# Initial Environmental Examination

April 2019

# Myanmar: Rural Roads and Access Project –
## Ayeyarwady Region Project Component

Prepared by the Ministry of Construction of the Republic of the Union of Myanmar for the Asian Development Bank.

## CURRENCY EQUIVALENTS

(as of 31 January 2019)

| | | |
|---|---|---|
| Currency unit | – | kyat (MK) |
| MK1.00 | = | $0.00066 |
| $1.00 | = | MK1512.35 |

## ABBREVIATIONS

| | | |
|---|---|---|
| asl | – | above sea level |
| CBD | – | Convention on Biological Diversity |
| CITES | – | Convention for International Trade of Endangered Species |
| CRRN | – | Core Rural Road Network |
| dBA | – | expression of the relative loudness of sounds in air as perceived by the human ear |
| DBST | – | Double Bitumen Surface Treatment |
| DDIS | – | Detailed Design and Implementation Support |
| DRD | – | Department of Rural Development |
| DRRD | – | Department of Rural Road Development |
| LDP | – | Liability Defects Period |
| EC | – | Electrical Conductivity |
| ECD | – | Environmental Conservation Department |
| ECC | – | Environmental Compliance Certificate |
| EHS | – | Environment Health and Safety |
| EHSO | – | Environment Health and Safety Officer |
| EIA | – | Environmental Impact Assessment |
| EMP | – | Environmental Management Plan |
| ESIA | – | Environmental and Social Impact Assessment |
| TGAD | – | Township General Administration Department |
| IEE | – | Initial Environmental Evaluation |
| IESS | – | International Environment Safeguard Specialist |
| IFC | – | International Finance Corporation |
| ILO | – | International Labour Organization |
| MOECAF | – | Ministry of Environmental Conservation and Forestry |
| MONREC | – | Ministry of Natural Resources and Environmental Conservation |
| MOLFRD | – | Ministry of Livestock, Fisheries and Rural Development |
| MSD | – | Masonry side drain |
| NEQG | – | National Environmental Quality Guidelines |
| NESS | – | National Environment Safeguard Specialist |
| OSH | – | Occupational health & safety |
| PA | – | Protected area |
| PEA | – | Program Executing Agency |
| PenMac | – | Penetrated Macadam |
| PPTA | – | Project Preparation Technical Assistance |
| RDP | – | Rural Development Programme |
| PPE | – | Personal Protective Equipment |
| RW | – | Retaining Wall |
| RCSD | – | Reinforced concrete side drain |
| RoW | – | Right of Way |

| | | |
|---|---|---|
| RRAP | – | Rural Road Access Programme |
| SPS | – | Safeguard Policy Statement |
| UNFCCC | – | United Nations Framework Convention on Climate Change |

**NOTE**

(i) In this report, "$" refers to United States dollars.

Date: 25.April .2019

Subject: **Letter of Commitment with respect to Initial Environmental Examinations for Rural Roads and Access Project**

With reference to the Initial Environmental Examination for the Rural Roads and Access Project, we confirm:

a) the accuracy and completeness of the IEE,

b) that the IEE has been prepared in strict compliance with applicable laws including Environmental Impact Assessment Procedure (2015), and

c) that the Rural Roads and Access Project will at all times comply fully with the commitments, mitigation measures, and plans in the IEE Report.

Tin Moe Myint
Deputy Director (Admin)
Department of Rural Road Development
Ministry of Construction

ရက်စွဲ။ ၂၀၁၉ ခုနှစ်၊ ဧပြီလ ၂၅ ရက်

## ကျေးလက်လမ်းနှင့်ဆက်သွယ်မှုစီမံကိန်းနှင့်စပ်လျဉ်း၍ လိုက်နာဆောင်ရွက်မည့်အချက်များ

ကျေးလက်လမ်းနှင့်ဆက်သွယ်မှုစီမံကိန်းနှင့်စပ်လျဉ်း၍ ကျေးလက်လမ်းဖွံ့ဖြိုးရေးဦးစီးဌာနအနေဖြင့် အောက်ပါအတိုင်း ကြီးကြပ်ဆောင်ရွက်ပါသည်-

(က) ကနဦးပတ်ဝန်းကျင်ဆန်းစစ်ခြင်းသည် တိကျခိုင်မာမှုရှိပြီးပြည့်စုံစွာ ပြုစုထားပါသည်။

(ခ) ပတ်ဝန်းကျင်ဆန်းစစ်ခြင်းဆိုင်ရာလုပ်ထုံးလုပ်နည်းအပါအဝင် သက်ဆိုင်ရာဥပဒေများကို တိကျစွာလိုက်နာ၍ ကနဦးပတ်ဝန်းကျင်ဆန်းစစ်ခြင်းကို ဆောင်ရွက်ထားပါသည်။

(ဂ) စီမံကိန်းသည် ကနဦးပတ်ဝန်းကျင်ဆန်းစစ်ခြင်း အစီရင်ခံစာပါ ကတိကဝတ်၊ ပတ်ဝန်းကျင်ထိခိုက်မှုလျော့ချရေး လုပ်ငန်းများနှင့် အစီအစဉ်များကို အပြည့်အဝ လိုက်နာဆောင်ရွက်မည် ဖြစ်ပါသည်။

တင်မိုးမြင့်
ဒုတိယညွှန်ကြားရေးမှူးချုပ် (စီမံရေး)
ကျေးလက်လမ်းဖွံ့ဖြိုးရေးဦးစီးဌာန
ဆောက်လုပ်ရေးဝန်ကြီးဌာန

Environmental Conservation Department
Ministry of Natural Resources and Environmental Conservation
Building No. 53
Nay Pyi Taw

26 April 2019

Subject: Letter of Commitment with respect to Initial Environmental Examinations for Rural Roads and Access Project

With reference to the Initial Environmental Examinations for the Rural Roads and Access Project we confirm:

a) the accuracy and completeness of the IEEs,

b) that the IEEs has been prepared in strict compliance with applicable laws including Environmental Impact Assessment Procedure (2015).

Myint Soe
National Environmental Consultant

သို့

ညွှန်ကြားရေးမှူးချုပ်
ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန
ဦးစီးချုပ်ရုံး
ရုံးအမှတ်(၅၃)နေပြည်တော်

ရက်စွဲ။ ၂၀၁၉ ခုနှစ် ဇူလိုင် ( ၂၅ ) ရက်

အကြောင်းအရာ။ ။ ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းများ ဆောင်ရွက်ရန် ကြားကာလ အကြံပေးလုပ်ကိုင်သူ မှတ်ပုံတင်ခြင်း အထောက်အထား လက်မှတ် လျှောက်ထားခြင်း။

ကျေးလက်ဒေသ ဖွံ့ဖြိုးတိုးတက်ရေး ဦးစီးဌာန၏ ကျေးလက်လမ်းကွန်ယက် ဖွံ့ဖြိုးရေး စီမံကိန်းများအား ADB၊ KfW ဘဏ်တို့ ၏ ကူညီထောက်ပံ့ပိုးမှုဖြင့် တည်ဆောက်ခဲ့ရာတွင် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းများကို ဆောင်ရွက်နိုင်ရေးအတွက် ကြားကာလ အကြံပေးလုပ်ကိုင်သူ မှတ်ပုံတင်ခြင်း အထောက်အထား လက်မှတ်ထုတ်ပေးပါရန် ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဦးစီးဌာန သို့ (၂၂.၁၂.၂၀၁၆) နေ့တွင် လျှောက်ထားခဲ့ပါသည်။

ကျွန်တော်သည် လျှပ်စစ်နှင့် စွမ်းအင် ဝန်ကြီးဌာန ၏ အာရှဖွံ့ဖြိုးရေးဘဏ်၊ ကမ္ဘာ့ဘဏ် တို့၏ ကူညီပံ့ပိုးမှုဖြင့် ဆောင်ရွက်သော လျှပ်စစ်နှင့် စွမ်းအင် ဝန်ကြီးဌာန ၏ လျှပ်စစ်မာတ်အားထုတ်လုပ်ရေး၊ ပို့ဆောင်ရေး နှင့် ဖြန့်ဖြူးရေး လုပ်ငန်းများတွင် အကြံပေးအဖြစ်ဆောင်ရွက်ရသည်ဖြစ်ပါ၍ ပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ထုံးလုပ်နည်း (၅၁၆/၂၀၁၅) အရ ကြားကာလ အကြံပေးလုပ်ကိုင်သူ မှတ်ပုံတင် အထောက်အထား လက်မှတ် ထုတ်ပေးနိုင်ပါရန် ဘွဲ့လက်မှတ် နှင့် အထောက်အထားများ ပူးတွဲလျှက် လေးစားစွာ လျှောက်ထား အပ်ပါသည်။

မြင့်စိုး
အမျိုးသားပတ်ဝန်းကျင်ထိန်းသိမ်းရေးအကြံပေး

# 1. အစီရင်ခံစာ အကျဉ်းချုပ် (EXECUTIVE SUMMARY)

## 1.1 နိဒါန်း (Introduction)

1. နိုင်ငံ၏ ကျေးလက်လမ်းအစီအစဉ်ဖွံ့ဖြိုးတိုးတက်ရေးနှင့် ဘဏ္ဍာငွေအကူအညီပေးရေးတွင် ထောက်ကူပေးနိုင်ရေးအတွက် ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်အစိုးရ၏ မေတ္တာရပ်ခံချက်ကို အာရှဖွံ့ဖြိုးရေးဘဏ် (ADB)အနေဖြင့် အကူအညီပေးရန် အတည်ပြုခဲ့ပါသည်။ စီမံကိန်းကို "ကျေးလက်လမ်းစီမံကိန်း (Rural Roads and Access Project -RRAP)"ဟူသောခေါင်းစဉ်ဖြင့် တိုင်းဒေသကြီး ၂ ခုတွင် ၁၅၂ ကီလိုမီတာ အရှည်ရှိသော ကျေးလက်လမ်းအား တိုးတက်စေရန်နှင့် နည်းပညာနှင့်စွမ်းဆောင်ရည်မြှင့်တင်ရန် ဖြစ်ပါသည်။

2. ကနဦးပတ်ဝန်းကျင်ဆန်းစစ်ခြင်းအစီရင်ခံစာ (IEE) ကို မြန်မာနိုင်ငံ၏ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာလုပ်ထုံးလုပ်နည်း(၂၀၁၅) လိုအပ်ချက်အရသော်လည်းကောင်း၊ ADB ၏ သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းကာကွယ်မှုဆိုင်ရာမူဝါဒထုတ်ပြန်ချက် (၂၀၀၉) (Safeguard Policy Statement (2009) အရသော်လည်းကောင်း လိုက်နာပြင်ဆင်ရေးဆွဲခဲ့ပါသည်။ ဤအစီရင်ခံစာသည် ကျေးလက်လမ်းဖွံ့ဖြိုးတိုးတက်ရေးနှင့်ပြန်လည်ပြုပြင်ခြင်းလုပ်ငန်းနှင့် အခြားဆက်စပ်လုပ်ငန်းများဖြစ်သော တံတားငယ်များနှင့် ရေနူတ်ပိုက်မြောင်းများတည်ဆောက်ခြင်းကြောင့် ဆက်စပ်ဖြစ်ပေါ်လာသော ပတ်ဝန်းကျင်ထိခိုက်မှုများအား ဆန်းစစ်ခြင်းဖြစ်ပါသည်။

3. ကျေးလက်လမ်းစီမံကိန်း (RRAP) သည် ADB ၏ အမျိုးအစားခွဲခြားသတ်မှတ်ချက်အရ Category B အဆင့်စီမံကိန်းအမျိုးအစားဖြစ်ပြီး ပတ်ဝန်းကျင်ထိခိုက်ခံရခြင်း၏ သိသာထင်ရှားရှိမှု(significance)ပေါ် အခြေခံ၍ ခွဲခြားထားပါသည်။ Category B သည် ADB မှ စီမံကိန်းများသို့ ထောက်ပံ့ပေးသည့် အကြောင်းစည်းကမ်းချက်များမှတစ်ခုဖြစ်သည်။ သစ်တော၊ ကာကွယ်ထိန်းသိမ်းတော နှင့် အခြား ဂေဟဗေဒအရထိခိုက်မခံနိုင်သည့် ဧရိယာများသို့ဦးတည်၍ (သို့) ဖြတ်သန်းသွားမည့်လမ်းများကို ချန်လှပ်ဆောင်ရွက်ရန် ADB မှစည်းကမ်းသတ်မှတ်ထားသည်။ Category B အမျိုးအစားဖြစ်သောကြောင့် စီမံကိန်းသည် ကနဦး ပတ်ဝန်းကျင်ဆန်းစစ်ခြင်းအစီရင်ခံစာ (IEE) တင်သွင်းရန် လိုအပ်ပါသည်။ ထို့အတူ မြန်မာနိုင်ငံ ၏ သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်းကြီးဌာနအနေဖြင့်လည်း ဤစီမံကိန်းကို IEE ဆောင်ရွက်ရမည့်စီမံကိန်းအမျိုးအစားအဖြစ်ပင် သတ်မှတ်ထားပါသည်။

4. စီမံကိန်း၏ လမ်းအသီးသီးနယ်နိမိတ်အတွင်းရှိ ပတ်ဝန်းကျင်အခြေအနေများနှင့် အများပြည်သူနှင့်ဆွေးနွေးတိုင်ပင်မှုရလဒ်များအား ပတ်ဝန်းကျင်ဆိုင်ရာတိုက်ဆိုင်စစ်ဆေးမှုစာရင်း(Environmental Checklist) အသုံးပြု၍ စုစည်းဆန်းစစ်အကဲဖြတ်ထားပါသည်။ ၄င်းတို့ကိုနောက်ဆက်တွဲ ၅ တွင် သီးခြားဖော်ပြထားပါသည်။

## 1.2 မူဝါဒနှင့် ဥပဒေရေးရာများ (Policies, Laws and Regulations )

5. ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်၏ ဖွဲ့စည်းပုံအခြေခံဥပဒေ(၂၀၀၈) တွင် နိုင်ငံတော်သည် သဘာဝပတ်ဝန်းကျင်ကို ကာကွယ်ထိန်းသိမ်းစော င့်ရှောက်ရမည်ဟု ဖော်ပြထားသည်။ အမျိုးသားပတ်ဝန်းကျင်မူဝါဒ (၁၉၉၄) ကို ဖွဲ့စည်းပုံအခြေခံဥပဒေ (၂၀၀၈) မထွက်မီကတည်းကပင် ပတ်ဝန်းကျင်မူဝါဒအဖြစ် ပြဋ္ဌာန်းထားပြီး

ဖြစ်သည်။ ထိုမူဝါဒတွင် မြန်မာနိုင်ငံ၏ လူမှုရေးနှင့်စီးပွါးရေးဆိုင်ရာဖွံ့ဖြိုးမှုလုပ်ငန်းများတွင် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ချက် လိုအပ်ကြောင်း ဖော်ပြပါရှိသည်။

6. တချိန်တည်းမှာပင် ထိုမူဝါဒကိုအကောင်အထည်ဖော်ရန် ဥပဒေ၊ နည်းဥပဒေများအား ပြဋ္ဌာန်းသတ်မှတ်ခဲ့ပါသည်။ ကျေးလက်လမ်းစီမံကိန်း (RRAP)နှင့် အဓိကသက်ဆိုင်သော ပတ်ဝန်းကျင်ဆိုင်ရာဥပဒေနှင့် နည်းဥပဒေများမှာ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဥပဒေ (၂၀၁၂)၊ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးနည်းဥပဒေ (၂၀၁၄)၊ ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်းဆိုင်ရာလုပ်ထုံးလုပ်နည်းများ(၂၀၁၅)၊ ဇီဝမျိုးစုံမျိုးကွဲနှင့် သဘာဝထိန်းသိမ်းရေးနယ်မြေများ ကာကွယ်စောင့်ရှောက်ခြင်းဆိုင်ရာဥပဒေ (၂၀၁၈) နှင့် သစ်တောဥပဒေ (၂၀၁၈) တို့ဖြစ်ပါသည်။

7. ထို့ပြင်မြန်မာနိုင်ငံအစိုးရသည် အမျိုးသားပတ်ဝန်းကျင်ဆိုင်ရာ အရည်အသွေး(ထုတ်လွှတ်မှု)လမ်းညွှန်ချက်များအား ၂၀၁၅ ခုနှစ်၊ ဒီဇင်ဘာလတွင် ထုတ်ပြန်ခဲ့ပြီး ၊ လုပ်ငန်းကဏ္ဍအသီးသီးနှင့်နည်းပညာအသုံးပြုမှုအမျိုးမျိုးတို့အတွက် အခိုးအငွေ့ထုတ်လွှတ်မှုနှင့် စွန့်ထုတ် အရည်ထုတ်လွှတ်မှုအဆင့်များအား ခွင့်ပြုသတ်မှတ်ခဲ့ပါသည်။ ဤလမ်းညွှန်ချက်များသည် ဖွံ့ဖြိုးဆဲနိုင်ငံများတွင်အသုံးပြုရန် အပြည်ပြည်ဆိုင်ရာလုပ်ငန်းကဏ္ဍအလိုက် ညစ်ညမ်းမှုကာကွယ်ခြင်း အလေ့အကျင့်ကောင်းများဆိုင်ရာ နည်းပညာလမ်းညွှန်ပေးသည့် အပြည်ပြည်ဆိုင်ရာ ဘဏ္ဍာရေးကော်ပိုရေးရှင်း (International Finance Corporation - IFC) ၏ ပတ်ဝန်းကျင်ဆိုင်ရာကျန်းမာရေးနှင့်ဘေးအန္တရာယ်ကင်းရှင်းရေး (Environmental Health and Safety - EHS) လမ်းညွှန်ချက်များမှ အဓိကကောက်နုတ်ထားသည်။

8. မြန်မာနိုင်ငံ၏ပတ်ဝန်းကျင်ဆိုင်ရာဥပဒေရေးရာများအပြင် ADB ၏သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းကာကွယ်မှုဆိုင်ရာမူဝါဒထုတ်ပြန်ချက် ၂၀၀၉ (ADB Safeguard Policy Statement (SPS 2009) ကိုလည်း လိုက်နာရန်လိုအပ်သည်။[1] ဤ SPS မူဝါဒကို ADB ၏ ငွေကြေးဖြင့်ဆောင်ရွက်သော စီမံကိန်း အားလုံးတို့တွင်လည်းကောင်း၊ ချေးငွေအားဖြင့်ဖြစ်စေ၊ ထောက်ပံ့ငွေအားဖြင့်ဖြစ်စေ၊ အခြားသောရှုယ်ယာ နှင့် အာမခံကဲ့သို့သောမည်သည့်ငွေကြေးထောက်ပံ့မှုဖြင့်ဖြစ်စေ ဆောင်ရွက်သည့် ရင်းနှီးမြှုပ်နှံမှုစီမံကိန်းများအပါအဝင် ADB နှင့်ဆက်စပ်ဆောင်ရွက်သောကြီးကြပ်မှုရှိသည်ဖြစ်စေ၊ ကြီးကြပ်မှုမရှိသည်ဖြစ်စေစီမံကိန်းတိုင်းတို့တွင် လိုက်နာဆောင်ရွက်ပါသည်။

9. ၄င်း SPS မူဝါဒ သည် စီမံကိန်းကြောင့် ဆိုးကျိုးဖြစ်လာမည့်အလားအလာများမှလူနှင့်ပတ်ဝန်းကျင်ထိခိုက်မှုအား ကာကွယ်၍ ရေရှည်တည်တံ့သောစီမံကိန်းအဖြစ် မြှင့်တင်ရန် ရည်ရွယ်ပါသည်။ ADB ၏ SPS တွင် ပတ်ဝန်းကျင်၊ ဆန္ဒမပါသောနေရာပြောင်းရွှေ့ မှု နှင့် တိုင်းရင်းသားမျိုး နွယ်စု ဟူ၍ အဓိကအားဖြင့်ပတ်ဝန်းကျင်ထိန်းသိမ်းကာကွယ်မှု ၃ ခု ပါဝင်ပါသည်။

## 1.3 စီမံကိန်းအကြောင်းအရာ (Description of the Project)

10. စီမံကိန်းသည် တိုင်းဒေသကြီး ၂ ခုတွင် ၁၅၂ ကီလိုမီတာအရှည်ရှိ ကျေးလက်လမ်းဖွံ့ဖြိုးတိုးတက်စေရန်နှင့် နည်းပညာနှင့်စွမ်းဆောင်ရည်မြှင့်တင် ရန် ရည်ရွယ်ပါသည်။ စီမံကိန်းဆောင်ရွက်မည့်တိုင်းဒေသကြီးများမှာ

[1] ADB 2009. Safeguard Policy Statement, Policy Paper https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf

မကွေးတိုင်းဒေသကြီး (၃၆.၄ ကီလိုမီတာ) နှင့် ဧရာဝတီတိုင်းဒေသကြီး (၁၁၅.၆ ကီလိုမီတာ) တို့ဖြစ်ပါသည်။ ဤ IEE အစီရင်ခံစာသည် ဧရာဝတီတိုင်းရှိ ကျေးလက်လမ်း များအတွက် ပြင်ဆင်ထားခြင်းဖြစ်ပါသည်။ မကွေးတိုင်းအတွင်းရှိ ကျေးလက်လမ်းများအတွက်မူ သီးခြား IEE အစီရင်ခံစာတွင် ဖော်ပြပါမည်။

11. ကနဦးအဆင့်အနေဖြင့် ADB သည် ဆောက်လုပ်ရေးဝန်ကြီးဌာနလက်အောက်ရှိ ကျေးလက်လမ်း ဖွံ့ဖြိုးရေးဦးစီးဌာနသို့ နည်းဗျူဟာနှင့် ပရိဂရမ်ဖွံ့ဖြိုးတိုးတက်စေရန်အတွက် နည်းပညာအကူအညီများအား ထောက်ပံ့ကူညီလျက်ရှိသည်။ ၄င်းတွင် ငွေကြေးထောက်ပံ့မှုတိုးမြှင့်ရရှိရေး၊ အရည်အသွေးတိုးတက်ရေးနှင့် စီမံခန့်ခွဲမှုနှင့် ပြုပြင်ထိန်းသိမ်းရေးလုပ်ငန်းများ တွင် ရေရှည်အစီအမံများတိုးမြှင့်ရေးတို့အတွက် မည်ကဲ့သို့ ဆောင်ရွက်ရသည် စသည်တို့ပါရှိပါသည်။ ရင်းနှီးမြှုပ်နှံရေးအတွက် ပင်မကျေးလက်လမ်း ကွန်ရက် (core rural road network (CRRN) စီမံချက်ဗျူဟာသဘောထားအား တင်ပြပါသည်။ ၄င်းမှာ ရွာတရွာချင်းစီသို့ အနည်းဆုံးဆက်သွယ်နေသော ကျေးလက်လမ်း ကွန်ရက်များနှင့် လမ်းတခုချင်းစီမှ အဓိကဦးတည်ရာ နေရာများအား အောက်ခြေမှ စတင်၍အထက်အဆင့်သို့ (bottom-up) အစီအစဉ်ဆွဲခြင်းဖြစ်သည်။ ဒုတိယအဆင့် အနေဖြင့် ရွေးချယ်ထားသောမြို့နယ်များအတွင်းရှိ ပင်မကျေးလက်လမ်းကွန်ရက် (CRRN) ဦးစားပေးစီမံချက်ပေါ် အခြေခံ၍ ကျေးလက်လမ်းတိုးတက်ရေးအတွက် စီမံကိန်းမှငွေကြေး ထောက်ပံခြင်းဖြစ်သည်။

12. ဧရာဝတီတိုင်းအတွင်းရှိ RRAP စီမံကိန်းတွင်ပါဝင်သော မြို့နယ်များမှာ ပန်း တနော်နှင့် မအူပင်မြို့နယ်တို့ဖြစ်ပြီး ၄င်းမြို့နယ်နှစ်ခုလုံးသည် မအူပင်ခရိုင်၏ အုပ်ချုပ်မှုအောက်တွင်ရှိပါသည်။ ဧရာဝတီတိုင်းအတွင်းရှိ မြို့နယ် နှစ်ခုလုံးတွင် ရွေးချယ်ထားသော စုစုပေါင်းလမ်းအရှည်မှာ ၁၁၅.၆ ကီလိုမီတာသတ်မှတ်ထားပါသည်။

13. စီမံကိန်းသည် ဧရာဝတီတိုင်းအတွင်းရှိ လမ်းများအား လမ်းစံနှုန်းများနှင့်အညီ လက်ရှိလမ်းအတိုင်း အတာအတွင်းသာ အဆင့်မြှင့်တင်ဆောင်ရွက်သွားမည်ဖြစ်သည်။ လမ်းအကျယ်မှာ အိမ်ရာရွှေ့ပြောင်းထိခိုက် ခံရခြင်းမှလွတ်ကင်းစေရန် ၂.၆ မီတာမှ ၃ မီတာအတွင်းဖောက်လုပ်မည်။ အနာဂတ်တွင်ဖြစ်ပေါ်လာနိုင်သည့် ရာသီဥတုပြောင်းလဲခြင်းနှင့် ရေကြီရေလျှံခြင်းတို့ကြောင့် လမ်း အမြင့်အား မြှင့်တင်ဆောင်ရွက်သွားမည်ဖြစ်သည်။ လမ်းမျက်နှာပြင်အား ရာသီဥတုဒဏ်ခံနိုင်မည့်ဒီဇိုင်း ပေါ်အခြေခံ၍ ဘိလပ်မြေကွန်ကရစ် cement concrete ၊ ကတ္တရာ (ကတ္တရာဖြန်းကျောက်လွှာ) bituminous (penetration macamdam [PEN-MAC] သို့မဟုတ် နှစ်ထပ်ကတ္တရာခင်းခြင်း double bituminous surface treatment [DBST] ဖြင့် ဆောင်ရွက်မည် ဖြစ်သည်။

14. လမ်းစံနှုန်းနှင့်အညီ လမ်းအခြေအနေတိုးတက်ကောင်းမွန်လာသည်နှင့်အမျှ မော်တော်ယာ ဉ်များ၏ အရှိန်မြှင့်မောင်းနှင်မှုကြောင့် လမ်းအသုံးပြုသူများအနေဖြင့် လမ်းအ နှောက်ယှက်များနှင့်ကြုံတွေ့မှု များပြားလာနိုင်ပါသည်။ ယာဉ်အသွားအလာများလည်း တိုးတက်များပြားလာမည်ဖြစ်သည်။ ဤအနှောက်ယှက်များမှ လျော့ကြေစေရန် ရပ်ရွာအခြေပြု လမ်းအနှောက်ယှက်ကင်းရှင်းစေရေးအစီအစဉ်ကိုလည်း ထည့်သွင်းထားပါသည်။ လမ်းအနှောက်ယှက် ကင်းရှင်းစေရန် အသေးစိတ် ဒီဇိုင်းတွင် အင် ဂျင်နီယာပိုင်းအစီအမံများထည့်သွင်းမည် ဖြစ်သော်လည်း များသောအားဖြင့် မတော်တဆမှုများမှာ လမ်းအသုံးပြုသူတို့၏ အပြုအမူများကြောင့် ဖြစ်ပွါးရခြင်းဖြစ်သဖြင့် ဤအစီအစဉ်တွင် လမ်းအသုံးပြုသူများအတွက်ဦးတည်၍ ပညာပေးလိုက်နာရေးကို ဆောင်ရွက်သွားမည် ဖြစ်သည်။ လမ်းအနှောက်ယှက်ကင်းရှ ငး်စေရေးအတွက် အရှိန်ထိန်းဂုံးများ **(speed bumps)** ကို ရွာ၏ တဖက်တချက်တွင်လည်းကောင်း၊ လမ်းအကွေ့များတွင် သတိပေး ဆိုင်းပုဒ်များ၊ တံတား ချဉ်းကပ်များတွင် အကာအရံများ (**guardrail**) ကိုတပ်ဆင်သွားမည်ဖြစ်သည်။

15. မြန်မာနိုင်ငံ၏ ဆောက်လုပ်ရေးလုပ်ငန်းများတွင် များသောအားဖြင့် စက်ပစ္စည်းအသုံးပြုမှုထက် လူအားဖြင့်သာ ဆောင်ရွက်လေ့ရှိသဖြင့် RRAP စီမံကိန်းအတွက်လည်း ထည့်သွင်းဆောင်ရွက်ရန်စဉ်းစား သင့်ပါသည်။ ယေဘုယျအားဖြင့်တည်ဆောက်ရေးလုပ်ငန်းများမှာ မြေရှင်းခြင်း၊ မလိုလားအပ်သောပစ္စည်းများအား ဖယ်ထုတ်ခြင်း၊ လမ်းတာများတည်ဆောက်ခြင်း၊ အောက်ခြေ လွှာခင်းခြင်း၊ လမ်းခင်းခြင်း၊ တံတားနှင့် ရေနုတ်ပိုက်မြောင်းများ တည်ဆောက်ခြင်းနှင့်လမ်းအန္တရာယ်ကာကွယ်ရေးပစ္စည်းများတပ်ဆင်ခြင်းတို့ပင်ဖြစ်သည်။

16. အကြိုဒီဇိုင်းအဆင့်အတွင်း မည့်သည့် နေရာအရင်းအမြစ်မှမြေသားများဖြင့် လမ်းမြေသားဖို့ ဆောင်ရွက်မည်ကို မသတ်မှတ် ထားသော်လည်း ကန်ထရိုက်တာအနေဖြင့် လမ်းမြေသားဖို့ရယူရန်အတွက် နေရာအားအကြံပြုသတ်မှတ်ဆောင်ရွက်သွားရမည်ဖြစ်သည်။ လမ်းခင်းကျောက်အနေဖြင့် ဧရာဝတီတိုင်း၏ ပြင်ပမှသာ ရယူဆောင်ရွက်သွားမည်ဖြစ်ပြီး တွဲရေယာဉ်များဖြင့် ဆောက်လုပ်ရေးလုပ်ငန်းခွင်အနီးသို့ သယ်ယူရမည်ဖြစ်သည်။ အသေးစားလမ်းစီမံကိန်းဖြစ်သဖြင့် ကန်ထရိုက်တာအနေဖြင့်လမ်းခင်းကျောက်များကို ပြည်တွင်းရှိခွင့်ပြုချက်ရရှိထားသော ကုန်သည်များဆီမှရယူမည်ဟု မျှော်လင့်ရသည်။ ယင်းအရင်းအမြစ်သည် အစိုးရ၏ဥပဒေများအတိုင်း ပတ်ဝန်းကျင် ဆိုင်ရာခွင့်ပြုချက်၊ တရားဝင်လုပ်ငန်းလိုင်စင်နှင့် အခြားလိုအပ်သည့် စာရွက်စာတမ်းများရှိထားရန်လိုပါသည်။

17. ဧရာဝတီတိုင်းအတွင်းတွင် တည်ဆောက်ရေးကာလမှာ နိုဝင်ဘာလမှ မေလအထိ ၇ လတာကာလဖြစ်ပါသည်။ မိုးရွာသွန်းမှုများသော ဇွန်လမှ အောက်တိုဘာလထိ (၅ လတာ)တွင် ဆောက်လုပ်ရေးလုပ်ငန်းများအား အတိုင်းအတာတခုထိသာ ခွင့်ပြုဆောင်ရွက်သွားမည်ဖြစ်သည်။

## 1.4 ပတ်ဝန်းကျင်ဆိုင်ရာအကြောင်းအရာဖော်ပြချက် (The Environmental Setting)

18. မအူပင်နှင့်ပန်းတနော်မြို့နယ်တို့သည် ဧရာဝတီတိုင်းဒေသကြီးအုပ်ချုပ်မှုအောက်တွင်ရှိပြီး ဧရာဝတီမြစ်ဝှမ်းဒေသ၏ အောက်ဘက်ပိုင်းတွင်တည်ရှိပါသည်။ မအူပင်နှင့်ပန်းတနော်မြို့နယ် ၂ ခုလုံးသည် ဧရာဝတီမြစ်၏ မြ စ်ဝကျွန်းပေါ်မြေပြန့်တွင်ရှိပါသည်။ ယေဘုယျအားဖြစ့် မြေပြန့်လွင်ပြင်သည် မြစ်ဝကျွန်းပေါ်နှင့် ဆက်စပ်နေသော မြေနုများဆင့် ကဲဖြစ်ပေါ်လာခြင်း လက္ခဏာဖြစ်သည်။ ၄င်းမြစ်ဝကျွန်းပေါ်တွင် မြစ် ကြောင်းများ၊ အင်းအိုင်၊ ရေကန် များနှင့် ရေထိန်းတမံများ ပေါများပါသည်။ (abandoned river channels, ponds and lakes in cut-off meanders and ancient levees and berms.)

19. ဤဒေသသည် ယေဘုယျအားဖြင့် အပူပိုင်းမုတ်သုံရာသီဥတုအောက်တွင်ကျရောက်ပြီး နွေ၊ မိုး၊ ဆောင်းရာသီဥတု ၃ခု ရှိပါသည်။ နွေရာသီသည် ဖေဖော်ဝါရီလကုန်မှ စတင်၍ မေလဆန်းထိလည်းကောင်း၊ မိုးရာသီသည် ဇွန်လမှ အောက်တိုဘာလထိ လည်းကောင်း၊ ဆောင်းရာသီသည် နိုဝင်ဘာလမှ ဖေဖော်ဝါရီလကုန်ထိလည်းကောင်းဖြစ်ပါသည်။ နွေရာသီနှင့်ဆောင်းရာသီတွင် မိုးရွာသွန်းမှုနည်းပါးသော်လည်း၊ မိုးရာသီတွင် အနောက်တောင်မုတ်သုံလေကြောင့် မိုးရွာသွန်းမှု များပြားပါသည်။

20. မြန်မာ့ရာသီဥတုဆန်းစစ်ချက် ၂ ခုကို မကြာမီကပင် ထုတ်ဝေခဲ့ပါသည်။ လာမည့်ရာစုနှစ်တွင် မြန်မာနိုင်ငံ၏ နှစ်စဉ်ပျမ်းမျှအပူချိန်တိုးမြှင့်လာမည်ဖြစ်ပြီး နိုင်ငံ၏ နေရာဒေသအသီးသီးတွင် အပူချိန်အမျိုးမျိုးဖြစ်လာမည်ဟု ခန့်မှန်းထားပါသည်။ ရာသီဥတုပူနွေးခြင်းသည် ၂၀၄၀ ခုနှစ် နောက်ပိုင်းတွင် ပိုမိုအားကောင်းလာနိုင်ပြီး ပျမ်းမျှအပူချိန်လည်း တိုးမြှင့်လာမည်ဖြစ်သည်။ နိုင်ငံတဝန်း မိုးရွာသွန်းမှုပုံစံသည်လည်း

လာမည့်ရာစုနှစ်တွင် ပြောင်းလဲနိုင်ပါသည်။ မိုးရွာသွန်းမှု ပုံစံပြောင်းလဲခြင်းခန့်မှန်းမှုမှာ မသေချာသော်လည်း ယခုမိုးရာသီ (ဇွန်လမှ အောက်တိုဘာလအတွင်း)ရွာသွန်းသည့်မိုးရေချိန်သည် ၁၉၈၀- ၂၀၀၅ ကာလအတွင်း အခြေခံထားသည့် မိုးရေချိန်နှင့်နှိုင်းယှဉ်ပါက ရေတို-ရေရှည်ကာလနှစ်မျိုးလုံးတွင် ပိုမိုရွာသွန်းလာပြီး တချို့ဒေသများတွင် မိုးရာသီအတွင်း ရေကြီးရေလျံမှုများ များပြားလာမည်ဟု တွက်ချက်ရရှိပါသည်။

21. ပင်လယ်ရေမျက်နှာပြင် မြင့်တက် မှုခန့်မှန်းတွက်ချက်ရာတွင် ၂၀၀၀-၂၀၀၄ ခုနှစ် ကာလအား အခြေခံထားတွက်ချက်ထားသော အလယ်ကိန်းအနေဖြင့် ၂၀၅၀ ခုနှစ်တွင် ၂၀-၄၁ စင်တီမီတာအထိ လည်းကောင်း၊ ၂၀၈၀ ခုနှစ်တွင် ၃၇-၈၃ စင်တီမီတာထိလည်းကောင်း မြင့်တက်နိုင်ပြီး ယင်းကာလအတွက် ၂၂၁ စင်တီမီတာထိအမြင့်ဆုံးမြင့်တက်မည်ဟု ခန့်မှန်းတွက်ချက်ရရှိပါသည်။ ၄င်းခန့်မှန်းချက်များအရ မြစ်ဝကျွန်းပေါ်ဒေသသည် ရာသီပြောင်းလဲမှုကြောင့် ပင်လယ်ရေမျက်နှာပြင်မြင့်တက်ခြင်းခံရမည်ဟု ခန့်မှန်းထားပါသည်။ မိုးရေချိန်ရွာသွန်းနှုန်းမြင့်မားလာခြင်းနှင့် ပင်လယ်ရေမျက်နှာပြင် မြင့်တက်လာခြင်းအကျိုးဆက် နှစ်ခုပေါင်းအနေဖြင့် မြစ်ဝကျွန်းပေါ်ဒေသသည် ရေကြီးရေလျံမှု အန္တရာယ်တိုးမြင့်လာမည်ဖြစ်သည်။ ထိုသို့သောအန္တရာယ်အလားအလာများကြောင့် ကာကွယ်သောနည်းလမ်းတခုအနေဖြင့် စီမံကိန်းဆောင်ရွက်မည့်လမ်းများသည် မကြာခနဖြစ်ပွားနိုင်သည့်ရေကြီးရေလျံမှုမှလွတ်ကင်းရန် ဖြစ်နိုင်လျှင် လမ်းမြင့်တင်ဆောင်ရွက်ရမည်ဖြစ်သည်။

22. မြန်မာနိုင်ငံ၏ ဘူမိသွင်ပြင်လက္ခဏာသည် မြေထုချပ်အားဖြင့် Indian plate, Burma Pate နှင့် Eurasian Plate ဟူ၍ အဓိကအားဖြင့် convergence of tectonic plate ဖြစ်သည်။ ဤဘူမိဒေသတွင် crustal plate convergence ပုံစံ ၃ မျိုးတွေ့ရှိရပြီး မြေထုချပ်များအချင်းချင်းဝင်ရောက်သွားခြင်းနှင့် လျော့တိုက်ရွေ့လျားခြင်းကြောင့် စစ်ကိုင်းပြတ်ရွေ့ကဲ့သို့ ဖြစ်ပေါ်လာသည်။ ဤသို့ တောင်- မြောက်သွယ်တန်းသော ထင်ရှားသည့် စစ်ကိုင်းပြတ်ရွေ့လှုပ်ရှားမှုကြောင့် ဤဒေသတွင် ငလျင်ဖြစ်ပွါးခြင်း ဖြစ်သည်။

23. ဧရာဝတီမြစ်ဝကျွန်းပေါ်၏ ကျောက်လွှာဖွဲ့စည်းမှု (lithology) မှာ သက်တမ်းနုသော Alluvial ဘူမိသွင်ပြင်ဖြင့် ဖွဲ့ စည်းထားပါသည်။ မအူပင်နှင့် ပန်းတနော်မြို့နယ်များသည် သက်တမ်းနုသော Holocene unconsolidated sediments တွင် တည်ရှိပါသည်။ မြေအမျိုးအစားမှာ မြစ်မှ အနယ်ကျမှုကြောင့် ဖြစ်ပေါ်လာသည့် alluvial soilဖြစ်ပါသည်။ မြေသက်တမ်းနု ခြင်း၊ အပင်အဟာရဓါတ်ပေါ်ကြွယ်ဝခြင်းနှင့် ရေလွှမ်းသည့်အချိန်တွင် မြေဆီ အဟာရပြန်လည်ဖြည့်တင်းခြင်းတို့ကြောင့် တိုင်းပြည်၏ ဆန်စပါးထုတ်လုပ်မှုတွင် ဦးဆောင်ကဏ္ဍမှပါဝင်ပြီး မြန်မာနိုင်ငံ၏ စပါးကျီအဖြစ်ထင်ရှားပါသည်။

24. ဧရာဝတီမြစ်သည် ကမ္ဘာ့အဆင့်သတ်မှတ်ချက်တွင် ပဉ္စမအကြီးဆုံး suspended load ရှိပြီး၊ စတုတ္ထအကြီးဆုံး total dissolved solid load အများဆုံးဖြစ်သည်။ လေ့လာမှုတခုအရ ဧရာဝတီနှင့် သံလွင်မြစ်ဝသို့ နှစ်စ ဉ်အနယ်ပို့ချမှုများပြားသော်လည်း ပင်လယ်ကမ်းရိုးတန်းသည် ၁၉၂၅ ခုနှစ်ကတည်းမှပင် ရာစုနှစ်တစ်စုနှစ်လျှင် ပျမ်းမျှ ၀.၃၄ ကီလိုမီတာထက်မပိုသောနှုန်းဖြင့် စုပုံခြင်းနှင့် တိုက်စားခြင်း စက်ဝန်းများကြောင့် မူလအနေအထားအတိုင်းပင်ရှိပါသည်။ ယေဘုယျအားဖြင့် ပင်လယ်ကမ်းရိုးတန်းသည် အနယ်ပို့ချမှုနှင့် ပင်လယ်ရေမြင့်တက်ခြင်းတို့ကြောင့် မျှခြေအဆင့်တွင်ရှိနေပါသည်။

25. စီမံကိန်းဆောင်ရွက်မည့် ဧရာဝတီတိုင်းဒေသကြီးအတွင်းရှိ လမ်းနယ်နိမိတ်များတွင် မြေတိုက်စားမှုနှင့် နှုန်းအနယ်ကျခြင်းကြောင့် မြစ်ကြောင်းပြောင်းလဲမှုပါ ဒွန်တွဲဖြစ်ပေါ်လာပါသည်။ စက်လေ့ခုတ်မောင်း ၍ လှိုင်းရိုက်ပုတ်မှုကြောင့် အတားအဆီးအကာအရံမဲ့သောကမ်းပါးများ/မြစ်ကြောင်းများသည် မြေဆီလွှာတိုက်စား

မှုဒါဏ်ခံနိုင်ရည်မဲ့လာပါသည်။ မြစ်ကြောင်းနှင့်အပြိုင်သွယ်တန်းဖောက်လုပ်မည့် လမ်းများသည် ဤဖြစ်ရပ်များ တွေ့ကြုံရပါမည်။

26. မြစ်ဝကျွန်းပေါ်ဒေသသည် မြေပေါ်ရေ (Surface water) ပေါကြွယ်ဝပြီး အဓိကရေအရင်းအမြစ်မှာ ဧရာဝတီမြစ်ဖြစ်ပါသည်။ ရေစီးနှုန်းမှာ 2,300 $m^3$/s မှ 32,600 $m^3$/ s အတွင်း အမျိုးမျိုးရှိပြီး ပျမ်းမျှအားဖြင့် 13,000 $m^3$/s နှုန်းဖြင့် တနှစ်လျှင်ပျမ်းမျှ 410 $km^3$ ထုတ်လွှတ်ပါသည်။ မြစ်ရေသည် မိုးရွာသွန်းမှု အမျိုးမျိုးကွာခြားမှုနှင့် Himalayan မှနှင်းများအရည်ပျော်ကျမှုကြောင့် မြစ်ရေစီးဆင်းမှု အတက်အကျ ပြောင်းလဲမှုကြီးမားပါသည်။

27. ၂၀၀၈ ခုနှစ်မှ ၂၀၁၁ ခုနှစ်အတွင်း ဧရာဝတီမြစ်နေရာ ၈ နေရာတွင် ရေအရည်အသွေး စောင့်ကြပ် ကြည့်ရှုခဲ့ပါသည်။ ဤစစ်ဆေးမှု အချက်အလက်အရ အထူးသဖြင့် မန္တလေး၊ မကွေးနှင့် ပခုက္ကူဒေသတို့တွင် သတ္ထုဇြပ်များ ဧရာဝတီမြစ်အတွင်း စီးဝင်ခြင်းကြောင့် ရာသီအလိုက်သော်လည်းကောင်း၊ နေရာ ဒေသအလိုက် သော်လည်းကောင်း ရေအရည်အသွေး ထိခိုက်ခံရနိုင်ကြောင်း တွေ့ရှိရပါသည်။

28. မြစ်ဝကျွန်းပေါ်ဒေသတွင် ရာသီအလိုက် ရေအိုင် နှင့် နွံအိုင် (wetlands) များ ကျယ်ကျယ်ပြန့်ပြန့် ဖြစ်ပေါ်ပါသည်။ ဤရေအိုင်များသည် မိုးရာသီတွင် ရေပြည့်နေပြီး၊ နွေရာသီ ရေနည်းချိန်တွင် စိုက်ပျိုးနိုင်ပါသည်။ တခြားသော သဘာဝရေကန်များမှာ ငါးကန်များအဖြစ်သို့ ပြောင်းလဲလျက်ရှိပါသည်။

29. မြေအောက်ရေကိုလည်း မြစ်ဝကျွန်းပေါ်တွင်တွေ့ရှိရပါသည်။ မြစ်ဝကျွန်းပေါ်ဒေသတွင် Holocene sediments ကြောင့် မြေအောက်ရေအနက်တိမ်ပါသည်။ ထို့ကြောင့် မြေအောက်ရေကို ရေတွင်းတူး၍သော်လည်းကောင်း၊ စုပ်ထုတ်၍သော်လည်းကောင်းတူးဖော်နိုင်ပါသည်။ သို့သော်လည်း အချို့နေရာများတွင် မြေအောက်ရေအရည်အသွေးညံ့ဖျင်းသဖြင့် အိမ်သုံး စွဲရန်အကန့်အသတ်ရှိပါသည်။ ထို့ပြင် တချို့နေရာများတွင် မြေအောက်ရေတွင် arsenic ပါဝင်ကြောင်း သိရပါသည် ။ မအူပင်မြို့ရှိ စီမံကိန်းဆောင်ရွက်မည့် အချို့နေရာများတွင် မြေအောက်ရေသည် ကျောက်လွှာများအောက်တွင်ရှိကြောင်း စမ်းရေစီးဆင်းမှုအခြေအနေ ပေါ်တွင်သိရှိနိုင်ပါသည်။ ရေပေးဝေမှုစနစ်မရှိသည့်နေရာများတွင် အိမ်အသုံးပြုရန်အတွက် မြေပေါ်မြေအောက် အရင်းအမြစ်နှစ်မျိုးလုံးမှသုံးစွဲရပါသည်။

30. ဧရာဝတီဒေသကြီးရှိ သစ်တောဖုံးလွှမ်းမှုမှာ လျော့နည်းလျက်ရှိပါသည်။ ပြန်လည်ဖာ၍စိုက်ပျိုးထားသော သစ်မာခင်းများသည်သာ မြို့ဧရိယာအတွင်း ပျံ့နှံ့ပေါက်ရောက်လျက်ရှိပါသည်။ စီမံကိန်းဆောင်ရွက်မည့် ဧရိယာများတွင် သစ်ပင်များသည် အိမ်ခြေများနှင့်ရောထွေး ပေါက်ရောက်နေပါသည်။ သစ်ပင်ကြီးများနှင့် ဟင်းသီးဟင်းရွက်ပင်များရှိသော သစ်မာဧရိယာတွင် သီးပင်၊ အလှပင်နှင့် မလေးရှားပိတောက်ပင် (Long Leaf Acacia)၊ ယူကလစ်ပင် (Eucalyptus) နှင့် Gmelina စသည့်မျိုးစိတ်များအား ပြန်လည်စိုက်ပျိုးလျက် ရှိပါသည်။ မြို့နယ်ဆန်းစစ်ချက် များအရ စီမံကိန်း ဆောင်ရွက်မည့် မအူပင်မြို့နယ်နှင့် ပန်းတနော်မြို့နယ် လမ်းဧရိယာနယ်နိမိတ်သည် သစ်တောကြိုးဝိုင်းအတွင်းတွင် မကျရောက်ပါ။ ထိန်းသိမ်းကာကွယ်တောများသည်လည်း စီမံကိန်းဆောင်ရွက်မည့်လမ်းများနှင့်ကွာဝေးပါသည်။

31. မြစ်ဝကျွန်းပေါ်ဒေသတွင် အိမ် ခြေများနှင့် စိုက်ပျိုး ရေးလုပ်ငန်းများသည်သာ မြေအသုံးချမှုလွှမ်းမိုးနေပါသည်။ မြေနေရာရရှိမှုပေါ်မူတည်၍ ကျေးရွာအခြေကျနေထိုင်မှုသည် ပြန့်ကြဲ လျက်ရှိပါသည်။ သို့သော်လည်း

ရေများဖြင့်ကန့်ပိတ်မိနေသောနေရာများတွင် အိမ်ရာအခြေကျမှုသည် လမ်း သိုမဟုတ် ရေနူတ်မြောင်းများနှင့် အပြိုင်မျဉ်းဖြောင့်အတိုင်းဖြစ်ပါသည်။ စီမံကိန်းဧရိယာအပါအဝင် မြစ်ဝကျွန်းပေါ်ဒေသတွင် စပါးအား အဓိကသီးနှံအဖြစ်စိုက်ပျိုးပါသည်။ ရေလုပ်ငန်းကိုလည်း ကျယ်ပြန့်စွာဆောင်ရွက်လျက်ရှိပြီး များသောအားဖြင့် ရေချိုငါးမွေးမြူရေးကန်များသာဖြစ်သည်။

32. ငှက်မျိုးစိတ် ၄၇၁ ခုအား ဧရာဝတီအောက်ခြေပိုင်းတွင်တွေ့ရသည် ဟု The Avibase-Worldwide Checklist of Birds[2]အစီရင်ခံစာအရသိရပါသည်။ ၄င်းတို့အနက်မှ မျိုးစိတ် ၁၉ ခုသည် globally threatened မျိုးစိတ်ဖြစ်ပြီး၊ မျိုးစိတ် ၁ ခုသည် introduced species ဖြစ်ပါသည်။ Birdlife International မှလည်း မြစ်ဝကျွန်းပေါ်ဒေသ၏ ကမ်းရိုးတန်းသည် အရေးကြီးသောဒေသက်ဧရိယာအဖြစ်သတ်မှတ်ထားပါသည်။

33. လမ်းစီမံကိန်းဧရိယာနယ်နိမိတ်အတွင်းတွင်ကျက်စားသော ငှက်မျိုးစိတ်များသည် ကွင်းပြင်များ၊ လူနေအိမ်ခြေများ၊ ခြုံ ပုတ်နှင့် မြက်ခင်းပြင်များနှင့် စိမ့်နွံအိုင်များတွင်ကျက်စားပါသည်။ ရွာနေလူထု နှင့်ဆွေးနွေးတိုင်ပင်ရာ ၄င်းတို့အနေဖြင့် ထိန်းသိမ်းထားသောငှက်မျိုးစိတ်အကြောင်းကို သိရှိခြင်းမရှိပါ။

34. ဧရာဝတီမြစ်တွင် ငါးမျိုးစိတ် ပေါင်း ၄၄ ခုနေထိုင်ကျက်စားသည်ဟု Fishbase အစီရင်ခံစာတွင်ပါရှိပြီး *Cyprinidae* မျိုးရင်းဝင် ၁၁ ခုပါရှိပြီး အရေအတွက်အများဆုံးဖြစ်သည်။ မျိုးစိတ် ၄၂ ခုမှာ ဒေသမျိုးများဖြစ်ပြီး ၂ ခုမှာ endemic ဖြစ်သည်။ ငါးမွေးမြူရေးလုပ်ငန်းကို ကျယ်ပြန့်စွာဆောင်ရွက်လျက်ရှိပြီး carp and non-carp species ကို မွေးမြူပါသည်။

35. ထင်ရှားသော ဧရာဝတီလင်းပိုင် (*Orocaella brevirostris*) မှာ ဧရာဝတီမြစ်တွင် နေထိုင်ကျက်စားပါသည်။ ၄င်းတို့အများစုမှာ မြစ်အပေါ် ပိုင်းတွင် ကျက်စားလျက်ရှိပြီး တချို့ဧရိယာများကို ကာကွယ်ထိန်းသိမ်းဧရိယာ protected area (PA) အဖြစ်သတ်မှတ်ထားပါသည်။ ထိန်းသိမ်းဧရိယာသည် မန္တလေးအနီးရှိမင်းကွန်းမှ မြောက်ဘက် ကျောက်မြောင်းထိ ၇၄ ကီလိုမီတာရှိပါသည်။ သမိုင်းအချက်အလက်အရ ပြည်မြို့၏အောက်ဘက်နေရာများတွင်ကျက်စားခြင်းမတွ့ရှိရပါ။ အစီရင်ခံစာများတွင် မြစ်ဝကျွန်းပေါ်ဒေသ၌ ဧရာဝတီလင်းပိုင်တွေ့ရှိမှုအား ဖော်ပြထားသည်ကိုမတွေ့ရပါ။

36. သဘာဝဘေးအန္တရာယ်အနေဖြင့်လည်း စီမံကိန်းဧရိယာသည် နိုးကြားနေသော tectonic နေရာပေါ်တွင်တည်ရှိပါသည်။ စစ်ကိုင်းပြတ်ရွှေအက်ကြောင်းကြောင့် ငလျင်ကြီး များဖြစ်ပေါ်ခဲ့ပါသည်။ ငလျင်ဆန်းစစ်ချက်အရ ငလျင်အန္တရာယ်ဇုံ ၅ ဇုံခွဲခြားထားပြီး၊ ဇုံ ၁ မှ ၅ အထိ မြေပြင်လှုပ်ခါမှုအနည်းအများခွဲခြားသတ်မှတ်ပါသည်။ RRAP စီမံကိန်းသည် အသင့်အတင့်ဇုံထဲတွင် ကျရောက်ပြီး probability 0.1g to 0.15g အတွင်းရှိပါသည်။

37. စီမံကိန်းဆောင်ရွက်မည့်လမ်းနေရာများ၏ ရေကြီးရေလျံမှုအန္တရာယ်ကိုလည်း Dartmouth Flood Observatory မှပြုလုပ်ထားသော ဆိုင်ကလုန်းနာဂစ်ရေကြီးရေလျံသောမြေပုံကို အသုံးပြု၍ စီမံကိန်းဧရိယာအား အကဲဖြတ်ဆောင်ရွက်ခဲ့ပါသည်။ MBN 019 မှလွဲ၍ တခြားသော မအူပင်မြို့နယ်အတွင်းရှိ စီမံ ကိန်းလမ်းများသည် ရေကြီးရေလျံခြင်းမှလွတ်ကင်းပါသည်။ ဤလမ်းအဆုံးနားတွင် လမ်းသည်ငါးကန်ဧရိယာအား

