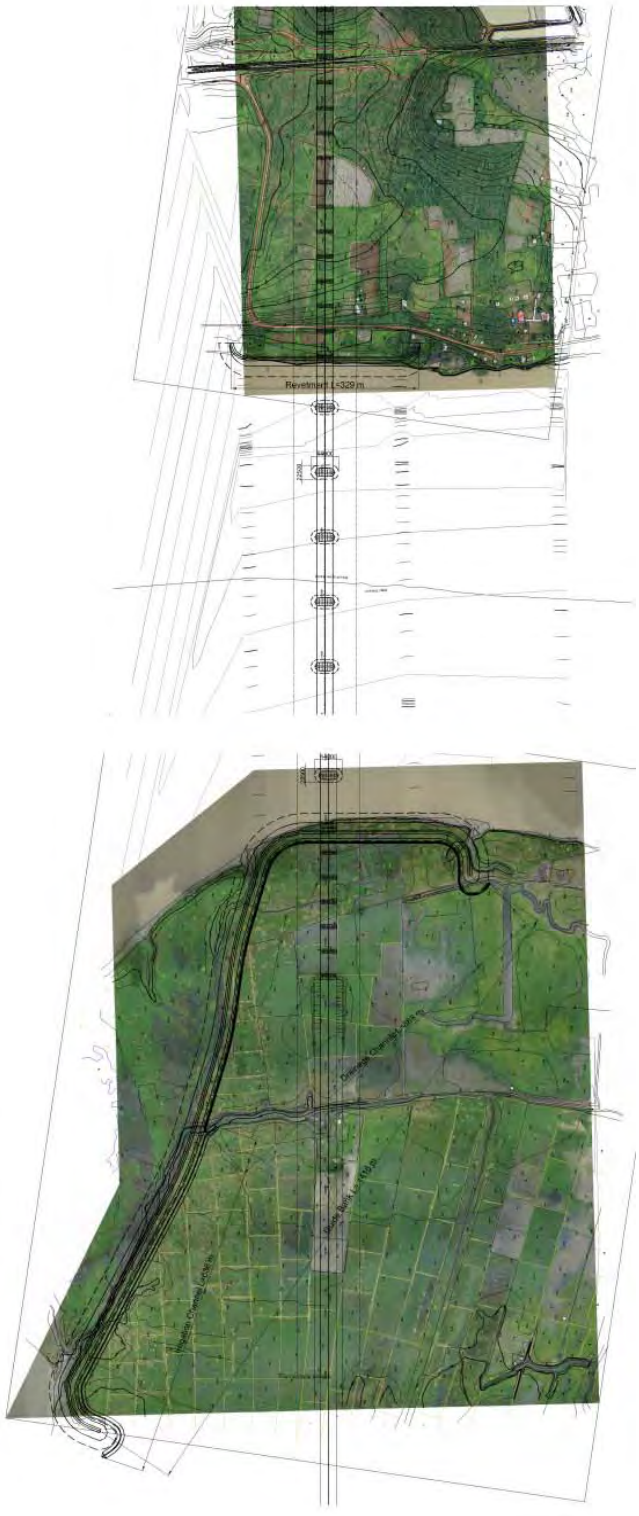
Source: JICA Study Team

Figure 2.1 Detailed Location of the Project

2.1.2. Detailed drawings

(1) Ground Plan

Detailed drawings a shown in Figure 2.2.

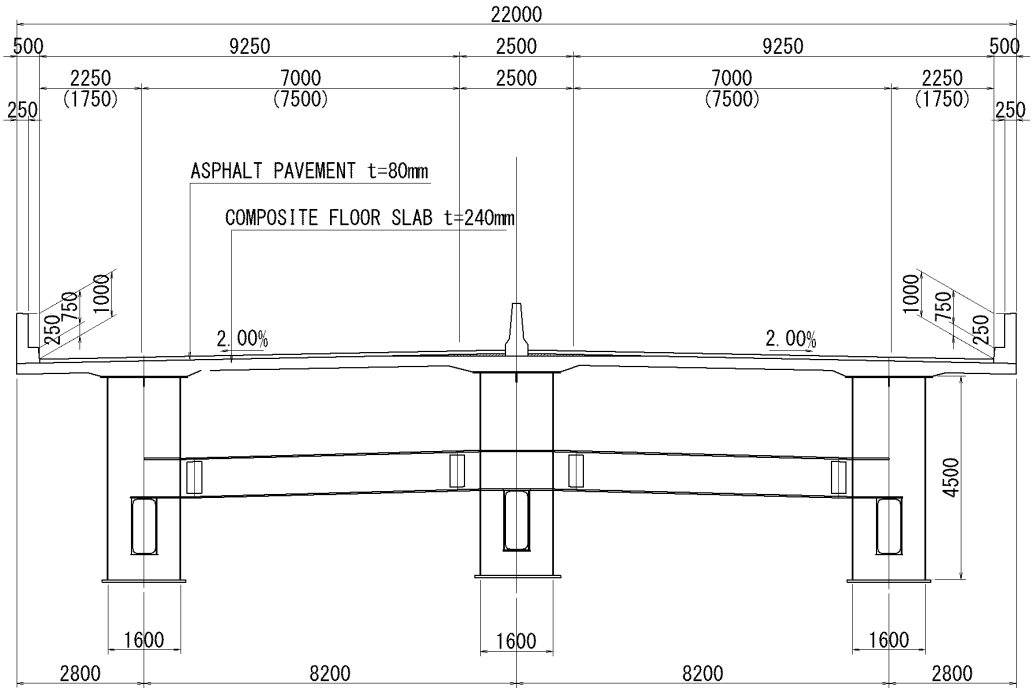


Source: JICA Study Team

Figure 2.2 Ground Plan for Bridge, Approach Bridge, Approach Road, Revetment and Guidebank

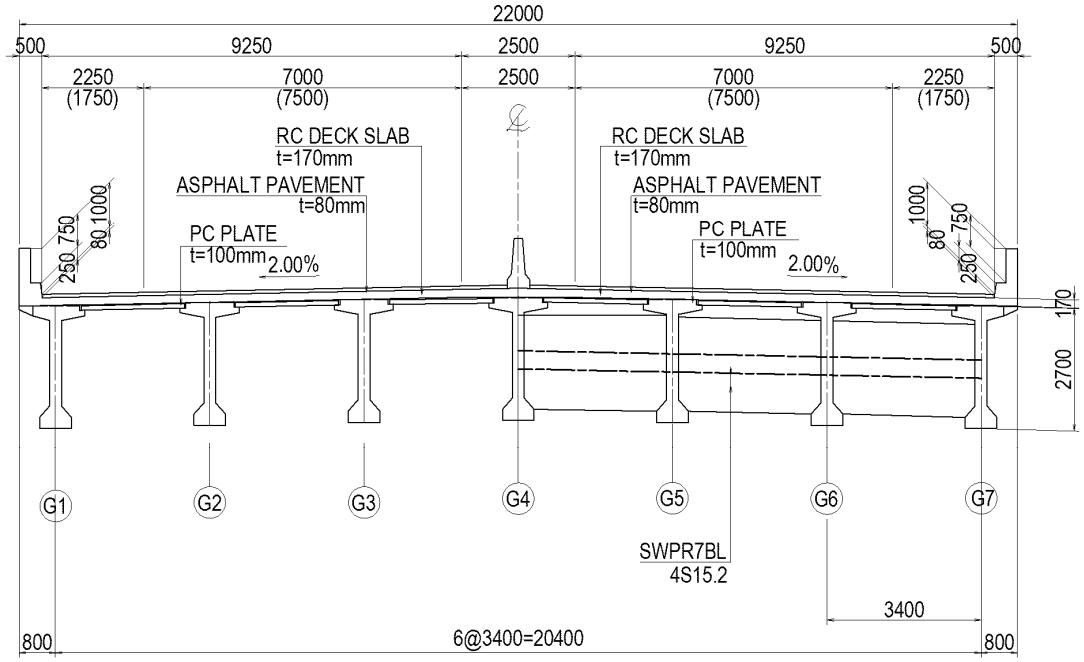
(2) Typical Cross Section

The typical cross section for earthwork, bridge, guidebank and revetment is shown below;



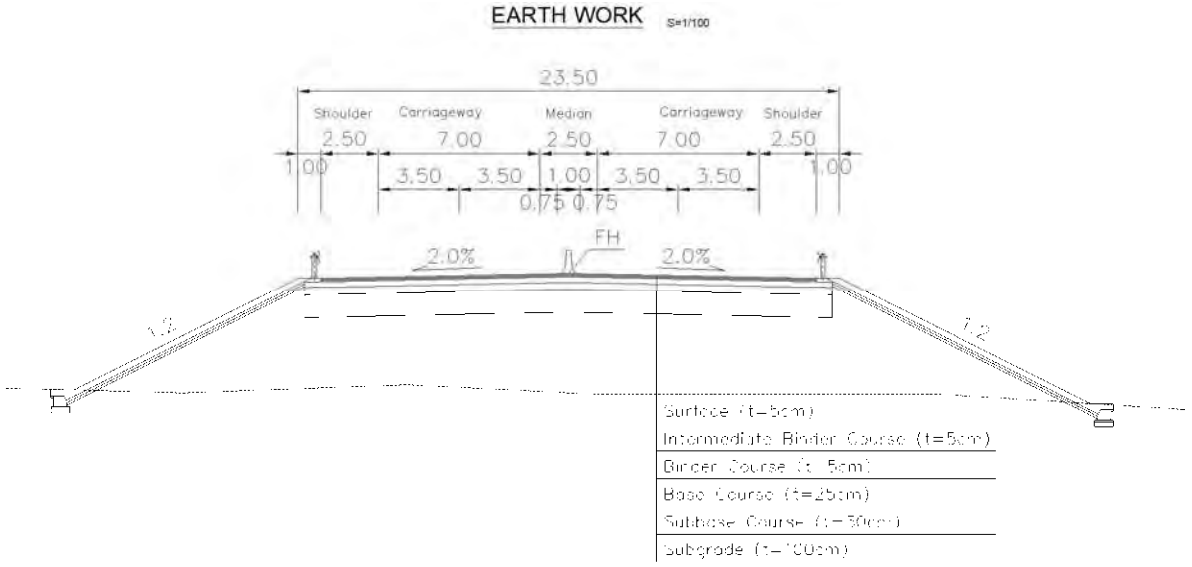
Note : ( ) shows the configuration for future operation stage
Source: JICA Study Team

Figure 2.3 Typical Cross Section of Main Bridge



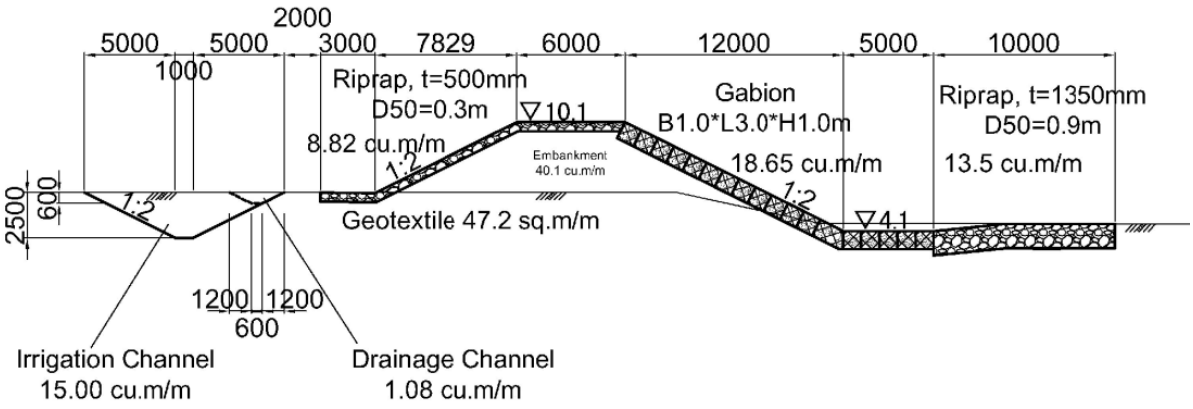
Note : ( ) shows the configuration for future operation stage
Source: JICA Study Team

Figure 2.4 Typical Cross Section of Approach Bridge



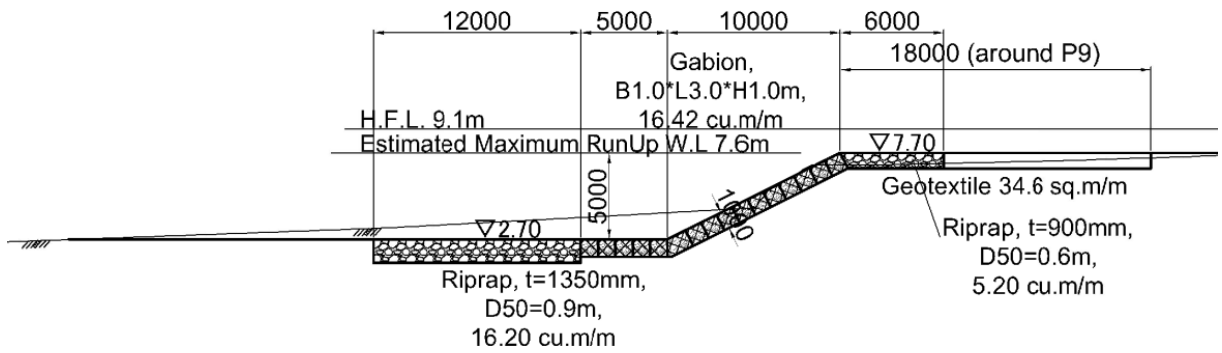
Source: JICA Study Team

Figure 2.5 Typical Cross Section of earth Work section



Source: JICA Study Team

Figure 2.6 Typical Cross Section of Guide Bank for Right Bank



Source: JICA Study Team

Figure 2.7 Typical Section of Revetment for Left Bank

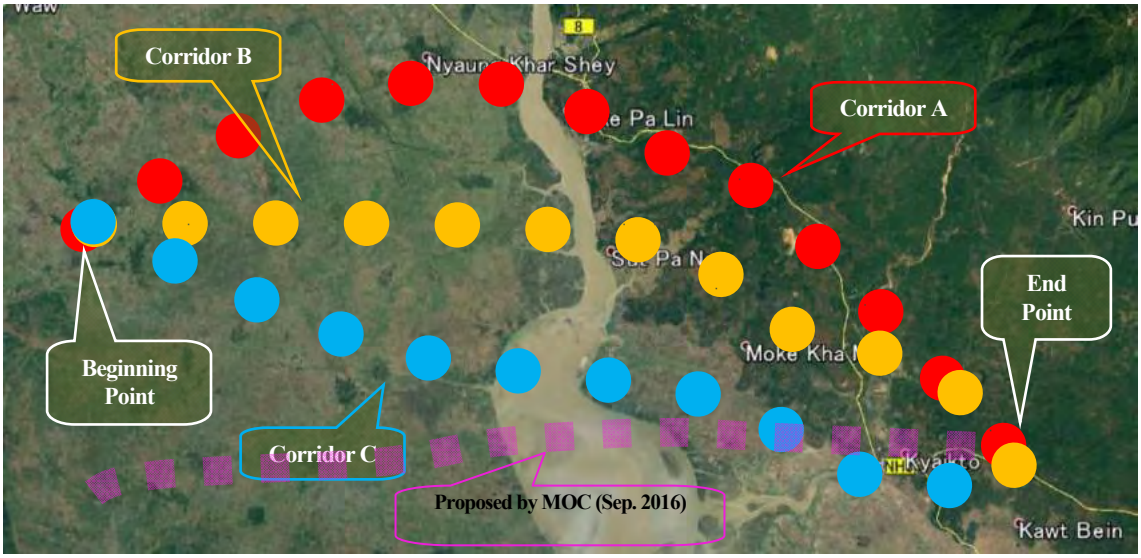
2.1.3. Alternative Analysis

(1) Alternative Analysis for Corridor

1) Extraction of Candidate Corridors

Among the possible corridors passing through the project area studied in the Pre-F/S, three (3) corridors were extracted as the possible candidates are given in Figure 2.8.

- Corridor "A", which runs mostly along the existing National Highway No.8 and crossing the Sittaung River beside the existing Sittaung Bridge.
- Corridor "B", which covers the possible alignments proposed in Pre-F/S running through Sut Pa Nu village and crossing the Sittaung River approximately 7 km downstream side of the existing Sittaung Bridge.
- Corridor "C", which is the shortest connection between New Bago City and Kyaikto City and crossing the Sittaung River approximately 13 km downstream side of the existing Sittaung Bridge.



Source: JICA Study Team

Figure 2.8 Plan View for Alternatives of Corridor

Note that the route highlighted in purple color given in Figure 2.8 was proposed by MOC in September 2016. The proposed alignment by MOC was consequently turned down due to the unreasonable bridge length (long) and the scoring impact by tidal bore which was already acknowledged by MOC during the Pre-F/S.

2) Comparative Study for the Selection of Eligible Corridor

The comparative study was conducted by multi-criteria analysis for the selection of eligible corridor for the East - West Economic Corridor Highway (New Bago – Kyaikto Section) that is shown in Table 2.2. Each of criteria below are given the classification (A to C) to measure the weight of performance for each candidate corridor under the comparative assessment as shown in Table 2.2.

