UB/FS-4

NEO ENERGY OASIS DEVELOPMENT Co.,Ltd.

FEASIBILITY STUDY AND BASIC DESIGN

UPPER BALUCHAUNG HYDROPOWER PROJECT

FINAL REPORT

VOLUME-IV : SUPPORTING REPORT (2/2)

ENVIRONMENTAL STUDY

2016

NEO ENERGY OASIS DEVELOPMENT CO., LTD.

NEO ENERGY OASIS DEVELOPMENT Co., Ltd.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT ON UPPER BALUCHAUNG HYDROPOWER PROJECT, NYAUNGSHWE TOWNSHIP, UNION OF MYANMAR

Final Report

2016

Resource & Environment Myanmar Co., Ltd.

Sustainable Environment Myanmar co., Ltd.

Table of Contents

List of the Table

List of the Figure

APPENDIX -9 HYDROLOGY DATA UPDATE

SUMMARY OF
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)
AND
ENVIRONMENTAL MANAGEMENT PLAN (EMP)

UPPER BALUCHAUNG HYDROPOWER PROJECT

November, 2016

1. Project Proponent / Owner

Project Owner - Neo Energy Oasis Development Company Ltd.

Leading Organization - Ministry of Electricity & Energy (former Ministry of Electricity and Energy)

2. Type of Project and IEE / EIA Requirement

1) Type of Project : Construction and Operation of 30.4 MW Hydropower Plant

2) IEE/EIA Requirement : EIA is required.

3. Implementation Organizations of EIA

There is two organization to implement EIA as follows;

1) Leading Organization : Resource and Environment Myanmar Ltd., (REM),

Address : 702 Delta Plaza, Shwegondaing Road, Bahan Township, Yangon,

Telephone : +959-73013448

Facsimile : 01-552901

Email : service@enviromyanmar.net

Contact Person : Mr. Soe Thura Tun

Designation : Managing Director

2) Secondary Organization - Sustainable Environment Myanmar Company Limited (SEM)

Address : B005 Delta Plaza, Shwegondaing Road, Bahan, Yangon

Tel : +959 261328891

Email : services@sustainablemyanmar.com

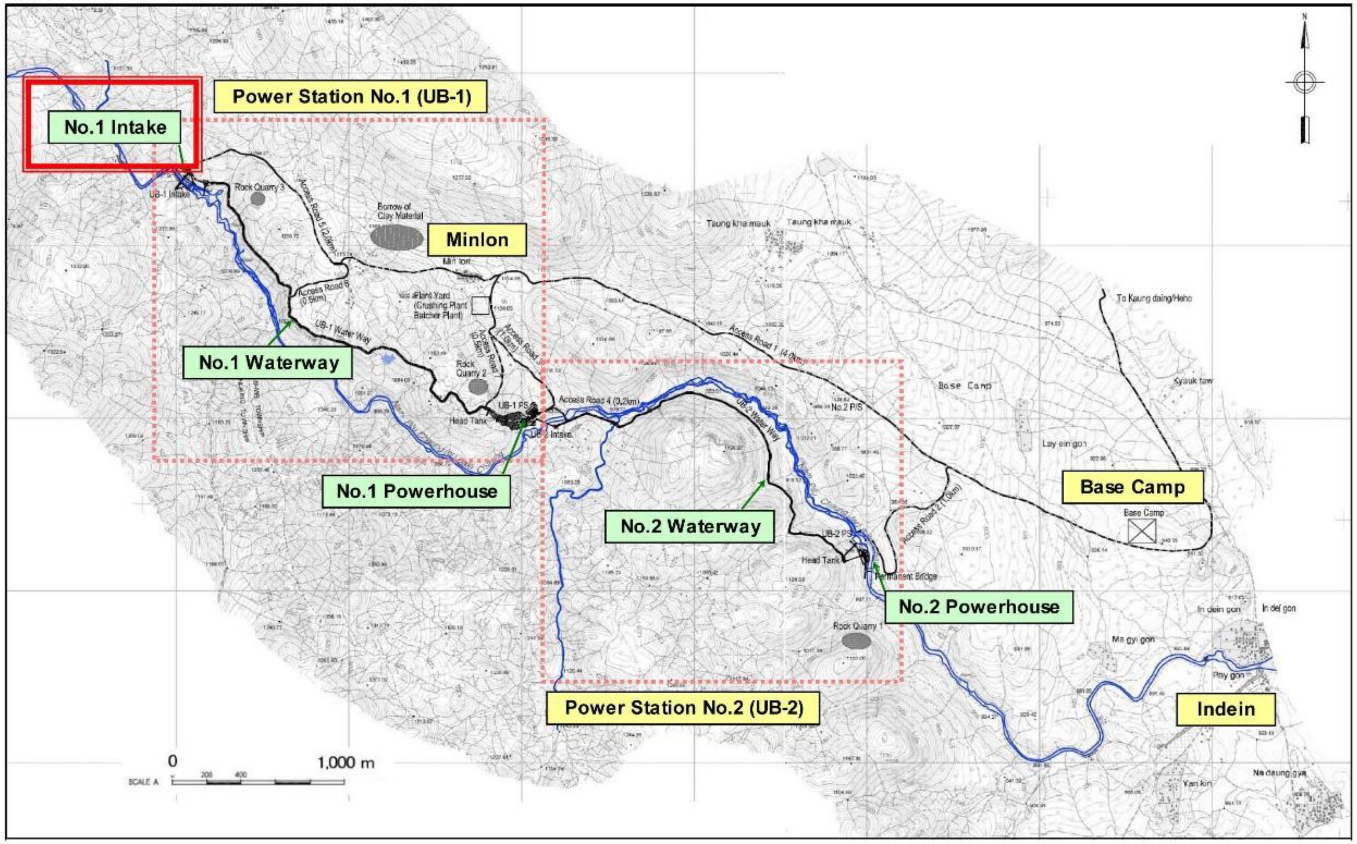
4. Project Outline

There are three large streams flow down to Inle Lake from western mountain range, the Yepe (Heho), Thandaung (Kalaw) & Upper Balu Chaung. Among them, Upper Balu Chaung is the largest one with the biggest catchment (836 sq.km) and perennial flow. Upper Baluchaung river originates at about 2miles west of Pinlaung Township, and flows from south to north, then turns through to the east flat plain crossing the Aung Pan – Loikaw road and running through the west of Inle Lake via Indein village. Before flowing to the Inle Lake, the river flows through the west escarpment of Inle Lake forming waterfalls and cascades, so that it becomes riches of hydropower resources. Along the river, between Saungwun & Indein village about 17.5 km length, the natural head difference occurs about 320m.Two run-off river type hydropower projects are planned at a place near Minlone village, about 5 km upstream of Indein village. One with installed capacity 20.4 MW and annual generation of 90.1 GWh, and the other one with installed capacity 10MW and annual generation of 44.5 GWh. The Upper Baluchaung Hydropower Project was planned to implement by two phases. Phase I(UB-1) included concrete dam (Weir type), Intake Structure, Intake Channel, Sand Settling Basin, Headrace Channel, Head Tank, Penstock and Powerhouse. Installed Capacity was designed 20.4 MW (10.2 MW x 2Nos). Phase II (UB-2) was planned without head up dam, it will take with direct link from Tail race channel of UB-1 to the Head race channel of UB-2 then to the Head Tank, Penstock and Powerhouse. Installed Capacity of UB-2 is 10 MW (5MW x 2 Nos.).

The Project site is located about 14.4 miles 23km south-west of Nyaungshwe Town in Southern Shan State. The project consists of construction of two run-off river type hydropower plants utilizing the available natural head along the river before entering into the Inle Lake. Four rivers viz Nam Let Chaung, Heho (Nagoya Chaung), Kalaw (Ngot) Chaung and Upper Baluchaung drain into the Inle Lake from western side.

4.1 Layout Plan of the Project

The general layout plan of the project is shown in Figure 4-1 and river profile and is shown in Figure 4-2.



General Layout of the Upper Baluchaung Hydropower Project

- 5 -

Figure 4-1: General Layout Plan of the Upper Baluchaung Hydropower Project.

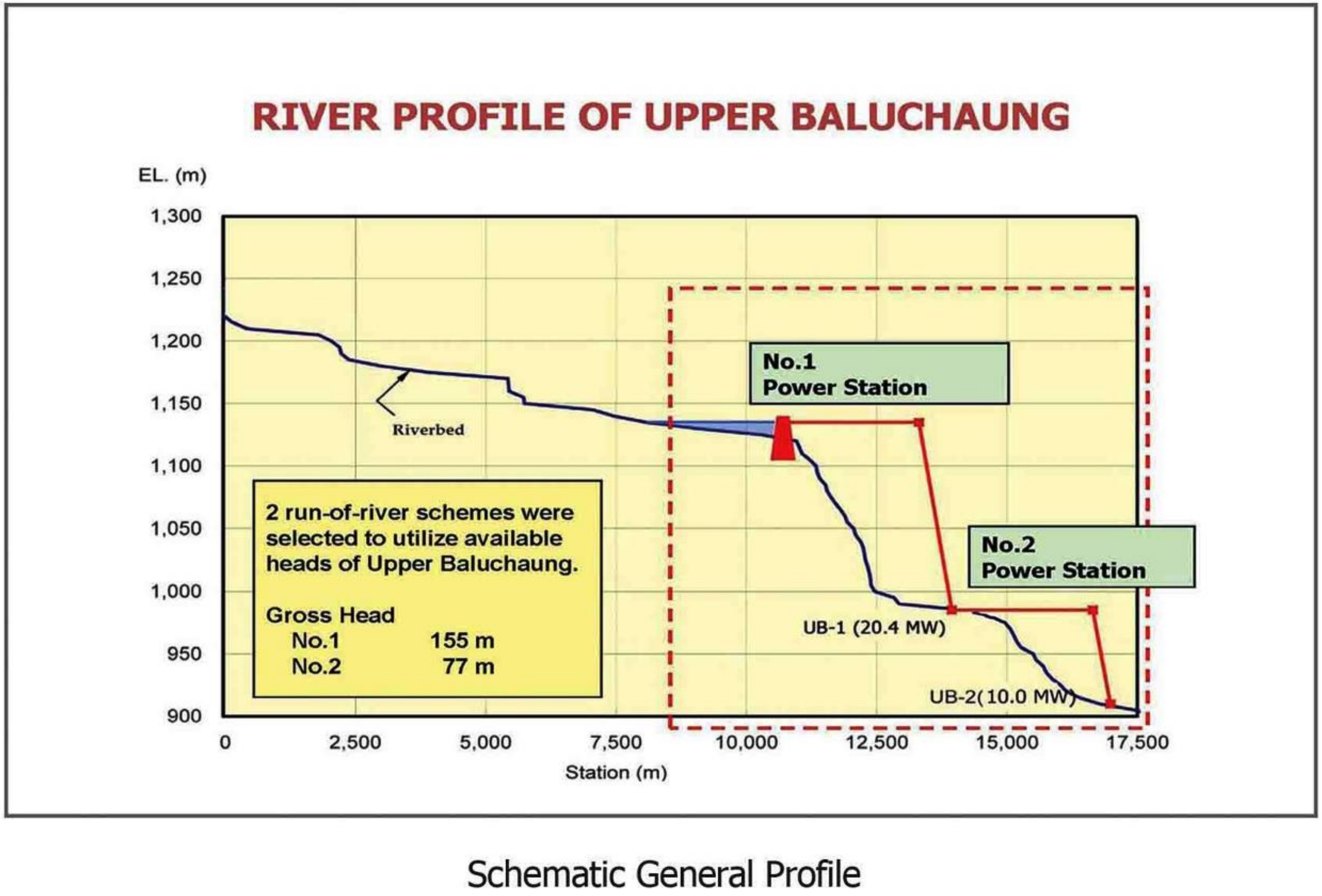


Figure 4-2: River profile of upper Baluchaung river.

5. Results of Environmental Impact Assessment (EIA)

Environmental and social impacts on the Project are predicted and evaluated based on the Project description, results of baseline survey. Chapter 6 describes the environmental and social impacts on the Project before/ during construction and operation phases.

6. Environmental Management Plan

Environmental Management Plan consists of two components 1) mitigation and consideration measures taken in the course of the project implementation were examined based on project description and result of EIA and 2) environmental monitoring plan to confirm taken mitigation and consideration measures properly and to confirm environmental levels in construction and operation through environmental measurement.

The environmental management (mitigation measures) plan and environmental monitoring activities are examined, and summarized in Table 6-1, 6-2 and table 6-3 respectively.

Table 6-1: Environmental Management for the impacts due to Project Facilities

No.	Potential Impact	Mitigation Measure	Necessary Action	Source of Cost
1.	Drying of river section between Intake Weir No.1 and Power Station No.2	River maintenance flow of 0.5m3/sec to be permanently released from intake wire No.2	Incorporation of river out lets of 0.5m3/sec at intake wire No.1 and No.2	Included in the cost
2.	Demolition of distribution pipes of domestic water supply to Minlone village due to road improvement works.	- Repair of distribution pipe. (temporary) - Installation of permanent water supply system	- (Already completed) - Detail design of water supply system to Minlone village from No.1 Pondage. - Construction of the permanent water supply system	Included in the project cost. Include in the project cost

Table 6-2: Environmental Management for the impact during construction period

No.	Potential Impact	Mitigation / enhancement measures	Necessary action	Source of cost
Impact on mobilization of manpower during construction				
1.	Impact on population increase on public and economic facilities	Construction of public facilities within Base Camp of the Project to avoid deficit / overuse of existing facilities of local people.	Detail design of necessary public facilities such as school, clinic park to be constructed in the Base Camp.	To be included in the project cost
			Construction of these public facilities based on the detailed design.	
2.	Impact of outside workers on conflict and security	Education of construction workers on security and necessary to keep harmony with local people	Incorporation of the mitigation measures in the technical specification of the construction work.	
3.	Impact of outside workers on public health	Education on public health to construction workers Regular health to construction workers.	Ditto -	
Impacts of transportation of heavy equipments and construction materials				
4.	- Increase of traffic volume	Improvement of road widening Placing of traffic control staff at critical locations Education of vehicle drivers about the traffic safely manner.	Detailed Design of road improvement and new road construction (under construction) Frequent Briefing to the drivers by authority.	To be included in the Project Cost.
5.	Increase of duct	Watering on road and vehicles Assurance of shell covering on load of truck s	Incorporation of the mitigation measures in the technical specification of construction work	
6.	Noise and vibration	Assurance of polite driving manner Good maintenance of vehicles	Do -	
Impacts of construction Works such as civil works / blasting				
7.	Air pollution (emission of gas and dust generation)	Watering on construction sites especially near settlement area Assurance of sheet covering on load of trucks Good maintenance of heavy machine	Incorporation of mitigation measures in the technical specifications of the construction work.	To be included in the Project Cost
8.	Increase of soil erosion and earth-related disaster	Implementation of prevention works such as: Retaining wall,	Incorporation of the mitigation measures in the technical specifications of the	To be included in construction cost

		Retaining pond, Vegetation covering, Rainwater drainage system, Terracing or bench system at soil bank,	construction work, Monitoring of soil erosion as described in Environmental Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measures should be made to minimized the impact	
9.	Water pollution (turbidity and high alkali water)	1) Implementation of prevention works such as: - Sediment/ retaining pond, - Waste water treatment system, - Rainwater drainage system, - Vegetation covering, etc.	Incorporation of the mitigation measures in the technical specifications of the construction work, Monitoring of water pollution in Upper Baluchaung River as described in Environmental Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measures should be made to minimized the impact.	To be included in construction cost
10.	Noise and vibration	Good maintenance, polite and gently operation of heavy machine, Education of operators of heavy machine for necessity of polite operation and maintenance	Incorporation of the mitigation measures in the technical specifications of the Construction work. Monitoring of noise and vibration as described in	To be included in construction cost
11.	Increase of waste generation	Adjustment of amount and frequency of explosive for blasting. Adjustment of location of crushing and batching plants so as to locate farther from settlement area, Socialization on possibility of noise and vibration pollution prior to the construction works, Establishment of waste treatment system. Education of all the construction workers to follow the treatment system	Environmental Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measure should be made to minimized the impact. Incorporation of the mitigation measures in the technical specifications of the construction work,	To be included in construction cost
12.	Soil contamination due to excavated materials	Establishment of waste treatment system for oily waste, Monitoring of soil contamination due to effluent water, and dumping	Incorporation of the mitigation measures in the technical specifications of the construction work,	To be included in construction cost

		of excavated materials in spoil bank	Monitoring of water quality as described in Environment Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measures should be made to minimized the impact.	