[2] http://avibase.bsc-eoc.org/checklist.jsp?region=MMay&list=howardmoore

ဖြတ်သွားပါသည်။ ထို့အတူ ပန်းတနော်တွင်လည်း တချို့သော PTN012 and PTN019 တို့၏ လမ်းအစိတ်အပိုင်းတို့မှလွဲ၍ စီမံကိန်းလမ်းများသည် ရေလွှမ်းဧရိယာအပြင်ဘက်တွင်ရှိပါသည်။

## 1.5 လူမှုစီးပွါးရေးအခြေအနေ (The Socio-Economic Condition)

38. ဧရာဝတီတိုင်းဒေသကြီးတွင် လူဦးရေ 6,184,829 ရှိပြီး ဗမာနှင့် ကရင်လူမျိုးမှာ အများစုဖြစ်ပြီး ၊ ရခိုင်လူမျိုးအနည်းစုသည် အနောက်ဘက်ကမ်းရိုးတန်းတွေနေထိုင်ပါသည်။ လူဦးရေ၏အများစုမှာ ဗုဒ္ဓဘာသာကို ကိုးကွယ်ပြီး အနည်းစုမှာ ခရစ်ယာန်၊ မွတ်စလင်၊ ဟိန္ဒူ နှင့် Bahai ဘာသာကို ကိုးကွယ်ကြပါသည်။

39. ဧရာဝတီတိုင်းဒေသကြီးတွင် ဆန်စပါးကိုသာ အဓိကစိုက်ပျိုးကြပြီး မြန်မာနိုင်ငံ၏ ဆန်အိုးကြီးဒေသ ဖြစ်သည်။ စပါးအပြင် ပြောင်း၊ နှမ်း၊ မြေပဲ၊ နေကြာ၊ ပဲအမျိုးမျိုးနှင့်ဂုံလျော်တို့အား စိုက်ပျိုးပါသည်။ စိုက်ပျိုးရေးလုပ်ငန်း၏ တိုးတက်မှုသည် အလုပ်သမားများစိုက်ပျိုးရေးလုပ်ငန်းတွင် ပါဝင်မှုပုံစံပေါ်တွင် မူတည်ပါသည်။ ငါးမွေးမြူရေးလုပ်ငန်းများဖြစ်သည့် ဖမ်းဆီးခြင်းနှင့် မွေးမြူခြင်းလုပ်ငန်းများသည်လည်း အရေးကြီးသော စီးပွားရေးလုပ်ငန်းဖြစ်ပြီး ငါး၊ပုစွန်၊ငါးပိ၊ ငါးခြောက်၊ပုစွန်ခြောက်နှင့် ငံပြာရည်တို့ကို ထုတ်လုပ်ပါသည်။

40. တနိုင်ငံလုံးတွင် လျှပ်စစ်မီးရရှိမှုမှာ အလွန်ပင်နည်းပါသည်။ MOLFRD (2015) အရ ကျေးလက်မီးရရှိမှုမှာ နိုင်ငံ၏ ရွာစုစုပေါင်း၏ ၄၁ ရာခိုင်နှုန်းသာရှိပါသည်။ မအူပင်ခရိုင်အတွင်းရှိ မြို့နယ် ၄ မြို့နယ်တွင် ၁၆၄၈ ကျေးရွာရှိသည့်အနက် ၆၁၀ ရွာသာမီးရရှိပါသည်။ ရွာများ၏ ၆၃ ရာခိုင်နှုန်းမှာ လျှပ်စစ်မီးမရရှိသေးပါ။ အိမ်ခြေအများစု (၉၅ ရာခိုင်နှုန်း )သည် ချက်ပြုတ်ရန်အတွက် ထင်းနှင့်စပါးခွံကိုသာ သုံးစွဲရပါသည်။

41. သောက်သုံးရေသန့်ရရှိမှုမှာလည်း အကန့်အသတ်ရှိပြီး မြစ်ဝကျွန်းပေါ်ဒေသ၏ လူဦးရေ ရာခိုင်နှုန်း အနည်းငယ်ကသာလျှင် အများပြည်သူရေပေးဝေရေးစနစ်နှင့် ချိတ်ဆက်ထားသည်။ မြေအောက်ရေတွင် arsenic ခါတ်ပါဝင်ခြင်းမှာလည်း စိုးရိမ်စရာဖြစ်ခဲ့ပြီး မြန်မာနိုင်ငံ၏ ပြည်သူ့ကျန်းမာရေးအတွက် မီးမောင်ထိုးပြသည့် အချက်ဖြစ်သည်။

42. စာတတ်မြောက်မှုနှုန်းမှာ ၂၀၁၄ ခုနှစ် သန်း ခေါင်စာရင်းအရ မြင့်မားပြီး၊ အတန်းပညာရေးမှာလည်း မြင့်ပါသည်။ တနိုင်ငံလုံးအနေနှင့် မူလတန်း သို့မဟုတ် အဆင့်မြင့်ပညာတတ်မြောက်သည့်လူဦးရေ ၇၅ ရာခိုင်နှုန်း အထက်ရှိပါသည်။ အတန်းပညာတတ်မြောက်မှုအနေဖြင့် မအူပင်မြို့တွင် အသက် ၂၅ နှစ်နှင့်အထက် မူလတန်း သို့မဟုတ် မူလတန်းနှင့်အထက် တတ်မြောက်သူသည် ၇၅ မှ ၉၀ ရာခိုင်နှုန်းရှိပါသည်။

43. မအူပင်မြို့နယ်တွင် တက္ကသိုလ် ၃ ခု၊ အထက်တန်းကျောင်း ၁၄ ကျောင်း၊ အလယ်တန်းကျောင်း ၂၃ ကျောင်းနှင့် မူလတန်းကျောင်း ၂၈၃ ကျောင်း၊ ဘုန်းတော်ကြီးပညာသင်ကျောင်း ၂ ကျောင်းရှိပါသည်။ ပန်းတနော်မြို့နယ်တွင် အထက်တန်းကျော င်း ၁၀ ကျောင်း၊ အလယ်တန်းကျောင်း ၁၄ ကျောင်း၊ မူလတန်းကျောင်း ၂၉၀ နှင့် ဘုန်းတော်ကြီးသင်ကျောင်း ၅ ကျောင်းရှိပါသည်။

44. ကျန်းမာရေးစောင့်ရှောက်မှုအနေဖြင့်မအူပင် မြို့နယ်တွင် အစိုးရဆေးရုံ ၃ ခုရှိပြီး၊ ကျေးလက်

ကျန်းမာရေးစင်တာ ၁၂ ခု၊ စင်တာခွဲ ၇၂ ခု၊ အခြေခိုက်ဆေးရုံ ၁ ခုနှင့် ပုဂ္ဂလိကဆေးရုံ ၁ ခုရှိပါသည်။ ပန်းတနော်မြို့နယ်တွင် အစိုးရဆေးရုံ ၁ ခု၊ ကျေးလက်စင်တာ ၆ ခု၊ စင်တာခွဲ ၄၄ ခုနှင့် ပုဂ္ဂလိကဆေးခန်း ၆ ခုရှိပါသည်။

45. ဌက်ဖျား၊ AIDS နှင့် အဟာရချို့တဲ့ခြင်းနှင့် အခြားဆက်စပ်ရောဂါများမှာ နိုင်ငံ၏အဓိက ပြဿနာများ ဖြစ်သည်။ တီဘီရောဂါသည်သေဆုံးမှုများသောအဓိကရောဂါဖြစ်ပါသည်။ မြန်မာနိုင်ငံ၏ တီဘီရောဂါ ဖြစ်ပွါးနှုန်းမှာ ကမ္ဘာတွင်အများဆုံးဖြစ်သည့် နိုင်ငံများမှ တစ်ခုဖြစ်သည် ။ နှစ်စဉ် 97,000 ဖြစ်ပွါးကြောင်းသိရပါသည်။ အဓိက ကူးစက်ရောဂါများမှာ (က) အစားအသောက် သို့မဟုတ် ရေ ကြောင့်ကူးစက်ရောဂါ - ဘက်တီးရီးယား၊ ပရိတိုဖိုးဝါး၊ ဝမ်းပျက်ဝမ်းလျော၊ အသည်းရောင်ရောဂါ A နှင့် တိုက်ဖွိုက်ရောဂါ (ခ) vector borne diseases-သွေးလွန်တုပ်ကွေးနှင့် ဌက်ဖျားရောဂါ (ဂ) water contact disease – leptospirosis (ဃ) animal contact disease: ခွေးရူးပြန်ရောဂါ တို့ဖြစ်သည်။ H5N1ဌက်တုပ်ကွေးရောဂါဖြစ်ပွါးမှုလည်း ဤနိုင်ငံတွင် တွေ့ရှိရပါသည်၊

## 1.6 ထိခိုက်မှုများအား ခန့်မှန်းခြင်းနှင့်ဆန်းစစ်ခြင်း (Impacts Prediction and Assessment)

46. RRAP စီမံကိန်း၏ အဓိကဝိသေသမှာ Category B စီမံကိန်းဖြစ်သဖြင့် လမ်းသည် သစ်တောကြိုးဝိုင်း၊ ကာကွယ်တော သို့မဟုတ် ဥပဒေ အရတားမြစ်ထားသော ကာကွယ်ထိန်းသိမ်းတောများသို့ ဖြတ်သန်းဖောက်လုပ်ခြင်းအား အတိအလင်းရှောင်ရှားဆောင်ရွက်သဖြင့် ဆိုးကျိုးသက်ရောက်မှု ကြီးများအား ဟန့်တားထားပါသည်။ အခြား RRAP စီမံကိန်း၏ ပတ်ဝန်းကျင်ထိခိုက်မှုလျော့နည်းအောင် ဆောင်ရွက်ချက်မှာ လက်ရှိလမ်း အူကြောင်းအတွင်းသာဆောင်ရွက်မည်ဖြစ်ပြီး၊ တချို့နေရာအနည်းငယ်တွင်သာ လမ်းအနွှာရာယ်ကင်းစေရန် လမ်အူကြောင်းအားပြန်လည်ပြင်ဆင်မည် ဖြစ်သည်။

47. RRAP စီမံကိန်းကြောင့်ထိခိုက်မှုကို အရည်အသွေး သက်ရောက်မှု (quality of impacts (positive, negative, direct indirect)) နှင့် ပမာဏအတိုင်းအတာ (magnitude (significance of impact), i.e. low moderate, high တို့ဖြင့် အကဲဖြတ်ပါသည်။ သက်ရောက်မှုပမာဏအတိုင်းအတာအား ဆန်းစစ်ရာတွင် သဘာဝအတိုင်းတုံ့ပြန်မှု (ဥပမာ။ ရပ်ရွာလူထု၊ ပတ်ဝန်းကျင်အရထိခိုက်မခံသည့် အရေးကြီးသောစားကျက်နှင့် အထူးနေရာများ) ၊ ထိခိုက်ခံရသည့်အချိန် ကာလအတိုင်းအတာ၊ ထိခိုက်ခံရသည့်အရွယ်အစားနှင့် ထိခိုက်မှုဖြစ်နိုင်သည့်ထုထည်ပမာဏတို့ပေါ်မူတည်၍ ဆန်းစစ်အကဲဖြတ်ပါသည်။ ဤလမ်းစီမံကိန်းတွင် တည်နေရာအနေအထားကြောင့် ထိခိုက်မှုနှင့် လုပ်ငန်းလည်ပတ်ဆောက်လုပ်မှုကြောင့်ထိခိုက်မှုများကို ခန့်မှန်းအကဲဖြတ်ပါသည်။ လုပ်ငန်း အားစွန့်လွတ်လိုက်ခြင်းအတွက် ဆန်းစစ်ခြင်းမဆောင်ရွက်ပါ၊ အဘယ်ကြောင့်ဆိုသော် ကျေးလက်လမ်းများသည် အစ ဉ်မပြတ်လိုအပ်ပြီး လမ်းအဆင့်မြှင့်သဖြင့် အနာဂတ်တွင်သက်မွေးဝမ်း ကျောင်းမှုလုပ်ငန်းများပိုမိုရရှိမည်ဖြစ်သည်။

48. ထိခိုက်မှုအမျိုးအစားသတ်မှတ်ရာတွင် တိုက်ဆိုင်စစ်ဆေးမှုစာရင်း checklist ကိုအသုံးပြုခြင်းနှင့် အခြားပုံစံတူစီမံကိန်း၏အတွေ့အကြုံများမှကောက်နှုတ်ခြင်း နည်းလမ်း ၂ ခုပေါင်း၍ဆောင်ရွက်ပါသည်။ IFIs, WB နှင့် ADBတို့မှလည်း ကိုးကားဆောင်ရွက်ပါသည်။ EIA ဆောင်ရွက်သည့် ပညာရှင်၏အတွေ့အကြုံသည်လည်း ထိခိုက်သက်ရောက်မှုခန့်မှန်းရာတွင် အဓိကကြပါသည်။

49. တည်နေရာကြောင့်ဖြစ်ပေါ်သောဆိုးကျိုးသက်ရောက်မှုမှာ RRAP လမ်းစီမံကိန်း၏ လမ်းနယ်နိမိတ်အတွင်း ရွာနေအိမ်များအခြေကျနေထိုင်ခြင်းနှင့် ရေထုရှိနေသောကြောင့် မရှောင်လွဲနိုင်သောထိခိုက်မှုရှိပါသည်။ အခြေချမှုများအပေါ်ထိခိုက်မှုဖြစ်ခြင်းမှာ ရွာအခြေချနေရာများအတွင်း ကျဉ်းသော လမ်းနေရာများအား ချဲ့ထွင်ခြင်းဖြစ်သည်။ လမ်းပြုပြင်ထိန်းသိမ်းခြင်းကို လက်ရှိလမ်းအကျယ်အတွင်းသာဆောင်ရွက်မည် ဖြစ်သည်။ လက်ရှိလမ်းအကျယ်သည် အကျဉ်းဆုံး ၁.၈ မီတာမှ အကျယ်ဆုံး ၈.၂ မီတာအတွင်းရှိပြီး နေရာတော်တော်များတွင် တသမတ်တည်း ၃ မီတာအကျယ်ရှိပါသည်။ လက်ရှိလမ်းအကျယ်အမျိုးမျိုးအတိုင်းသာ ဖောက်လုပ်မည်ဖြစ်သဖြင့် ဧရာဝတီတိုင်းအတွင်းရှိ အဆိုပြုစီမံကိန်းလမ်းအားလုံး ၁၁၅ ကီလိုမီတာတွင် အိမ်ရာရွှေ့ပြောင်းမှုမရှိသလောက်နီးပါး (zero resettlement impacts) ဖြစ်သည်။

50. အခြားသောထိခိုက်နိုင်မှုအလားအလာမှာ စိုက်ပျိုးရေးလုပ်ငန်းချိန်ဖြစ်သော ရိတ်သိမ်းချိန်နှင့် လမ်းဖောက်လုပ်ရေးအကြား ပဋိပက္ခများဖြစ်နိုင်ပါသည်။ ရိတ်သိမ်းချိန်တွင် ယာဉ်အသုံးပြုမှုများတိုးမြှင့်လာခြင်းနှင့်နွေရာသီတွင် စပါးစေ့များအား လမ်းပေါ်တွင် အခြောက်လှမ်းခြင်းတို့ဖြစ်ပါသည်။ ၄င်းဖြစ်ရပ်မှာ တနှစ်လျှင် ၂ သီးစား သို့မဟုတ် ၃ သီးစားစိုက်ပျိုးသူများရှိသည့် ဒေသများတွင် ပို၍သိသာမည်ဖြစ်သည်။ ထိုထိခိုက်မှုမှ လျော့ နည်းသက်သာစေရန် တခြားခြွေလှေ့ ခြင်းဆောင်ရွက်နိုင်မည့်နေရာများအား သတ်မှတ်ထားရမည် ဖြစ်သည်။ ကန်ထရိုက်တာအနေဖြင့်လည်း လုပ်ငန်းခွင်တွင် ယာဉ်အသုံးပြုမှုကို သင့်တော်သလို ကိုင်တွယ်သင့်သည်။

51. လမ်းနယ်နိမိတ်အတွင်းတွင် ရေနှင့်ရေသွင်းမြောင်းများအား ညစ်ညမ်းမှုအန္တရာယ်လည်း ရှိလာနိုင်ပါသည်။ လမ်းတလျောက်ရှိ ရေညစ်ညမ်းမှုမှကင်းဝေးရန် နှင့် ရေသွင်းမြောင်းများပျက်စီးခြင်းမှ ကင်းဝေးရန် အတွက် ပစ္စည်းစီမံကိုင်တွယ် ခြင်းနှင့် ဆောက်လုပ်ရေးလုပ်ငန်းများ အား အနီးကပ်ကြီးကြပ်ဆောင်ရွက်သင့်ပါသည်။

52. တည်ဆောက်ရေးကာလအတွင်း အဓိကထိခိုက်မှုမှာ တည်ဆောက်ရေးလုပ်ငန်းခွင်နေရာ (camps) ထားရှိမှုပင် ဖြစ်ပါသည်။ လုပ်ငန်းခွင်နေရာထားရှိခြင်းသည် ၄င်း၏တည်နေရာပုံသေဖြစ်ခြင်း၊ အန္တရာယ်ရှိသော ပစ္စည်းများအား သိုလှောင်ခြင်းနှင့် ကိုင်တွယ်ခြင်း ကြောင့် ပတ်ဝန်းကျင်ထိခိုက်မှုအများဆုံးဖြစ်နိုင်ပါသည်။ လူမှုရေးထိခိုက်မှုအလားအလာအနေဖြင့် ရပ်ရွာလူထုနှင့် လုံခြုံရေး ကြားပဋိပက္ခ၊ ရပ်ရွာလူထု၏ ကျန်းမာရေး အန္တရာယ်ကြုံတွေ့နိုင်ပါသည်။

53. လုပ်ငန်းခွင်နေရာ(camp)ကြောင့်ထိခိုက်မှုမှလျော့ချရန် ရွာရှိအိမ်ရာ များအားငှါးရမ်းဆောင်ရွက်ခြင်းဖြင့် ဆောက်လုပ်ရေးလုပ်ငန်းခွင်လိုအပ်ချက်အား လျော့ချနိုင်ပါသည်။ လုပ်သားတန်းလျားဆောက်လုပ်ပေးခြင်း အစား ဒေသခံအလုပ်သမားများအား အိမ်မှလုပ်ငန်းခွင်သို့ အခမဲ့ပို့ဆောင်ပေးခြင်းဖြစ်လည်း လျော့ချနိုင်ပါသည်။ မကောင်းသည့်လုပ်ငန်းခွင်နေရာသည် ပြဿနာများဖြ စ်ပေါ်နိုင်ပြီး ကန်ထရိုက်တာအတွက်လည်း ကုန်ကျစရိတ်တိုးလာနိုင်သည့်အတွက် မှန်ကန်သော လုပ်ငန်းခွင်နေရာရွေးချယ်ခြင်းသည်လည်း အဓိကထိခိုက်မှုလျော့ချသည့် နည်းလမ်းဖြစ်သည်။

54. အလုပ်သမားတန်းလျားများအပြင် ပုံမှန်လုပ်ငန်းခွင်နေရာတွင် ပစ္စည်များထားသို သည့်နေရာ၊ စက်သုံးဆီနှင့် ယန္တရားများတပ်ဆင်နှင့်ပြင်ဆင်ရန်နေရာ၊ ကတ္တရာနှင့် လမ်းခင်းအချောထည် asphalt or batching plant များပါဝင်သည်။ စက်များမောင်းနှင်ခြင်းကြောင့် ဆူညံခြင်းနှင့် အမှုန်ထခြင်းတို့ ဖြစ်ပွါး

နိုင်ပါသည်။ ဤထိခိုက်မှုအားလျော့ချရန် အနီးဆုံး လူနေအိမ်သည် လုပ်ငန်းခွင်နေရာနှင့် အနည်းဆုံး ၃၀၀ မီတာ အကွာတွင်ထားရှိသင့်ပါသည်။ ညစ်ညမ်းမှုမှကွာကွယ်ရန်အတွက်မူ ကန်ထရိုက်တာအနေဖြင့် လုပ်ငန်းခွင်နေရာ သည် မြေပေါ်ရေနှင့်ဝေးရာနေရာတွင် ထားသင့် ပြီး အခြေခံ ပတ်ဝန်းကျင်ဆိုင်ရာ အကာအကွယ်ပစ္စည်းများ တပ်ဆင်သင့်သည်။ အလုပ်သမားများ၏ လုပ်ငန်းခွင် ကျန်းမာရေး နှင့်လုံခြုံမှုရှိရေးအတွက် ကန်ထရိုက်တာသည် နေရာ၊ ရေပေးဝေမှု၊ စားသောက်ရန်နေရာနှင့် သန့်ရှင်းမှုတို့အတွက် အပြည်ပြည်ဆိုင်ရာအလုပ်သမားစခန်းများ အတွက်ညွှန်ကြားချက် (e.g. ILO, OSHA) များနှင့်အညီ အလုပ်သမားအိမ်နေရာများ ထားရှိရမည်။ ထို့ပြင် အလုပ်သမားတန်းလျားများအတွက် လုံခြုံမှုရှိရန် အစီအမံများထားရှိသင့်သည်။

55. ကန်ထရိုက်တာသို့လုပ်ငန်းခွင်နေရာလွှဲပြောင်းပြီးနောက် ကနဦးအဆင့်အနေဖြင့် သစ်ပင်များအပါအဝင် အလုပ်ခွင်ဧရိယာအတွင်း တခြားသောပစ္စည်များကိုဖယ်ရှားခြင်းအပါအဝင် ရှင်းလင်းခြင်းဆောင်ရွက်ရမည်။ ပစ္စည်းများကိုလည်း ပြန်လည်နေရာချထားရမည်။ အကာအကွယ်များမထားရှိပါက အပင်ခုတ်ခြင်းနှင့် ဖယ်ရှားခြင်းတို့သည် လုပ်ငန်းခွင်နေရာပြင်ပသို့ ထိခိုက်နိုင်ပါသည်။ ထို့ပြင် စက်ပစ္စည်း အကြီးစားများ မောင်းနှင်လည်ပတ်ခြင်းသည်လည်း ဖုံနှင့်ဆူညံသံကို ဖြစ်ပွါးစေပါသည်။ ပထမဦးစွာ ကန်ထရိုက်တာသည် ရွာမှတာဝန်ရှိသူများ၊ ပစ္စည်းကြောင့် ထိခိုက်မှုရှိမည့် ပစ္စည်းပိုင်ရှင်များနှင့်ချိတ်ဆက်ဆောင်ရွက်သင့်သည်။ လုပ်ငန်းခွင်နေရာကို ခြံခတ်ခြင်း၊ သစ်ပင်ခုတ်ခြင်းအတွက် ခွင့်ပြုချက်ရယူခြင်းနှင့် တရားဝင်အမှိုက် စွန့်ပစ်ရန်နေရာ သတ်မှတ်ခြင်းတို့ကိုဆောင်ရွက်ရမည်။ အများပြည်သူထိခိုက်မှုမရှိရ ေးအတွက်လည်း အချက်ပြ signs များ၊ အတားအဆီးများ၊ အချက်ပြသူများထားရှိသင့်သည်။

56. သစ်ပင်များဖယ်ရှားရန်အတွက် ပုဂ္ဂလိကပိုင်ရှင်ထံမှ ခွင့်ပြုချက်ရယူရန်လိုအပ်သလို ကျွန်းပင်များ ဖြစ်ပါက သစ်တောဥပဒေတွင်ကျွန်းပင်အားလုံးသည်နိုင်ငံတော်မှပိုင်သည်ဟုပါရှိချက်အရ ကန်ထရိုက်တာသည် ကျွန်းပင်ဖယ်ရှားရန်အတွက်မူ သစ်တောဦးစီးဌာနမှခွင့်ပြုချက်ရယူဆောင်ရွက်သင့်သည်။

57. မလိုလားအပ်သောပစ္စည်းများဖယ်ရှားခြင်းမှာ အကယ်၍ လက်ရှိလမ်း (ကျောက်ခင်းလမ်း)ရှိပါက ဖယ်ရှားခြင်းနှင့်လိုအပ်ပါကအောက်ခြေလွှာဖယ်ရှားရန်ဖြစ်သည်။ ပုံမှန်အားဖြင့်ခင်းထားသောလမ်းရှိ stripped pavement များကိုဖယ်ရှားရန်ဖြစ်သော်လည်း ပစ္စည်းအလွယ်တကူမရသောနေရာများတွင် ၄င်းတို့အားခွဲချေ၍ ပြန်လည်အသုံးပြုနိုင်ပါသည်။ ကုန်ကြမ်းရင်းမြစ်ရှားပါးသဖြင့် RRAP စီမံကိန်းကိုလည်း ထိုသို့ပင် ပြန်လည်သုံးစွဲမည်ဟု ခန့်မှန်းရသည်။ အသုံးပြုရန် မသင့်သောပစ္စည်းများကိုမူ မြေအမျိုးစားပေါ်မူတည်၍ ဖို့မြေအဖြစ်လည်းကောင်း၊ လမ်းပုခုံးသားအဖြစ်လည်းကောင်း ပြန်လည်အသုံးပြုသွားမည်။ တချို့လမ်း လုပ်ဆောင်ချက်များသည် လမ်းပိတ်ဆောင်ရွက်ရန်လိုပြီး စက်ယန္တရားကြီးများအသုံး ပြုရန် လိုပါသည်။ လမ်းပိတ်ဆို့မှုများဖြစ်ပေါ်လာနိုင်ပါသည်။ ထို့ကြောင့် ကန် ထရိုက်တာအနေဖြင့် တည်ဆောက်ရေးမစတင်မီ ရပ်ရွာနှင့်တိုင်ပင်၍ traffic management plan ကို ပြင်ဆင်ထားရန်လိုအပ်ပါသည်။ ဖုံမှုန့်နှင့် ဆူညံသံများ ထိန်းချုပ်ရန်အတွက်လည်း plan ထဲတွင် ထည့်သွင်းရမည်။ ဆူညံသံလျော့ချရေးပစ္စည်းများလည်း ထည့်သွင်း တပ်ဆင်ရမည်။

58. လမ်းတာ (embankment) ဆောက်လုပ်ရာတွင်လည်း အခြေခံပစ္စည်းများအား သယ်ယူခြင်း၊ နေရာချခြင်းနှင့် ဖို့သိပ်ခြင်းစသည့်လုပ်ငန်းများ ပါဝင်ပါသည်။ တချို့စနစ်များတွင် သဲကို လုပ်ငန်းခွင်နေရာသို့ ရေယာဉ်ဖြင့်သယ်ပို့ပြီး၊ သဲကို slurry ဖျော်စပ်ရာတွင် ထည့် သွင်းအသုံးပြုပါသည်။ ထိုသို့ရေယာဉ်ဖြ င့် ပို့ဆောင်ရာတွင် ရေယာဉ်ကြောင့် ဘေးပတ်ဝန်းကျင်ရေထုအား နှုန်းတင်ပို့မှု မဖြစ်စေရန် စီမံခန့်ခွဲမှု

ပြုလုပ်ရန်လိုပါသည်။ အခြားနည်းအားဖြင့် တည်ဆောက်ရေးပစ္စည်းများအား ကုန်တင်ကားဖြင့်သယ်ယူမည် ဆိုပါကလည်း လမ်းပိတ်ဆို့မှုဖြစ်ပွါးနိုင်ပြီး ဖုံနှင့်ဆူညံမှုများ ဖြစ် ပွါးနိုင်သလို အများပြည်သူများလည်း မတော်တဆမှုများ ဖြစ်ပွါးနိုင်ပါသည်။ လမ်းဆောက်လုပ်ရေးတွင် အသုံးပြုမည့် စက်ယန္တရားများမှာ road grader and road roller ဖြစ်ပါသည်။ အကြီးစား စက်ယန္တရားအသုံးပြုခြင်းကြောင့် ဆူညံသ၊ တုန်ခါမှု၊ အခိုးအငွေ့ထုတ်လွှတ်မှုတို့ ဖြစ်ပေါ်လာနို င်ပါသည်။ လမ်းပိတ်ဆောင်ရွက်မှုများကြောင့် ရပ်ရွာနေလူထုအတွက် အဆင်မပြေဖြစ်ခြင်း၊ ခရီးနှောင့်နှေးခြင်းတို့ ဖြစ်ပွားနိုင်ပါသည်။

59. လမ်းပိတ်ခြင်းကြောင့်ထိခိုက်မှုမရှိစေရန် ယာယီလမ်းသတ်မှတ်ဆောင်ရွက်ရမည်။ ကန်ထရိုက်တာသည် ဖုံမှုန့်၊ ဆူညံသံများထိန်းချုပ်ရန်နှင့် အများ ပြည်သူများ လမ်းအန္တရာယ်ကင်းဝေးရန် လိုအပ်သလို ကာကွယ် နှိမ်နင်းနည်းများ အကောင်အထည်ဖော်ဆောင်ရွက်ရမည်။ စီမံကိန်းကားများမှ ယာဉ်မောင်းများအား ယာဉ်အန္တရာယ်ကာကွယ်ရေး သင်တန်းများပို့ချသင့်သည်။ မော်တော်ဆိုင်ကယ်များနှင့် ခြေကျင်လျောက်သူများ တည်ဆောက်ရေးလုပ်ငန်းခွင်သို့ ဖြတ်သန်းသွားရာတွင် အန္တရာယ်ကင်းစွာ သွားလာနိုင်ရေးအတွက်လည်း ပြုလုပ်ပေးရမည်။ သတိပေးဆိုင်းဘုတ်များ၊ လမ်းအကာများညာဘက်တွင်မြင်အောင် မီးထွန်းခြင်း၊ အလင်းပြန်ပစ္စည်းထားရှိခြင်းတို့ ဆောင်ရွက်ပေးသင့်သည်။

60. လမ်းခင်းခြင်းတွင် လမ်းခင်းကျောက်များဖြန့်ခင်းခြင်း၊ ကနဦးကတ္တရာလွှာ (prime coat) ခင်းခြင်း ၊ ၄င်းနောက်ကတ္တရာခင်းခြင်း bitumen တို့ဖြစ်သည်။ ၄င်းတို့ကို လူအားဖြစ်သော်လည်းကောင်း၊ စက်အား ဖြင့်သော်လည်းကောင်း ဆောင်ရွက်နိုင်သည်။ တည်ဆောက်ရေးလုပ်ငန်းကြောင့် အလုပ်သမားတို့ အတွက် လုပ်ငန်းခွင်အန္တရာယ် ဖြစ်ပွါးနိုင်ပါသည်။ လူအား ဖြင့်လမ်းတည်ဆောက်ရေးလုပ်ဆောင်ပါက အန္တရာယ် ပိုတွေ့ကြုံနိုင်ပါသည်။ လူအားဖြင့်ဆောင်ရွက်ပါက လုပ်ငန်းခွင် ကျန်းမာရေးအပြင် ပတ် ဝန်းကျင်ထိခိုက်မှုလည်း မြင့်မားမည်ဖြစ်သည်။

61. တခြားနည်းလမ်းမှာ truck mounted aggregate spreader, gas fired bitumen heater and truck mounted bitumen sprayer စက်များအသုံးပြုခြင်းဖြစ်သည်။ ဤနည်းလမ်းအသုံးပြုခြင်းမှာ လူအားကြောင့် ဖြစ်ပေါ်လာနိုင်သည့် လုပ်ငန်းခွင်အန္တရာယ်များအားလျော့ချနိုင်မည်ဖြစ်သည်။ လုပ်ငန်းခွင်အန္တရာယ်ကင်းရှင်း စေရန် အလုပ်သမားများအနေဖြင့် personal protection equipment (PPE) တပ်ဆင်ထားသင့်သည်။ ကန်ထရိုက်တာအနေဖြင့် အလုပ်သမားများအား အပူချိန်မြင့်မားခြင်းကြောင့် ဖြစ်လာနိုင်သည် များကိုလည်း ပြင်ဆင်ထားသင့်သည်။ အများပြည်သူများအန္တရာယ်ကင်းစေရေးအတွက် ဆိုင်းဘုတ်များ၊ အကာအရံများကို လုပ်ငန်းခွင်နှင့်လူသွားလမ်းခြားတွင် တပ်ဆင်ထားသင့်သည်။

62. ဘိလပ်မြေကွန်ကရစ်လမ်းခင်းခြင်းကို တချို့ ရွေးချယ်ထားသောနေရာများတွင် ဆောင်ရွက်သွားမည် ဖြစ်သည်။ ဤလုပ်ငန်းကြောင့် ထိခိုက်မှုမှာ mobile mixers များမှဆေးချသောရေများစွန့်ပစ်မှုဖြစ်သည်။ ဆေးချသောရေသည် အင်ဓါတ် (base)ဓါတ်များသောကြောင့် စွန့်ပစ် ရေကန်တွင် စနစ်တကျစွန့်ပစ်ပြီး တခြားနေရာများတွင်ပြန်လည်အသုံးပြုနိုင်ပါသည်။ ဥပမာ။ ဖုံမထစေရန် ရေဖျန်းခြင်း နှင့် စက်ပစ္စည်းများ ဆေးကြောခြင်းတို့တွင် ပြန်လည်အသုံးပြုနိုင်ပါသည်။

63. လမ်းတွင်ရေကျော်များစွာရှိသောကြောင့် ရေနှုတ်ပိုက်မြောင်းများ၊ ရေထုတ်ပြွန်များဆောက်လုပ်ခြင်း သည် ဤလမ်းလုပ်ငန်း၏ အစိတ်အပို င်းတခုဖြစ်ပါသည်။ ရေနှုတ်ပိုက်မြောင်းနှင့်ရေထုတ်ပြွန် တည်ဆောက်ခြင်း

သည် ရေ သွင်းမြောင်းများသို့ ထိခိုက်မှုရှိနိုင်ပါသည်။ ရေ သွင်းမြောင်းထိခိုက်မှုကြောင့် လယ်ကွင်းသို့ရေပေးခြင်း ထိခိုက်နိုင်ပြီး အကျိုးဆက်အားဖြင့် လယ်သမားများအား ထိခိုက်မည်ဖြစ်သည်။ အထူးသဖြင့် စိုက်ချိန်ပျိုးချိန်တွင် ရေသွင်းခြင်းသည်အရေးပါသောကိစ္စဖြစ်သည်။

64. ထို့ပြင် ရေနူတ်ပိုက်မြောင်းနှင့် ရေထုတ်မြောင်းတည်ဆောက်ခြင်းသည် ငါးကန်များကို ထိခိုက်နိုင်ပါသည်။ အသင့်တပ်ဆင်ပြီးသော ရေနူတ်ပိုက်၊ ပိုက်နှင့်ပစ္စည်းတို့ ကိုအသုံးပြုခြင်းသည် ညစ်ညမ်းမှုအန္တရာယ်မှ လျော့ချနိုင်ပြီး တည်ဆောက်ရေးလုပ်ငန်းကိုမြန်စေနိုင်ပါသည်။ ရေသွင်းမြောင်းများသို့ ထိခိုက်နိုင်သည့် အလားအလာများမှလျော့ချနိုင်ရန် ကန်ထရိုက်တာသည် လယ်သမားအဖွဲ့များနှင့် ဆည်မြောင်းဌာနတို့နှင့် ဆက်သွယ်ဆွေးနွေးသင့်သည်။ ထို့ပြင် ကန်ထရိုက်တာသည် လုပ်ငန်းပြီးပါက လုပ် ငန်းခွင်အား ရှင်းလင်းသင့်သည်။ တံတားဆောက်နေစဉ် လမ်းလျောက်ဖြတ်ကူးမည့်သူများအတွက်လည်း ခြေလျင်ဖြတ်ကူးတံတားများထားပေးသင့်သည်။ အခြားနည်းအနေဖြင့် လုပ်ငန်းခွင်ကိုရှောင်ရှားလိုသူ ရပ်ရွာနေသူများ အနေဖြင့် စက်လှေအသုံးပြုပါက ဆိုက်ကပ်ရန်နေရာ စီစဉ်ပေးသင့်သည်။

65. မအူပင်နှင့် ပန်းတနော် မြို့နယ်ရှိအချို့သောလမ်းများသည် ရေလမ်းကြောင်းများနှင့်ပြိုင်လျက် တည်ရှိနေသောကြောင့် စက်လှေမောင်းနှင်၍လှိုင်းပုတ်ခြင်းကြောင့် လမ်းတိုက်စားမှုဖြစ်နိုင်ပါသည်။ ဧရာဝတီရှိ RRAP စီမံကိန်းအောက်တွင်ရှိသော ဖောက်လုပ်မည့်လမ်းများ၏ မြစ်ကမ်းပါးများတိုက်စားခြင်းမှ ကာကွယ်ရန် bioengineering methods ကို အသုံးပြုရန် အဆိုပြုပါသည်။

66. တံတားဆောက်လုပ်ခြင်းသည်လည်း ရေနူတ်ပိုက်မြောင်းဆောက်လုပ်သကဲ့သို့ပင် တူညီသောထိခိုက်မှုရှိနိုင်ပါသည်။ ထို့ပြင်ဆောက်လုပ်ရေးကြောင့် ရေလမ်းကြောင်းနှောင့်နှေးမှုဖြစ်နိုင်ပါသဖြင့် ကန်ထရိုက်တာအနေဖြင့် လှေများဖြတ်သန်းနိုင်ရန်နှင့် ညဘက်တွင်ပါမြင်နိုင်ရန် စီစဉ်ပေးသင့်သည်။

67. အန္တရာယ်ရှိသောပစ္စည်းများကို လုပ်ငန်းခွင်တွင်သာ သိုလှောင်ရန်လိုအပ်ပါသည်။ အန္တရာယ်ရှိမှုနှင့် ညစ်ညမ်းမှု အန္တရာယ်အား လျော့ချရန်အတွက် ကန်ထရိုက်တာသည် ကတ္တရာစေး၊ စက်သုံးဆီနှင့် ချောဆီတို့အားကိုင်တွယ် သိုလှောင်ရာတွင် နည်းလမ်းကောင်းများအားအသုံးပြုသင့်သည်။

68. ဆောက်လုပ်ရေးလုပ်ငန်းကြောင့်ထွက်ရှိလာမည့် အန္တရာယ်ရှိသောစွန့်ပစ်ပစ္စည်းများလည်း အတူတူပင်ဖြစ်သည်။ ၄င်းတွင် အသုံးပြုပြီးသောဆီများ နှင့် ပျော်ဝင်ပစ္စည်းများ၊ ဆီစွန်းနေသောပစ္စည်းများ၊ ဥပမာ ။ အဝတ်စုတ်၊ oil filter and sludges များ။ ကန်ထရိုက်တာသည် သိမ်းဆည်းခြင်း၊ ယာယီသိုလှောင်ခြင်းနှင့် စွန့်ပစ်ခြင်းစသည်တို့ပါဝင်သော hazardous waste management plan ကို အကောင်အထည်ဖော်သင့်သည်။

69. လုပ်ငန်းခွင်အတွင်း နေရာအမျိုးမျိုးမှ စွန့်ပစ်သည့် အမျိုးမျိုးသောအမှိုက်များမှာလည်း ထည့်သွင်းစဉ်းစားရမည့်အကြောင်းတခုဖြစ်သည်။ ဆိုလိုသည်မှာ အိမ်သုံးအမှိုက်၊ စက်ပစ္စည်းများထိန်းသိမ်းနေရာမှထွက်ပေါ်လာသည့်အမှိုက်များ။

70. ကန်ထရိုက်တာသည် အမှိုက် များကိုခွဲခြမ်းစိတ်ဖြာ၍ ပြန်လည်အသုံးပြုနိုင်သည်များအား ရှာဖွေခြင်းတို့ကို ဆောင်ရွက် ပါမည်။ အန္တရာယ်မရှိသောအမှိုက်များကို ဇီဝနည်းဖြင့်ချေဖျက်နိုင်သောအမှိုက်၊ ဇီဝနည်းဖြင့် မချေဖျက်နိုင်သောအမှိုက်နှင့် ပြန်လည်အသုံးပြုနိုင်သောအမှိုက်ဟူ၍ ခွဲခြမ်းပါမည်။ ပြန်လည်အသုံးပြုနိုင်သော

ပစ္စည်းများကို ခွဲခြား၍ ပြန်လည်ရောင်းချပြီး၊ ကျန်ရှိသောအမှိုက်များကို မြို့နယ်ရှိ အမှိုက်စွန့်ပစ်မည့်နေရာများသို့ စွန့်ပစ်သွားမည်ဖြစ်သည်။

71. လုပ်ငန်းခွင်နေရာတွင် wastewater treatment systems ထားရှိသွားမည်။ ဥပမာ။ မိလ္လာကန်များအား soaking pit နှင့်ပိတ်ခြင်း၊ နှင့် batching plant။ ဖြစ်နိုင်လျှင် အနယ်စစ်ကန်များထားရှိသွားမည်ဖြစ်ပြီး transit mixer မှဆေးချသောရေများအား စုဆောင်းသွားမည်ဖြစ်သည်။

72. ဖို့မြေကျင်း borrow pits ၏ထိခိုက်မှုများမှလျော့နည်းစေရန် ကန်ထရိုက်တာသည် ဖို့ မြေကျင်းနေရာရွေးချယ်ခြင်းဆိုင်ရာ ညွှန်ကြားချက်များကိုလိုက်နာသင့်သည်။ ဥပမာ။ စိုက်ပျိုးဖြစ်ထွန်းနေသောမြေများနှင့် စီပွါးရေးအရအရေးပါသောနေရာများ။သင့်တော်သောနေရာမှာ အကာအရံများထားရှိရမည် ဖြစ်ပြီး အိမ်ခြေများနှင့် ဂေဟဗေဒအရထိခိုက်မခံသောနေရာများနှင့် ကွာဝေးရမည်။ ထို့ပြင် ကန်ထရိုက်တာသည် borrow pits နှင့်သက်ဆိုင်သည့် လိုအပ်သော ခွင့်ပြုချက်များရယူထားသင့်သည်။

73. ဆောက်လုပ်ရေးလုပ်ငန်း ပြီးမြောက်ခြင်းပေါ်မူတည်၍ ကန်ထရိုက်တာသည် အလုပ်သမားများ အား တာဝန်မှထွက်ခွာစေခြင်းနှင့် စက်ပစ္စည်းများအား နေရာဖယ်ရှားခြင်းပြုလုပ်ရမည်။ ကန်ထရိုက်တာသည် လုပ်ငန်းခွင်၊ ဆောက်လုပ်ရေးစခန်း၊ ပစ္စည်းစုပုံထားသောနေရာ စသည်တို့မှ စက်ပစ္စည်းအားလုံး၊ အဆောက်အအုံးများ၊ စွန့် ပစ်ပစ္စည်းများကို ဖယ်ရှားရမည်။ ထို့နောက် မြေရှင်နှင့်စာချုပ်ပါ သဘော တူညီချက်အရ မြေအားပြန်လည်ကောင်းမွန်အောင်ပြုလုပ်ပေးရမည်။

74. ကျေးလက်လမ်းလုပ်ငန်းလည်ပတ်သည့်အဆင့်ဆိုသည်မှာ လမ်းပြီးမြောက် ပြီးနောက် ကျေးလက်လမ်းဦးစီးဌာနက ထိုလမ်းအား လွှဲပြောင်းတာဝန်ယူသည့်အချိန်ကာလဖြစ်သည်။ ဤကာလတွင် ကျေးလက်လမ်းဦးစီးဌာန၏ အဓိကတာဝန်မှာ ပုံမှန်ပြုပြင်ထိန်းသိမ်းမှုပြုလုပ်ရန်ဖြစ်သည်။ ထိုသို့ပြင်ဆင်ထိန်းသိမ်းမှုဆောင်ရွက်ရာတွင် အလုပ်သမားများ၏လုပ်ငန်းခွင်အန္တရာယ်လုံခြုံမှုရှိရေးကိုလည်း စ ဉ်းစားရမည်။ အလုပ်သမားများ၏ဘေးကင်းလုံခြုံရေးအတွက် ယာ ဉ်ဖြတ်သန်းရာနေရာများတွင် အကာအရံများ၊ အမှတ်အသားများ ထားရှိသင့်သည်။ အလုပ်သမားများကိုလည်း လုံခြုံရေးဆိုင်ရာ အဝတ်အစားများ high viz vests၊ ရှူးဖိနပ်၊ လက်အိတ်စသည်တို့ကိုလည်း ပံ့ပိုးပေးသင့်သည်။

75. ကမ္ဘာ့ဘဏ်၏ လေ့လာမှုတ စ်ခုအရ ကျေးလက်လမ်းဖောက်လုပ်ခြင်းကြောင့် ဖန်လုံအိမ်ခါ တ်ငွေ့ထုတ်လွှတ်မှု GHG emissions မှာ 90 to 103 t $CO_2$ eq/km, gravel and DBST အသီးသီးဖြစ်ပါသည်။ အာရှတွင်ဆောက်လုပ်ရေးလုပ်ငန်းများကြောင့် ဖန်လုံအိမ်ခါတ်ငွေ့ မြင့်မားရခြင်းမှာ ဝယ်ယူသောပစ္စည်း၊ ဆောက်လုပ်ခြင်းအလေ့အထများ၊ နည်းပညာဟောင်းများနှင့် ဟောင်းနွမ်းသောစက်ပစ္စ ည်း အသုံးပြုခြင်းတို့ကြောင့်ဖြစ်သည်။ ဖန်လုံအိမ်ခါတ်ငွေ့လျော့ချရန် asphalt plant and mobile equipmentများ အသုံးပြုသင့်ပြီး ထိန်းသိမ်းမှုများ ပြုလုပ်ထားသင့်သည်။

## 1.7 အခြားဆောင်ရွက်နိုင်သောနည်းလမ်းများအား ခွဲခြမ်းစိတ်ဖြာခြင်း (Analysis of Alternatives)

76. ADB's SPS 2009 ၏ ပတ်ဝန်းကျင်ဆန်းစစ်ခြင်းအပိုင်းတွင် စီမံကိန်းတည်နေရာ၊ ဒီဇိုင်း၊

နည်းပညာနှင့်အခြားသောဆက်စပ်ပါဝင်မှုများ၏ အခြားနည်းဖြင့်ဆောင်ရွက်နိုင်မည့် နည်းလမ်းများ (alternatives) နှင့်၄င်းတို့၏ ပတ်ဝန်းကျင်နှင့် လူမှုရေးထိခိုက်မှုတို့ ဆန်းစစ်ရန်လိုအပ်ပြီး တခြား နည်းဆောင်ရွက်ရန် မရှိသောစီမံကိန်း ("no project" alternative) ကိုလည်း စ ဉ်းစားပါသည်။ ဤနေရာတွင် နိုင်ငံတကာထောက်ပံ့မှုအပြည့်အဝဖြင့်ဆောင်ရွက်သည့် နိုင်ငံ၏ဖွံ့ဖြိုးမှုလုပ်ငန်းများတွင် "no project" alternative ကိုလက်မခံပါ။

77. ယခု စီမံကိန်းတွင် လက်ရှိရှိနေသော လမ်းအူကြောင်း (alignment) အတိုင်းသာဆောင်ရွက်မည်ဖြစ်ပြီး တချို့လမ်းအပိုင်းအနည်းငယ်ကိုသာ လမ်းအနွှာရယ်ကင်း ရှင်းရန် လမ်းအူကြောင်းအား ပြန်လည်ပြင်ဆင်ရန် လိုအပ်ပါသည်။ ထို့အတွက် မြေနေရာအချို့ရယူရန်လိုအပ်ပါသည်။ အသေးစိတ်ဒီဇိုင်းနှင့်အကောင်အထည်ဖော်မှု ကြီးကြပ်ရေးအကြံပေး (Detailed Design and Implementation Supervision Consultant) နှင့် ကန်ထရိုက်တာများသည် လူမှုရေး (ဥပမာ။ ရပ်ရွာလူထုထိခိုက်မှု ) နှင့်ပတ်ဝန်းကျင်ထိခိုက်မှု (ဥပမာ။ သစ်ပင်ဖယ်ရှားခြင်း ) အနည်းဆုံးဖြစ်မည့် အခြားဖြစ်နိုင်မည့် နေရာများအားလည်း စဉ်းစားရပါမည်။

78. စီမံကိန်းလမ်းအမျိုးမျိုး၏ မတူညီသောအခြေအနေများကြောင့် သင့်တော်သော လမ်းခင်းခြင်းပုံစံ ၃ ခုဖြင့်ဆောင်ရွက်ရန် ဒီဇိုင်းပညာရှင်မှ စ ဉ်းစားထားပါသည်။ လမ်းခင်းခြင်းပုံစံများမှာ ဘိလပ်မြေကွန်ကရစ် (concrete cement), ကတ္တရာဖြန်းကျောက်လွှာ (penetrated macadam) and double bitumen surface treatment (DBST).ဘိလပ်မြေကွန်ကရစ်လမ်းခင်းခြင်းမှာ အကန့်အသတ်ဖြစ်သာအသုံးပြုနိုင်ပါသည်။

## 1.8 အများပြည်သူများနှင့်ဆွေးနွေးထုတ်ဖော်ခြင်း: (Public Consultations and Disclosure)

79. အများပြည်သူတို့နှင့်ဆွေးနွေးခြင်းစီမံချက် (Public Consultation Plan) ကို SweRoad မှအကြံပေးအဖွဲ့၏ အကူအညီနှင့် ကျေးလက်ဦးစီးဌာနမှ ပြင်ဆင်ခဲ့ပါသည်။ အများပြည်သူများနှင့် တွေ့ဆုံဆွေးနွေးရာတွင် ပါဝင်ပက်သက်သူ (stakeholders)များကို အဆိုပြုစီမံကိန်းအကြောင်းအရာများနှင့် ရည်ရွယ်ချက်များကို တင်ပြခဲ့ပြီး ပတ်ဝန်းကျင်နှင့်လူမှုရေးထိခိုက်နိုင်မှု အလားအလာများကို ဆွေးနွေးခဲ့ကြပါသည်။ ပတ်ဝန်းကျင်နှင့် လူမှုရေးနှင့်ပက်သက်သော ဆွေးနွေးရန်ကိစ္စများကိုလည်း တောင်းခံခဲ့ပါသည်။ ဆွေးနွေးပွဲကို မကွေးနှင့် ဧရာဝတီတို့တွင် ဆောင်ရွက်ခဲ့ပါသည်။

80. ဦးစွာပတ်ဝန်းကျင်ဆိုင်ရာတိုင်းတာရေးအဖွဲ့သည် မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးမှူးရုံးမှ တာဝန်ရှိသူများနှင့်တွေ့ဆုံခဲ့ပါသည်။ ထို့နောက် သစ်တောဌာန၊ လယ်ယာမြေစီမံခန့်ခွဲရေးနှင့်စာရင်းအင်းဦးစီးဌာန စသည်တို့မှ တာဝန်ရှိသူများနှင့်ဆွေးနွေးခဲ့ပါသည်။ အစိုးရတာဝန်ရှိသူများနှင့်တွေ့ဆုံဆွေးနွေးရာတွင် မအူပင်-ဖျာပုံလမ်းစီမံကိန်း၏အတွေ့အကြုံပေါ်အခြေခံ၍ ထင်မြင်ချက်များကိုဆွေးနွေးကြပါသည်။ အဖွဲ့မှလည်း ယခုစီမံကိန်းသည် ကျေးလက်လမ်းဖြစ်သောကြောင့် သတ်မှတ်ချက်များနှင့်အကောင်အထည်ဖော်ဆောင်ရွက်မှုမှာ အရင်လမ်းဆောင်ရွက်ပုံနှင့်ကွဲပြားကြောင်းပြောကြားခဲ့ပါသည်။

81. ထို့ပြင်အုပ်စုလိုက် ဆွေးနွေးပွဲများ၊ ကျပန်းအင်တာဗျူးများကို ၁၆ အောက်တိုဘာ ၂၀၁၇ မှ ၂ နိုဝင်ဘာလ ၂၀၁၇ ထိနှင့် ဖေဖော်ဝါရီ ၂၀၁၈ တို့တွင် တချိန်တည်းမေးမြန်းခဲ့ပါသည်။ ကျေးရွာနေပြည်သူများသည် ကျေးလက်လမ်းဦးစီးဌာနမှ ဝန်ထမ်းများ၏ အကြိုကွင်းဆင်းဆောင်ရွက်မှုများကြောင့် ယေဘုယျအားဖြင့် စီမံကိန်းအကြောင်းအရာများအား သိရှိထားကြပါသည်။ စီမံကိန်းတွင် ပါဝင်ပက်သက်သူများ stakeholders ၏

ယေဘုယျအခြင်မှာ ၄င်းတို့၏ ရွာများဖွံ့ဖြိုးတိုးတက်လာမည်မျှော်လင့်လျက် စီမံကိန်းကိုအကောင်းမြင်ပါသည်။ ရွာသားများမှလည်း ၄င်တို့ရွာအသီးသီးနှင့်လမ်းနယ်များတွင် မကြာခ ဏာရေကြီးရေလျံမှုနှင့် တခြားသဘာဝ ဘေးအန္တရာယ်ဖြစ်ပေါ်မှုများသတင်းပေးကြပါသည်။

82. ယေဘုယျအားဖြင့် ပါဝင်ပက်သက်သူ stakeholders များသည် အဆိုပြုစီမံကိန်းသည် ရွာကိုအကျိုးပြုသည်ဟု မျှော်လင့်သဖြင့် စီမံကိန်းကို ကြိုဆိုကြပါသည်။ တချို့မြေပိုင်ရှင်များသည် လမ်းရရှိရေးအတွက် သူတို့ပိုင်မြေကိုရပ်ရွာအတွက် အသုံးပြုရန်လျှဒါန်းလိုကြပါသည်။ တ ချို့စိုက်ပျိုးမြေများ၊ သစ်ပင်နှင့် structuresများထိခိုက်နိုင်မှုအလားအလာရှိပါသည်။ သို့သော်လည်း အဓိကအကြောင်းအရာမှာ ပတ်ဝန်းကျင်ကိစ္စထက် မြေရရှိရေး land acquisition ဖြစ်ပါသည်။

83. အများပြည်သူနှင့်ဆွေးနွေးခြင်းကို စီမံကိန်း အကောင်အထည်ဖော်ခြင်းကာလ တလျောက်လုံး ဆောင်ရွက်သွားရမည်။ အများပြည်သူနှင့်တွေ့ဆုံခြင်းကို ကန်ထရိုက်တာ၄င်းရမ်းပြီး လုပ်ငန်းမစတင်ခင် အချိန်တွင် ဆက်လက်ပြုလုပ် သင့်သည်။ ပုသိမ်မြို့နယ်တွင်အခြေစိုက်သည့် တိုင်းဒေသကြီး ပတ်ဝန်းကျင် ထိမ်းသိန်းရေးဦးစီဌာနရုံးသို့လည်း ရှင်းလင်းတင်ပြမှု ဆက်လက်လုပ်ဆောင်ရန်လိုပါသည်။ အ ဘယ်ကြောင့်ဆိုသော် မအူပင်ခရိုင် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာနအနေဖြင့် စောင့်ကြပ်ကြည့်ရှုရမည့်တာဝန်ရှိပါသည်။