(1) Riverbank Stability / Influence for Erosion

- A: Relatively stable / minor erosion in the past
- B: Stable with countermeasures / Intermediate erosion in the past
- C: Unstable / Large erosion in the past

(2) Construction Cost

- A: Cheapest option
- B: More than 20% higher than the cheapest option
- C: More than 50% higher than the cheapest option

(3) Environmental Impact (Conservation area or zone)

- A: No impacts on Ramsar site nor IBA/KBA
- B: Impacts to Ramsar site or IBA/KBA
- C: Impacts to Ramsar site and IBA/KBA

(4) Land Acquisition and Compensation

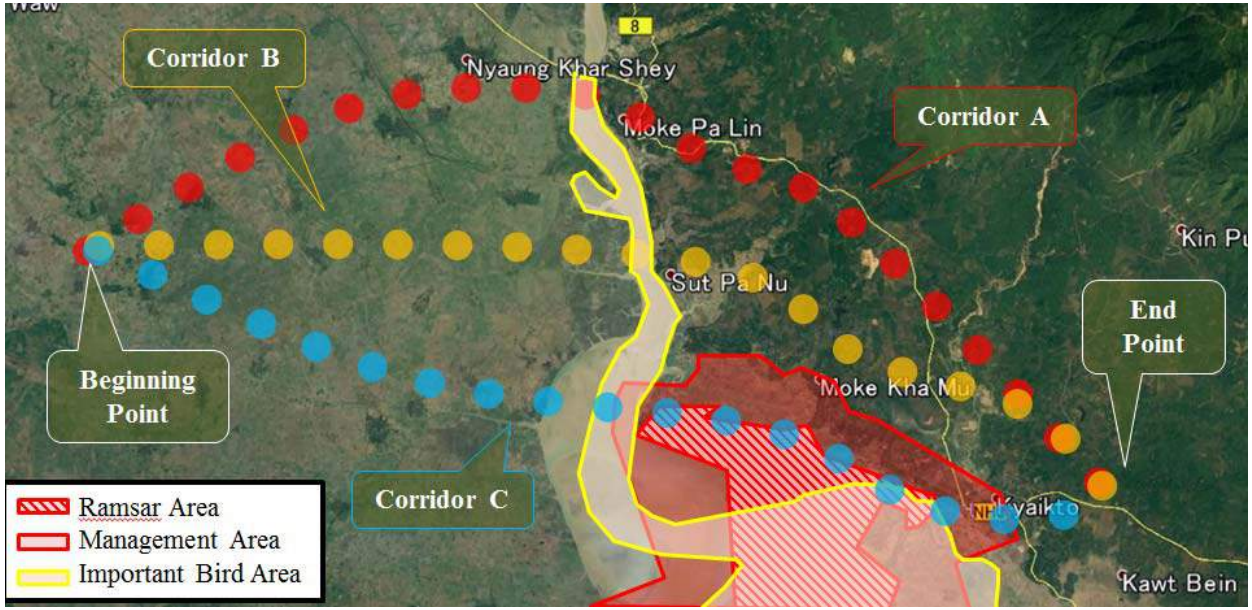
- A: Almost no residential area in/around the corridor
- B: Some residential areas in/around the corridor
- C: Many residential areas in/around the corridor

The evaluation was made by scoring method based on the following formula. The alternative which has the highest score will be selected as an optimum candidate corridor among the alternatives.

Score = Σ(Criteria (1) x Evaluation (A:20pt, B:10pt, C:0pt) …….. Criteria (4) x Evaluation).

In addition, the alternative corridor which has ranked “C” evaluation will be disqualified (even for having single evaluation “C”), because it gives an essential factor to affect the performance of project road. As a result, Corridor “B” was recommended by acquiring the highest score of 60/80 points while other alternatives were disqualified. Corridor “A” was assessed to be relatively shown a lower performance due to unreasonable length of project road and given potentially high social impact for the large resettlement. Corridor “C” was assessed to be unreasonable bridge length crossing close to the river mouse and unstable riverbank due to direct influence of tidal bore while providing reasonable (short) road length.

Table 2.2 Comparison of the Corridor for New Bago – Kyaikto Highway

Alternative	Corridor A		Corridor B		Corridor C	
Summary	• Along the existing highway (NH8). • New bridge beside the existing Sittaung Bridge. • Road length : app. 45km • Crossing river length: app. 650m		• Short road length: app. 40km. • New bridge at narrow river crossing area: Crossing river length is app. 750m		• Short road length: app. 40km • Long new bridge: Crossing river length app. 2.8km	
Alternative Corridors						
Riverbank stability / Influence of tidal bore	• "Relatively stable" but scoured by minor tidal wave	A	• "Relatively stable" but scored by minor tidal wave	A	• Unstable scored by tidal bore • Large erosion at present	C
Construction cost (Ratio with lowest cost)	• "Reasonable" because of shorter bridge length but longer distance of road • (1.03)	A	• "Reasonable" because of shorter bridge length. • (1.00)	A	• "Very High" because of longer bridge length. • (1.87)	C
Environmental Impact	• No impact to Ramsar site, but impact to IBA/KBA	B	• No impact to Ramsar site, but impact to IBA/KBA	B	• Impact to Ramsar site and IBA/KBA	C
Land acquisition and compensation	• 13 residential areas in the corridor	C	• 5 residential areas in the corridor	B	• 2 residential areas in the corridor	A
Total assessment	Score = 50/80, (Disqualified)		**Recommended** Score = 60/80		Score = 20/80 (Disqualified)	

Source: JICA Study Team

(2) Selection of Eligible Alignment

1) Alignment Setting in Suitable Corridor

Upon the results of comparative study on the corridor selection, it was recommended to find eligible alignment for new bridge location within the range of Corridor "B". Several alternative alignments can be proposed taking into account the control points including the existing facilities (road, railway and irrigation facilities, etc.), local communities. The most eligible bridge site should be selected by the criteria considering the suitability of bridge site crossing a river as below.

- Steady river flow without cross currents;
- Straight trail of the river;
- Narrow channel with firm banks;
- Suitable high banks above high flood level on each side;
- Rock or other hard soil conditions for slope and river bed;
- Absence of sharp curves in the approaches;
- Absence of expensive river training works;
- Avoidance of excessive underwater construction;
- Economical approaches danger of floods, free from obstacles, frequent drainage crossings, or place for troublesome in environment assessment, land acquisition and resettlement, etc.

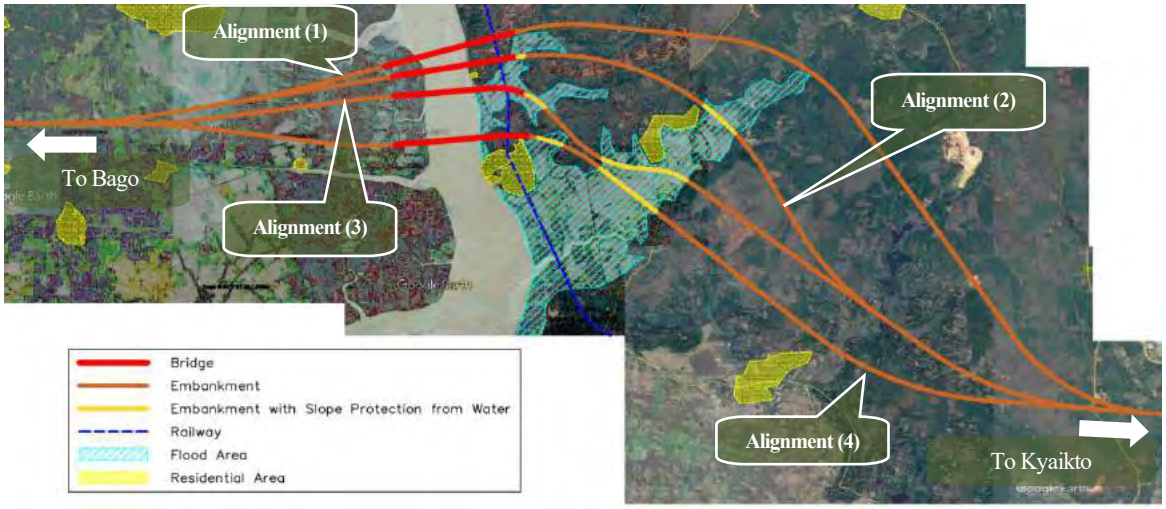
For selecting a suitable site for New Sittaung Bridge, the field reconnaissance was conducted by JICA Study Team to get impression of the landscape and to extract the possible types of the structure to the bridge site. Four numbers of probable alternative sites were selected on the site which is likely to serve the need of the bridge with reasonable cost.

Within certain width of Corridor "B", four (4) possible alternative alignments were proposed as given in Figure 2.9. The candidate alignments pass through the area from east to west. Right (west) riverbank is sedimentary flood terrain while left bank observed stiff hilly terrain and partially paddy field. The elevation of paddy field is rather low, thus, is normally flooded during rainy season.

Since there is no critical control point at the right bank side, the route selection was made in consideration of conditions of left bank side.

- Alignment (1), which stretches most upstream side amongst the alternatives (700 m apart from Pre-F/S route), becomes longest route length but can avoid passing thru flood area on the left bank.
- Alignment (2), which runs through secondly upstream side amongst the alternatives (400m upstream side from Pre-F/S route), crosses the narrowest point of river width and passes thru mostly hilly area except some flood area on the left bank.
- Alignment (3), which overlays the route proposed by Pre-F/S.
- Alignment (4), which runs through most downstream side amongst the alternatives (850 m apart from Pre-F/S route), becomes shortest route length but passes thru some flood

area on the left bank.



Source: JICA Study Team

Figure 2.9 Plan View for Alternatives of Route

2) Comparative Study for the Suitable Bridge Site (Alignment)

The selection of alignments was conducted by similarly the selection method of corridor based on the multi-criteria analysis. The weighting of evaluation criteria were slightly adjusted to suit for the selection of eligible alignment as below.

(1) Riverbank Erosion (last 10 year's erosion progress ratio "m/year")

- A: Relatively Stable (less that 3m/year)
- B: Tolerable stable (less than 10m/ year)
- C: Unstable (more than 10m /year)

(2) Approach Road

- A: Not run in flood area
- B: Runs in flood area for small part
- C: Runs in flood area for large part

(3) Construction Cost

- A: Lowest/ Reasonable (within 5% higher than lowest)
- B: Intermediate (More than 5% higher than lowest option)
- C: Unreasonable (More than 10% higher than lowest option)

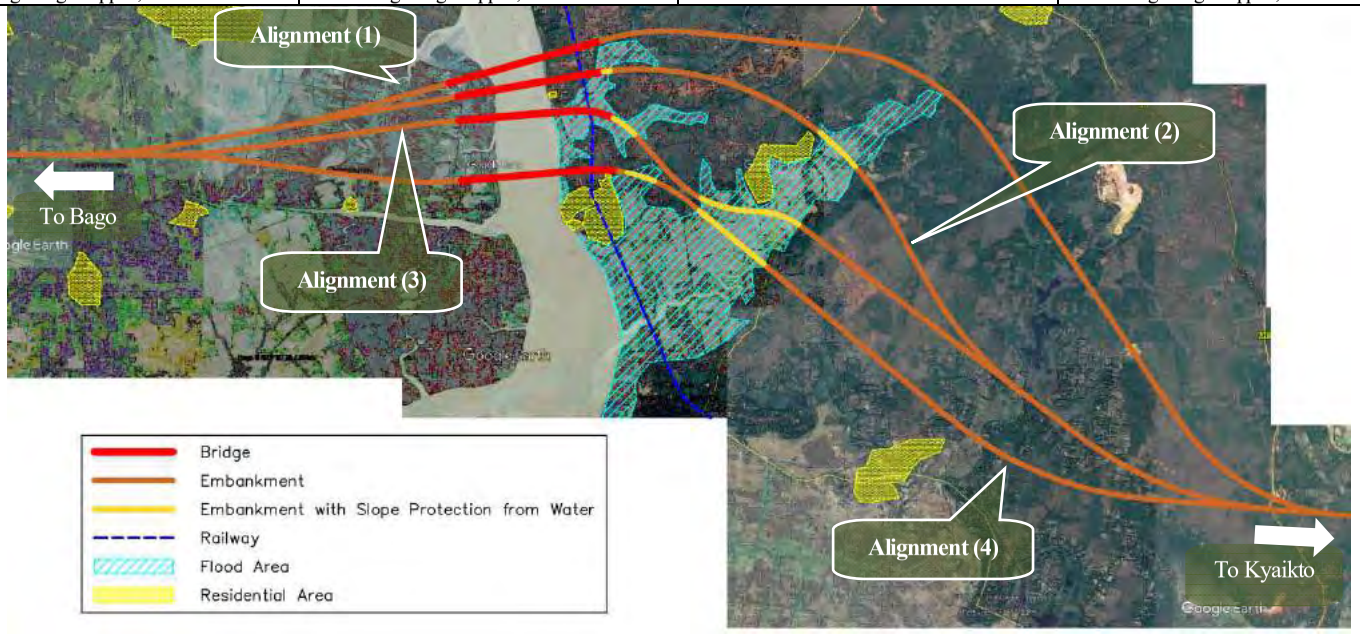
(4) Land Acquisition and Compensation

- A: Less than 10 households affected
- B: Less than 50 households affected
- C: More than 50 households affected

The comparative study for alignment of New Sittaung Bridge is shown in Table 2.3. As a

result, it was recommend that Alignment (2) should be most eligible alignment for crossing the Sittaung River. The description of the comparisons of alternative alignment should be separately furnished in other chapter of report along with salient details of each alternative alignment.

Table 2.3 Comparison of the Route for New Sittaung Bridge

Alternative	Alignment (1)		Alignment (2)		Alignment (3)		Alignment (4)	
Summary	• Avoiding flood area all along the alignment • Road length : app. 22km • River crossing length : app. 880m • Bridge length: app. 2,200m		• Avoiding flood area at river crossing point. • Road length : app. 22km • River crossing length : app. 720m • Bridge length: app. 2,100m		• Pre-F/S Alignment • Road length : app. 21km • River crossing length : app. 800m • Bridge length: app. 2,200m		• Avoiding flood area at river crossing point. • Road length : app. 21km • River crossing length : app. 870m • Bridge length: app. 2,200m	
Sketch								
River Bank Erosion (10 years erosion ratio (m/year))	• Tolerable stable East (9.0m /year) West (2.1m/year)	B	• Relatively stable East (1.8m/year) West (4.8m/ year)	A	• Unstable East (0.5m/year) West (20.0m/year)	C	• Unstable East (0.6m/year) West (30.3 m/year)	C
Approach Road	• No flood area along the alignment.	A	• Some flood area needs slope protection.	B	• Some flood area needs slope protection.	B	• Some flood area needs slope protection.	B
Construction Cost (Ratio)	• Intermediate (1.08)	B	• Lowest (1.00)	A	• Reasonable (1.03)	A	• Reasonable (1.06)	A
Land Acquisition and Compensation	• 17 households are affected.	B	• 26 households are affected.	B	• 20 households are affected.	B	• 29 households are affected.	B
Evaluation	Score = 50/80		**Recommended** Score = 60/80		Score = 40/80 (Disqualified)		Score = 30/80 (Disqualified)	

Source: JICA Study Team

(3) Without Project Case

Some adverse natural and social environmental impacts are not caused during construction without project case. However acceleration of traffic congestion and increasing travel time will give negative impacts on economic activities and generation of greenhouse gases. These level of adverse negative impacts are serious than without project case. In case of with-project, temporary negative impacts are given during construction, however since such negative impacts are minimized by appropriate mitigation measures, implementation of project is desirable.

a) Negative Impacts

· The congested situation must be accelerated due to insufficient capacity of the road and New Sittaung Bridge. This congestion and passing of large cargo tracks will give adverse impacts on pollution and traffic safety.

· The accelerated congestion must make all of vehicles decrease travelling speed, and then volume of greenhouse gases increase from vehicles.

b) Positive Impacts

· Resettlement and land acquisition is not caused in the affected area

2.2. Efforts to avoid or minimize negative impact on land acquisition and Resettlement

In order to minimize the negative impact on land acquisition and resettlement, following measures are considered.

- For the route alignment, the alternative analysis was conducted from various perspectives including resettlement aspect. The alternative analysis conducted is shown in 2.1.3.
- Apart from the consideration in route alignment, meaningful consultations (socialization meetings) were held with Project Affected Persons (PAPs) twice during F/S stage and opinions and comments on minimizing negative impacts raised from PAPs were considered by JICA Study Team and MOC. The detailed information on consultations are described in Chapter 9.
- All the measures for resettlement and land acquisition will be taken by MOC in accordance with existing laws and regulations of Myanmar as well as JICA Guidelines.
- All the measures to be taken in each stages of the project implementation will be closely monitored by people in the project area, project proponents and monitoring agency for the purpose of minimization of the adverse impact.

2.3. Objective of Resettlement Action Plan

The main objective of this Resettlement Action Plan is to ensure that no affected persons are worsened off as a result of the Project, and that:

- Adverse social and physical impacts are avoided, minimized, and mitigated;
- Stakeholders, and more importantly the Project-Affected Persons (PAPs), will benefit from the Project;
- All PAPs who stand to lose their respective houses, land or other livelihood assets due to construction/ improving of the project are provided with sufficient compensation and assistance which will help them improve or at lease restore their pre-project standard of living; and
- Resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those PAPs.