Table 6-3: Environmental Management plan including mitigation and monitoring plan during operation period and some part of construction phase

Objective	Activity	Mitigation/Enhancement	Monitoring	Responsibility
Social				
Opportunities associated with Local employment benefits	Employment generation Procurement	• Disclosure of Recruitment Policy; • Localized disclosure of need for staff and labours in construction work	Disclosed Recruitment and Procurement Policies in Site Office and Administrative offices; • Village supporting committee meeting minutes; and • To be disclosed in employment offices and policy to be referred to in job adverts.	Neo Energy Oasis and EMU
Project commitment on workers' rights	Employment conditions	• Develop and implement a Human Resources Policy; • Issue each member of staff with an individual contract, of employment; • Insert clauses in contractors' agreements to ensure compliance with all policies, plans, procedures and identified mitigation measures. Also, include clauses to monitor and enforce safety plans and report accidents and incidents; and • Provide all workers with a summary of their service and training activities.	Payment of wages and bonuses on time; • Hours worked during period and hours lost; and • Fully described job descriptions for all roles.	Neo Energy Oasis and EMU

Protecting the workforce	Labour management	• Provide appropriate PPE (as identified through risk assessment); • Emergency Response Teams; • Emergency Preparedness and Response Plan (EPRP) to be developed covering health and safety risks to workers in emergencies; • Incident and accident logs to be maintained; and • Review of primary supply chain for occupational health and safety (OHS) issues.	Neo Energy to review Contractors Hazard and Operability (HAZOPS) and EHS Plan to ensure continuity with company EHS requirements (including commitment to this ESMP).	Neo Energy Oasis and all contractors
Maintain the well-being of workers living in camps	Labour management	• Workers' Accommodation Plan.	• Worker camp audit reports, corrective measures and action plan, photographs demonstrating corrective measures implemented.	Neo Energy Oasis and all contractors
Inform workers of HIV/AIDS and sexually transmitted disease (STD) risks and protection to minimise risk of infection to workers and communities	Labour management	• HIV/AIDS and STDs awareness and prevention briefings	• Members of staff to receive brochure which raises HIV/AIDS awareness; • Staff to sign acknowledging receipt and understanding of brochure	Neo Energy Oasis and all contractors
Community Grievance Plan	Safeguarding community health, safety and security	• Project performance grievance mechanism; • Record water use baseline prior to construction activity of dam and; • Provide temporary and permanent community water solutions if downstream water user are affected; • Community health and safety campaign	• Maintenance of complaints log and resolution process; and	Neo Energy Oasis
Restrict access to sites, especially	Safeguarding community	Site security measures including:	Provision / review of the following documentation:	Neo Energy Oasis

hazardous areas	health, safety and security	• Appropriate fencing; and • Signage around site perimeter and where identified through risk assessment process	• Description / photographs of fencing / signage around site perimeter; • company licenses and individual training records of security personnel proposed as per contract requirements; and • Site registry identification system.	
Cultural sharing and tolerance	Induced development, population changes and the potential for cultural tension	• Modifications to procurement practices; and • Training of all local and outside workers in cultural sensitivities.	• Staff to sign training sheet confirming attendance.	Neo Energy Oasis
Improved road condition and transport	Infrastructure work (roads and bridges).	• Road maintenance to leave a useful asset for communities after the construction phase.	• Monitoring of road conditions	Neo Energy Oasis
Redundancy of personnel	Project closure	• Develop Retrenchment Plan	• Implement Retrenchment Plan.	Neo Energy Oasis
Ecology and Biodiversity				
Management of Biodiversity issues Habitat conservation And management	Project footprint	• Production of a draft Biodiversity Action Plan (BAP); • Stakeholder consultation, suggest a series of one to one meetings and local community's stakeholder workshops.	• BAP completed and circulated to all stakeholders and contractors; and • Approve the Neo's BAP by the Ministry of Environment (MOECAF).	Neo Energy Oasis, EMU and MOECAF
Minimise habitat loss and disturbance (terrestrial ecology)	Construction lay down, layout of associated infrastructure and temporary working areas	• Avoidance measures by design layout of associated infrastructure and location of laydown to take into consideration local environmental / ecological conditions; • Minimise size of temporary working area; • Develop Ecological Management Plan; and	• Monthly audit of construction areas; • MOECAF approval of the Ecological Management Plan developed by Neo Energy.	Neo Energy Oasis, EMU and MOECAF
Minimise hunting	Increased	• Code of Conduct for	• Hunting prevention measures	Neo Energy

and poaching	access to area; Construction workers	construction workers banning hunting; and • Signage highlighting hunting ban in all Project areas.	to be included within Contractor's scope through acceptance of Neo EHS requirements.	Oasis
Minimise habitat loss and disturbance (aquatic ecology	In river construction works	• Minimum working areas; • Pollution prevention measures; • Sediment control • Fishing ban on construction workforce; and • No construction works during peak migration/spawning periods on the Baluchaung River.	• Daily monitoring and monthly audit of site preparation / Construction activities.	Neo Energy Oasis
Habitat conservation and management	Reinstatement of habitats	• Production of Habitat Management Plan; and • Land purchase or land agreement and planting for habitat creation.	• Annual review of success of created habitat areas; and • % of habitats reinstated to good condition within 12 months of the completion of works.	Neo Energy Oasis
Water Resources and Water Quality				
Protection of surface water quality for the environment	In dam construction works	• Good practice construction measures	• No contamination of any surface waters; • Regular visual water monitoring; and • Regular review of contractor activities and implementation of Construction EMP by Neo's Project Manager.	Neo Energy Oasis and EMU
Maintain sufficient water flow for boat users	Changed / lowered flow regime due to operation of dams	• Operate in with minimum flow requirements.	• Regular flow monitoring in line with that set out in the ESIA.	Neo Energy Oasis and EMU
Water irrigation and agricultural use	Changed / lowered flow regime due to operation of dams	• Operate in with minimum flow requirements. • Implement catchment management scheme to ensure long-term water supply to users.	• Regular flow monitoring in line with that set out in the ESIA.	Neo Energy Oasis and EMU
Maintain water supply to local	Impact on river sections	• Provide alternative supply to affected users'	• Annual monitoring of water flow	Neo Energy Oasis and

villages	between intake weirs and power stations due to diversion of water for power generation.			EMU
Geology, Landslides and Seismic Risks				
Prevent soil erosion and transportation	Site preparation, excavation, construction of dams, water ways and access roads	• Good engineering practice shall be undertaken to mitigate or manage soil erosion.	• To be defined under Contractors Construction EMP requirements.	Neo Energy Oasis and EMU
Stability of slopes to prevent landslides	Road and Dam and water ways construction	• Where slope instabilities are of concern, then good engineering practice shall be undertaken to mitigate or manage slope movements so as to reduce the impact on the Project and local community.	• To be defined under Contractors Construction EMP requirements. • Plans and method statements to be reviewed and approved by EMU	Neo Energy Oasis and EMU
Minimize destabilization of slopes	Water ways	• The cuttings must be adequately supported / inclined according to good engineering practice; • Reduce where possible the amount of tree felling; and • Reinstate tree cover on cleared ground along side roads as soon as possible after water ways construction completed.	• To be defined under Contractors Construction EMP requirements. • Plans and method statements to be reviewed and approved by EMU	Neo Energy Oasis and EMU
Prevent soil erosion and landslide	Erosion of Water ways	• Maintain integrity of road surface through regular maintenance.	• Regular visual observation.	Neo Energy Oasis and EMU
Materials and Waste Management				
Minimization and safe disposal of	Spoil generated as a result of	• Where possible, spoil material will be used as a construction material and for	• Maintain records of amount of material disposed of to each	Neo Energy Oasis and EMU

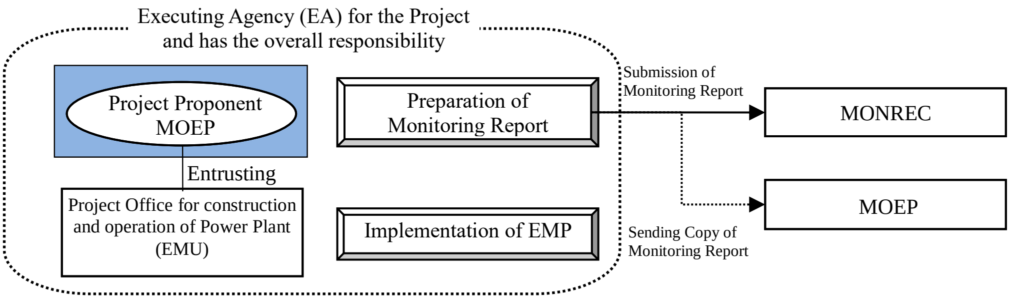
waste	rock blasting	concrete batching; and • Other spoil will be disposed of in spoil disposal sites which have been identified at a number of locations within the Project area.	spoil disposal site; and • Monitor spoil disposal sites for erosion	
Minimize pollution	Materials handling and storage	• Appropriately covered and bounded storage located away from sensitive receptors; • Appropriate spill kits nearby (as necessary for hazardous liquids); • Secure and protected from risk of theft or vandalism; • Easily accessible in a safe manner; and • Located next to any required PPE (as necessary for irritants and hazardous materials)	• Audit of Contractor's materials storage facilities by EMU; and • Number of pollution incidents.	Neo Energy Oasis and EMU
Noise and Vibration				
Avoid noise Nuisance generated by on-site plant and construction activities	Site preparation excavation and foundations, construction and blasting	• Restricted general hours of working to avoid sensitive periods; • Positioning of temporary site compounds as far as reasonably practicable from sensitive receptors; • Undertaking construction activities in accordance with good practice; • Maintaining equipment in good working order and fitting with appropriate noise control at all times; • Consider acoustic enclosures for compressors/generators if located near sensitive receptors; • Ensure deliveries arrive and depart so as not to disturb	• Requirement for contractors to implement mitigation as part of the contracts; • EMU to monitor noise levels using sound level meter at the nearest residential properties to construction activities for comparison against standards; and • Record noise complaints and investigate using sound level meter via the community grievance mechanism.	Neo Energy Oasis and EMU

		residents at inconvenient times; • Setting noise limits; • A regime of noise monitoring where appropriate; and • Providing the public with advance notice of planned noise-generating activities.		
Avoid noise nuisance generated by construction traffic	Site traffic movements to and from site including abnormal loads	• Maintaining equipment in good working order and fitting with appropriate noise control at all times; • Setting noise limits; and • A regime of noise monitoring where appropriate.	• Requirement for contractors to implement mitigation as part of the contracts; • EMU to monitor noise levels using sound level meter at the nearest residential properties to construction activities for comparison against standards; and • Record noise complaints and investigate using sound level meter via the community grievance mechanism.	Neo Energy Oasis and EMU
Air Quality				
Minimize dust emissions	Land clearing, quarrying, road construction, spoil deposition and general construction activities.	• Minimizing dust from material handling and storage sources by using covers and/or control equipment (water suppression); and • Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements.	• Environmental Manager to undertake daily visual checks; and • Number of dust complaints.	Neo Energy Oasis and EMU
Minimize dust emissions	Traffic and vehicle movements on site roads	• Restrict traffic to tarmac roads as far as possible. Speed limit for all off road traffic to be <20 km/hr to minimize dust; and • All vehicles should be tarped	• Environmental Manager to undertake bi-weekly visual checks of construction vehicles. (violation to be reported only); • Contractor to maintain servicing	Neo Energy Oasis and EMU

		to prevent dust generation from the loads.	records for all vehicles; and • EMU to review Contractors servicing records at beginning of contract and thereafter on six monthly basis for those longer term contracts lasting more than six months	
Minimize construction machinery / vehicle emissions	Construction traffic and machinery	• Manage emissions from mobile sources as per IFC EHS guidelines for Air Emissions and Ambient Air Quality; and • Locate generators away from receptors (workers' camps and residents).	• Environmental Manager to undertake bi-weekly visual checks of construction vehicles. • Contractor to maintain servicing records for all machinery. And • EMU to review Contractors servicing records at beginning of contract and thereafter on six monthly basis for those longer term contracts lasting more than six months.	Neo Energy Oasis and EMU
Greenhouse Gases and Climate Change				
Reduce Greenhouse Gas (GHG) emissions	-Material Sourcing -Use of vehicles, construction plant and generators with emissions.	• Sourcing materials from local supplier's wherever possible to avoid potentially long distance travel for materials; and • Use of materials recovered at site (rock and aggregates) in preference to remote suppliers. • Using well maintained diesel generators and other plant to ensure the maximum efficiency and lowest fuel/energy consumption	• Inventory of materials to include source; and • Procurement Policy to include requirement for sourcing most geographically local materials whenever possible. • Record evidence of new plant being employed; • Monitor and record of plant maintenance; and • Monitor and record fuel consumption.	Neo Energy Oasis and EMU
Climate change mitigation	Forestry regeneration	• Plant new forestry to replace forestry removed for construction or lost through inundation to act as carbon	• Number of trees planted.	Neo Energy Oasis and EMU

		sink reducing the carbon cost of construction.		
Landscape and Visual Amenity				
Reduce visual intrusion of construction activities and areas	Site clearance, Road construction and quarrying	• Construction sites to be kept tidy; • Clearing of vegetation around construction sites to be minimized; and • Landscape planting strategy to identify appropriate re-vegetation	• EMU to review Contractors CEMP; and • Environmental Manager to undertake bi-weekly visual checks of construction areas.	Neo Energy Oasis and EMU
Reduced visual footprint	Dams, powerhouses, roads etc.	• Landscape planting strategy with appropriate re-vegetation.	• Annual survey of re-forestation and re-vegetation.	Neo Energy Oasis and EMU
Flora and fauna rehabilitated areas		Enforcement of rules of the reserve and forest exploitation must be done. Monitoring (by guards) for illegal activities in forest around project areas and the imposing of sanctions as fines will be continued.	Project Area	Neo Energy Oasis and EMU

7. Institutional Arrangement



Source: Resource & Environment Myanmar Co., Ltd

Figure 7.1: Proposed Organization Structure for Implementation of EMP and Monitoring Plan for Upper Baluchaung HPP Project.