84. သတင်းအချက်အလက်ထုတ်ပြန်ကြေညာခြင်းနှင့်ပက်သက်၍ ADB သည် ၄င်း၏ website တွင် စီမံကိန်း၏ IEE အစီရင်ခံစာနှင့်စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးခြင်း အစီရင်ခံစာ (monitoring reports) ကို ထုတ်ပြန်သွားပါမည်။

## 1.9 တိုင်ကြားစာများလက်ခံဆောင်ရွက်ခြင်းလုပ်ငန်းစဉ် (Grievance Redress Mechanism)

85. တိုင်ကြားစားများလက်ခံဆောင်ရွက်ခြင်းသည် ADBမှ ထောက်ပံ့သောစီမံကိန်းများအတွက် လိုအပ်ချက်များထဲမှ တ စ်ခုဖြစ်သည်။ တည်ဆောက်ရေးလုပ်ငန်းစဉ်အတွင်း ပတ်ဝန်းကျင်နှင့်ပက်သက်သည့် ဆောင်ရွက်ချက်များနှင့် ဆက်စပ်သည့်တိုင်ကြားစာများအား ဖြေရှင်းသည့်နည်းလမ်းလုပ်ငန်းစဉ်ထူထောင်ရန် ADB၏ ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးကာကွယ်ရေးမူဝါဒ ၁၁ ချက်တွင် တစ်ခုအပါအဝင်ဖြစ်သည်။

86. တခြားသော မြန်မာနိုင်ငံအတွင်းလမ်းလုပ်ငန်းစီမံကိန်းများ၏ အတွေ့အကြုံအရ အဓိကတိုင်းကြားစာများမှာ နွေရာသီအတွင်း ဖုံမှုန်များအားထိန်းချုပ်မှုမလုံလောက်ခြင်း၊ ပစ္စည်းများ စွန့်ထုတ်လွှတ်မှုကြောင့် လယ်ကွင်းများပျက်စီးခြင်း၊ စွန့်ထုတ်လိုက်သောပစ္စည်းများ ရေသွင်းမြောင်းအတွင်းစီးဝင်ခြင်း၊ ရောစပ်သည့် နေရာ batching plant များလည်ပတ်ခြင်းကြောင့် ဖုံမှုန့်ထွက်ရှိခြင်း၊ လူတို့၏ အသုံးအဆောင်ပစ္စည်းအတွင်းသို့ ဝင်ရောက်လာမှု (ဥပမာ၊ ရေပေးဝေရေ)၊ အစိုးရဌာနများအချင်းချင်းကြားဆက်သွယ်ဆောင်ရွက်မှုမရှိခြင်းကြောင့် အစိုးရ၏ အခ ြခံအဆောက်အအုံများ၏ စီမံကိန်းကြောင့်ထိခိုက်ခြင်း (ဥပမာ၊ ဆည်မြောင်းဌာန )။ ဤတိုင်ကြားမှုများကိုဖြေရှင်းရန်မှာ စီမံကိန်းအဆိုပြုသူ၊ ကန်ထရိုက်တာကွပ်ကဲကြီးကြပ်သူများနှင့် ကန်ထရိုက်တာတို့၏ လုပ်ပိုင်ခွင့်အတွင်းတွင်ရှိပါသည်။

87. စီမံကိန်းအတွင်း အထူးအားဖြင့် တချို့လမ်းပိုင်းများတွင် လမ်းချဲ့ခြင်း သို့မဟုတ် လမ်းအူကြောင်းအား

အနည်းငယ်ညှိရန်လိုသောအခါများတွင် မြေယာပြဿနာများပေါ်ပေါက်လာနိုင်ပါသည်။ ထိုသို့သောပြဿနာများကို သီးခြားကိုင်တွယ်ဖြေရှင်းခြင်း (သို့မဟုတ်) စီမံကိန်းအဆင့်တွင် ကိုင်တွယ်မဖြေရှင်းနိုင်ပါက ရပ်ရွာအဆင့်တွင် ဖြေရှင်းရန်လိုပါသည်။

88. တခြားသော အများပြည်သူ နှင့်ပက်သက်သည့် ယာဉ်မတော်တဆဖြစ်မှုကဲ့သို့သော မတော်တဆမှုများအား ဖြေရှင်း ရန်အတွက် အခြားသောအစိုးရ တာဝန်ရှိသူများမှ ကြားဝင်ဆောင်ရွက်ပေးရန်လိုပါသည်။ ဆိုလိုသည်မှာ ရဲ၊ မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးမှူး စသည်ဖြင့်။

89. ကျေးလက်လမ်းစီမံကိန်းအတွက် တိုင်ကြားစာလက်ခံဖြေရှင်းခြင်းနည်းစနစ် (GRM) တွင် အဆင့် ၃ ဆင့်ဖြင့်ဆောင်ရွက်ရန် အကြံပြုပါသည်။ (၁) ပထမ စီမံကိန်းအဆင့် - ဤအဆင့်တွင် အသေးစိတ်ဒီဇိုင်းနှင့် လုပ်ငန်းအကောင်အထည်ဖော်ခြင်းကြီးကြပ်အကြံပေးအဖွဲ့ (DDIS Consultant) မှ တိုင်ကြားစာများအား ၂ ရက်အတွင်းတုံ့ပြန်ဖြေရှင်းခြင်း (၂) ဒုတိယ ကျေးလက်လမ်းဦးစီးဌာန /ဆောက်လုပ်ရေးဝန်ကြီးဌာနအဆင့် - တိုင်ကြားစာကိုစိစစ်သုံးသပ်ရန် ၅ ရက်နှင့် ဖြေရှင်းရန် ၅ ရက် (၃) တတိယအဆင့်အနေဖြင့် တရားဥပဒေအရဖြေရှင်းခြင်းဖြစ်ပါသည်။

90. တိုင်ကြားစာလက်ခံဖြေရှင်းခြင်းစနစ် (GRM)ကို စီမံကိန်းလုပ်ငန်းခွင်နေရာတွင် အဓိကရွာလူကြီးထံ လိပ်မူတိုင်ကြားရမည်။ ရွာလူကြီးသည် ထိခိုက်ခံစားရသူ၏ကိုယ်စား တိုင်ကြားစာကိုဖိုင်သွင်း ထားပါမည်။ ထို့နောက် တိုင်ကြားစာကိုမှတ်တမ်းတင်သည့် စီမံကိန်း၏ပတ်ဝန်းကျင်နှင့်ဘေးအန္တရာယ်ကင်းရှင်းရေးအရာရှိ (environment and safety officer) ထံမှတဆင့် ကန်ထရိုက်တာ၏ စီမံကိန်းမန်နေဂျာထံသို့ပို့ရမည်ဖြစ်သည်။ ကန်ထရိုက်တာသည် ကြီးကြပ်ကွပ်ကဲရေးအကြံပေးအဖွဲ့ DDIS Consultant ဆီသို့အကြောင်းကြားရန် တာဝန်ရှိပါသည်။

91. ကျေးလက်လမ်းဦးစီးဌာန၏ မူလတာဝန်မှာ တိုင်ကြားစာလက်ခံဖြေရှင်းခြင်းစနစ် (GRM)ကို (DDIS Consultant)၏ အကူအညီဖြင့် ဖွဲ့စည်းရန်နှင့် စီမံခန့်ခွဲရန်ဖြစ်သည်။ ကျေးလက်လမ်းဦး စီးဌာန၏ တာဝန်မှာ တိုင်ကြားစာကိုစာရင်းသွင်းခြင်းနှင့် ဆောက်လုပ်ရေးဝန်ကြီးဌာနသို့ တိုင်ကြားချက်နှင့်ပက်သက်၍ အကြောင်းကြားရန်ဖြစ်သည်။ တိုင်ကြားစာ များနှင့်ပက်သက်၍ ကြီးကြပ်အကြံပေးရေးအဖွဲ့ DDIS Consultantများမှ လစဉ်တိုးတက်မှုအစီရင်ခံစာနှင့် ၆ လပါတ်ပတ်ဝန်းကျင်စောင့်ကြပ်ကြည့်ရှုမှုအစီရင်ခံစာတွင်ထည့်သွင်းရမည်။

92. ကျေးလက်လမ်းဦးစီးဌာနသည် GRM အကြောင်းကိုအများပြည်သူနှင့်တိုင်ပင်ဆွေးနွေးပွဲများတွင် သိရှိနိုင်ရန်ထုတ်ဖော်တင်ပြပြီး စီမံကိန်းဧရိယာတွင် အသိပေးဆိုင်းဘုတ်ဖြင့်ဖော်ပြသင့်သည်။ ထိုအသိပေးဆိုင်းဘုတ်တွင် စီမံကိန်းအမည်၊ ကန်ထရိုက်တာအမည်၊ ရုံးနှင့် ဆက်သွယ်ရမည့်သူတို့၏ အသေးစိတ်ပါရှိရမည်။

## 1.10 ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် (Environmental Management Plan)

93. ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် (EMP) ကို လျော့နည်းသက်သာစေရေးနည်းလမ်းများအား သင့်တော်သလိုအကောင်အထည်ဖော်ဆောင်ရွက်နိုင်ရန်အတွက် ပြင်ဆင်ထားခြင်းဖြစ်သည်။ ၄င်းအကောင်းအထည်ဖော်ဆောင်ရွက်မှုတွင် အဖွဲ့ အစည်းများနှင့် ပါဝင်ပက်သက်သူအမျိုးမျိုး၏ အခန်းကဏ္ဍ သတ်မှတ်

ထားခြင်း၊ စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးခြင်းနှင့် အစီရင်ခံစာတင်သွင်းခြင်း လုပ်ငန်းစဉ် နှင့် EMP ကိုအကောင်အထည်ဖော်ရာတွင် စောင့်ကြပ်ကြည့်ရှုခြင်း လုပ်ငန်းစဉ်အတွက်လိုအပ်မည့် အရင်းအမြစ်များခန့်မှန်းခြင်းတို့ ပါဝင်ပါသည်။ ပတ်ဝန်ကျင်ဆိုင်ရာလျော့နည်းသက်သာစေခြင်း နှင့်စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးခြင်း အစီအစဉ်များကို ဇယားပုံစံဖြင့် ဖော်ပြထားပါသည်။

94. EMP ကို အကောင်အထည်ဖော်ရာတွင် ကျေးလက်လမ်းဦးစီးဌာန (အကောင်အထည်ဖော်ဆောင်ရွက်သည့်အေဂျင်စီ)၊ ကွပ်ကဲအကြံပေးအဖွဲ့ (DDIS Consultant)၊ ကန်ထရိုက်တာများ၊ စီမံကိန်းကြောင့်အကျိုးခံစားခွင့်ရှိသူများ၊ ကျေးရွာနှင့်မြို့နယ်တာဝန်ရှိသူများ၊ သယံဇာတနှင့်သဘာဝပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဝန်ကြီးဌာနနှင့် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဦးစီးဌာန အသီးသီးမှ ခွဲဝေတာဝန်ယူဆောင်ရွက်ရမည်ဖြစ်ပါသည်။

95. ကျေးလက်လမ်းဦးစီးဌာနသည် စီမံကိန်းအကောင်အထည်ဖော်ဆောင်ရွက်သည့်အေဂျင်စီဖြစ်သဖြင့် EMP ကို အကောင်အထည်ဖော်ဆောင်ရွက်ရာတွင် DDIS Consultant အကူအညီဖြင့်လုပ်ငန်းအားလုံးအားကြီးကြပ် ကွပ်ကဲရန် တာဝန်ရှိပါသည်။ DDIS Consultant အဖွဲ့မှ international and national environment safeguard specialist တို့သည် EMP အကောင်အထည်ဖော်ဆောင်ရွက်ရန်၊ စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးရန်နှင့် အစီရင်ခံစာတင်သွင်းရန် တာဝန်ရှိပါသည်။ ထို့ပြင် စောင့်ကြပ်ကြည့်ရှုရာတွင် ကန်ထရိုက်တာ၏ EMP အကောင်အထည်ဖော်မှုမှားယွင်းစွာဆောင်ရွက်နေပါက ပြုပြင်ရန်နည်းလမ်း corrective measures များကိုချမှတ်ရန် DDIS Consultant တွင်တာဝန်ရှိသည်။ တခြားတဖက်တွင်လည်း ကန်ထရိုက်သည် လျော့နည်းသက်သာစေမည့်နည်းလမ်းများကို အသုံးပြုရန် တိုက်ရိုက်တာဝန်ရှိပါသည်။ ထို့ပြင် ၄င်းတို့၏ environment and safety officer မှလည်း EMP အကောင်အထည်မှုအား ကိုယ်တိုင် စောင့်ကြပ်ကြည့်ရှုရန်တာဝန်ရှိပါသည်။ အာဏာပိုင်အဖွဲ့ဖြစ်သည့် ECD အနေဖြင့်လည်း စီမံကိန်းသည် ပတ်ဝန်းကျင်ဆိုင်ရာ ဥပဒေရေးရာများအားလိုက်နာခြင်း ရှိ၊မရှိကို စောင့်ကြပ်ကြည့်ရှုရန် အာဏာရှိပါသည်။ ADB ၏ အခန်းက ဏ္ဍာတခုအနေဖြင့်လည်း စာချုပ်ပါအတိုင်း ဆောင်ရွက်ရမည့် တာဝန်များအားလိုက်နာမှုရှိစေရန် review missions မှ ကွင်းဆင်းစစ်ဆေးပြီး၊ ပတ်ဝန်းကျင်ဆိုင်ရာစောင့်ကြပ်စစ်ဆေးမှုအတွက်မူ တတိယအဖွဲ့အစည်းအားလည်း တာဝန်ပေးအပ်ဆောင်ရွက်နိုင်ပါသည်။

96. EMP အားလိုက်နာဆောင်ရွက်မှုကို international environment specialist (IESS) မှ ထုတ်နှုတ်ထားသည့် တိုက်ဆိုင်စစ်ဆေးမှုစာရင်း checklist ကို အသုံးပြု၍ DRRD environment safeguard specialist နှင့်အတူ DDIS ၏ national environment safeguard specialist (NESS)မှ နေ့စဉ်စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးသင့်ပါသည်။ နေ့စဉ်စစ်ဆေးမှုကို NESS မှ စု ထားပြီး ကွန်ပျူတာစာရင်းသွင်းထားရမည်။ နေ့စဉ်စောင့်ကြပ်ကြည့်ရှုသည့်အစီရင်ခံစာသည် လစဉ်တိုးတက်မှုအစီရင်ခံစာပြင်ဆင်ခြင်း အတွက် အခြေခံအုတ်မြစ်ဖြစ်ပြီး နှ ၆ လပတ် ပတ်ဝန်းကျင်ဆိုင်ရာစောင့်ကြပ်ကြည့်ရှုစစ်ဆေးခြင်းဆိုင်ရာ အစီရင်ခံစာကို ဆောင်လုပ်ရေးဝန်ကြီးဌာန၊ ADB နှင့် ECD သို့ အသီးသီးတင်ပြရမည်။

97. IESS သည် ၆ လတာကာလတွင် တစ်လတာဝန်ယူဆောင်ရွက်ရမည်။ သူ၏ပထမဆုံးအခန်းကဏ္ဍမှာ စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးခြင်းအစီအစဉ် monitoring plan ပြင်ဆင်ရန်ဖြစ်သည်။ ထို plan တွင် စောင့်ကြပ်ကြည့်ရှုမည့်လုပ်ငန်းစဉ်၊ အမှားဆောင်ရွက်မှုများ အတွက်ပြင်ဆင်ချက်လုပ်ငန်းစဉ်၊ တိုက်ဆိုင်စစ်ဆေးရန်စာရင်း monitoring checklist ၊ စောင့်ကြပ်ကြည့်ရှုရမည့်အကြိမ်နှင့် အစီရင်ခံစာအတွက် ပုံစံ (Format) တို့ပါဝင်သင့်သည်။ IESS သည် စောင့်ကြပ်ကြည့်ရှုခြင်းအား စိစစ်ခြင်း၊ လုပ်ငန်းခွင်းများသို့ ကွင်းဆင်း

စစ်ဆေးခြင်းနှင့် ထူးခြားသော ပြဿနာများအား ကန်ထရိုက်တာနှင့် စည်းဝေးတိုင်ပင်ရမည်။ IESS သည် ၆ လပါတ် ပတ်ဝန်းကျင်စောင့်ကြပ်ကြည့်ရှုစစ်ဆေးခြင်းအစီရင်ခံစာအားပြင်ဆင်ခြင်းနှင့် EMP အား စိစစ်ရန် တာဝန်ရှိသည်။

98. ပတ်ဝန်းကျင်အရည်အသွေးအား စောင့်ကြပ်ကြည့်ရှု ရာတွင် ဆူညံသံ၊ ဖုန်မှုန့်၊ ညစ်ညမ်းမှုနှင့် စီးမျောမှု၊ အမှိုက်စီမံခန့်ခွဲမှုများစသည်တို့ကို အခြင် အားဖြင့်သတ်မှတ်ပါမည်။ ဆူညံသံကို mobile devices ဖြင့် တိုင်းတာနိုင်ပါသည်။ လည်ပတ်နေသောလုပ်ငန်းခွင်အနားရှိ အခြေချနေထိုင်သူများအား လည်း သွားရောက်၍ ပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအပေါ် တိုင်ကြားရန်ရှိ၊မရှိကို မေးမြန်းစုံစမ်းပါမည်။ မျက်မြင်တွေ့ရှိချက်များကို မှတ်သား ထား၍ အစီရင်ခံစာတင်ပြပါမည်။ ရပ်ရွာလူထုမှထိခိုက်မှုရှိကြောင်းတိုင်ကြားပါက ပြင်ပပတ်ဝန်းကျင် အရည်အသွေးအား စက်များဖြင့်တိုင်းတာပြီးသက်သေပြနိုင်ရန် စစ်ဆေးဆောင်ရွက်ပါမည်။

99. IESS ၏ ပထမအကြိမ်လာရောက်စဉ်တွင် DRRD နှင့် ကန်ထရိုက်တာများအား EMP အကြောင်းရှင်းလင်းတင်ပြရမည်။ IEE and EMP တို့မှ အရေးကြီသောအချက်များဖြစ်သော လျော့နည်းသက်သာစေမည့်နည်းလမ်းများနှင့် EMP အကောင်အထည်ဖော်ရာတွင် ကန်ထရိုက်တာ၏ တာဝန်ယူမှုအကြောင်းတို့အား ရှင်းပြသင့်သည်။ အလုပ်သမားများကိုလည်း ဆောက်လုပ်ရေးလုပ်ငန်းမစတင်မီ EMP အကြောင်း ရှင်းလင်းဆွေးနွေးသင့်သည်။ EMP ဖယားကို မြန်မာဘာသာပြန်ဆိုထားသင့်သည်။ EMP အကောင်အထည်ဖော်ရာတွင် အလုပ်သမားများ၏ကဏ္ဍ နှင့်တာဝန်ဝတ္တရားများကိုလည်း အလေးထားဖော်ပြ ရမည်။ EMP အကြောင်းကို NESS မှလည်း အနည်းဆုံး ၄ လတကြိမ်ရှင်းလင်းတင်ပြပါမည်။

100. ကန်ထရိုက်တာ၏ health and safety officer မှလည်း တကိုယ်ရည်သန့်ရှင်းရေးနှင့် ကျန်းမာရေး အကြောင်းကို အလုပ် သမားများအား သင်တန်းပြုလုပ်ရမည်။ လုပ်ငန်းခွင်ဘေးအန္တရာယ်ကင်းရှင်းရေးနှင့် အများပြည်သူဘေးအန္တရာယ်ကင်းရှင်းရေးတို့အတွက် ကန်ထရိုက်တာသည် အလုပ်သမားများအား သင်တန်းပေး ရမည်။ လမ်းအန္တရာယ်ကင်းရှင်းရေးကိုလည်း အထူးသဖြင့် ကန်ထရိုက်တာ၏ယာဉ်မောင်းများအတွက် ဆောင်ရွက်ပေးရမည်။ ဘေးအန္တရာယ်ကင်းရှင်း ရေးသင်တန်းများကို ၄ လတကြိမ် လုပ်ငန်းခွင်၌ ပုံမှန်သင်တန်းတိုပြုလုပ်ပေးသင့်သည်။ ဘေးအန္တရာယ်ကင်းရှင်းရေးနှင့်သက်ဆိုင်သော သတိပေးဆိုင်းဘုတ်များ အား အလုပ်သမားများစုဝေးတတ်သည့်နေရာများတွင် ထင်ထင်ရှားရှားမြင်သာအောင်ထားရမည်။ HIV ရောဂါ ကာကွယ်ရေးနှင့်ပက်သက်၍လည်း ပညာပေးသင်တန်းများလည်းပြုလုပ်ရမည်။

101. ဆောက်လုပ်ရေးလုပ်ငန်းများမစတင်မီ အောက်ပါတို့ကို ပြင်ဆင်ရန်လိုအပ်ပါသည်-

- IESS မှ စောင့်ကြပ်ကြည့်ရှုခြင်းအစီအစဉ် (monitoring plan) ပြင်ဆင်ခြင်း
- ကန်ထရိုက်တာ၏ Contractor's Environmental Management Plan (CEMP) တွင် site plans များအပြည့်အစုံပါရမည်ဖြစ်ပြီး စီမံကိန်း၏အဆင့်လိုက် အချိုးကျကျပြင်ဆင်ခြင်း
- Traffic Safety Plan နှင့် Occupational Health and Safety Planများအား ကန်ထရိုက်တာမှ ပြင်ဆင်ခြင်း
- IESS မှ EMP အကြောင်းကို DRRD နှင့် ကန်ထရိုက်သို့ ရှင်းလင်းတင်ပြခြင်း

102. ကန်ထရိုက်တာမှပြင်ဆင်ထားသော plan များကို DDIS Consultant အဖွဲ့သို့တင်ပြပြီး ကန်ထရိုက်တာထံအလုပ်မအပ်မီ အတည်ပြုချက်ရယူရမည်။

103. EMP ကို IESS မှ ၆ လတကြိမ်ပြန်လည်စိစစ်၍ လိုအပ်သလို ဖြည့်စွက်ရမည်။

## 1.11 နိဂုံး (Conclusion)

104. ကျေးလက်လမ်းစီမံကိန်း (RRAP) လမ်းများအား ထိခိုက်မှုဆန်းစစ်ချက်ထွက်ပေါ်ရလဒ်များအရ ဧရာဝတီတိုင်းဒေသကြီး၊ မအူပင်ခရိုင်ရှိ မအူပင်မြို့နယ်နှင့် ပန်းတနော်မြို့နယ်တို့တွင် ဆောင်ရွက်မည့် အဆိုပြုလမ်းအဆင့်မြင့်တင်စီမံကိန်းသည် သိသာထင်ရှားသောဆိုကျိုးသက်ရောက်မှုဖြစ်ပေါ်ရန် အလားအလာ မရှိကြောင်း ကောက်ချက်ချပါသည်။ ရွာများသည် လမ်းနှင့်အနီးကပ်တည်ရှိနေသည်မှလွဲ၍ လမ်းများ၏ နယ်နိမိတ်အတွင်းတွင် ပတ်ဝန်းကျင်ဆိုင်ရာ အထိအခိုက်မခံသည့် သစ်တော၊ ထိန်းသိမ်းကာကွယ်တော များမရှိပါ။ ဤစီမံကိန်းအတွက် ADB ၏ စည်းကမ်းချက်မှာလည်း လမ်းများသည် သစ်တောဧရိယာနှင့် ထိန်းသိမ်းကာကွယ်တောများအတွင်းကျရောက်ခြင်းမရှိရပါ။

105. ကျေးလက်လမ်းစီမံကိန်း RRAP၏ လမ်းများအဆင့်မြှင့်တင်ခြင်းသည် လက်ရှိတည်ရှိနေသော လမ်းအကြောင်းအတွင်းသာ အများအားဖြင့်ဆောင်ရွက်သွားမည်ဖြစ်သည်။ ဆောက်လုပ်ရေးလုပ်ငန်းများမှာ လည်း အသေးစားလမ်းစီမံကိန်းများ ဖောက်လုပ်ခြင်းပုံစံဖြစ်သော လမ်းအကြောင်းရှင်းလင်းခြင်း၊ မလိုလား အပ်သောပစ္စည်းများအားဖယ်ရှားခြင်း၊ လမ်းတာများဆောက်လုပ်ခြင်းနှင့်လမ်းခင်းခြင်းတို့ ကို အစဉ်လိုက် ဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။

106. စီမံကိန်း၏လုပ်ငန်းများကြောင့် ထိခိုက်မှုများမှာ ကြိုတင်ခန့်မှန်း နိုင်ပြီး လျော့နည်းသက်သာအောင် ဆောင်ရွက်နိုင်ပါသည်။ သိသာထင်ရှားသည့်ကြွင်းကျန်သက်ရောက်မှုများလည်း မရှိပါ။ မမျှော်လင့်သော ထိခိုက်မှုများဖြစ်ပွါးလာပါက အစီရင်ခံတင်ပြမည်ဖြစ်ပြီး လျော့နည်းသက်သာစေရေးနည်းလမ်းများ အသုံးပြု ဆောင်ရွက်သွားပါမည်။ အထက်ပါတွေ့ရှိချက်များကြောင့် ကျေးလက်လမ်းစီမံကိန်း RRAP သည် Category B အမျိုးအစား စီမံကိန်းဖြစ်ပါသည်။

**Ministry of Construction**
**Department of Rural Road Development**
**ADB TA-9184 MYA**
**Rural Roads and Access Project**
**PPTA Consulting Services**

# INITIAL ENVIRONMENTAL EXAMINATION (IEE)

# AYEYARWADY REGION

## April 2019

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# 1. EXECUTIVE SUMMARY

## 1.1 Introduction

1. Asian Development Bank (ADB) has approved the Government of the Republic of the Union of Myanmar's request for support to develop and contribute to the financing of a national rural roads and access program. The project entitled Rural Roads and Access Project (RRAP) will improve 152 km of rural roads in two regions and develop the technical bases and capacity for the program.

2. This initial environmental examination (IEE) was carried out to comply with ADB's Safeguard Policy Statement (2009), as well as satisfy the requirements of the Myanmar Environmental Impact Assessment Procedure (2015). The report assesses the environmental impacts associated with the rehabilitation and improvement of the rural roads and the construction of small associated structures such as bridges and culverts.

3. The RRAP is a Category B project based on ADB's classification of projects according to significance of its environmental impacts. The Category B is one of the conditions of ADB in supporting the project. ADB condition explicitly excluded roads that lead or traverse forest, reserved forests and other ecologically sensitive areas. As a Category B, the project is required to submit an initial environmental examination (IEE) report. The Myanmar's Ministry of Natural Resources and Environmental Conservation (MONREC) has likewise classified the RRAP as an IEE type project.

4. For this project, environmental checklists were used to assess and summarize the environmental conditions prevailing within the various road corridors and the outcome of public consultation. These are presented as a separate appendix to this IEE (Appendix 5).

## 1.2 Policies, Laws and Regulations

5. The Republic's mandate to protect and conserve the environment is enshrined in the 2008 Constitution of the Republic of the Union of Myanmar (Myanmar). But even prior to the 2008 constitutional amendment, Myanmar had already adopted its environment policy as declared in the 1994 National Environmental Policy. This policy established the environmental impact assessment requirement for social and economic development activities in Myanmar.

6. Subsequently, laws and regulations were enacted for implementing the policy. The key environmental laws and regulations relevant to the RRAP are the Environmental Conservation Law (2012), Environmental Conservation Rules (2014), Environmental Impact Assessment Procedure (2015) Protection of Biodiversity and Natural Protected Areas Law (2018), Forest Law (2018).

7. The government of Myanmar has also issued its Environmental Quality (Emission) Guidelines in December 2015 (EQGS) provide emission and effluent discharges levels permitted for different sectors and technologies. These Guidelines have been primarily excerpted 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.

8. In addition to Myanmar's environmental regulations, compliance with ADB Safeguard Policy Statement (SPS 2009) is required.[1] The SPS applies to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects and their components, regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees.

9. The goal of the SPS is to promote the sustainability of project outcomes by protecting the

[1] ADB 2009. Safeguard Policy Statement, Policy Paper https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf

environment and people from potential adverse impacts of projects. ADB's SPS encompasses 3 key safeguard areas, environment, involuntary resettlement, and Indigenous Peoples.

## 1.3 Description of the Project

10. The project aims to improve 152 km of rural roads in two regions and develop the technical bases and capacity for the program. The selected regions are Magway (36.4 km) and Ayeyarwady (115.6 km). This IEE covers the rural roads in Ayeyarwady. The roads in Magway are covered in a separate IEE.

11. As an initial step ADB has been providing technical assistance (TA) to MOC's Department of Rural Road Development (DRRD) to develop a strategy and program on how to increase financing, improve quality, and develop sustainable arrangements for management and maintenance. To focus investments, the strategy introduces the planning concept of the core rural road network (CRRN), which refers to the minimum network of rural roads connecting each village and key destination by a single road, which results from bottom-up planning. As a second step, the project will finance rural road and access improvements prioritized on the basis of the CRRN in selected townships. \

12. The townships of Ayeyarwady that are included in the RRAP are Pantanaw and Maubin. Both are within the administrative District of Maubin. The selection and ranking of the sub-projects in Ayeyarwady have identified a combined length of 115.6 Km in the two townships.

13. The project will upgrade the sub-project roads within the existing unsealed roads or tracks in Ayeyarwady region to paved standard. The road widths will be ranging about 2.6 meter (m) to 3.0 m, to avoid any potential resettlement impacts. For climate resiliency, the roads elevations will be raised above the frequently occurring flood level and considering future climate change impacts. Pavement surfacing will be cement concrete based on climate resilient design considerations, bituminous (penetration macamdam [PEN-MAC] or double bituminous surface treatment [DBST].

14. Given the improved road conditions to paved standards it is highly likely the road users will be exposed to safety risks due to increased speeds of motorized vehicles. Also, traffic is expected to be increased as well. To mitigate these risks this output will introduce a community-based road safety program. While essential road safety engineering elements will be included in the detailed design, given that majority of crashes are due to road user behavior, this proposed program will focus on road user education and enforcement. For improved road safety, speed bumps will be installed at either side of villages, signage at sharp curves, guardrail at bridge approaches.

15. Manual construction, rather than mechanized, is rather common in Myanmar and is considered for RRAP. The general activities that will be undertaken during construction are clearing, excavation of unsuitable materials, construction of embankment, laying of base courses, paving, construction of culverts and bridges and installation of safety features.

16. The sources of earth fill materials have not been identified during the preliminary design stage. The contractor will have to identify and recommend borrow sites for earth fill materials. Aggregates in Ayeyarwady Region are primarily sourced from outside areas and shipped to or near the construction sites by river barges. It is expected that for smaller subprojects the contractor will source aggregates through local construction material traders from the legitimate sources. The sources need to have necessary clearances, valid licenses, and environmental approvals based on government laws and regulations.

17. The construction season in Ayeyarwady Region last from November to May (7 months). High rainfall during the period from June to October (5 months) allow only for limited levels of construction activities.

## 1.4 The Environmental Setting

18. The administrative region of Ayeyarwady, where the townships of Maubin and Pantanaw are located, occupies the lower reaches of the Ayeyarwady River Basin. Both Maubin and Pantanaw are located in the deltaic plains of Ayeyarwady River. The generally flat terrain is punctuated by subtle

topographic features associated with the evolution of the delta. These features include abandoned river channels, ponds and lakes in cut-off meanders and ancient levees and berms.

19. The region and the country in general experiences a tropical-monsoon climate with three dominant seasons, summer, rainy and winter season. The summer season prevails from end of February to beginning of May, rainy season is June to October and winter season is from November to end February. The summer and winter seasons bring little rainfall. It is the Southwest Monsoon (rainy season) that brings most of Myanmar's rainfall.

20. Two analyses of the climate of Myanmar were recently published. Average annual temperature in Myanmar is expected to rise over the coming century with varying magnitude of warming in the different regions of the country. The warming may accelerate beyond 2040, raising the average temperatures. Precipitation patterns across Myanmar are projected to change over the coming century. Despite the inherent uncertainty in predicting change in precipitation, the outcome of the models indicates that the current wet season months (June to October) will experience increased rainfall both in the near and long term relative to the 1980-2005 baseline and will exacerbate wet season flooding in some regions.

21. The middle range projections of sea level rise above the 2000-2004 base period level in Myanmar is projected at 20-41 cm in the 2050s and by 2080s 37-83 cm, with 122 cm as the highest range of projection for this period. It is predicted that the delta region will be prone to impacts of climate change aggravated by the rising sea level. The combined effects of sea level rise and increased rainfall intensity will increase the flooding hazards in the delta. This risk has been recognized and as part of resiliency measures the sub-project roads will be elevated above the frequent flood levels whenever possible and practical.

22. Myanmar is in a region where the geology and tectonics is dominated by the convergence of tectonic plates, mainly the Indian Plate, the Burma Plate and the Eurasian Plate. Three (3) types of crustal plate convergence are recognized in this geologic region such as; subducting and rifting as expressed by Sagaing Fault which absorbs the collision through its strike slip movement. This makes the north-south trending Sagaing Fault the most prominent geologic structure in this region with its movement generating earthquake events in this part of the country.

23. The lithology of the Ayeyarwady delta is made up of the very young Alluvial geologic formation. The townships of Maubin and Pantanaw are situated on this youngest geologic formation of Holocene unconsolidated sediments. The soil over the delta is alluvial soil with silt developed from recent deposits of the river plains. It is relatively young and rich in plant nutrients and the soil is replenished during flood season which makes the delta the leading rice producer of the country and has earned the distinction of being the granary of Myanmar.

24. The Ayeyarwady River is ranked globally as having the fifth-largest suspended load and the fourth highest total dissolved solid load. But according to one study, despite the large sediment load delivered annually to the gulf by the Ayeyarwady and Thanlwin (Salween) Rivers, the coastline has been largely stable advancing at an average rate of no more than 0.34 km per century since 1925 with a cycle of accumulation and erosion occurring. But generally, the coastline is in equilibrium, and that sediment deposition currently balances subsidence and sea level rise.

25. Within the corridors of the sub-project roads in Ayeyarwady, active erosion and sedimentation accompanies the migration of river channels. The unprotected banks of rivers / canals are susceptible to erosion caused by boat wakes. The sub-project roads paralleled by navigation channels are prone to this process.

26. Surface water is copious in the delta region and its main water resource is the Ayeyarwady River. The flow of the river varies throughout the year between 2,300 $m^3/s$ and 32,600 $m^3/s$, the average being 13,000 $m^3/s$ with an annual average discharge is 410 $km^3$/year. The river experiences huge fluctuation in river flow due to the strong variation in precipitation and seasonal melting of snow from the Himalayan slopes.

27. The lower reaches of the Ayeyarwady River was monitored for quality in eight stations from 2008 to 2011. The monitoring data showed distinct seasonal and spatial variation in water quality particularly in

the region of Mandalay, Magway and Pakokku where water quality is suspected to be affected by discharges of mineralized springs into the Ayeyarwady River.

28. Seasonal ponds and wetlands occur widely in the delta. These ponds fill with water during the rainy season and are cultivated during the dry season when water subsides. Other natural ponds have been permanently converted to fishponds.

29. Groundwater is also present in the delta. The Holocene sediments allow the occurrence of shallow water table in the delta region. The groundwater is tapped by dug wells and tube wells. However, poor quality of groundwater in some areas limits its use as domestic water source. In addition, the presence of arsenic in groundwater is reported in certain parts of the delta. In some parts of the project area in Maubin, groundwater is present under confined condition as indicated by the presence of free-flowing springs. In the absence of a water supply system, the households use both surface and groundwater as sources for domestic use.

30. Forest cover in Ayeyarwady has been decimated. Only patches of regrowth wooded areas are scattered within the townships. Within the sub-project area, the wooded areas are mostly associated with the settlements. Trees and vegetation that make up the wooded areas include fruit bearing, ornamental plants and reforestation species like Long Leaf Acacia, Eucalyptus, Gmelina, etc. There is no reserved forest within the corridors of the sub-project roads in Maubin and Pantanaw according to the township assessment, and protected areas are distant from the sub-project areas.

31. Settlements and agriculture are the dominant anthropogenic land uses in the delta region. The village settlements are generally spread out in areas where land space is available. However, in areas where land is limited as confined by water bodies, the settlements are in linear pattern, following the road or canal. The delta region, including the sub-project corridors are intensely cultivated with rice as the major crop. Aquaculture is also widely practiced, mostly freshwater ponds.

32. The Avibase-Worldwide Checklist of Birds[2] reported that within the lower Ayeyarwady there are 471 species of birds, 19 of these are globally threatened and one introduced species. Birdlife International has identified an important bird area in the coastal area of the delta.

33. Within the sub-project corridors, the bird species consist mainly of species associated with open fields, edge of settlements, brush and grassland and wetlands. The residents consulted are not aware of the presence of any unusual or protected species.

34. Fishbase reported that there are 44 fish species in Ayeyarwady River, belonging to 11 families with *Cyprinidae* having the most number of species. 42 are classified as native species with 2 classified as endemic. Aquaculture is widely practiced in the delta and fish species commonly reared carp and non-carp species.

35. The Irrawaddy River is the known habitat of the Irrawaddy Dolphin (*Orocaella brevirostris*). The known population inhabits the upper part of the Irrawaddy with part of it having been declared as a protected area (PA). The PA stretches from Mingun near Mandalay north to Kyauk Myaung spanning 74 km of the Irrawaddy River. Historic information reported sighting no farther downstream than Prome (Pyay). There is no report of sightings of the Irrawaddy Dolphin in the delta.

36. In terms of natural hazard, the sub-project areas are located in a tectonically active region. The rifting along the Sagaing Fault has generated large earthquakes. Earthquake analysis has zoned the country into 5 earthquake hazard zones, zones 1 to 5 (low to high ground shaking). The RRAP sub-project areas in Ayeyarwady are located in a Moderate Zone (probability of 0.1g to 0.15g).

37. The assessment of the flood hazard in the sub-project areas was carried out using the Cyclone Nargis flood map done by the Dartmouth Flood Observatory. It is notable that the sub-project roads of Maubin are located outside the flooded areas, except for MBN 019. The end part of this road traverses the

[2] http://avibase.bsc-eoc.org/checklist.jsp?region=MMay&list=howardmoore

fishpond area. Similarly, the sub-project roads in Pantanaw are also located outside flooded area, except for certain parts of PTN012 and PTN019.

## 1.5 The Socio-Economic Condition

38. The Ayeyarwady Region has a population of 6,184,829 with Bamar and Karen making up majority of the population with a small minority of Rakhine in western coastal regions. The majority of the population are Buddhist, with small minorities of Christians, Muslims, Hindu and Bahai.

39. The Ayeyarwady Region is mainly agricultural and known as the rice bowl of Myanmar. In addition to rice, the region also produces maize, sesame, groundnut, sunflower, beans, pulses, and jute. The dominance of agriculture is reflected in the employment pattern of agriculture as the main provider of employment. Fisheries, capture and cultured fishery, are also important economic activities producing fish, prawn, fish-paste, dry fish, dry prawn, and fish sauce.

40. Rural electrification is rather low in the entire country. According to MOLFRD (2015), rural electrification is only enjoyed by 41% of the total villages of the country. Of the villages within the 4 townships of Maubin District only 610 of the villages out of a total of 1,648 have access to electricity. More than 63% of the villages are yet to have access to electricity. Majority of households (95 percent) depend on wood and rice husks for cooking and heating.

41. Access to safe drinking water is also limited as only a small percentage of the rural population in the delta is connected to a public drinking water system. The situation is aggravated by arsenic contamination of groundwater and this is an emerging public health issue in Myanmar.

42. Based on available data, literacy rate is relatively high as the results of the 2014 Census revealed a very high rate of school education: Nationally the proportion of the population who have received primary or more advanced education is usually more than 75%. This high rate of school education is reflected in the township of Maubin with 75 to 90% of population aged 25 years old and older have primary education or higher.

43. Maubin has 3 universities, 14 high schools, 23 middle and 283 primary schools, 2 monastic schools. Pantanaw on the other hand has 10 high schools, 14 middle schools, 290 basic schools and 5 monastic schools.

44. In terms of health services, the township has 3 government hospitals, 12 rural health center, 72 sub-centers, I station hospital and 1 private hospital. Pantanaw on the other hand has 1 government hospital, 6 rural health centers, 44 sub-centers and 6 private clinics.

45. Malaria, AIDS, and malnutrition and related diseases are serious problems in the country. Tuberculosis is a major killer. Myanmar's tuberculosis rate is one of the highest in the world, with 97,000 new cases detected annually. The major infectious diseases in terms of degree of risk are: a) food or waterborne diseases: bacterial and protozoal diarrhoea, hepatitis A, and typhoid fever; b) vector borne diseases: dengue fever and malaria; c) water contact disease: leptospirosis; d) animal contact disease: rabies. Highly pathogenic H5N1 avian influenza has been identified in this country.

## 1.6 Impacts Prediction and Assessment

46. The main feature of the RRAP that precludes major adverse environmental impacts is the condition that RRAP should be Category B which explicitly excludes roads in protected forests, reserved forest or other legally protected areas. The other aspects of RRAP that minimizes the adverse environmental impacts are that the sub-project rural roads are pre-existing alignments, either as unpaved roads or tracks. Realignment maybe done to improve design for safety but this for very short distances.

47. The impacts of the RRAP are assessed in terms of quality of impacts (positive, negative, direct indirect) and in terms of magnitude (significance of impact), i.e. low moderate, high. The magnitude of an impact is assessed based on the nature of the receptor (e.g. human community, environmentally sensitive

receptors important habitats and special areas), the duration of the impact, the size of the area that will be affected and the nature and volume of materials that will cause the impact. For these sub-projects, impacts due to location and impacts due to construction and operations are predicted and assessed. No assessment for abandonment is done as rural roads are continually in service and there is more likelihood for its upgrading in the future rather than abandonment.

48. The identification of the impacts is done through a combination of methods such as the use of checklist and drawing from experiences in other similar projects. Publications by IFIs, WB and ADB are also referred to. The experience of the environmental impact assessment specialist conducting the environmental impact assessment is also key in impacts prediction.

49. The adverse impacts due to location of the RRAP sub-project roads is imminent due to the presence of village settlements and water bodies within the corridor. The impacts on settlements are amplified by the narrow road opening within village settlements. The road rehabilitation will be only within the existing road widths. The existing road width varies from 1.8 m as the minimum to 8.2 m, but generally most sections are uniformly 3.0 m in width. With this approach of varying widths, the proposed project may have almost zero resettlement impacts on all 115.6 km of Ayeyarwady roads.

50. Another possible impact due to location is the potential conflict of construction with farm activities during harvest season. There is a marked increase in the number of farm vehicles during harvest season and farmers use the roads for drying grains and grain threshing at the road side. This is possibly more significant in areas where two or three cropping is done per year. To mitigate this impact, an agreed alternative site for drying and threshing should be identified. Also, the Contractor should properly manage the traffic at the work site.

51. There is the risk of polluting and obstructing the water bodies / irrigation ditches within the corridor. The measures to avoid pollution of water bodies and/or damaging irrigation ditches along the roadside include proper materials management and close supervision of construction activities.

52. A key source of impact during construction is the operations of a construction camp. Camps have higher risks in terms of adverse environmental impacts because of its fixed location, duration of use and storage of hazardous. Not to mention the potential social impacts, i.e. conflict with host community and the security and health hazards it poses to host communities.

53. Mitigation of impacts due to camps include minimizing the need for construction camp by hiring residents. Instead of providing housing, local workers can be provided with free transport to and from work places. The selection of the camp site is also key to mitigating impacts as an ill-located camp can be problematic and costly to the Contractor.

54. Aside from workers' accommodation, the camp typically includes stockpiles area, fuel and equipment depot and maintenance shop, asphalt or batching plant. The operations of the plants will generate noise and dust. To mitigate these impacts, a minimum separation distance of 300 meters between camp and nearest house should be observed. To prevent pollution, the Contractor should locate camps away from surface water bodies, install basic environmental facilities. For the protection of the workers' health and safety, the Contractor should provide accommodations that comply with international guidelines for workers' camp (e.g. ILO, OSHA) in terms of space, water supply, dining and sanitation facilities. Contractor should also implement measures for the security of camp dwellers.

55. After the site has been handed over to the Contractor, the initial activity is the clearing and grubbing which involves the removal of all structures within the work area, including trees. Relocation of utilities is also done. Damages to structures or cutting of trees outside the work area may occur without protection measures. Additionally, heavy equipment will be used creating noise and dust. Initially, the contractor should coordinate with the village officials and owners of affected structures. The work sites shall be properly demarcated, tree cutting permit secured and licensed waste disposal site identified. Public safety measures should be put in place, e.g. signs, barriers, and signal men.

56. The removal of trees need approval from the private owner and in case of teak trees, the contractor will have to abide with the forestry law which states that all teak trees belong to the state. Permit to remove

teak should be secured from the Forestry Department.

57. The removal of unsuitable materials follows. This will entail the removal of the existing pavement (if paved) and excavation of the base if needed. Commonly, the stripped pavement is disposed, but in places where materials are not readily available, the stripped pavement material is crushed and re-used. Due to scarcity of sources of materials, it is assumed that the same will be done for the RRAP. The unsuitable materials will be used as filling materials in areas where such quality of soil is acceptable (e.g. shoulder). This construction activity will entail closure of the road and will require the use of heavy equipment. The road closure will impede the traffic. It is essential that the contractor prepares a traffic management plan in consultation with the village prior to start of construction. Dust suppression and measures to control noise should be put in place. Noise mitigation measures should be implemented.

58. The construction of the embankment ensues which will involve mainly the delivery and placement of base materials and compaction. One method of delivery of sand to site is by barge and sand is unloaded as slurry. This delivery method will require proper management of the return water to prevent heavy siltation of surrounding water bodies. Alternatively, materials can be delivered by trucks which will result to increased road traffic, causing impacts on dust and noise and exposing the public to traffic hazards. Equipment that will be used for this phase of road construction are road grader and road roller. The operation of the heavy equipment will generate noise and vibration and emissions. This phase of road construction will require closure of the road causing inconvenience and delay in travel time.

59. To alleviate impacts due to road closure, alternate temporary routes will have to be identified and provided. Contractor should implement measures for dust suppression, noise control, and protection of public and traffic safety. Project vehicle drivers should be given traffic safety training. Safe access through the construction site should be provided for motorcycles and pedestrians. Warning signs and barriers should be visible at night, through the provision of lighting and reflectorized materials.

60. The paving of the road starts with the spreading of aggregates, application of prime coat followed by bitumen. This is done either by hand or mechanically. This construction activity exposes the workers to occupational hazards. The risk is higher with the manual method of road construction. Aside from occupational hazards, the threat of adverse environmental impacts is also higher with the manual method.

61. The alternative to the manual method is the mechanical method which uses a truck mounted aggregate spreader, gas fired bitumen heater and truck mounted bitumen sprayer. This method mitigates most of the occupational hazard associated with the manual method. To further enhance occupational safety workers should be equipped with personal protection equipment. Measures to protect workers from exposure to high temperature should also be implemented by the contractor. For public safety, signs and barriers should be installed to separate pedestrians from the work site.

62. Concrete cement paving will be done in selected areas. The possible source of impacts of this activity is the disposal of wash water of mobile mixers. The wash water is highly basic and should be disposed properly in a wastewater facility at the plant site for re-use, e.g. dust suppression and equipment washing.

63. There are numerous water crossings and the construction of culverts and drains is an essential component of the sub-project roads. The main concern with the construction of culverts and drains is the possible impact on the irrigation canals. The obstruction of the irrigation canals can affect delivery of irrigation water to the fields with dire consequences to the farmers. Particularly, if done during the growing season when delivery of irrigation water is critical.

64. Additionally, fishponds are also prone to impacts of culvert and drainage construction. Use of pre-cast culverts, pipe and box, will minimize risks of pollution and should hasten the construction. To mitigate the possible impacts on irrigation, the contractor should consult with the farming community and irrigation department. Further, contractor should clean-up work sites upon completion of the work. Safe foot bridges should be provided to allow pedestrians to cross. Alternatively, boats maybe used by residents to avoid the work site so landing sites should be provided.

65. Some of the rural roads in Maubin and Pantanaw are paralleled by navigational canals making the

road sides prone to erosion due to boat wakes. It is proposed that bioengineering methods be adopted for the bank protection of RRAP sub-project roads in Ayeyarwady.

66. Bridge construction may have the same impacts as culvert construction. Additionally, construction may hinder navigation for which case the contractor should provide a safe passage for boats through the work site and shall ensure that the passage way is visible at night time.

67. Hazardous materials will need to be stored on site. To mitigate hazards and risk of pollution, the contractor should observe good practices in storing and handling bitumen, fuel, lubricants etc.

68. The same for hazardous wastes that will be generated during construction. It will include used oil and solvents; oil tainted materials, e.g. rags, oil filter and sludges. The contractor should implement a hazardous waste management plan that covers collection, temporary storage and disposal.

69. Solid wastes will also be a concern as different solid wastes will be generated by different sources within the camp, i.e. domestic waste and wastes from the equipment maintenance yard.

70. The contractor shall implement waste segregation and recovery of recyclables. The non-hazardous wastes shall then be classified into biodegradable, non-biodegradable and recyclables. All recyclable materials segregated and sold while the residual wastes shall be disposed at the township disposal facility.

71. The camp shall be provided with wastewater treatment systems e.g. sealed septic tank with soaking pit and the batching plant, if any, shall be provided with a sedimentation pond where plant and transit mixer wash water shall be collected.

72. To minimize the impacts of borrow pits, the contractor should follow guidelines for selecting borrow site, e.g. avoid productive agricultural lands and ecologically important places, prefer sites which are shielded, i.e. outside view corridors and prefer sites that are distant from settlements and away from ecologically sensitive receptors. Additionally, the Contractor should obtain the necessary permits for the borrow pit.

73. Upon completion of the construction, the contractor shall demobilize workers and equipment. The contractor shall remove all equipment, structures and waste materials from the work sites, construction camp, stockpile areas, etc and rehabilitate the land according to the agreement with the landowner.

74. The operations stage of the rural roads is the period when the MOC / DRRD takes over the completed roads. During this stage, the main responsibility of the MOC / DRRD is the regular maintenance. During this period the concern is the safety of workers as they carry out the maintenance work. For workers' safety, workers should be separated from the vehicular traffic through the use of markers and barriers. Workers should be provided safety equipment such as high viz vests, safety shoes, gloves, etc.

75. According to a WB study, that GHG emissions for rural road construction is 90 to 103 t $CO_2$ eq/km, gravel and DBST, respectively. The relatively high GHG emissions due to construction activity in Asia is said to be a factor of the procurement and construction practices and due to the use of old technology and equipment of poor condition. To minimize GHG emission, the asphalt plant and mobile equipment shall be current models and should be properly maintained.

## 1.7 Analysis of Alternatives

76. As part of the environmental assessment ADB's SPS 2009 requires the examination of alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and consider the "no project" alternative. The no project alternative is not acceptable in this case as it will set back the country's development that the government has embarked on with full support from international donors.

77. The "with the project scenario", alignment is existing and will be maintained except perhaps for some short sections that need to be realigned to improve road safety. Limited land taking is necessary for

this purpose and the DDIS Consultant and contractor will see to it that alternative sites are considered to minimize social (e.g. impacts on community facilities) and environmental impacts (e.g. tree removal).

78. The design consultant has considered three types of pavements appropriate for different conditions of the sub-project roads. The types of pavements include concrete cement, penetrated macadam and double bitumen surface treatment (DBST). Concrete cement pavement is considered but its use will be limited.

## 1.8 Public Consultations and Disclosure

79. A Public Consultation Plan was prepared by the DRRD, with the assistance of SweRoad consultants. The public consultation informed the stakeholders about the proposed project and its objectives, discussed the anticipated environmental and social impacts. Concerns were also solicited on environmental and social issues. The consultation meetings were done at Magway and Ayeyarwady.

80. As an initial step, the Environmental Survey team met with township level representatives of the General Administration Department (TGAD). Thereafter, consultations were conducted with the Forest Department, Department of Agricultural Land Management and Statistics (DALMS), etc. It was noted during the consultation with the township officials that some of the concerns and opinions mentioned during the meeting were based on experiences with the Maubin-Pyapon Road project. They were reminded that this is a rural road project with different specifications and implementation arrangements.

81. Subsequently, small group meetings and random interviews were conducted simultaneous with the reconnaissance survey undertaken from 16 October to 02 November 2017 and in February 2018. The villagers generally knew about the project with information obtained from DRRD staff who conducted the earlier surveys during project preparation stage. The general perception of stakeholders of the project is very positive as they are anticipating the improvement of access to their villages. Information was also solicited from the villagers regarding the occurrence of flooding and other natural hazards in their respective villages and road corridor in general.

82. In general, all the stakeholders welcome the proposed project because of the expected benefits to the villages. There are land owners who are willing to donate their land to help the community get assess road. There are also concerns on possible impacts on farmland, trees and structures; however, these primarily related to land acquisition rather than environmental concerns.

83. The public consultation shall be a continuing activity for the duration of the project implementation. The succeeding round of public consultation should be conducted after the Contractor has been procured but prior to start of ground work. A presentation to the regional ECD office based in Pathein should also be carried out since it will be the ECD office that will be responsible for monitoring the project in Maubin District.

84. For purposes of information disclosure, ADB will disclose on its website the project's IEE and monitoring reports.

## 1.9 Grievance Redress Mechanism

85. Grievance redress is one of the requirements for ADB supported project. GRM is one of the 11 policy principles of environmental safeguard where the project is required to establish a mechanism to address grievances pertaining to the environmental performance during construction.

86. The key complaints on road project's environmental performance as experienced in road projects in Myanmar are insufficient dust suppression during the dry season, damage to farmlands brought about by spillage of materials, spillage of materials into irrigation ditch, dust due to operations of batching plant, encroachment on community facilities (e.g. water supply); lack of coordination with government agencies with jurisdiction on government infrastructures affected by project activities (e.g. Irrigation Department). The resolutions of these complaints are usually within the authority of the Contractor, Project Proponent and the DDIS Consultant.