2.4. Potential Impacts

In the preliminary design stage, selecting the alignment that will entail minimal involuntary resettlement and disturbance to the community, particularly in terms of displacement was the main concern for this project. It is however still inevitable that some properties would be affected. In terms of extent and duration of impacts, it will be permanently or temporarily, partially or fully from land acquisition as a result of the Project.

2.5. Summary of Project Impacts

2.5.1. Summary of Project Affected Households and Persons

This RAP survey was conducted based on the design prepared for the Preparatory Survey for the East-West Economic Corridor Highway Development Project (New Bago-Kyaikto Highway Section) - Construction of New Sittaung Bridge. Almost all of affected households for the project were surveyed with prepared socioeconomic questions. As a result of the survey, a total number of 20 households or 106 people located in 3 villages, 2 townships and 2 regions are regarded as Project Affected Households (PAHs) or Project Affected Persons (PAPs) respectively.

It is found out that among the total 20 PAHs, 16 PAHs (86 PAPs) are categorized as households losing 10% or more of their productive land and/ or income source. As 3 PAHs will lose their residential house and 1 PAH will have an impact on their seasonal house, a totally 4 PAHs and 24 PAPs are required to be resettled. In addition, 4 PAHs comprising of 17 PAPs falls under Vulnerable Affected Households (VAHs). The detailed definition of the VAHs are described in 3.3.2(3) Vulnerability. Among all of the PAHs and PAPs, there are no informal settlers who do not have formal legal title to land or recognizable right to claim to the land. A category-wise outline of PAHs and PAPs are described in Table 2.4.

It is also noted that the impact to the livelihood of fishermen is not expected therefore the fishermen are not considered as project affected persons for the project. The information on fishery was analyzed in the Environmental Impact Assessment (EIA) prepared for the project. The summary of the expected impact to the fishery is described in Appendix G.

Table 2.4 Summary of Project Affected Households and Persons

No. of PAHs/ PAPs								
	Total		of which					
			Households losing 10% or more of their productive land and/ or income source		Relocation Households		Vulnerable Affected Households (VAHs)	
Location	No. of PAHs	No. of PAPs	No. of PAHs	No. of PAPs	No. of PAHs	No. of PAPs	No. of PAHs	No. of PAPs
Shan Kaing Village, Waw Township, Bago District, Bago Region	8	38	5	24	1	3	2	6
Sut Pa Nu Village,Kyaito Township,Thaton District, Mon State	8	49	8	49	3	21	2	11
Kha Lun Village,Kyaito Township,Thaton District, Mon State	4	19	3	14	0	0	0	0
Total	**20**	**106**	**16**	**87**	**4**	**24**	**4**	**17**

Source: JICA Study Team

2.5.2. Inventory of Affected Fixed Assets

(1) Land

Land acquisition will mainly involve agricultural land, specifically garden land and crop land but some structures developed on agricultural land will also be impacted. Note that the original land use status for structures fall under agricultural land and compensation of entitlement will be considered as agricultural land rather than residential land and or other land use.

For bridge construction including guide bank and embankment, a total of 62.53 acres (253,050 m^2) of land will be acquired and the table below breaks down expected acres of land on a per village basis.

Most of the affected garden land is located in Sut Pa Nu Village, which comprises of 23.65 acres (253,050 m^2) of land, while only 1 acre of affected garden land and no affected garden land exists in Kha Lun Village and Shan Kaing Village respectively. Such garden lands are occupied with trees such as rubber and betel vines which are the major livelihood of people in this region.

Regarding with the crop land, 22.85 acres (92,471 m^2) of affected land located in the Bago Region side and the remaining 15.03 acres (60,824m^2) of crop land are in Mon State which mostly consists of paddies, peas and beans.

Table 2.5 Summary of Lands to be Acquired under Proposed Alignment

State /Region	Village	Approximated Amount of Land to be Acquired						Total	
		No. of Affected Land Owner (No.)	Crop Land (acre)	No. of Affected Land Owner (No.)	Garden Land (acre)	No. of Affected Land Owner (No.)	Residential Land (acre)	No. of Affected Land Owner*1 (No.)	Total Land (acre)
Bago Region	Shan Kaing	7	22.85	0	0	0	0	7	22.85
Mon State	Sut Pa Nu	3	6.12	7	23.65	0	0	8	29.77
Mon State	Khalon	4	8.91	1	1.00	0	0	4	9.91
Total		**13*2**	**37.88**	**8**	**24.65**	**0**	**0**	**18*3**	**62.53**

* 1 No. of Affected Land owner shows PAHs who have impact on Crop Land or/ and Garden Land.
* 2 1 PAH has 2 crop land in Sut Pa Nu and Kha Lun, therefore total PAHs who impacted on land is totally 13
* 3 As mentioned in *2, PAHs has land plot both in Sut Pa Nu and Kha Lun, therefore total no. of affected owner is totally 18
Source: JICA Study Team

(2) Structure

A total of 4 main structures and 8 secondary structures will also be impacted due to land acquisition. The affected 3 houses are located in Sut Pa Nu Village, Mon State and 1 Seasonal House is located in Shan Kaing Village, Bago Region. Affected Secondary Structures are composed of 5 Huts, 2 Toilets and 1 water tank and all of them are located in Mon State. Details are shown in Table 2.6.

Table 2.6 Inventory of Affected Structures

State/Region	Village	No. of Structure Affected	Structure Type	No. of Secondary Structure Affected	Structure Type
Bago Region	Shan Kaing	1	1 Seasonal House	0	
Mon State	Sut Pa Nu	3	3 Houses	8	5 Huts + 2 Toilets +1 Water tank
Mon State	Kha Lun	0		0	
Total		**4**		**8**	

Source: JICA Study Team

(3) Trees and Crops

As mentioned above, a total of 62.53 acres (253,050 m^2) of agricultural land will need to be acquired by the project. The garden lands are mainly used for growing trees such as rubber, betel vines etc. The crop lands are used mainly for growing paddy and varieties of peas and beans. Affected crops and yields are shown in Table 2.7 and all affected trees by types regardless of commercial or home consumption are also broken down in Table 2.8.

Regarding with the affected crops, they are owned by 10 PAHs, which composed of 10 PAHs of paddy owners and 7 PAHs of peas and beans owners. Among those affected crop farmers, 1 farmer is a tenant farmer who rents land from land owner, while 9 affected farmers are agricultural land owners. The tenant farmer grows both paddy as well as peas and beans.

In respect to the trees, a total of 15,439 trees are identified in the project area. Among the 3 villages and 2 regions of the project locations, the trees are existing mainly in Sut Pa Nu Village and Khalon Village of Mon State side, while there are no trees affected in Shan Kain Village of Bago Region side. The owners of the affected tress shown in the table are disaggregate numbers of the owners of each types of trees, therefore the number of affected tree owners disaggregated by villages are 0 PAHs in Shan Kaing Village, 6 PAHs in Su Pa Nu Village and 1 PAH in Khalon Village. Among those 7 tree owners, there is 1 PAH who grows trees on rented land in Sut Pa Nu Village. The other 6 PAHs possess their trees on their own land.

Table 2.7 Inventory of Affected Crops

State/Region	Village	Crop Type	No. of Affected Crop owner (No.)	Yield (Basket)	Crop Type	No. of Affected Crop owner (No.)	Yield (Basket)
Bago Region	Shan Kaing	Paddy	7	1,371	Peas and Beans	7	457
Mon State	Sut Pa Nu	Paddy	1	258	Peas and Beans	0	0
Mon State	Khalon	Paddy	2	996	Peas and Beans	0	0
Total			**10**	**2,625**		**7**	**457**

1 Basket = 20.9 kg
Source: JICA Study Team

Table 2.8 Inventory of Affected Trees

Type	Shan Kain (Bago Region)		Sut Pa Nu (Mon State)		Khalon (Mon State)		Total	
	No. of Affected Tree owner	No. of Affected Trees	No. of Affected Tree owner	No. of Affected Trees	No. of Affected Tree owner	No. of Affected Trees	No. of Affected Tree owner	No. of Affected Trees
	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)
Rubber	0	0	3	3,808	1	530	4	4,338
Betel vine	0	0	5	9,365	0	0	5	9,365
Mango	0	0	4	5	0	0	4	5
Betel nuts	0	0	1	4	0	0	1	4
Jack Fruit	0	0	3	9	0	0	3	9
Danyin	0	0	2	3	0	0	2	3
Plam	0	0	1	1	0	0	1	1
Pomelo	0	0	1	1	0	0	1	1
Guava	0	0	1	4	0	0	1	4
Tikto	0	0	0	0	1	1	1	1
Kinmunchin	0	0	0	0	1	1	1	1
Banana	0	0	2	140	1	6	3	146
Dannalun	0	0	1	2	0	0	1	2
Bamboo	0	0	4	1,550	0	0	4	1,550
Kokeko	0	0	1	1	0	0	1	1
Banyan	0	0	1	1	0	0	1	1
Thit mwe	0	0	1	7	0	0	1	7
Total	**0**	**0**	**31**	**14,901**	**4**	**538**	**35**	**15,439**

Source: JICA Study Team

CHAPTER 3 Census and Socioeconomic Studies

3.1. Overview

This section analyzes the findings of the Socio-economic Survey (SES) relevant to the PAHs and PAPs by land acquisition of the project. This section will also analyze findings from the Census and Inventory of Loss Assets (IOL) Survey specific to 20 households impacted by land acquisition in both Mon State and Bago Region. All compensation and resettlement activities shall follow from these surveys, including individual household compensation entitlements and livelihood restoration targets.

3.2. Methodology for Census and Socioeconomic Survey

The section discusses the methodologies for the SES, Census and IOL and analyses findings relevant to impacted households as defined by this RAP. The Census and IOL of first stage were identification of all PAPs at the time of declaring the Cut-Off Date (COD) and all the assets of those PAPs that will need to be compensated. The census and socioeconomic survey was conducted after the cut-off date[1] declaration (on 1 January 2018). Those surveys were conducted by JICA study team joined by officers/staffs from Township Level of General Administration Department (GAD), DOB/MOC, Department of Agricultural Land Management and Statistics (DALMS), and Ward/ Village Tract Administrators.

As the project is in preliminary stage, delineation of affected structures and identification of project-affected persons was based on preliminary design of the Bridge alignment which also includes embankment works with the assistance from DALMS, alignment was plotted on cadastral maps and lot numbers of land parcels to be affected were noted down. Potential affected land and structure owners were interviewed with well prepared questionnaires. This census and socio economic survey covers every single household impacted by land acquisition except 1 household who have been working in overseas for some duration. Data of the survey includes information of households affected by the project, information regarding presence of vulnerable people. The detailed definition of the vulnerable households are described in 3.3.2(3) Vulnerability. Moreover, data needed for formulation of necessary relocation assistance schemes were also collected. Summary of survey components and methodology is presented in Table 3.1. The contents of this RAP is to be updated in accordance with updated detailed design in next stage. The detail schedule should refers to Chapter 11.

[1] This is the date commonly recognized when the census and the inventory of assets of the people affected by the project are started. People occupying the project area after the cut-off date are not eligible for compensation and/or resettlement assistance. In the same way, fixed assets (like built structures, crops, fruit trees and woodlots) that appear after this date, or an alternative mutually agreed on date, will not be compensated. In the project, the policy was informed to PAPs through the state governments, LGUs and townships.

Table 3.1 Summary of Survey Components and Methods

	Survey Component	Method	No. of Survey target
1	Inventory data of occupied land and assets of each household	-To count no. of facilities -To measure size	20 PAHs
2	Land use condition	-To collect secondary data -To observe sites	20 PAHs
3	Socioeconomic condition of affected households Perception of the household heads regarding the project	By face-to-face interview with questionnaire form including: -Baseline information on household (name of household head, location etc.) -Family structure and education level -Income and expenditures by source -House structure -Properties Owned -Period of living and/or business -Registration and/or ownership -Project awareness/preference	19 PAHs (accounting for 95 % of total PAHs) (1 PAH were not able to be surveyed as the household stay overseas during survey period, although the information on gender of household head was acquired from relatives and neighbouring household)

Source: JICA Study Team

3.3. Results of the Survey

3.3.1. Profile of Project Affected Households

(1) Gender

Table 3.2 shows the number of PAHs based on the census survey. According to the survey result, 18 PAHs are male headed households and 2 PAHs are female headed households. The number comprises 90% of male headed household and 10 % of female headed household.

Table 3.2 Gender of PAHs

Gender of Household Head	Shan Kain (Bago Region)		Sut Pa Nu (Mon State)		Kha Lun (Mon State)		Total	
	No.	%	No.	%	No.	%	No.	%
Male headed HH	7	88%	7	88%	4	100%	18	90%
Female headed HH	1	13%	1	13%	0	0%	2	10%
Total	**8**	**100%**	**8**	**100%**	**4**	**100%**	**20**	**100%**

Source: JICA Study Team

(2) Ethnicity

Distribution of PAHs by ethnicity is presented in Table 3.3. It is found that all of the project affected households are Barmar. However, the information of 1 PAH wasunavailable since the PAH is livingoutside of Myanmar, therefore the survey result on the 1 PAH is not reflected in the Table.

Table 3.3 Ethnicity of PAHs

State/Region	Village	Ethnicity			
		Barmar	Mon	Others	Total
Bago Region	Shan Kaing	8	0	0	8
Mon State	Sut Pa Nu	7	0	0	7
Mon State	Kha Lun	4	0	0	4
Total		**19**	**0**	**0**	**19**

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

(3) Religion

Table 3.4 shows the distribution of PAHs by religion in the project site. As a result of the survey, 100% of the PAHs in the project area are Buddhist, although the information of 1 PAH was not accessible.

Table 3.4 Religion of PAHs

State/Region	Village	Religion				
		Buddhist	Christian	Islamic	Hindu	Total
Bago Region	Shan Kaing	8	0	0	0	8
Mon State	Sut Pa Nu	7	0	0	0	7
Mon State	Kha Lun	4	0	0	0	4
Total		**19**	**0**	**0**	**0**	**19**

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

(4) Daily Languages of PAHs

Daily language used by PAHs is shown in Table 3.5. It shows that all of the PAHs in project area communicate in Burmese languages on daily basis.

Table 3.5 Daily Language Used by PAHs

State/Region	Village	Daily Language used			
		Burmese	Mon	Others	Total
Bago Region	Shan Kaing	8	0	0	8
Mon State	Sut Pa Nu	7	0	0	7
Mon State	Kha Lun	4	0	0	4
Total		**19**	**0**	**0**	**19**

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

(5) Education Level of Household Heads

The education level of household heads in the bridge alignment and the additional revetment area is shown in Table 3.6. In accordance with the surveyed results, there are 6 household heads that have the monastic education, 7 household heads have completed the primary education level, 2 household heads accomplished middle school education and 3 have attained a high school education in the project area. Moreover, it is found that there is only one household head that completed the University/ Graduate level.

Table 3.6 Education Level of Household Heads

Education Level	Shan Kain (Bago Region)		Sut Pa Nu (Mon State)		Khalon (Mon State)		Total	
	No.	%	No.	%	No.	%	No.	%
No education	0	0.0	0	0.0	0	0.0	0	0.00
Monastic	1	12.5	1	14.3	4	100.0	6	31.58
Primary	3	37.5	4	57.1	0	0.0	7	36.84
Middle	0	0.0	2	28.6	0	0.0	2	10.53
High School	3	37.5	0	0.0	0	0.0	3	15.79
University	0	0.0	0	0.0	0	0.0	0	0.00
Graduate	1	12.5	0	0.0	0	0.0	1	5.26
Total	**8**	**100.0**	**7**	**100.0**	**4**	**100.0**	**19**	**100.0**

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

(6) Occupation of Household Heads

Table 3.7 shows the main occupation of household heads in the project area where the bridge alignment and additional revetment exits. It is found that in Sut Pa Nu Village, 5 household heads are growing orchards, and the rest of the household heads are wage workers and annual crop farmers. In Kalong Village, 2 household heads are engaging in orchard plantation, and the other 2 household heads are a casual employee and the other raising livestock. For Shan Kaing Village, the main occupation of household heads is farming rice and crops. Out of all the households in Shan Kaing Village on the Bago side, 6 household heads are farmers, one household head is a shop owner and one household head is dependent. For combining both the Bago Region side and the Mon State side, 7 household heads (36.84%) are found farming rice and crops, 7 household heads (36.84%) grow orchards, and the rest of them have different occupations. This result shows that the agriculture is the major occupation in the project area.