ပတ်ဝန်းကျင်ဆိုင်ရာနှင့် လူမှုဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုအကဲဖြတ်ခြင်း အနှစ်ချုပ်

နှင့်

ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ်

အထက် ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်း

၂၀၁၆

၁။ စီမံကိန်း ဆောင်ရွက်သူ/ ပိုင်ရှင်

စီမံကိန်းဆောင်ရွက်သူ - Neo Energy Oasis Development Company Ltd.

ဦးဆောင်သည့် အဖွဲ့အစည်း - လျှပ်စစ်နှင့် စွမ်းအင် ဝန်ကြီးဌာန (ယခင် လျှပ်စစ်နှင့် စွမ်းအင်ဝန်ကြီးဌာန)

၂။ စီမံကိန်းအမျိုးအစားနှင့် ကနဦးပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း/ ပတ်ဝန်းကျင် ထိခိုက်မှုဆိုင်ရာ ဆန်းစစ်ခြင်း လိုအပ်ချက်

၁) စီမံကိန်းအမျိုးအစား - ၃၀.၄ မဂ္ဂါဝပ် ရေအားလျှပ်စစ် စက်ရုံ တည်ဆောက်ခြင်းနှင့်လည်ပတ်ခြင်း

၂) ကနဦးပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း/ ပတ်ဝန်းကျင် ထိခိုက်မှုဆိုင်ရာ ဆန်းစစ်ခြင်း လိုအပ်ချက် - ပတ်ဝန်းကျင် ထိခိုက်မှုဆိုင်ရာ ဆန်းစစ်ခြင်း လိုအပ်ပါသည်။

၃။ ပတ်ဝန်းကျင် ထိခိုက်မှုဆိုင်ရာ ဆန်းစစ်ခြင်းအား အကောင်အထည်ဖော်သည့် အဖွဲ့အစည်း

ပတ်ဝန်းကျင် ထိခိုက်မှုဆိုင်ရာ ဆန်းစစ်ခြင်းအား အကောင်အထည်ဖော်ရန် အဖွဲ့အစည်းနှစ်ခုကို အောက်တွင်ဖော်ပြထားပါသည်။

၁) ဦးဆောင်သည့် အဖွဲ့အစည်း- Resource and Environment Myanmar Ltd., (REM)၊

လိပ်စာ - ၇၀၂ ဒယ်တာ ပလာဇာ၊ ရွှေဂုံတိုင်လမ်း၊ ဗဟန်းမြို့နယ်၊ ရန်ကုန်မြို့။

တယ်လီဖုန်း - ၉၅၉-၇၃၀၁၃၄၄၈

ဖက်စီမိုင်း - ၀၁-၅၅၂၉၀၁

Email : service@enviromyanmar.net

ဆက်သွယ်ရန်ပုဂ္ဂိုလ် - ဦး စိုးသူရထွန်း

ရာထူး - အုပ်ချုပ်မှုဒါရိုက်တာ

၂) အဖွဲ့ခွဲ - Sustainable Environment Myanmar Company Limited (SEM)

လိပ်စာ - ဘီ၀၀၅ ဒယ်တာ ပလာဇာ၊ ရွှေဂုံတိုင်လမ်း၊ ဗဟန်းမြို့နယ်၊ ရန်ကုန်မြို့

တယ်လီဖုန်း - +၉၅၉ ၂၆၁၃၂၈၈၉၁

Email: services@sustainablemyanmar.com

၄။ စီမံကိန်းအကြောင်းအရာ ဖော်ပြချက်

အနောက်ဘက် တောင်တန်းများမှ အင်းလေးကန်အတွင်းသို့ စီးဝင်သော ချောင်းကြီးသုံးခုမှာ ရေပီး (ဟဲဟိုး)၊ သန်တောင် (ကလော) နှင့် အထက် ဘီလူးချောင်း တို့ဖြစ်ပါသည်။ ၎င်းတို့အထဲတွင် အထက်ဘီလူးချောင်းသည် အကြီးဆုံးဖြစ်ပြီး အများဆုံးရေဝပ်ဧရိယာမှာ (၈၃၆ စတုရန်းကီလိုမီတာ) နှင့် အမြဲစီးဆင်းနေပါသည်။

အထက်ဘီလူးချောင်း မြစ်သည် ပင်လောင်းမြို့နယ်၏ အနောက်ဘက် ၂မိုင်ခန့်မှ စတင်စီးဆင်း၍ တောင်မှ မြောက်သို့ စီးဆင်းပြီး အောင်ပန်း-လွိုင်ကော်လမ်းအားဖြတ်နေသော အရှေ့ဘက် မြေပြန့်လွင်ပြင်ဘက်သို့ လှည့်လည်စီးဆင်းပြီးနောက် အင်းတိမ်ရွာမှတဆင့် အင်းလေးကန်၏အနောက်ဘက်သို့ ဖြတ်သန်းစီးဆင်းနေပါသည်။

အင်းလေးကန်အတွင်းသို့ မစီးဆင်းမီ မြစ်သည် အင်းလေးကန်၏ အနောက်ဘက်ကမ်းပါး ယံမှဖြတ်သန်းစီးဆင်းပြီး ရေတံခွန်များဖြစ်ပေါ်၍ ၎င်းသည် ရေအားလျှပ်စစ် အရင်း အမြစ်ကြီးဖြစ်လာပါသည်။

ဆောင်ဝန်နှင့် အင်းတိမ်ရွာ ကြား ၁၇.၅ ကီလိုမီတာအရှည် မြစ်ကြောင်းတစ်လျှောက်တွင် သဘာဝအတိုင်း အနိမ့်အမြင့် ခြားနားချက်သည် ၃၂၀ မီတာခန့် တွေ့ရှိရပါသည်။

Run-off river type အမျိုးအစား ရေအားလျှပ်စစ် စီမံကိန်း နှစ်ခုကို အင်းတိမ် ရွာ၏ ချောင်းအထက် ၅ကီလိုမီတာခန့်အကွာရှိ မင်းလုံးရွာအနီးတွင် တည်ဆောက်ရန် စီစဉ်ထားပါသည်။

နှစ်စဉ်လည်ပတ်အား တစ်နာရီလျှင် ၉၀.၁ GWh (ဂစ်ဂါဝပ်) နှင့် ၂၀.၄ မဂ္ဂါဝပ်စွမ်းရည်ရှိမည့် စီမံကိန်းတစ်ခုနှင့် နှစ်စဉ်လည်ပတ်အား တစ်နာရီလျှင် ၄၄.၅ GWh (ဂစ်ဂါဝပ်) နှင့် ၁၀ မဂ္ဂါဝပ်စွမ်းရည်ရှိမည့် စီမံကိန်းတစ်ခုတို့ ဖြစ်ပါသည်။

အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းကို အဆင့်နှစ်ဆင့်ဖြင့် အကောင်အထည်ဖော်ရန် စီစဉ်ခဲ့ပါသည်။

အဆင့် ၁ (ယူဘီ-၁)တွင် ကွန်ကရစ် ရေကာတာ (တာတမံအမျိုးအစား)၊ ရေဝင်ရေထွက် ပုံသဏ္ဌာန်၊ရေဝင် ရေထွက်မြောင်း၊ သဲစစ်ကန်၊ ရေခေါ်မြောင်း၊ ရေလှောင်ကန်၊ ရေဖိအားမြှင့်ပိုက်လိုင်း နှင့်

ဓာတ်အားထုတ်လုပ်ရုံ တို့ပါဝင်ပါသည်။

တည်ဆောက်ပြီး ထွက်ရှိလာမည့် လျှပ်စစ်စွမ်းအားကို ၂၀.၄ မဂ္ဂါဝပ် (၁၀.၂ မီဂ္ဂါဝပ်× ၂ ခု) အဖြစ်ဒီဇိုင်းဆွဲခဲ့ပါသည်။

အဆင့် ၂ (ယူဘီ-၂) ကို ရေကာတာ အမြင့် မထားဘဲ စီစဉ်ရေးဆွဲခဲ့ပါသည်။ ၎င်းသည် ယူဘီ-၁၏ Tail race channel မှ ယူဘီ-၂၏ Head Race ကို တိုက်ရိုက်ချိတ်ဆက်ပြီး ရေလှောင်ကန်၊ ရေဖိအားမြှင့်ပိုက်လိုင်း နှင့် ဓာတ်အားထုတ်လုပ်ရုံ သို့ ချိတ်ဆက်သွားမည် ဖြစ်ပါသည်။ ယူဘီ-၂ ၏ အသုံးပြုနိုင်သည့် စွမ်းရည်မှာ ၁၀မဂ္ဂါဝပ် (၅ မီဂ္ဂါဝပ်× ၂ ခု) ဖြစ်ပါသည်။

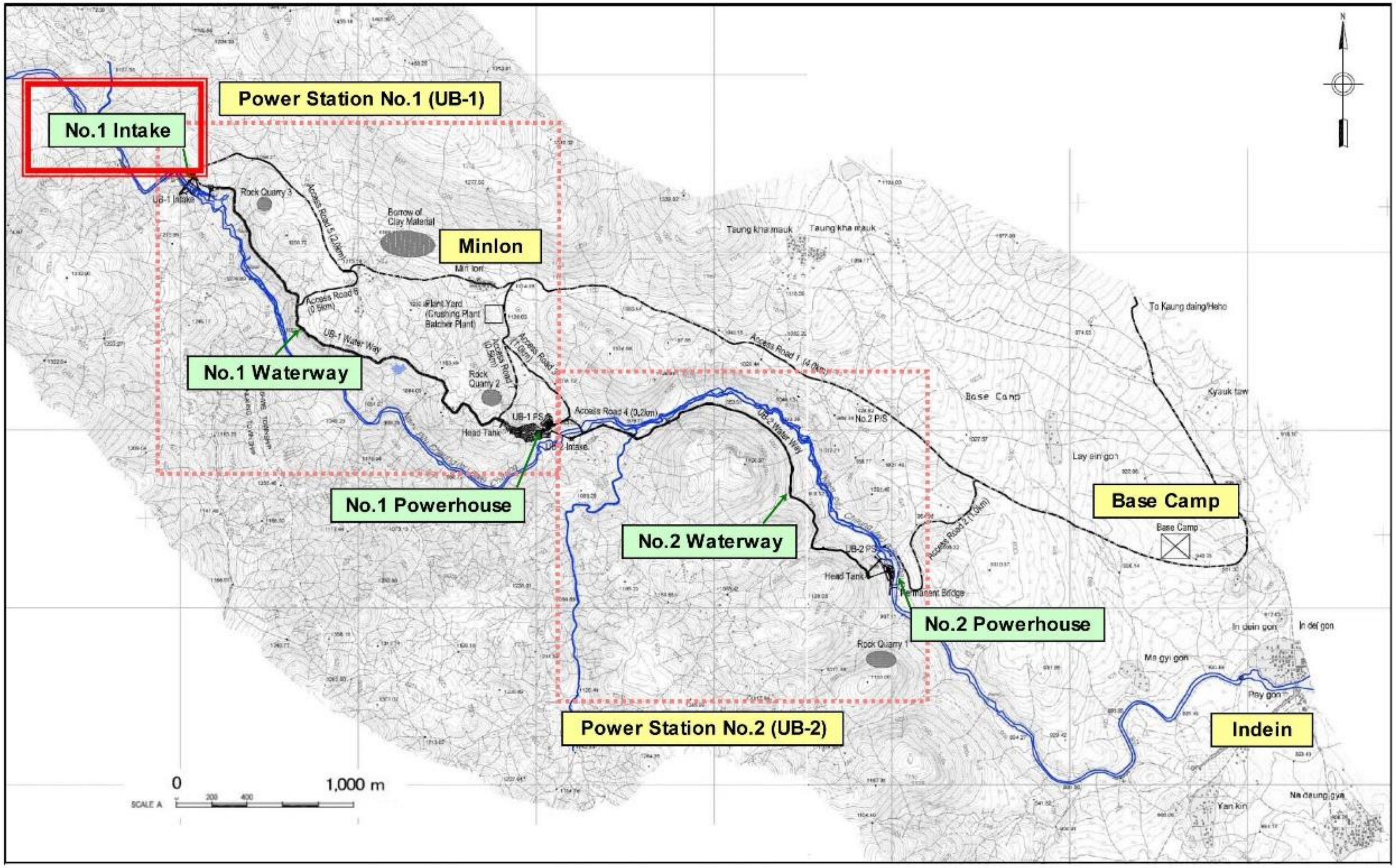
စီမံကိန်းနေရာသည် ရှမ်းပြည်နယ်တောင်ပိုင်း၊ ညောင်ရွှေမြို့၏ အနောက်တောင်ဘက် ၂၃ကီလိုမီတာ/ ၁၄.၄မိုင်ခန့်အကွာတွင် တည်ရှိပါသည်။

စီမံကိန်းတွင် အင်းလေးကန်အတွင်းသို့မဝင်မီ မြစ်ကြောင်းတစ်လျှောက် ရရှိနိုင်သည့် သဘာဝအတိုင်း အနိမ့်အမြင့်ကွာခြားချက်ကို အသုံးပြုထားသော run-off river type အမျိုးအစား ရေအားလျှပ်စစ် စက်ရုံနှစ်ခု တည်ဆောက်ခြင်း ပါဝင်ပါသည်။