87. Land issues may arise in this project particularly in sections where some widening or minor adjustment of the road alignment is needed. Resolution of such issues shall be handled separately or maybe beyond the project level and require resolution at village levels.

88. Other issues like accidents (vehicular) involving the public may require resolutions that need intervention of other government authorities, i.e. police, township administration, etc.

89. For the rural roads project, a 3 level GRM is recommended: first is project level, at the level of the contractor and project DDIS Consultant, who should respond or resolve the complaints within 2 days. The second level is MOC/DRRD level which has 5 days to review and respond and 5 days to resolve the complaint. The third level is to resort to legal proceedings.

90. The focus person of the GRM on site shall be the village chief. The village chief may file the complaint in behalf of the affected person. The complaint is to be received by the contractor's project manager through the environment and safety officer who shall record the complaint. The contractor is responsible for reporting the complaint to the DDIS Consultant.

91. The DRRD is primarily responsible for organizing and managing the grievance redress mechanism with the assistance of the DDIS Consultant. The DRRD shall be responsible for recording the complaints and reporting the complaints to MOC. The complaints shall be included in the monthly progress reports prepared by the DDIS Consultant, and in the semi-annual environmental monitoring reports.

92. The DRRD shall publicize the existence of the GRM by disclosing it in public consultations and through the installation of information signages within the project area. The information board shall state the project name, the name and office of the contract person the contact details.

## 1.10 Environmental Management Plan

93. The EMP is prepared to guide the appropriate implementation of the mitigation measures. It defines the organization and the roles of the different stakeholders in the implementation; it puts in place the process for monitoring and reporting and estimate of the required resources to monitor the implementation of the EMP. The environmental mitigation and monitoring plan has been prepared and presented in table form.

94. The responsibilities for the implementation of the EMP are shared among the different entities involved: DRRD (implementing agency), the detailed design and DDIS Consultant (DDIS), works contractors, the project beneficiaries, village and township officials, MONREC and ECD.

95. The DRRD as the implementing agency shall have the overall responsibility for overseeing the implementation of the EMP with the assistance of the DDIS Consultant. The DDIS consultant through its international and national environment safeguard specialist shall have the responsibility for monitoring and reporting the EMP implementation. The DDIS consultant shall also be responsible for setting up the process for contractor's implementation of corrective measures for monitored EMP non-compliance. The works contractor on the other hand shall be directly responsible for implementing the mitigation measures. It will also have the responsibility for self-monitoring of EMP implementation through its environment and safety officer. The ECD, as the regulatory body has the authority to monitor the project's compliance with the environmental regulations. ADB for its part will conduct review missions to ensure compliance with contractual obligations and may commission a third party for environmental monitoring.

96. The daily monitoring of EMP compliance by the DDIS' national environment safeguard specialist (NESS) together with the DRRD environment safeguard specialist shall be done using a checklist to be devised by the international environment specialist (IESS). The daily monitoring by the NESS shall be compiled in an electronic database. The daily monitoring report shall be the basis for the preparation of the monthly progress reports and the semi-annual environmental monitoring reports submitted to ECD, MOC and ADB, respectively.

97. The (IESS) shall be deployed for a month every 6 months. Among his/her role during the first deployment is to prepare a monitoring plan. The plan should include the monitoring procedure, procedures for corrective actions, the monitoring checklists, frequency of monitoring and report format. The IESS shall

review the monitoring, carry out an inspection of the work sites, and conduct meeting with the contractor for outstanding issues. The IESS shall draft the semi-annual environmental monitoring report. The IESS shall also be responsible for the review of the EMP.

98. The monitoring of environmental quality (i.e. noise, dust, pollution and spillage, waste management, etc.) shall be done visually. For noise, mobile devices may be used. Also, informal interviews of residents around the active work site can be done for any complaints they might have on the environmental management. Visual observations shall be documented and reported. Instrumental monitoring of ambient environmental quality shall be done to verify complaints from affected community. The cost of the monitoring shall be for the account of the client.

99. The IESS during the first period of deployment shall orient the DRRD and the contractor on the EMP. The salient points of the IEE and EMP should be presented with emphasis on the mitigating measures and the contractor's obligation on the EMP implementation. The workers shall also be given orientation on the EMP prior to the start of construction work. The EMP matrix should be translated to Myanmar. An emphasis on the roles and responsibilities of the workers in the EMP implementation should be emphasized. This orientation on EMP shall be done by the NESS at least on a quarterly basis.

100. The contractor's health and safety officer shall conduct training on personal hygiene and health for workers. Safety training for workers shall also be conducted by the contractor encompassing occupational safety and public safety. Traffic safety shall be done specially for the contractor's vehicle drivers. The safety training shall be done quarterly, with regular tool box meetings. Appropriate signs to remind workers of safety shall be posted in conspicuous areas where workers congregate. Training on HIV prevention awareness shall also be done.

101. The following are the necessary preparations to be undertaken prior to start of construction:

- Preparation of a monitoring plan by the IESS;
- Contractor's preparation of a Contractor's Environmental Management Plan (CEMP) complete with site plans that is commensurate to the level of the project;
- Preparation of Traffic Safety Plan, Occupational Health and Safety Plan by the Contractor
- Conduct of orientation on EMP for DRRD and Contractor by IESS;

102. The plans to be prepared by the Contractor should be submitted and approved by the DDIS Consultant before the site is handed to the contractor.

103. The EMP should be reviewed by the IESS every 6 months and updated as necessary.

## 1.11 Conclusion

104. Based on the outcome of the impact assessment of RRAP sub-projects, it can be concluded that the proposed upgrading of the RRAP sub-project roads in the townships of Maubin and Pantanaw in Maubin District, Ayeyarwady Region is not likely cause significant adverse environmental impacts. With exception of villages adjacent to the roads, there are no environmentally sensitive receptors such as forest and or protected areas present within the sub-project corridors. The ADB conditions for this project specifically excludes roads located in forests and protected areas.

105. The upgrading of the RRAP sub-project roads will be mostly confined within existing alignments of rural roads and/or tracks. The construction activities that will be carried out are typical of small road projects that will entail, clearing of the road alignment, removal of unsuitable substrate, building of the embankment and paving.

106. The impacts that these activities will generate are predictable and can be mitigated. No significant residual impact is anticipated. The occurrence of an unanticipated impact shall be reported and mitigation measures implemented. In view of the above findings, RRAP is a Category B project.

# 2. INTRODUCTION

107. Asian Development Bank (ADB) has approved the Government of the Republic of the Union of Myanmar's request for support to develop and contribute to the financing of a national rural roads and access program. The project entitled Rural Roads and Access Project (RRAP) will improve 152 km of rural roads in two regions and develop the technical bases and capacity for the program.

108. This initial environmental examination (IEE) was carried out to comply with ADB's Safeguard Policy Statement (2009), as well as satisfy the requirements of the Myanmar Environmental Impact Assessment Procedure (2015). The report assesses the environmental impacts associated with the rehabilitation and improvement of the rural roads and the construction of small associated structures such as bridges and culverts.

109. The RRAP is a Category B project based on ADB's classification of projects according to significance of its environmental impacts. The Category B is one of the conditions of ADB in supporting the project. ADB condition explicitly excluded roads that lead or traverse forest, reserved forests and other ecologically sensitive areas. As a Category B, the project is required to submit an initial environmental examination (IEE) report. The Myanmar's Ministry of Natural Resources and Environmental Conservation (MONREC) has likewise classified the RRAP as an IEE type of project.

110. For this project, environmental checklists were used to summarize the environmental condition prevailing within the various road corridors and the outcome of public consultation. These are presented in Appendix 6. The constraint in the conduct of the IEE is that the site inspections were conducted during the rainy season when the access to the sites was difficult and the sub-project roads were unpassable to motorized vehicles. Inspections had to be done on foot and bull carts where available.

# 3. POLICY, LAWS AND REGULATIONS

## 3.1 Environmental Policy and Regulations of the Republic of the Union of Myanmar

111. The Republic's mandate to protect and conserve the environment is enshrined in the 2008 Constitution of the Republic of the Union of Myanmar (Myanmar). But even prior to the 2008 constitutional amendment, Myanmar had already adopted its environment policy as declared in the 1994 National Environmental Policy. This policy established the environmental impact assessment requirement for social and economic development activities in Myanmar.

112. Subsequently, laws and regulations were enacted for implementing the policy. The key environmental laws and regulations relevant to the RRAP are the Environmental Conservation Law (2012), Environmental Conservation Rules (2014), Environmental Impact Assessment Procedure (2015), the Protection of Biodiversity and Natural Protected Areas Law (2018), Forest Law (2018). These specific laws are summarized in the following table:

**Table 1. Summary of environmental policy, regulations and laws relevant to the RRAP**

| No | Title of the Law | Brief Description of the Law | Relevance to RRAP |
|---|---|---|---|
| 1 | National Environmental Policy (passed 05 December 1994) | Proclaims the government's commitment to the principle of sustainable development. It also highlights the integration of environmental considerations into the development process to enhance the quality of life of all its citizens. | The broad declaration of this policy covers RRAP. |
| 2 | The Environmental Conservation Law (passed March 2012) | This law creates the Environmental Conservation Commission and defines its duties and powers. The provisions of this law encompass waste management and pollution control, the adoption of environmental quality standards, environmental permitting of projects or activities, management of urban environment and the protection of natural and cultural resources. | The activities of RRAP are subject to environmental assessment requirements according to the general provisions of the law. |
| 3 | Environmental Conservation Rules (passed June 2014) | The environmental impact assessment implementation law of Myanmar, stipulating the requirement for projects and activities to secure environmental permit. It also stipulates the requirement for firms and individuals that conduct environmental impact assessment to register with | The road upgrading project is covered by this law and is subject to environmental assessment. |

| | | | |
|---|---|---|---|
| | | the MOECAF (now MONREC). | |
| 4 | Environmental Impact Assessment Procedures (passed December 2015) | Enacted pursuant to the Environmental Conservation Law of 2012. It establishes the environmental impact assessment procedure from project screening, scoping, investigation, reporting, review, approval and monitoring; it enumerates the general content and coverage of IEE and EIA studies; provides the transitory conditions for projects in progress at the time of the enactment of the law; it enumerates the authority of MONREC in the review and approval; It also provides a categorization of projects / activities for the purpose of environmental permitting. | The road upgrading, from seasonal to all weather road is covered by the EIA law of Myanmar. The RRAP individual sub-project roads are < 50 km and are not required to prepare IEE. However, the road upgrading should secure prior permit from MONREC / ECD;<br><br>Quarrying and dredging for construction materials are covered by the EIA Law and should secure environmental permits from ECD/MONREC. |
| 5 | The Protection and Preservation of Cultural Heritage Regions Law (The State Peace and Development Council Law No. 9/98, passed September 1998 and amending law 2009) | This law governs the protection of the cultural resources of Myanmar which includes ancient monuments or ancient sites, structures, houses, walls, moat, stone inscriptions, carvings among others. Among its provisions are the prohibited acts and penalties. | This Law is applicable only if the road project will affect cultural heritage resources. |
| 6 | Forest Law<br>(The Pyidaungsu Hluttaw Law No. 29, passed 2018). | Repealed the 1902 Forest Act. Enforces among others the forestry and environmental conservation policies of the Government and developing the State's economy. Among its provisions relevant to RRRP are (i) All standing teak trees, regardless of location, are owned by the State (known as a Reserved Tree);<br>(iv) Permits are required for extracting or moving forest produce and establishing wood-based industries; and<br>(v) Any tree which cut within a township (such as the trees along the project road) cannot | This law is applicable if trees are to be removed and if the road project is within forests. Also, applicable if Teak trees will need to be cut. |

| | | | |
|---|---|---|---|
| | | be removed from the township unless a permit is given by MOECF (now MONREC) | |
| 7 | National Environmental Quality (Emission) Guidelines (issued December 2015) | This contains the environmental guidelines for emissions and effluents from various specific sources including roads and construction activities. | The construction effluents and emissions including those emanating from construction camp, quarry and other off-site areas should comply with the NEQG. |
| 8 | Health and Safety Legislation and Standards | The new *Law on Safety and Health in Workplaces'* was enacted in March 2019 by the Pyidaungsu Hluttaw requires the prevention of air and water pollution and to improve safety at worksites, including fire prevention, and the requirement for construction workers to use protective equipment, ensuring the safety of worksite operators and taking precautions for natural disasters. | Although this has not yet been passes as a law, protection of workers health and safety should be among the obligations of the Contractors. Aside from social and environment, the ADB Environment Safeguards Policy Principles (2009) includes protection of workers health and safety |
| 9 | The Conservation of Water Resources and Rivers Law of 2006, Amending law 2017 | This law is aimed at (a) conservation and protection of the water resources and rivers system for beneficial utilization by the public; (b) safety of navigation in waterways i.e rivers and creeks; (c) to contribute to the development of State economy through improving water resources and river system; (d) to protect environmental impact. | This is applicable to RRAP with respect to use of river banks for stockpiling of construction aggregates; Navigational use of channels for delivery of materials; and river dredging for construction materials which can only be done with the recommendation of the Director (Water Directorate) |

*Compliance with The Environmental Impact Assessment Procedures*

113. Road projects are explicitly within the purview of the Environmental Conservation Law (March 2012). Under the implementing rules of the EIA Procedures (December 2015), *Annex 1 – Categorization of Economic Activities for Assessment Purpose* requires road improvement and upgrading from seasonal to all weather equal or greater than the threshold of 50 km belongs to IEE Type of Economic Activity.

**Table 2. Categorization of Economic Activities for Assessment Purpose.**

| Type of Economic Activity | Criteria for IEE Type of Economic Activity | Criteria for EIA Type of Economic Activity |
|---|---|---|
| ***Transportation projects*** | | |
| Road Improvement (upgrading from seasonal to all weather surface, widening of shoulders) | Length ≥ 50 km | Any road project where the IEE process yields to do so |
| Extraction of rock, gravel or sand from a river or marine waters | 1,000 cu m/a but < 50,000 cu m/a | > 50,000 cu m/a |

114. The Environmental Procedures require the submission of a project proposal to ECD for the purpose of project screening and categorization. On the basis of the project proposal, ECD issues a decision on the scope and TOR for the required environmental report (i.e. EIA or IEE) and the conduct of the environmental assessment. It should be noted that the Environmental Procedures has a condition for accreditation of EIA preparers, i.e. environmental reports submitted to ECD should be prepared by accredited preparers. The EIA assessment procedure in Myanmar is illustrated in the following flow chart (Figure 1).

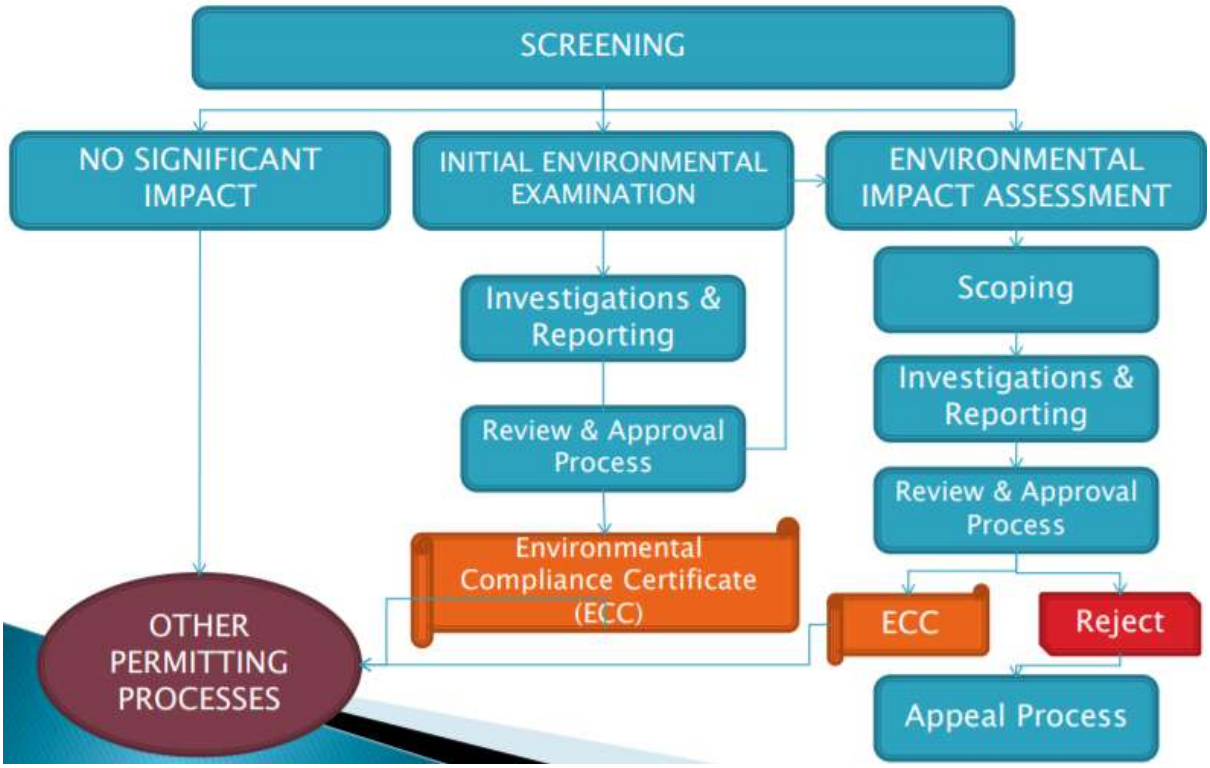

**Figure 1. Process for EIA Assessment in Myanmar (Sein Aung Min 2017)[3]**

## 3.2 Environmental Standards

115. The Myanmar Environmental Quality (Emission) Guidelines were issued in December 2015. The guidelines cover both water and atmosphere emissions related to a wide range of projects and industries including construction. These Guidelines have been primarily excerpted 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.

*Noise and Ambient Air Quality*

116. The Myanmar Government has yet to adopt ambient air quality standards, in the absence of such, international guidelines apply such as the WHO guideline for ambient air quality is as follows:

**Table 3. WHO ambient air quality guidelines (IFC, 2007)[4]**

| WHO Ambient Air Quality Guidelines | | |
|---|---|---|
| | Averaging Period | Guideline value in ≈g/m³ |
| **Sulfur dioxide ($SO_2$)** | 24-hour<br>10 minute | 20 (guideline)<br>500 (guideline) |
| **Nitrogen dioxide ($NO_2$)** | 1-year<br>1-hour | 40 (guideline)<br>200 (guideline) |
| **Particulate Matter $PM_{10}$** | 1-year<br>24-hour | 20 (guideline)<br>50 (guideline) |
| **Particulate Matter $PM_{2.5}$** | 1-year<br>24-hour | 10 (guideline)<br>25 (guideline) |
| **Ozone** | 8-hour daily maximum | 100 (guideline) |

117. The allowable noise levels during different times in different areas, i.e. residential, institutional and educational, commercial and industrial is enumerated in the following table:

[3] Sein Aung Min, 2017. Overview of Environmental Impact Assessment (EIA) Procedure SEA and Sustainable Development Goals in Myanmar https://www.ifc.org/wps/wcm/connect/b1af454f-0a88-4605-91df-bb623c27f7e8/1c+SEA+baselne+workshops+MONREC.pdf?MOD=AJPERES

[4] IFC 2007. Environmental, Health, and Safety Guidelines GENERAL EHS GUIDELINES: ENVIRONMENTAL

**Table 4. Noise Guidelines**

| Receptor | One Hour LAeq (dBA)[a] | |
|---|---|---|
| | Daytime 07:00 - 22:00 (10:00 - 22:00 for Public holidays) | Nighttime 22:00 - 07:00 (22:00 - 10:00 for Public holidays) |
| Residential, institutional, educational | 55 | 45 |
| Industrial, commercial | 70 | 70 |

[a] Equivalent continuous sound level in decibels

118. This NEQS guidelines require that noise generated by construction activities and the operations of the asphalt plant, batching plant and crusher should not cause in the receptor area noise above the ambient noise levels mentioned in **Table 4** or should not cause an increase of more than 3 decibels above the ambient noise level.

*Quality of Site Run-Off from Construction*

119. The other environmental standard applicable is the standard for site run-off from construction site and sanitary wastewater discharges from the camps and facilities. The guideline is enumerated in the following table:

**Table 5. Guideline for quality of site runoff and wastewater discharges (construction phase)**

| Parameter | Unit | Maximum Concentration |
|---|---|---|
| Biological oxygen demand | mg/l | 30 |
| Chemical oxygen demand | mg/l | 125 |
| Oil and grease | mg/l | 10 |
| pH | S.U.[a] | 6-9 |
| Total coliform bacteria[4] | 100 ml | 400 |
| Total nitrogen | mg/l | 10 |
| Total phosphorus | mg/l | 2 |
| Total suspended solids | mg/l | 50 |

[a] Standard unit

*Guidelines for Effluent for Extraction of Construction Materials*

120. The NEQG 2015 also provides the guidelines for effluent for extraction of construction materials, i.e. quarry, borrow pits. The effluent standard is as follows:

**Table 6. Effluent guideline for extraction of construction materials – NEQG, 2015**

| Parameter | Unit | Maximum Concentration |
|---|---|---|
| Biological oxygen demand | mg/l | 30 |
| Chemical oxygen demand | mg/l | 125 |
| Oil and grease | mg/l | 10 |
| pH | S.U.[a] | 6-9 |
| Total coliform bacteria | 100 ml | 400 |
| Total nitrogen | mg/l | 10 |
| Total phosphorus | mg/l | 2 |
| Total suspended solids | mg/l | 50 |

[a] Standard unit

## 3.3 International Conventions

121. The Republic of the Union of Myanmar is a party to relevant international environmental conventions, treaties and agreements on the principles and actions necessary for sustainable development and environmental protection (see Table below). It has ratified on 1994 both the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change. These international conventions explicitly refer to the application of environmental assessment to address the effects of human activities. The Convention on Biological Diversity, in particular, promotes the use of appropriate procedures requiring environmental impact assessment of proposed projects that are likely to have significant adverse effects on biological diversity. With respect to air quality and climate change, Myanmar is party to the Kyoto Protocol and the Montreal Protocol. Recently, Myanmar ratified the Paris Agreement to combat climate change and adapt to its effects, 2016.

122. With respect to Pollution Control, Myanmar is party to Stockholm Convention, Basel Convention, and MARPOL Convention. In addition to the Convention on Biological Diversity, Myanmar is party to many other international biodiversity agreements including Cartagena Protocol, Nagoya Protocol, CITES, and Ramsar.

**Table 7. International Environmental Agreements.**

| Theme | Convention/treaty/agreement | Status* |
|---|---|---|
| **Climate** | United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification (UNCCD), Paris, 1994 | Accession (1997) |
| **Air and climate change** | United Nations Framework Convention on Climate Change (UNFCCC), New York, 1992 | Ratification |
| | Kyoto Protocol to the Convention on Climate Change, Kyoto, 1997 | Accession (2003) |
| | Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985 | Ratification (1993) |
| | Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987 + amendments | Ratification (1993, 2012 for recent amendments) |
| | ASEAN Agreement on Transboundary Haze Pollution, Kuala Lumpur, 2002 | Ratification (2003) |

| Theme | Convention/treaty/agreement | Status* |
|---|---|---|
| | Paris Agreement to combat climate change and adapt to its effects, 2016 | Ratification (2017) |
| **Pollution control** | Stockholm Convention on Persistent Organic Pollutants (POPs), Stockholm, 2001 | Accession (2004) |
| | Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Basel, 1989 | Accession (2015) |
| | International Convention for the Prevention of Pollution from Ships (MARPOL), London, 1973 plus amendments in 1978 | Accession 4/8/1988 |
| **Biodiversity and natural resources** | Convention on Biological Diversity (CBD), Rio de Janeiro, 1992 | Ratification(1994) |
| | Cartagena Protocol on Biosafety to the CBD, Cartagena, 2000 | Ratification (2008) |
| | Nagoya Protocol on Access and Benefit Sharing (ABS) to the CBD, Nagoya, 2010 | Accession (2014) |
| | Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, D.C., 1973 + amendments (1979 Bonn, Germany) | Accession (1997) |
| | Agreement on Establishment of ASEAN Regional Centre for Biodiversity | Ratification (2009) |
| | ASEAN Agreement on the Conservation of Nature and Nature Resources, Kuala Lumpur, 1985 | Signatory (1997) |
| | Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971 + amendments in 1982 and 1987 | Accession (2004) |
| | MRC Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin – April 1995 | Became Dialog Partner with MRC in 1996 |
| | Agreement between International Union for Conservation of Nature (IUCN), and the government of the Republic of the Union of Myanmar to establish an IUCN Office in Myanmar. This laid the foundation for future collaboration on addressing challenges and maximizing opportunities related to biodiversity conservation and sustainable development in the country. | 31 March 2016 Host Country Agreement (HCA) signed |

| Theme | Convention/treaty/agreement | Status* |
|---|---|---|
| | Mangroves for the Future (MFF) – MFF was founded on the vision, "Healthy coastal ecosystems for a more prosperous and secure future for coastal communities." The vision was supported by a mission statement, "To promote healthy coastal ecosystems through a partnership-based, people focused and policy relevant approach that builds and applies knowledge, empowers communities and other stakeholders, enhances governance, secures livelihoods, and increases resilience to natural hazards and climate change." https://www.mangrovesforthefuture.org/what-we-do/focus-areas-and-objectives/ | In 2014, Myanmar joined as the 11th member country. |
| **Cultural heritage** | The Convention for the Protection of the World Culture and Natural Heritage, Paris, 1972 | Acceptance 1994) |
| | Declaration on ASEAN Heritage Parks | Signatory (2003) |
| | Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property, 1970 | Ratified |
| | Convention for the Safeguarding of the Intangible Cultural Heritage, 2003 | Ratified |

### 3.4 ADB Safeguard Policy

123. As an ADB funded project, the RRAP must comply with the bank's safeguard policy. ADB's environmental safeguard requirements are contained in the ADB Safeguards Policy Statement of 2009[5]. This SPS applies to all ADB-financed and/or ADB-administered sovereign and non-sovereign projects, and their components regardless of the source of financing, including investment projects funded by a loan; and/or a grant; and/or other means, such as equity and/or guarantees.

124. The goal of the Safeguard Policy Statement (SPS) is to promote the sustainability of project outcomes by protecting the environment and people from potential adverse impacts of projects. ADB's SPS encompasses 3 key safeguard areas: environment, involuntary resettlement, and Indigenous Peoples.

125. The environmental safeguard contains 11 safeguards policy principles that are applied in all projects. These policy principles are:

a. Use a screening process for each proposed project, as early as possible,
b. Conduct an environmental assessment for each proposed project to identify potential impacts
c. Examine alternatives
d. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts
e. Carry out meaningful consultation with affected people and establish a grievance redress mechanism to resolve concerns and grievances regarding the project's environmental performance.
f. Disclose a draft environmental assessment (including the EMP) in a timely manner

[5] ADB 2009. Safeguard Policy Statement, Policy Paper. Manila.

g. Implement the EMP and monitor its effectiveness.
h. Do not implement project activities in areas of critical habitats,
i. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards
j. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.
k. Conserve physical cultural resources

## 3.5 Project Screening and Categorization

126. As stipulated in the RRAP TOR sub-project roads with very significant environmental impacts, e.g. located in ecologically sensitive areas are explicitly excluded from RRAP. Accordingly, the RRAP has been screened and categorized based on ADB criteria as Category B Project. As a Category B project, it is required to conduct an Initial Environmental Evaluation (IEE) and environmental management plan (EMP).

127. A project proposal has been submitted by DRRD to ECD on 04 April 2018 and a decision confirming the project's IEE category was issued by MONREC on 19 April 2018 (**Appendix 1)**

# 4. DESCRIPTION OF THE PROJECT

128. ADB has approved the financial assistance to the Government of the Republic of the Union of Myanmar (Myanmar) for its national rural roads and access program. The project aims to improve 152 km of rural roads in two regions and develop the technical bases and capacity for the program. The selected regions are Magway (36.4 km) and Ayeyarwady (115.6 km).

129. As an initial step ADB has been providing technical assistance (TA) to MOC's Department of Rural Road Development (DRD) to develop a strategy and program. The new strategy will consider how to increase financing, improve quality, and develop sustainable arrangements for management and maintenance. To focus investments, the strategy introduces the planning concept of the core rural road network (CRRN), which refers to the minimum network of rural roads connecting each village and key destination by a single road, which results from bottom-up planning.

130. As a second step, the project will finance rural road and access improvements prioritized on the basis of the CRRN in selected townships. The implementation of the project is aimed at improving implementation arrangements and the planning approach. At the same time, the technical trials for civil work is expected to develop national standards. In parallel, the project will build the government's capacity, to enable it to manage the national program, and absorb in the future larger scale foreign funding.

131. The project has three outputs:

132. **Output 1: Climate Resilient Roads Rehabilitated.** The proposed project will upgrade about 150 kilometer (km) of existing unsealed roads or tracks in Ayeyarwady and Magway Regions to paved standard. The road widths will be ranging about 2.6 meters (m) to 3.0 m, to avoid any potential resettlement impacts. To increase resilience, the roads will be raised above frequently-occurring flood levels, and considering future climate change impacts. Pavement surfacing will be cement concrete, or bituminous (macadam or double bituminous surface treatment [DBST]. Under this output, DRRD will recruit a Detailed Design and Implementation Supervision Project Management and Contract Supervision (DDIS) Consultant. An international consulting firm will be recruited to assist DRRD to design all roads, procure and supervise all civil works, monitor safeguards implementation, and support project management.

133. **Output 2: Rural Road Maintenance Management Improve.** The project will develop simple inventories of the rural road network starting from the project roads. The inventories will cover data on geographical location, length, cross section, historical maintenance records, future maintenance plans, budgetary requirements, evaluations etc., with respect to routine and periodic maintenance. The project will also help DRRD improve its delivery of emergency maintenance works. The project will support DRRD in developing suitable contracting modalities (e.g. term-based contracts) that allow procurement to take place before the disaster manifests itself, and that allow works to be initiated through a simple work order. The Project will also help DRRD assess the disaster vulnerability of the rural road network in the flood-prone Ayeyarwady Region, by creating or gathering disaster damage inventory, flood hazard maps, and climate change impacts, and integrating them in the CRRN database. Identification of the most disaster-prone road segments will help guide the selection of works and gradually improve the resilience of the network. Building from this information, the project will develop a pilot emergency management plan for DRRD in the Ayeyarwady Region. This will enable a quicker response to disasters for saving lives and livestock.

134. **Output 3: Rural Road Safety Improved.** Given the improved road conditions to paved standards it is highly likely the road users will be exposed to safety risks due to increased speeds of motorized vehicles. Also, traffic is expected to be increased as well. To mitigate these risks this output wll introduce a community-based road safety program. While essential road safety engineering elements will be included in the detailed design, given that majority of crashes are due to road user behavior, this proposed program will focus on road user education and enforcement.

135. The project will target 4 townships in the two selected regions. The selected regions for RRAP implementation are Magway and Ayeyarwady.

136. The location of the prioritized townships for RRAP are shown in the following figure:

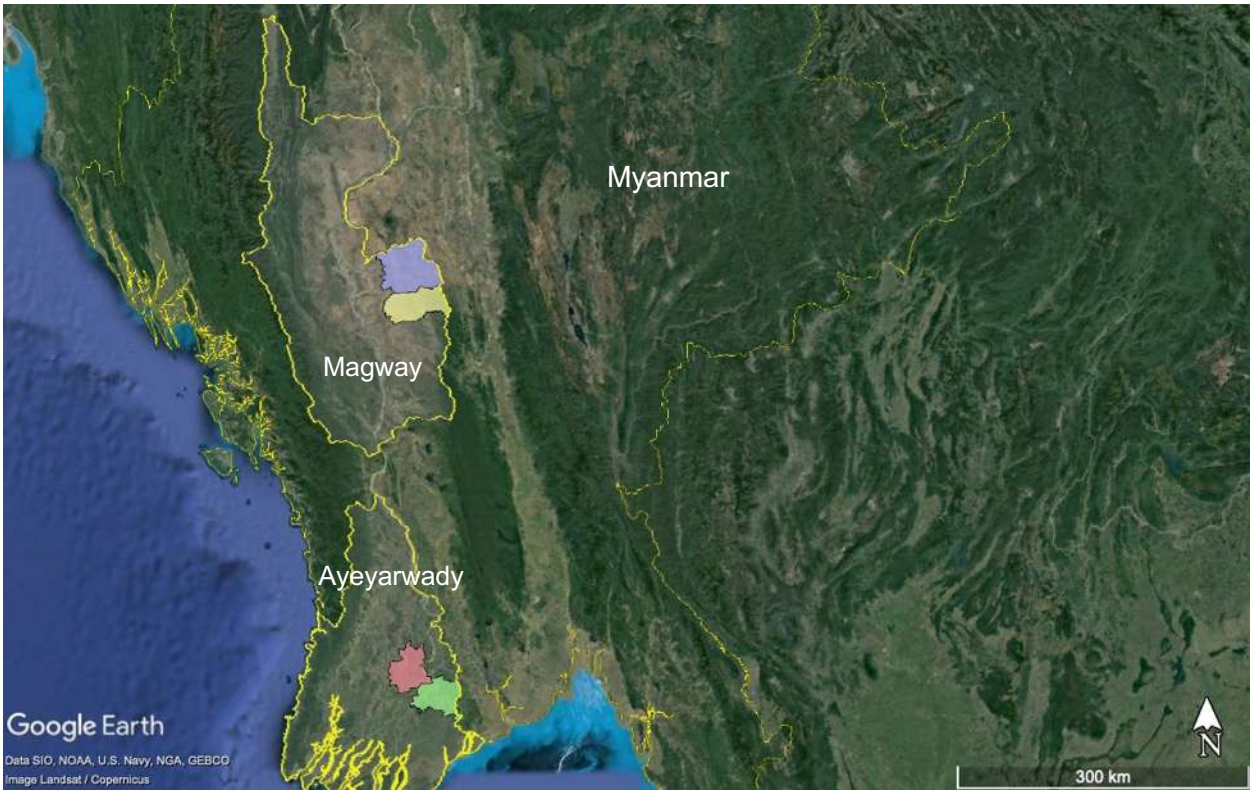


**Figure 2. Geographic location of the RRAP sub-project areas ( Ayeyarwady and Magway Regions)**

137. From the long list, a set of priority sub-project roads were selected from both Ayeyarwady and Magway Regions. This IEE covers the rural road rehabilitation/upgrade for Ayeyarwady Region only. The Magway Region component is assessed in a separate IEE.

## 4.1 The Ayeyarwady Sub-Project Roads

138. The townships of Ayeyarwady that are included in the RRAP are Pantanaw and Maubin. The upgrading of the prioritized sub-project roads and the corresponding lengths are listed in the following table.

**Table 8. Sub-project roads in Ayeyarwady Region**

| Townships | Road Package | Length in Km |
|---|---|---|
| Maubin | MBN 019 | 9.9 |
| Maubin | MBN 039 | 12.1 |
| Maubin | MBN 004 | 16.3 |
| Maubin | MBN 005 | 11.7 |
| Maubin | MBN 028 | 12.0 |

| | | |
|---|---|---|
| Pantanaw | PTN 008 | 10.0 |
| Pantanaw | PTN 011 | 10.0 |
| Pantanaw | PTN 031 | 4.6 |
| Pantanaw | PTN 005 | 10.3 |
| Pantanaw | PTN 012 | 4.6 |
| Pantanaw | PTN 019 | 14.1 |
| **Grand Total Ayeyarwady** | | **115.6** |

139. Geographic location of the sub-project roads in each township is shown the in the following maps (**Figure 3**). More detailed maps are presented in **Appendix 5.**

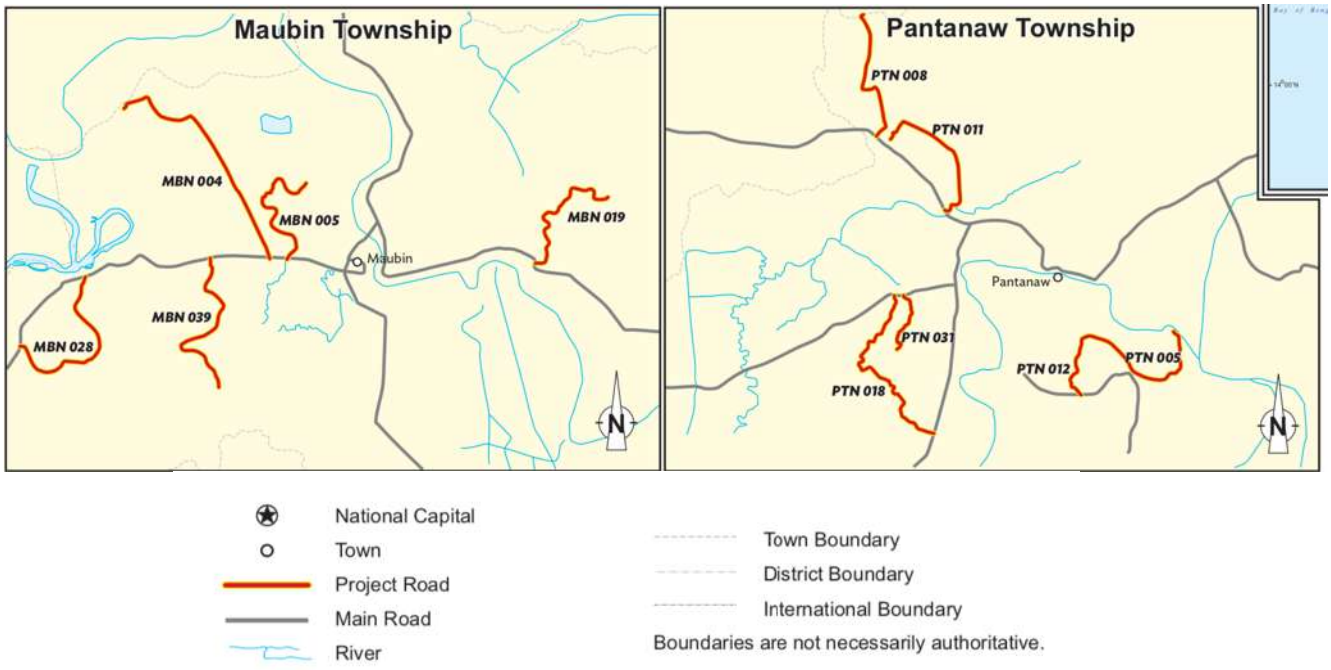


**Figure 3. Location map of sub-project roads in Pantanaw and Maubin Townships**

## 4.2 Rural Road Design

140. The project will upgrade the sub-project roads about 152 km of existing unsealed roads or tracks in Ayeyarwady Region to paved standard. The existing road width varies from 1.8 m as the minimum to 8.2 m, to avoid any potential resettlement impacts. For resiliency the roads elevations will be raised above the frequently occurring flood level and will consider future climate change impacts. Pavement surfacing will be cement concrete based on climate resilient design considerations, or bituminous (penetration macadam [PEN-MAC] or double bituminous surface treatment [DBST]

141. In consideration of the varying conditions of the sub-project roads, fourteen (14) specific typical

cross section types have been selected and these can be categorized according to pavement types and sites conditions as follows:

A. Pavement types to include:
   - Flexible pavements – DBST
   - Flexible pavements – Penmac
   - Rigid pavements – Concrete (non-reinforced)

B. Site conditions to include:
   - Cross Section Type 1 – for open field areas and flat terrain
   - Cross Section Type 2 – for open field areas and flat terrain including oxcart tracks
   - Cross Section Type 3 – for areas of limited spaces (village areas etc.)
     Cross section category Type 3 further differentiates sub-categories describing the various proposed road features for enabling the construction of the roads through these congested areas as follows:
     i. Masonry Side Drains (MSD)
     ii. Reinforced Concrete Side Drains (RCSD)
     iii. Retaining Walls (RW)

142. In some exceptional cases combination of two different typical cross section types will be used, for instance an oxcart track is to be built on one road side only or a limited space cross section is only required on one side of the road while on the other side a normal according to ordinary slope is possible.

Examples:

- Left: DBST Type 1 / Right: DBST Type 2
- Left: Penmac Type 2 / Right: Penmac Type 3 (RW)
- Left: Concrete Type 3 (RCSD) Right; Concrete Type 3 (RW)

(Note, combination refers to side drains and oxcart track only. A combination of different pavement types at same station is not possible).

143. The typical cross sections of the three types of surface pavements, i.e. penetrated macadam (penmac), DBST, and concrete cement is shown in the following figures. **Appendix 2** describes the different pavement types being considered.

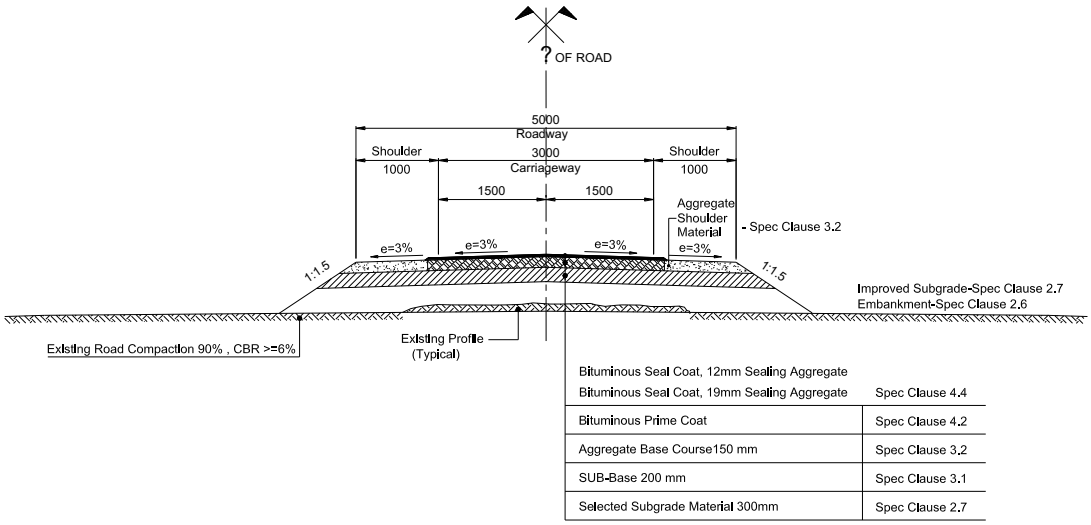


**Figure 4. Typical cross section Type 1 - DBST general section**

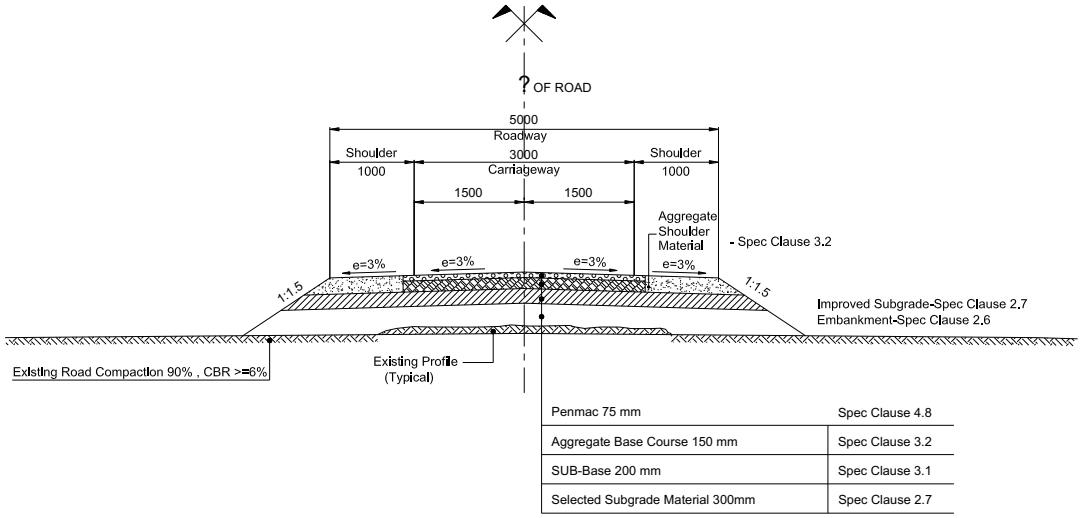


**Figure 5. Typical cross section Type 2 - PENMAC general section**

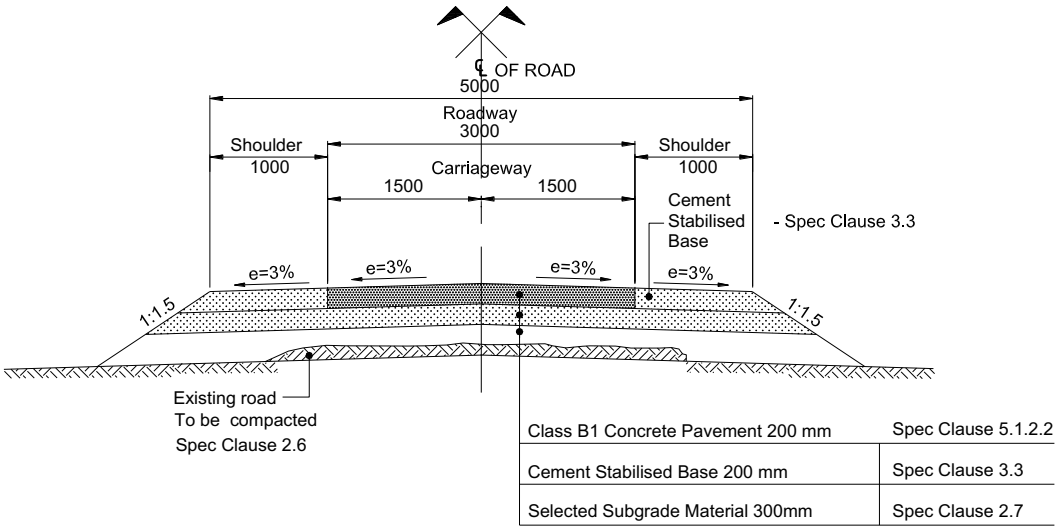


Figure 6**. Typical cross section Type 2 - Concrete general section**

## 4.3 Water Crossing (Bridges and Culverts)

144. Existing bridges will be replaced to meet the MOC's standard for one lane rural roads equivalent to AASHTO HS 20-44 (36-ton design load). The bridges will generally consist of reinforced concrete decks and substructures on bored concrete pile foundations where soils are weak, and on spread concrete footings where the ground is stronger. Spans will be typically 10-15 m. Details of exact bridge location, bridge works, etc will be available upon completion of the DED.

## 4.4 Safety Features

145. Road safety features to be provided will include (i) speed bumps either side of a village, and within a village if it is relatively long, accompanied by solar-powered flashing lights; (ii) signage at village entry points and where a road hazard exists, such as a sharp curve; (iii) guard rail at bridge approaches; and, where feasible, widened pavements to allow the safe passing of vehicles.

## 4.5 Construction Activities

146. It is important that the construction method is described as significance of impacts of road construction can vary according to the method. For instance, double bitumen surface treatment (DBST) and penetrated macadam (Penmac) types of paving will not require hot mix asphalt plant which reduces the road project's possible sources of adverse impacts. The use of rigid pavement, i.e. concrete cement pavement will require the setting up concrete batching plant which can be a source of moderate to high environmental impacts due to its fixed location and the presence of hazardous materials.

147. For RRAP, the contemplated construction methods for flexible pavement are DBST and PenMac. Manual construction, rather than mechanized, is common in Myanmar and will likely be adopted for RRAP. The general construction activities that will be undertaken are the following:

**Table 9. List of general activities during rural road construction**

| Construction Activities | Description of the Activities |
|---|---|
| Clearing of ROW | This is the initial activity prior to construction. This involves the removal of obstructions and |

| | |
|---|---|
| | possible trees and other vegetation within the ROW. |
| Excavation and removal of materials | Excavation along the road will be done to construct the drains as well as to remove materials where strengthening is necessary. The excavated soil will be used for embankment provided its quality is suitable for the purposes. Unsuitable materials will be used for landscaping or spread in an approved location. It may also be given free to residents who desires to elevate their yard for flood proofing. Excavator, or backhoe will be used. |
| Construction of embankment | This is necessary to raise elevation of the road in certain sections. This activity entails the hauling of materials from sections of the road where cut materials are suitable for use in the embankment; or from borrow pit. Hauling is by truck or boat; loading is with the use of a loader; unloading is by tipping; This is followed by compacting using road / vibratory rollers. |
| Laying of base course, sub-base | Entails the hauling materials from quarry or aggregate plant; material is unloaded at the site by tipping and spread by machine or by hand. This is followed by compacting using road rollers. |
| Paving | DBST entails several steps such as application of prime coat, spreading of aggregates on the road section, application of bitumen, which is done twice, thus the term double bitumen surface treatment. The paving may either be done manually or mechanically (e.g. use of truck mounted aggregate spreader, truck mounted bitumen sprayer).<br>Penmac is similar to DBST, except that bitumen treatment is only done once.<br>For concrete cement, the construction will require the installation of forms, pouring of the concrete mix and curing. Concrete mixing can either be done on site or delivered to site from a batching plant.<br>Unlike bitumen surfaces which are immediately usable, concrete cement pavement will require curing time. |
| Construction of culverts | Removal of existing structure; excavation according to the design; installation of form works (if cast in place); installation of rebars, concreting; removal of formworks; mixing of concrete cement on site. Alternatively, pre-cast culverts may also be used simplifying the process. |
| Bridge Construction | The construction of the bridge includes excavation of foundation and abutment, concreting works; casting and the construction of bridge approach; construction of bridge deck, railings |
| Bank Protection / River training structures | The project intends to use bioengineering for bank protection, i.e. use of wood or bamboo stakes and the planting of suitable plants to protect the bank from erosion. |
| Installation of road safety features | The installation of road safety features includes the installation of signs, road markings and guard rails. |

## 4.6 Sources of Construction Materials

148. The sources of earth fill materials have not been identified during the preliminary design stage. The contractor will have to identify and recommend borrow sites for earth fill materials. Aggregates in Ayeyarwady Region are primarily sourced from outside areas and shipped to or near the construction sites by river barges. In the absence of rock aggregates in Ayeyarwady, Contractors will have to identify outside sources either rock or river quarry.

149. A study reported that stone of various sizes is delivered from quarries in Mandalay, although there were no samples available for testing. River shingles are available locally and tests indicated that these are suitable for road construction. Rock materials are available in Pantanaw supplied from quarries in Na Pa Taw and Shwe Twintow townships, and these were found suitable for road construction. River sands available in both RRAP Townships were found to require blending with coarse sand to achieve suitable

gradation and fineness modulus.

150. A materials availability study conducted in Maubin Township with DRRD staff in December 2017 reported the following: The main items traded at the location are (i) sand, (ii) natural river aggregates, (iii) crushed aggregates and (iv) stones (used as raw material for producing road base MacAdam aggregates and stone masonry). These materials are all measured in the traditional unit called the “Sud” (1 Sud is a stack 10 feet x 10 feet x 1 foot = 100 cubic feet = approx 2.8 m3).

151. The trading place is located at the bank of Irrawaddy River and materials are shipped directly to Maubin in barges of various sizes. The river transport shipping distances depend on material type as follows:

- Sand is harvested locally from the river below Maubin Bridge approx. 5 km away.
- Stones and Crushed Aggregates originate from Myaungmya Township and are transported over a distance of 250 km

152. It is necessary that the Contractor shall only purchase materials from sources that have the necessary government permits, i.e. mining permit, business permit, environmental permit, among others. These permits shall be presented by the Contractor to the DDIS Consultant together with the materials testing results for approval.

## 4.7 Implementation Arrangements and Project Implementation Schedule

153. The Ministry of Construction (MOC) will be the executing agency (EA). The Department of Rural Road Development (DRRD) will be the implementing agency for the Project. DRRD will establish a project management unit (PMU) that will be responsible for the day-to-day management of the project. The PMU will be headed by a full-time project director of chief engineer level; and will comprise experienced professional accounting staff, including a finance officer (accountant), procurement officer, infrastructure officer (engineer), an environment specialist, and a social safeguard specialist. The PMU will be based in Nay Pyi Taw, with representation in the DDRD offices in Regional Divisions of DRRD (Ayeyarwaddy, Magway and Sagaing) and in the Project townships.

154. DRRD PMU will monitor the progress of implementation of EMP and verify the compliance with environmental measures and standards and progress toward intended outcomes; document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports; follow up on these actions to ensure progress toward the desired outcomes; disclose semi-annual monitoring reports locally; and submit semi-annual monitoring reports on safeguard measures as required by ECD/MONREC and as agreed with ADB.

155. The Regional DRRD will serve as the technical hub to provide engineering services, including basic design, cost estimation, construction support to townships, and supervision of civil works. Some of the supervision and monitoring responsibilities of the DDRD PMU can be delegated to the Regional DRRD if capacities are confirmed to be adequate.

156. MOC will contract a DDIS Consultant. An international consulting firm will be recruited to procure works contracts, supervise all civil works, monitor safeguards plan implementation, and support project management by DRRD. The DDIS Consultant’s role will include training of contractors in preparing contract-specific EMPs, applying modern construction techniques and ensuring compliance with EMP and EHS requirements.

157. Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) is the relevant authority to ensure that all subprojects comply with the national legal and regulatory framework for environmental safeguards. ECD has the responsibility for the administration on the environmental assessment process and its implementation per the Environmental Impact Assessment Procedure (2015). It is also responsible for safeguards supervision and compliance

monitoring during implementation.

158. ECD has regional offices in all regions, including in the regions targeted by the project. The regional level ECDs will be involved in the monitoring of the implementation of the environmental management plans for the project.

159. The Asian Development Bank (ADB) will monitor and supervise overall project implementation. ADB will conduct supervision missions with detailed review by ADB's safeguard specialists/officers or consultants; review the periodic monitoring reports submitted by the DRRD to ensure that adverse impacts and risks are mitigated as planned and that necessary corrective actions have been identified are being implemented and being monitored; work with the DRRD to rectify to the extent possible any failures to comply with their safeguard commitments, as covenanted in the legal agreements, and exercise remedies to re-establish compliance as appropriate; and prepare project completion reports that assess whether the objective and desired outcomes of the EMPs have been achieved, taking into account the baseline conditions and the results of monitoring.

160. The construction season in Ayeyarwady Region last from November to May (7 months). High rainfall during the period from June to October (5 months) allow only for limited levels of construction activities.

161. The project is expected to be approved in December 2019. Loan effectiveness is anticipated in February 2020, after which the project implementation period is six years. The project is expected to be physically completed by 28 February 2024. The loan closing date will be 31 December 2024. The project's overall project implementation is described in the table below.