Table 3.7 Occupation of Household Heads

Occupation	Shan Kain (Bago Region)		Sut Pa Nu (Mon State)		Khalon (Mon State)		Total	
	No.	%	No.	%	No.	%	No.	%
Dependent	1	12.5	0	0.0	0	0.0	1	5.26
Student	0	0.0	0	0.0	0	0.0	0	0.00
Odd Job (Casual Employee)	0	0.0	0	0.0	1	25.0	1	5.26
Wage Worker (Long Term contract)	0	0.0	1	14.3	0	0.0	1	5.26
Farming Rice and Other Crops	6	75.0	1	14.3	0	0.0	7	36.84
Farming Vegetables	0	0.0	0	0.0	0	0.0	0	0.00
Orchard	0	0.0	5	71.4	2	50.0	7	36.84
Livestock	0	0.0	0	0.0	1	25.0	1	5.26
Fishery	0	0.0	0	0.0	0	0.0	0	0.00
Handicraft	0	0.0	0	0.0	0	0.0	0	0.00
Government Employee	0	0.0	0	0.0	0	0.0	0	0.00
Shop Owner	1	12.5	0	0.0	0	0.0	1	5.26
Retired or over working age	0	0.0	0	0.0	0	0.0	0	0.00
Others	0	0.0	0	0.0	0	0.0	0	0.00
Total	**8**	**100.0**	**7**	**100.0**	**4**	**100.0**	**19**	**100.0**

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

3.3.2. Socioeconomic Condition of Project Affected Households

(1) Annual Income of PAHs

Table 3.8 shows that the range of the annual income of the PAHs in the project area. According to the survey result, the PAHs have an annual income between 10,000.001-20,000,000 kyat in the project area. Out of the total 19 PAHs, 5 (26%) PAHs earn below 10,000,000 kyat and 20,000,001- 30,000,000 kyat. Although all of the PAHs in Shan Kaing Village earn less than 30,000,000 kyat annually, 4 PAHs in Sut Pa Nu Village and in Kha Lun Village earn more than 30,000,001 kyat annually. 1 PAH in Sut Pa Nu Village earns 30,000,001 - 40,000,000 kyat, 1 PAH also in Sut Pa Nu Village earns 40,000,001 - 50,000,000 kyat and 2 PAHs in Kha Lun Village earn above 50,000,000 kyat per year.

Table 3.8 Distribution of PAHs by Annual Income

Annual Income (Kyat)	Shan Kain (Bago Region)		Sut Pa Nu (Mon State)		Kha Lun (Mon State)		Total	
	No.	%	No.	%	No.	%	No.	%
10,000,000 or Below	4	50%	0	0%	1	25%	5	26%
10,000,001 – 20,000,000	2	25%	3	43%	1	25%	6	32%
20,000,001 – 30,000,000	2	25%	2	29%	0	0%	4	21%
30,000,001 – 40,000,000	0	0%	1	14%	0	0%	1	5%
40,000,001 – 50,000,000	0	0%	1	14%	0	0%	1	5%
Above 50,000,000	0	0%	0	0%	2	50%	2	11%
Total	**8**	100%	**7**	100%	**4**	100%	**19**	100%

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

(2) Annual Expenditure of PAHs

The annual expenditure range by PAHs in the project area is displayed in Table 3.9. Of those surveyed, the majority of the PAHs spend less than 15,000,000 kyat per year, that is 16 PAHs, and they accounts for 85%. As for the rest of the PAHs, 1 PAH spends 15,000,001 – 20,000,000 kyat and 2 PAHs spend above 20,000,000 kyat annually.

Table 3.9 Distribution of PAHs by Annual Expenditure

Annual Expenditure (Kyat)	Shan Kain (Bago Region)		Sut Pa Nu (Mon State)		Khalon (Mon State)		Total	
	No.	%	No.	%	No.	%	No.	%
5,000,000 or Below	5	63%	0	0%	1	25%	6	32%
5,000,001 – 10,000,000	2	25%	3	43%	1	25%	6	32%
10,000,001 – 15,000,000	1	13%	2	29%	1	25%	4	21%
15,000,001 – 20,000,000	0	0%	0	0%	1	25%	1	5%
Above 20,000,000	0	0%	2	29%	0	0%	2	11%
Total	**8**	100%	**7**	100%	**4**	100%	**19**	100%

Note: Information on 1 PAHs are not included in this table.
Source: JICA Study Team

(3) Vulnerability

In Myanmar, there is no official definition of vulnerable groups at present. In this project, however, particular attention is paid to respective groups. For vulnerable groups, the project defines a household headed by woman, a household headed by elderly (over 60 years old), a household including a person with disability, a household below the poverty line, a household including indigenous peoples, a household headed by child and a landless households by referring JICA and other international practices.

Regarding with the poverty line, there is no poverty line defined by Government. However, the "An analysis of poverty in Myanmar" was published by the Government of Myanmar and the World Bank in 2017 and the poverty line was established as the household expenditure per adult per day of 1,303 kyat (0.92 USD in the JICA exchange rate as of September 2018) or the household expenditure per capita per day of 1,241 kyat (0.88 USD in the JICA exchange rate as of September 2018).

For the criteria of the indigenous person, the definitions WB OP 4.10 is referred. The details of the applicability of the criteria is verified in Appendix E Checklist of Applicability on Indigenous People. Table 3.10 shows that there are 2 vulnerable households in Sut Pa Nu Village, Mon State and 2 vulnerable households in Shan Kaing Village, Bago Region among interviewed PAHs. Of them, 2 PAHs are categorized as household headed by woman, 2 PAHs are categorized as household headed by an elderly person and 1 PAH is categorized as a household including a member of person with disability. There are no PAHs which: fall under the poverty line; are a household including indigenous people;, are a household headed by a child; nor are there landless households.

Table 3.10 Number of Vulnerable People among PAHs

Vulnerability	Bago Region	Mon State	Mon State	Total
	Shan Kaing	Sut Pa Nu	Kha Lun	
	No.	No.	No.	No.
Household headed by woman	1	1	0	2
Household headed by elderly person (over 60)	2	0	0	2
Household including a person with disability	0	1	0	1
Household below the poverty line	0	0	0	0
Household including indigenous peoples	0	0	0	0
Household headed by child	0	0	0	0
Landless households	0	0	0	0
Total	2*	2	0	4*

* 1 PAH in Bago Region falls under 2 vulnerable criteria; therefore the total vulnerable PAH is 4.
Note: Information on 1 PAH are not included in this table.
Source: JICA Study Team

(4) Project Acceptability

As shown in Table 3.11, 100 % of PAHs expressed a positive response or accepted the project. Typical opinions for "Yes" for that the project are:

i) Improve quality of life; and

ii) Improve accessibility.

Although there are no PAHs who disagree with the project implementation, they think the

major negative impact of the project could be:

i) Loss of income/land.

The following points are major opinions from PAHs:

i) Conduct fair compensation for lost assets;

ii) Desire to implement the project soon.

Table 3.11 Project Acceptability

Project Acceptability					
State/Region	Village	Answer			
		Yes		No	
		No.	%	No.	%
Bago Region	Shan Kaing	8	42.11	0	0
Mon State	Sut Pa Nu	7	36.84	0	0
Mon State	Khalon	4	21.05	0	0
Total		19	100.00	0	0

Note: Information on 1 PAH are not included in this table.
Source: JICA Study Team

CHAPTER 4 Policy and Legal Framework

4.1. Relevant Laws and Regulations in Myanmar

Currently in Myanmar, there is no comprehensive law stipulating land acquisition and resettlement. The Land Acquisition Act, enacted in 1894, is still the legal basis for land acquisition in Myanmar. The Land Nationalization Act 1953 which was repealed by the Farmland Law 2012 determines nationalization of farmlands and procedures for conversion of farmlands for other purposes (La Na 39). Resettlement-related issues are depicted in some of the existing laws and regulations. However, in most cases, details such as procedures and conditions related to resettlement issues are yet to be determined. Table 4.1 indicates relevant Myanmar laws and regulations for land acquisition and resettlement which are applicable to lower Myanmar where the Project Area is located.

Table 4.1 Relevant Laws in Myanmar

- Constitution of the Republic of the Union of Myanmar, 2008
- Land Acquisition Act, 1894 (Amended in 1937 (Adaptation of Laws Orders), and 1940 (Burma Act 27)
- Farmland Law, 2012
- Farmland Rules, 2012
- Vacant, Fallow and Virgin Lands Management Law, 2012
- Vacant, Fallow and Virgin Lands Management Rules, 2012
- Forest Law, 2018
- Transfer of Immovable Property Restriction Law, 1987
- The Law Amending the Disposal of Tenancies Law, 1965
- The Lower Burma Town and Village Land Act, 1899 (amendment , 2015)
- The Land and Revenue Act 1876 (Amended in 1945 (Burma Act No 12), 1946 (Burma Act No 64), and 1947 (Burma Act No 6)
- The Lower Burma Land Revenue Manual, 1876
- National Land Use Policy, 2016
- Development Committee Law, 1993
- Directions of Central Land Committee

Source: Prepared based on "Guidance Note on Land Issues Myanmar" UNHCR, UNHABITAT

Among these national laws, relating clauses in key laws are shown as follows.

1) Constitution of the Republic of the Union of Myanmar (2008)

37. The Union:

(a) 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;

(b) shall enact necessary law to supervise extraction and utilization of State-owned natural resources by economic forces;

(c) shall permit citizens right of private property, right of inheritance, right of private initiative and patent in accord with the law.

357. The Union shall protect the privacy and security of home, property, correspondence and other communications of citizens under the law subject to the provisions of this Constitution.

2) Land Acquisition Act (1894)

- Stipulates that the Government holds rights to take over land where the State asserts that such land is needed for public purposes
- Outlines relevant procedures of land acquisition and the method of valuation of land.

3) Farm Land Law (2012)

- Calls for suitable compensation and indemnity in case of repossession of farmland in the interest of the Union State.

4) Farm Land Rules (2012)

- Stipulates for farmers right to work on the farmland.
- States that when farmlands are converted into different forms of land based on the interest of the State or Public, the Stare of Public needs to make compensation to the farmers without delay.

4.2. JICA's Policy on Resettlement

JICA has policies on resettlement, which are stipulated in JICA Guidelines on Environmental and Social Considerations (April, 2010). The key principle of JICA policies on involuntary resettlement is summarized below:

a. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.

b. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.

c. People who must be resettled involuntary and people whose measures of livelihood will be hindered or losses 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.

d. Compensation must be based on the full replacement cost[2] as much as possible.

[2] WB OP 4.12 defines the replacement cost as follows:
For agricultural land, it is the pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
For land in urban areas, it is the pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration .
For houses and other structures, it is the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.
In determining the replacement cost, depreciation of the asset and the value of salvage materials are not taken into account, nor is the value of benefits to be derived from the project deducted from the valuation of an affected asset.
Where domestic law does not meet the standard of compensation at full replacement cost, compensation under domestic law is supplemented by additional measures so as to meet the replacement cost standard.

e. Compensation and other kinds of assistance must be provided prior to displacement.

f. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

g. In preparing a resettlement action plan, consultations must be prompted in the planning, implementation, and monitoring of resettlement action plans.

h. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. In addition to the above policies, JICA also applies for the following policies stipulated in World Bank OP 4.12.

i. 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 advantage of such benefit.

j. Eligibility of Benefits include, 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.

k. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

l. Provide support for the transition period (between displacement and livelihood restoration).

m. 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.

n. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, an abbreviated resettlement plan is to be prepared.

4.3. International Practices on Resettlement

Most international funding organizations and donors developed polices and guidelines for environmental social considerations including resettlement occurring under development projects. In principle, international practices on resettlement are conducted based on such polices and guidelines. The EWEC Project is composed of the JICA bridge section and the ADB bypass section, therefore major polices and guidelines applicable for the project are listed hereunder:

- JICA Guidelines for Environmental and Social Considerations (April, 2010)
- World Bank (WB) Environmental and Social Safeguard Policies: Operational Policy on Involuntary Resettlement (OP 4.12)
- Asian Development Bank (ADB) Safeguard Policy: Safeguard Policy Statement 2009 (SPS)

For the project of the bridge section, an RAP is prepared based mainly on the JICA Guidelines which also cite WB OP 4.12 but also referring to ADB SPS. However, the RP of ADB bypass sections mainly follows ADB SPS and satisfyies the requirement of ADB SPS, therefore it is not necessarily same as the contents of JICA RAP.

4.4. Gap Analysis

In principle, there are no gaps in the policies of international donors, therefore no gaps between the JICA Guidelines and ADB SPS is expected, although some gaps are often found between the policies of international donors and the laws and guidelines in the respected counties. The comparisons between current laws/regulations of the Government of Myanmar, JICA Guidelines for Environmental and Social Considerations (April, 2010) and ADB Safeguard Policy Statement (2009) are shown in Table 4.2.

Table 4.2 Comparisons between Laws in Myanmar, JICA Guidelines and ADB SPS

No.	JICA Guidelines	ADB Safeguard Policy Statement (2009)	Laws and Guidelines in Myanmar	Gap between JICA GL and ADB SPS (Upper column) Gap between JICA GL and Laws in Myanmar (Lower column)	Project Policy
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	The objectives are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives. (Para 3, Safeguard Requirements 2)	Not applicable	In the ADB SPS, avoidance and minimization are parallelly described. (There is no difference.) There is no regulation which mentions or requestsavoiding or minimizing involuntary resettlement and loss of livelihood means.	The project examines alternatives to avoid or minimize resettlement impact.
2	When, population	The objectives are to avoid	Market-value	There is no difference.	Follow JICA

No.	JICA Guidelines	ADB Safeguard Policy Statement (2009)	Laws and Guidelines in Myanmar	Gap between JICA GL and ADB SPS (Upper column) Gap between JICA GL and Laws in Myanmar (Lower column)	Project Policy
	displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives. (Para3, Safeguard Requirements 2) 43. The objectives of ADB's safeguards are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible. (Para43, A. Overarching Statement on ADB's Commitment and Policy Principles, V. Safeguard Policy Statement)	compensation shall be paid (Land Acquisition Act, Articles 23(1) and 23(2)) Compensation or indemnity is provided for farmland acquisition for the interest of the State or public (Farmland Law (2012) Art. 26, Farmland Rules (2012) Art. 64).	There is no difference.	GL
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. (JICA GL)	In the case of economically displaced persons, regardless of whether or not they are physically displaced, the borrower/client will promptly compensate for the loss of income or livelihood sources at full replacement cost. The borrower/client will also provide assistance such as credit facilities, training, and employment opportunities so that they can improve, or at least restore, their income-earning capacity, production levels, and standards of living to pre displacement levels. (Para 12, Safeguard Requirements 2)	Damages to standing crops/trees, lands, movable/immovable properties, relocation cost, economic activities are requested to compensate. (Land Acquisition Act (1894) Art. 23, Farmland Rules (2012) Art. 67)	There is no difference. There is no stipulation of improving or at least restoring living standard, income opportunities, and production levels to pre-project levels in the Myanmar legal framework.	The project considers the assistance to improve or restore the livelihood.
4	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	The rate of compensation for acquired housing, land and other assets will be calculated at full replacement costs. (Para10, Safeguard Requirements 2)	Land and other property: Market-value compensation shall be paid(Land Acquisition Act, Articles 23(1) and 23(2)) Crops: Compensation at three times of the value calculated based on the average production of crops in the current market price of that area is provided.	There is no difference. Land and other property: There is no clear indication of the method of valuation of compensation price although the law stipulates the compensation at market value. Crops: There is no difference.	Follow JICA GL

No.	JICA Guidelines	ADB Safeguard Policy Statement (2009)	Laws and Guidelines in Myanmar	Gap between JICA GL and ADB SPS (Upper column) Gap between JICA GL and Laws in Myanmar (Lower column)	Project Policy
			(Farmland Rules (2012) Art. 67)		
5	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Pay compensation and provide other resettlement entitlements before physical or economic displacement.(Para 11)	When compensation is not paid on or before land acquisition, compensation amount awarded with interest rate must be paid.	There is no difference. There is no clear indication about timing of compensation payment in the Myanmar legal framework.	The project supports the compensation process so that the compensation and other kinds of assistance to be provided prior to displacement.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	The borrower/client will prepare a resettlement plan, if the proposed project will have involuntary resettlement impacts.(Para 17, Safeguard Requirements 2) The borrower/client will provide relevant resettlement information, including information from the documents in para. 26 in a timely manner, in an accessible place and in a form and language(s) understandable to affected persons and other stakeholders. For illiterate people, suitable other communication methods will be used.(Para 27, Safeguard Requirements 2)	Not applicable	There is no difference. There is no regulation requesting to prepare resettlement action plan.	The project prepares resettlement action plan and make available to the public.
7	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. (JICA GL)	The borrower/client will conduct meaningful consultation with affected persons, their host communities, and civil society for every project and subproject identified as having involuntary resettlement impacts. Meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and	Not applicable	There is no difference. There is no regulation requesting to organize consultations with PAPs.	The project will hold consultations with the affected people and their communities on sufficient information made available to them in advance.

No.	JICA Guidelines	ADB Safeguard Policy Statement (2009)	Laws and Guidelines in Myanmar	Gap between JICA GL and ADB SPS (Upper column) Gap between JICA GL and Laws in Myanmar (Lower column)	Project Policy
		readily accessible to affected people; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. (Para.28, Safeguard Requirements 2)			
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Not Applicable	Not applicable	There is no difference. There is no regulation requesting to use a form, manner and language understandable for affected persons to be used in consultation.	The project considers appropriate explanation when consultations are held.
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	Carry out meaningful consultations with affected persons, host communities, and concerned non government organizations. Ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programs. (Para.2)	Not applicable	There is no difference. There is no regulation requesting participation of PAPs in planning, implementation, and monitoring of resettlement action plans.	The project considers the appropriate participation of affected people.
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Establish a grievance redress mechanism to receive and facilitate resolution of the affected persons' concerns. (Para. 2)	1) Notice of compensation amount to PAPs directly: appeal to the court within 6 weeks from the date of compensation award 2) Notice of compensation amount to representatives of PAPs: i) within 6 weeks of receipt of compensation notice, or ii) within 6 months from the from the date of compensation award, whichever period shall be first expire (Land Acquisition Act (1894) Art. 18)	There is no difference. The procedure of grievance in the Myanmar context is direct settlement at the court, which is not necessarily easy or accessible to PAPs	The project considers the grievance redress mechanism by utilizing the existing administration system to be convenient for PAPs.