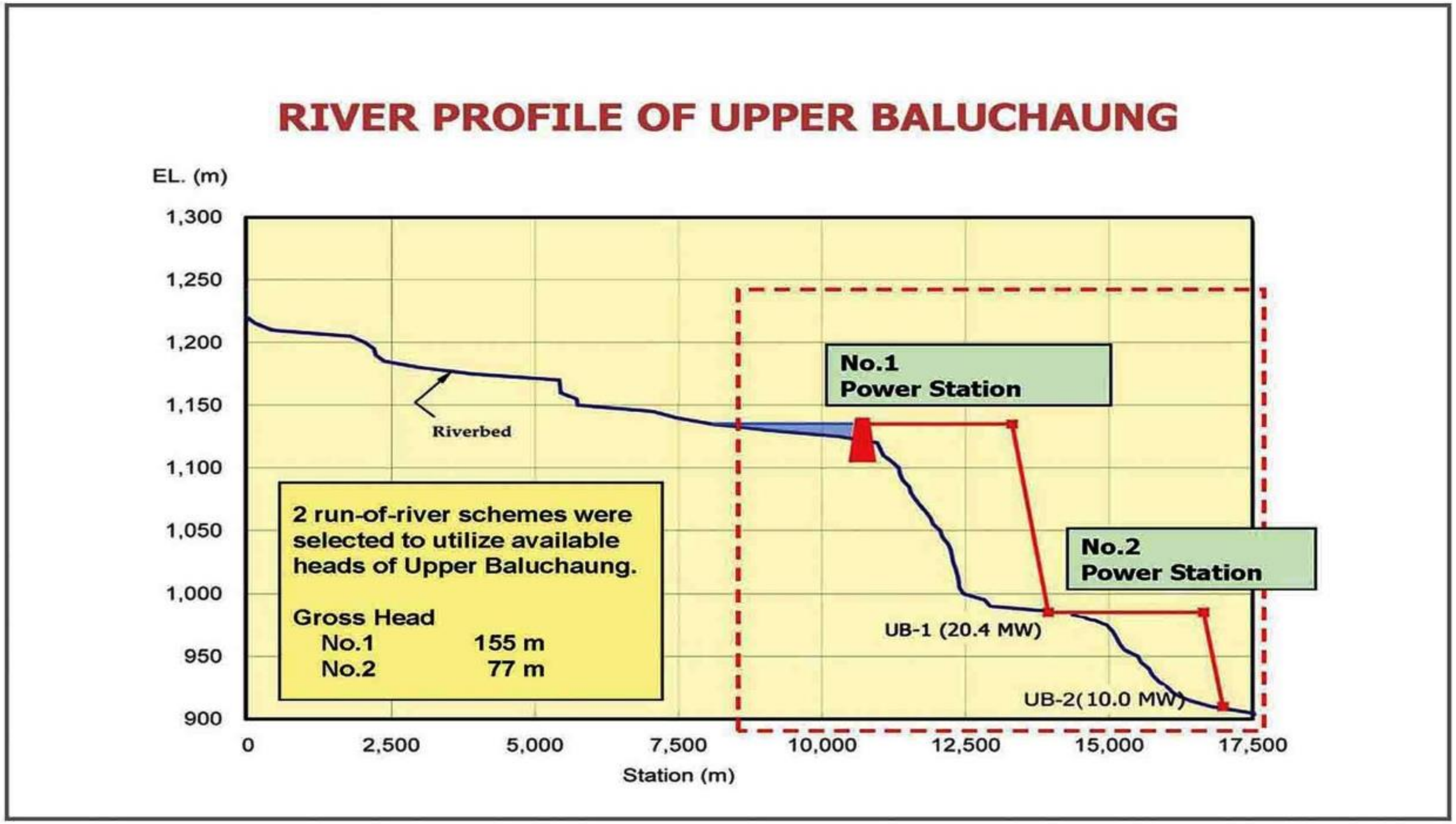
နန်းလက်ချောင်း၊ ဟဲဟိုး (ငါးရချောင်း)၊ ကလော (ငုတ်) ချောင်းနှင့် အထက် ဘီလူးချောင်း အမည်ရှိသော မြစ်လေးခုသည် အနောက်ဘက်အခြမ်းမှ အင်းလေးကန်အတွင်းသို့ စီးဝင်ပါသည်။

၄.၁ စီမံကိန်း Layout Plan အစီအစဉ်

စီမံကိန်း၏ ယေဘုယျ layout plan ကို ပုံ ၄-၁ တွင်ဖော်ပြထားပြီး မြစ်၏ profile ပုံစံကို ပုံ ၄-၂တွင် ဖော်ပြထားပါသည်။



ပုံ ၄-၁ အထက် ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်း၏ ယေဘုယျ ဖွဲ့စည်းပုံ အစီအစဉ်



Schematic General Profile

ပုံ ၄-၂ အထက် ဘီလူးချောင်း၏ မြစ်၏ အနိမ့်အမြင့် ပုံစံ

၅ ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း၏ ရလဒ်များ

စီမံကိန်းကြောင့် ပတ်ဝန်းကျင်ဆိုင်ရာနှင့် လူမှုဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများကို စီမံကိန်းဖော်ပြချက်၊ အခြေခံအချက်အလက်ကောက်ယူခြင်း၏ ရလဒ်များအပေါ် အခြေခံ၍ ကြိုတင်ခန့်မှန်းပြီး တွက်ချက်ထားပါသည်။

အခန်း ၆ တွင် တည်ဆောက်ရေးကာလနှင့် လည်ပတ်ကာလ မတိုင်မီ/အတွင်း စီမံကိန်းကြောင့် ပတ်ဝန်းကျင်ဆိုင်ရာနှင့် လူမှုဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများကို ဖော်ပြထားပါသည်။

၆။ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်

ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်တွင် အစိတ်အပိုင်း နှစ်ခုပါဝင်ပါသည်။ ၁) စီမံကိန်းအကောင်အထည်ဖော်ဆောင်ရွက်ရာတွင် လျော့ချရေးနှင့် စီမံကိန်းအကောင်အထည်ဖေါ်ဆောင်ရန် စဉ်းစားထားသည့်နည်းလမ်းများ ကို စီမံကိန်းဖော်ပြချက်နှင့် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း၏ ရလဒ်များအပေါ် အခြေခံ၍ ဖော်ထုတ်ထားပြီး ၂) လျော့ချရေးနှင့် စဉ်းစားထားသည့်နည်းလမ်းများ ကို သေချာစေရန် နှင့် ဆောက်လုပ်ရေးနှင့် လည်ပတ်ကာလတွင် ပတ်ဝန်းကျင်အတိုင််းအတာအရ သတ်မှတ်ထားသော ပတ်ဝန်းကျင်ဆိုင်ရာ အဆင့်များကိုု သေချာစေရန် ပတ်ဝန်းကျင်ဆိုင်ရာ စောင့်ကြပ်ကြည့်ရှုရေး အစီအစဉ် တို့ပါဝင်ပါသည်။

ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအစီအစဉ် (လျော့ချရေး နည်းလမ်းများ) နှင့် ပတ်ဝန်းကျင်ဆိုင်ရာ စောင့်ကြပ်ကြည့်ရှုခြင်း လုပ်ဆောင်ချက်များကို ဖော်ထုတ်ပြီး ဇယား ၆-၁၊ ၆-၂ နှင့် ၆-၃ တို့တွင် အသီးသီး အနှစ်ချုပ်ဖော်ပြထားပါသည်။

ဇယား ၆-၁ စီမံကိန်း လုပ်ငန်းများကြောင့် ထိခိုက်မှုများအတွက် ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု

စဉ်။	ဖြစ်နိုင်ချေရှိသော ထိခိုက်မှု	လျှော့ချရေးနည်းလမ်း	လိုအပ်သောလုပ်ဆောင်မှု	ကုန်ကျစရိတ် အရင်းအမြစ်
၁။	ရေယူအဆောက်အအုံ အမှတ်-၁နှင့် ခေတ်အားပေးဌာန အမှတ်-၂ ကြား မြစ်အပိုင်းတွင် ရေနည်းကာ ခြောက်သွေ့နိုင်ခြင်း။	မြစ်ထိန်းသိမ်းစီးဆင်းမှု တစ်စက္ကန့်လျှင် ဂ.၅ ကုဗမီတာနှင့် အတူ ရေယူအဆောက်အအုံ အမှတ်-၂ မှ အမြဲတမ်း ထုတ်လွှတ်ရန်။	ရေယူအဆောက်အအုံ အမှတ်-၁နှင့် အမှတ်-၂ တွင် တစ်စက္ကန့်လျှင် ဂ.၅ ကုဗမီတာစီးသော မြစ်ရေလွှဲပေါက်များ ပေါင်းစပ်ဖွဲ့စည်းခြင်း။	ကုန်ကျစရိတ်တွင် ပါဝင်ပြီး
၂။	လမ်းတိုးမြှင့်ရေးလုပ်ငန်းများကြောင့် မင်းလုံးရွာသို့ အိမ်သုံးရေထောက်ပံ့သော ဖြန့်ဖြူးရေးပိုက်များ ဖြိုဖျက်ခြင်း။	- ဖြန့်ဖြူးရေးပိုက် ပြင်ဆင်ခြင်း (ယာယီ)။ - အမြဲတမ်း ရေပေးဝေရေးစနစ် တပ်ဆင်ခြင်း။	- (လုပ်ဆောင်ပြီး) - အမှတ်-၁ Pondage မှ မင်းလုံးရွာသို့ ရေပေးဝေရေးစနစ်၏ အသေးစိတ် ပုံစံ - အမြဲတမ်း ရေပေးဝေရေး စနစ် တည်ဆောက်ခြင်း	စီမံကိန်း ကုန်ကျ စရိတ်တွင် ပါဝင်ပြီး။

ဇယား 6-2 တည်ဆောက်ရေးကာလအတွင်းဖြစ်ပေါ်လာမည့် ပတ်ဝန်းကျင်ဆိုင်ရာ သက်ရောက်မှုများအား စီမံခန့်ခွဲခြင်း

စဉ်	အလားအလာရှိသော သက်ရောက်မှုများ	လျှော့ချခြင်း/ တိုးမြှင့်ခြင်းနည်းလမ်းများ	လိုအပ်သော လုပ်ဆောင်ချက်	တန်ဖိုး အရင်းအမြစ်
တည်ဆောက်ရေးကာလအတွင်း လူစွမ်းအား ရွှေ့လျားမှုကြောင့်ဖြစ်ပေါ်လာသော သက်ရောက်မှုများ				
၁။	လူဦးရေတိုးပွားလာမှုကြောင့် လူထုနှင့် စီးပွားရေးဆိုင်ရာ သက်ရောက်မှုများ။	စီမံကိန်း၏ အခြေခံစခန်းအတွင်း ဒေသခံပြည်သူများအတွက် အဆောက်အဦးများတည်ဆောက်ရာတွင်လိုအပ်ချက်ရှိခြင်းများ၊ အပိုသုံးစွဲခြင်းများကို ရှောင်ကြဉ်ခြင်း။	-စာသင်ကျောင်းနှင့် ဆေးပေးခန်းစသော လူထုအတွက်အခြေခံကျသော အဆောက်အဦးများ တည်ဆောက်ရန် အသေးစိတ် ပုံစံဆွဲပေးရမည်။ -၄င်းအဆောက်အဦးများ၏အသေးစိတ် ပုံစံအတိုင်း တည်ဆောက်ရမည်။	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲတွင် ထည့်သွင်းရမည်။
၂။	ပြင်ပ အလုပ်သမား	ဆောက်လုပ်ရေးအလုပ်သမားများ	ဆောက်လုပ်ရေးလုပ်ငန်း၌	

	များ၏ ပြဿနာ များနှင့် လုံခြုံရေး။	၏ လုံခြုံရေးဆိုင်ရာ ပညာပေး မှုများနှင့် ဒေသခံပြည်သူများနှင့် သဟဇာတဖြစ်ရေး။	နည်းပညာအထူးပြုဆောင်ရွက် ခြင်းများဖြင့် လျှော့ချခြင်း ဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်းဆောင်ရွတ်ခြင်း။	
၃။	ပြင်ပ အလုပ်သမား များ၏ ကျန်းမာရေးစောင့် ရှောက်မှု။	ဆောက်လုပ်ရေး အလုပ်သမားများအား ကျန်းမာရေးဆိုင်ရာပညာပေးမှု များ ဆောင်ရွက်ခြင်း။ ဆောက်လုပ်ရေးအလုပ်သမား များ၏ ကျန်းမာရေးအား ပုံမှန်ကောင်းမွန်စေရေး ဆောင်ရွက်ခြင်း။	- အထက်ပါအတိုင်း ဆောင်ရွက်ခြင်း။	
ကြီးမားသော ပစ္စည်းကိရိယာများနှင့် တည်ဆောက်ရေးဆိုင်ရာ ပစ္စည်းများ သယ်ယူပို့ဆောင်ရာတွင် ဖြစ်ပေါ်လာသော သက်ရောက်မှုများ				

၄။	ယာဉ်အသွားအလာ ပမာဏ ကြီးမားလာခြင်း။	-လမ်းများ ချဲ့ထွင်ခြင်း -လမ်းအူကြောင်း၏ အဓိကနေရာများတွင် ယာဉ်အသွားအလာရှင်းလင်းရေး ဝန်ထမ်းများ ခန့်အပ်ထားရှိခြင်း။ -ယာဉ်မောင်းသမားများကို ယာဉ်အန္တရာယ် ကင်းရှင်းရေးအတွက် သင်တန်းများပေးခြင်း။	လမ်းအူကြောင်း ချဲ့ထွင်ခြင်း နှင့်လမ်းကြောင်းအသစ် ဖေါက်လုပ်ခြင်း လုပ်ငန်းများအတွက် အသေး စိတ်ပုံစံဆွဲခြင်း (တည်ဆောက်ရေးကာလ အတွင်း) ယာဉ်မောင်းသမားများအား သွားလာမှု အနည်းဆုံး ဖြစ်စေရန် ထိန်းချုပ်ခြင်း။	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။
၅။	သယ်ယူပို့ဆောင် ရေးပိုက်များ တိုးမြင့်လာခြင်း။	-လမ်းများနှင့် ယာဉ်များတွင် ရေဖြန်းစနစ်များ တတ်ဆင်ခြင် -ယာဉ်များကို အမိုးအကာအရံများတပ်ဆင်ခြင်း။	ဆောက်လုပ်ရေးလုပ်ငန်း၌ နည်းပညာအထူးပြု ဆောင်ရွက်ခြင်းများဖြင့် လျှော့ချခြင်းဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်း ဆောင်ရွတ်ခြင်း။	
၆။	ဆူညံသံနှင့် တုန်ခါမှုများ။	-ယာဉ်အသွားအလာ ညင်သာမှုရှိစေခြင်း။ -ယာဉ်များကိုကောင်းမွန်သော ထိန်းသိမ်းမှုများ ထားရှိခြင်း။	- အထက်ပါအတိုင်း ဆောင်ရွက်ခြင်း။	
တည်ဆောက်ခြင်း နှင့်ဖောက်ခွဲခြင်း စသော တည်ဆောက်ရေးဆိုင်ရာလုပ်ငန်းများ၏ သက်ရောက်မှုများ				
၇။	လေထု ညစ်ညမ်းခြင်း (ဓါတ်ငွေ့များနှင့် ဖုန်မှုန်များ ထုတ်လွှတ်ခြင်း) ။	-တည်ဆောက်ခြင်းလုပ်ငန်းများ တွင် ဖုန်မှုန့်နှင့် အခြားသော အငွေ့အသက်များ မထွက်စေရန် ရေဖြန်းခြင်း ဆောင်ရွက်ခြင်း (အထူးသဖြင့် လူနေနီးသော နေရာများတွင် အဓိကထား လုပ်ဆောင်ခြင်း) ။ -ယာဉ်များကို အမိုးအကာအရံများ တပ်ဆင်ခြင်း။ -ကြီးမားသောယာဉ်ကြီးများကို ကောင်းမွန်သော ထိန်းသိမ်းမှုများ ထားရှိခြင်း။	ဆောက်လုပ်ရေးလုပ်ငန်း၌ နည်းပညာအထူးပြု ဆောင်ရွက်ခြင်းများဖြင့် လျှော့ချခြင်းဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်း ဆောင်ရွတ်ခြင်း။	ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။
၈။	မြေဆီလွှာ တိုက်စားမှုနှင့် သာဘာသဘေး အန္တရာယ်တိုးပွား လာခြင်း။	တိုးမြင့်ဆောင်ရွက်ရမည့်ကာကွယ် ရေးဆိုင်ရာ လုပ်ငန်းများ။ - အကာအရံများ ထိန်းသိမ်းခြင်း - ရေကန်များကို ထိန်းသိမ်းခြင်း - ကောက်ပဲသီးနှံ စိုက်ခင်းများ ထိန်းသိမ်းခြင်း။ - မိုးရေ စီးစင်းသည့်စနစ်	- တိုက်စားမှုကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆိုင်ရာ စောင့်ကြည့်ရေး အစီအစဉ်တွင် ထည့်သွင်းဖော်ပြရန်။ - အကယ်၍ စောင့်ကြည့် စစ်ဆေးရာ တွင်	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။