**Table 10. Project Implementation Plan**

| MYA: Rural Roads and Access Ssector Project | Start Date | Duration (months) | End Date | 2019 Q1 | 2019 Q2 | 2019 Q3 | 2019 Q4 | 2020 Q1 | 2020 Q2 | 2020 Q3 | 2020 Q4 | 2021 Q1 | 2021 Q2 | 2021 Q3 | 2021 Q4 | 2022 Q1 | 2022 Q2 | 2022 Q3 | 2022 Q4 | 2023 Q1 | 2023 Q2 | 2023 Q3 | 2023 Q4 | 2024 Q1 | 2024 Q2 | 2024 Q3 | 2024 Q4 | 2025 Q1 | 2025 Q2 | 2025 Q3 | 2025 Q4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A. DMF** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Consultancy Services** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Approval of Submission for DDIS | 08-Jun-19 | 1 | 08-Jul-19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Advertising of PIC | 08-Jul-19 | 1 | 07-Aug-19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Preparation and approval of Submission 1 DDIS | 07-Aug-19 | 1 | 06-Sep-19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 RFP | 13-Sep-19 | 1 | 13-Oct-19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 Technical/financial evaluation and approval, negotiations and mobilization | 13-Oct-19 | 1.5 | 27-Nov-19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 Implementation of DDIS services | 10-Apr-20 | 60 | 15-Mar-25 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Output 1 - Rural Roads** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Detailed Engineering Design | 10-Apr-20 | 6 | 07-Oct-20 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Procurement | 07-Oct-20 | 6 | 05-Apr-21 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Civil Works | 05-Apr-21 | 36 | 20-Mar-24 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 Defect Notification Period | 20-Mar-24 | 12 | 15-Mar-25 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Output 1 - Preparation of other rural road subprojects** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Planning | 05-Apr-21 | 6 | 02-Oct-21 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 DED and safeguards preparation | 02-Oct-21 | 12 | 27-Sep-22 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Procurement | 27-Sep-22 | 6 | 26-Mar-23 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Output 2 - Road maintenance management** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Maintenance System Development and Capacity building activities | 10-Apr-20 | 48 | 20-Mar-24 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Output 3 - Rural road safety** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Program design | 07-Oct-20 | 6 | 05-Apr-21 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Program implementation | 05-Apr-21 | 48 | 15-Mar-25 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **B. Management Activities** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Procurement plan key activities to procure contract packages | 07-Oct-20 | 6 | 05-Apr-21 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Consultant selection procedures | 08-Jun-19 | 5.5 | 20-Nov-19 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Environment management plan key activities | 31-Mar-22 | 7 | 27-Sep-22 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 Gender action plan key activities | 27-Sep-22 | 6 | 26-Mar-23 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 Communication strategy key activities | 02-Oct-21 | 8 | 31-Mar-22 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 Annual and/or midterm review | 31-Mar-22 | 0.5 | 15-Apr-22 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 Project completion report | 15-Mar-25 | 3 | 13-Jun-25 | | | | | | | | | | | | | | | | | | | | | | | | | | |

DMF = design and monitoring framework, Q = quarter.
Source (s): Asian Development Bank

# 5. DESCRIPTION OF THE ENVIRONMENT

## 5.1 Regional Setting

162. The administrative region Ayeyarwady occupies the lower reaches of the Ayeyarwady River Basin. The basin is about 404,200 square kilometres in size with the headwater located in the northern region of Kachin State, extending southwards towards the delta and the Andaman Sea. The catchment is divided into 2 physiographic regions, the upper basin and the lower basin which includes the Ayeyarwady Delta (see Figure below).

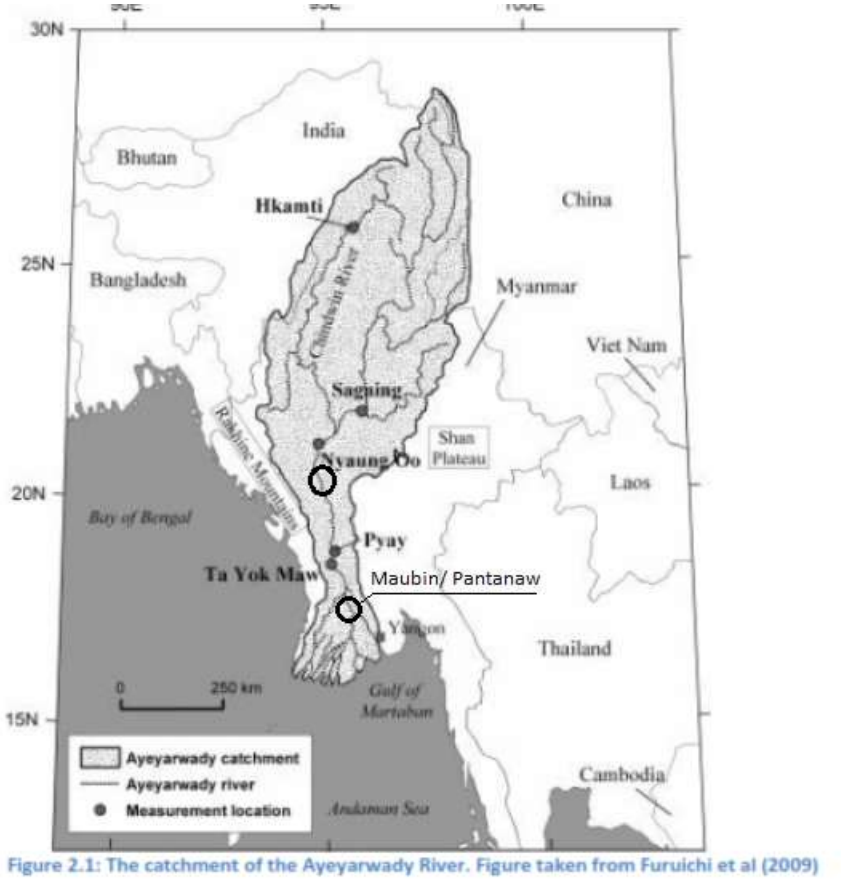


Figure 2.1: The catchment of the Ayeyarwady River. Figure taken from Furuichi et al (2009)

**Figure 7. Location of RRAP in Ayeyarwady basin (map from Furuichi et al 2009 cited in Hendriks 2016) [6]**

## 5.2 Climate

163. Myanmar experiences a tropical-monsoon climate with three dominant seasons, summer, rainy and winter season. As described by Htwe, M.W. (2015)[7] summer season prevails from end of February to beginning of May with highest temperatures during March and April. From November to end February is winter season with temperature in hilly areas of over 3000 feet dropping to below 32F (0°C) with average

[6] Hendriks, E. 2016. Development of a Delft3D model for the Ayeyarwady delta, Myanmar. Part II: Data acquisition and model validation. TU Delft and Deltares.

[7] Htwe, M.W. 2015. Country report on on the status of National Soil Resources in Myanmar, http://www.fao.org/fileadmin/user_upload/GSP/docs/asia_2015/Myanmar_WinMinHtwe_MYANMAR.pdf

temperature across the country of 10 to 18°C. The hot and winter seasons bring little rainfall.

164. The Southwest Monsoon (rainy season) prevails from mid-May to the end of October, the season when Myanmar receives most of its rainfall. The Southwest Monsoon (rainy season) according of Aung, L.L. (2017)[8] has 4 stages, the pre-monsoon (Mid April to start onset date), early monsoon (June), mid or peak monsoon (July, August), late monsoon (September to withdrawal date) and post monsoon (October, November). The Southwest monsoon sets in initially in lower Myanmar about the third week of May, extending gradually northwards and is usually established over the whole country by about the first week of June. The highest annual precipitation is observed in the Rakhine Coastal Region, followed by the Ayeyarwaddy Delta in the wet season. (Horton, R., De Mel, M., Peters, D., et al. 2015)[9] The Ayeyarwaddy Delta receives total monthly average of 2,772 mm as measured in Pathein, 2,392 in Yangon and 2261 mm in Tharrawaddy.[10]

## 5.3 Climate Trends

### *The Current Situation*

165. Two reports on analysis of the climate of Myanmar recently published, using different approaches, have consistently detected the increase in temperature based on 1960 to 2010 climate date but the studies by Horton et al. (2017) and Aung et al. (2017) differ on the analysis of the change in rainfall during the same period.

- Temperature

166. Both the studies of Horton et al. (2017) and Aung et al. (2017) have detected the increasing temperature all over Myanmar. The analyses of historical climate data of Myanmar by Horton et al. (2017) for the recent decades from 19 weather stations showed that the national average daily temperatures increased by about 0.25°C per decade during the period 1981-2010 and daily maximum temperatures have risen at a slightly faster rate of 0.4°C per decade over the same period which the authors said these rates are consistent with the global averages for the same time period (IPCC 2014).

167. The Horton et al. (2017) analysis likewise showed variation in temperature change between the coastal and inland areas for both average temperature and maximum temperature. The rate of temperature change is noted to be faster in the inland region at 0.35ºC per decade compared to 0.14ºC for coastal regions. This trend is said to be consistent with national trends of maximum temperatures rising slightly faster than daily average temperatures in both coastal and inland areas.

- Precipitation

168. The change in precipitation has also been detected in the country. The analysis of rainfall data indicated the following change in coastal region: (a) increase of 157mm (4.5%) per decade in annual total rainfall; (b) increase in precipitation during dry season is 85mm per decade or 17% per decade; (c) gain of 72mm per decade or 2.5% per decade during the rainy season of June-to-October monsoon months.

169. Within the inland region the change in rainfall is a more moderate at 37mm (2.5%) per decade in annual total rainfall. No notable change in rainfall during the dry season which suggests that the slight change is due to higher rainfall in the monsoon months. No significant change in number of rainy days is detected during the period 1981 to 2010 indicating the increase to be due to more intense rainfall events.

[8] Aung, L.L., Zin, E.E. Theingi, P. Elvera, N. Aung, P.P. Han, T.T. Oo, Y. and Skaland, R.G. 2017. Myanmar Climate Report https://www.met.no/...report/_/.../MyanmarClimateReportFINAL11Oct2017.pdf date accessed 06 Dec 2017

[9] Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2017). Assessing Climate Risk in Myanmar: Technical Report. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

[10] Kraas, F. Spohner, R. Myint, A.A. (2017). SOCIO-ECONOMIC ATLAS OF MYANMAR http://www.steiner-verlag.de/fileadmin/Dateien/Steiner/Presseblaetter/9783515116237_f.pdf

This trend of higher monsoonal rains globally is said to be mainly due to the increase in atmospheric moisture content (Christensen et al. 2014, cited in Horton et al. 2017).

*Climate Change Projections*

- Temperature

170. The change in average annual temperature in Myanmar according to Horton et al. (2017), is expected to rise over the coming century with varying magnitude of warming in the different regions of the country. It is projected that for the period 2011-2040 the annual average temperatures are projected to rise by 0.7-1.1°C compared with the 1980-2005 base period. The warming may accelerate beyond 2040, bringing the average temperatures higher by 1.3-2.7°C with some areas experiencing more warming. The cool season (November-February) and hot seasons (March-May) are most likely to warm at a similar rate to the annual average. The wet season temperature changes are projected to be smaller. By 2041-2070, wet season (June to October) mean temperatures are projected to increase by 1.1°C to 2.4°C, which is 0.3-0.5°C less than the projected warming during the remainder of the year. Regional differences in mean warming manifest after 2040; by 2041-2070 temperatures in inland areas are projected to warm 0.3-0.4°C more than coastal ones.

171. Uncertainty in these temperature projections increases into the future. The range of temperature projections presented (i.e., the difference between the high and low estimates) spans 0.3-0.4°C for 2011-2040, increasing to 1.0-1.5°C by 2041-2070. The uncertainty range is generally consistent across regions and seasons.

- Precipitation

172. Precipitation patterns across Myanmar are projected to change over the coming century. Despite the inherent uncertainty in predicting change in precipitation, the outcome of the models indicates that the current wet season months (June to October) will experience increased rainfall both in the near and long term relative to the 1980-2005 baseline. This will result to increase of the national average of wet season total precipitation beyond 2040 and will exacerbate wet season flooding in some regions.

173. But for the cool (November-February) and hot season (March-May) precipitation trends are uncertain, whether it will increase or decrease. By 2041-2070, precipitation projections during the hot season are more likely to increase than decrease, and the cold season is equally likely to decrease or increase.

## 5.4 Air Quality and Noise

174. No air quality data is currently available for the project roads in Maubin and Pantanaw. The only air quality data available is the air quality monitoring in the town of Maubin on December 2016 done for the the Maubin-Pyapon Road Project

**Table 11. Air quality data, Maubin Town, December 2016 (from baseline monitoring of Maubin Road Rehabilitation Project)**

| Sampling Location | TSPM µg/m³ | $Pm_{10}$ µg/m³ | $SO_2$ µg/m³ | $NO_2$ µg/m³ | CO µg/m³l | % Relative Humidity | Temperature °C |
|---|---|---|---|---|---|---|---|
| Maubin Town | 46.19 | 18.55 | 10.48 | 37.6 | 136.67 | 65.82 | 24.68 |
| *WHO Guidelines* | | *50 24 Hr* | *20 24 hr* | *200 1 hr* | | | |

175. As compared with the WHO guidelines (equivalent to Myanmar Environmental Quality Guidelines), the 2016 air quality data monitored in the town of Maubin shows very low concentrations of air pollutants.

This is taken as typical of rural areas where industrial sources of air pollutants are very few.

176. The location of the air quality monitoring station is shown in the following figure. For the purpose of monitoring the impacts of the project on air quality, a baseline air quality monitoring shall be carried out prior to construction by DRRD with the assistance of the DDIS Consultant.


**Figure 8. Air quality monitoring station, Maubin Road Rehabilitation Project.**

## 5.5 Sea Level Rise

177. As reported by Horton et al. (2017) the middle range[11] projections of sea level rise above the 2000-2004 base period level in Myanmar is projected at 5 t0 13 cm in the 2020s, 20 cm to 41 cm in the 2050s and by 2080s 37 cm to 83 cm, with 122 cm as the highest range of projection for this period. It is assumed that a 0.5 m sea-level rise would shift the shoreline along the Ayeyarwady delta by 10 km inland (NAPA, 2012).

## 5.6 Implication of the Projected Climate Change on the RRAP sub-project roads

178. The delta region is prone to impacts of climate change aggravated by the rising sea level. The delta constantly experiences flooding, and the 2008 flooding associated with Cyclone Nargis is considered to be the worse event recorded to date. The combined effects of sea level rise and increased rainfall intensity will increase the hazards of flooding in the delta. This risk has been recognized and as part of climate resiliency measures the sub-project roads will be elevated above the frequent flood levels whenever possible.

## 5.7 Topography and Soil

179. The sub-project area in Ayeyarwady Region is situated in the eastern side of the expansive Ayeyarwady delta. The Ayeyarwady Delta is the broad low-lying land (approx. 69,600 sq km) makes up the southern end of the Ayeyarwady Region. The delta covers the edge of the tidal area at Myan Aung to the Bay of Bengal and Andaman Sea, about 290 km to the south at the mouth of the Ayeyarwady River. Much of the delta is low lying merely 3 m above sea level. The highest point of the delta is Waphu Mount with an elevation of 404 m (1,325 ft). This topographic high lies between Pathein and Mawtin Zun (point), on the western strip of the delta. Confining the delta to the west is the Rakhine Yoma and to the east by the Bago Yoma. As typical of huge deltas, several distributaries of Ayeyarwady River divide the delta into islands and

[11] The middle range refers to the 25th to 75th percentile of model-based outcomes for sea level rise projects.

peninsulas. The main flowing distributaries of Ayeyarwady River are the Pathein River, Pyapon River, Bogale River, and Toe River. Several smaller distributaries are present as well.

180. Although the topography of the delta, particularly at the sub-project sites of Pantanaw and Maubin, is seemingly flat, the topography is punctuated by subtle topographic features. These features include levees, ponds, berms, associated with abandoned meanders. The abandoned meanders are easily identifiable because of arcuate form. These arcuate forms are accentuated arcuate ponds, arcuate vegetation patterns and in some areas by roads and settlements built on the elevated levees and berms.

181. The soil over the delta is described by Htwe (2015) as Fluvisols/ Gleysols. alluvial soil with silt developed from recent deposits of the river plains. It is relatively young and rich in plant nutrients and the soil is replenished during flood season. Because of these favourable factors, the delta is the leading rice producer of the country and has earned the distinction of being the granary of Myanmar.

## 5.8 Regional Tectonics and Geology

182. Myanmar is in a region where the geology and tectonics is dominated by the convergence of tectonic plates, mainly the Indian Plate, the Burma Plate and the Eurasian Plate. Three (3) types of crustal plate convergence are recognized in this geologic region such as; subducting (Indian plate being consumed beneath the Burma plate); obducting, (collision of Indian plate with the Eurasian plate causing the continued uplift of the Himalayas); and rifting as expressed by Sagaing Fault which absorbs the collision through its strike slip movement. This makes the north-south trending Sagaing Fault the most prominent geologic structure present in this region of the country. It runs from the Himalayan highlands at the northern territory of Myanmar to the south up to the Andaman Sea. This tectonic feature marks the boundary between the Indian and Sunda and has over the years, generated large earthquake events in this part of the country.

183. The lithology of the Ayeyarwady delta according to the 2014 Geology Map by the Myanmar Geosciences Society is made up of the very young geologic formation. The townships of Maubin, Pantanaw, Nyaundong and Kyaiklat are situated on this youngest geologic formation of Holocene unconsolidated sediments. This geologic formation generally contains layers of sandy soil and mud and clay (soft soil). This soil type has poor engineering quality that soil stabilization has to be undertaken in one of the road projects in Maubin-Pyapon. The generally geology of the Ayeyardwady basin is shown in the following figure.

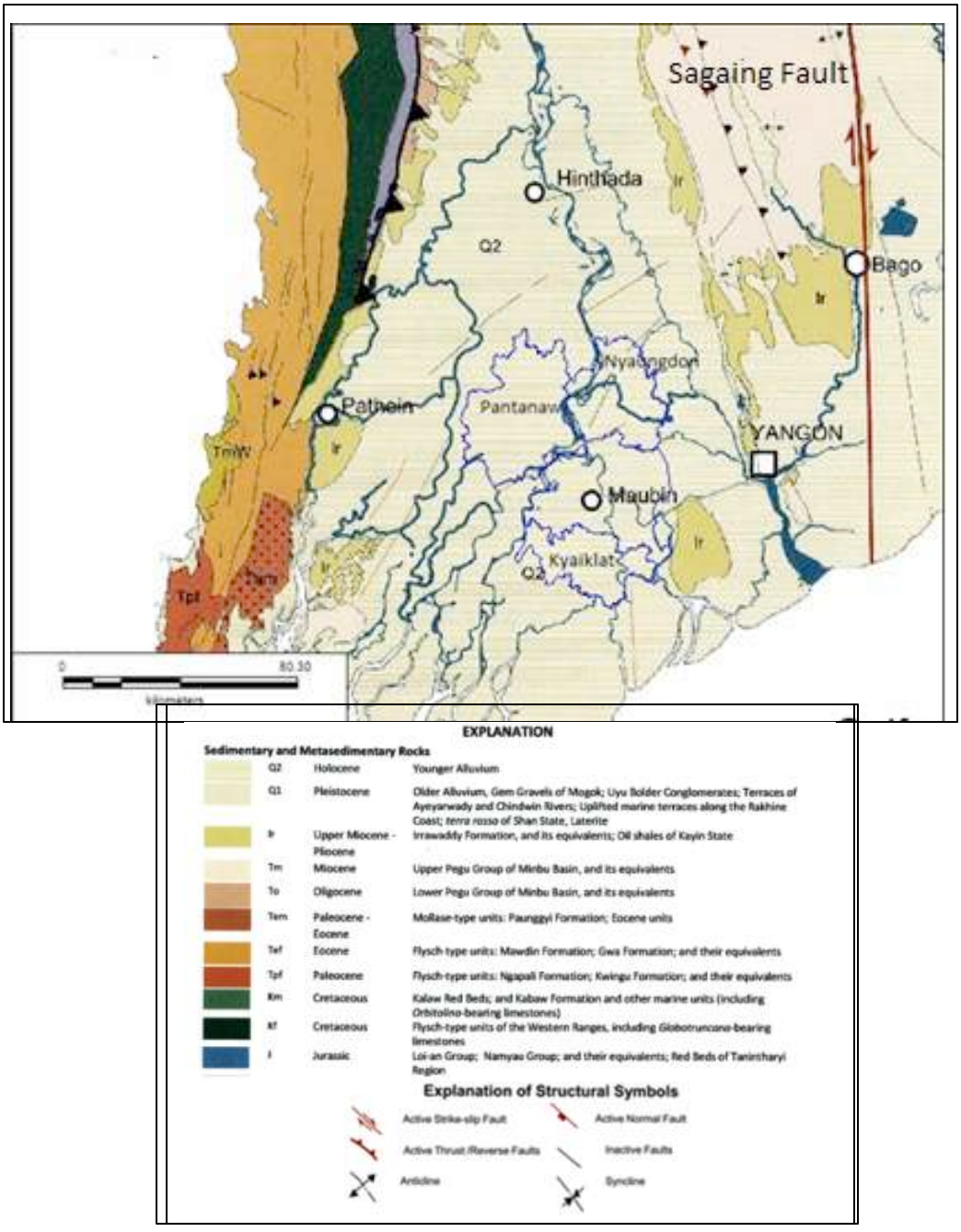


**Figure 9. Geology map (Excerpted from the 2014 Geology Map by the Myanmar Geosciences Society Water Resources**

## 5.9 Active Geologic Processes: Sedimentation of Ayeyarwady River

184. The Irrawaddy (Ayeyarwady) River of Myanmar is ranked globally as having the fifth-largest suspended load and the fourth highest total dissolved solid load. The estimated annual suspended

sediment load of Ayeyarwady River is placed at 364+ 60 MT[12]. But according to one study, despite the large sediment load delivered annually to the gulf by the Ayeyarwady and Thanlwin (Salween) Rivers, the coastline has been largely stable for 156 years, advancing at an average rate of no more than 0.34 km per century since 1925 with a cycle of accumulation and erosion occurring. But generally, the coastline according to Hedley et al., 2010 (cited in Delta Alliance, 2013) is in equilibrium, and that sediment deposition currently balances subsidence and sea level rise[13].

185. Within the corridors of the sub-project roads in Ayeyarwady, active erosion and sedimentation are taking place. The unprotected banks of rivers / canals are subject to erosion due to boat wakes. One such location is near the end of MBN019 (see following photograph).

**Figure 10. Bank erosion near the end of MBN019**

## 5.10 Water Resources

186. The main water resource of the Ayeyarwady Basin is the Ayeyarwady River. The river has a total length of 2,170 km encompassing a drainage area of 413,710 sq km, accounting for over 60% of the country's land area. From its headwater, the Ayeyarwady River occurs as a river with one main braided channel until Kyangin. Downstream of Kyangin, Ayeyarwady separates into a complex of distributary rivers namely: (a) Pathein/Ngawun; (b) Ywe; (c) Pyarmalot; (d) Ayeyarwdy; (e) Bogalay; (f) Pyapon; (g) Toe; and Yangon / Hlaing.

187. The flow of the river varies throughout the year between 2,300 $m^3$/s and 32,600 m3/s, the average being 13,000 m3/s with an annual average discharge of 410 $km^3$/year. The significant fluctuation in river flow is due to the strong variation in precipitation in addition to seasonal melting snow from the Himalayan slopes.

[12] R. A. J. Robinson, R.A.J. Bird, M.I. Nay Win Oo, T. B. Hoey, T.B. Maung Maung Aye, Higgitt, D.L. Lu X. X., Aung Swe, Tin Tun, and Swe Lhaing Wino. 2007. The Irrawaddy River Sediment Flux to the Indian Ocean: The Original Nineteenth-Century Data Revisited. [The Journal of Geology, 2007, volume 115, p. 629–640] 2007 by The University of Chicago
https://www.researchgate.net/publication/40702559_The_Irrawaddy_River_Sediment_Flux_to_the_Indian_Ocean_The_Original_Nineteenth-Century_Data_Revisited

[13] Delta Alliance, 2013. Vulnerability and Resilience Assessment Ayeyarwady Delta, Myanmar Scoping Phase , GWP / BOBLME Project http://www.delta-alliance.org/gfx_content/documents/documentation/Ayeyarwady%20Delta%20Final%20Report%20def%20submitted%20web%20version.pdf

188. A decrease in the annual discharge of the Ayeyarwady River over the last 100 years based on a statistical comparison with data collected in the 19th century has been reported by Furuichi et al. (2009). However, the causes remain unclear (Taft and Evers, 2016).[14]

189. Seasonal ponds occur widely in the delta. These ponds fill with water during the rainy season and cultivated during the dry season. Other wetland areas have been permanently converted to fishponds.

190. Groundwater is also present in the delta. The Holocene sediments allow the occurrence of shallow water table in the delta region. The groundwater is tapped by dug wells and tube wells. However, poor quality of groundwater in some areas limits its use as domestic water supply. In addition, the presence of arsenic in groundwater is reported in certain parts of the delta. In some parts of the project area in Maubin, groundwater is present under confined condition as indicated by the presence of free-flowing springs.

191. In the absence of a water supply system, the households use both surface and groundwater for domestic use.

*Surface Water Quality – Ayeyarwady River*

192. The lower reaches of the Ayeyarwady river was monitored in eight stations from 2008 to 2011. The monitoring data reported by Khon Ra (2011)[15] showed distinct seasonal and spatial variation in water quality. Water quality monitoring was done in 8 stations from the lower part of the basin down to the delta. The monitoring covered the dry and wet season with sampling done in March and September, respectively. The following map shows the location of the monitoring stations. The results of the water quality monitoring is presented in the following matrix.

[14] Taft, L. and Evers, M. 2016. A review of current and possible future human–water dynamics in Myanmar's river basinsHydrol. Earth Syst. Sci., 20, 4913–4928, 2016 www.hydrol-earth-syst-sci.net/20/4913/2016/

[15] Khon Ra, 2011. Water Quality Management at River Basin in Myanmar. Hydrology Branch Irrigation Department. Ministry of Agriculture and Irrigation


**Figure 11. Location of the Ayeyarwady sub-project areas within the Ayeyarwady catchment**

**Table 12. Dry season water quality monitoring**

| | MARCH | 2008 | | | 2009 | | | 2010 | | | 2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sta No | Sta Name | pH | EC µmhos/cm | Total Hardness ppm | pH | EC µmhos/cm | Total Hardness ppm | pH | EC µmhos/cm | Total Hardness ppm | pH | EC µmhos/cm | Total Hardness ppm |
| 1 | Myitkyina | 7.1 | 121 | 52 | 7.2 | 125 | 90 | 7.3 | 97 | 97 | 7.33 | 134 | 94 |
| 2 | Mandalay | 8.2 | 136 | 48 | 8.3 | 104 | 80 | 8.21 | 117 | 117 | 7.89 | 107 | 108 |
| 3 | Pakokku | 6.87 | 150 | 91.5 | 6.9 | 155 | 100.5 | | | | 7.25 | 160 | 144 |
| 4 | Magwe | 6.95 | 470 | 111 | 6.9 | 199 | 120 | 6.95 | 195 | 195 | 7.5 | 200 | 135 |
| 5 | Pyay | 7.5 | 199 | 96 | 7.57 | 200 | 124 | 7.75 | 165 | 165 | 7.65 | 205 | 132 |
| 6 | Henzada | 6.87 | 189 | 113.5 | 7.38 | 237 | 112 | 7.65 | 191 | 191 | 6.99 | 156 | 107 |
| 7 | Danubyu | 7.18 | 221 | 106 | 7.17 | 210 | 94 | 7.15 | 200 | 200 | 7.16 | 200 | 88 |
| 8 | Dedaye | 7.45 | 270 | 96 | 7.47 | 257 | 92.5 | 7.5 | 258 | 258 | 7.5 | 259 | 93 |

**Table 13. Wet season water quality monitoring**

| SEPTEMBER | | 2008 | | | 2009 | | | 2010 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sta No | Sta Name | pH | EC µmhos/cm | Total Hardness ppm | pH | EC µmhos/cm | Total Hardness ppm | pH | EC µmhos/cm | Total Hardness ppm |
| 1 | Myitkyina | 6.95 | 90 | 58 | 6.99 | 75 | 48.5 | 6.98 | 100 | 67 |
| 2 | Mandalay | 8.01 | 89.5 | 71 | 7.95 | 125 | 70 | 8.11 | 100 | 73 |
| 3 | Pakokku | 6.95 | 142 | 102 | | | | 7.24 | 150 | 114 |
| 4 | Magwe | 6.95 | 249 | 99.5 | 7.02 | 94 | 94 | 7.01 | 250 | 102 |
| 5 | Pyay | 6.32 | 133 | 64 | 7.67 | 48.5 | 48.5 | 7.49 | 100 | 56 |
| 6 | Henzada | 6.92 | 179 | 70 | 7.62 | 100 | 52 | 7.87 | 62 | 60 |
| 7 | Danubyu | 6.76 | 130 | 52 | 7.2 | 100 | 43 | 7.5 | 70 | 85 |
| 8 | Dedaye | 7.37 | 150 | 61 | 7.35 | 150 | 60 | 7.4 | 160 | 38 |

193. The pH values showed little seasonal variation. The average of pH values obtained from 8 stations during the dry season sampling (2008 to 2011) is 7.4 and 7.3 during the wet season sampling from 2008 to 2010. But in terms of spatial variation, the highly basic characteristic of water sample from Mandalay is very noticeable and is noted to be consistent for all the sampling episodes, wet and dry seasons. The rest of the stations showed pH values that range from slightly basic to slightly acidic. The spatial trend showed identical trends for both wet and dry except for Pyay and Henzada (Hinthada) stations.

194. The electrical conductivity values obtained from the 8 stations showed distinct temporal and spatial variation (see **Figure 12**). The dry season graph of the conductivity showed a generally increasing trend from headwater to the delta region. This is expected due to the influence of the saltwater wedge which migrates farther inland during the dry season. The same trend is mirrored during wet season except for lower values. Interestingly, both trends show an increase in conductivity in Pakokku and Magway.

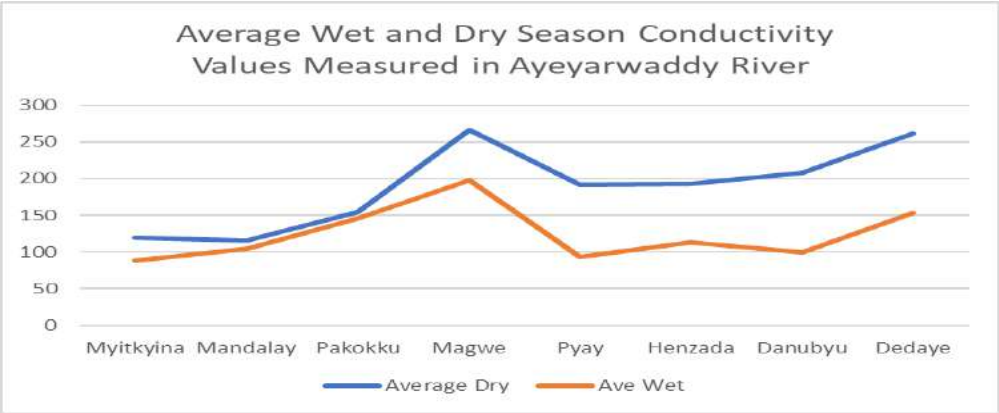


**Figure 12. Wet and dry season conductivity measurements, Ayeyarwady River**

195. The average total hardness also shows a distinct spatial pattern with the shift in pattern occurring at Magwe (see **Figure 13**). During the dry season sampling, the average total hardness rises from Myitkyina until Pakokku and Magway and remains elevated to the delta. But during the wet season, the value rises till Pakokku and Magway and then declines at about Pyay and stayed depressed up to the delta (Dedaye sampling station).

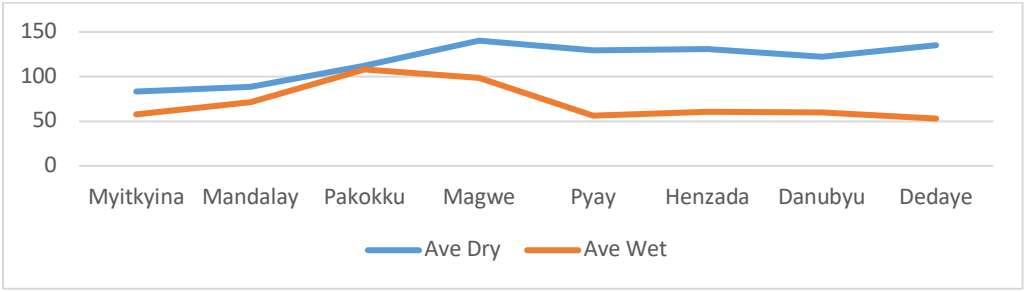


**Figure 13. Average total hardness for wet and dry season**

196. The distinct spatial variation of high conductivity and hardness in the area of Pakokku and Magway is likely due to the presence of mineralized thermal springs that drain into Ayeyarwady River.

197. Another study (Bowles, 2013)[16] reported the presence of arsenic and cyanide in the middle reaches (Sit Ku and Mandalay) of Ayeyarwady River. Seasonally, arsenic levels vary from 30 ppb n in summer months and 10 10 ppb in the rainy season. Downstream in Pyay, Hinthada, and Nyaung Done, arsenic concentrations vary from10 ppb during the summer and disappears during the rainy season. Cyanide levels in the study area, attributed to mining activities are said to occur in serious levels in SintKu, Mandalay, and Nyaung Done throughout the study period. The concentration of cyanide reaches 0.14 mg/l during dry season far exceeding the WHO maximum acceptable level 0.07 mg/L.

### *Water Quality – Pyapon River*

198. Very limited water quality data is available for the project corridors in Maubin. The only available water quality available is the baseline water quality data obtained in November 2016 for another ADB

[16] Bowles, J. 2013. The Irrawaday River Research https://www.researchgate.net/profile/Josiah_Bowles/publication/258045519_Irrawaddy_River_Research/links/59732920aca2728d02483e2b/Irrawaddy-River-Research.pdf Date Accessed 21 Oct 2018

supported project, the Maubin-Pyapon Road Rehabilitation Project. The water quality monitoring stations are irrigation channels and small streams connected to Pyapon River. Pyapon River is one of the distributaries of Ayeyarwady River. The results of the analysis are summarized in the following table and the sampling locations are shown in Figure 15.

**Table 14. Surface Water Quality Data, Maubin-Pyapon Road Project, November 2016**

| Sampling Locations | Fecal Col CFU/100ml | Total Col CFU/100ml | pH | BOD mg/l | DO mg/l | SS mg/l | Oil and Grease mg/l |
|---|---|---|---|---|---|---|---|
| 1 | 20 | 32 | 7.4 | 22 | 5.6 | 126 | 4 |
| 2 | 45 | 63 | 6.7 | 10 | 5.6 | 23 | 2 |
| 3 | 30 | 52 | 6.4 | 10 | 5.4 | 44 | 1.1 |
| 4 | 48 | 62 | 6.7 | 12 | 6.6 | 37 | 3.6 |
| 5 | 30 | 42 | 6.5 | 12 | 5.6 | 52 | 1.2 |
| 6 | 36 | 60 | 6.9 | 20 | 6.8 | 92 | 4.1 |

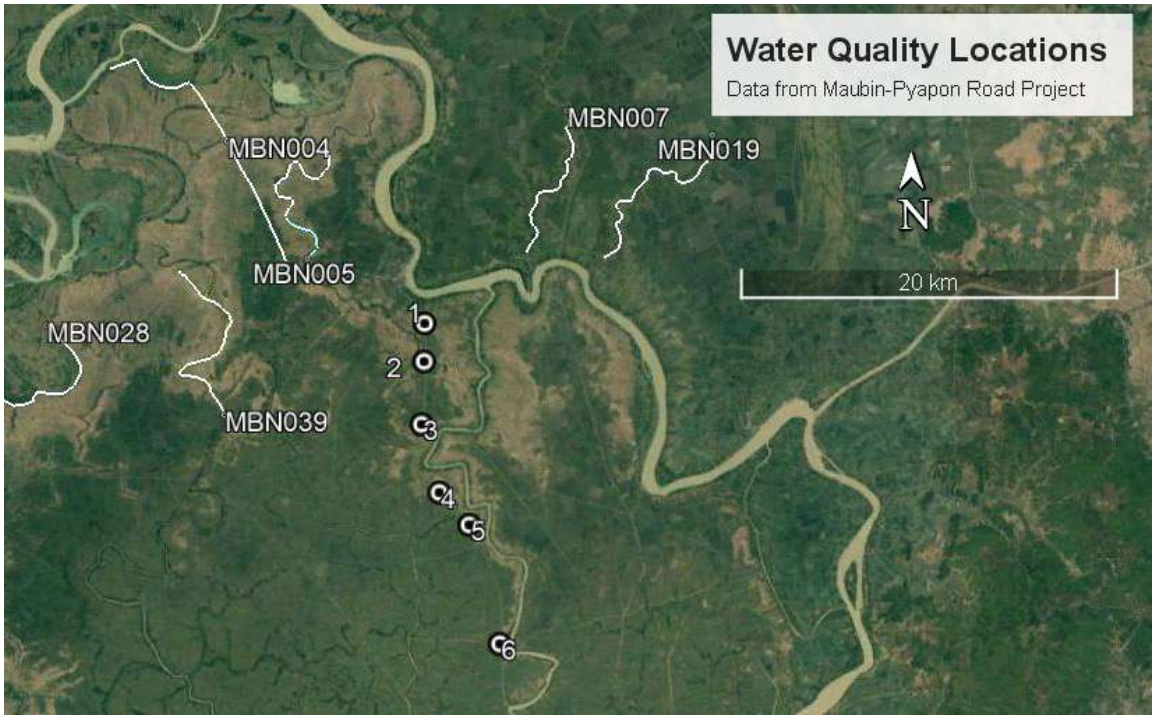


**Figure 14. Surface water quality sampling locations**

199. For purposes of monitoring project impacts on environmental quality, baseline monitoring for surface water quality within the sub-project corridors shall be done by DRRD with the assistance of the DDIS Consultant prior to construction works.

## 5.11 Ecological Condition

### *Vegetation Cover*

200. Forest cover in Ayeyarwady has been decimated. It is reported that only patches of regrowth wooded areas are scattered within the townships. As shown in the following vegetation map, the sub-project

areas in Ayeyarwady are now dominated by cultivated land (indicated as Other Lands in the following map).

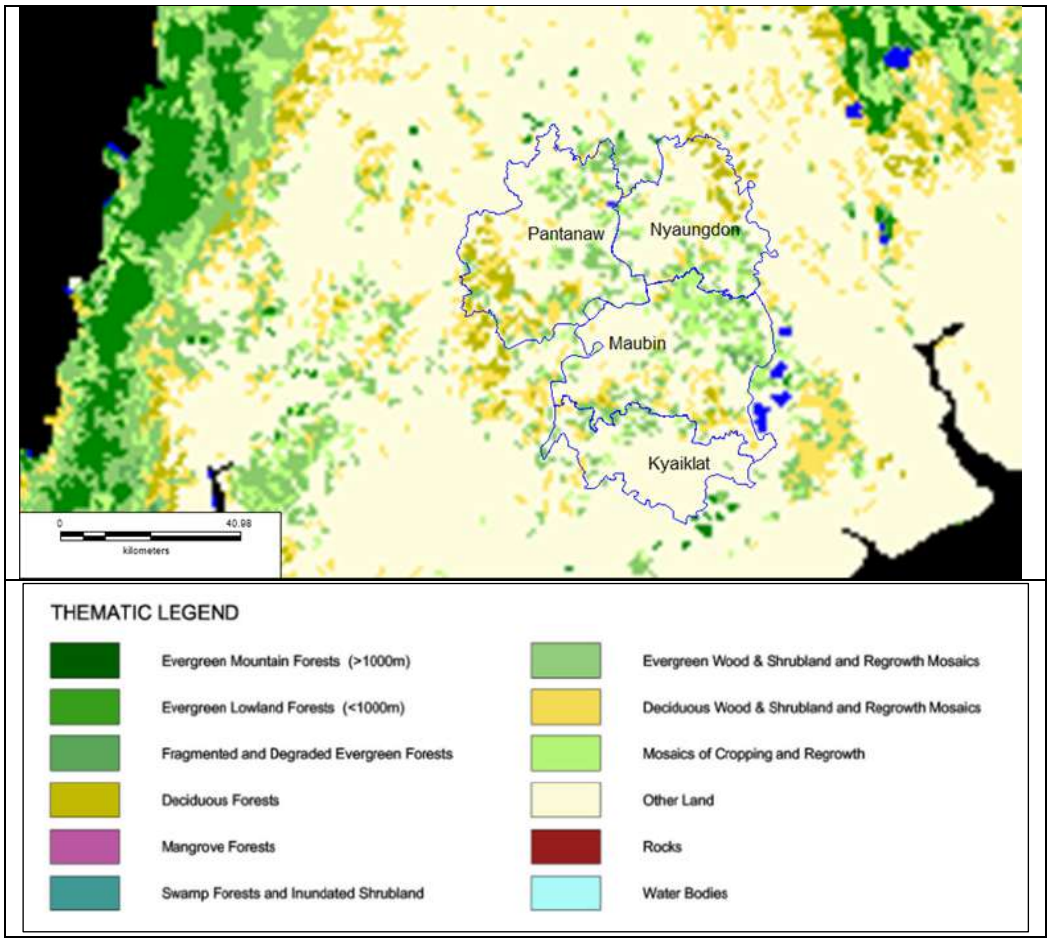


**Figure 15. Vegetation cover map**

201. Within the sub-project area, the wooded areas are associated with existing settlements. Trees and vegetations that make up the wooded areas include fruit bearing and ornamental plants It includes Bamboo groves, Coconut Palm, Toddy Palm, Rain Tree (*Samanea sp*), Teak (*Tectona grandis*), Padauk (*Pterocarpus macrocarpus*), *Casia Siamea*, Golden Shower (*Casia Fistula)*, Tamarind (*Tamarindus indica*), Mango (*Mangifera indica*) Terminalia sp, *Delonix regia*, reforestation species like Long Leaf Acacia, Gmelina and Eucalyptus are also present along the road corridors.

### *Anthropogenic Land Uses*

202. Settlements and agriculture are the dominant anthropogenic land uses in the delta region. The village settlements are generally spread out in areas where land space is available. However, in areas where land is limited as confined by water bodies, the settlements are in linear pattern, following the road or canal. The delta region, including the sub-project corridors are intensely cultivated with rice as the major crop. Aquaculture is also widely practiced, mostly freshwater ponds.

203. Institutional land use, i.e pagodas, monastery, schools are interspersed within the settlements.

## 5.12 Wildlife Fauna

204. The Avibase-Worldwide Checklist of Birds[17] reported that within the lower Ayeyarwady (see following map) there are 471 species of birds, 19 of these are globally threatened and one introduced species.

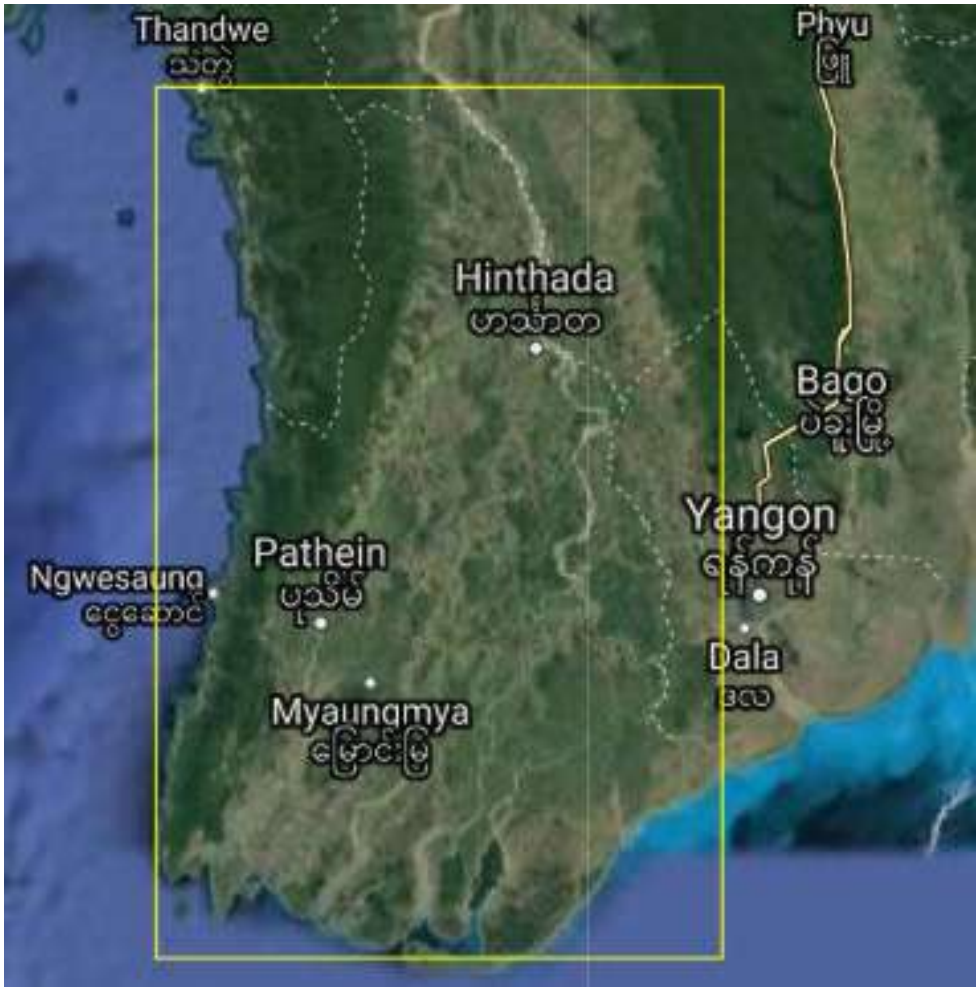


**Figure 16. Region in Ayeyarwady covered by the AviBase data**

205. Among the common birds encountered in the sub-project areas in Maubin and Pantanaw are Common Myna, House Crows, Sparrow, Scaly Breasted Munia, Grey Heron, Great Egret, Black Drongo (*Dicrurus macrocercus*), Bulbul, Whistling Duck (Dendrocygna sp), Weaver Bird, Oriental Magpie (*Copsychus saularis*), common Kingfisher (*Alcedo atthis*), Spotted Dove (*Streptopelia chinensis*), Little Cormorant and Shrikes.

[17] http://avibase.bsc-eoc.org/checklist.jsp?region=MMay&list=howardmoore


**Figure 17. Some of the common birds in Maubin (photos by Consultant)**

## 5.13 Aquatic Fauna

206. Fishbase[18] reported that there are 44 fish species in Ayarwady River, belonging to 11 families with Cyprinidae having the most number of species. 42 are classified as native species with 2 classified as endemic. Aquaculture fish species common reared in the delta are rohu catla and mrigal (belong to the carp family). The non-carp include pangasius, tilapia and pacu[19].

[18] https://fish.mongabay.com/data/ecosystems/Ap.htm

[19] https://www.researchgate.net/publication/318144403_AQUACULTURE_IN_MYANMAR_FISH_FARM_TECHNOLOGY_PRODUCTION_ECONOMICS_AND_MANAGEMENT

## 5.14 Protected Areas and Key Biodiversity Areas

207. There is no reserved forest in Maubin and Pantanaw according to the township assessment, and protected areas are distant from the sub-project areas (**Figure 18**).


**Figure 18. Map showing location of the protected areas and the RRAP townships**

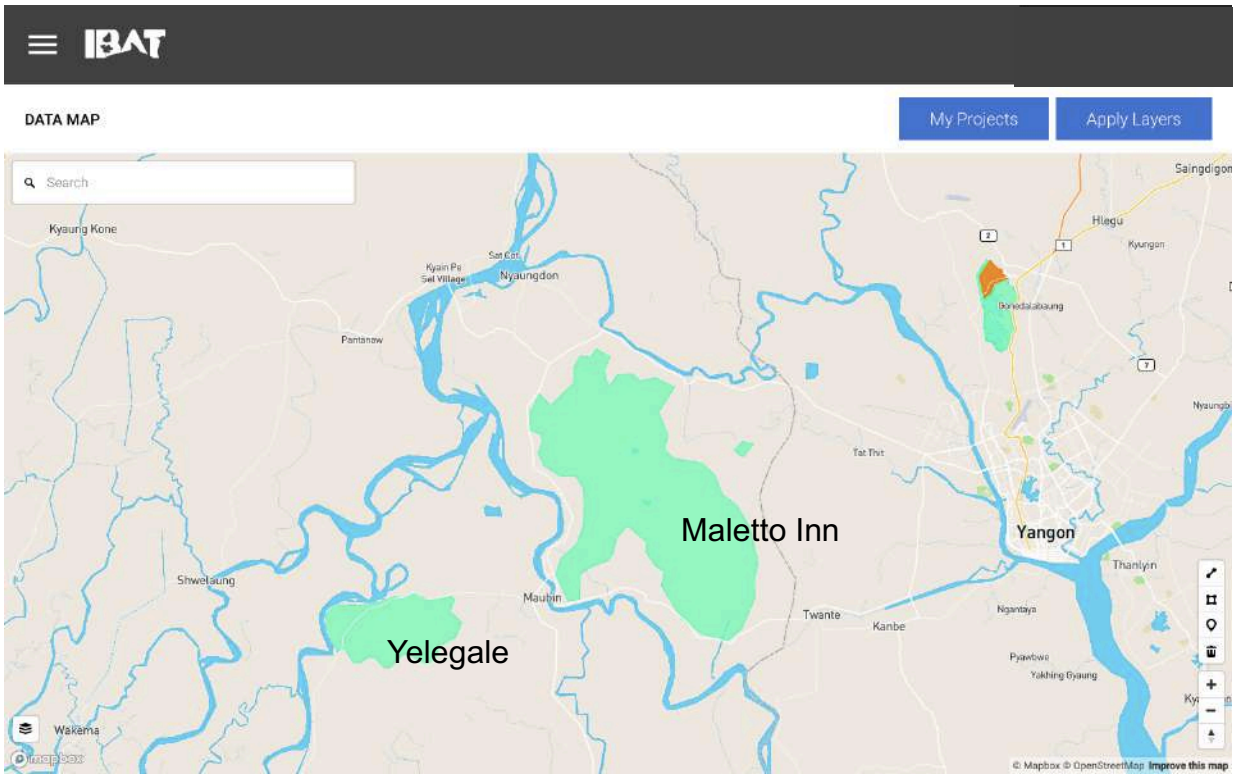


**Figure 19. Key Biodiversity Areas in Maubin Township**

208. **Key Biodiversity Areas.** The Integrated Biodiversity Assessment Tool (IBAT)[20] was used to determine the proximity of the subprojects to protected areas and key biodiversity areas. The screening identified two KBAs in the Maubin Township; Maletto Inn and Yelegale (**Figure 20**). Subproject road MBN 028 is near to the Yelegale KBA but will not encroach on the KBA. Subproject road MBN 019 is aligned near but outside the boundary of the Maletto Inn KBA for most of its length. The final two or three km, which provide access to fishponds, are within the boundary of the KBA (**Figure 20**). .

209. The Maletto Inn KBA was proposed in 2012 with an area of about 359 sq km[21]. The Maletto Inn KBA is an aquatic ecosystem that is habitat for Sarus Crane, Yellow-breasted Bunting and Congregatory waterbirds. In the absence of a detailed delineation of the KBA, its boundary and possible extent was interpreted from the Maubin Township Map, published by MIMU (Map ID MIMU154v04) and the December 1984 Google Earth imagery. The delineated area is about 410 sq km which roughly approximates the proposed area of 395 sq km. The sweeping transformation of the Maletto wetland over a period of 3 decades is documented by the temporal imageries published by Google Earth and the change is shown in Figure 22.

210. It can be discerned from Figure 22 that the entire wetland has been converted into aquaculture ponds. As interpreted from the series of temporal Google Earth imageries from 1984 to 2017, the transformation of the wetland seemed to have been a combination of natural and anthropogenic activities. The natural shallowing and colonization by vegetations of the ponds and lakes at the northern part of the wetland from 1990 to 2000 seemed to have abetted the development. The pond development commenced early 2000 and proceeded until most of the wetland has been developed. The wetland is now fully developed into aquaculture ponds and rice paddies.

211. No recent assessment of its importance as a KBA is available but its omission in the Birdlife International's 2018[22] fact sheet of the Ayeyarwady Delta maybe an indication of the diminished importance of the area as a wildlife habitat. Given the highly developed and altered status of the wetland, the threat of encroachment due to the upgrading of the rural road MBN 007 and MBN 019 is considered very low.

[20] The Integrated Biodiversity Assessment Tool (**IBAT**) is a multi-institutional program involving BirdLife International, Conservation International, IUCN and UNEP-WCMC. **IBAT** provides a basic risk screening on biodiversity.

[21] https://myanmarbiodiversity.org/wp-content/uploads/2015/04/Myanmar-Key-Biodiversity-Areas.xlsx

[22] BirdLife International (2018) Important Bird Areas factsheet: Ayeyarwady Delta (including Meinmahla Kyun). Downloaded from http://www.birdlife.org on 20/10/2018.

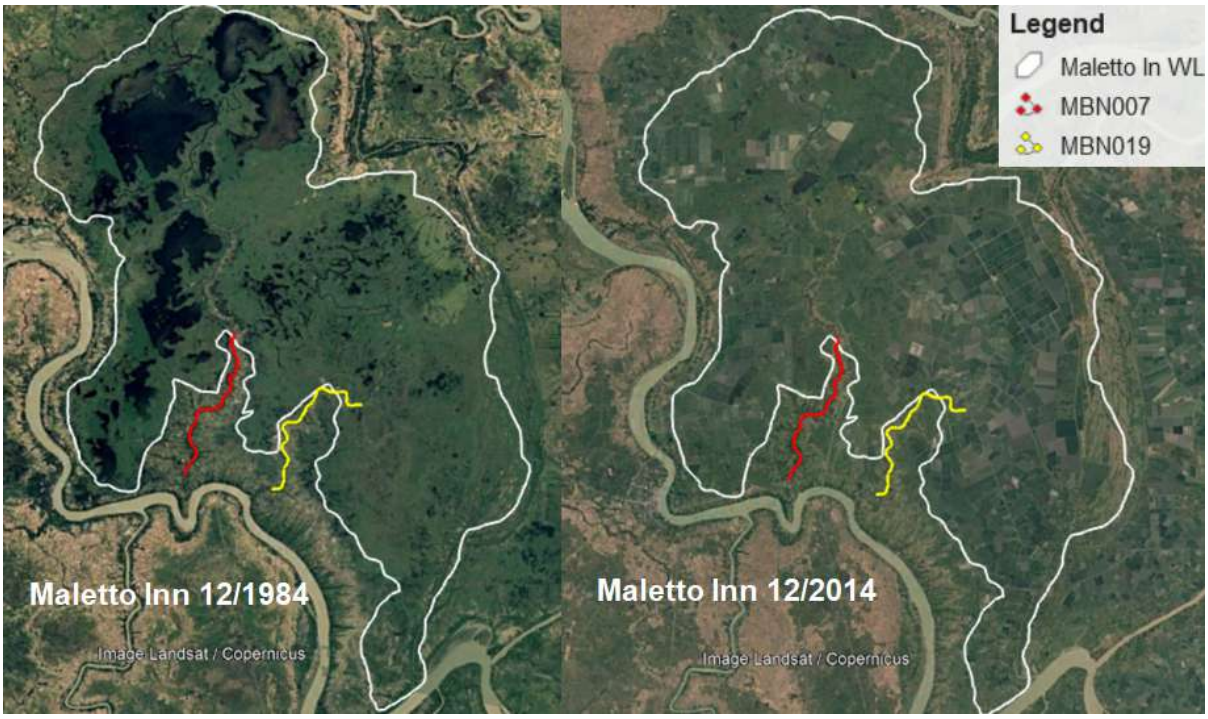


**Figure 20. The Maletto Inn KBA's evolution from 1984 to 2014.**

212. Another KBA, an important bird area (IBA) has been identified by Birdlife International in the coastal part of the delta (see following figure). This site is located at the estuarine which is more than 5 km south of Maubin and the sub-project roads.