No.	JICA Guidelines	ADB Safeguard Policy Statement (2009)	Laws and Guidelines in Myanmar	Gap between JICA GL and ADB SPS (Upper column) Gap between JICA GL and Laws in Myanmar (Lower column)	Project Policy
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. (WB OP 4.12 Para. 6)	Screen the project early on to identify past, present, and future involuntary resettlement impacts and risks. (Para.1) The borrower/client will conduct socioeconomic survey(s) and a census, with appropriate socioeconomic baseline data to identify all persons who will be displaced by the project and to assess the project's socioeconomic impacts on them. For this purpose, normally a cut-off date will be established by the host government procedures. In the absence of such procedures, the borrower /client will establish a cut-off date for eligibility. Information regarding the cutoff date will be documented and disseminated throughout the project area.(Para.15, Safeguard Requirements 2)	A notification of land acquisition or public purposes is published in the Gazette, which is also published at the convenient place in the concerned municipality. (Land Acquisition Act (1894) Article 4)	There is no difference. There is no specific description of identifying affected people as early as possible in the national law. In addition, there is no Myanmar law regarding the cut-off date.	The project identifies and records the affected people at the project identification stage.
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 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 OP 4.12 Para. 15)	Displaced persons in a project area could be of three types: (i) persons with formal legal rights to land lost in its entirety or in part; (ii) persons who lost the land they occupy in its entirety or in part who have no formal legal rights to such land, but who have claims to such lands that are recognized or recognizable under national laws; and (iii) persons who lost the land they occupy in its entirety or in part who have neither formal legal rights nor recognized or recognizable claims to such land. The involuntary resettlement requirements apply to all three types of displaced persons. (Para.7, Safeguard Requirements 2)	Occupiers/stakeholders of lands to be acquired are given an explanation about acquisition and claims to compensations. (Land Acquisition Act (1894) Article 9)	There is no difference. Detailed procedures as well as eligibility criteria are not clearly defined. Also there is no specific indication about displaced persons without titles.	The project considers eligibility for assistance to all households whose income sources or assets are confirmed as affected due to project implementation .

No.	JICA Guidelines	ADB Safeguard Policy Statement (2009)	Laws and Guidelines in Myanmar	Gap between JICA GL and ADB SPS (Upper column) Gap between JICA GL and Laws in Myanmar (Lower column)	Project Policy
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP 4.12 Para. 11)	Preference will be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (Para.9, Safeguard Requirements 2)	Not Applicable	There is no difference. There is no regulation stipulating to give land-based resettlement strategies.	The project considers the land-based resettlement strategies.
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4. 12, para.6)	The rate of compensation for acquired housing, land and other assets will be calculated at full replacement costs. The calculation of full replacement cost will be based on the following elements: (i) fair market value; (ii) transaction costs; (iii) interest accrued, (iv) transitional and restoration costs; and (v) other applicable payments, if any.(Para.10, Safeguard Requirements 2)	Not Applicable	There is no difference. There is no regulation stipulating to provide support for the transition period.	The project considers the support for the transition period.
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 OP 4.12 Para. 8)	As part of the social impact assessment, the borrower/client will identify individuals and groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status. Where such individuals and groups are identified, the borrower/client will propose and implement targeted measures so that adverse impacts do not fall disproportionately on them and they are not disadvantaged in relation to sharing the benefits and opportunities resulting from development. (Para.16, Safeguard Requirements 2)	Not Applicable	There is no difference. There is no regulation stipulating to provide particular attention to the vulnerable groups.	The project pays particular attention to vulnerable groups.

Source: JICA Study Team

CHAPTER 5 Compensation Entitlements and Entitlement Matrix

5.1. Cut-off Date for Entitlement

The cut-off date (COD) for entitlements is recognized by international institutions such as WB, JICA and ADB. It is a tool to determine eligibility for entitled assistance. The COD is set on in order to avoid influx of population into the project area, and people who encroach on the area after the COD are not entitled to compensation or any other form of resettlement assistance. Although the census begins normally on the COD, the COD could also be the date the project area was delineated, prior to the census, provided that there has been an effective public dissemination of information on the area delineated, according to World Bank OP 4.12. Based on the concept, the COD for this project was declared on **1 January 2018** by MOC. An non-objection letter from the chief minister of Mon State and Bago Region followed. Then, the announcement was officially posted on the bulletin board of the township administration of Kyaikto Township of Mon State and Waw Township of Bago Region for informing the public. In addition, PAPs were reminded verbally several times during socialization meetings and census and SES interview surveys.

As mentioned, additional land and structure development is to be limited after the COD, and the policy is being explained and understood among the PAPs in occasions such as public consultation meetings, interviewing, etc. In addition, local administrations and local officials of MOC in charge of the matter monitor the situation and try to collect information on unfair development or illegal encroachment of people from the dwellers and so on.

Although the design may be revised and adjusted during DD stage, the COD will not be re-declared. Instead, the COD declared during F/S stage will be re-informed in the times of socialization meeting to be held before census and IOL update of DD stage. The continuous monitoring to prevent the influx of people and ineligible new development should be conducted by local administrations. Any disputes that are unresolved or that come after the Census/IOL will be referred to the project proponent or Grievance Redress Mechanism.

5.2. Entitlement Matrix

The entitlement matrix is a matrix to systematically show the relations of compensation, which includes type of loss, application, person entitled, assistance policy and responsible entity. The matrix is developed based on the impact identified through the census survey and other related activities. In this Project, the Entitlement Matrix was prepared as Table 5.1 to show the eligibility conditions and the main compensation measures proposed to PAPs according to the type of impact. It should be noted that depending on the type of impact, the PAP may be eligible for one or more compensation measure.

This entitlement matrix of the resettlement plan may be updated after the detailed design stage to reflect the relevant changes, but the standards set in the original entitlement matrix should not be changed when the resettlement plan is revised and finalized. It is also noted that the assistance policy for each item for each eligibility should be harmonized with ADB bypass sections as much as possible, although ADB RP is prepared in accordance with ADB SPS.

Table 5.1 Entitlement Matrix

	Type of loss/ impact	Application	Eligible Persons	Entitlements	Implementation issues
1	Land				
1.1	Agricultural Land (Crop Land and Garden Land)	Marginal loss (less than 10% of total agricultural landholding of the household)	Land owner/ Occupant or a person who has recognizable right to claim to the land	(A) Cash compensation at replacement cost for the affected land area	(a) Replacement cost for agricultural land should include the market value of land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
1.2		Severe loss (10% or more than 10% of total agricultural landholding of the household)	Land owner/ Occupant or a person who has recognizable right to claim to the land	(A) Cash compensation at replacement cost for the affected land area (B) Assistance for SAH as specified in 5.1 (C) Be entitled to participate in Income Restoration Program (IRP)	(a) Replacement cost for agricultural land should include the market value of land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes. (b) If the remaining area of the land plot is no longer economically viable (too small area or the shape is difficult for cultivation) and if the land user requests, the entire plot shall be acquired and compensated by replacement cost. (c) IRP will be elaborated during RAP updating .
1.3	Residential Land	Full or Partial Impact	Land owner/ Occupant or a person who has recognizable right to claim to the land	(A) Cash compensation at replacement cost for the affected land area	(a) Replacement cost for residential land should include the market value of land of equal size and use, plus the cost of any registration and transfer taxes. (b) If the remaining area of the land plot is no longer economically viable (too small area or the shape is difficult for usage) and if the land user requests, the entire plot shall be acquired and compensated by replacement cost.
2	Structure				

2.1	Residential House	Loss of partial houses	House owner regardless of tenure status	(A) Cash compensation at replacement cost for the affected portion with no depreciation and no deduction for salvageable materials (B) Assistance to repair the remaining portion of structure	(a) Replacement cost for houses and other structures should include the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees.
2.2		Full Impact (Relocation)	House owners whose houses are built on their own land	(A) Cash compensation at replacement cost for the affected portion with no depreciation and no deduction for salvageable materials (B) Relocation options (i) Regardless of affected land type, AHs will be allowed to rebuild their houses on their non-affected land area. (ii) AHs will purchase replacement land for self-relocation with the cash compensation at replacement cost received for the affected land. **Relocation assistance** (C)Transportation assistance; (D)Relocation assistance as prescribed in Item 5.2 and 5.3 (E) Assistance for SAH as specified in 5.1 (F)Be entitled to participate in the IRP	(a) Replacement cost for houses and other structures should include the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees. (b) The transportation assistance will be determined during the RAP updating (c) AHs will be provided with the notice of land clearance 6 months in advance in a particular segment of the Project

2.3		Loss of full houses (relocation)	Owner regardless of tenure status (Squatter)	(A) Cash compensation at replacement cost for the affected portion with no depreciation and no deduction for salvageable materials **Relocation assistance** (C)Transportation assistance; (D)Relocation assistance as prescribed in Item 5.2 and 5.3 (E) Assistance for SAH as specified in 5.1 (F)Be entitled to participate in the IRP	(a) Replacement cost for houses and other structures should include the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees. (b) The transportation assistance amount will be determined during the RAP updating (c)APs will be noticed 6 months prior to site clearance
2.4	Secondary Structures (Structures such as hut, toilet, water tank, fences, wells etc.)	Partial or Full Impact	Owners of the structure	(A) Cash compensation at replacement cost for the affected portion with no depreciation and no deduction for salvageable materials (B) If removal is required, for movable structures, assessment on ability to move the dismantled structure will be considered. Assistance will be provided to cover the replacement costs of site preparation, dismantling, moving and rebuilding the structure	(a) Replacement cost for houses and other structures should include the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees.
3	Crops and Trees				
3.1	Annual Crops	Loss of Annual Crops	Crop owners (regardless of the ownership of land)	(A) Cash assistance which is equivalent to 3 years value of crops (market price) in the areas which PAPs can no longer cultivate If the impact to the crops accounts for 10 % or more than 10% of income sources of the households, following assistance shall also be provided. (B) Assistance for SAH as specified in 5.1 (C) Be entitled to participate in the	(a) DPs will be given 6 months' notice to harvest rice prior to site clearance and not-plant for next season (b) If crops are not in ripening stage, PAPs will be provided the full market value of production cost)

				IRP	
3.2	Trees	Loss of Trees	Tree owners (regardless of the ownership of land)	(A) Fruits tree/ Production Tree: Cash compensation at market price for loss of crops/fruits calculated as number of years needed to bear fruit (B) Timber tree/ Shade Tree: Cash compensation equivalent to the market price of the tree as timber/firewood If the impact to the crops accounts for 10 % or more than 10% of income sources of the households, following assistance shall also be provided. (B) Assistance for SAH as specified in 5.1 (C) Be entitled to participate in the IRP	(a)The AHs have the right to use salvageable trees (b) Assistance amount is calculated based on yield amount recorded in DALMS or confirmed at survey
4	Loss of Business/work/employment				
4.1	Loss of Business (Shops/ Restaurant other business such as fish pond or laterite quarry)	Non-direct impact (The residual portion is still viable for business after repairing) the business (which relocation of the business is not required)	Owners of the business (shop/restaurant/other business such as fish pond or laterite quarry)	(A) Cash assistance for the income loss during the period of the business disruption while the remaining structure is being repaired	(a) The amount will be based on either official evidence of income (such as tax receipts or similar evidence) or otherwise based on assessed minimum wage in the project area multiplied by an assessed reasonable period required to carry out the repairs.
4.2		Direct impact to the business (In which the relocation and re-establishment of the business is required because of the entire portion is affected by the COI or the residual portion is unviable to continued business after	Owners of the business (shop/restaurant/other business such as fish pond or laterite quarry)	(A) Cash assistance for the income loss during the relocation and re-establishment of the affected business in new place	(a) The amount will be based on either official evidence of income (such as tax receipts or similar evidence) or otherwise based on assessed minimum wage in the project area multiplied by an assessed reasonable period required to carry out the business relocation and re-establishment in the new place.

		repairing)			
4.3	Loss of leasehold due to end of agreement before expiry	Loss of leasehold of Land and structure	Tenants who are operating business (including agriculture) on the rented land	(A) One time assistance in looking for alternative place to rent, plus transportation costs to move to the new place: $250/household	
4.4	Employment	Temporary disruption of employment	Employees of affected business who will experience temporary or loss of employment due to the business disruption	(A) Cash assistance equivalent to lost wages for the period for the business disruption up to 3 months	(a) Employees are to confirm whether they have been working for the affected business HH at least 6 months at the time of business disruption. They have to show their employment contract or their actual employment status must be confirmed by the village administrators. (b) The amount of lost wages to be based on official employment records or standard wages for similar work in the project areas assessed by the Township General Administration.
4.5		Permanent loss of employment	Employees of the affected business who will experience permanent loss of employment due to the business disruption	(A) Cash assistance equivalent to lost wages for 6 months and entitled to participate in the vocational training if they are not able to find alternative employment	(a) Employees are to confirm whether they have been working for the affected business HH at least six months at the time of business disruption. They have to show their employment contract or their actual employment status must be confirmed by the village administrators. (b) The amount of lost wages to be based on official employment records or standard wages for similar work in the project area as assessed by the Township General Administration.
5	Special Assistance				
5.1	Assistance for SAH		AHs who will have 10% or more than 10% of total production landholding or relocation households	(A) Cash assistance for 3 months based on the minimum subsistence level	(a)Subsistence level based on poverty rate of $1.25 per day per person

5.2	Relocation stabilization assistance		Residential relocation but non-vulnerable households (Non-vulnerable households are the PAHs do not fall under any of the criteria described in 5.5)	(A) Relocation stabilization assistance for 2 months	(a) Level and types of relocation assistance to be provided to relocation households will be determined by the Regional/State General Administration during RAP updating
5.3			Residential relocation and vulnerable households (Vulnerable households are the PAHs who fall under one or more of the criteria described in 5.5)	(A) Relocation stabilization assistance for 4 months	(a) Level and types of relocation assistance to be provided to relocation households will be determined by the Regional/State General Administration during RAP updating
5.4	Transportation Assistance		Relocation household	(A) One-time cash assistance for transportation cost for moving	(a) The transportation assistance amount will be determined during the RAP updating
5.5	Vulnerable assistance		Vulnerable Households who fall under one or more of the criteria below; (i) Poor households; (ii) Female headed households; (iii) Households including a person with disability; (iv) Households headed by elderly; (v) landless households; (vi) ethnic minority	(A) Cash assistance: 300,000 Kyat/ household (B) Be entitled to participate in IRP	(a) Households that fall into more than one vulnerability criterial are entitled to receive the assistance once.
5.6	Income Restoration Program (IRP)		Vulnerable Households (Vulnerable households are the PAHs who fall under one or more of the criteria described in 5.5)	(A) IRP supporting through IRP implementation	(a) The IRP supporting will be in-kind or through-IRP. (b) The relevant supporting amount will be elaborated during RAP updating
5.7			Households losing 10-30 % of total production landholding	(A) IRP supporting through IRP implementation	(a) The IRP supporting will be in-kind or through-IRP. (b) The relevant supporting amount will be elaborated during RAP updating
5.8			Households losing 30-70 % of total production landholding	(A) IRP supporting through IRP implementation	(a) The IRP supporting will be in-kind or through-IRP. (b) The relevant supporting amount will be elaborated during RAP updating

5.9			Households losing more than 70% of total production landholding	(A) IRP supporting through IRP implementation	(a) The IRP supporting will be in-kind or through-IRP. (b) The relevant supporting amount will be elaborated during RAP updating
5.10			Relocation households	(A) IRP supporting through IRP implementation	(a) The IRP supporting will be in-kind or through-IRP. (b) The relevant supporting amount will be elaborated during RAP updating
6	Public Assets				
6.1	Public Assets	Partial or Full Impact	Affected communities which owns the public assets	(A) For the affected shrine: compensation for affected land and affected structures at replacement cost and costs for the related religious activities when dismantling and reconstruction of the shrine; (B) For the affected gas pipeline sections: Concrete boxes will be constructed to protect the pipeline sections (C) For other structures: Cash compensation at replacement cost to reconstruct the affected structures	

Source: JICA Study Team

CHAPTER 6 Income Restoration Program

6.1. Overview of Livelihood Impacts

In the project area, there are no direct impact to the shops or kiosks identified, but loss of productive farming land is the major cause of the impacts to the livelihood of PAHs. The PAHs will be entitled to receive compensations for affected items such as lands and crops etc. as described in Entitlement Matrix, but they may be have difficulty to restore their standard of life to pre-project level without taking any action such as purchasing new farmland and restore the scale of agricultural activity to the pre-project level or generating income by seeking new business opportunity.

Therefore, the Income Restoration Program (IRP) as supplemental support is proposed to aiming at improving or restoring and stabilizing the livelihoods of PAHs at least to pre-project levels after land acquisition and resettlement. The program is intended to 1) To improve vocational skills and income levels or at least restore pre-project levels, or 2) to improve the living standard and production level of PAPs in their new places by (a) providing technical assistance to continue farming or raising livestock/cattle, (b) creating job opportunities by vocational training and (c) creating career opportunities through vocational trainings and job creating activities in/around the project area. Those training sessions may be provided together with in-kind/ materials support.