		- လှေကားထစ်ပုံ မြေဆီလွှာအကာအရံများ စသောစနစ်များထားရှိခြင်း။	ဆိုးဝါးသော သက်ရောက်မှုများ တွေ့ရလျှင် ၄င်းတို့ကို အနည်းဆုံးဖြစ်အောင် ဆောင်ရွက်ခြင်း။	
၉။	ရေညစ်ညမ်းမှု (ရေနောက်ကျိမှုနှင့် ဆားဓါတ်ပါဝင်မှု မြင့်မားခြင်း) ။	- တိုးမြှင့်ဆောင်ရွက်ရမည့်ကာကွယ်ရေးဆိုင်ရာ လုပ်ငန်းများ - နုန်းအနည်အနှစ် ပို့ချမှုနှင့် ရေကန်များ ထိန်းသိမ်းခြင်း - ရေဆိုးသန့်စင်သည့် နည်းစနစ် - မိုးရေ စီးစင်းသည့် နည်းစနစ် - ကောက်ပဲသီးနှံစိုက်ခင်းများ ထိန်းသိမ်းခြင်းစနစ်	- ဆောက်လုပ်ရေးလုပ်ငန်း၌ နည်းပညာအထူးပြုဆောင်ရွက်ခြင်းများဖြင့် လျော့ချခြင်းဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်းဆောင်ရွက်ခြင်း။ - ဘီလူးချောင်းအထက်ပိုင်း ရေထုညစ်ညမ်းမှု စောင့်ကြည့် ခြင်းကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆိုင်ရာ စောင့်ကြည့်ရေး အစီအစဉ်တွင် ထည့်သွင်း ဖော်ပြရန်။ - အကယ်၍ စောင့်ကြည့် စစ်ဆေးရာတွင် ဆိုးဝါးသော သက်ရောက်မှုများ တွေ့ရလျှင် ၄င်းတို့ကို အနည်းဆုံး ဖြစ်အောင် ဆောင်ရွက်ခြင်း။	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။
၁၀။	ဆူညံသံနှင့် တုန်ခါမှု	- ယာဉ်ကြီးများကိုကောင်းမွန်သော ထိန်းသိမ်းမှုများ ထားရှိခြင်း။ - ယာဉ်ကြံခိုင်မှုနှင့် ညင်သာစွာမောင်းနှင်ရေး ပညာပေး လုပ်ငန်းများဆောင်ရွက်ခြင်း။	- ဆောက်လုပ်ရေးလုပ်ငန်း၌ နည်းပညာအထူးပြု ဆောင်ရွက်ခြင်းများဖြင့် လျော့ချခြင်းဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်းဆောင်ရွက်ခြင်း။ - ဆူညံသံနှင့် တုန်ခါမှု ကို ပတ်ဝန်းကျင်ထိခိုက်မှုဆိုင်ရာ စောင့်ကြည့်ရေး အစီအစဉ်တွင် ထည့်သွင်း ဖော်ပြရန်။ - အကယ်၍ စောင့်ကြည့် စစ်ဆေးရာ တွင် ဆိုးဝါးသော	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။

			သက်ရောက်မှုများ တွေ့ရလျှင် ၎င်းတို့ကို အနည်းဆုံးဖြစ်အောင် ဆောင်ရွက်ခြင်း။	
၁၁။	စွန့်ပစ် ပစ္စည်းများ တိုးပွားလာမှု	- ဖောက်ခွဲခြင်းလုပ်ငန်းများကို ထိန်းညှိခြင်းနှင့် အကြိမ်အရေအတွက် ထိန်းညှိခြင်း။ - လူသူ အနီးအနားတွင် ဖောက်ခွဲခြင်းလုပ်ငန်းမ ဆောင်ရွက်ရန် ထိန်းညှိဆောင်ရွက်ခြင်း။ - လူမှုရေးလုပ်ငန်းများတွင် အစောပိုင်း ဆောက်လုပ်ခြင်း လုပ်ငန်းများကြောင့် ဆူညံသံနှင့် တုန်ခါမှု ဖြစ်ပေါ်ခြင်းကို လျော့ချခြင်း။ - စွန့်ပစ်ပစ္စည်း သန့်စင်သည့်စနစ် တည်ထောင်ရန်။ - တည်ဆောက်ရေး အလုပ်သမားများကို သက်သာစေသော နည်းလမ်းများအတိုင်း ဆောင်ရွက်နိုင်စေရန် ပညာပေးခြင်း။	- စွန့်ပစ်ပစ္စည်းများ တိုးပွားလာမှုကို ပတ်ဝန်းကျင်ထိခိုက်မှုဆိုင် ရာ စောင့်ကြည့်ရေး အစီအစဉ်တွင် ထည့်သွင်းဖော်ပြရန်။ - အကယ်၍ စောင့်ကြည့် စစ်ဆေးရာတွင် ဆိုးဝါးသော သက်ရောက်မှုများ တွေ့ရလျှင် ၎င်းတို့ကို အနည်းဆုံးဖြစ်အောင် ဆောင်ရွက်ခြင်း။ - ဆောက်လုပ်ရေးလုပ်ငန်း၌ နည်းပညာအထူးပြုဆောင် ရွက်ခြင်းများဖြင့် လျော့ချခြင်းဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်းဆောင်ရွက်ခြင်း။	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။
၁၂။	တူးဖော်ခြင်းလုပ်ငန်း များကြောင့် မြေဆီလွှာ ယုတ်လျော့ ပျက်စီးလာခြင်း။	- ဆီနှင့်ဆိုင်သောစွန့်ပစ် ပစ္စည်းသန့်စင်သည့်စနစ် တည်ထောင်ရန်။ - ရေလွှမ်းမိုးမှုနှင့် တူးဖော်မှုတို့ကြောင့် မြေဆီလွှာ ပျက်စီးမှုတို့ကို စောင့်ကြည့်စစ်ဆေးရန်။	- ဆောက်လုပ်ရေးလုပ်ငန်း၌ နည်းပညာအထူးပြု ဆောင်ရွက်ခြင်းများဖြင့် လျော့ချခြင်းဆိုင်ရာ နည်းလမ်းများတွင် ပူပေါင်းဆောင်ရွက်ခြင်း။ - ရေအရည်အသွေး စောင့်ကြည့်မှုကို ပတ်ဝန်းကျင်ထိခိုက်မှု ဆိုင်ရာ စောင့်ကြည့်ရေး	စီမံကိန်း၏ ကုန်ကျစရိတ်ထဲ တွင် ထည့်သွင်း ရမည်။

			အစီအစဉ်တွင် ထည့်သွင်း ဖော်ပြရန်။ - အကယ်၍စောင့်ကြည့်စစ်ဆေးရာတွင် ဆိုးဝါးသော သက်ရောက်မှုများ တွေ့ရလျှင် ၄င်းတို့ကို အနည်းဆုံးဖြစ်အောင် ဆောင်ရွက်ခြင်း။	

ဇယား ၆-၃ လည်ပတ်ကာလနှင့် ဆောက်လုပ်ရေးကာလ၏ အချို့အပိုင်းများ အတွင်း လျော့ချရေးနှင့် စောင့်ကြပ်ကြည့်ရှုခြင်း အစီအစဉ်အပါအဝင် ပတ်ဝန်းကျင်ဆိုင်ရာစီမံခန့်ခွဲမှုအစီအစဉ်

ရည်ရွယ်ချက်	လုပ်ဆောင်ချက်များ	သက်သာစေခြင်း/တိုးမြင့်စေခြင်း	စောင့်ကြည့်လေ့လာခြင်း	တာဝန်ယူခြင်း
လူမှုရေးဆိုင်ရာ				
ဒေသခံအလုပ်သမားများ အကျိုးစီးပွားရေးနှင့် ဆက်စပ်သော အခွင့်အလမ်းများ။	အလုပ်ခန့်ထားမှု မျိုးဆက် ထိန်းထားခြင်း။	• အလုပ်ခန့်ထားရေး မူဝါဒ ဖော်ထုတ်ခြင်း။ • တည်ဆောက်ရေး လုပ်ငန်းအတွင်းရှိ အလုပ်သမားများနှင့် ရုံးဝန်ထမ်းများ အတွက် နေရာအလိုက် လိုအပ်ချက်များကို ဖော်ထုတ်ခြင်း။	• လုပ်ငန်းခွင်ရုံးနှင့် စီမံခန့်ခွဲရေး ရုံးများတွင် အလုပ်ခန့်ထားရေးနှင့် အစားထိုးခြင်း မူဝါဒများ • ကျေးရွာအထောက်အကူ ပြုကော်မတီအစည်းအဝေး အတိုချုပ်မှတ်တမ်းနှင့် • အလုပ်ကြော်ငြာများကို ရည်ညွှန်းသည့် အလုပ်ခန့်ထားခြင်း ရုံးများနှင့် မူဝါဒများကို ဖော်ထုတ်နိုင်ရန်	Neo Energy Oasis and EMU
အလုပ်သမားများ ရပိုင်ခွင့် အပေါ် စီမံကိန်းမှ ကတိကဝတ်	အလုပ်ခန့်ထားမှု အခြေအနေများ	• လူသားအရင်းအမြစ် မူဝါဒတစ်ခု အကောင်အထည် ဖော်ခြင်းနှင့် ဖွံ့ဖြိုးလာစေခြင်း။ • လုပ်ခန့်ထားမှုတွင် တစ်ဦးချင်း၏	• လုပ်အားခများနှင့် အပိုဆုကြေးများကို အချိန်မှန်ပေးချေခြင်း • ဆုံးရှုံးသော အချိန်နှင့် ကာလအတွင်း လုပ်ဆောင်သည့် နာရီများ • ကဏ္ဍများအားလုံး အတွက်	Neo Energy Oasis and EMU

		စာချုပ်ချုပ်ဆိုမှုနှင့် အတူ ဝန်ထမ်းတစ်ဦးချင်း အပေါ် အလေးထားခြင်း • မူဝါဒများ၊ အစီအစဉ်များ၊ လုပ်ထုံးလုပ်နည်းများ အတိုင်းဖြစ်စေရန် ကန်ထရိုက်တာများ၏ သဘောတူညီချက်တွင် ထည့်သွင်းရန်နှင့် လျှော့ချရေးနည်းလမ်း များအား ခွဲခြား သတ်မှတ်ရန်။ ဘေးအန္တရာယ်ကင်းရှင်း ရေး အစီအစဉ်များတွင် စောင့်ကြပ်ကြည့်ရှုရန်နှင့် ဖြည့်တင်း ဆောင်ရွက်ရန်နှင့် မတော်တဆ ထိခိုက်မှုများကို သတင်းပို့နိုင်ရန် ဖြစ်ပါသည်။ • အလုပ်သမားများအား ၎င်းတို့ လုပ်သက်အလိုက် လေ့ကျင့်ရေးလုပ်ငန်းများ ဆောင်ရွက်ရန်။	အလုပ်ဖော်ပြချက်များကို ပြည့်စုံစွာ ဖော်ပြပေးရမည်။	
အလုပ်သမား အင်အားများကို ကာကွယ်ခြင်း	အလုပ်သမားစီမံ ခန့်ခွဲမှု	• သင့်တော်သော တစ်ကိုယ် ရေသုံးအကာ အကွယ်ပစ္စည်းများအား ပေးရမည်။ (ဖြစ်ပေါ်လာနိုင်သည့် အန္တရာယ်ကိုသတ်မှတ်၍) • အရေးပေါ်တုံ့ပြန်နိုင်သော အဖွဲ့ • အရေးပေါ်အခြေအနေ	လိုအပ်ချက်များ (ESMP နှင့်ကတိကဝတ် အပါအဝင်) နှင့် အတူ Contractors Hazard and Operability (HAZOPS) and EHS Plan ကို ပြည်လည် သုံးသပ်ရန်။	Neo Energy Oasis နှင့် ကန်ထရိုက်တာ များ အားလုံး

		တွင် အလုပ်သမားများ ဘေးကင်းလုံခြုံရေးနှင့် ကျန်းမာရေးအန္တရာယ်မှ ကာကွယ်ပေးနိုင်ရန် အရေးပေါ် ပြင်ဆင်မှုများနှင့် တုံ့ပြန်နိုင်သော အစီအစဉ် ဖွံ့ဖြိုး နေရမည်။ • ထိခိုက်မှုနှင့် မတော်တဆထိခိုက်မှု မှတ်တမ်းများကို ထိန်းသိမ်းထားရမည်။ • လုပ်ငန်းခွင် ကျန်းမာရေးနှင့် ဘေးကင်းလုံခြုံရေး အကြောင်းကိစ္စအတွက် အခြေခံထောက်ပံ့ပေး ထားသော ကွင်းဆက်ကို ပြန်လည်ဆန်းစစ်ခြင်း။		
အလုပ်သမား တန်းလျားတွင် နေထိုင်သော အလုပ်သမားများ၏ ကျန်းမာခြင်းကို ထိန်းသိမ်းပေးခြင်း။	အလုပ်သမား စီမံခန့်ခွဲမှု	အလုပ်သမားများ နေရာထိုင်ခင်း အစီအစဉ်။	အလုပ်သမားတန်းလျား စစ်ဆေးခြင်း အစီရင်ခံစာ။ အမှားပြင်ဆင်သောနည်းလမ်း များနှင့် အရေးယူဆောင်ရွက်မှု အစီအစဉ်၊ အကောင်အထည် ဖော်လျက်ရှိ သောအမှား ပြင်ဆင်သောနည်းလမ်းများကို သရုပ်ပြသော ဓာတ်ပုံများ။	Neo Energy Oasis နှင့် ကန်ထရိုက်တာ များ အားလုံး
အလုပ်သမားအား HIV/AIDSနှင့် လိင်နှင့်ပတ်သက် သောကူးဆက်ရော ဂါများ၏ အန္တရာယ်များ အသိပေးခြင်းနှင့် အလုပ်သမား များနှင့် အစုအဖွဲ့များအား ကူးစက်မှု အန္တရာယ်များ	အလုပ်သမား စီမံခန့်ခွဲမှု	HIV/AIDSနှင့် လိင်နှင့်ပတ်သက်သော ကူးဆက်ရောဂါများ အသိပညာပေးမှုများနှင့် ကြိုတင်ကာကွယ်ရေးနည်း များ ။	• ဝန်ထမ်းများအား HIV/AIDS အသိပညာပေးမှု မြင့်မား စေသော လက်ကမ်း စာစောင်များ မျှဝေခြင်း။ • ဝန်ထမ်းများအား အသိပညာပေးမှု နှင့် လက်ကမ်းစာစောင်အား နားလည်ခြင်း လက်ခံမှတ်တမ်းတွင် လက်မှတ်ထိုးစေရန်။	Neo Energy Oasis နှင့် ကန်ထရိုက်တာ များ အားလုံး။