**Figure 21. Important bird area in Ayeyarwady Delta[23]**

[23] BirdLife International (2017) Important Bird Areas factsheet: Ayeyarwady Delta (including Meinmahla Kyun). Downloaded from http://www.birdlife.org on 28/11/2017.

213. The Ayeyarwady River is the known habitat of Irrawady Dolphin (*Orocaella brevirostris*) but the species only inhabit the upper reaches of the river from Mingun near Mandalay north to Kyauk Myaung spanning 74 kilometers. The Irrawady dolphins are not known to thrive in the estuary.

## 5.15 Overview of Natural Hazards Prevailing in the sub-project Areas

### *Earthquake Related Hazards*

214. The sub-project areas are located in a tectonically active region where active convergence of 3 tectonic plates mainly the Indian Plate, the Burma Plate and the Eurasian Plate, is taking place. Three (3) types of crustal plate convergence are present in this region such as; subducting (Indian plate being consumed beneath the Burma plate); obducting, (collision of Indian plate with the Eurasian plate causing the continued uplift of the Himalayas); and rifting (Sagaing Fault) which absorbs the collision through its strike slip movement (see **Figure 22**).

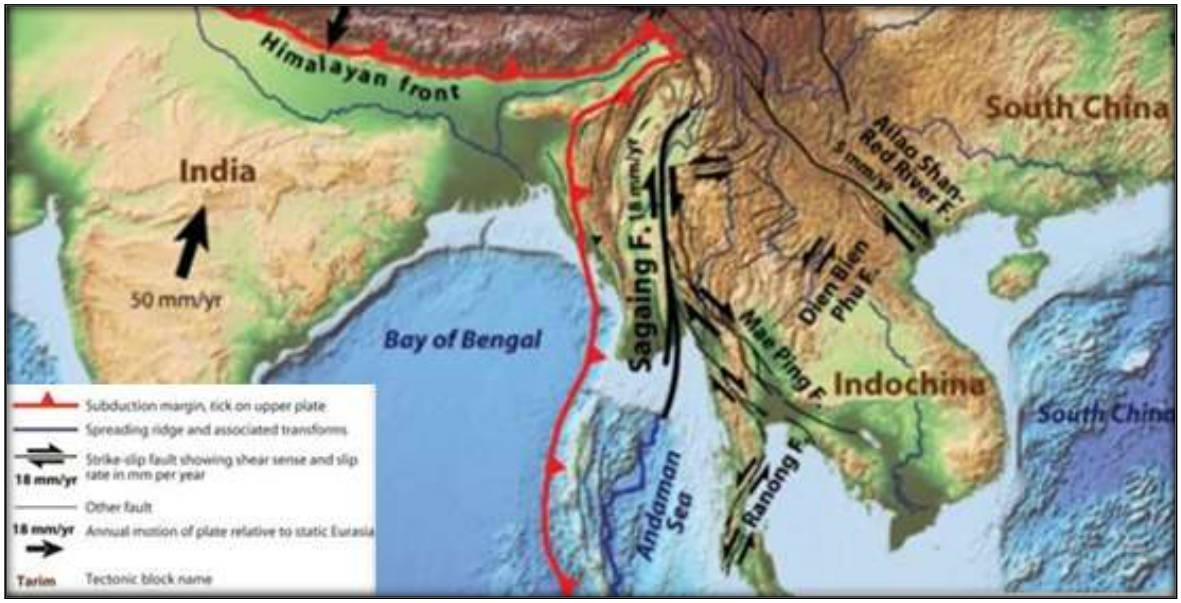


**Figure 22. Regional tectonic map**

215. The rifting along the Sagaing Fault has generated large earthquakes. Due to its susceptibility to earthquake hazards a seismic analysis was done. The analysis zoned the country into 5 earthquake hazard zones, Zones 1 to 5, with Zone 5 having the probability of experiencing earthquakes that can generate ground acceleration of 0.4g to 0.5 g with equivalent modified Mercalli scale of IX (the highest). The RRAP sub-project areas in Ayeyarwady are located in a Moderate Zone (probability of 0.1g to 0.15g).

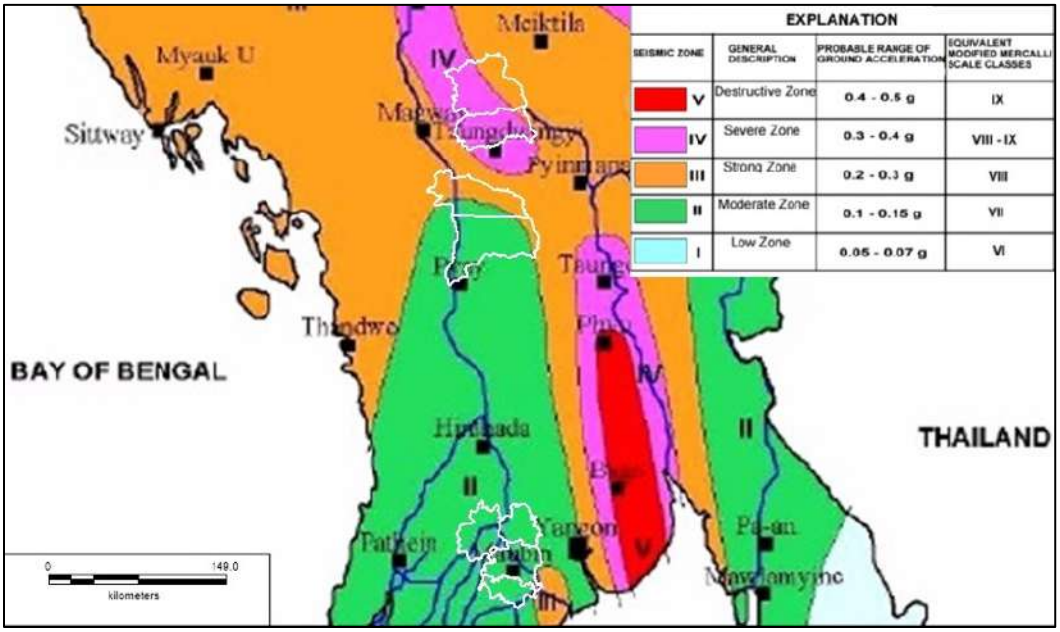


**Figure 23. Earthquake Hazard Zoning Map[24]**

### *Flood Hazard*

216. An assessment of the flood hazard in the sub-project areas was likewise carried out using the flood map done by the Dartmouth Flood Observatory. [25] The flood hazard map showed the widespread flooding caused by Cyclone Nargis, the worst flooding experienced. It is notable that the sub-project roads of Maubin are located outside the flooded areas, except for MBN 019, the end part of this road traverse the fishpond area. But according to residents, the road itself was not inundated. Similarly, the sub-project roads in Pantanaw are also located outside flooded area, except for certain parts of PTN012 and PTN019.

217. The flooding maps for both Maubin and Pantanaw, excerpted from the Dartmouth Flood Observatory mapping are shown in **Figure 24** and **Figure 25**

[24] Source: Myanmar Earthquake Commission cited in UN Habitat (undated), Manual on Earthquakes: Causes, effects and preparedness
http://www.themimu.info/sites/themimu.info/files/documents/Guideline_Earthquake%20Manual_UN-Habitat.pdf

[25] Flood map is excerpted from Dartmouth Flood Observatory, 2016. Myanmar Flooding, July 28-August 9, 2016 from NASA MODIS and ESA Sentinel 1 Data (Experimental data product). http://floodobservatory.colorado.edu/Events/2016Myanmar4365/2016Myanmar4365.html


**Figure 24. RRAP roads in Maubin superimposed on the Nargis flood map (flooded area blue)**

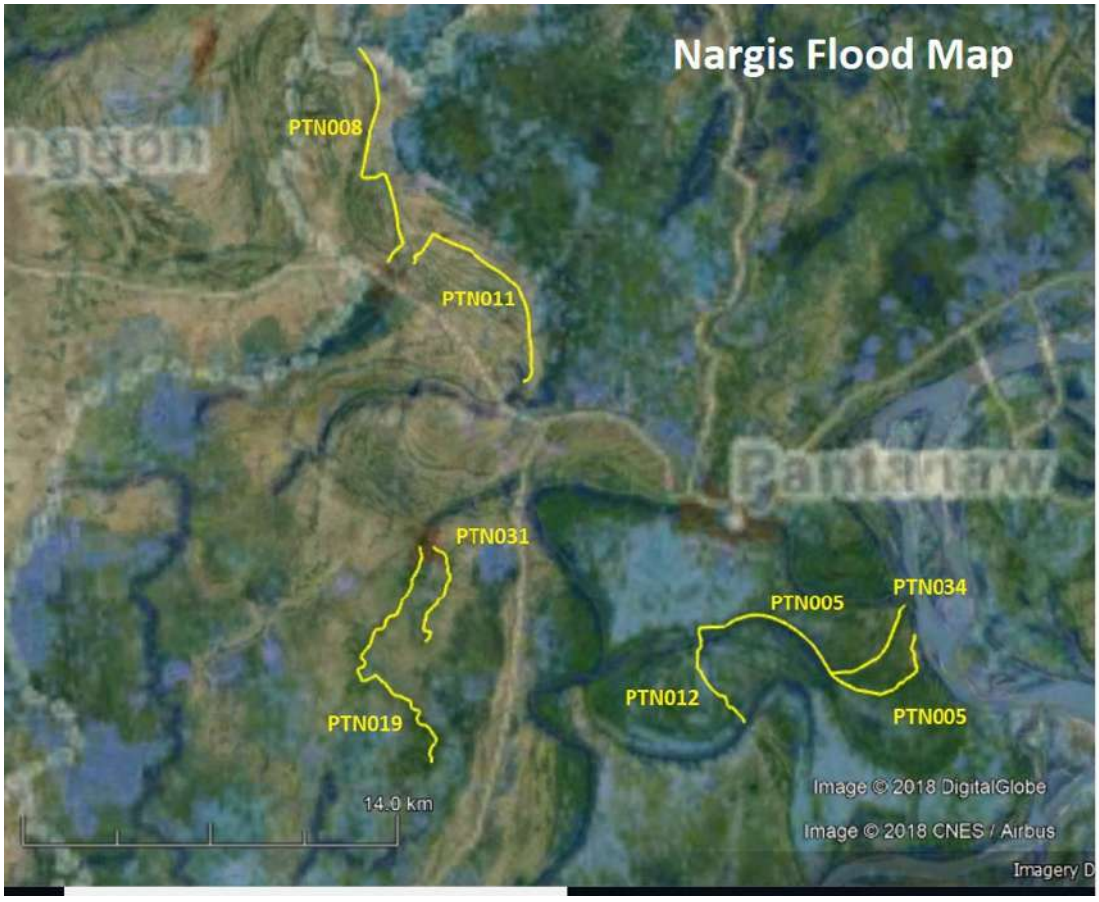


**Figure 25 Pantanaw RRAP roads superimposed on the Nargis flood map**

## 5.16 Socio-Economic Setting

*Regional Overview*

218. According to the 2014 the National Census 2014 of Myanmar, the Ayeyarwady Region has a population of 6,184,829 with Bamar and Karen making up majority of the population with a small minority of Rakhine in western coastal regions. The majority of the population are Buddhist, with small minorities of Christians, Muslims, Hindu and Bahai.

219. The Ayeyarwady Region is mainly agricultural and known as the rice bowl of Myanmar. In addition to rice, the region also produces maize, sesame, groundnut, sunflower, beans, pulses, and jute. The dominance of agriculture is reflected in the employment pattern of agriculture as the main provider of employment. The average farm size per household in Ayeyarwady Delta is 11.2 acres (some 4.5 ha) according to UNDP (June, 2007). This is ranked at 1st among the Union in terms of farmland size per household (Delta Alliance, 2013).

220. The dominance of agriculture in the Ayeyarwady basin is reflected by the land use distribution (**Table 15**).

**Table 15. Land use distribution in the Ayeyarwady Region, 2012 to 2013 (source: Irrigation Department)**

| Type | Area in ha | % |
|---|---|---|
| Cultivatable Land | 1,818,467 | 51.91 |
| Forest and Reserved Forest | 720,088 | 20.55 |
| Cultivable Waste Land | 149,168 | 4.26 |
| Virgin Land | 23,020 | 0.66 |
| Other Area | 792,447 | 22.62 |
| Total | 3,503,190 | 100 |

221. Capture and cultured fishery are also important economic activities producing fish, prawn, fish-paste, dry fish, dry prawn, and fish sauce.

222. According to MOLFRD (2015), rural electrification is only enjoyed by 41% of the total villages of the country, more than 50% has yet to be connected to the grid. In Ayeyarwady region, 383 villages in 10 townships are located remote from the national grid and may only be connected to the grid in the next 10 years. Based on the report of the Ministry of Energy and Electrification (MOEE)[26], of the villages within the 4 townships of Maubin District only 610 of the villages out of a total of 1,648 have access to electricity. More than 63% of the villages are yet to have access to electricity.

223. Majority of households (95 percent) depend on solid fuels such as wood and rice husks for cooking and heating. In the delta area many people still depend on local energy sources. In the lower delta fuelwood extraction from mangrove areas is one of the two main drivers for mangrove degradation.

224. Only a small percentage of the rural population in the delta is connected to a public drinking water system. Arsenic contamination of groundwater is an emerging public health issue in Myanmar. Drilled wells

[26] http://www.moee.gov.mm/en/ignite/page/51

are not feasible because the water quality is bad below 30 meters (AG Meeting 19 Sept 2015)

225. The results of the 2014 Census reveal a very high rate of school education: nationally the proportion of the population who have received primary or more advanced education is usually more than 75%. This high rate of school education is reflected in the township of Maubin with 75 to 90% of population aged 25 years old and older have primary education or higher.

226. Malaria, AIDS, and malnutrition and related diseases are serious problems in the country. Tuberculosis is a major killer. Myanmar's tuberculosis rate is one of the highest in the world, with 97,000 new cases detected annually. The major infectious diseases in terms of degree of risk are: a) food or waterborne diseases: bacterial and protozoal diarrhea, hepatitis A, and typhoid fever; b) vectorborne diseases: dengue fever and malaria; c) water contact disease: leptospirosis; d) animal contact disease: rabies. Highly pathogenic H5N1 avian influenza has been identified in this country.

227. The socio-economic profiles of Maubin and Pantanaw presented in matrix form and enclosed as **Appendix 3 and 4,** respectively. The socio-economic profiles presented here are from the town assessment done by DRRD during the preparatory stage of the project.

## 5.17 Description of the Environmental Condition of the Road Corridors

228. The following sections presents the description of the condition along each of the sub-project road. In addition, a checklist for each of the sub-project road is enclosed as Appendix 5. The checklist contains additional information, photographs and maps of land use, location of sensitive receptors and other environmental features along the road alignment. The base map used for the alignment map is Google Earth Imagery.

*[redacted]MBN 004*

229. Rural road MBN 004 traverses a corridor that is predominantly cultivated for rice paddies. The topography is generally flat with subtle topographic variations due to floodplain features such as levees, abandoned river channels, etc. The elevation within the road corridor range from 2m to 11 m with elevation generally rising towards the northern end of the road. The influence of old river channels in development is ubiquitous with roads, farm outlines, settlements following the arcuate shapes of old meanders. The section of MBN 004 for one follows one of the abandoned meanders hence the arcuate shape. The road is distant from rivers, the closest distance of the road to the river is 250 m from the end of MBN004. The soil along the road alignment is silty which makes the road very dusty during the dry season and very muddy during the rainy season.

230. The corridor of MBN004is almost entirely cultivated, mostly paddy rice. The road shoulder in unpopulated sections is vegetated by grasses and shrubs with intermittent trees. In settlements, small patches of vegetable garden, banana plantations maybe present.

231. The road survey inventoried about 155 trees alongside the road, however, exact count of trees that will need to be removed will only be known after the centreline has been staked on the ground.

232. An embankment of about a meter high is present at the right side and power line is present along MBN004. Settlements are spread along MBN004 In some sections, structures extend right on the road's edge as shown in the following photographs:

**Figure 26. Condition along alignment of MBN 004**

233. The sensitive receptors located alongside the road are listed in the following table:

**Table 16. Sensitive receptors within 50 m of MBN004**

| Sensitive receptors | | |
|---|---|---|
| 1 | Village settlements | Isolated houses line the roads, the following are the village settlements traversed by the road:<br>7+250<br>9+000<br>10+500<br>11+500<br>12+500<br>13+500 to 14+500 |
| 2 | Religious features, i.e. monastery, pagoda, religious trees or shrines present alongside the road | Km15+150 LS<br>Km13+800LS<br>Km13+450LS<br>Km13+000LS<br>Km11+900LS |
| 3 | School located alongside the road or other community facility | Km3+950 LS<br>Km 13+500 LS |
| 4 | Ponds | Ponds, aquaculture and water supply impoundment are present at the following stations:<br>Km0 to 0+800<br>Km1+200<br>Km1+900<br>Km2+800<br>Km7+900 |

| | | |
|---|---|---|
| | | Km8+100<br>Km8+300 |
| 5 | Water supply facilities alongside the road | Km8+830 RS tube well |
| 6 | Irrigation crossing | Km4+170<br>Km5+900<br>Km7+300<br>Km9+130 |
| 7 | Power and communication poles present along road | Power poles present left side of the road MBN 004; right side MBN004; |
| 8 | Trees | 155 trees inventoried during road survey;<br>Common plants and trees along the road include banana plants, Bamboo groves, Coconut Palm, Toddy Palm, Rain Tree (*Albizzia Lebbeck*), Padauk (*Pterocarpus macrocarpus*), *Casia Siamea*, Golden Shower (*Casia Fistula)*, Tamarind (*Tamarindus indica*), Mango (*Mangifera indica*) *Terminalia sp*, *Delonix regia*, reforestation species like *Acacia mangium* and *Acacia auricoliformis, Gmelina and Eucalyptus* are present. |

*MBN 005*

234. MBN 005 starts off a bridge at its connection to the main road and follows a waterway from start to finish and there are sections where the water comes right up to road's edge. The road is broken into two parts one is contiguous on the west bank while other is located on the east bank. The sub-project is located in low lying area where the elevation of the road corridor ranges from 3 m asl to 12 m asl. Average maximum slope is 4.3% to 5.5% and average slope of 0.9% to 1%. The subtle change in elevation is due to presence of abandoned river meanders and its natural levees and alluvial terraces, among others.

235. The houses are spread all along the entire length of MBN005, along the road and the waterway. The corridor is widely cultivated for paddy rice; with small plots of orchards, banana plantations, fruit trees, small flower and vegetable patches located alongside the road in settlements. The following photos show the condition in the populated section of the road. Top left is the road in front of a school, with the water channel bounding the road to the right side; top right shows section of the road with large Rain Tree on the bank at right edge of the road; bottom left is banana plantation on both sides of the road and bottom right is the village settlement at the start of east bank of MBN005.

**Figure 27. Photos of sections of MBN005**

236. The trees are commonly rain trees, tamarind, mango trees, coconut and betel palm line the road and the waterway. The road survey has identified 155 trees along the alignment, but the exact number of trees that will need to be removed will only be known after the road centreline has been staked on the ground.

237. The road is threatened by bank erosion in sections where the road's edge is on the bank of the waterway. It was observed during the site inspection that boat wakes are the main cause of bank erosion. It is noted that the band of vegetation that lines up the bank offers some protection from boat wakes as it dampens the wave before hitting the banks.

238. The sensitive receptors located alongside the road are as follows:

**Table 17. Sensitive receptors along MBN 005.**

| | **Sensitive Receptors** | |
|---|---|---|
| | Village Settlement | Houses are spread all along the entire length of MBN005, along the road and across the irrigation and navigation channel |
| | Monasteries / Pagodas | MBN 005 Km 1+060 Pagoda left side<br>End of MBN005 (west bank) – Pagoda<br>Grave where MBN 041 crosses the waterway<br>MBN005 (east bank) – 1+700 RS Pagoda;<br>Km 3+300 RS Monastery |

| | Sensitive Receptors | |
|---|---|---|
| | Schools | Km 2+500 San Lin Daunt Primary School, left side |
| | Irrigation Channel | Irrigation canal parallels the road from MBN 005. |
| | Water Supply | Km 2+500 LS Dug well |

*MBN 019*

239. The road corridor is low lying with elevation varying from 4 m asl to 13 m asl. The elevation is highest at the start and gradually declining towards the end of the road corridor where wetlands have almost been totally developed into aquaculture ponds. Low density settlements are spread out alongside the road and the parallel waterway. It is only at the start where settlement is relatively dense. Some houses in the narrow sections of MBN 019 are located right at the road's edge, built over the waterway (see photo in **Figure 28**).

240. The entire road corridor has been developed for agriculture and aquaculture. Agriculture is common from start to about Km5+000 and from thereon, aquaculture ponds predominate with ponds on both sides of the road. Paddy rice is the major crop with orchards, beans and vegetable cultivation around the settlements.

241. Trees are present alongside the road and these are mostly fruit bearing (mango and tamarind), ornamental tree species, rain tree, ficus, reforestation tree species such as acacia and eucaplyptus, bamboo, some coconut and betel palms. Small banana plantations are present towards the end section of the road section. Grass lines the road's edge in some unpopulated sections.

242. Erosion is noted to be prevalent at about Km 6+000, Km 9+000 up to the end of MBN019 where road is bordered by the water channel. As observed, boat wakes seem to be among the main causes of erosion as boat traffic is noted to be frequent. Eroded road edge and isolated individual large trees with the water channel indicate active erosion and bank retreat.

243. Photographs of certain sections of the road is shown in Figure 30, top left photo is the start of MBN019, top right shows house near the road and erosion of the edge of the road; bottom left, road in the village settlement and bottom right bird's eye view of the road and the waterway alongside MBN019.

244. A key biodiversity area has been identified in this location of Maubin and MBN019 seems to encroach into the KBA, known as the Maletto Inn KBA. This is reported to be a KBA for certain avian species, however, almost the entire Maletto wetland has now been converted to aquaculture ponds and agriculture. The present condition part of the Maletto wetland closes to the sub-project road is now fully developed for aquaculture as shown in Figure 3.1.

**Figure 28. Condition in selected sections of MBN019**

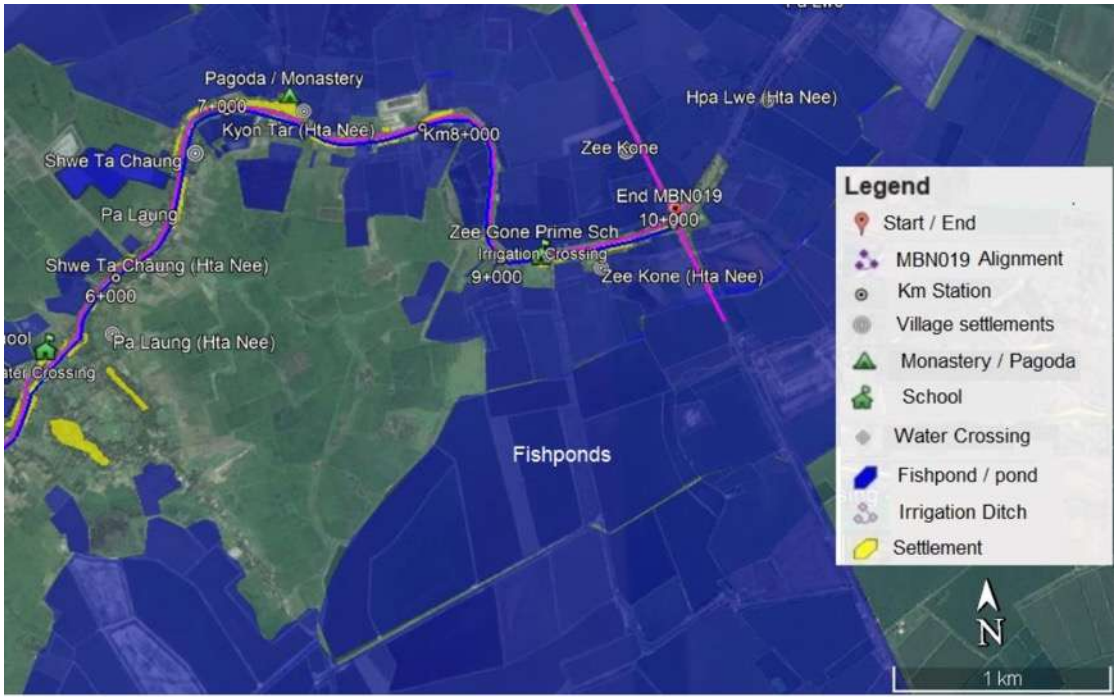


**Figure 29. Aquaculture ponds (part of the Maletto wetland) at the end section of MBN019**

245. The sensitive receptors identified along the road alignment are listed in the following table.

**Table 18. Sensitive receptors MBN 019**

| | Sensitive Receptors | |
|---|---|---|
| 1 | Village Settlements | Houses are present along the entire length of the road. |
| 2 | Monasteries & Pagodas | Km 0+200<br>Km1+600 – across the water channel<br>Km 7+310 – across the water channel |
| 3 | Schools | Km 1+830<br>Km 5+520- across the water channel<br>Km 9+120 |
| 4 | Aquaculture Ponds | Km 5+150 to the end |
| 5 | Irrigation Crossings | Km 5+470<br>Km8+840<br>Km 9+230<br>Km10+000 end of MBN019 |
| 6 | Irrigation / Water Channel | From start to end, left side of the road is a water channel |
| 7 | Trees | 323 trees |

*MBN 028*

246. MBN 028 has an arcuate alignment, following an ancient levee, part of an old river meander. The road corridor is low lying, with the elevation ranging from 4 m asl to 13 m asl. MBN 028's start is about 600 m from a distributary of Ayeyarwady River while the end is about 50 m away.

247. The road corridor is extensively cultivated for rice paddy. Other seasonal crops are planted as well. Settlements are lined alongside the road from about 600 m from the start to end. The settlements are generally low density except at the end point in Chauk village track. Dense woodlands surround the settlements with bamboo thickets mixed with fruit bearing trees, ornamental trees and other trees. In some sections shrubs and vine thickets crowd the road. It is common to find drinking water stand and covered waiting sheds right on the road's edge. Power poles are located along the edge of the road. There is a big school along the road and as can be expected large group of students take to the road during school days. Photos in **Figure 30** depict the condition in selected sections of MBN 028.


**Figure 30. Conditions in selected sections of MBN 028**

248. The sensitive receptors within 50 m from each side of the road are listed in the following table:

**Table 19. Sensitive receptors MBN 028**

| | **Sensitive Receptors** | |
|---|---|---|
| 1 | Settlements | Settlements and individual houses are scattered all along the road. |
| 2 | Monasteries, Pagodas and religious shrines | Monasteries and Pagodas<br>a. Km 1+500 LS<br>b. Km5+590<br>c. Km6+600 RS<br>d. Km7+710 L & RS<br>e. Km8+330 LS<br>f. Km9+590<br>g. Bodhi Tree Km 1+340 |
| 3 | Schools | a. Km 6+540 LS<br>b. Km *+570 LS<br>c. Km 9+020 LS<br>d. Km10+000 LS |
| 4 | Community Water Supply | Community Water Supply<br>a. Km 5+000 – LS Pond<br>b. Km 11+870 RS Pond<br>c. Km 7+470 LS Pond<br>d. Km 8+350 Tank LS |
| 5 | Irrigation Crossing | a. Km 5+360<br>b. Km 7+220<br>c. Km 10+110 |
| 6 | Other Community Facilities | 1. Cemetery at Km10+380 RS<br>2. Village Admin Office, Km 8+570 & Km 9+080 LS |

| | | |
|---|---|---|
| | | 3. Waiting shed with water drinking stations at:<br>a. Km 3+870 LS<br>b. Km 4+240 RS<br>c. Km 9+900<br>d. Km 10+460<br>e. Km 11+710 RS<br>f. Km 11+880 RS |

*MBN 039*

249. The road corridor has a very low relief, with elevation ranging from 6 m asl to 12 m asl. The land is seemingly flat but subtle landforms are present such as levees of ancient meanders and alluvial terraces. The land development in this part of the delta is influenced by the geomorphology as structures including road follow the arcuate outlines of abandoned ancient meanders.

250. The road is paralleled by a waterway starting at Km 0+500 which persists up to the end of MBN 039. The road narrows down to a track at Km 7+000 where the road is bordered by the waterway and the line of houses on the other side. The track persists up to the end of MBN 039. The sections of MBN 039 where water comes up to the road edge is threatened by bank erosion. In some sections, banana plantations line the road in one side and houses on the other side. Some structures are located right on the road's edge like approaches of the footbridges that cross the waterway. The residents use the waterway as an alternative to road to road transport.

251. The condition of the alignment of MBN 039 is shown in the following photographs:

**Figure 31. Prevailing conditions along the alignment of MBN 039**

252. The road corridor is extensively cultivated planted to paddy rice. The sensitive receptors along within 50 m from each side of the road is listed in the following table:

**Table 20. Sensitive receptors along the alignment of MBN 039**

| | **Sensitive Receptors** | |
|---|---|---|
| 1 | Village Settlements | Km 0+500 to 2+150<br>2+500 to 3+000<br>3+460 to 7+000<br>7+700 to 7+920<br>8+400 to 8+840<br>10+330 to 10+460 |
| 2 | Monasteries & Pagodas & other religious features | Km 6+500 Pagoda<br>Km8+475 Christian Church |
| 3 | School | Km3+700 RS – school |
| 4 | Community Facilities | Graveyard- Km 3+170<br>Drinking water stand at<br>Km1+900 RS<br>Km6+600RS<br>Km6+700 |
| 5 | Irrigation/ water crossing | Major crossing is at<br>Km 1+850<br>Km 2+260<br>Km 5+500<br>Km 7+500<br>Km8+200<br>Km8+650<br>Km9+280<br>Km9+780 |
| 6 | Drinking water | Drinking water stand at:<br>• 3+650 |

| | | |
|---|---|---|
| | | • 4+600<br>Health Center at 8+750 |
| 7 | Trees | The road survey has inventoried 248 trees alongside the road. |

### [redacted] *PTN 005, PTN 012*

253. PTN 005 and PTN 012 are located in a meander zone, upstream of where Ayeyarwady bifurcates into several distributary channels. This part of the floodplain is comparatively younger (geologically speaking) as abandoned meanders are still very pronounced with the abandoned channels still in the process of sedimentation and ponds still occupy some of the abandoned channels. The start of the road is about 150 m away from Ayeyarwady and starts to veer away at about Km 2+000 where the road trends to a more southwest direction. At Km 6+350, PTN 005 approaches a waterway and veers to a northwest course and parallels the channel up to the end. The road is about 50 m from the water channel.

254. The elevation of the road corridor ranges from 6 m asl to 13 m asl with several sections prone to flooding. The flood prone sections are low lying areas, specifically at points where the road crosses abandoned meanders.

255. Within village settlements, the road is typically bordered by houses and structures. Vegetation such as grasses, shrubs and cultivated plants line the road's edge as well. The road survey group has inventoried about 298 trees along the road. But the exact count of trees to be removed will only be known after the road centreline has been staked on the ground.

256. The photos in **Figure 32** shows the condition of the roads; top left, start of road; top right, graveyard at Km0+400; bottom left Km 4+800; and bottom right old and new bridge.

**Figure 32. Condition in selected sections of PTN 005 and PTN 012**

257. The sensitive receptors along PTN 005 and PTN 012 are enumerated in the following table:

**Table 21. Sensitive receptors along PTN 005, PTN 012**

| | Sensitive Receptors | Location |
|---|---|---|
| 1 | Village settlements | PTN 005<br>a. Km 0+000 to Km 3+500<br>b. Km 6+200 to Km 9+000<br>c. Km9+800 to end of PTN 005<br>PTN 012<br>Km0+000 to Km 0+200<br>PTN034<br>Km 0+000 to Km 2+000 |
| 2. | Monastery, pagoda, and / or shrines present alongside the road | PTN 005<br>a. Pagoda Km0+420 – about 100 meters from PTN005<br>b. Pagoda Km 1+080 LS<br>c. Graves at Km0+420 RS;<br>d. Pagoda Km3+240 LS<br>e. Christian Church Km8+600 RS |
| 3 | Schools | a. Km 1+380 PTN005 School RS<br>b. Km 3+060 PTN005 School LS<br>c. Km10+230 PTN005 School RS<br>d. Km1+150 RS PTN034 School RS |
| 4 | Water Pond | PTN 0005 – Km 1+850 |
| 5 | Irrigation Channel | PTN 005 Km 8+000 to End – LS major irrigation and navigation channel |
| 6 | Trees | The road survey has inventoried 298 trees along the alignment |

[redacted]*PTN 008*

258. PTN 008 is located at the edge of an abandoned meander belt, following its arcuate outline. The topography is generally flat with subtle topographic highs formed by natural levees associated with the abandoned river meanders. The elevation of the road varies from 6 m asl to 18 m asl, giving a relief of 12 m. The road is distant from Ayeyarwady River and any of its distributary. The road parallels a waterway from Km5+000 onwards to the end, but the separation of the road and waterway is more 70 m. It is only at the end section, Km9+500, where the road traverses the bank of the waterway.

259. Settlements are distributed along the road's alignment, generally sparse houses except at the beginning where residential and commercial structures are present. The road is in a good condition and with wide opening. The road is bordered by houses and structures within settlements with intermittent wooded areas consisting mostly of fruiting trees and bamboo groves.

260. The dominant land use within the road corridor is paddy rice and farmers are able to plant more than one crop a year. It was observed during the site inspection that the road is used for drying the grains and traffic is relatively high during harvest season as farmers transport the harvest.

261. The photos below show the condition of PTN 008: (a) start of PTN 008, near its intersection with the main road (top left); (b) top right photo shows queue of tractors transporting the harvests, (c) bottom shows a section within a village settlement, note the wide right of way; and (d) bottom right showing the

section near the end, the big tree in the background is a Bodhi tree with a statue of Buddha at the other side of the road.

262. The sensitive receptors along PTN 008 are listed in the following table:

**Figure 33. Conditions at certain sections of PTN 008**

**Table 22. Sensitive receptors along PTN 008**

| | **Sensitive Receptors -PTN008** | |
|---|---|---|
| 1 | Settlements | a. Km 0+000 to 0+350<br>b. Km1+420 to Km 1+900<br>c. Km2+040 to Km 4+270<br>d. Km4+320 to Km 5+250 LS<br>e. Km5+880 to Km 8+900 LS<br>f. Km9+250 LS<br>g. Km9+540 to end |
| 2 | Monasteries, Pagoda and shrines | a. Km2+700 RS<br>b. Km3+430 RS<br>c. Km6+450 LS<br>d. Km7+120 LS<br>e. Km8+040 LS |

| | | |
|---|---|---|
| | | f. Km9+620 RS Buddha Shrine & Bodhi Tree |
| 3 | Schools | a. Km2+070 LS<br>b. Km 4+620 LS<br>c. Km7+950 RS<br>d. Km 9+550LS |
| 4 | Waterway | Water crossing at Km 0+400<br>A waterway runs to the left of the road from Km4+500 to end of PTN 008; distance from road to waterway varies from 70 to 200 m; closest at the end Km 9+500 where the road is on the bank of the waterway. |

[redacted]*PTN 011*

263. PTN 011 starts at its intersection with the Pantanaw-Pathein Road, immediately southeast of PTN 008. Like PTN 008, this road is located at the edge of an abandoned meander belt following its curved outline. The corridor is generally flat and low lying with the road's elevation ranging from 4 m asl to 15 m asl.

264. The road corridor is planted to paddy rice with two cropping a year. Harvest periods are October to November and April and May. Similar to PTN 005, this road is used by the farmers for drying the grains after harvest.

265. The houses and village settlements are distributed throughout the road interspersed among the paddy fields. Power poles are located alongside the road. PTN 008 has two waterway crossing. The first is at Km 0+950 where the road crosses the Muy Thia River. A dilapidated wooden bridge spans this water crossing and the second water crossing is at Km 3+840.

266. Trees present along the road includes rain tree, neem, cotton tree, banyan, padauk, tody palms and fruit bearing trees. Banana plantations are present in some sections of the road. The following photos illustrate the condition of certain sections of PTN008: (a) top left photo is the start, intersection with the Pantanaw-Pathein Road; (b) top right photo shows a typical section in unpopulated section, road bordered by rice paddies and vegetation, brush and grasses; road used for drying grains; (c) road within village settlement at Km8+150; and bottom right is the end of PTN 008.

**Figure 34. Condition of Road PTN011**

267. The sensitive receptors along PTN 011 are listed in Table 23.

**Table 23. Sensitive receptors along PTN 011**

| | **Sensitive Receptors** | |
|---|---|---|
| 1 | Village Settlements | Km0+120 to 0+590<br>Km1+180 to 1+740<br>Km2+670 to 3+000<br>Km3+420 to 3+810<br>Km3+880 to 4+100<br>Km4+390 to 5+210<br>Km 5+480 to 5+880<br>Km6+660 to 7+660<br>Km8+150 to 8+360 |
| 2 | Monasteries & Pagodas and other religious features | Km 0+550 LS<br>Km1+590 RS<br>Km2+400 RS<br>Km8+190 RS |
| 3 | Schools | Km10+000 School, RS<br>Km 4+810 LS<br>Km2+800 |
| 4 | Ponds and Waterways | Km 1+000 LS water pond<br>Km 1+400 to 1+900 LS<br>Km2+850 RS 200 m away from road<br>Km3+910 LS 200 m from road |
| 5 | Water Crossing | Km 0+950 Muy Thia River.<br>Km 3+840 irrigation |
| 6 | Community Facilities | Km9+650 Health Center<br>Km9+930 Village Track Administration Office |

*[redacted]PTN 019*

268. The start point of this road is at its junction with the Pantanaw-Einme Road and the end point connects to the Pantanaw-Shwelaung Road. The road corridor is low lying with road elevation ranging from 3 m asl to 14 m asl. The road is distant from Ayeyarwady River and any of its major distributaries. But it parallels a waterway from start to about Km 10+300 where the waterway veers away from the road. There

are locations within this section that the road runs on the bank of the waterway. Bank erosion is noted in some parts.

269. Settlements are lined along the road and along the waterway. Numerous bridges and foot bridges connect the road to the settlement across the waterway. Power poles line the left side of the road. Trees and vegetation alongside the road includes mango, tamarind, Teminalia (Indian Almond tree), ficus, rain tree, coconut palm, beetle nut palm, bamboo and banana plants. Thick bamboo groves also line the road in unpopulated sections. Ornamental hedges line the road in some of the populated sections. The PTN 019 has a wide ROW with the last 2 km with concrete cement paving, built according to residents with funds donated by a monk.

270. Tree cutting has been done in some sections by the power company to clear the power line corridor.

271. The following photographs show the condition in certain sections of the road; (a) top left photos shows the start of the road near the junction with the Pantanaw-Einme Road; (b) top right photo is at Km 2+340 showing the road opening within a village settlement; (c) Km 5+500, showing a section of PTN 019 running along the bank of the waterway; (d) the paved end section of PTN 019. More photographs are presented in the checklist in Appendix 5.

**Figure 35. Exiting conditions in certain sections of PTN 019**

**Table 24. Sensitive receptors along PTN 019**

| | Sensitive Receptors | |
|---|---|---|
| 1 | Village Settlements | a. Km 0+000 to 0+100<br>b. Km 1+000 to 1+280<br>c. Km1+500 to 1+690<br>d. Km1+820 to 2+000<br>e. Km2+060 to 2+160<br>f. Km 2+360 to 3+350<br>g. Km 3+410 to 3+880<br>h. Km 4+000 to 4+010<br>i. Km 4+240 to 4+350<br>j. Km 5+340 to 5+700<br>k. Km 5+740 to 6+410<br>l. Km 6+480 to 6+940 – sparse housing<br>m. Km 7+080 to 7+640<br>n. Km 7+760 to 9+910<br>o. Km 9+360 to 10+500<br>p. Km 10+630 to 10+710<br>q. Km 13+680 to 13+730<br>r. Km 13+840 to 13+940 |
| 2 | Monasteries, Pagodas and other religious features | a. Km2+160 monastery<br>b. Km3_530 mosque<br>c. Km7+140 monastery<br>d. Km 9+360 RS Shrine and Bodhi Tree (Ficus) |
| 3 | Schools | Km3+350<br>Km8+510 |
| 4 | Irrigation Channel/ Waterway | Irrigation channel is located at the right side of the road from start to Km 11+500; the distance of channel from road's edge ranges from 1m to 200 m |
| 5 | Trees | 175 trees according to road survey |
| 6 | Other infrastructures alongside or connected to the road | Numerous bridges across the irrigation channel connecting PTN019 to communities at the other side of the channel: |
| | | Km1+210<br>Km1+870<br>Km2+620<br>Km3+220<br>Km3+040<br>Km 3+930<br>Km 5+040<br>Km 5+690<br>Km5+800<br>Km 5+220<br>Km 6+110<br>Km 6+310<br>Km6+600<br>Km 7+160<br>Km7+310<br>Km8+940<br>Km9+440<br>Km 9+660<br>Km10 +270<br>Km 10+730<br>Km 10+930<br>Km 11+100 |

*[redacted]PTN 031*

272. PTN 031 starts at the Pantanaw-Einme Road, about 500 m east of PTN 019. The road is distant from Ayeyarwady River and its major distributaries. As typical of the Ayeyarwady delta, the road corridor is a plain but with subtle topographic variation. The elevation of the road range from 5 m asl to 16 m asl. The road corridor is extensively cultivated for paddy rice. Patches of wooded areas are present around village settlements. Mixed with the trees are banana plantations, bamboo groves. Grasses and shrubs are present at the road's edge.

273. Several sections of the road are unpassable to vehicles including motorcycles during the rainy season. One such section is shown in the photographs below. In another section villagers have to improvise ways of getting through the mud either by laying bamboo walkway (see photo below), laying banana trunks or sand bags on the road. The site inspection for environment during the rainy season had to be completed mostly on foot.

274. The road opening is generally wide, except in some sections within village settlements where bushes and structures (such as fences) are present at the road's edge. One example is shown in bottom right photo. Also, note that the road is used by farmers for drying grains during the harvest season.

**Figure 36. Conditions in selected sections of PTN 031**

275. The trees present along PTN 031 are fruiting trees (mango, tamarind), tody palm, ficus, padauk

(*Pterocarpus macrocarpus*), rain tree, bamboo groves and coconut palms are also present alongside the road.

**Table 25. Sensitive receptors along PTN 031**

| | **Sensitive Receptors** | |
|---|---|---|
| 1 | Village Settlements | a. Km 0+000 to 0+290 – sparse houses L & RS<br>b. Km 0+490 sparse houses LS<br>c. Km 0+760 sparse houses L & RS<br>d. Km 3+120 to 3+260 RS sparse houses<br>e. Km3+520 to 3+750 L & RS<br>f. Km 4+000 to end – sparse houses |
| 2 | Monasteries & Pagodas and other religious features | Km4+200 RS |
| 3 | Schools | Km2+860 RS<br>Km4+340 RS |
| 4 | Community facilities | Waiting sheds Km2+800, Km3+590 RS<br>Health Center Km 4+170 LS |

# 6. ENVIRONMENTAL IMPACTS AND MITIGATIONS

## 6.1 Impacts Prediction and Assessment

276. Generally, impacts are qualitatively rated as negative, positive or unknown and are classified as direct or indirect impacts. Direct impact is defined by the WB Handbook on Roads and Environment[27] as impacts caused by the road itself such as road construction. The, significance of impacts is qualitatively assessed as low, moderate, high. The assessment is based on, the nature of the receptor (e.g. human community, environmentally sensitive receptors such as important habitats, special areas), the duration of the impact (temporary, short term if it persists during construction period, long term if it prevails beyond construction period, like residual impacts), the size of the area that will be affected, the nature and volume of materials that will cause the impact.

277. It is anticipated that the direct impacts due to rural road rehabilitation/upgrade will be mostly confined within a narrow corridor of 50 m of the road centreline, from each side of the road (corridor of 100 m). The direct impacts within this corridor may include taking of land, removal of trees and vegetation, removal of structures, occupation of temporary areas for materials stockpile, occurrence of nuisance noise levels and dust. Temporary disruption of access and commercial activities can also occur within this corridor. Concerns on public safety will also be present during construction. The risk of pollution of water bodies is another consideration during construction. But most of these impacts can be mitigated with minimal residual impacts.

278. Off-site impacts are expected, in relation to construction camps, borrow pits, quarries, transport of materials. Guidelines for site selection and operations are presented as part of the mitigating measures.

279. The main aspect of the RRAP which precludes significant adverse environmental impacts is the criterion that RRAP should be Category B, i.e. excluding roads leading to protected forests such as reserved forest. Furthermore, the other factors that limits the adverse environmental impacts during construction are the following reasons:

- Sub-project rural roads are pre-existing alignments, either as unpaved roads or tracks. Realignment maybe done to improve design for safety but this for very short distances;
- The ecological setting of the project corridor is mainly agro-ecosystem, predominated by development and human activities;
- The construction will utilize a limited number of equipment, thus limiting the sources of emissions, noise and construction hazards;
- Rural roads have smaller footprints compared to regular roads and hence will require comparatively lesser materials than regular roads;
- The proposed bitumen paving will not require hot mix asphalt plant;
- The duration of the project is relatively short and the exposure of sensitive receptors is limited as works will be moving along the road alignment.

280. As part of impact assessment and mitigation, the sensitive receptors along the road corridors were identified. The sensitive impact receptors along the sub-project rural roads are:

- Human communities / settlements
- Water bodies such as irrigation and aquaculture ponds
- Community facilities, health centers, water supply facility
- Places of worship and religious facilities / features

[27] http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1107880869673/chap_6.pdf

- Schools
- Ecologically significant areas, e.g. natural water bodies, creeks and rivers and lakes, reserved forest, IBA, KBA.

281. As an initial part of the impact prediction and assessment, an impact screening of the project is done and is presented in the following table.

**Table 26. Impacts screening**

| Environmental Resource | Component | Potential Impacts | Source of Impacts | Significance of Impacts |
|---|---|---|---|---|
| Air | Air Quality | Air pollution | • Equipment operations;<br>• Earth moving activities;<br>• Transport of materials; | Moderate (-)- temporary nature of construction, limited number of equipment;<br>Impacts can be mitigated; |
| | | Noise and vibration | | |
| Land | Soil | Loss of soil | • Soil erosion from construction sites, borrow pit, stockpile;<br>•<br>• Extraction of soil & aggregates;<br>• Disposal of spoils | Low (-) – site is plain with low susceptibility to erosion, site is a depositional environment; |
| | Quarry Resources | Consumption of resources | | Low (-) |
| | Landscape | Alteration of landscape due to extraction of materials; | | Low (-) site is plain with no unique landscape feature |
| Water | Groundwater | Depletion and pollution | • Extraction for construction water supply;<br>• Construction camp operations<br>• Culvert & drainage construction;<br>• Accidental spillage | Low (-) Abundant groundwater albeit poor quality; short duration of construction; |
| | | | | |
| | Natural water bodies | Siltation & pollution | | Low to high (-) – short duration of the construction; but if unmitigated, adverse impact can have significant environmental and socio-economic impact |
| | Ponds | Siltation & pollution | | |
| | Irrigation / aquaculture water supply | Siltation, pollution and possible interruption of services | | |
| Ecology & Biodiversity | Terrestrial flora & fauna | Loss of trees | Clearing and grubbing | Moderate (-) – lost trees can be replaced; but will take time to replace the lost mature trees. |
| | | Encroachment on ecologically important areas (i.e. reserved forests, KBA, IBA, PA) | Off site activities | NA |
| | Freshwater | Siltation of waterbodies; Obstruction of water flow | Culvert construction | Low to high (-) – short duration of the construction; but if unmitigated, adverse impact can have significant impact on ecology |

| | | | | |
|---|---|---|---|---|
| Human Environment | Health & safety | Traffic accidents;<br>Exposure of residents and pedestrians to hazards due to construction activities;<br>Exposure to diseases that may be transmitted by workers. | Construction activities in general | Low to high (-)– temporary; short duration of construction; relatively low number of persons exposed to hazards; |
| | Livelihood | Temporary additional income;<br>Disruption of farming and aquaculture production / activities | • Temporary employment<br>• Disruption of irrigation;<br>• Pollution of surface water<br>• Impeded access to farms and aquaculture ponds | Low (+)<br><br>Moderate (-) |
| | Socio-cultural activities | Disruption of worship services;<br>Impeded access to places of worship and community facilities | • Construction noise,<br>• Obstruction of access due to construction | Low (-) |
| | Physical cultural assets | Accidental discovery;<br>Damage to cultural assets | Construction activities, e.g. excavation, vibration | Low (-) |

282. Mitigation measures shall be drawn up for the high and moderate adverse environmental impacts and minimize the residual impacts.

283. By practice, impacts are predicted and assessed for the various project stages or cycle or components, such as impacts due to location and impacts due to construction and operations and maintenance and abandonment. For this project, no assessment for abandonment is done as rural roads are continually in service and there is more likelihood for its upgrading in the future rather than abandonment.

## 6.2 Impacts Due to Location

284. The prediction of impacts due to location is presented to focus on the possible adverse impacts on sensitive receptors and to emphasize the need for mitigations. The sensitive impacts receptors within the project corridor are the numerous settlements, community facilities, places of worship and religious sites and water bodies, such as irrigation canals, ponds and aquaculture ponds. The locations of these receptors are listed in detail in Section 5.17 of this IEE.

285. The sub-project roads traverse numerous village settlements in both Pantanaw and Maubin Townships. In areas where land space is not constrained, settlements are typically clustered and spread out. However, in sub-project areas where land is limited such as in Maubin and Pantanaw, the settlements are linear in pattern, established parallel to the sub-project roads. The disadvantage of the linear development is that more households are exposed to the project's impacts (construction and operations) as compared with clustered settlement pattern. The following maps show the difference in village settlement patterns between Ayeyarwady sub-project areas and the Magway sub-project areas. The top map is Maubin

MBN 019 and the bottoms is Myothit MYT 044.

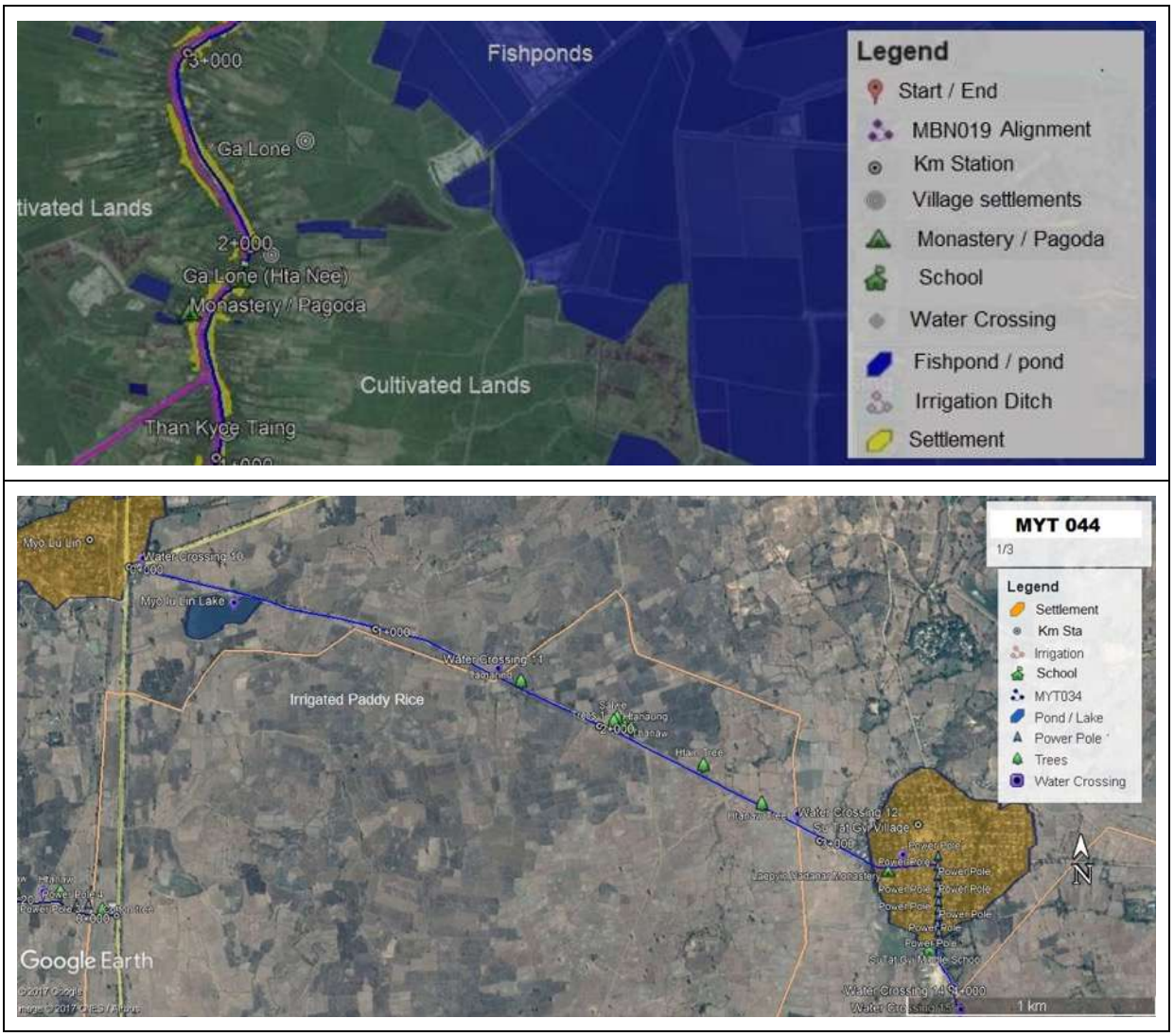


**Figure 37. Settlement patterns in Maubin, Ayeyarwady and Myothit in Magway.**

286. The rural roads within village settlements are typically narrow, 12 feet or less and this can amplify adverse environmental and social impacts. The road rehabilitation will be only within the existing road widths. The existing road width varies from 1.8 m as the minimum to 8.2 m. The section of 1.8 m is a short section of about 40 m in length. This section may require land acquisition to have the road width about 3.0 m, but generally most sections are uniformly 3.0 m in width. With this approach of varying widths, the proposed project may have almost zero resettlement impacts on all Ayeyarwady roads.