The target of IRP is to be set at (i) the Severely Affected Households (SAHs) composing of those who will lose 10% or more of their production/income-generating assets and relocation households and (ii) the VAHs, as those people are regarded as to be significantly impacted by the Project in terms of restoration/ rehabilitation of their livelihood.

In the Project, 16 households of (i) SAHs and 4 households of (ii) the VAHs are identified. It is noted that among the 16 SAHs, 4 households are also regarded as VAHs, therefore a total of 16 eligible PAHs to participate in the IRP are identified during feasibility study. The final figures of the SAHs and VAHs will be updated during the DMS survey in the detailed design stage of the Project.

6.2. Preliminary Needs Assessment

In the Feasibility Study Stage, a preliminary needs assessment for the IRP was undertaken to support in designing income restoration measures to be involved in IRP. The survey target in preliminary assessment was all the PAHs regardless of eligibility of IRP. This survey was conducted from 16th to 17th of May, 2019 by the JICA Study Team (JST). JST clarified objectives for conducting the survey with PAHs before the survey and interviewed each of the representatives of the PAHs. The results of the questions are presented below.

6.2.1. Tendency of the attitudes towards income restoration activities of PAHs

As an expected income restoration activity, the likely attitude of PAHs towards income restoration after the Project can be categorized to the following points:

(1) Do nothing (Not planning to restore the income after project)
(2) Purchase replacement farmland /stores and restore the income at least to the pre-project level
(3) Change current income earning activity and try to find/ start new job to restore the

income at least to the pre-project level

(4) No idea at this moment

(5) Others (Specify)

The interview survey result is shown in Table 6.1. Considering the majority of the PAHs are depends on agricultural activities, 10 PAHs do not want to change their occupation and therefore intended to purchase replacement farmland and continue agricultural activities. On the other hand, 7 PAHs are interested in new business opportunities and would like to alter their economic activities. Although 1 PAH have answered that she will not attempt to do any activity for income restoration although she does not fall under SAHs nor VAHs. Two PAHs have no idea at the current stage.

Table 6.1 Tendency of the attitudes towards income restoration activities of PAHs

Tendency of the attitudes towards income restoration activities of PAHs	No. of PAHs
(1) Do nothing (Not planning to restore the income after project)	1
(2) Purchase replacement farmland / stores and restore the income at least to the pre-project level	10
(3) Change current income earning activity and try to find/ start new job to restore the income at least to the pre-project level	7
(4) No idea at this moment	2
(5) Others (Specify)	0
Total	**20**

Source: JICA Study Team

6.2.2. Willingness for participation and preference of IRP

Regarding the IRP, willingness for participation for IRP was interviewed to the representative of PAHs. According to the survey result, 16 household heads would like to attend IRP, whilst 4 household heads were not interested. Regarding to the household members, t15 household members from 11 PAHs are willing to participate in IRP. In regard to the perspective of gender-balance, 81% are male household head and 19% are female household heads who are interested in IRP as the number of male household heads are greater than female household heads. On the other hand, gender balance of household members are almost equal, 7 male household members answered they are interested, while 8 female household members replied the same.

Table 6.2 Number of PAHs who Wish to Attend IRP

Household-head		Household-members	
Yes	No	Yes	No
16	4	11	9

Source: JICA Study Team

Table 6.3 Number of PAPs who Wish to Attend IRP by Gender

Household-head			Household-members		
Total	Male	Female	Total	Male	Female
16	13	3	15	7	8

Source: JICA Study Team

In addition, Table 6.4 shows the preference of IRP program from each PAHs. Most of PAHs showed interest on technical assistance for agricultural activity and would like to continue farming/tree plantation, while 2 PAHs are seeking new business opportunity and are interested in opening a restaurant and some shops in the project area. Other 2 PAHs have not decided the future plan yet and they answered they may consider the future plan after determination of compensation price. One PAH is not interested in IRP because the PAH has enough income source which will not be affected by the Project and therefore are not worrying about their livelihood after land acquisition and resettlement caused by the Project.

As a noteworthy comment raised by 3 PAHs, it was mentioned that some assistance of loans for PAHs are favorable because they can invest in some goods, etc., for their income-generating activity.

Table 6.4 Preference of IPR Selected by PAHs

	Preferences of IRP affected households	No. of PAHs
	Provide technical assistance for those who want to continue farming or raising livestock/cattle	
1	Buy replacement paddy land to continue farming/ tree planation	15
2	Cow fattening	0
3	Duck raising	0
4	Raising chicken/pig	0
5	Raising cow and goat	0
	Provide technical assistance or/and small business/service models for those who want to do business	
6	Buy a tractor for renting to the farmers	0
7	Buy backhoe for road construction	0
8	Buy buses to do the bus-service in the area	0
9	Buy cars for transportation service	0
10	Buy harvesting machines to do the service in the local	0
11	Buy small trucks for transportation service	0
12	Buy trawlergies	0
13	Buy tuk tuks for transportation service	0
14	Open agricultural machinery shops	0
15	Open an organic agricultural products shop	0
16	Open beauty salons	0
17	Open betel leaves shops	0
18	Open clothing shops	0
19	Open cold drinks shop selling juice, coca cola etc.	0
20	Open construction materials shops	0
21	Open electronics repairing/selling shop	0
22	Open fruit shops	0
23	Open furniture selling goods	0
24	Open gasoline stations	0
25	Open grocery shops	0
26	Open mini-marts	0
27	Open pea and bean selling shops	0
28	Open rice shop	0
29	Open rubber shops	0
30	Open shop selling agricultural tools.	0
31	Open shop selling fertilizer and pesticide	0

	Preferences of IRP affected households	No. of PAHs
32	Open small motorcycle repairing/selling shops	0
33	Open small restaurants	2
34	Open souvenir shops	0
35	Open tea shops	0
36	Open vegetable shops	0
37	Open welding shops	0
	Create career opportunities through vocational trainings and job creating activities	
38	Work in the construction sites	0
39	**Others**	0
40	**Not yet decided**	2
41	**Not interested at all**	1
	Total	**20**

Source: JICA Study Team

6.3. Proposed Framework of IRP

The framework of IRP is prepared as described below. The detailed contents of IRP shall be further designed and implemented based on the framework.

Table 6.5 Framework of Income Restoration Program

Name of Program	Income Restoration Program (IRP)
Objectives	The primary objectives are described as follows; a) To improve vocational skills and improve or restore the income levels at least to the pre-project levels b) To improve living standard and production level of PAPs in their new places
Period	To be examined and decided during detailed design stage based on the detailed needs assessment as well as the monitoring result of livelihood rehabilitation status of affected persons during implementation stage.
Target	(i) the SAHs who will lose 10% or more of their production/income-generating assets and relocation households; (ii) the VAHs of the Project who will fall under any of the criteria of followings; a) Household headed by a woman; b)Household headed by elderly; c) Household including a person with disability; d) Household below the poverty line; (e) Household including indigenous peoples; (f) Household headed by child; (g) Landless households.
Responsible/ Implementation Organization	Responsible Organization is PMU (DOB) supported by resettlement specialist of the consultant team. The IRP will be implemented by service provider such as other concerned ministry or NGO in cooperation with Regional Government and other concerned local authorities under management of PMU (DOB) with resettlement specialist.
Approach	In order to develop and implement the IRP, PMU (DOB) supported by resettlement specialist will take following processes and approaches; 1) Identification of eligible PAHs based on the updated RAP prepared during the DMS survey in the detailed design stage of the Project; 2) Consultation with IRP eligible households and carry out detailed needs assessment survey as well as the capacity assessment of eligible households to engage in the IRP; 3) Discuss with local administration and relevant agencies such as relevant ministry or NGOs on the availability of technical cooperation program or vocational training program; 4) Coordinate with local administration and PMU (DOB) for review and approval of the IRP; 5) Implementation of specific IRP activities and supporting eligible PAHs to participate to the IRP; 6) Regular monitoring of the status of the IRP implementation and providing support to the participants as required;
Potential Income Restoration Program	The program to be proposed under IRP can be classified to three main categories. Those programs are intended to be provided in the combination of technical assistance/ vocational training and in-kind/ materials support. In addition, those shall ensure equal opportunities for man and woman as well as the equal and effective participation of man and woman by considering gender aspect. (a) Providing technical assistance to continue farming or raging livestock/cattle; To achieve the first objective of providing the technical assistance for those who want to continue farming or raising livestock/cattle, the program will provide assistance and organizing training courses on agricultural extension models to the eligible households. (b) creating job opportunities by vocational training; With the objective of providing technical assistance or/and small business/service models for those who want

	to do business locally, the program will provide them with technical advice, small business/service models and other training courses, study tours, and some in-kind/materials support for business establishment. (c) Create career opportunities through vocational training and job creating activities in/around the project area. To create career opportunities through vocational training and job creating activities, the program will organize training courses that suit their needs, capacity and provide supplementary training, consultations, allowance and other support to participants attending the courses as well as tools/equipment for career establishment after being trained.
Monitoring	Both internal and external monitoring shall be included (a) Internal monitoring shall be done by regular checking of the status/progress of the IRP as well as the issues raised and measures taken during the IRP. (b) External monitoring shall be done by regular checking of the status/ progress of the IRP and the livelihood restoration status of participated PAHs. Monitoring of IRP will be conducted under the scope of RAP monitoring and also be reported in the RAP monitoring.
Grievance Redress mechanism	Receive the information (complaints, requests) made by PAPs and local residents and keep them as records take necessary actions, and responses will be done base on the type of received information by not only collaboration with PMU (DOB) and concerned local authorities but also regular consultation with PAHs.
Information disclosure	Job recruitment notifications will be posted in the visible and easily accessible places for PAPs and PAHs.

Source: JICA Study Team

CHAPTER 7 Implementation Framework

The Department of Bridges (DoB) is the core responsible body for the resettlement action plan as the driving force of the Project. Besides DoB, the Ministry of Agriculture, Livestock and Irrigation (MOALI) and the Ministry of Home Affairs (MOHA), Ministry of Social Welfare, Relief and Resettlement (MSWRR) shall be involved in managing land issues and compensation. Local authorities at state, township and village levels must be constituents as well. A possible example of the organizations concerned and the roles involved in the resettlement action plan is shown in Table 7.1. The organizations are to form a consortium chaired by DoB, the so-called Resettlement Implementation Committee (RIC), to go ahead with the activities of the resettlement action plan in harmony with stakeholders.

Processes regarding major RAP implementation activities are as follows:

1) RAP approval: the RAP is created by the Project entity (DoB) with assistance of resettlement specialists/ consultants, examined and approved within the entity and submitted to JICA.
2) Budget securement and approval: The RIC including Project entity re-valuates the RAP budget plan, introduces the revised budget to Central government. After tabling the budget is to be approved.
3) Compensation payment: The entity explains and gets approval on compensation coverage from PAPs. The PAP can negotiate the coverage with the entity. After attaining an agreement in a writing form, compensation must be conducted for sure. The land ownership is transferred to the entity by contract. Internal and external monitoring activities help to secure the process of compensation and check the flow.

Table 7.1 Roles of Organizations to Implement the Resettlement Action Plan

Organization	Composition	Major Roles
Department of Bridge (DoB), MOC		- Overall Execution of the Project - Directs the PMU/DOB - Responsibilities for approving Updated RAP (URAP) - Securing resources related RAP
Project Management Unit (PMU), DoB		- Responsibilities to update RAP - Responsibility to coordinate all organizations concerned on RAP activities - To supervise RAP implementation activities - Responsible organization of IRP implementation
Resettlement Implementation Committee (RIC)	- PMU/DOB, MOC - DOH, MOC - State/Regional Government (Mon State and Bago Region) - District (Bago District and Thaton District) - Township (Waw Township and Kyaito Township) - MONREC - Department of Industrial Crops Development (DICD), MOALI	- To examine and valuate the awards (entitlement, compensation), usually led by respective township administrator - To valuate compensation of agricultural products (crops, trees, livestock) - To examine and valuate the awards (entitlement, compensation), usually led by respective township administrator - To valuate compensation of agricultural products (crops, trees, livestock) - In cooperation with the related organizations and stakeholders, - To drive RAP implementation activities - To administrate the schedule and progress of compensation

Organization	Composition	Major Roles
		and livelihood assistance - To contact for grievance redress
Department of Agricultural Land Management and Statistics (DALMS), MOALI		- To investigate farmland conditions to be acquired (area size, ownership etc.) - To prepare application for land acquisition in case of legal ownership - To survey replacement cost of lands - To monitor unfair farm land trading in cooperation with township/village administrators
General Administration Department (GAD), MOHA		- To monitor unfair land trading in cooperation with township/village administrators
District Government (Township, village)		- To monitor encroachment of illegal settlers into the project area after the COD - To manage relocation site
State Government (Bago, Mon)		- To supervise the district government - To issue land lease grant
Monitoring Experts		- Internal Monitoring - DoB in assistance with GAD - External Monitoring – Experts in accordance with the TOR

Source: JICA Study Team

CHAPTER 8 Grievance Redress Mechanism

Complaints and conflicts may arise during the construction, land acquisition and compensation process. These complaints and conflicts can be of many kinds. It could be:

I. Land Acquisition and Compensation

i) Errors in the identification of people and property affected by the Project;

ii) Disagreement on land, either between the affected person and the expropriation agency, or between two neighbors;

iii) Conflict over the ownership of a property between two affected persons;

iv) Disagreement over the assessment of property;

v) Family problems (estates, divorces) that raise disputes between heirs or members of the same family regarding a property, parts of a property or other property;

vi) Disagreements about resettlement measures, location of a resettlement site, type of compensation or habitat proposed, characteristics of the parcel, quality of the new areas of use, etc.;

II. EIA

vii) Unexpected natural and social adverse impacts by the project construction activities;

viii) Other issues related to the Project.

The aim of the Grievance Redress Mechanisms (GRM) is to ensure that grievances and concerns raised by PAPs or other people within the communities can be effectively dealt with in a timely and satisfactory manner. Given the potential for quick and effective resolution on the ground, utilizing local dispute mechanisms as a first step in line with current traditional practices makes the mechanism more effective. Normally, a grievance redress mechanism is developed to ensure that:

i) All complaints related to resettlement, compensation and other assistances are appropriately dealt with;

ii) Easily access for those who have complaints related to resettlement and others assistance; and

iii) Adequate measures are taken to resolve raised issues.

Grievances related to any aspect of the Project or sub-projects shall be handled through a consultative manner appropriately, easily and speedily. The Grievance Redress Committee (GRC) is suited as the main entity that takes care of the issues. The composition of the GRC includes the following members:

i) Representatives from PMU/DOB and regional DOB;

ii) Representatives from DOH;

iii) Village Tract leader/ Representatives from the relevant community (at least 1 female member);

iv) Representatives from Township Women Association;

v) Township GAD, MOHA;

vi) Township officer of DALMS, MOALI;

vii) Ministry of Natural Resources and Environmental Conservation;

viii) Ministry of Agriculture, Livestock and Irrigation;

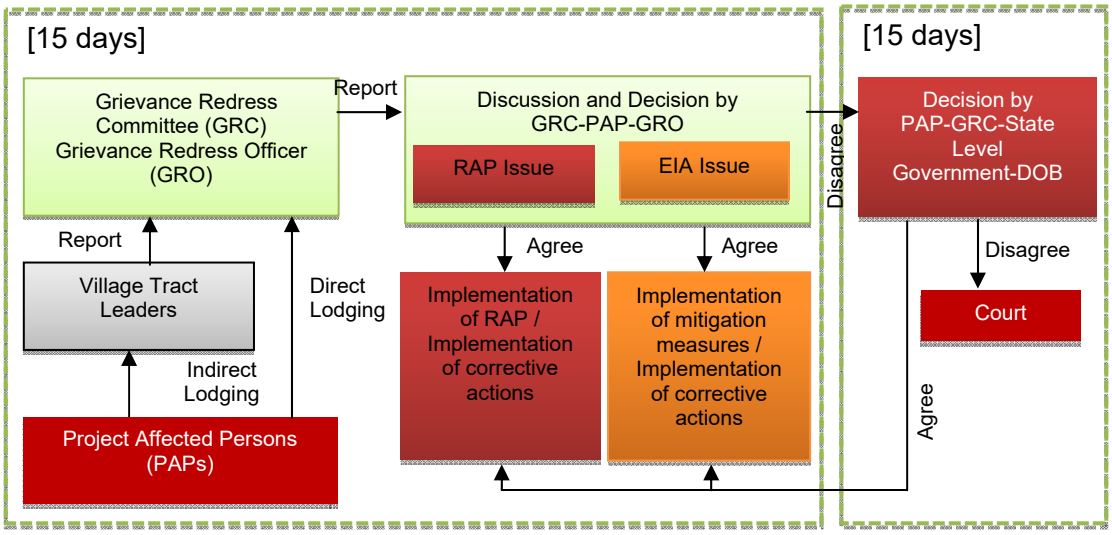
ix) Other relevant organization, if any.

The GRC members are mainly composed of relevant officials at the township level. However, depending on the type the complaint or the situation, the GRC may also ask representatives of the relevant organization to take part in the procedure of grievance resolution, such as state/ regional government, contractor and consultants. For the gender perspective, the GRC should include few female members.