လျှော့ကျရန် ကာကွယ်ခြင်း။				
လူထုနစ်နာကြေး အစီအစဉ်	လူထု ကျန်းမာရေး၊ ဘေးကင်း ရေးနှင့် လုံခြုံရေးအား စောင့် ရှောက်ခြင်း။	•စီမံကိန်း လုပ်ဆောင်မှုအလိုက် နစ်နာကြေး ကိစ္စများ။ •ရေကာတာ ဆောက်လုပ်ရေးလုပ်ငန်း မတိုင်မီ ရေအသုံးပြုသော အခြေခံအချက် အလက်အားမှတ်သားထား ခြင်း။ • မြစ်အောက်ပိုင်းရှိ ရေအသုံးပြုသူများကို ထိခိုက်ခံရပါက ယာယီနှင့် အမြဲတမ်း လူထု ရေ ဖြေရှင်းချက်များကို ထားရှိပါမည်။ • လူထု ကျန်းမားရေးနှင့် ဘေးအန္တရာယ်ကင်းရှင်းရေး လုပ်ဆောင်ချက်များ။	• ဝေဖန်မှု မှတ်တမ်းနှင့် စိတ်ပိုင်းဖြတ်မှု ဖြစ်စဉ်အား ထိန်းသိမ်းထားခြင်း။	Neo Energy Oasis
လုပ်ငန်းနေရာ အထူးသဖြင့် ဘေးအန္တရာယ်ရှိ သောနေရာသို့ သွားရောက်ရန် ကန့်သတ်ခြင်း။	လူထု ကျန်းမာရေး၊ ဘေးကင်းရေးနှင့် လုံခြုံရေး အားစောင့်ရှောက် ခြင်း။	• လုပ်ငန်းခွင် လုံခြုံရေး အတိုင်းအတာများထားရှိခြင်း- • သင့်လျော်သည့် ခြံစည်းရိုးထားရှိခြင်းနှင့် • လုပ်ငန်းခွင် နယ်နိမိတ်နှင့် ဘေးအန္တရာယ်ဖြစ်ပေါ် နိုင်သည့် ဖြစ်စဉ်များကို သတ်မှတ်၍ ထင်ရှားသည့် အမှတ်အသား ထားရှိခြင်း။	အောက်ဖော်ပြပါ မှတ်တမ်းများ စီမံခြင်း/ ပြန်လည်သုံးသပ်ခြင်း- • လုပ်ငန်းခွင် ဝန်းကျင် ထင်ရှားသည့် အမှတ်အသား/ ခြံစည်းရိုးအား ဖော်ပြထားခြင်း/ ဓာတ်ပုံဖြင့်ဖော်ပြခြင်း။ • ကုမ္ပဏီလိုင်စင်နှင့် စာချုပ်လိုအပ်များအရ တစ်ကိုယ်ရေလုံခြုံမှုအ လိုက်တစ်ဦးချင်းစီ၏ လေ့ကျင့်ရေးမှတ်တမ်းများ • လုပ်ငန်းခွင် မှတ်ပုံတင် သတ်မှတ်ခြင်း စနစ်	Neo Energy Oasis
ယဉ်ကျေးမှု ဖလှယ်ခြင်းနှင့် နားလည်ခြင်း	ဖွံ့ဖြိုးမှုလုပ်ငန်းအပါ အဝင် လူဦးရေပြောင်းလဲ ခြင်းနှင့် ယဉ်ကျေးမှုဆိုင်ရာ တင်းမာမှု အတွက် အလားအလာ။	• ထိန်းသိမ်းရေး အလေ့အထများအား ပြုပြင်ခြင်းများနှင့် • ယဉ်ကျေးမှုဆိုင်ရာ ကိစ္စရပ်များတွင် ဒေသခံနှင့် ပြင်ပလုပ်သားများအား သင်တန်းပေးခြင်း။	• Staff to sign training sheet confirming attendance. • ဝန်ထမ်းများအား တက်ရောက်စာရင်း မှတ်တမ်းတွင် လက်မှတ်ထိုးစေခြင်း။	Neo Energy Oasis Neo Energy Oasis

လမ်းအနေအထား နှင့် သွားလာရေးအ တွက်တိုးမြှင့်လုပ် ဆောင်ခြင်း။	အခြေခံ အဆောက်အအုံ လုပ်ငန်းများ (လမ်းများနှင့် တံတားများ)	• တည်ဆောက်ရေးကာလပြီး နောက် သွားလာရေးအတွက် လူထုအတွက်အကျိုးရှိသော လမ်းများထိန်းသိမ်းထား ရှိခြင်း။	• လမ်းအခြေအနေအား စောင့်ကြပ်ကြည့်ရှုခြင်း	Neo Energy Oasis
ဝန်ထမ်းများ လျော့ကျခြင်း	စီမံကိန်း ပိတ်သိမ်းခြင်း	• လျော့ချရေး အစီအစဉ်များ ဖော်ထုတ်ခြင်း	• လျော့ချရေး အစီအစဉ်များ လုပ်ဆောင်ခြင်း	Neo Energy Oasis
ဂေဟဗေဒနှင့် ဇီဝမျိုးစုံမျိုးကွဲ				
ဇီဝမျိုးစုံမျိုးကွဲ အကြောင်းကိစ္စ စီမံခန့်ခွဲမှု၊ ကျက်စားရာဒေသ ထိန်းသိမ်းခြင်းနှင့် စီမံခန့်ခွဲမှု။	စီမံကိန်းပုံစံငယ်	• ဇီဝမျိုးစုံမျိုးကွဲဆိုင်ရာ အရေးယူဆောင်ရွက်မှု မူကြမ်း ထုတ်ပေးခြင်း။ • ပါဝင်ပတ်သက်သူများနှင့် ညှိနှိုင်းတိုင်ပင်ခြင်း၊ တစ်ဦးမှတစ်ဦး တွေ့ဆုံခြင်း၊ ဒေသခံ အစုအဖွဲ့များ၊ ပါဝင်ပတ်သက်သူ အလုပ်ရုံဆွေးနွေးပွဲများစ သည့် အကြောင်းအရာအစီ အစဉ်တစ်ခုကို တင်ပြရမည်။	• အပြီးသတ်ခဲ့ပြီးသော BAP ကို ပါဝင်ပတ်သက်သူများအားလုံးနှ င့် ကန်ထရိုက်တာများဆီသို့ လက်ဆင့်ကမ်းပေးရမည်။ • နီရို၏ ဇီဝမျိုးစုံမျိုးကွဲဆိုင်ရာ အရေးယူဆောင်ရွက်မှုကို ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာနမှ အတည်ပြုရမည်။	Neo Energy Oasis, EMU and MOECAF
ကျက်စားရာဒေသ ပျောက်ဆုံးခြင်းနှင့် နှောင့်ယှက်မှုများ ကို အနည်းဆုံး အဆင့်သို့ လျော့ချပေးရမည်။ (ကုန်းနေ ဂေဟဗေဒစနစ်)	တည်ဆောက်ပုံချမှ တ်ခြင်း၊ ယာယီလုပ်ငန်းနေ ရာနှင့် ဆက်စပ် နေသော အခြေခံ အဆောက်အဦ ပုံစံ	• ရေးဆွဲထားသည့် ဆက်စပ်နေသော အခြေခံအဆောက်အဦ ပုံစံအရ ရှောင်ရှားခြင်း နည်းလမ်းများနှင့် ဒေသ၏ ပတ်ဝန်းကျင်/ဂေဟဗေဒ ဆိုင်ရာ အခြေအနေများကို ထည့်သွင်းစဉ်းစားထားသည့် ချမှတ်ထားသောနေရာ။ • ယာယီလုပ်ငန်းနေရာ၏ အရွယ်အစားကို လျော့ချပေးရမည်။ • ဂေဟဗေဒဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်ကို ဖွံ့ဖြိုးအောင် လုပ်ပေးရမည်။	• ဆောက်လုပ်ရေးနေရာအား လစဉ်စစ်ဆေးခြင်း။ • နီရို စွမ်းအင်မှ စီစဉ်ပြုလုပ်သော ဂေဟဗေဒဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်ကို ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဝန်ကြီးဌာန၏ အတည်ပြုချက်ယူရမည်။	Neo Energy Oasis, EMU and MOECAF
ကျူးကျော်ဝင် ရောက်ခြင်းနှင့် အမဲလိုက်ခြင်းအား လျော့ချခြင်း	ဆောက်လုပ် ရေးလုပ်သားများ လုပ်ငန်းခွင်နေရာ သို့ အလွယ်တကူသွား လာနိုင်စေရမည်။	• ဆောက်လုပ်ရေး လုပ်သားများ အမဲလိုက်ခြင်း တားဆီး ရန်အတွက် ဥပဒေမူကြမ်းကို ပြုလုပ်ထားရမည်။ • စီမံကိန်း ဧရိယာအတွင်း	• အမဲလိုက်ခြင်း ကာကွယ်သည့် နည်းလမ်းများတွင်လက်ခံနိုင် သော နီရို၏ EHS လိုအပ်ချက်များအရ ကန်ထရိုက်တာ၏ အမြင်များလဲပါဝင်ရမည်။	Neo Energy Oasis

		အမဲလိုက်ခြင်းကို တားမြစ်သည့် ထင်ရှားသော ဆိုင်းဘုတ်များကို ပြုလုပ်ထားရမည်။		
ကျက်စားရာဒေသ ပျောက်ဆုံးခြင်းနှင့် နှောင့်ယှက်မှုများ ကို အနည်းဆုံး အဆင့်သို့ လျော့ချပေးရမည်။ (ရေနေ ဂေဟဗေဒစနစ်)	မြစ်များအတွင်း ဆောက်လုပ် ရေးလုပ်ငန်းများ	• အသေးဆုံး လုပ်ငန်းခွင် ဧရိယာ • ညစ်ညမ်းမှုကာကွယ်သည့် နည်းလမ်းများ • နုန်းပို့ချမှု ထိန်းချုပ်ခြင်း • ဆောက်လုပ်ရေး အလုပ်သမားအင်အားစုတွင် ငါးဖမ်းခြင်းအား တားမြစ်ခြင်း။ • ဘီလူးချောင်းမြစ်တွင် ငါးများဥပေါက်ခြင်း/ ပြောင်းရွေ့ ြခင်း အမြင့်ဆုံးကာလအတွင်း ဆောက်လုပ်ရေးလုပ်ငန်းများ မပြုလုပ်ခြင်း။	• နေ့စဉ် စောင့်ကြည့်လေ့ လာခြင်းနှင့် ဆောက်လုပ်ရေး လုပ်ငန်းများ ဆောင်ရွက်မှု/လုပ်ငန်းခွင် မြေနေရာ ပြင်ဆင်ခြင်းများကို လစဉ်စစ်ဆေးခြင်း။	Neo Energy Oasis
ကျက်စားရာဒေသ ထိန်းသိမ်းကာ ကွယ်ခြင်းနှင့် စီမံခန့်ခွဲမှု။	ကျက်စားရာဒေသ များကို မူလအခြေ အနေပြန်ဖြစ် အောင်လုပ်ပေး ခြင်း။	• ကျက်စားရာဒေသ စီမံခန့်ခွဲမှု အစီအစဉ် ထုတ်လုပ်ခြင်း • မြေယာဝယ်ယူခြင်း သို့ မြေယာသဘောတူညီမှုနှင့် ကျက်စားရာဒေသဖန်တီး ရန်အတွက် စိုက်ပျိုးခြင်း။	• ဖန်တီးထားသော ကျက်စားရာဒေသနေရာများ အောင်မြင်မှုကို နှစ်စဉ် ပြန်လည် စစ်ဆေးခြင်း။ • လုပ်ငန်းပြီးဆုံးချိန် ၁၂လအတွင်း ကောင်းမွန်သော အခြေအနေသို့ရာက်ရန် မူလအတိုင်းပြန်ဖြစ်အောင် ပြုလုပ်ထားသော ကျက်စားရာဒေသရာခိုင်နှုန်း	Neo Energy Oasis
ရေအရင်းအမြစ်နှင့် ရေအရည်အသွေး				
ပတ်ဝန်းကျင်အ တွက် မြေပေါ်ရေ အရည်အသွေး ကာကွယ်ခြင်း။	ဆည် ဆောက်လုပ် ရေး လုပ်ငန်းခွင်အ တွင်း	• ကောင်းမွန်သော လက်တွေ့ကျသည့် ဆောက်လုပ်ရေး နည်းလမ်းများ။	• မည့်သည့် မြေပေါ်ရေမှ ညစ်ညမ်းမှု မရှိစေခြင်း • ပုံမှန် သာမန်မျက်စိဖြင့် ရေထုအား စောင့်ကြည့်လေ့လာခြင်း။ • ပုံမှန် ကန်ထရိုက်၏ လုပ်ဆောင်မှုများကို ပြန်လည်စစ်ဆေးခြင်းနှင့် နီရို၏ စီမံကိ ်န်း မန်နေဂျာမှ ရေးဆွဲထားသော ဆောက်လုပ်ရေးနှင့်	Neo Energy Oasis and EMU