287. The houses and settlements, schools, monasteries, pagodas (see list of sensitive receptors in Section 5.17), fronting the roads will be exposed to noise and dust during construction. The contractor should suppress dust in these sections of the roads by watering at least twice a day, once in the morning and early afternoon. Noise mitigation measures should also be implemented, i.e. operations of the heavy equipment and construction activities that generate high noise level should only be done between 0700H

to 1800H. Contractor shall ensure that equipment is well maintained and fitted with noise mufflers. Stationary sources of noise (e.g. compressors, portable power generators) should be located away from receptors.

288. Impacts on dwellings may occur in some sections of the sub-project road in Maubin, e.g. MBN 019 wherein houses are built right at the road's edge. This will have resettlement issues which are addressed in the Resettlement Plan. The presence of power poles alongside the road may also pose constraint to the improvement of the rural road. Alternative to relocating the power poles is widening only on one side of the road.

289. The following photos show examples of narrow sub-project roads, the left photo is from Myothit 004 taken during the rainy season, and right is Pantanaw, 019.

**Figure 38. MBN 028 (Maubin), PTN 019 (Pantanaw)**

290. The option open to the road designer during DED to minimize the resettlement issues is to reduce the width of the road to stay within the road opening or find an alternate alignment. The location of the village settlements along sub-project roads in Maubin and Pantanaw are listed in Tables 15 to Table 24, Section 5.17 of this IEE.

291. Another possible impact due to location is the possible conflicts of construction with hauling of farm produce during harvest seasons. It was observed that there is a marked increase in the number of farm vehicles during harvest season to transport harvested grains. The other possible conflicts are the farmers' practice of using the roads for drying grains and grain threshing on the road side during harvest season. This is of particular concern in Maubin and Pantanaw and possibly more significant in areas where two or three cropping is done. The following photographs taken during harvest season in Pantanaw show the use of road for drying and the queue of tractors transporting the harvests.

**Figure 39. Grains drying on the road (PTN 011), long queue of tractors hauling grains (PTN 008)**

292. The mitigation of these possible impacts will require consultation with the farming communities to identify acceptable alternative sites for drying and temporary alternative routes to bypass the work sites. Also, the Contractor should properly manage the work site.

293. The presence of water ponds, canals and irrigation ditches along the project roads is another concern in road construction in the delta region. Mitigation measures should be implemented to prevent the pollution, obstruction and damaging of the water ponds and irrigation canals during construction. The measures to avoid pollution of water bodies alongside the roadside include prohibition of bitumen storage, bitumen heating on canal / river banks. The location of the water crossings along the sub-project roads are listed in Tables 13 to 22.

**Table 27. Water Bodies**

| Road Package | Location / Station |
|---|---|
| MBN 004 | Water crossings<br>• Km4+170<br>• Km5+900<br>• Km7+300<br>• Km9+130<br>Ponds, aquaculture and water supply impoundment are present at the following stations:<br>• Km0 to 0+800<br>• Km1+200<br>• Km1+900<br>• Km2+800<br>• Km7+900<br>• Km8+100<br>• Km8+300 |
| MBN 005 | • Irrigation canal parallels the road from MBN 005 |
| MBN 019 | • Km 5+150 to the end - fishponds |
| MBN 028 | • Km 5+360<br>• Km 7+220<br>• Km 10+110 |
| MBN 039 | • Major crossing is at Km 1+850, Km 2+260<br>• Km 5+500<br>• Km 7+500<br>• Km8+200<br>• Km8+650<br>• Km9+280<br>• Km9+780 |
| PTN 005, PTN 012 | PTN 005 Km 8+000 to End – LS major irrigation and navigation channel |
| PTN 008 | Water crossing at Km 0+400<br>A waterway runs to the left of the road from Km4+500 to end of PTN 008; distance from road to waterway varies from 70 to 200 m; closest at the end Km 9+500 where the road is on the bank of the waterway. |

| | |
|---|---|
| PTN 011 | • Km 1+000 LS water pond<br>• Km 1+400 to 1+900 LS<br>• Km2+850 RS 200 m away from road<br>• Km3+910 LS 200 m from road |
| PTN 019 | Irrigation channel is located at the right side of the road from start to Km 11+500; the distance of channel from road's edge ranges from 1m to 200 m |

294. To protect water bodies during construction, the following measures shall be implemented:

- No materials will be stored within 50 m of a water course, including soil, spoil, aggregates, chemicals or other materials used during construction.
- Temporary drainage provision shall be provided during construction to ensure that any storm water running off construction areas will be controlled around al permanent water bodies.
- Water collection basins and sediment traps are to be installed in all areas where construction equipment is washed. Contaminated water will be removed off-site for disposal in the facilities identified in the Construction
- Construction in erosion and flood-prone areas shall be mainly restricted to the dry season where possible;
- Control silt runoff particularly around permanent rivers;

295. The sub-projects in Ayeyarwady will not affect any protected areas, key biodiversity areas (KBA), or important bird areas (IBA). The closest KBA is the Maletto Inn KBA but this wetland has extensively been developed into aquaculture ponds. It is now highly disturbed and severely degraded natural habitat. In fact, Birdlife International has not included this KBA in its updated list of KBAs in the Ayeyarwady Delta.

### 6.3 Land Acquisition and Resettlement Impacts

296. The road design parameters are variable to generally be within existing road widths. The typical road paved width is 3 m. This minimizes land acquisition requirements while still meets the needs of the local village communities for all-weather sealed roads. An engineering review and inventory of losses was undertaken in March 2019 covering all the proposed roads to identify road sections where the available road widths were insufficient to accommodate 3 m-wide sealed pavements, and if not, to assess whether to narrow the road width in those sections or acquire land to widen the road. The IOL was conducted based on on-site physical measurement by project consultants together with village authorities and interviews with affected households. During project implementation, detailed engineering designs will be prepared for each of the project roads. A detailed measurement survey will then be undertaken based on the final design to update or confirm involuntary resettlement impacts on land and non-land assets as well as impacts on livelihoods.[28]

297. **Preliminary Impacts Assessment.** Potential land acquisition and resettlement impacts for civil works were determined within corridors of impact (COI) of the roads. The typical COI is 3 m, but on some of the roads varies between 2.6 m and 3 m width to avoid involuntary resettlement impacts. Anticipated impacts including households losing marginal strips of land together with associated trees and crops. There will be no loss of structures nor physical displacement. There will be marginal impacts on livelihoods of

[28] Resettlement and Ethnic Group Plan (draft). April 2019. Proposed MYA: Rural Roads Access Project Department of Rural Road Development (DRRD), Ministry of Construction (MOC), Republic of the Union of Myanmar

households losing productive land. No shops or other livelihood sources are affected.

298. **Land Losses.** Land losses will be experienced in Maubin Township for road MBN005. One household will lose a marginal strip of productive rice paddy land along the road edge total 74 $m^2$. This loss is less than 1% of total productive land used by the household (see Table below)

**Affected Land:**

| Road | Chainage km | Village | Affected person | Land Type | Affected Area ($m^2$) | Percentage Loss |
|---|---|---|---|---|---|---|
| MBN005 | Right 7+050 | Maung Htaung Su | U Aung Zay | Paddy | 74 | 0.3% |

299. **Impacts on Structures**. No structures will be affected.

300. **Impacts on Productive Resources and Livelihoods**. As above, one household is expected to lose productive land (less than 1% of total productive area). No commercial or other income generating assets will be affected.

301. **Impact on Vulnerable Households**. None of the affected households were assessed as being vulnerable. Moreover, all of the affected households are Bamar.

302. **Impacts on Community Facilities**. There will be no impacts on community facilities

## 6.4 Impacts Due to Construction

### *Sourcing of Construction Materials*

303. To avoid promoting or supporting illegal sand mining, extraction of rock through illegal quarry operations, and extraction of construction materials from illegal borrow pits, contractors will be required demonstrate that all construction materials are obtained from legitimate sources. Bidding documents will explicitly set out this requirement.

304. More particularly, the Contractor must use legitimate sources for aggregates, sand, and other construction materials. Legitimate sources are sources that have all legally approved licenses, permits and environmental approvals in accordance with the government requirements, and are free from any kind of disputes, If the materials will be sourced from the commercial suppliers, the requirements for the suppliers are the same as above. In addition to this, if the suppliers are sourcing the materials from illegal or disputed sources, the projects should not purchase the materials from such suppliers.

### *Construction Camp, setting and operations*

305. Construction camp have higher risks in terms of adverse environmental impacts because of its fixed location, relatively extended period of existence; use of local resources, i.e. water; disposal of domestic water and solid waste; storage of hazardous materials (e.g. fuel, lubricants, prime coat, bitumen solvents, etc. All these are possible sources of pollution. The construction camp can also be source of social impacts, i.e. conflict with host community, pose security and health hazards to residents.

306. The mitigation of the impacts of construction camp starts in its planning. Minimizing the need for construction camp by hiring local residents. This has been achieved in one of the road projects in Maubin, where the contractor hired local residents who are shuttled to and from the work sites.

307. The selection of the camp site is also key to mitigating impacts. While the contractor's main criteria for selecting site are cost and accessibility, of equal importance is the environmental criteria, e.g. distance

of camp from water bodies, forested areas, settlements / houses. An ill-located camp can be problematic and costly to the Contractor. Aside from workers' accommodation, the camp typically includes stockpiles area, fuel and equipment depot and maintenance shop, asphalt or batching plant. Activities within the camp will generate noise and dust and to protect the community from these impacts, not to mention the possible social conflict between camp dwellers and the community. To minimize these impacts, a minimum separation distance of 300 meters between camp and nearest house should be observed.

308. To prevent pollution, the Contractor should locate camps away at least 300 m from surface water bodies and shall implement the following:

- The Contractor must observe pollution prevention measures in the camp through the following means:
- Provide camp with wastewater treatment facility, e.g. septic tanks with soaking pit;
- Practice waste management for hazardous and non-hazardous wastes;
- Observe proper handling and storage of fuel, lubricant and bitumen; fuel and lubricant storage area should be provided with impervious flooring, containment wall and sump;
- Refuelling of equipment should be supervised;
- There shall be no burning of waste in the camp or work sites.

309. For the protection of the workers' health and safety, the Contractor should implement the following:

- Providing separate accommodations and toilet and baths for men and women;
- Providing the camp with sufficient supply of clean water;
- Provide camp with first aid kit and fire suppression equipment;
- Conduct AIDS/HIV prevention awareness training for the workers;

310. For the security of workers, the Contractor shall implement the following:

- Install perimeter fence;
- Impose camp rules such as curfew, prohibitions of gambling, consumption of alcohol, carrying deadly weapons in the camp and work places;
- Conduct regular workers' orientation.

*Clearing and Grubbing*

311. After the site has been handed over to the Contractor, the initial activity is the clearing and grubbing of the work site. As typically defined in the contract, it involves removal of all structures within the work area, including the removal of trees. Relocation of utilities is also done by the utilities' owner in coordination with the Consultant and MOC/DRRD. Grubbing refers to the removal of tree trunks and excavation of the roots. This activity generates waste which may include concrete rubbles and bricks, tin sheets, waste wood and vegetation materials from the cut trees, spoils. Equipment such as excavators, pavement breakers maybe be used which are sources of noise and emissions. The contractor should exercise caution during clearing to avoid damage to properties and utilities and removal of trees outside the work area. The contractor should coordinate with the village official and affected property owners prior to the clearing. The work area should be demarcated on the ground using highly visible markers such as stakes, flags, barrier tapes. The disposal site of the waste materials should be identified prior to clearing. Any damage to properties during clearing should be immediately repaired by the contractor. Public as well as traffic safety measures (e.g. warning signs, barriers, signal men) should be in place.

- Tree Removal

312. The road survey has inventoried the following number of trees for each of the roads (Table 28). But it is not yet certain how many trees will need to be removed. This information will only be available after the centreline of the road has been staked on the ground.

**Table 28. Number of inventoried trees**

| Road | Number of Trees |
|---|---|
| 1. MBN 004 | 155 |
| 2. MBN 019 | 323 |
| 3. MBN 039 | 248 |
| 4. PTN 005, PTN 012 | 298 |
| 5. PTN 019 | 175 |

313. DRRD shall develop tree nurseries with the cooperation of the host communities. Following advice during consultations, trees should be planted as close to the locations of the removed trees as possible and in pagodas and schools and other suitable areas which will not affect road safety/visibility. Privately owned trees will be compensated through the Resettlement Plan. For trees on government-owned land, as a general guideline, the contractor shall plant three trees for every tree removed. This is to assure the survival of replacement tree. The host communities shall be consulted on the preferred species for replacement planting. Trees will be replanted in the appropriate season to increase their viability. Technical assistance in tree replanting shall be sought from the Department of Forestry.

314. The procedures to be followed for the removal of the trees are as follows:

a. Conduct an inventory of trees and mark all trees for removal within the construction zone.
b. Secure Permit from the Department of Forestry for removal of Teak and other trees; Present the permit to the DDIS Consultant.
c. The Contractor should submit a Request for Inspection (RFI) to the DDIS Consultant to gain approval for actual tree cutting;
d. Felled trees (except Teak trees which belongs to the government), roots, stem, brush and other vegetation materials are to be taken to an off-site that is approved by the DDIS Consultant; with agreement with the Department of Forestry, Teak trees may also be temporarily stockpiled by the Contractor on behalf of the Department of Forestry;
e. The Contractor shall turn over the trees to the tree owner or host community.
f. Local residents are free to collect the trimmings and branches of the felled trees for firewood and other uses.

- Community Facilities

315. Community facilities such as water supply system, drinking water stands, waiting sheds, footbridges located on the road's edge, if cannot be avoided will have to be removed and replaced by the project. Prior community consultation shall be carried out by DRRD, with the assistance of the Contractor and DDIS Consultant to prevent inconveniencing the users. The community shall be consulted on the timing of the removal and replacement, the location of the replacement structures and/or the provision of temporary facilities.

316. The clearing may cause inadvertent damage to facilities, or hinder access to community facilities like health centers or schools, places of worships (see Section 5.17 for the list of community facilities located along the sub-project roads). In such an event, the Contractor should immediately repair the damage.

317. A typical example of the condition of rural roads within village settlements is shown in the following photo of a section of MBN 039. The photo shows some of the structures located on the road side which may be affected such as the approach of the footbridge at the left side and the presence of a drinking water stand at the right side.

318. To mitigate this impact, the Contractor should clearly demarcate the boundary of the clearing area.

Items to be removed shall be tagged and clearing crew is properly oriented. The clearing should be supervised and monitored by DDIS Consultant. The village shall be informed of clearing schedule in advance. Damage incurred to community facilities during clearing shall be immediately repaired by the Contractor.

**Figure 40. A section of MBN 039**

- Access

319. The clearing of the ROW will entail temporary closure of the roads and this will cause delays and inconvenience the travelling public. The Contractor and DDIS Consultant shall provide the village residents advance information on schedule of clearing works. Traffic management at the work site and the provision of alternative access routes are to be implemented by the Contractor. This should be part of the Contractor's traffic management plan. It is important that the Contractor / DRRD inform the affected communities of any temporary road closure well ahead of actual works.

- Interference with Farming Activities

320. The clearing and grubbing works will also prevent the use of the road by farmers for drying grains and hinder access due to temporary road closures.

321. To mitigate these impacts, the Contractor should conduct a consultation with village officials and farmers to inform them of the work schedule, agree on the alternative drying sites and alternative access routes.

- Waste Disposal

322. The clearing and grubbing of the ROW will generate varied waste materials which may include concrete rubbles, waste wood, discarded tin sheets and metals and vegetation materials. The Contractor should identify a waste disposal site and present the site to the DDIS Consultant prior to clearing. To minimize disposal, recyclables and re-usable materials should be gathered. Concrete and masonry waste materials should be recycled as construction materials or used as fill materials if approved by the DDIS Consultant. The waste metals can be recovered and sold to aggregators of recycled materials. The wood materials can be given out for use as wood fuel by residents. The waste vegetation materials (leaves, small branches) should be collected in a composting site provided by the host community.

- Noise and dust

323. Clearing and grubbing will use equipment such as pavement breakers, back hoe / excavator and trucks for hauling materials. In road sections where sensitive receptors are present within 50 m of the road centreline, Contractor should implement mitigating measures and among these are: (a) limiting the operations of equipment between 0700H and 1800H; (b) noise generating stationary equipment like compressors, portable power generators should be located away from houses, schools, places of worships and other sensitive receptors.

324. Dust suppression by spraying water over the work area in populated sections should be done at least twice a day, once in the morning and once in the early afternoon.

*Removal of unsuitable materials*

- Disposal of removed pavements and unsuitable materials

325. The removal of unsuitable materials is a necessary part of road construction to attain the desired quality of the road. This will entail the removal of the existing pavement (if paved) and excavation of the base if needed. Commonly, the stripped pavement is disposed, but in places where materials are not readily available, the stripped pavement material is crushed and re-used as base material as done in the Maubin-Pyapon Road. Due to scarcity of sources of materials, it is assumed that the same will be done for the RRAP. It is also anticipated that the unsuitable materials will be used as filling materials in areas where such quality of soil is acceptable (e.g. shoulder). Spoils not suitable as fill material shall be used for cladding the embankment to enhance vegetation growth.

326. Disposal sites for spoils should be identified following the guidelines (Section 6.2.) for preventing contamination or siltation of water bodies. All disposal sites should be approved by the DDIS Consultant and relevant environmental protection authorities.

- Road Closure

327. This construction activity will entail partial or total closure of the road. The road closure will impede the traffic. To mitigate this impact the Contractor shall: (a) Inform affected villages of work schedule and schedule of road closure; (b) with the assistance of the village officials, select and provide temporary alternative routes; and (c) provide safe passageway through the work site for pedestrians and motorcycles;

- Noise and Dust

328. Dust suppression and measures to control noise should be put in place. Noise generating activities including operation of heavy equipment should only be carried out between 0700H and 01800H. Stationary sources of noise should be located away from sensitive receptors and Contractor shall only ensure that equipment is equipped with noise mufflers and that equipment are regularly serviced.

*Building the Embankment and Laying of Base Materials*

- Siltation during delivery of materials

329. The construction of the embankment will involve mainly the delivery and placing of base materials and compaction. In other parts of Myanmar, one method of delivery of sand to site is by barge and sand is unloaded as slurry. The sand is pumped from the boat and conveyed to site through pipes. This delivery method will require collection of the return water and holding it to allow sediments to settle. Discharging directly to water bodies will cause very high turbidity which may exceed the existing environmental guidelines. The other impact of boat delivery of construction materials is that it will increases boat traffic and may impede access to boats transporting farm and aquaculture products (e.g. MBN 019)

330. The return water from sand delivery should not be allowed to flow directly into water body. It should be retained to allow sediments to settle. The common practice is to create a pond using the delivered sand and retain water within. This impact is critical in the MBN 019 where aquaculture ponds are widely present.

- Increased boat traffic and possibly congestion due to delivery of materials

331. Contractor or materials supplier should consult with host community and village officers on the selection of berthing and unloading point along the waterway. The materials unloading should not interfere with communities use of waterways.

- Noise and dust during to transport of materials

332. Alternatively, materials can be delivered by trucks, but given the narrow width of the rural roads, materials will have to be delivered by small trucks. This will increase road traffic, causing impacts on dust and noise and expose the public to traffic hazards. Other equipment that will be used for this phase of road construction that will generate noise and vibration are road grader and road roller.

333. Dust suppression by watering the bare areas in populated areas should be done at least twice daily, early morning and mid-afternoon, the periods when the roads are likely to be busy. Noise mitigating measures such as scheduling of noisy activities between 0700H to 1800H. Ensure Contractor's equipment is fitted with noise mufflers and that the communities have prior information on the work schedule.

- Road Closure

334. To alleviate impacts due to road closure, alternate temporary routes will have to be identified and provided in consultation with the host community, i.e. village officers and residents. This should be part of the Contractor's traffic management plan.

- Public Safety

335. The increased traffic due to the construction, road closure and operations of equipment will pose threat to public safety. To mitigate these impacts the following, among others, should be implemented;

  - Prepare traffic plan and present to the village officials
  - Install warning at both approaches of work sites and install directional signs as necessary
  - Assign traffic signal men, coordinate with village officials for traffic control if necessary
  - Separate pedestrians from traffic using barriers
  - Use light and/or reflectorized paints to make signs visible at night;
  - Provide lighting in work sites

- Conduct regular traffic safety training and refresher course for drivers and other project staffs

*Paving – Penetrated Macadam and Double Bitumen Surface Treatment*

336. The paving of the road starts with the spreading of aggregates, application of prime coat followed by bitumen. For DBST this process is done twice, spreading of aggregates followed by the second spreading of bitumen. This is done either by hand or mechanically. The typical manual process is shown in the following photos taken from road repair activity in Maubin.


**Figure 41. Typical road repair in Myanmar**

**Figure 42. Heating of bitumen using firewood**

- Occupational Hazards

337. This construction activity exposes the workers to hazards of inhaling bitumen fumes, burn injury, and heat stroke. The risk is higher with the manual method. The manual method as observed in Myanmar road repair involves spreading of aggregates by hand, heating bitumen using firewood and spreading of bitumen by hand with compaction done using a road roller.

338. The alternative to the manual method is the mechanical method which uses a truck mounted aggregate spreader, gas fired bitumen heater and truck mounted bitumen sprayer. This method mitigates most of the occupational hazard associated with the manual method. To further enhance occupational safety workers should be equipped with personal protection equipment, safety shoes, gloves, eye protection, high visibility vest. Also, ample drinking water should be provided since workers will be exposed to heat and will need frequent rehydration. Regular rest period and rotation of workers should also add to occupational safety during this phase of the work. For public safety, signs and barriers should be installed to separate work site from pedestrians.

- Pollution from heating of bitumen

339. The open heating of bitumen in numerous locations will increase the threat of pollution from bitumen spillage (see **Figure 42**). Also, the use of firewood for heating bitumen can lead to cutting of trees for fuel. The use of gas fired bitumen heaters and truck mounted sprayers is the best alternative to manual open heating.

340. The pollution of waterbodies during bitumen paving can occur if it rains before the prime coat has dried up. The prime coat can be washed out by the run-off. Paving should be put off if rain is predicted. Work stoppage during the rainy season is provided in the contracts of other road projects in Myanmar and should be imposed in the RRAP as well.

### *Concrete Cement Paving*

- Pollution from concrete paving

341. Concrete cement paving will involve the installation of forms and pouring of the concrete mix. The concrete mix maybe supplied from a batching plant and transported to site by a transit mixer. For small requirements of the rural roads, concrete maybe mixed on site using portable concrete mixer. One concern with the delivery of concrete mix by transit mixer is the disposal of the transit mixer's wash water after delivery. The wash water is highly basic and should be disposed properly in a wastewater facility at the plant site for re-use, e.g. dust suppression and equipment washing. It is anticipated that the risk of pollution due to the use of concrete cement mix will be low due to the comparatively small requirement for concrete cement paving. However, should the Contractor decide to put up a batching plant, the contractor should provide it with a sedimentation pond. Additionally, the Contractor should secure the necessary permit and strictly disallow discharge of transit mixer wash water in canals / rivers or banks. Transit mixer wash water should be disposed at the batching plant sedimentation pond.

### *Construction of Culverts*

- Pollution and interruption of water delivery to farms and aquaculture ponds

342. The construction of culverts and drains will entail the removal of existing structures and excavation to attain the required specification. Culverts can either be cast in place or pre-cast. Use of pre-cast culverts is preferred to minimize pollution at the construction site. Cast in place will require the installation of forms and mixing on site and pouring of concrete mix. The main concern with the construction of culverts and drains is the possible impact on the irrigation canals present in the sub-project roads. This will require cutting off the water flow through the section where construction is taking place. The obstruction of the irrigation canals can affect delivery of irrigation water to the fields with dire consequences to the farmers. Particularly, if done during the growing season when delivery of irrigation water is critical.

343. The protection of the fishponds from pollution coming from construction activity is another concern during construction of the culverts. Use of pre-cast culverts, pipe and box, will minimize risks of pollution and should hasten the construction. To mitigate the possible impacts on irrigation, the contractor should consult with the farming community for the timing of the work and to seek other possible measures, e.g. provision of temporary diversion canals. Further, contractor should clean-up work sites upon completion of the work.

- Temporary loss of safe water crossing at culvert construction sites

344. The construction of the culverts will incumber safe crossing across waterways. To mitigate this, the contractor should provide temporary bridges to allow pedestrians and motorcycles to safely cross the water channel.

### *Bridge Construction*

- Erosion and siltation during bridge construction

345. Bridge construction will entail the removal of existing structures, excavation for the abutment, construction of the abutment, installation of the bridge deck. Possible impacts of bridge construction will be obstruction of rivers used for navigation and possible pollution of the waterway. Increased water turbidity may occur during the excavation for the footings of the bridge.

346. For mitigation, the Contractor should implement the following: (a) Stabilize banks to prevent slumping / erosion of excavations; (b) Excavated materials for disposal should be hauled immediately from the site: (c) Waste form materials should be cleared and disposed properly; (d) There shall be no discharge of transit mixer wash water into the water body; (e) Materials accidentally dropped into the waterbody should be removed immediately.

- Boating safety at work site

347. Some of the waterways that will be worked on are used by community for navigation. For safety of navigation during construction, the Contractor shall: (a) Inform the community of the work schedule; (b) Contractor should provide safe navigation passage through the work site; (c) The passage through the work site should be properly marked and visible at night time.

*Hazardous Materials Management*

- Bitumen and Prime Coat

348. The management of bitumen and prime coat for prevention of pollution shall include the following:

- The bituminous materials storage area should be located away from water bodies shall be kept neat and tidy.
- Drums of bituminous material shall be stacked on their sides and only in small quantities with gaps between each stack to reduce fire risk. The stockpile area should be lined by sand to allow easy collection of spilled materials. The collected materials can be re-used for road repair.
- Empty bitumen drums shall be stacked upright to prevent spillage of residual materials remaining in the drums. Drums can be sold to recyclers.
- If bitumen delivered in plastic packaging, it should be stored in covered area, away from sunlight; storage should be lined by a layer of sand to allow easy collection of spilled bitumen and use of spilled bitumen for road repair;
- Packaging should be collected and disposed in approved waste facility;
- Delivery of bitumen in reusable bulk containers is preferred.

- Fuel and Lubricants

349. For safety and the prevention of pollution by fuel and lubricant, the Contractor should implement the following: (a) Fuel and lubricant depot should be secured, covered and provided with hard standing with a containment wall. (b) Refuelling and delivery of fuel shall be supervised. (c) Warning signs, e.g. Flammable, No Open Flame, No Smoking shall be posted. (d) Fire extinguisher should be provided at the fuel depot.

- Hazardous Wastes

350. Hazardous wastes that will be generated during construction will include used oil and solvents; oil tainted materials, e.g. rags, oil filter and sludges. All these will be collected from equipment service yard / repair shop, fuel depot. These materials shall be stored in 200-liter steel drums or plastic barrels with lid and shall be labelled. There materials shall be stored temporarily in a storage area in the camp. The storage shall be roofed, with concrete flooring and containment wall. It will also be fitted with a floor sump for oil and water separation. The sludge material from the sump shall be cleaned and collected and disposed together with the used oil and other hazardous waste materials. The used oil can be sold to recyclers, while the oil tainted materials should be disposed in an approved site.

### *Solid Waste Management*

351. Solid wastes from the camp will include organic wastes from kitchen and mess hall; plastic packaging of food, condiments, plastic water bottles, aluminium cans, tin cans, waste fabrics; waste papers and plastics from the offices. Waste LED bulbs may also be generated from the camp and facilities.

352. Solid wastes from the equipment maintenance yard may include packaging materials (cardboards and plastics), plastic containers, waste equipment parts. Worn out rubber tires are other wastes that will come from equipment maintenance. The waste air filters, spent oil filters and oil stained fabrics (rags) are considered hazardous and should be managed as such.

353. The contractor shall implement waste segregation and recovery of recyclables. Solid wastes shall be classified into hazardous and non-hazardous (general wastes). The non-hazardous wastes shall then be classified into biodegradable, non-biodegradable and recyclables. All recyclable materials such as plastic bottles, glass bottles, tin cans, metal scraps shall be segregated and shall be sold to buyers of recyclable materials. Residual wastes shall be contracted out to the township for collection and disposal at its disposal facility.

354. Waste bins shall be provided for bio-degradable and non-biodegradable materials. The bins shall be placed in various places in all the facilities. The plastic bins shall be marked and color coded for biodegradables, non-biodegrable and recyclables for easy identification by the workers. The waste shall be collected every day and shall be temporarily stored in a holding area where it will be collected and hauled by the waste contractor.

### *Wastewater Management*

355. The camp shall be provided with wastewater treatment systems e.g. sealed septic tank with soaking pit. All waste water from toilets, bathroom, kitchen shall be conveyed to the septic tank. Final disposal of septic effluent shall be through a soaking pit that is properly located with respect to wells and dwelling places.

356. The batching plant, if any, shall be provided with a sedimentation pond where plant and transit mixer wash water shall be collected. The wash water shall be re-used for dust suppression and equipment washing.

### *Borrow pits*

357. The removal of materials from borrow pits will cause permanent change in topography and land use. To minimize the impacts of borrow pits the contractor should observe the following guidelines for selecting site for borrow pits: (1) avoid productive agricultural lands and ecologically important places; (2) Prefer sites which are shielded, i.e. outside view corridors to maintain scenic view quality of the landscape ; (3) Choose sites that are distant from settlements and away from ecological impact receptors like surface water bodies, forested areas and the like; The Contractor should obtain the necessary permits for the borrow pit; The contractor should rehabilitate the borrow pit upon completion of the excavation to prevent hazards to the public.

358. As much as possible opening of borrow pit shall be avoided by adopting the following measures:

- Reuse excavated materials from different sections of the road provided these are suitable and with the approval of the DDIS Consultant.
- Borrow materials may be obtained by widening cuts, widening ditches or by excavating from other sources outside the planned cross section within the right-of-way or slope easements and within the limits of the project, with the approval by the DDIS Consultant.
- For borrow sites outside the ROW, the Contractor should secure approval with the land owner and should confine excavations within the permitted area only.

- On completion of work all faces shall be trimmed to a slope flatter than 1 in 4. Where this is impracticable or where the working face is to be left exposed, the edge of the borrow pit shall be permanently fenced.

### *GHG Emissions*

According to a WB[29] study, globally, transportation was the second largest source of energy related emissions of about 13.9% with road transport accounting for about 90 to 95% of the transport's contribution to GHG emissions. In the Asian region, road transport's share in transport GHG emissions is 95 to 100% as compared to 72% for the entire world. The study estimated that GHG emissions for rural road construction is 90 to 103 t $CO_2$ eq/km, gravel and DBST, respectively. The breakdown of emissions by work items for rural roads are as follows:

**Table 29. Typical GHG emissions for construction of 1 km of rural road (from WB 2010)**

| Emissions t $CO_2$ eq./km | Rural Road Gravel | Rural Road DBST |
|---|---|---|
| Earthworks | 2.74 | 2.68 |
| Pavement | 72.2 | 85.53 |
| Culverts | 11.85 | 11.57 |
| Structures | 3.03 | 2.95 |
| Road Furniture | 0.00 | 0.00 |
| Total | 89.82 | 102.74 |

359. The above table shows that pavement is the main source of GHG emissions. The total for rural road is merely 2.8 to 3.2 factor equivalent to GHG emissions of expressway construction. The relatively high GHG emissions due to construction activity in Asia is said to be a factor of the procurement and construction practices and due to the use of old technology and equipment of poor condition. To minimize GHG emission, asphalt plant and mobile equipment shall be current models and properly maintained. The indicative amount of GHG emissions that RRAP will generate can be deduced from the above emissions table, and are estimated to amount to 10,350-11,900 t $CO_{2eq}$ for the entire construction period.

### *Abandonment*

360. Prior to completion and demobilization, the Contractor should prepare an abandonment plan for the approval by the DDIS Consultant. Upon completion of the construction, the contractor shall demobilize, workers and equipment as per the approved abandonment plan. The contractor shall remove all equipment, structures and waste materials from the work sites, construction camp, stockpile areas, etc and rehabilitate the land according to the agreement with the landowner.

## 6.5 Impacts Due to Operations

361. The operations stage is when the MOC / DRRD has taken over the completed roads. The main responsibility of the MOC / DRRD is the regular maintenance which includes the repair and patching of potholes, cleaning out of drains, restoration of safety features such as road markings and clearing of roadside vegetation. The environmental impacts of these activities are minimal. But of primary concern is the safety of workers as they carry out the maintenance work. For workers' safety, workers should be separated from the vehicular traffic through the use of markers and barriers. Workers should be provided safety equipment (e.g., high viz vests, safety shoes, gloves). To prevent pollution, bitumen heating area shall be cleaned up after repair is completed and materials shall be stockpiled away from the road shoulder, if not possible, markers and warning signs should be installed on both approaches of maintenance area.

[29] World Bank 2010. Greenhouse Gas Emissions Mitigation in Road Construction and Rehabilitation: A Toolkit for Development Countries. http://siteresources.worldbank.org/INTEAPASTAE/Resources/GHG-ExecSummary.pdf

# 7. ANALYSES OF ALTERNATIVES

362. ADB's SPS 2009 contains a requirement for the examination of alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and consider the no-project alternative.

## 7.1 The Without the Project Alternative

363. The government proposes to establish a national rural roads and access strategy and program to mobilize effectively larger resources to the task, improve governance and raise quality, inspired from good international examples. In 2015, an ADB study revealed that an estimated 20 million people in Myanmar live in villages without access to an all-season road, which is over half of Myanmar's rural population. After the release of the ADB study, the government convened to increase financing and launch a coordinated approach to rural road development during a high-level workshop in 2016.

364. To meet the government's request, ADB has responded by providing technical assistance (TA) and introduces the planning concept of the core rural road network (CRRN), which refers to the minimum network of rural roads connecting each village and key destination by a single road. As a second step, the project will finance rural road and access improvements prioritized on the basis of the CRRN in selected townships. Lessons learnt will help develop strong implementation arrangements and fine-tune the planning approach. Civil works will also feature technical trials needed to develop national standards. In parallel, the project will build the government's capacity, to enable it to manage the national program, and absorb in the future larger scale foreign funding.

365. Improving rural road access is key to the economic development of the country. The "without the project" alternative is not acceptable as it will set back the development that the country with the assistance of international donors has embarked on.

## 7.2 With the Project Alternative

### [redacted] *Alignment*

366. The general alignments of the rural roads are set since the sub-project roads are existing, either as tracks or unpaved rural road. There might be some sections where minor adjustment will be needed to improve road safety. Limited land taking is necessary for this purpose and the DDIS Consultant and contractor will see to it that alternative sites are considered to minimize social (e.g. impacts on community facilities) and environmental impacts (e.g. tree removal).

### [redacted] *Pavement Types*

367. The design consultant has considered three types of pavements appropriate for different conditions of the sub-project roads. The types of pavements include concrete cement, penetrated macadam and double bitumen surface treatment (DBST). Penetrated macadam is very common type of pavement used in rural roads of Myanmar which is constructed by hand. This method exposes the workers to occupational hazards with high risk of pollution due to heating of bitumen on open fire using wood fuel. For RRAP, use of mechanical methods should be considered.

368. DBST is similar to penetrated macadam except that the aggregates are of small size and bitumen paving is done twice. This may also be carried out manually, but the common method is the mechanical method using bitumen spray and aggregate spreader.

369. Concrete cement pavement is considered but its use will be limited.

*Construction Method*

370. The construction of the rural roads can either be done manually or with the use of equipment. Manual road construction is very common in Myanmar and local contractors are very familiar with the method. One of the benefits of the manual construction is the amount of temporary work that it will generate. However, the downside of the manual method is that workers are exposed to many hazards, e.g. exposure to bitumen fumes, burns, exposure to heat and dust among others. Also, the heating of bitumen in drums in open areas using firewood is prone to spillage and pollution.

371. On the other hand, the construction can be done using equipment such as truck mounted gas fired bitumen heater and spreader, aggregate spreader. This minimizes the hazards to the workers and minimizes the risk of pollution from open heating of bitumen. The mechanical method is the preferred method from environmental management point of view.

# 8. INFORMATION DISCLOSURE AND PARTICIPATION

## 8.1 Public Consultations

372. Information disclosure and meaningful public consultation are part of the ADB safeguards policy principles and a requirement for environmental assessment in Myanmar as provided for by the EIA Procedures of 2015.

373. The EIA Procedures 2015 require public consultation at every stage of the IEE / EIA process (e.g. scoping and public hearing) and disclosure of project information via public media or posting of legible signboards at the project site. Public consultation should be done through press conferences and interviews with local communities, PAPs local authorities and community-based organizations.

374. An initial public consultation was carried out in all the sub-project roads as part of the environmental survey done in October 2017. The initial public consultation covered the following:

a. Informed the stakeholders about the proposed project and its objectives
b. Discussed the potential impacts and proposed mitigation measures;
c. Gathered concerns and suggestions from the stakeholders on environmental and social issues related to the implementation of the proposed project.

375. As an initial step, the Environmental Survey team met with township level representatives of the General Administration Department (TGAD). Thereafter, consultations were conducted with the Forestry Department, Department of Agricultural Land Management and Statistics (DALMS), etc. The project was presented to the government offices during these consultations. Information regarding possible sources of materials and necessary permits and clearances were also solicited during these meetings with the government offices. Other information was solicited pertaining to land use and cultural information. Also discussed were the concerns, opinions and suggestions of the agency representatives regarding the project.

376. The representatives of government offices who were present in the consultations are the following:

**Table 30. Representatives of government officials who were present in the consultations**

| Sr | Name | Township | Designation | Date |
|---|---|---|---|---|
| 1 | U Aung Myint Thein | Maubin | Administrator TGAD | 25.10.17 |
| 2 | U Tin Aung | Maubin | Forestry | 25.10.17 |
| 3 | U Soe Tint | Maubin | Land Management | 25.10.17 |
| 4 | U Thant Zin Min Tun | District | Executive Engineer | 25.10.17 |
| 5 | Daw Htet Myat Mon | Maubin | SAE | 25.10.17 |
| 6 | Daw Phyu Phyu Thant | Maubin | Junior Engineer | 25.10.17 |
| 7 | U Ye Min Aung | Pantanaw | Administrator TGAD | 26.10.17 |
| 8 | U Thaung Tun | Pantanaw | Office Staff | 26.10.17 |
| 9 | Daw May Thu Win | Pantanaw | Office Staff | 26.10.17 |
| 10 | U Thant Zin Min Tun | District | Executive Engineer | 26.10.17 |
| 11 | Daw Su Nanda Aye | Pantanaw | DRRD (S.A.E) | 26.10.17 |

377. It was noted during the consultation with the township officials that some of the concerns and opinions mentioned during the meeting were based on experiences with the Maubin-Pyapon Road project. The consultants reminded the officials that this is a rural road project with different specifications and implementation arrangements.

378. Subsequently, small group meetings and random interviews were conducted simultaneous with the reconnaissance survey undertaken from 16 October to 02 November 2017 and in February 2018, involving

84 potentially affected people. The participants and respondents during these consultations included the village administrators, community-based organizations, village elders and village residents. The list of participants and respondents are listed in tables below. The public consultation meetings were supplemented by small group meetings and random interviews with village representatives such as monks, land owners, and farmers.

379. Public Consultation during preparation on the IEE was limited and cannot be considered to be gender inclusive. For example:

i. Four (4) women out of 11 for the public consultation meeting with the government official staff in Ayeyarwaddy
ii. Five (5) women out of 56 for the public consultation meeting with community at Maubin Township
iii. Three (3) women out of 60 for the public consultation meeting with community at Pantannaw Township

380. It is recommended that there is equal participation of women and men for the future public consultation in community during project implementation (see Section 8.4).

**Table 31. Public consultations in Maubin**

| | Name | Township | Position / Designation | Date |
|---|---|---|---|---|
| ***MBN004 Tar Part- Seik Thar- Kywe Done*** | | | | |
| 1 | U Aye Thein | Maubin | Village Tract Leader | 19 Feb18 |
| 2 | U Tin Kyaing | Maubin | Village Leader | 19 Feb18 |
| 3 | U Aunt Sein | Maubin | Village Elder | 19 Feb18 |
| 4 | U Maung San | Maubin | Village Elder | 19 Feb18 |
| 5 | U Kyaw Oo | Maubin | Village Leader | 19 Feb18 |
| 6 | U Zaw Hoe | Maubin | Village Elder | 19 Feb18 |
| 7 | U Aye Aye | Maubin | Village Elder | 19 Feb18 |
| ***MBN005 AungHeik-PaLeGon-SaLinDaung Village*** | | | | |
| 1 | U Moe Kyaw | Maubin | Village Tract Leader | 24.10.17 |
| 2 | U Win Aung | Maubin | Village Resident | 24.10.17 |
| 3 | U Lwin oo | Maubin | Village Resident | 24.10.17 |
| 4 | U Soe Than | Maubin | Village Resident | 24.10.17 |
| 5 | U San Maung | Maubin | Village Resident | 24.10.17 |
| 6 | U Sein Ka Lar | Maubin | Village Resident | 24.10.17 |
| 7 | U Thein Toe | Maubin | Village Resident | 24.10.17 |
| 8 | U Myo Myint | Maubin | Village Resident | 24.10.17 |
| 9 | U Myint Than Kyaw | Maubin | Village Resident | 24.10.17 |
| 10 | U Win Aye | Maubin | Village Resident | 24.10.17 |
| 11 | U Kyaw Thu Aung | Maubin | Village Resident | 24.10.17 |
| 12 | U Myo Min Aung | Maubin | Village Resident | 24.10.17 |
| 13 | U Zaw Htun | Maubin | Village Resident | 24.10.17 |
| 14 | U Thi Ha | Maubin | Village Resident | 24.10.17 |
| 15 | U Ko Naing | Maubin | Village Resident | 24.10.17 |
| ***MBN019, Ta Ni-Galo-Shwe Ta Chaung- Kyon Ta- Zi Gon Village*** | | | | |
| 1 | U Win Aye | Maubin | Village Tract Leader | 24.10.17 |
| 2 | U Soe Lwin | Maubin | Chair, Road Committee | 24.10.17 |
| 3 | U Ohn Tint | Maubin | Villag Elder | 24.10.17 |
| 4 | U Mya Aung | Maubin | Village Elder | 24.10.17 |
| 5 | U Htay Lwin | Maubin | Village Resident | 24.10.17 |
| 6 | U Sein Myint | Maubin | Village Resident | 24.10.17 |

| | | | | |
|---|---|---|---|---|
| 7 | U Kyin Khaing | Maubin | Village Resident | 24.10.17 |
| 8 | U Myint Sein | Maubin | Village Resident | 24.10.17 |
| 9 | U Nay Myo Aung | Maubin | Clerk | 24.10.17 |
| 10 | U Ohn Hlaing | Maubin | M/C Spare Parts | 24.10.17 |
| 11 | U Win Hlaing | Maubin | Shopkeeper | 24.10.17 |
| 12 | Daw Than Than Htay | Maubin | Shop keeper | 24.10.17 |
| 13 | U Aye Win | Maubin | Fish farming | 24.10.17 |
| ***MBN028, Chauk Ywa- Nga Hpa Ein Village*** | | | | |
| 1 | U Kyaw Lwin | Maubin | Village Leader | 25.10.17 |
| 2 | U Thant Zin Aung | Maubin | Village Leader | 25.10.17 |
| 3 | U Thar Yin | Maubin | Village Elder | 25.10.17 |
| 4 | U Kyaw Linn | Maubin | Village Elder | 25.10.17 |
| 5 | U Hla Myint Lay | Maubin | Village Elder | 25.10.17 |
| 6 | U Thein Myint | Maubin | Village Elder | 25.10.17 |
| 7 | U Aung Min | Maubin | Chair for Community Hall | 25.10.17 |
| 8 | U Tin Aye | Maubin | Village Elder | 25.10.17 |
| 9 | U Tun Kyaw Thu | Maubin | Village Elder | 25.10.17 |
| 10 | U Kyi Sein | Maubin | Village Elder | 25.10.17 |
| 11 | U Sit Oo | Maubin | Village Elder | 25.10.17 |
| 12 | U Tun Aung | Maubin | Villager | 25.10.17 |
| 13 | U Kyaw Oo | Maubin | Villager | 25.10.17 |
| 14 | U Ye Myint Zaw | Maubin | VT Clerk | 25.10.17 |
| 15 | U Tun Tun Win | Maubin | Villager | 25.10.17 |
| 16 | U Hla Myint Gyi | Maubin | Villager | 25.10.17 |
| 17 | Daw War War Win | Maubin | Shop Keeper | 25.10.17 |
| 18 | U Aung Myint Soe | Maubin | Farmer | 25.10.17 |
| 19 | U Thaung Shwe | Maubin | Villager | 25.10.17 |
| 20 | Daw Kyin Mya | Maubin | Villager | 25.10.17 |
| 21 | Daw Nan | Maubin | Villager | 25.10.17 |
| ***MBN 039 Swan Theik- Sin Gaung- Min Ball-Thae Phyu- Mhan Pin- Gna Ein Tan- Kalarsu village*** | | | | |
| 1 | U Maung Maung | Maubin | Village Tract Leader | 19.2.18 |
| 2 | Daw Shwe Zin Hteik | Maubin | Village Tract Leader | 19.2.18 |
| 3 | U Win Kyi | Maubin | Road Committee | 19.2.18 |
| 4 | U Hla Nyunt | Maubin | Road Committee | 19.2.18 |
| 5 | U Pyone | Maubin | Road Committee | 19.2.18 |
| 6 | U Mg Myint Aye | Maubin | Road Committee | 19.2.18 |
| 7 | U Thein Aye | Maubin | Road Committee | 19.2.18 |
| 8 | U Moe Thee | Maubin | Road Committee | 19.2.18 |
| 9 | U San Naing | Maubin | Road Committee | 19.2.18 |
| 10 | U Bo Bo | Maubin | Road Committee | 19.2.18 |

**Table 32. Public consultations in Pantanaw**

| | Name | Township | Position / Designation | Date |
|---|---|---|---|---|
| ***PTN 012 Gonmin Meinma Byay-Road*** | | | | |
| 1 | U Ye Min Hlaing | Pantanaw | Village Tract Leader | 20.2.18 |
| 2 | U Mya Aung | Pantanaw | Road Committee | 20.2.18 |

| | | | | |
|---|---|---|---|---|
| 3 | U Soe Kyaing | Pantanaw | Road Committee | 20.2.18 |
| 4 | U Zaw Min Oo | Pantanaw | Road Committee | 20.2.18 |
| 5 | U Maung Swe | Pantanaw | Road Committee | 20.2.18 |
| 6 | U Kyaw Kyaw Lin | Pantanaw | Road Committee | 20.2.18 |
| 7 | U Maung Gyi | Pantanaw | Road Committee | 20.2.18 |
| ***PTN 005 Daung Gyi-Taw Kyaung -Pyin Tone Gyi-Tu Chaung -Gonmin*** | | | | |
| 1 | U Aung Kyi | Pantanaw | Village tract leader | 20.2.18 |
| 2 | U June Kyaw Lwin | Pantanaw | Village Leader | 20.2.18 |
| 3 | U Han Tin | Pantanaw | Village Elder | 20.2.18 |
| 4 | U Win Myint | Pantanaw | Village Elder | 20.2.18 |
| 5 | U Kyaw Htay | Pantanaw | Village Leader | 20.2.18 |
| 6 | U Naing Win | Pantanaw | Village Leader | 20.2.18 |
| 7 | U Htun Htun | Pantanaw | Chaiman Road committee | 20.2.18 |
| 8 | U Thar Htoo | Pantanaw | Village Leader | 20.2.18 |
| 9 | U Tin Aung | Pantanaw | Village Elder | 20.2.18 |
| ***PTN 034 Htein Kone Village Road*** | | | | |
| 1 | U Thant Lwin Naing | Pantanaw | Village Tract Leader | 20.2.18 |
| 2 | Daw Min Min Aye | Pantanaw | Staff VT Administration Office | 20.2.18 |
| 3 | U Saw Htun Oo | Pantanaw | Village Leader | 20.2.18 |
| ***PTN011 Ka Nyin Ngu- Kayin Pat Taw- Inn Ta Kaw Village*** | | | | |
| 1 | U Myint San | Pantanaw | Village Tract Leader | 26.10.17 |
| 2 | U San Hlaing | Pantanaw | Development assistant | 26.10.17 |
| 3 | U Win Tin | Pantanaw | Village Elder | 26.10.17 |
| 4 | U Win Kyaing | Pantanaw | Village Elder | 26.10.17 |
| 5 | U Than Htwe | Pantanaw | Village Elder | 26.10.17 |
| 6 | U Nyi Nyi Aung | Pantanaw | Village Elder | 26.10.17 |
| 7 | U Maung Thet | Pantanaw | Village Elder | 26.10.17 |
| 8 | U Win Bo | Pantanaw | Village Elder | 26.10.17 |
| 9 | U Myat Tun | Pantanaw | Village Elder | 26.10.17 |
| 10 | U Than Naing | Pantanaw | Village Elder | 26.10.17 |
| 11 | U Myint Thein | Pantanaw | Village Elder | 26.10.17 |
| 12 | U Wai Lin Phyoe | Pantanaw | Village Elder | 26.10.17 |
| 13 | U Aung Win | Maubin | Village Tract Leader | 26.10.17 |
| 14 | Daw Aye Aye Naing | Maubin | Shopkeeper | 26.10.17 |
| ***PTN 008 Inn Ma -Inntakaw -Khayae Gan Road*** | | | | |
| 1 | U Than Myint | Pantanaw | Village Tract Leader | 26.10.17 |
| 2 | U Win Bo | Pantanaw | Road Committee | 26.10.17 |
| 3 | U Mae Aye | Pantanaw | Village Tract Leader | 26.10.17 |
| 4 | U Htay Aung | Pantanaw | NLD Party | 26.10.17 |
| 5 | U Kyi Sein | Pantanaw | Road Committee | 26.10.17 |
| 6 | U Gar Sein | Pantanaw | Road Committee | 26.10.17 |
| 7 | U Kyaw Soe | Pantanaw | Road Committee | 26.10.17 |
| 8 | U Lin Zaw Htwe | Pantanaw | Road Committee | 26.10.17 |
| ***PTN019 Kyon Tai Kale VT - Nga Kyin Chaung Mayan Thayet Ngu-Asugi-Kyon Pa Taw Village*** | | | | |
| 1 | U Khin Maung Win | Pantanaw | Village Leader | 27.10.17 |
| 2 | U Sein Min | Pantanaw | | 27.10.17 |
| 3 | U Tin oo | Pantanaw | | 27.10.17 |
| 4 | U Soe Lin Aung | Pantanaw | | 27.10.17 |

| | | | | |
|---|---|---|---|---|
| 5 | U Than Naing | Pantanaw | | 27.10.17 |
| 6 | U Min Zaw | Pantanaw | VT Leader | 27.10.17 |
| 7 | U Myint Aung | Pantanaw | Village Elder | 27.10.17 |
| 8 | U Kyaw San | Pantanaw | Village Elder | 27.10.17 |
| 9 | U Myint San | Pantanaw | Village Leader(100HH) | 27.10.17 |
| 10 | U Myint Shwe | Pantanaw | | 27.10.17 |
| 11 | U Myint Aung | Pantanaw | | 27.10.17 |
| 12 | U Htay Zaw Oo | Pantanaw | | 27.10.17 |
| 13 | U Than Myint | Pantanaw | | 27.10.17 |
| ***PTN031 Pi Tauk Su-Kyon Tha Naung-Yone Chaung-Aye Pon Su Village*** | | | | |
| 1 | U Sein Sa Tin | Pantanaw | Village Leader (100HH) | 27.10.17 |
| 2 | U Win Kyi | Pantanaw | | 27.10.17 |
| 3 | U Phoe Than | Pantanaw | | 27.10.17 |
| 4 | U Tun Mhwe | Pantanaw | | 27.10.17 |
| 5 | U Min Min Tun | Pantanaw | | 27.10.17 |
| 6 | U Aung Zaw Myint | Pantanaw | | 27.10.17 |

381. The village and township stakeholders were informed about the proposed project. The villagers generally knew about the project. Their knowledge of the project was obtained from DRRD staff who conducted the earlier surveys during project preparation stage. The general perception of stakeholders of the project is very positive as they are anticipating the improvement of access to their villages. Information were also solicited from the villagers regarding the occurrence of flooding and other natural hazards in their respective villages and road corridor in general. The presence of any reserved forest and other protected areas and culturally sensitive areas was also verified during the consultations. The villagers' concerns and suggestions/recommendations on project implementation were likewise discussed.

382. The opinions and concerns brought up by village officials and residents during the consultations are the following:

a. In general, all the stakeholders welcome the proposed project because of the expected benefits of the villages.
b. There are land owners who are willing to donate their land to help the community get access road.
c. There is concern on possible damage to crops during construction. It is recommended that construction should be scheduled during the dry season to avoid the rice planting season.
d. Farmers and shopkeepers who were interviewed in villages said that they understand that the project may affect gardens, their bamboos and trees or disturb their shops and that they are willing to cooperate with the project.
e. Those with poor road condition said that the project will help improve their lives because of the convenience it will bring. The project may also help improve business operations.

## 8.2 Consultation and Disclosure during preparation of the Resettlement and Ethnic Group Plan

383. Consultation meetings were conducted with Village Tract authorities and local stakeholders in each of the project road areas during the preparation of the project. Women were well represented in these meetings. The meetings presented an overview of the project and REGP preparation requirements[30].