A possible scheme for grievance redress mechanism is illustrated in Figure 8.1 and its process is as follows:

1) PAPs can lodge claims or complaints on natural and social impacts, resettlement and compensation directly to the GRC or indirectly through the village tract. A Grievance Redress Officer (GRO) at the corresponding township in GRC is responsible for the contact;
2) The chairperson of the GRC/GRO assigns an officer-in-charge from the GRC members in accordance with the nature of the lodged complaint in order to interview the PAP concerned who raised the issue; **[5 days]**
3) The GRC holds discussions based on the evidences obtained, takes an approach and makes an initial decision. The appointed officer starts negotiation with the PAP in consultation with the RIEC; **[10 days]**
4) In case an agreement is not achieved between the concerned PAP and the GRM within 15 working days from the day the complaint is lodged, the case is to be forwarded to the DoB and the corresponding state government in addition to the GRC. The relevant section in DoB reviews the documents and discusses with the PAP until an agreement is obtained; and **[15 days]**
5) If, however, the agreement is not reached within another 15 days at this stage, the case may to be sent to the court for legal steps.

Once grievances are raised in the GRC, the contents of the grievances and status of the resolution process shall be recorded until closure of the complaint.



Source: JICA Study Team

Figure 8.1 Scheme for Grievance Redress Procedure

This GRM will be separately established from the one to be established for the ADB road section since the project proponent will be a different organization. However, the proposed GRM of ADB are almost the same mechanism with GRM of JICA Bridge section. Any issues related to the Project such as RAP matter or EIA matter can be raised to the GRC. The components of the GRC are almost same in both GRM. Also, the same steps to be followed both in JICA GRM and ADB GRM as both GRM propose to discuss first on the township level and secondly on the state/regional level if it's not resolved in the first step.

It is also noted that GRM procedures will have to be disclosed and discussed with various stakeholders of the communities around the project area including PAPs of RAP and fishermen to the extent possible in order to ensure that they recognize the GRM, and agree and understand the process. The mechanism is usually established just after the public consultation meeting by re-investigating the RAP contents during the detailed design stage. A plaintiff (PAP) will not need to bear the cost in case if the case can be finalized within the committee. The management cost is enough within the total RAP implementation cost. However, the plaintiff is to bear the relevant cost which the domestic legal system defines in case a suit at law would be filed.

CHAPTER 9 Monitoring Activity

Monitoring activity normally consists of internal and external monitoring. The main purpose of the monitoring activity is to ensure that all PAPs who lost their respective houses, land or other livelihood assets have been provided with sufficient compensation and assistance according to the policies and procedures which is described in RAP.

9.1. Internal Monitoring

The specific objectives of Internal Monitoring are to oversee RAP implementation to ensure resettlement objectives are met and that resettlement activities are on track. DoB alternatively referred to as Internal Monitoring Agent (IMA) shall be responsible for internal monitoring. The involvement of PAPs in monitoring activities should also be encouraged. As such, village heads and household representatives will continually be consulted during monitoring activities. It will be undertaken by DoB with support from resettlement specialists/ consultants with the assistance from RIC. Internal Monitoring will consist of monthly reports during the implementation of this RAP.

The main tasks of the IMA include:

- Regular supervision and monitoring the RAP implementation as designed and planned in coordination with RIC;
- Ensuring the timely and complete disbursement of compensation and assistance to each PAHs in accordance with agreements between RIC and PAHs; and
- Recording all grievances raised by PAPs and ensuring that all complaints are promptly addressed.

9.2. External Monitoring

External monitoring should be periodically carried out conducted by an independent local/international External Monitoring Agent (EMA) to provide an independent view on the achievement of the RAP. Furthermore, the External Monitor will conduct its assessment based on reviewing Project documentation such as compensation records, reviewing Internal Monitoring reports, conducting field visits, and interviewing PAPs and relevant authorities. External monitoring reports should be provided on a quarterly basis during the implementation of RAP and IRP and biannual basis during the post-resettlement and IRP period for 2 years.

The main activities of external monitoring should include:

- Reviewing and verification internal monitoring results;
- Identifying any discrepancy between assistance provided and its actual implementation;
- Assessing the effectiveness, impact and sustainability of resettlement activities, particularly with regards to livelihood and restoration and/ or enhancement of living standards; and
- Providing recommendations, if necessary regarding the resettlement activities to achieve the principles and objectives of JICA guideline, and relevant laws.

Examples of RAP monitoring form and TOR for External Monitoring are shown in **Appendix F**.

CHAPTER 10 Information Disclosure, Consultation and Participation

10.1. Background and objectives of the consultation

Public consultation is an important phase in the implementation and success of RAP implementation. It is an activity that consists of holding meetings to inform the public about the Project and gather the opinions and suggestions of the affected people. The objective is to sufficiently involve the populations to obtain their adhesion to the Project. Thus, the Project must inform, consult and give the opportunity for the Project Affected Persons to participate in all stages of the process in a constructive manner.

Insofar as the land acquisition and resettlement for public purpose is the Government action that may affect the well-being of the population, it is mandatory that the people affected by the Project be fully informed of the intentions of the public authorities. Project disclosure and consultation at an early stage provides a good venue for PAPs to express their opinions, apprehensions, and even objections. It opens grounds for discussion, and allows the Implementing Office to address issues raised, most of which can be incorporated into the final design and resettlement plan.

Generally in the RAP preparation process, meetings inviting PAPs in different two stages are planned, firstly prior to the preparation of RAP and secondly after preparation of Draft RAP. Table 10.1 shows the general objectives of the meeting in each stage.

Table 10.1 Activities for Public Consultation Meetings

Category	Milestone and Objectives
1st Stage (Before RAP Preparation)	Prior to Preparation of RAP a. To inform the PAPs about: i) the activities and scope of work of the Project; ii) the expected adverse impacts such as loss of property and displacement; iii) the no-worse off policy of JICA and World Bank, iv) the activities, process of RAP survey and declaration of Cut-off date b. To encourage PAPs to express their ideas, concerns and apprehensions, and other related issues.
2nd Stage (After Draft RAP Preparation)	After Preparation of Draft RAP a. To inform the PAPs about the RAP survey result; b. To inform the PAPs about the compensation policy to be followed; c. To ask the PAPs to give their comments/objections on the RAP; d. To inform the PAPs about the future schedule and process of the RAP

Source: JICA Study Team

Concerning the Project, 3 public consultation (socialization) meetings were held in concerned villages with PAPs. The first two took place prior to the preparation of RAP and the third after data collection and preparation of Draft RAP.

After conducting of first meeting held on 20th December, the project component of guide bank and revetment was added, therefore the additional socializations were held to inform the project scope of work at the earliest possible time to additional PAPs concerned. The schedule of conducted meetings is shown in Table 10.2.

Table 10.2 Schedule of RAP Socializations Conducted

No.	Category of RAP Socialization	Purpose of the Socialization	Target Component of the Project	Date
1	1st Stage (Before RAP Preparation)	To inform about the project and RAP survey process to PAPs and exchange opinions.	-Bridge	December 20th 2017
2	1st Stage (Before RAP Preparation)	To inform about the project and RAP survey process to additional PAPs and exchange opinions.	-Guide bank and revetment	June 13th -14th 2018
3	2nd Stage (After Draft RAP Preparation)	To inform about the RAP survey result and future process/schedule of RAP to all the PAPs finally identified and exchange opinions.	-Bridge -Guide bank and revetment	August 28th - 29th, 2018

Source: JICA Study Team

In the stage of updating RAP during DD, RAP socializations are to be held before additional survey and draft Updated RAP (URAP) stage.

10.2. Result of the Consultation

10.2.1. 1st RAP Socialization (1st Stage for Bridge)

(1) Schedule and location of the meeting

a) Mon State
20th December 2017 10:00~12:00 Monastery of Village, Sut Pa Nu Village, Kyaikto Township, Mon State

b) Bago Region
20th December 2017 14:30~15:30 General Administrative Office, Shan Kaing Village, Waw Township, Bago Region

(2) Notification of the meeting

The venue and date of the meetings have been notified by MOC, local government and village leader directly to the project affected persons at least 2-3 days prior to the meeting after identification of PAPs.

(3) Major participants

Table 10.3 Participants of 1st RAP Socialization

Date	State/ Region	Major Participants
20th December 2017	Mon State	Government: 6 (MOC, Local Government), PAPs: Local People 16 (Including 8 PAPs) , JICA Study Team: 3, Eguard Environmental Services: 4 Total: 29 (Male: 22, Female: 7)
20th December 2017	Bago Region	Government: 8 (MOC, Local Government), , Local People: 19 (Including 2PAPs), JICA Study Team: 3, Eguard Environmental Seervices: 4 Total: 34 (Male:28, Female: 6)

Source: JICA Study Team

(4) Agenda of the Meeting and Language

MOC and Eguard has explained project summary, Law & Guideline to be followed, Process and Schedule of RAP, and then exchange opinions have been conducted in Burmese.

(5) Summary of the Discussion

Public opinions, concerns and questions were presented during the meeting. Table 10.4 and Table 10.5 show the summary of opinions and answers exchanged.

Table 10.4 Opinions and Answers on 1st RAP Socialization (Mon State)

No	Major opinion and Answer				
	Question/Comment		Answer		Reaction of questioner
	Name/Position	Question/Comment	Name/Position	Answer	
1	PAPs/Villager (Female)	I want to know how the compensation will be paid for affected rubber trees	DOB/MOC	RAP survey will be conducted after this socialization and all assets including land, structures and tress will be entitled for compensation. For trees, the calculation method is also based on age of the trees, i.e., how many times of produce from the tree (e.g., mango tree, two times in a year), etc. Compensation amount for each affected unit will be based on the market price surveyed through local peoples and concerned government authorities such as DOA, Department of Agricultural Land Management and Statistics (DALMS), GAD and MOC, etc.	Accepted the answer
2	PAPs/Villager (Male)	According to the bridge alignment, farmlands that I bought recently will be affected. I have a plan to develop a fish pond and poultry farm on this farmland and it will be affected when the Project is implemented.	DOB/MOC	Compensation will be considered for only existing assets. Once the cut-off date is declared, any additional business activity or encroachments will not be eligible for compensation. Therefore, I would like to suggest you not to do new business activity or new development as it will be risk investment in economic.	Accepted the answer
3	PAPs/Villager (Male)	Village will be developed more due to this Project and we are happy to hear about the construction of a new bridge.			-
4	PAPs/Villager	For example, if affected house is under construction, should it be continued or not until is finished.	DOB/MOC	Construction can be completed for the whole structure but the current completion status of the structure will be recorded during the survey and compensation will be calculated upon it.	Accepted the answer
5	Village Chief (Male)	If any accident happens, villagers have to go Waw Hospital urgently. It is difficult to reach the hospital in time due to weak	DOB/MOC	Although the design standard of the bridge and road is not finalized yet, the concept of the Project is that the road/ bridge	Accepted the answer

		transportation network of Kyaikto Township and Waw Township. Is it possible to access the New Sittaung Bridge and new road directly from the road inside of the village near the railway? If direct access is possible, it will be very convenient for villagers to travel to Waw Township for any urgent matters.		should be connected to a major highway. Therefore, direct access from the road inside of the village might be difficult. Thus, please use the existing road to the nearest junction and access the new project road and bridge.	

Source: JICA Study Team

Table 10.5 Opinions and Answers on 1st RAP Socialization (Bago Region)

No	Major opinion and Answer				
	Question/Comment		Answer		Reaction of questioner
	Name/Position	Question	Name/Position	Answer	
1	PAPs/Villager (Male)	I am not sure whether my farmlands will be affected or not as I don't know the exact location of the bridge alignment. How is the compensation rate if farm lands are affected?	DOB/MOC	The detailed alignment will be informed during interview survey with affected persons. Compensation will be paid with government budget. We will survey market price for affected farmlands and assess the compensation rate in this feasibility survey stage. The final compensation price will be decided in the detailed design stage.	Accepted the answer
2	PAPs/Villager (Male)	After the New Sittaung Bridge, will any vehicles such as tractors or Trawalergyi (Agricultural vehicles) be allowed to pass through?	DOB/MOC	For safety reasons as well as the road / bridge design standards, there will be a limitation of vehicle types which are allowed to pass through the Bridge. Basically, only vehicles that are officially registered and possess a license plate can pass.	Accepted the answer
3	PAPs/Villager (Male)	Does the road alignment pass the Shan Kaing Village?	DOB/MOC	The road section is not fixed yet since it is survey section of ADB and they will start the survey from now on. Therefore, ADB will explain on road alignment separately in the future.	Accepted the answer
4	PAPs/Villager (Male)	Will construction vehicles use the village road to access the construction site?	DOB/MOC	At the moment, we cannot say exactly. If village road is used for transportation of construction materials, upgrading of the existing road will be needed.	Accepted the answer
5	PAPs/Villager (Male)	The existing village road is not good condition and we want MOC to upgrade our existing road.	DOB/MOC	Please request this issue to Parliament members to be able to submit to Parliament. MOC may be able to consider this issue and upgrade the road with budget allocation from the government.	Accepted the answer

6	Village Chief (Female)	Regarding the affected area on Bago Region side (right bank side), the land owner sometimes live on the Mon State side (left bank side). Also, the registered land owner is sometimes not actual land owner. Therefore, some project affected persons are not attending this meeting.	DOB/MOC	In the RAP site survey to be started soon, the actual affected persons will be re-confirmed and the survey team will visit them individually. At that time, the contents of the meeting such as project summary and Guidelines and laws for compensation will be explained.	Accepted the answer

Source: JICA Study Team

10.2.2. 2nd RAP Socialization (1st Stage for Guide bank and Revetment)

(1) Schedule and location of the meeting

a) Mon State
13th June 2018 10:00~12:00 Monastery of Village, Sut Pa Nu Village, Kyaikto Township, Mon State

b) Bago Region
14th June 2018 10:00~12:00 General Administrative Office, Shan Kaing Village, Waw Township, Bago Region

(2) Notification of the meeting

The venue and date of the meetings have been notified by MOC, local government and village leader directly to the project affected persons at least 2-3 days prior to the meeting after identification of PAPs.

(3) Major participants

Table 10.6 Participants of 2nd RAP Socialization

Date	State/ Region	Major Participants
13th June 2018	Mon State	Government: 4 (Local Government, MOC), PAPs: Local People 11 (Including 4 PAPs) , JICA Team: 1, Eguard Environmental Services: 4 Total: 20 (Male: 19, Female: 1)
14th June 2018	Bago Region	Government: 4 (Local Government, MOC), Local People: 16 (Including 6 PAPs), JICA Team: 1, E Guard Environmental Services: 4 Total: 25 (Male:17, Female: 8)

Source: JICA Study Team

(4) Agenda of the Meeting and Language

MOC and Eguard has explained project summary, Law & Guideline to be followed, Process and Schedule of RAP, and then exchange opinions have been conducted in Burmese.

(5) Summary of the Discussion

Public opinions, concerns and questions were presented during the meeting. Table 10.7 and Table 10.8 show the summary of opinions and answers exchanged.

Table 10.7 Opinions and Answers on 2nd RAP Socialization (Mon State)

No	Major opinion and Answer				
	Question/Comment		Answer		Reaction of questioner
	Name/Position	Question	Name/Position	Answer	
1.	Village Chief (Male)	Is there any consideration for local people in bridge design? For example, will there be a sidewalk accessible by local people?	JICA Study Team	At this moment, we cannot say if a side-walk will be included or not as the detail design (and operational policy) of the bridge is not decided yet. However, all the vehicles which obtained license plate can access the bridge, and will be accessible by local people too.*	Accepted the answer
2.	PAPs/ Villager (Male)	When will the construction start? Should the farmers stop the work on affected land right now?	JICA Study Team	As we are now at F/S stage, it is difficult to say construction starting date. However, the construction starting date will be informed in advance.	Accepted the answer
3.	PAPs/Villager (Male)	Can farmers continue plantation on their lands?	JICA Study Team / Sub-Consultant	Paddy, beans or other seasonal crops and existing perennial plants can be continued until the project implementation. However, perennial plants like rubber that needs to wait for 4 or 5 years for the production stage should not be grown. As we declared in COD last January 2018, new development shall not be considered or compensated. As this is F/S stage, it will take time to start construction. Construction work may not be started at least within in one year.	Accepted the answer
4.	PAPs/Villager (female)	I am worry about my income as all of my land may be impacted.	JICA Study Team / Sub-Consultant	All the PAPs shall get compensation at market price and RAP shall consider for all kinds of project impact.	Accepted the answer
5.	PAPs/Villager (Male)	Is possible to consider land to land compensation?	Sub-Consultant	As we might aware that available land are decreasing nowadays, so it is difficult to compensate back land to land. However, land compensation would be cash compensation equivalent with market price.	Accepted the answer
6.	PAPs/Villager	We would like to suggest	JICA Study Team	We will take it into account	Accepted the

	(Male)	developing a sidewalk for the bridge as local people would like to cross the bridge for daily purposes.			answer

* The necessity of the sidewalk was re-examined under MOC and it was concluded that no sidewalk will be installed because the bridge will be developed as "Access Controlled Expressway" considering the purpose of the East-West Economic Corridor Highway Development Project and the roles of the road and bridge.