			သက်ဆိုင်သော ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှု အစီအစဉ် အကောင်အထည်ဖော် ဆောင်ရွက်ခြင်း။	
လေ့အသုံးပြုသူများ အတွက် လုံလောက်သော ရေစီးဆင်းမှုအား ထိန်းသိမ်းထား ခြင်း။	ဆည်တည် ဆောက်ခြင်း ကြောင့် ရေဝပ်ဒေသအနီး ဝန်းကျင် ရေစီးဆင်းမှုနည်း ပါးသွားခြင်း/ ပြောင်းလဲသွား ခြင်း။	• အနည်းဆုံးရေစီးဆင်းမှု လိုအပ်ချက်များနှင့် အညီ လည်ပတ်ရမည်။	• ပုံမှန် ရေစီးဆင်းမှုအား စောင့်ကြည့်လေ့လာခြင်းကို ESIA တွင် တပြေးညီ ရေးဆွဲထားရမည်။	Neo Energy Oasis and EMU
ရေဖြန့်ဝေခြင်းနှင့် စိုက်ပျိုးရေး အတွက် အသုံးပြုခြင်း။	ဆည် တည်ဆောက် ခြင်း ကြောင့် ရေဝပ်ဒေသအနီး ဝန်းကျင် ရေစီးဆင်းမှုနဲပါး သွားခြင်း/ ပြောင်းလဲသွား ခြင်း။	• အနည်းဆုံးရေစီးဆင်းမှု လိုအပ်ချက်များနှင့် အညီ လည်ပတ်ရမည်။ • ဒေသခံများ ရေရှည်ရေသုံးစွဲနိုင်ရန် ရေဝပ်ဒေသစီမံခန့်ခွဲမှု စီမံချက်များကို အကောင်အထည်ဖော်ဆောင် ရွက်ရမည်။	• ပုံမှန် ရေစီးဆင်းမှု စောင့်ကြည့်လေ့လာခြင်းကို ESIA တွင် တပြေးညီ ရေးဆွဲထားရမည်။	Neo Energy Oasis and EMU
ဒေသခံရွာများဆီသို့ ရေထောက်ပံ့မှုအား ထိန်းသိမ်းထားရမ ည်။	လျှပ်စစ်ထုတ် လုပ်ရန် ရေလမ်းကြောင်းလွှဲ ခြင်းကြောင့် ရေယူအဆောက် အဦနှင့် ဓာတ်အားစက်ရုံ ကြား ပိုင်းခြား ထားသော မြစ်များအပေါ် ဆိုးကျိုးများသက် ရောက်ခြင်း။	• သက်ရောက်မှုခံရသော ရေအသုံးချသူများထံသို့ အခြားထောက်ပံ့ခြင်းများကို ပေးကမ်းရမည်။	• ရေစီးဆင်းမှု စောင့်ကြည့်လေ့လာခြင်းကို နှစ်စဉ်ပြုလုပ်ရမည်။	Neo Energy Oasis and EMU
ဘူမိဗေဒ၊ မြေပြိုခြင်းနှင့် မြေလျှောင် အန္တရာယ်များ				
မြေတိုက်စားမှု ကာကွယ်ခြင်းနှင့် သယ်ယူပို့ဆောင် ရေး။	လုပ်ငန်းခွင်မြေနေ ရာ ပြုပြင်ခြင်း၊ တူးဖော်ခြင်း၊ ဆည်တည်	• ကောင်းမွန်သော လက်တွေ့ကျသော အင်ဂျင်နီယာနည်းလမ်းများ ဖြင့် မြေတိုက်စားမှုကို	• ကန်ထရိုက်တာ၏ ဆောက်လုပ်ရေးနှင့် ဆိုင်သော ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှု အစီအစဉ် လိုအပ်ချက်များ	Neo Energy Oasis and EMU

	ဆောက်ခြင်း၊ ရေလမ်းကြောင်းများနှင့် သွားလာရေးလမ်းကြောင်းများ။	ကိုင်တွယ်စီမံရန် သို့ သက်သာလျော့နည်းစေရန် တာဝန်ယူဆောင်ရွက်ရမည်။	အောက်တွင် နယ်နိမိတ်သတ်မှတ်ရမည်။	
မြေပြိုခြင်းများ ကာကွယ်ရန် တောင်စောင်းများ၏ မြဲမြံခြင်း။	လမ်းများ၊ ဆည်၊ ရေလမ်းကြောင်းများ တည်ဆောက်ခြင်း။	• တောင်စောင်းများ၏ မြဲမြံခြင်းနှင့် ပတ်သက်၍ စီမံကိန်းနှင့် ဒေသခံအဖွဲ့အစည်းအပေါ် ဆိုးကျိုးသက်ရောက်မှုများ လျော့နည်းစေရန် ရည်ရွယ်၍ တောင်စောင်းများ ရွေ့လျားခြင်းကို ကိုင်တွယ်စီမံရန် သို့ သက်သာလျော့နည်းစေရန် ကောင်းမွန်ပြီး လက်တွေ့ကျသော အင်ဂျင်နီယာနည်းလမ်းများဖြင့်တာဝန်ယူဆောင်ရွက်ရမည်။	• ကန်ထရိုက်တာ၏ ဆောက်လုပ်ရေးနှင့် ဆိုင်သော ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှု အစီအစဉ် လိုအပ်ချက်များအောက်တွင် နယ်နိမိတ်သတ်မှတ်ရမည်။ • အစီအစဉ်များနှင့် နည်းလမ်းဖော်ပြချက်များကို ပြန်လည်စစ်ဆေးခြင်းနှင့် အတည်ပြုခြင်းများကို EMU က ပြုလုပ်ရမည်။	Neo Energy Oasis and EMU
တောင်စောင်းများ မမြဲမြံခြင်းအား အနည်းဆုံးအဆင့်သို့ လျော့ချခြင်း။	ရေလမ်းကြောင်းများ	• တောင်ပိုင်းဖြတ်မှု အစောင်းများကို ကောင်းမွန်သော အင်ဂျင်နီယာ နည်းလမ်းများအရ လုံလောက်စွာ ထောက်ပံ့ပေးရမည်။ • သစ်ပင်လှဲခြင်း ပမာဏများကို လျော့ချရမည်။ • ရေလမ်းကြောင်းဖောက်လုပ်ခြင်းလုပ်ငန်းများပြီးလျှင်ပြီးခြင်း လမ်းဘေးတစ်လျှောက် ရှင်းလင်းနေသော မြေနေရာများတွင် မူလအခြေအနေအတိုင်း သစ်ပင်များ ပြန်လည်ပေါက်ရောက်အောင် ပြုလုပ်ပေးရမည်။	• အစီအစဉ်များနှင့် နည်းလမ်းဖော်ပြချက်များကို ပြန်လည်စစ်ဆေးခြင်းနှင့် အတည်ပြုခြင်းများကို EMU က ပြုလုပ်ရမည်။	Neo Energy Oasis and EMU

မြေတိုက်စားမှုနှင့် မြေပြိုမှုများအား ကာကွယ်ခြင်း။	ရေလမ်းကြောင်း များ တိုက်စားခြင်း။	• ပုံမှန်စည်းစနစ်တကျ ထိန်းသိမ်းပြုပြင်ခြင်းများဖြင့် ပြည့်စုံသောလမ်းမျက်နှာ ပြင်အား ထိန်းသိမ်းထားခြင်း။	• ပုံမှန်စည်းစနစ်တကျ အမြင်ဖြင့် လေ့လာစူးစမ်းခြင်း။	Neo Energy Oasis and EMU
ပစ္စည်းများနှင့် စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲမှု				
လျှော့နည်းအောင် ပြုလုပ်ခြင်းနှင့် စွန့်ပစ်ပစ္စည်းများ အား စနစ်တကျ စွန့်ပစ် ခြင်း။	ကျောက်မိုင်းခွဲခြင်း ကြောင့် ထွက်ပေါ်လာသော ကျောက်အပိုင်းအစ များ	• ထွက်ရှိလာသော ကျောက်အပိုင်းအစများကို ဆောက်လုပ်ရေး လုပ်ငန်းသုံး ပစ္စည်းအဖြစ် ဘိလပ်မြေနှင့် ရောစပ်၍ တတ်နိုင်သမျှ အသုံးပြုရမည်။ • ဆောက်လုပ်ရေး လုပ်ငန်းသုံးအဖြစ် အသုံးပြု၍မရသော ကျောက်အပိုင်းအစများကို စီမံကိန်း ဧရိယာအတွင်း နေရာတစ်ခု သတ်မှတ်၍ စွန့်ပစ်ရမည်။	• စွန့်ပစ်မြေစာပုံတစ်ခုချင်းစီတွင် စွန့်ပစ်ထားသော စွန့်ပစ်ပစ္စည်းပမာဏကို မှတ်တမ်းယူ၍ ထိန်းသိမ်းထားရမည်။ • စွန့်ပစ်မြေစာပုံများ တိုက်စားသယ်ဆောင်ပို့ချခြင်းကို လည်း စောင့်ကြည့် လေ့လာရမည်။	Neo Energy Oasis and EMU
ညစ်ညမ်းခြင်းများ ကို လျှော့နည်း အောင် ပြုလုပ်ခြင်း။	စွန့်ပစ်ပစ္စည်းများ အား စနစ်တကျ ထိန်းသိမ်းသို လှောင်ထားခြင်း။	• စွန့်ပစ်ပစ္စည်းများကို သင့်တော်သလို ဖုံးကာ၊ စည်းခတ်သိုလှောင်၍ အထိခိုက်လွယ် အဖွဲ့အစည်းများ၏ အဝေးတွင် ထားရှိရမည်။ • တိတ်တဆိတ်ယူဆောင်ခြင်း သို့ လွယ်လင့်တကူ ယူဆောင်နိုင်ခြင်းများ မရှိစေရန် လုံခြုံစွာ ထိန်းသိမ်းကာကွယ်ထားရ မည်။ • လုံခြုံစိတ်ချလွယ်ကူစွာ သွားလာနိုင်ခြင်း။ • လိုအပ်သော လုပ်ငန်းခွင်ဘေးအန္တရာယ် ကာကွယ်ရေးသုံး ပစ္စည်း များကိုအနီးအနားတွင်ထားရှိရ မည်။	• EMU မှ ကန်ထရိုက်တာ၏ စွန့်ပစ်ပစ္စည်း သိုလှောင်မှုတွင် အသုံးပြုသော အထောက်အပံ့ပစ္စည်းများအား စစ်ဆေးခြင်း။ • ညစ်ညမ်းခြင်းဖြစ်ပွားမှု အကြိမ်အရေအတွက်	Neo Energy Oasis and EMU

ဆူညံသံနှင့် တုန်ခါမှု				
လုပ်ငန်းခွင်အတွင်းရှိ စက်ရုံနှင့် ဆောက်လုပ်ရေး လုပ်ငန်းဆောင်ရွက်မှုများမှ ထွက်ပေါ်လာသော စိတ်အနှောင့် အယှက်ဖြစ်စေသော ဆူညံသံများအား ရှောင်ရှားခြင်း။	လုပ်ငန်းခွင်မြေနေရာ ပြင်ဆင်ခြင်း၊ တူးဖော်ခြင်း၊ အုတ်မြစ်ချခြင်း၊ ဆောက်လုပ်ခြင်းနှင့် မိုင်းခွဲခြင်း။	• ထိခိုက်လွယ်သော ကာလများကို ရှောင်ရှားရန် ယေဘူယျ အလုပ်ချိန်များအား ကန့်သတ်ထားရမည်။ • ယာယီစက်ရုံဝင်းနေရာအား ထိခိုက်လွယ် အဖွဲ့အစည်းများမှ ဝေးကွာသော နေရာတွင် ယာယီလုပ်ငန်းခွင်ကိုထားရှိရမည်။ • ကောင်းမွန်သော နည်းလမ်းများဖြင့် ဆောက်လုပ်ရေးလုပ်ငန်းများကို တာဝန်ယူ ဆောင်ရွက်ရမည်။ • ကောင်းမွန်သော လုပ်ငန်း အစီအစဉ်ဖြင့် ကိရိယာများကို ထိန်းသိမ်း ခြင်းနှင့် သင့်တော်သော ဆူညံသံ ထိန်းကိရိယာများကို အချိန်တိုင်းတပ်ဆင်ထားရမည်။ • ထိခိုက်လွယ် အဖွဲ့အစည်းများအနီးတွင် လေဖိအားပေး စက်/မီးစက်များတည်ရှိပါက ၎င်းတို့၏ အသံများကိုလည်း ထည့်သွင်းစဉ်းစားရမည်။ • မသင့်တော်သောအချိန်တွင် ကုန်ပစ္စည်းများရောက်ရှိခြင်းနှင့် ထွက်ခွာခြင်းများသည် လူနေရပ်ကွက်များသို့ နှောင့်ယှက်ခြင်းမရှိအောင် ဆောင်ရွက်ရမည်။ • ဆူညံသံ ကန့်သတ်ချက်များကို ချိန်ညှိထားရမည်။ • စီမံကိန်းအနီးဝန်းကျင်တွင် ဆူညံသံ စောင့်ကြည့် လေ့လာခြင်းနေရာ	• စာချုပ်၏ တစ်စိတ်တစ်ပိုင်းအဖြစ် သက်သာစေခြင်း အကောင်အထည်ဖော်ဆောင်ရွက်ရန်မှာ ကန်ထရိုက်များအတွက်လို အပ်ချက် ဖြစ်သည်။ • EMU သည် စံချိန်စံညွှန်းများနှင့် ဆန့်ကျင်ခြင်းရှိ၊ မရှိကို နှိုင်းယှဉ်ရန်အတွက် ဆောက်လုပ်ရေး လုပ်ဆောင်မှုများနှင့် အနီးဆုံးတွင်ရှိသော လူနေရပ်ကွက်များ၌ ဆူညံသံတိုင်း ကိရိယာများကို အသုံးပြု၍ ဆူညံသံအနိမ့်အမြင့်အား စောင့်ကြည့်လေ့လာရမည်။ • ရပ်ကွက်လူထု၏မကျေနပ်ချက်များမှ တစ်ဆင့်ဖြင့် ဆူညံသံတိုင်း ကိရိယာကို အသုံးပြု၍ စုံစမ်းစစ်ဆေး ခြင်းနှင့် ဆူညံသံနှင့် ပတ်သက်၍တိုင်ကြားချက်များကို မှတ်သားထားရမည်။	Neo Energy Oasis and EMU

		သတ်မှတ်ထားရမည်။ • ဆူညံသံထွက်ပေါ်နိုင်သည့် လုပ်ဆောင်မှုအကြောင်း အစီအစဉ်ရေးဆွဲထားသည့် အကြောင်းကြားစာအား ပြည်သူများထံ ပေးရမည်။		
ဆောက်လုပ်ရေး သုံး ယာဉ်များ ကြောင့်ထွက်ပေါ် လာသော စိတ်အနှောင့်အ ယှက်ဖြစ်စေသော ဆူညံသံများမှ ရှောင်ရှားမှု	သာမန်ထက်ပို သော ဝန်များကို တင်ဆောင်၍ လုပ်ငန်းခွင် တစ်နေရာမှ တစ်နေရာသို့ ယာဉ်များသွားလာ မှု	• ကောင်းမွန်သော လုပ်ငန်းအစီအစဉ်ဖြင့် ကိရိယာများကို ထိန်းသိမ်းခြင်းနှင့် သင့်တော်သော ဆူညံသံထိန်း ကိရိယာများကို အချိန်တိုင်းတပ်ဆင်ထား ရမည်။ • ဆူညံသံ ကန့်သတ်ချက်များ ကို ချိန်ညှိထားရမည်။ • ဆူညံသံထွက်ပေါ်နိုင်သည့် လုပ်ဆောင်မှုအကြောင်း အစီအစဉ်ရေးဆွဲထားသည့် အကြောင်းကြားစာအား ပြည်သူများထံ ပေးရမည်။	• စာချုပ်၏ တစ်စိတ်တစ်ပိုင်း အဖြစ် သက်သာစေခြင်း အကောင်အထည် ဖော်ဆောင်ရွက်ရန်မှာ ကန်ထရိုက်များအတွက်လို အပ်ချက် ဖြစ်သည်။ • EMU သည် စံချိန်စံညွှန်းများနှင့် ဆန့်ကျင်ခြင်းရှိ၊ မရှိကို နှိုင်းယှဉ်ရန်အတွက် ဆောက်လုပ်ရေး လုပ်ဆောင်မှုများနှင့် အနီးဆုံးတွင်ရှိသော လူနေရပ်ကွက်များ၌ ဆူညံသံတိုင်း ကိရိယာများကို အသုံးပြု၍ ဆူညံသံ အနိမ့်အမြင့်အား စောင့်ကြည့်လေ့လာရမည်။ • ရပ်ကွက်လူထု၏ မကျေနပ်ချက်များမှ တစ်ဆင့်ဖြင့် ဆူညံသံတိုင်း ကိရိယာကို အသုံးပြု၍ စုံစမ်းစစ်ဆေးခြင်းနှင့် ဆူညံသံနှင့် ပတ်သက်၍ တိုင်ကြားချက်များကို မှတ်သားထားရမည်။	Neo Energy Oasis and EMU
လေအရည်အသွေး				
ဖုန်မှုန့် ထုတ်လွှတ်ခြင်း အား လျှော့ချရမည်။	မြေအပြောင်ရှင်း ခြင်း၊ ကျောက်တူးထုတ် ခြင်း၊ လမ်းများဖောက် လုပ်ခြင်း၊ ကျောက်အပိုင်းအစ များ စုပုံခြင်းနှင့်	• အဖုံးအကာများ သို့ ထိန်းချုပ်သည့် ကိရိယာများကို အသုံးပြု၍ စွန့်ပစ်ပစ္စည်းများ ထိန်းသိမ်း သိုလှောင်ထားသော အရင်းအမြစ်များမှ ဖုန်မှုန့်များထွက်ရှိမှုအား အနဲဆုံးဖြစ်စေရမည်။	• ပတ်ဝန်းကျင်နှင့် ဆိုင်သည့် အလုပ်ကိစ္စ စီမံခန့်ခွဲသူသည် နေ့စဉ်အမြင်ဖြင့် စစ်ဆေးမှုများ ဆောင်ရွက်ရမည်။ • ဖုန်မှုန့်နှင့် ပတ်သက်၍ တိုင်းကြားချက်များ အကြိမ်အရေအတွက်	Neo Energy Oasis and EMU