[30] Resettlement and Ethnic Group Plan (draft). April 2019. Proposed MYA: Rural Roads Access Project Department of Rural Road Development (DRRD), Ministry of Construction (MOC), Republic of the Union of Myanmar

Interviews were conducted with each of the affected households and census where they were provided key information regarding the project road upgrading, project impacts and entitlements.

384. Public consultation from November to December 2018 in the Ayeyarwady Region in the villages where the proposed roads are to be constructed. At the time of the meetings, the widths of the proposed roads had not been determined. The purpose of the meetings was to introduce the project, explain survey processes to prepare a resettlement plan and to gauge preliminary concerns and issues if the existing roads are to be widened by the project.

385. Information was presented during the meetings by the team leader of the survey team. Information presented during public meetings included introduction of the project, identification of potential losses through surveys and provision of compensation for losses. Following the presentation, meeting participants were invited to ask questions, raise issues and make proposals. The approved REGP will be publicly disclosed on ADB's website and a summary of the REGP's translated version in the language of Myanmar will be disseminated in local village and Government offices for public access. A list of public consultations (meetings) undertaken during the survey is provided in below table. Women were well represented in these meetings A summary of key issues raised and ways in which the REGP addresses these is presented in the table below and records of the meetings are presented in Appendix 1 of the REGP.

**Community Consultation Sessions Conducted**

| Date | Road | Village | Place | Attendance |
|---|---|---|---|---|
| 30-Nov-18 | MBN 019 | Htan Nee | Htan Nee Village Administrative Office | 20 |
| 5-Dec-18 | MBN 005 | San Linn Daunt | San Linn Daunt Monastery | 74 |
| 8-Dec-18 | MBN 004 | Sate Thar | Sate Thar Village Leader House | 18 |
| 10-Dec-18 | MBN 039 | Soon Theik | Mhanpin Minball Monastery | 32 |
| 12-Dec-18 | MBN 028 | Chaut | Chaut Village Administrative Office | 26 |
| 14-Dec-18 | PTN 011 | KanyinGu | KanyinGu Monastery | 55 |
| 17-Dec-18 | PTN 008 | Kayay Kan | Pankayay Hall, Kayay Kan Village | 33 |
| 19-Dec-18 | PTN 019 | Kyone Tai Kalay | Kyone Tai Kalay Monastery | 19 |
| 20-Dec-18 | PTN 031 | Yone Kyaung | Yone Kyaung Monastery | 42 |
| 24-Dec-18 | PTN 005 | Taw Kyaung | Taw Kyaung Monastery | 25 |
| 27-Dec-18 | PTN 005(012) | Dala | Dala Village Leader House | 11 |
| **Total** | | | | **355** |

386. Main issues raised by the meeting participants included the need for the road to improve access to health services, school and markets, difficulties during rainy season due to poor road conditions, eagerness for the road works to be implemented soon, opinions about road widths and related impacts (see Table

below).

**Summary of Issues Raised in the Consultation Meetings**

| Key Issues Raised | REGP Response |
|---|---|
| Road width:<br>The project roads only need to be upgraded to a maximum of 20 to 25 feet (6-7.5m). | The design approach is for the roads is to utilize existing road widths as much as possible. It is expected that roads will have a paved width ranging from 2.6m to 3m. This approach minimizes the need for land acquisition. During detailed design, the final widths of the road works will be finalized. |
| There are also some electricity poles near the road edge. The posts were installed with funds from the villagers and so if they are needed to be moved, the project will need to assist. (MBN004) | IOL survey indicates that removal of poles can be avoided as the road width will be 3m on that road. If the electricity poles need to be moved, they will be relocated and reinstalled with assistance under the project REGP. |
| Compensation:<br>Impacts on productive farm land should be minimized. Loss of productive farm land should be compensated. There were also common comments that people are willing to donate some small portions of land and property. | All acquired property, including land and fixed assets that cannot be easily moved will be compensated at replacement cost. The project design will minimize impacts on productive land. The approach of designing according to existing road widths as much as possible (anticipated 2.6m to 3m) means that not much productive farm land will be lost. |
| Impacts on main structures:<br>The road widths should be reduced in built up areas within the villages to minimize impacts on houses and shops. Minor structures such as huts and fences can be moved back as needed. | The design approach of utilizing existing road widths as much as possible means that impacts on houses and shops are expected to be avoided. |
| Harvesting of crops:<br>Timing of site clearance and commencement of works should allow sufficient time for harvesting of crops (October-November). | The final implementation schedule is yet to be determined. Land acquisition and civil works will not commence before 2020. Communities and affected people will be notified well in advance of commencement of works. Any affected crops that cannot be harvested in time will be compensated at the price of the harvested crop. |

## 8.3 Consultations during Preparation of the Gender Action Plan

387. A Gender Action Plan[31] was prepared through focus groups established in Maubin and Patanaw. Participants were all women. The issues addressed included: (i) Women Groups in the village; (ii) Common source of Income; (iii) Interest in working as laborers for the road projects; (iv) Awareness and Interest to participate in Road Safety Program; (v) Awareness and Interest to participate in HIV and Human Trafficking

[31] Gender Action Plan (draft). April 2019. Proposed MYA: Rural Roads Access Project
Department of Rural Road Development (DRRD), Ministry of Construction (MOC), Republic of the Union

Program; and (vi) Incidents with fatalities due to emergency floods, snake bites, lightning, dog bites, emergency patient's deaths on the way to medical help.

## 8.4 Future Public Consultations and Information Disclosure

388. Public consultation shall be a continuing activity for the duration of the project implementation. The succeeding round of public consultation should be conducted prior to start of the project. The public consultation should: (a) share information regarding the progress of the project, (b) the work schedule, (c) provide orientation on the project's EMP and the GRM process; (e) introduce the contractor/s. The consultations should cover all villages within the road corridor, the township officials and the government offices. Consultations should ensure that there is equal participation by women and men.

389. The draft IEE has been submitted to ECD including the regional ECD office based in Pathein. Once the IEE and its EMP is cleared by ADB, the IEE/EMP will be disclosed on the project website. DRRD will send written endorsements to ADB for disclosing the IEE/EMP on ADB's website. Documents should be disclosed prior to obtaining ADB approval to start construction.

390. To comply with EIA Procedures 2015, signboards should be posted in all the sub-project roads of RRAP. Semi-annual monitoring reports will also be disclosed on the DDRD and ADB website.

# 9. GRIEVANCE REDRESS MECHANISM (GRM)

391. Per ADB's SPS 2009, the project is required to establish a mechanism to address grievances pertaining to the environmental performance of the project during construction and operation.

392. The GRM shall allow to prevent and address community concerns, reduce risks, and assist the project to maximize environmental and social benefits. In addition to serving as a platform to resolve grievances, the GRM should help achieve the following objectives: (i) open channels for effective communication, including the identification of new environmental issues of concern arising from the project; (ii) demonstrate concerns about community members and their environmental well-being; and (iii) prevent and mitigate any adverse environmental impacts on communities caused by project implementation and operations. The GRM must be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Opportunities for confidentiality and privacy for complainants are to be honored where this is seen as important.

393. The common complaints on road project's environmental performance as experienced in road projects in Myanmar are insufficient dust suppression during the dry season, damage to farmlands brought about by spillage of materials, spillage of materials into irrigation ditches, dust due to operations of batching plants, encroachment on community facilities (e.g. water supply); lack of coordination with government agencies with jurisdiction on government infrastructures affected by project activities (e.g. Irrigation Department). The resolutions of these complaints are usually within the authority of the Contractor, Project Proponent and the DDIS Consultant.

394. Land issues may arise in this project particularly in sections where some widening or minor adjustment of the road alignment is needed. Other issues like accidents (vehicular) involving the public may require resolutions that need intervention of other government authorities, i.e. police, township administration, etc.

395. For the rural roads project, a 3 level GRM is recommended as follows:

**Table 33. Grievance redress mechanism**

| No | Actions and Procedures |
|---|---|
| 1 | Level 1 – To Contractor<br>Upon receipt of the complaint, the complaint is immediately referred to the Contractor's Project Manager and EHS staff who shall then screen and determine if complaint is environmental in nature and within their jurisdiction. If yes, action is initiated to resolve the complaint. The resolution of the complaint is documented in the environment complaints register and the complainant is notified of the outcome. If the complainant is satisfied, the grievance is closed.<br>If the complaint is not within the jurisdiction of the contractor and DDIS Consultant, or need intervention by another party the complaint is referred to MOC and DRRD.<br>If the complaint is filed with the contractor, the DDIS Consultant should be notified within 24 hours of the complaint and the (proposed) resolution. The complaint is reported to DRRD/MOC by the DDIS Consultant through the monthly progress reporting.<br>Complaints should be resolved within 2 days, if not complainant can bring up the issue to the second level, i.e. submit the complaint to regional DRRD. |
| 2 | Level 2 - To Regional DRRD Office<br>The complaint is submitted to DRRD PMU through the regional DDRD. The DDRD PMU (through the Public Complaint Officer) screens the nature of the complaint and identifies offices / agencies (Township GAD, Police, MONREC/ECD, MOC, Department of Forestry, etc) with jurisdiction over the complaint. DRRD convenes a meeting among the offices with jurisdiction over the complaint within 5 working days of receipt of the |

| | |
|---|---|
| | complaint. The DRRD has 5 working days to arrive at a decision. Once resolved and the complainant is satisfied with the resolution, the complaint is closed in the ECR.<br>However, in case the complainant is not satisfied, he/she has the option to resort of legal means. |
| 3 | Level 3<br>If not resolved at Level 2 GRM, the Complainant may resort to legal channels. |

396. The DRRD is primarily responsible for organizing and managing the grievance redress mechanism with the assistance of the DDIS Consultant. DRRD will appoint a Public Complaints Officer (PCO) to the DRRD PMU to coordinate the GRM and deal with complaints from affected people throughout implementation of the Project.

397. Prior to construction, the PCO will finalize the GRM in collaboration with the regional DRRD and local governments. The regional DRRD will act as focal point for contact with the PCO. DRRD PMU and the regional DRRD will issue notices to inform the public within the project area of the GRM. Phone numbers, address, email addresses of the PCO, the regional DDRD, the DDIS Consultant and the works contractors will be disseminated to the people through displays at the respective offices of the government administrations, at construction sites and public places.

398. The DRRD shall be responsible for recording the complaints and reporting the complaints to MOC and ADB. The complaints shall be included in the monthly progress reports and the semi-annual environmental monitoring reports prepared by the DDIS Consultant. The tracking and documenting of grievance resolutions will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the DRRD.

# 10. ENVIRONMENTAL MANAGEMENT PLAN

## 10.1 Purpose and Objectives

399. This Environmental Management Plan (EMP) identifies the potential project environmental impacts and defines mitigation measures and monitoring requirements for the pre-construction, construction, and operational stages of the project. It also defines the institutional arrangements and mechanisms, the roles and responsibilities of different institutions, procedures and budgets for implementation of the EMP.

400. The EMP seeks to ensure environmental protection activities during preconstruction, construction, and operation continuously improve to prevent, reduce, or mitigate adverse environmental impacts and risks. The EMP draws on the findings of this IEE and the Project Preparation Technical Assistance (PPTA), and discussions and agreements with relevant government agencies and the Asian Development Bank (ADB).

401. Where impacts and risks cannot be avoided or prevented, mitigation measures and actions are identified so that the project is designed, constructed, and operated in compliance with applicable laws and regulations of Myanmar and meets the requirements specified in this document and the ADB SPS (2009).

402. The EMP includes an environmental monitoring program. The monitoring results will be used to evaluate (i) the extent and severity of actual environmental impacts against the predicted impacts, (ii) the performance of the environmental protection measures and compliance with relevant Myanmar laws and regulations as well as internationally accepted standards as defined in the IFC Environment, Health and Safety Guidelines, (iii) trends of impacts, and (iv) overall effectiveness of the project EMP.

403. The EMP is a “living document” that shall be updated by the DDIS Consultant based on the then available detailed engineering design before the beginning of the construction phase. In addition, the EMP shall be updated once per year, if necessary, in order to include new issues that were not or not sufficiently considered in the EMP so far. Monitoring must commence as soon as loan effectiveness date, as it includes monitoring of pre-construction measures and is required to establish baseline for some of the environmental components such as air quality and noise in a more comprehensive manner.

## 10.2 Responsibilities for the Implementation of the EMP

404. The project’s executing agency is the Ministry of Construction (MOC) and the implementing agency is the DRRD. The DRRD has established a project management unit (PMU) that will be responsible for the day-to-day management of the project. The PMU is headed by a full-time project director who will be assisted by two subproject directors, one for Magway and one for Ayeyarwady. The DRRD PMU office will be staffed with engineering, financial, administrative and safeguards specialists. PMU representatives will also be based in project townships of Maubin, Pantanaw.

405. The PMU will serve as the technical hub to provide engineering services, including basic design, cost estimation, construction support to townships, and supervision of civil works. Some of the supervision and monitoring responsibilities of the DDRD PMU can be delegated to the Regional DRRD if capacities are confirmed to be adequate.

406. MOC will contract a Detailed Design and Implementation Support (DDIS) Consultant. An international consulting firm will be recruited to review and update the IEE and EMP based on final project design, procure works contracts, supervise all civil works, monitor safeguards plan implementation, and support project management by DRRD. The Consultant’s role will include training of contractors in preparing contract-specific EMPs, applying modern construction techniques and ensuring compliance with EHS requirements.

407. The works contractors (CW01 and CW02) will be required to develop a site-specific construction

EMP (CEMP) in accordance with the IEE/EMP and environment safeguards requirements.[32] These shall be reviewed, cleared and monitored by the DDIS consultant and submitted to DRRD and ADB for information. The contractors will be responsible for implementing the impact mitigation measures of their respective CEMPs during the construction phase of the subproject under the supervision of the DDIS consultant. Contractors will assign an environmental officer (EO) responsible for CEMP implementation supervision and monitoring, and one qualified person responsible for construction and occupational health and safety officer (OHS). The OHS will ensure worker and public safety regulations of Myanmar.

408. Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) is the relevant authority to ensure that the project complies with the national legal and regulatory framework for environmental safeguards. ECD has the responsibility for the administration on the environmental assessment process and its implementation per the Environmental Impact Assessment Procedure (2015). It is also responsible for safeguards supervision and compliance monitoring during implementation.

409. ECD has regional offices in all regions, including in the regions targeted by the project. The regional level ECDs will be involved in the monitoring of the implementation of the environmental management plan.

410. The Asian Development Bank (ADB) will monitor and supervise overall project implementation. ADB will conduct supervision missions with detailed review by ADB's safeguard specialists/officers or consultants; review the periodic monitoring reports submitted by the DRRD to ensure that adverse impacts and risks are mitigated as planned and that necessary corrective actions have been identified are being implemented and being monitored; work with the DRRD to rectify to the extent possible any failures to comply with their safeguard commitments, as covenanted in the legal agreements, and exercise remedies to re-establish compliance as appropriate.

411. The responsibilities for the implementation of the EMP is shared among the different entities involved. These entities and their corresponding responsibilities are listed in **Table 34**:

**Table 34. Sharing of responsibilities for implementation of RRRP EMP**

| Organization | Responsibilities |
|---|---|
| Department of Rural Road Development (DRRD) | • The Project Implementing Agency<br>• Overall planning, management and monitoring of the environmental management including compliance with existing environmental laws;<br>• Ensure that environmental protection and mitigation measures proposed in the project EMP are incorporated into the detailed design and that the Project is implemented following Myanmar's environmental regulations and standards and compliant with ADB's environmental and social safeguards policies;<br>• Ensure that tender documents and civil works contracts include the project EMP (specific conditions) and specify requirement for preparation and implementation of construction EMP by contractors;<br>• Designate qualified safeguards officer;<br>• Responsible for reporting on EMP performance to the MOT and ADB monthly and semi-annually, respectively.<br>• Responsible for reporting and submitting the IEE to ECD for approval;<br>• ensuring meaningful public consultation and ensuring that disclosure requirements are met;<br>• supervision of, monitoring of, and reporting on the implementation of environmental management plans; |

[32] The need to comply with the EMP and to develop a construction EMP shall be defined in the bidding documents for all works packages.

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| | • reviewing corrective action plans and ensure that corrective actions are undertaken; and<br>• appointment of a Project Complaint Officer (PCO), establishment and operation of grievance redress mechanism (GRM). |
| PMU-Regional Offices | • Assign a regional PMU safeguards officer;<br>• The regional PMU safeguards officer shall be directly responsible for monitoring EMP implementation;<br>• Regional PMU safeguards officer shall conduct regular monitoring of EMP implementation and shall participate in the regular monitoring done by the DDIS Consultant and ADB Missions;<br>• The regional PMU safeguards officer shall be responsible for liaising with the regional ECD offices;<br>• Submit weekly EMP monitoring results to PMU DRRD;<br>• Act as local entry point for GRM, participate in processing grievances. |
| Detailed Design and Implementation Support Consultant (DDIS) | • Assist DDRD in reviewing and revising IEE and EMP to reflect final project design and any design adjustments during project implementation;<br>• Assist DRRD in preparing tender documents and ensure that the EMP is included in the tender documents and civil works contracts;<br>• Conduct training and orientation on the RRAP's EMP for DRRD, ECD, Contractors, host communities;<br>• Conduct baseline monitoring and periodic effect monitoring in compliance with the monitoring plan;<br>• Review and approve the Contractor's Environmental Management Plan (EMP) and ensure that it is completed prior to handing over of the site to Contractor;<br>• Assist the DRRD in resolution of environmental complaints;<br>• Assist DRRD in monitoring the implementation of mitigation measures and the environmental performance of contractors based on the EMP;<br>• Incorporate in the regular reports the results of environmental monitoring; compile semi-annual environmental monitoring reports in format acceptable to ADB; |
| Construction Contractor | The Contractor should:<br>• Assign a health, environment and safety officer;<br>• Prepare a Contractor's Environmental Management Plan, including an occupational health and safety plan; traffic safety plan, waste management plan, material usage plan, tree compensation plan;<br>• Secure all necessary permits and licenses prior to commencement of works, and share these with DRRD and DDIS Consultant;<br>• Implement the Contractor's EMP;<br>• Conduct self-monitoring of the implementation of the mitigation measures according to the EMP;<br>• Establish and maintain Grievance Register;<br>• Submit monthly reports to DDIS Consultant/ DRRD; |
| ADB | • conduct supervision missions including site visits for detailed review of compliance with the EMP; and<br>• review the periodic environmental safeguard monitoring reports submitted to ensure that adverse impacts and risks are mitigated as planned. |
| Stakeholders-communities along Project Road | • Monitor and assess the implementation of the mitigation measures and monitoring as proposed in the EMP;<br>• Participate in public consultation and provide opinions regarding the implementation of the EMP; |
| Village Officers | • Participate in project monitoring<br>• Participate in grievance redress procedures |

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| District / Township Authorities | • Participate in project monitoring<br>• Participate in grievance redress procedures |
| MONREC / ECD | Government's government agency tasked with the implementation and enforcement of environmental regulations and policies. Responsible for screening and issuing environmental permits to projects as well as monitoring compliance with environmental regulations. |

## 10.3 Impacts and Mitigation Measures

412. The potential impacts of the rural road rehabilitation from the IEE that are summarized in Table 33 are caused primarily from the road rehabilitation/upgrading works. The short-term construction disturbances concern noise, dust, soil erosion & surface water sedimentation, reduced access, increased traffic and risk of traffic accidents, worker and public safety, and construction solid and liquid waste. These short-term impacts can be managed and mitigated with measures defined in the Mitigation Plan provided below.

413. The mitigation measures defined in the EMP will be reviewed and updated where necessary to meet the detailed designs of the rural roads upgrading. The EMP will be incorporated into tender documents and construction contracts. The effectiveness of these measures will be evaluated based on the results of the environmental monitoring conducted by the DDIS Consultant and DRRD.

414. Each contractor will be required to prepare a site-specific **Contractor's Environmental Management Plan (CEMP)** prior to commencement of any site works. The CEMP shall specify the responsibilities, location, associated costs, schedule/timeframe and other relevant information for implementing its provisions. The CEMP to be prepared by the Contractor shall be based on:

- The project EMP that is enclosed in the tender documents; and
- The Contractor's contract where specifications of EMP and included.

415. The basic coverage of the CEMP is as follows:

a. Contractor's institutional arrangements for EMP implementation, supervision, reporting
b. Camp Establishment & Management
c. Spill Prevention and Contingency Plan
d. Soil Erosion Prevention and Control Management Plan
e. Occupational Health and Safety Plan
f. Waste Management Plan
g. Borrow Pits and Spoils Management Plan (including permits and licenses)
h. Noise, Dust and Vibration Control Plan
i. Tree Retention, Removal and Replanting Plan
j. Public Communication Plan

416. The CEMP should be completed and submitted to the DRRD PMU and reviewed by the DDIS Consultant. After approval by PMU and DDIS Consultant, the CEMP shall be submitted to ADB for information. The CEMP should be completed and approved prior commencement of works.

**Table 35. Environmental mitigations and monitoring plan**

| IMPACTS DUE TO LOCATION | | | | | | | |
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| IMPACTS MITIGATIONS | | | | | IMPACT MONITORING | | |
| **Activities / Item No** | **Impacts** | **Mitigation Measures** | **Mitigation Responsibility** | **Cost** | **Parameters to be monitored** | **Frequency and Means of Verification** | **Monitoring Responsibility** |
| 1.1 | Damage / removal of community facilities | • The construction plan should be presented and discussed with the community, including agreements on the need for removing structures and the condition for replacing the community and privately owned structures<br>• Any damage to community facility or private properties will be repaired by the contractor at once;<br>• Damaged sites shall be restored | Contractor | Part of construction cost | Presence / absence of community facilities; condition of the facilities prior to construction; | Before and after construction;<br>Actual condition of the facility before and after;<br>Complaints from affected persons. | DRRD; DDIS Consultant; Contractor |
| 1.2. | Exposure of residents to noise, dust, emissions | • Noise mitigations should be implemented in populated sections, location of schools and places of worships. Mitigations include: (1) all equipment are to be fitted with noise mufflers and properly maintained; (2) Operation of equipment and construction work in general shall be confined within with the daytime hours of 0600H and 1800H; (3) Noise generating stationary equipment such as generators or compressors shall be stationed distant from the dwelling places; (4) No servicing of equipment shall be done on work sites within village settlements; (5) watering of the road in village settlements shall be done at least twice daily or more often depending on the season. | Contractor | Part of construction cost | Noise levels; Dust and equipment emissions | Regular, daily if necessary within village settlements; indicative noise levels monitored using smartphone app, e.g. Sound Level Analyzer (SLA); dust and emission visual observation and/or complaints from affected persons | DRRD<br>DDIS Consultant<br>Contractor |

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| 1.3. | Conflicts with farmers' activities during harvest season | • Harvest season takes place May and January and will coincide with construction work; To avoid conflicts, DRRD and Contractor should agree with the farmers on alternative locations for rice drying and areas where threshing can be done outside the active work area;<br>• Farmers will need to transport harvest and the contractor shall make sure that temporary alternate routes are opened when construction work begins in particular areas; | DRRD<br>Contractor | Part of construction cost | Alternative drying and threshing areas;<br>Alternate route | Before start of construction; regular inspection during construction during harvest seasons; Visual inspection of site and review of plan. | DRRD<br>DDIS Consultant<br>Contractor |
| 1.5. | Pollution of waterways | • No materials will be stored within 50 m of a water course, including soil, spoil, aggregates, chemicals or other materials used during construction.<br>• Temporary drainage provision shall be provided during construction to ensure that any storm water running off construction areas will be controlled around al permanent water bodies.<br>• Water collection basins and sediment traps are to be installed in all areas where construction equipment is washed. Contaminated water will be removed off-site for disposal in the facilities identified in the Construction<br>• Construction in erosion and flood-prone areas shall be mainly restricted to the dry season where possible;<br>• Control silt runoff particularly around permanent rivers; | DRRD<br>Contractor | Part of Construction Cost | Location of stockpile areas;<br>Status, or signs of spillage; | Visual inspection of sites;<br>Regular inspection of sites, at least weekly; | DRRD<br>DDIS Consultant<br>Contractor |

| IMPACTS DUE TO CONSTRUCTION | | | | | | | |
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| IMPACTS MITIGATIONS | | | | | IMPACT MONITORING | | |
| **Activities / Item No** | **Impacts** | **Mitigation Measures** | **Mitigation Responsibility** | **Cost** | **Parameters to be monitored** | **Frequency and Means of Verification** | **Monitoring Responsibility** |
| 2. Setting up and operation of the Camp | | Contractor shall prepare and submit a contractor's environment management plan (CEMP) including a site plan for the construction camp as part of CEMP; | Contractor | Part of construction cost | CEMP Site plan showing among others the drainage, location of septic tanks, | Review of CEMP before construction starts | DRRD DDIS Consultant |
| 2.1 | Guidelines for setting construction camp | • Camp should be at least 100 m from waterways to prevent water pollution<br>• Camp location should be away from forested areas<br>• Campsite should be safe from natural hazards (e.g. flood, landslide)<br>• Contractor should secure the necessary permits for setting up Camp<br>• Secure lease agreement with the land owner<br>• Secure permit from Village and township authority | Contractor | Part of construction cost | Location of the proposed camp | Actual inspection prior to setting up of camp. | DRRD DDIS Consultant |

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| 2.2 | Pollution of camp site | • The Contractor must observe pollution prevention measures in the camp through the following means:<br>• Provide camp with wastewater treatment facility, e.g. septic tanks with soaking pit;<br>• Practice waste management for hazardous and non-hazardous wastes;<br>• Observe proper handling and storage of fuel, lubricant and bitumen; fuel and lubricant storage area should be provided with impervious flooring, containment wall and sump;<br>• Refuelling of equipment should be supervised;<br>• There shall be no burning of waste in the camp or work sites. | Contractor | Part of Construction Cost | Site plan of construction camp;<br><br>Actual condition of the of camp site | Inspection of proposed camp site prior to construction of camp;<br>Regular inspection, e.g. weekly, of the actual condition of the camp, i.e. cleanliness and upkeep | DRRD<br>DDIS Consultant |
| 2.3 | Security risks to workers | Contractor should ensure security of workers and camp by:<br>• Installing perimeter fence<br>• Imposing camp rules such as curfew, prohibitions of gambling, consumption of alcohol, carrying deadly weapons in the camp and work places;<br>• Conduct regular workers' orientation | Contractor | Part of Construction Cost | Review of camp rules;<br><br>Actual inspection of camp | Once prior to occupation of the camp by workers;<br>Regular inspection of camp;<br>Monitoring of camp situation | DRRD<br>DDIS Consultant |

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| 2.4 | Health and safety of workers living in the camp | Contractor should look after health and safety of workers by:<br>• Providing separate accommodations and toilet and baths for men and women;<br>• Providing the camp with sufficient supply of clean water;<br>• Provide camp with first aid kit and fire suppression equipment<br>• Conduct AIDS/HIV prevention awareness training for the workers; | Contractor | Part of Construction Cost; HIV/AIDS awareness lectures are conducted by health NGOs free of charge. | Inspection of the camp for presence of the required sanitary facilities for men and women; availability of clean water supply; presence of first aid kits in camp and work site; presence of fire-fighting equipment Review of the Contractor's AIDS/HIV awareness plan for workers; Monitor incidence of disease in camp | Once after camp has been set up;<br><br>Once before camp is occupied; Review of the documentation of lectures given | DRRD<br>DDIS Consultant |
| ***3. Clearing and grubbing*** | | | | | | | |

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| ***3.1*** | Loss of trees | • Conduct an inventory of trees and mark all trees for removal within the construction zone.<br>• Secure Permit from the Department of Forestry for removal of Teak and other trees; Present the permit to the DDIS Consultant.<br>• The Contractor should submit a Request for Inspection (RFI) to the DDIS Consultant to gain approval for actual tree cutting;<br>• Felled trees (except Teak trees which belongs to the government), roots, stem, brush and other vegetation materials are to be taken to an off-site that is approved by the Engineer; With agreement with the Department of Forestry, Teak trees may also be temporarily stockpiled by the Contractor in behalf of the Department of Forestry;<br>• The Contractor shall turn over the trees to the tree owner or host community.<br>• Local residents are free to collect the trimmings and branches of the felled trees for firewood and other uses.<br>• Tree removal shall be supervised by DRRD and DDIS Consultant;<br>• Replacement of lost trees shall be done with the assistance of the Department of Forestry who will provide the planting material and location if necessary | Contractor | Part of Construction Cost | Marking of trees;<br>Tree removal permit;<br>Disposition of the cut trees and disposal of vegetation waste materials; | On site verification of trees to be removed prior to removal; and site inspection after removal of tree | DRRD<br>DDIS Consultant<br>Contractor<br>Department of Forestry<br>TGAD |

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| | Inadvertent damage to community facilities | • Contractor should clearly demarcate the boundary of the clearing area.<br>• Items to be removed shall be tagged and clearing crew is properly oriented.<br>• The clearing shall be supervised and monitored by DDIS Consultant;<br>• The village shall be informed of clearing schedule in advance.<br>• Damage incurred to community facilities during clearing shall be immediately repaired by the Contractor. | Contractor | Part of construction cost | Public complaints; Reports by NSS/DRRD | Visual inspection as need arises | Contractor<br>DDIS Consultant<br>TGAD<br>DRRD |
| | Obstruction of access | • The Contractor and DDIS Consultant shall provide the village residents advance information on schedule of clearing works.<br>• Traffic management at the work site and the provision of alternative access routes are to be implemented by the Contractor | Contractor | Part of construction cost | Public complaints; Reports by NSS / DRRD | Review of traffic management plan prior to construction; Site inspection as needed | Contractor<br>DDIS Consultant<br>TGAD<br>Village committee<br>DRRD |
| | Interference with farming activities | • Contractor should conduct a consultation with village officials and farmers to inform them of the work schedule, agree on the alternative drying sites and alternative access routes. | Contractor | Part of construction cost | Public complaints; Reports by NSS / DRRD | Review of traffic management plan prior to construction; Site inspection as needed | Contractor<br>DDIS Consultant<br>TGAD<br>Village Committee<br>DRRD |

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| 3.2 | Generation of wastes | • The Contractor should identify a waste disposal site and present the site to the DDIS Consultant prior to clearing.<br>• recyclables and re-usable materials should be segregated;<br>• Concrete and masonry waste materials should be recycled as construction materials or used as fill materials if approved by the DDIS Consultant.<br>• Waste metals can be recovered and sold to recyclers;<br>• The wood materials can be given out for use as wood fuel by residents;<br>• The waste vegetation materials (leaves, small branches) should be collected in a composting site provided by the host community. | Contractor | Part of Construction Cost | Presence of wastes in work site; general condition of work site | Visual inspection of work site; Regular monitoring of work sites, daily if possible | DRRD<br>DDIS Consultant |
| 3.3 | Noise, dust and emission | • Contractor should implement mitigating measures and among these are: (a) limiting the operations of equipment between 0700H and 1800H; (b) noise generating stationary equipment like compressors, portable power generators should be located away from houses, schools, places of worships and other sensitive receptors.<br>• Dust suppression by spraying water over the work area in populated sections should be done at least twice a day, once in the morning and once in the early afternoon | Contractor | Part of Construction Cost | Public complaints; Reports by NSS / DRRD; Actual site condition | Regular visual inspection of site | DRRD<br>DDIS Consultant |
| ***4. Removal of unsuitable materials*** | | | | | | | |

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| 4.1 | Generation of waste pavement materials and unsuitable soil material | • Recycle waste pavement material, crush and use as base material;<br>• Use unsuitable material as filling material in areas where soil quality is suitable;<br>• Identify and secure landowner permit for a disposal site for unsuitable soil; | Contractor | Part of construction cost | Construction plan;<br>Permit for use of disposal site | Review construction plan;<br>Inspect disposal site;<br>Regular inspection of work site and disposal site | DRRD<br>DDIS Consultant |
| 4.2 | Road closure leading to delays in travel time | • Inform affected villages of work schedule and schedule of road closure;<br>• With the assistance of the village officials, select and provide temporary alternative routes;<br>• Provide safe passageway through the work site for pedestrians and motorcycles; | Contractor | Part of Construction Cost | Traffic management plan;<br>Traffic management on site;<br>Condition of passage through the work site | Review traffic management plan;<br>Regular inspection of work site, daily if possible | DRRD<br>DDIS Consultant |
| 4.3 | Noise dust and emissions | • See dust, noise mitigation in Section 3.3 | | | | | |
| ***5. Construction of Embankment*** | | | | | | | |
| | Siltation during delivery of materials by boat | • The return water from sand delivery should not be allowed to flow directly into water body.<br>• It should be retained to allow sediments to settle. The common practice is to create a pond using the delivered sand and retain water within. | Contractor | Part of Construction Cost | Public complaints;<br>Reports by NSS / DRRD;<br>Actual site condition | Regular visual inspection of site | DRRD<br>DDIS Consultant |
| | Boat congestion due to delivery of materials by river | • Contractor or materials supplier should consult with host community and village officers on the selection of berthing and unloading point along the waterway;<br>• The materials unloading should not interfere with communities use of waterways | Contractor | Part of Construction Cost | Public complaints;<br>Reports by NSS / DRRD;<br>Actual site condition | Regular visual inspection of site | DRRD<br>DDIS Consultant |

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| | Noise, dust, emissions | • See dust, noise and emission mitigation in Section 1.2 | | | | | |
| 5.2 | Road closure, delay in travel time | • See section 4.2 | | | | | |
| 5.3 | Traffic Hazard | • Prepare traffic plan and present to the village officials<br>• Install warning at both approaches of work sites and install directional signs as necessary<br>• Assign traffic signal men, coordinate with village officials for traffic control if necessary<br>• Separate pedestrians from traffic using barriers<br>• Use light and/or reflectorized paints to make signs visible at night;<br>• Provide lighting in work sites<br>• Conduct regular traffic safety training and refresher course for drivers and other project staffs | Contractor<br>DDIS Consultant | Part of construction cost | Traffic management plan;<br>Safety training plan/schedule;<br>Presence of traffic safety signs and use of traffic safety barriers; | | DRRD<br>DDIS Consultant<br>Village officials |
| **6. Bitumen Paving** | | | | | | | |

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| 6.1 | Occupational health and safety | • Preference for mechanical method over manual method;<br>• Provide workers with PPE, safety shoes, gloves, googles, high viz vest<br>• Provide ample drinking water at work site;<br>• Rotate workers to minimize exposure to high temperature;<br>• Separate workers from traffic through use of barriers<br>• Orient workers on health and safety of working with bitumen | Contractor | Part of construction cost | Bitumen application method;<br>Workers' PPE;<br>Presence of drinking water at site;<br>Presence of barriers at work site;<br>Orientation / induction program for workers | Review of construction plan prior to start of actual work;<br>Visual inspection;<br>Regular inspection of active work site, daily if possible | DRRD<br>DDIS Consultant |
| 6.2 | Pollution due to bitumen heating | • Prefer the use of gas fired bitumen heater over wood fired heating at road side;<br>• Clean up heating site of empty drums and bitumen spillage;<br>• No bitumen heating on river bank or canal bank; | Contractor | Part of construction cost | Review of construction plan;<br>Condition of work site, particularly the bitumen heating area | Review of plan prior to start of road work;<br>Regular visual inspection of work site, daily if possible | DRRD<br>DDIS Consultant |
| **7. Concrete Paving** | | | | | | | |

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| | Pollution from batching plant and transit mixer wash water; | • Batching plant should be provided with sedimentation pond;<br>• No discharge of transit mixer wash water in canals / rivers or banks;<br>• Transit mixer wash water should be disposed at the batching plant sedimentation pond; | Contractor | Part of construction cost | Review of batching plant site plan – should indicate the location of sedimentation tank;<br>Review of orientation / induction plan for workers, particularly transit mixer drivers | Review of plant site plan prior to installation;<br>Review of orientation / induction messages at the start of works; | DRRD<br>DDIS Consultant |
| **8. Construction of culverts** | | | | | | | |
| 8.1 | Damage and interruption of irrigation water | • Construction of irrigation crossings should be coordinated with irrigation department;<br>• Farmers should be given advance notice of the works;<br>• Temporary diversion canal should be provided if necessary;<br>• Any damage to irrigation canal should be repaired immediately by the contractor | Contractor | Part of construction cost | Documentation of coordination meeting with Irrigation Department;<br>Review of construction plan; | Review of documentation of coordination meeting:<br>Review of construction plan prior to start of works;<br>Regular ocular inspection of work sites, daily if possible. | DRRD<br>DDIS Consultant |
| 8.2 | Pollution of waterway | • Canal / river should be cleaned of any construction waste;<br>• Provide temporary diversion channel if necessary; | Contractor | Part of construction cost | Review construction plan;<br>Actual condition of work site | Review of construction plan before start of work;<br>Regular ocular inspection of work sites, daily if possible | DRRD<br>DDIS Consultant |

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| 8.3 | Temporary loss of safe water crossing | • Contractor should provide temporary bridges to allow pedestrians and motorcycles to safely cross the waterway; | Contractor | Part of construction cost | Review construction plan;<br>Actual condition of work site | Review of construction plan before start of work;<br>Regular ocular inspection of work sites, daily if possible | DRRD<br>DDIS Consultant |
| **9. Bridge Construction** | | | | | | | |
| 9.1 | Siltation of waterbody | • Stabilize banks to prevent slumping / erosion of excavations;<br>• Excavation materials for disposal should be hauled immediately from the site:<br>• Waste form materials should be cleared and disposed properly;<br>• There shall be no discharge of transit mixer wash water into the water body;<br>• Materials accidentally dropped into the waterbody should be removed immediately | Contractor | Part of construction cost | Review construction plan;<br>Actual condition of work site | Review of construction plan before start of work;<br>Regular ocular inspection of work sites, daily if possible | DRRD<br>DDIS Consultant |
| **9.2** | Unsafe safe navigation condition across work sites | • Contractor should inform community of work schedule<br>• Contractor should provide safe navigation passage through the work site;<br>• Passage through the work site should be properly marked and visible at night time. | Contractor | Part of Construction Cost | Public complaints;<br>Reports by NSS / DRRD;<br>Actual site condition | Regular visual inspection of site | DRRD<br>DDIS Consultant |
| **10 Management of hazardous materials** | | • Contractor shall prepare spill prevention and hazardous waste management plan covering the following items: | | | | | |

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| | Pollution from Bitumen and Prime coat | • The bituminous materials storage area should be located away from water bodies shall be kept neat and tidy.<br>• Drums of bituminous material shall be stacked on their sides and only in small quantities with gaps between each stack to reduce fire risk. The stockpile area should be lined by sand to allow easy collection of spilled materials. The collected materials can be re-used.<br>• Empty bitumen drums shall be stacked upright to prevent spillage of residual materials remaining in the drums. Drums can be sold to recyclers.<br>• If bitumen delivered in plastic packaging, it should be stored in covered area, away from sunlight; storage should be lined by a layer of sand to allow easy collection of spilled bitumen and use of spilled bitumen for road repair;<br>• Packaging should be collected and disposed in approved waste facility;<br>• Delivery of bitumen in reusable bulk containers is preferred. | Contractor | Part of construction cost | Review of site plan;<br>Actual condition of storage areas | Review of construction plan prior to start of work;<br>Ocular inspection of the condition of the bitumen holding areas. | DRRD<br>DDIS Consultant |
| | Pollution and safety of fuel and lubricants | • Fuel and lubricant depot should be secured, covered and provided with hard standing with a containment wall.<br>• Refuelling and delivery of fuel shall be supervised.<br>• Warning signs, e.g. Flammable, No Open Flame, No Smoking shall be posted.<br>• Fire extinguisher should be provided at the fuel depot. | Contractor | Part of construction cost | Review of site plan of fuel storage area;<br>Actual site condition | Review prior to start of work;<br>Regular ocular inspection of fuel storage area at least on a weekly basis. | DRRD<br>DDIS Consultant |

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| | Pollution from improperly handled / stored Hazardous wastes | • Hazardous wastes will be collected from equipment service yard / repair shop, fuel depot.<br>• These materials shall be stored in 200 liter steel drums or plastic barrels with lid and shall be labelled and stored temporarily in a storage area in the camp.<br>• The storage shall be roofed, with concrete flooring and containment wall. It will also be fitted with a floor sump for oil and water separation. The sludge material from the sump shall be cleaned and collected and disposed together with the used oil and other hazardous waste materials.<br>• Used oil can be sold to recyclers,<br>• Other hazardous wastes shall be disposed in an approved site. | Contractor | Part of construction cost | Review of waste management plan;<br>Actual condition of the haz waste storage; | Review of waste management plan prior to start of work;<br>Regular ocular inspection of hazardous wastes materials storage facility. | DRRD<br>DDIS Consultant |

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| **11. Solid waste management** | Environmental health hazard and eye sore | • The contractor shall implement waste segregation and recovery of recyclables<br>• All recyclable materials such as plastic bottles, glass bottles, tin cans, metal scraps shall be segregated and sold to recyclers.<br>• Residual wastes shall be contracted out to the township for collection and disposal at its disposal facility.<br>• Waste bins shall be provided for bio-degradable and non-biodegradable materials.<br>• The bins shall be placed in various places in all the facilities. The bins shall be marked and color coded for easy identification by the workers.<br>• The waste shall be collected everyday and shall be temporarily stored in a holding area where it will be collected and hauled by the waste contractor. | Contractor | Part of construction cost | Review of waste management plan;<br>Actual practices in waste management | Review of waste management plan prior to start of work;<br>Regular inspection of work sites, camp to observe compliance with IEE-EMP requirements, week inspection | DRRD<br>DDIS Consultant |
| **12. Wastewater management** | Inappropriate disposal of wastewater can create health hazards and pollute water bodies | • The camp shall be provided with wastewater treatment systems e.g. sealed septic tank with soaking pit. All waste water from toilets, bathroom, kitchen shall be conveyed to the septic tank. Final disposal of septic effluent shall be through a soaking pit that is properly located with respect to wells and dwelling places.<br>• The batching plant shall be provided with a sedimentation pond where plant and transit mixer wash water shall be collected. The wash water shall be re-used for dust suppression and equipment washing. | Contractor | Part of construction cost | Review of waste management plan;<br>Actual condition of the camp and work site. | Review of waste management plan prior to start of works;<br>Regular inspection of camp site, temporary sites and work sites, daily if possible | DRRD<br>DDIS Consultant |

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|---|---|---|---|---|---|---|---|
| **13. Borrow pits** | Opening of new pits imposes change of land use; loss of productive land; and create unsafe condition for the public | • Reuse excavated materials from different sections of the road provided these are suitable and with the approval of the DDIS Consultant.<br>• Borrow materials may be obtained by widening cuts, widening ditches or by excavating from other sources outside the planned cross section within the right-of-way or slope easements and within the limits of the project, with the approval by the DDIS Consultant;<br>• For borrow sites outside the ROW, the Contractor should secure approval / agreement with the land owner and should confine excavations within the permitted area only.<br>• All borrow pits shall have the necessary permits from ECD;<br>• On completion of work all faces shall be neatly trimmed to a slope flatter than 1 in 4. Where this is impracticable or where the working face is to be left exposed, the edge of the borrow pit shall be permanently fenced. | Contractor | Part of Construction Cost | Review of the material usage / balance prepared by Contractor;<br>Inspection of proposed borrow sites;<br>Inspection of the agreement with land owner;<br>Inspection of the actual condition of the borrow pit upon completion of materials extraction | Once prior to approval of the borrow pit location;<br>Inspection of the proposed borrow site prior to start of extraction;<br>Inspection of the agreement between landowner and Contractor<br>Regular inspection during operations and once after abandonment | DRRD<br>DDIS Consultant |
| **14 Abandonment** | Unsafe conditions at the temporary work sites;<br>Environmental hazards in temporary work sites; | • Contractor should prepare an abandonment plan<br>• Upon completion of the construction, the contractor shall demobilize, workers and equipment.<br>• The contractor shall remove all equipment, structures and waste materials from the work sites, construction camp, stockpile areas, etc;<br>• Rehabilitate the land according to the agreement with the landowner. | Contractor | Part of construction cost | Review of abandonment plan;<br>Actual condition of rehabilitated sites | Review of plan at least 6 months before abandonment;<br>Visual inspection of rehabilitated site | DRRD<br>DDIS Consultant |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **15. GHG Emission** | Road construction generates GHG with paving work as the main contributor | • Contractor should use new and well-maintained equipment, e.g. heavy equipment and asphalt plant. | Contractor | Part of construction cost | Review of construction plan; Condition of heavy equipment | Review prior to start of works; Regular inspection of equipment, at least once a month. | DRRD<br>DDIS Consultant |

| **IMPACTS DUE TO OPERATIONS** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **IMPACTS MITIGATIONS** | | | | | **IMPACT MONITORING** | | |
| **Activities / Item No** | **Impacts** | **MITIGATIONS** | **Mitigation Responsibility** | **Cost** | **Parameters to be monitored** | **Frequency and Means of Verification** | **Monitoring Responsibility** |
| **1. Maintenance works during Operations** | | | | | | | DRRD |
| 1.1 Vegetation trimming and repair of potholes | • Pollution due to bitumen spillage;<br>• Traffic hazard due to stockpile of materials at the road shoulder;<br>• Workers exposed to traffic hazards | • Bitumen heating area shall be cleaned up after repair is completed;<br>• Materials shall be stockpiled away from the road shoulder, if not possible, markers and warning signs should be installed on both approaches;<br>• Workers should be separated from traffic by barriers. | MOC/DRRD | Government budget | Actual condition of work site | Regular inspection of work in progress | DRRD / TGAD |

## 10.4 Monitoring and Reporting

*Environmental Baseline Monitoring*

417. Air and water baseline survey shall be carried out by the DRRD through the DDIS Consultant prior to the start of construction site. The parameters for baseline survey for air quality and water quality are as follows:

**Table 36. Air quality parameters and methods of analysis**

| Ambient Air Quality Parameters | METHODS OF ANALYSIS | Averaging (IFC Guidelines) |
|---|---|---|
| TSP | High Volume – Gravimetric, USEPA 40 CFR, Part 50, Appendix B | |
| $PM_{10}$ | High Volume with 10 micron particle-size inlet; Gravimetric, USEPA 40 CFR, Part 50, Appendix J | 24 hours |
| $SO_2$ | Gas Bubbler and Pararosaniline Method (West and Gaeke Method), or Flame Photometric Detector, USEPA 40CFR, Part 50, Appendix A | 24 hours |
| $NO_2$ | Gas Bubbler Griess-Saltzman, or Chemiluminescence Method, USEPA 40 CFR, Part 50, Appendix F | 1 hour |
| CO | Non-dispersive Infra-red Spectrophotometry (NDIR), USEPA 40 CFR, Part 50, Appendix C | 1 hour |
| Noise | A weighted Noise Meter | 24 hours, night time and day time |

**Table 37. Water Quality Baseline Parameters and methods**

| Water Quality Parameters | Method or Equivalent Methods |
|---|---|
| Total suspended solids (TSS) | Gravimetric method<br>EPA Method 160.2 |
| Biochemical oxygen demand (BOD5) | *Method* 5210B in the Standard *Methods* for the Examination of Water and Wastewater |
| Dissolved Oxygen(DO) | In-situ measurement using Membrane Electrode following EPA Method 360.1 |
| Total Coliform | USEPA Method 1604: Total Coliforms and Escherichia coli in Water by Membrane Filtration |
| Fecal Coliform | Multiple-tube fermentation procedures, USEPA Method 1680 |
| Oil and Grease | Gravimetric<br>USEPA Method 1664 |
| pH | pH electrode<br>USEPA Method 8156 |

**Table 38. Number of baseline air and water monitoring stations per sub-project road**

| ROAD PACKAGE | Number of Air Quality Stations | Number of Water Quality Stations |
|---|---|---|
| MBN004 | 1 | 2 |
| MBN005 | 1 | 2 |
| MBN019 | 1 | 3 |
| MBN028 | 1 | 1 |
| MBN039 | | 2 |
| PTN005+012 | 1 | 3 |
| PTN008 | 1 | 2 |
| PTN011 | 1 | 1 |
| PTN019 | 1 | 2 |
| PTN031 | 1 | 1 |

418. Only one air quality station within village settlement is recommended per sub-project road since all the corridors have similar rural setting and do have major sources of air pollution. As for water quality, the monitoring of baseline water quality data is limited to sub-projects with main water crossing (natural waterways and irrigation channels).

*Regular Monitoring of EMP Compliance, Reporting*

419. Daily monitoring of EMP compliance shall be done by the DDIS Consultant's National Environment Safeguard Specialist (NESS) together with the DRRD Safeguard Specialist. A checklist for EMP implementation monitoring should be devised based on Table 35. The checklist should contain all the mitigation measures. The NESS should report, e.g. compliant or non-compliant. If non-compliant issues are noted, the NESS shall discuss the issues directly with the Contractor's environmental officer for corrective action. If the issue is beyond the environment officer's authority, the NESS shall fill out an inspection form and submitted to the contractor's project manager. The form shall state the required corrective action by contractor and designated date for completion of corrective action. Upon completion, the issue is closed and documented as so.

420. The daily monitoring by the NESS shall be compiled electronically. The NESS should prepare a **weekly summary** submitted to the DDIS Consultant Project Manager. The project manager takes up the outstanding issues with the contractor during the weekly progress meeting to discuss the issue and agree on the resolution. A tracking list shall be set up to monitor outstanding issues and Contractor's compliance.

421. The weekly summary shall be compiled and summarized for the **monthly progress report** submitted by the DDIS Consultant to DRRD / MOC. The report shall also include complaints received during the reporting period and the resolutions.

422. The International Environment Safeguard Specialist (IESS) shall be deployed for a month every 6 months. The role of the IESS is to review the EMP implementation monitoring, conduct training and orientation on the EMP and to prepare the **semi-annual environmental monitoring report** to ADB, MOC and ECD. The IESS is also responsible for preparing a monitoring plan during his/her initial deployment. The plan should include the monitoring procedure, non-compliance procedures, the monitoring checklists, frequency of monitoring and report format.

423. The monitoring of environmental quality (i.e. noise, dust, pollution and spillage, waste management, etc.) shall be done visually. For noise, hand-held devices may be used. Also, informal interviews of

residents around the active work site should routinely during site inspections by the NESS, and be done for any complaints they might have on the environmental management. Visual observations shall be documented and reported.

424. Instrumental monitoring of ambient environmental quality shall be done to verify complaints from affected community. The cost of instrumental monitoring shall be borne by DRRD. For that purpose, adequate budget shall be provided in the DDIS Consultant's contract.

*ADB Monitoring Mission*

425. ADB conducts regular review missions. The IESS, NESS and DRRD PMU safeguards specialist need to be present during such missions.

## 10.5 Required Environmental Staffs

426. The monitoring and supervision of the environmental management of RRAP will require participation of the client, DDIS Consultant and DRRD.

**Table 39. Required environmental staff**

| Organization | Required Environmental Staff | No | Deployment Schedule |
|---|---|---|---|
| Contractor | Environmental Officer | 1 | Full time |
| | Health and Safety Officer | 1 | Full time |
| DDIS Consultant | National Environment Safeguard Specialist | 1 | Full time |
| | International Environment Safeguard Specialist | 1 | 1 month every 6 months |
| DRRD PMU | Environment Safeguard Specialist | 1 | Full time |
| Regional DRRD Office | Safeguard Coordinator | 1 | Part time |
| 3rd party environmental service provider | Field sampling and analysis of ambient environmental quality | | As needed, through DDIS Consultant's contract |

## 10.6 Training and Capacity Development

*Orientation of DRRD and Contractors on the EMP*

427. The IESS during the first period of deployment shall orient the DRRD and the contractors on the EMP. The salient points of the IEE and EMP should be presented with emphasis on the mitigating measures and the contractor's obligation on the EMP implementation.

428. The workers shall also be given orientation on the EMP prior to the start of construction work. The EMP matrix should be simplified and translated to Myanmar. An emphasis on the roles and responsibilities of the workers in the EMP implementation should be emphasized.

429. This orientation on EMP shall be done by the Contractor with support of the NESS at least on a quarterly basis.

*Health and Safety Training*

430. The Contractor's health and safety specialist shall conduct training on personal hygiene and health.

The training shall encompass occupational safety and public safety. Traffic safety shall be done specially for the contractor's vehicle drivers. The safety training shall be done quarterly, with regular tool box meetings. Appropriate signs to remind workers of safety shall be posted in conspicuous areas where workers congregate.

431. Training on HIV prevention awareness shall also be done by the Contractor with assistance from NGOs involved in HIV awareness programs.

## 10.7 Cost Estimate for EMP Implementation Monitoring

432. The cost estimate for monitoring EMP implementation including the baseline environmental quality monitoring is enumerated in the following table. The remuneration and per diem are split evenly between Ayeyarwady and Magway.

**Table 40. Cost estimate for EMP monitoring for Ayeyarwady**

| **Remuneration** | **Rate/Mmo in US$** | **No Mos** | **Total US$** |
|---|---|---|---|
| International Environmental Specialist | 20,000.00 | 3 | 60,000.00 |
| National Environment Specialist | 6,000.00 | 15 | 108,000.00 |
| **Per Diem** | **Rate/Day** | **No of Days** | **Total** |
| IES | 100.00 | 90 | 9,000.00 |
| NES | 45.00 | 432 | 19,440.00 |
| Sub-total | | | 196,440.00 |
| **Baseline Environmental Quality** | **Cost / Sta** | **No of Sta** | **Total** |
| Air Quality | 1,000.00 | 9 | 9,000.00 |
| Noise | 600.00 | 9 | 5,400.00 |
| Water Quality | 550.00 | 19 | 10,450.00 |
| Sub-total | | | 24,850.00 |
| **Grand Total** | | | **221,290.00** |

# 11. CONCLUSION

433. Based on the outcome of the impact assessment of RRAP sub-projects, it can be concluded that the proposed upgrading of the RRAP sub-project roads in the townships of Maubin and Pantanaw in Maubin District, Ayeyarwady Region are not likely to cause significant adverse environmental impacts. There are not environmentally sensitive receptors such as forest and or protected areas present within the sub-project corridors. The ADB conditions for this project specifically exclude roads that lead or cuts across primary forests and protected areas.

434. The upgrading of the RRAP sub-project roads will be mostly confined within existing alignments of rural roads and/or tracks. The construction activities that will be carried out are typical of small road projects that will entail clearing of the road alignment, removal of unsuitable substrate, building of the embankment and paving.

435. The impacts that these activities will generate are predictable and can be mitigated. No significant residual impact is anticipated. The occurrence of an unanticipated impact shall be reported and the EMP shall be updated and revision of IEE if needed. In view of the above findings, Category B is confirmed, and the project is feasible from an environmental safeguards point of view.