Source: JICA Study Team

Table 10.8 Opinions and Answers on 2nd RAP Socialization (Bago Region)

No	Major opinion and Answer				
	Question/Comment		Answer		Reaction of questioner
	Name/Position	Question	Name/Position	Answer	
1	PAPs/Villager (Male)	How far is it from the bridge location to Shan Kaing Village?	JICA Study Team	Approximately 1.5 miles (2km)	Accepted the answer
2	PAPs/Villager (Male)	Will all the area of our land which we own be occupied, or only the project affected area?	Sub-Consultant	Only the area which is impacted by Project will be acquired. Therefore people can continue their activity on the remaining land which is not impacted.	Accepted the answer
3	PAPs/Villager (Male)	Due to the guide bank construction, some farm lands will be divided into two parts and it may be difficult to continue the farming activity at the remaining area which is close to the river side. I want to know any consideration for this impact.	JICA Study Team	We will take into account this issue and consider the compensation plan if the remaining land is useless or other activities cannot be done.	Accepted the answer
4	PAPs/Villager (Female)	Can we continue faming activity if the Project does not start right now?	Sub-Consultant	Yes, you can continue. As we declared in the COD January 2018, we would like to suggest not to develop long term business. There would be no consideration and compensation for new development.	Accepted the answer
5	PAPs/Villager (Male)	As the road alignment seems far from our village, we would like to suggest the road alignment to be closer to our village. Our local people will greatly appreciate it if the road will pass through or near our village. So, we would like to suggest the road will pass through near our village and we will be happy upon land acquisition.	JICA Study Team	As our bridge location was confirmed by both JICA and MOC, it is difficult to change location. However, the road alignment is part of ADB project. Please also suggest this to ADB team. We will share this information to ADB.	Accepted the answer

Source: JICA Study Team

10.2.3. 3rd RAP Socialization (2nd stage for Bridge, Guide bank and revetment)

(1) Schedule and location of the meeting

a) Mon State
28th August, 2018: 02:30 ~ 03:40pm at Sin U Pa Gote Ta Monastery, Sut Pa Nu Village, Kyaikto Township, Mon State

b) Bago Region
29th August, 2018: 11:00 ~ 11:40am at Village Administrator Office, Shan Kaing Village, Waw Township, Bago Region

(2) Notification of the meeting

The venue and date of the meetings have been notified by MOC, local government and village leader directly to the project affected persons at least 2-3 days prior to the meeting.

(3) Major participants

Table 10.9 Participants of 3rd RAP Socialization

Date	State /Region	Major Participants
28th August 2018	Mon State	Government: 1 (MOC), PAPs: 7 , JICA Study Team: 3, Eguard Environmental Services: 7 Total: 18 (Male: 11, Female: 7)
29th August 2018	Bago Region	Government: 1 (MOC), PAPs: 5 (out of 8 people), JICA Study Team: 3, Eguard Environmental Services: 7 Total: 16 (Male: 10, Female: 6)

Source: JICA Study Team

(4) Agenda of the Meeting and Language

MOC in cooperation with the JICA Study Team has explained about the project summary, law and guidelines to be followed, RAP survey result, the compensation policy and entitlement and future process and schedule of RAP, and then exchange of opinions have been conducted in Burmese.

(5) Summary of the Discussion

Public opinions, concerns and questions were presented during the meeting. Table 10.10 and Table 10.11 show the summary of opinions and answers exchanged.

Table 10.10 Opinions and Answers on 3rd RAP Socialization (Mon State)

No	Major opinion and Answer				
	Question/Comment		Answer		Reaction of questioner
	Name/Position	Question/Comment	Name/Position	Answer	
1	PAPs / Villager (Female)	Currently the concerned PAH lives in overseas. When does MOC want to contact the landowner and need documents of registration on properties?	MOC	Documents are not necessary now. It should be obtained when the landowner comes back from overseas during the vacation.	Accepted the answer
2	PAPs/ Villager (Female)	Will compensation be paid once or twice for loss of property?	JICA Study Team	In general once for compensation payment. However, the MOC and JICA will discuss this matter with ADB	Accepted the answer

3	PAPs/ Villager (Male)	To what extent is my land impacted and what is the owner's right for the impact?	MOC	MOC side clarified the affected area, and then MOC replied that all your affected land will be compensated.	Accepted the answer
4.	PAPs/ Villager (Female)	In the compensation policy, how does the policy consider growing crops between survey stage and the actual compensation time?	MOC	Compensation will be made for those crops existing at the time of cut-off date.	Accepted the answer
			JICA Study Team	As survey will be carried out before the construction period in the Detailed Design Stage and compensation will be made on age and number of plants. The current stage is the Feasibility Study, thus final evaluation will be done in the next survey.	Accepted the answer
5	PAPs/ Villager (Male)	Compensation for rubber tree plantation should consider the age of the trees.	MOC	It is not guarantee for the compensation in consideration with age. However, opinions such as this is considered for the finalization of the compensation policy.	Accepted the answer

Source: JICA Study Team

Table 10.11 Opinions and Answers on 3rd RAP Socialization (Bago Region)

No	Major opinion and Answer				
	Question/Comment		Answer		Reaction of questioner
	Name/Position	Question	Name/Position	Answer	
1	PAPs/ Villager (Male)	The compensation rate for the paddy fields should be same, it should not be changed depending on the detailed location and condition.	JICA Study Team	The price of compensation for the land is finally negotiated based on the rate set at detailed design stage. Besides, the compensation rate may change according to time and circumstances.	Accepted the answer
		It is important that the compensated amount for effected land has to be enough to buy another land.	Township Officer, Waw Agricultural Department	The compensation for the impacted land has to be carried out. The compensation for the crops will be carried out according to the criteria of the Ministry of Agriculture, livestock and Irrigation, at the rate of three times the value of the crop.	Accepted the answer
2	PAPs/ Villager (Male)	Can we still continue cultivating the affected land?	JICA Study Team	The Project has not start yet. It will need to take some years before it will begin. Thus, the owners can still cultivate at the moment.	Accepted the answer

Source: JICA Study Team

10.3. Activity on Information Disclosure

Another important activity for promoting the people's understanding of the Project is information disclosure. Explanation and discussion in the public consultation is part of the information disclosure and the RAP document and the related information of the RAP is required to be disclosed in accordance with JICA guideline and WB OP4.12. Apart from the public consultation (socialization), the activity of information disclosure is planned as below.

1) FS stage (RAP preparation stage)

In the FS stage, the finalized this RAP (in English) will be uploaded on JICA's website and made available to the public.

2) DD stage (Updated RAP)

After updating RAP in DD stage, the approved updated RAP will be translated into Burmese and disclosed in the location where PAPs can access it, such as local administration offices.

CHAPTER 11 Cost and Financing

The cost and financing aspects for the implementation of the resettlement process at this stage of preliminary design are presented in this Chapter. The budget items include detailed costs of land acquisition, relocation, and income restoration and other administrative cost for RAP implementation.

11.1. Basic Calculation for Compensation Amount

In this RAP, approximate costs are estimated based on the results from the Replacement cost survey (RCS), socio-economic survey and other related information. Basic calculation methods are as follows and valuation and detailed calculation method is provided in **Appendix C**. In order to harmonize the compensation amount with the one in the RP of road section, the RP for ADB section is also mutually referred.

- Cash compensation for the loss of all types of lands including (Crop Land, Garden Land, and Residential Land): the amount is calculated based on current market prices and information obtained by interviews with local PAPs, gov. staff from Township DALMS and local GADs as well as examples of a neighboring similar projects.
- Cash compensation for the affected structures: this amount is calculated based on market prices of construction materials, construction fee and interviews with the structure owners. It is noted that depreciation of the asset and value of salvage materials are not taken into account.
- Cash assistance to cover business (income) loss of affected annual crops, fruits trees and other productive trees (especially paddy, peas and beans, rubber and other fruits tree in this Project) for the transition period:
    - Paddy/other crops: 3 times of annual yield from the crop
    - Rubber: 3 times of annual production from the tree (replacement cost of tree as timber wood is also considered under the category below)
    - Other fruits or production tree: 3 times of annual production from the tree

    Note: the amount is based on current market prices obtained through interviews and compensation method used by other projects near similar project areas.
- Cash compensation for the loss of timber/ shade trees on affected land: the amount is based on current market prices obtained through interviews and compensation method used by other projects near similar project areas.
- Cash assistance to cover business loss (income) for affected structure including (shop & shop with residents) for transition period: Cash assistance for the income loss during the relocation and re-establishment of the affected business in new place
- Vulnerable allowance for VAH ((i) Poor households; (ii) Female headed households; (iii) Households including a person with disability; (iv) Households headed by elderly; (v) landless households; (vi) ethnic minority): apply up to 300,000 kyats per household in this Project based on minimum subsistence level.
- Other special assistance such as SAH assistance and relocation stabilization assistance are referring to other projects as well as coordinated with the plan of road section.

11.2. RAP Implementation Budget

The estimated RAP implementation budget for the Project is summarized in Table 11.1.

Within the categories of land and structures, compensation for affected trees, crops, income restoration and vulnerable allowance have been included.

DoB (MOC) is responsible for providing adequate funds for land acquisition and resettlement related to the Project. It is important to note that these figures need to be updated during updating of the RAP in the Detailed Design stage.

Table 11.1 RAP Implementation Budget

No.	Activity/ Cost Item	Unit	Unit Price (MMK/unit)	Quantity	Estimated Budget		Note
					MMK	USD	
1	**Compensation Cost**						
1.1	Compensation for Land						
1.1.1	Crop Land (Waw)	acre	22,129,830	22.85	505,666,616	337,111	
	Crop Land (Kyaikto)	acre	41,186,072	15.03	619,026,662	412,684	
1.1.2	Garden Land	acre	12,294,350	24.65	303,055,728	202,037	
	Sub-total 1.1				**1,427,749,005**	**951,833**	
1.2	Compensation for Structures / Secondary structures						
1.2.1	Structures	item	-	4	22,484,000	14,989	Cost for structure and secondary structure were individually valuated
1.2.2	Secondary Structures	item	-	8	1,100,000	733	Cost for structure and secondary structure were individually valuated
1.2.3	Transportation assistance	HH	150,000	4	600,000	400	Relocation cost for those whose houses are affected
	Sub-total 1.2				**24,184,000**	**16,123**	
1.3	Compensation for Crops						
1.3.1	Paddy	Basket	21,000	2,625	55,125,000	36,750	3 times of crop yield amount (Annual Production x income of 3 years)
1.3.2	Peas and Beans	Basket	105,000	457	47,985,000	31,990	3 times of crop yield amount (Annual Production x income of 3 years)
	Sub-total 1.3				**103,110,000**	**68,740**	
1.4	Compensation for Trees						
1.4.1	Rubber Trees	Tree	-	4,338	244,694,419	163,130	Tree cost + 3 times of annual production
1.4.2	Fruits/ Production Tree	Tree	-	9,542	37,125,000	24,750	3 times of annual production
1.4.3	Timber and Shade Trees	Tree	-	1,559	2,705,000	1,803	Tree cost
	Sub-total 1.4				**284,524,419**	**189,683**	
	Sub-total 1				**1,839,567,424**	**1,226,378**	

2	**Other Assistance**						
2.1	Other Cash Assistance						
2.1.1	SAH Assistance	Person	158,625	87	13,800,375	9,200	112.5 USD/person
2.1.2	Relocation stabilization assistance for Non-vulnerable household	HH	282,000	2	564,000	376	200 USD/HH
2.1.3	Relocation stabilization assistance for Vulnerable household	HH	564,000	2	1,128,000	752	400USD/HH
2.1.4	Transportation assistance	HH	150,000	4	600,000	400	Relocation cost for those whose houses are affected
2.1.5	Vulnerable Allowance	HH	300,000	4	1,200,000	800	For PAHs with woman- headed, person with disability, elderly etc.
	Sub-total 2.1				**17,292,375**	**11,528**	
2.2	IRP Assistance						
2.2.1	Vulnerable Households	HH	634,500	4	2,538,000	1,692	450 USD/HH
2.2.2	Household losing 10-30% total production landholding	HH	705,000	4	2,820,000	1,880	500 USD/HH
2.2.3	Household losing 30-70% total production landholding	HH	1,128,000	12	13,536,000	9,024	800 USD/HH
2.2.4	Household losing more than 70% total production landholding	HH	2,115,000	0	0	0	1,500 USD/HH
2.2.5	Relocation Household	HH	1,128,000	4	4,512,000	3,008	800 USD/HH
	Sub-total 2.2				**23,406,000**	**15,604**	
	Sub-total 2				**40,698,375**	**27,132**	
3	**RAP Implementation Cost**						
3.1	Public Consultation	Set			4,000,000	2,667	
3.2	IRP Service Provider	Set			70,500,000	47,000	
3.3	External Monitoring	Set			60,000,000	40,000	
	Sub-total 3				**134,500,000**	**89,667**	
4	**Total (1+2+3)**				**2,014,765,799**	**1,343,177**	
5	Contingency (+10%)				201,476,580	134,318	
6	**Grand Total (4+5)**				**2,216,242,379**	**1,477,495**	

Note1): 1 USD = 1,500 MMK (As of January 2020)
Note2): The compensation amount of Fruits tree/ Production Tree should be estimated based on the age of the trees. Therefore, it should be re-calculated at the time of the updating RAP.
Source: JICA Study Team

CHAPTER 12 Implementation Schedule

Following the preparation of RAP in F/S stage, the updating and formal approval of the RAP is to be conducted in DD stage after approval of the Project and then disbursement of compensation and assistance to each PAHs are to be implemented. The implementation of RAP particularity payment of the compensation is required prior to any displacement according to the JICA guideline. Key steps to update and implement the RAP are set out below:

1) RAP approval (FS stage): the RAP is prepared by the project entity (DoB) with assistance of the JICA Study Team, examined and approved within the entity as well as JICA.
2) RAP update (DD stage): the Updated RAP (URAP) will be prepared based on the detailed design and approved by MOC and JICA. In the preparation of URAP, the RAP socialization are to be held prior to the survey and URAP draft stage.
3) Re-valuation of Budget by Resettlement Implementation Committee (RIC): RIC will be established and the RAP budget will be re-valuated by RIC.
4) Notification and negotiation with PAPs: RIC will notify to the PAPs and negotiate the compensation price. The price will be finalized and agreement on the price with PAPs will be prepared in written form.
5) Budget securement and approval: After obtaining agreement with PAPs, RIC will sum up and re-valuates the RAP budget plan, submit the revised budget to Union government through Ministry of Finance & Planning (MOPF) for approval.
6) Implementation of RAP: After budget is verified, RIC will disburse the payment of the compensation to each PAPs.
7) Handover the sections: PMU (MOC) will give the Contractor right of access to, and possession of, all parts of the Site where payments of compensation, resettlement of Displaced Persons (DPs) and relocation of relevant properties are completed.

The schedule for the activities relating to the RAP preparation, updating and implementation are shown in Table 12.1.

Table 12.1 RAP Implementation Schedule

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* (RIC): Resettlement Implementation Committee
Source: JICA Study Team

CHAPTER 13 Result of Review on ADB RP and Recommendations

13.1. Result of Review on ADB RP

For the ADB bypass section, the ADB RP was prepared by ADB Technical Assistance Team in accordance with ADB SPS and relevant Myanmar laws. The ADB RP was finalized on April 2019 and shared with JICA side, thereafter JICA Study Team reviewed the ADP RP in August 2019.

As the result of the review, it was confirmed that ADB RP satisfies the requirement of JICA Guidelines and WB OP 4.12 Annex A, mainly the following issues, therefore appropriate environmental and social considerations particularly on RAP related issues will be ensured for the ADB section as well.

As the result of the review, it was confirmed that ADB RP satisfies the following major requirements of JICA Guidelines and WB OP 4.12 and Myanmar relevant law, mainly the following issues, therefore appropriate environmental and social considerations particularly on RAP related issues will be ensured for the ADB section.

- ✓ Analysis of legal framework
- ✓ Planning of the Institutional Framework for implementation of RP
- ✓ Establishment of the resettlement measures including compensation entitlement and estimation of the necessary budget through census survey, SES, IOL survey and RCS
- ✓ Monitoring system and Grievance Redress Mechanisms
- ✓ Holding of consultation with PAPs and building the consensus on the contents of the RP

13.2. Recommendations

Although the JICA Bridge section and the ADB Road Section are separately planned to be financed as well as to be implemented, both RAPs shall be well-harmonized in order to minimize the negative impact and to maximize the effectiveness of the both projects. During FS stage, some of the items have already been harmonized between ADB and JICA section, however, further harmonization are necessary in the updating and implementation of both RAPs. Major issues to be considered are followings;

(1) Harmonization of the Eligibility, Entitlement and the Price of Compensation /Assistance

1) Eligibility: During updating RAPs in DD stage, the detailed eligibility criteria and detailed survey method should be harmonized such as SAHs and VAHs (the Poor, indigenous peoples, landless, etc.)

2) Entitlement: During updating RAPs in DD stage, the detailed contents of the entitlement should be harmonized especially on the items not defined in the Myanmar Law such as Category of Land type, Business loss, Assistance for Informal settlers, Other special Assistance (SAH assistance, Vulnerable Assistance, Transportation Assistance, Relocation stabilization assistance) and IRP.

3) Unit Price of Compensation/ Assistance: During conducting survey in DD stage, the unit price for each compensation/assistance and the detailed survey method of Replacement Cost Survey (RCS) should be harmonized

(2) Institutional Framework: similar framework and institutional structure shall be established particular in terms of Procedure of RAP update to the RAP implementation, timing of establishment of the RIC, member of the RIC.

(3) Grievance Redress Mechanism (GRM): similar GRMs shall be established and applied for both such as procedure of GRM, timing of establishment of the GRM and the member of the Grievance Redress Committee.