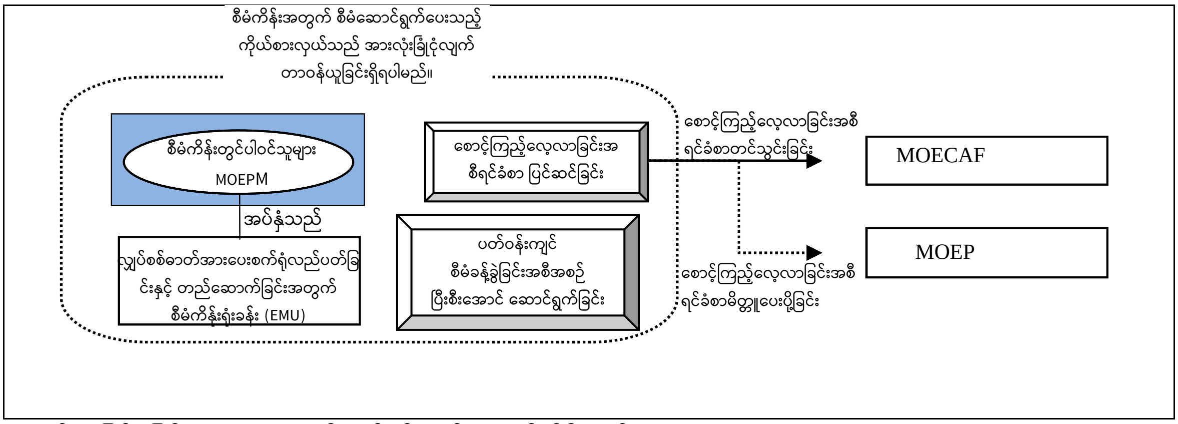
	အထွေထွေ ဆောက်လုပ်ရေးလုပ်ငန်းများ။	• ယာဉ် သွားလာမှုများမှ ထွက်လာသော ဖုန်မှုန့်များ လျော့နည်းစေရန် ရေဖျန်းခြင်း သို့ အဆိပ်အတောက် မြဖစ်နိုင်သည့်ဓာတုပစ္စည်းများ အသုံးပြုခြင်းကဲ့သို့သော ဖုန်မှုန့်များသိပ်သည်း ကျစ်လစ်သွား အောင် ပြုလုပ်သည့် နည်းပညာများ ကို အကောင်အထည်ဖော် ဆောင်ရွက်သင့်သည်။		
ဖုန်မှုန့် ထုတ်လွှတ်ခြင်း အား လျော့ချခြင်း။	လုပ်ငန်းခွင်နေရာရှိ လမ်းများပေါ်တွင် ယာဉ်များသွားလာမှု	• ဖုန်မှုန့်များ လျော့ချရန် နိုင်လွန်ကတ္တရာလမ်းပေါ်တွင် တစ်နာရီ ၂၀ ကီလိုထက်မ ပိုသော အရှိန် ကန့်သတ်ချက် ဖြင့် ယာဉ်များသွားလာမှုအား ကန့်သတ်ထားရမည်။ • ဝန်များမှ ထွက်ပေါ်လာသည့် ဖုန်မှုန့်များကို ကာကွယ်ရန် ယာဉ်များအားလုံး မိုးကာ ဖျင်များ အုပ်ထားသင့်သည်။	• ပတ်ဝန်းကျင်နှင့် ဆိုင်သည့် အလုပ်ကိစ္စ စီမံခန့်ခွဲသူသည် နှစ်ပတ်လျှင်တစ်ကြိမ် ဆောက်လုပ်ရေးသုံးယာဉ်များ အား မျက်မြင်စစ်ဆေးခြင်းကို တာဝန်ယူဆောင်ရွက်ရမည်။ • ကန်ထရိုက်တာသည် ယာဉ်များအားလုံးအတွက် ပြင်ဆင်ထိန်းသိမ်းမှု မှတ်တမ်းများကို သိမ်းထားရမည်။ • EMU သည် သဘောတူစာချုပ်အစဥ် ကန်ထရိုက်တာများ၏ ပြင်ဆင်ထိန်းသိမ်းခြင်း မှတ်တမ်းများကို ပြန်လည်စစ်ဆေးခြင်းနှင့် ခြောက်လထက်ပိုမိုကြာမြင့် သော ရေရှည်သဘော တူစာချုပ်များ အတွက် အခြေခံအနေဖြင့် ခြောက်လတစ်ကြိမ် ပြန်လည်စစ်ဆေးရမည်။	Neo Energy Oasis and EMU
ဆောက်လုပ်ရေး သုံး စက်ယန္တရား/ ယာဉ်များမှ ထုတ်လွှတ်ခြင်းများ လျော့ချခြင်း။	ဆောက်လုပ်ရေး သုံး ယာဉ်သွား လာမှုနှင့်စက်ယန္တ ရား	• ပတ်ဝန်းကျင် လေအရည်အသွေးနှင့် လေထု ထုတ်လွှတ်ခြင်း များအတွက် IFC EHS လမ်းညွှန်ချက်များအတိုင်း ရွှေ့လျားနိုင်သည့်	• ပတ်ဝန်းကျင်နှင့် ဆိုင်သည့် အလုပ်ကိစ္စ စီမံခန့်ခွဲသူသည် နှစ်ပတ်လျှင်တစ်ကြိမ် ဆောက်လုပ်ရေးသုံးယာဉ်များ အား မျက်မြင်စစ်ဆေးခြင်းကို တာဝန်ယူဆောင်ရွက်ရမည်။	Neo Energy Oasis and EMU

		အရင်းအမြစ်များမှ ထုတ်လွှတ်ခြင်းများကို စီမံခန့်ခွဲရမည်။ • မီးစက်များကို ထိခိုက်ခံအဖွဲ့အစည်း အဝေးတွင် ထားရှိရမည်။ (အလုပ်သမားတန်းလျားနှင့် လူနေရပ်ကွက်များ)	• ကန်ထရိုက်တာသည် စက်ယန္တရားအားလုံးအတွက် ပြင်ဆင်ထိန်းသိမ်းမှု မှတ်တမ်းများကို သိမ်းထားရမည်။ • EMU သည် သဘောတူစာချုပ်အစဉ် ကန်ထရိုက်တာများ၏ ပြင်ဆင်ထိန်းသိမ်းခြင်း မှတ်တမ်းများကို ပြန်လည်စစ်ဆေးခြင်းနှင့် ခြောက်လထက်ပိုမိုကြာမြင့်သော ရေရှည်သဘောတူ စာချုပ်များ အတွက် အခြေခံ အနေဖြင့် ခြောက်လတစ်ကြိမ် ပြန်လည်စစ်ဆေးရမည်။	
ဖန်လုံအိမ် ဓာတ်ငွေ့များနှင့် ရာသီဥတုပြောင်းလဲမှု				
ဖန်လုံအိမ်ဓာတ်ငွေ့များ ထုတ်လွှတ်ခြင်းများအား လျှော့ချခြင်း။	-ပစ္စည်းများ၏ အရင်းမြစ် -ယာဉ်များ အသုံးပြုမှု၊ ဆောက်လုပ်ရေးရုံနှင့် မီးစက်များမှ ထုတ်လွှတ်မှုများ	• အရင်းအမြစ်များမှ ဖြစ်ပေါ်နိုင်သော ရေရှည်သွားလာရေးကို ဖြစ်နိုင်သမျှ ရှောင်ရှားနိုင်ရန် ။ • သင့်သောထိန်းသိမ်းမှုများနှင့် လုပ်ငန်းခွင်နေရာ တွင် ပြန်လည်အသုံးပြုနိုင်သော ပစ္စည်းများ (ကျောက်နှင့် စုပုံပစ္စည်းများ) • လောင်စာဆီ သုံးစွဲမှု အနဲဆုံးနှင့် ထိရောက်မှု အရှိဆုံးဖြစ်စေရန် ကောင်းစွာ ပြင်ဆင်ထိန်းသိမ်းထားသည့် ဒီဇယ် မီးစက်များနှင့် အခြားစက်များ သုံးစွဲခြင်း။	• အရင်းအမြစ် ပါဝင်သည့်ပစ္စည်းများ စာရင်းကောက်ယူခြင်း • ဖြစ်နိုင်သမျှ ဘူမိဗေဒအရ လိုအပ်ပါက ပြည်တွင်းဖြစ် ပစ္စည်းများကို အစားထိုးအသုံးပြုရေးမူဝါဒတွင် ထည့်သွင်းရန် • စတင်လည်ပတ်မည့် စက်ရုံသစ်၏ မှတ်တမ်း အထောက်အထား • စက်ရုံ ပြင်ဆင်ထိန်းသိမ်းမှုအား မှတ်တမ်းယူထားခြင်းနှင့် စောင့်ကြည့်လေ့လာခြင်း • လောင်စာဆီ သုံးစွဲခြင်းအား မှတ်တမ်းယူခြင်းနှင့် စောင့်ကြည့်လေ့လာခြင်း။	Neo Energy Oasis and EMU
ရာသီဥတုပြောင်းလဲမှုအား သက်သာစေခြင်း။	သစ်တောများ မျိုးဆက်ခြင်း။	• ဆောက်လုပ်ရေး လုပ်ငန်းအတွက် ရှင်းလင်းခြင်းခံရသော သစ်တောများနေရာ အစားထိုးရန်အတွက် သို့ ဆောက်လုပ်ရေးလုပ်ငန်း၏ ကာဗွန်တန်ဖိုးလျှော့ချခြင်း	• စိုက်ပျိုးထားသည့် အပင်အရေအတွက်	Neo Energy Oasis and EMU

		တွင် ကာဗွန်စုပ်ယူသည့် အရင်းမြစ်တစ်ခုအဖြစ် လုပ်ဆောင်မည့် သစ်တောများ ဆုံးရှုံးခြင်း အတွက် သစ်တော အသစ်များ ပြန်လည်စိုက်ပျိုး ပေးရမည်။		
မြေယာရှုခင်းနှင့် အမြင်သာယာမှု				
ဆောက်လုပ်ရေး လုပ်ငန်းများနှင့် ဧရိယာတွင် အမြင်ပိုင်းဆိုင်ရာ နှောင့်ယှက်မှု လျော့ကျခြင်း။	မြေနေရာ အပြောင်းရွှေ့မှု၊ လမ်းဖောက်ခြင်း နှင့် ကျောက်တူး ထုတ်ခြင်း။	• ဆောက်လုပ်ရေး လုပ်ငန်းခွင်နေရာအား ရှင်းလင်း သေသပ်စွာထားရမည်။ • ဆောက်လုပ်ရေး လုပ်ငန်းခွင် ဝန်းကျင်တွင်ရှိသော သဘာဝပေါက်ပင်များအား ရှင်းလင်းခြင်းကို လျော့ချရမည်။ • သင့်လျော်သည့် အပင်များ ပြန်လည်ပေါက်ရောက်ခြင်းသ တ်မှတ်ရန်မြေယာရှုခင်း စိုက်ပျိုးခြင်း မဟာဗျူဟာ	• EMU သည် ကန်ထရိုက်တာများ၏ CEMP ကို ပြန်လည်စစ်ဆေးရမည်။ • ပတ်ဝန်းကျင်နှင့် ဆိုင်သည့် အလုပ်ကိစ္စ စီမံခန့်ခွဲသူသည် နှစ်ပတ်လျှင်တစ်ကြိမ် ဆောက်လုပ်ရေးလုပ်ငန်းခွင်နေ ရာအား မျက်မြင်စစ်ဆေးခြင်းကို တာဝန်ယူဆောင်ရွက်ရမည်။	Neo Energy Oasis and EMU
မျက်မြင် သွင်ပြင်များအား ထိခိုက်မှု လျော့ချခြင်း	ဆည်များ၊ လျှပ်စစ်ဓာတ်အား ရုံများ၊ လမ်းများ စသဖြင့်	• သင့်တော်သော အပင်များ ပြန်လည်ပေါက် ရောက်ခြင်း နှင့်အတူ မြေယာရှုခင်း စိုက်ပျိုးခြင်း မဟာဗျူဟာ	• သစ်တောများ ပြန်လည်ပျိုး ထောင်ခြင်းနှင့် အပင်များ ပြန်လည်ပေါက်ရောက်ခြင်းများ ကို နှစ်စဉ်တိုင်းတာရမည်။	Neo Energy Oasis and EMU
အပင်နှင့်သတ္တဝါ များ ပြန်လည်ထူ ထောင်ရေးနေရာ များ		ကြိုးဝိုင်းတောများ၏ ဥပဒေများအား လိုက်နာ စေခြင်းနှင့် သစ်တော သယံဇာတထုတ်ယူသုံးစွဲခြင်း များအား ဥပဒေများ၊ စည်းကမ်းများအတိုင်း လိုက်နာစေခြင်းများကို ပြုလုပ်ရမည်။ စီမံကိန်း ဧရိယာဝန်းကျင်ရှိ သစ်တောထဲတွင် တရားမဝင် လုပ်ဆောင်များအတွက် အစောင့်များဖြင့် စောင့်ကြည့်လေ့လာခြင်းနှင့် ခွင့်ပြုမိန့်ဖြင့် ဒဏ်ငွေရိုက်၍ ပြစ်ဒဏ်သတ်မှတ်ခြင်းများကို ဆက်လက် လုပ်ဆောင်	စီမံကိန်း ဧရိယာ	Neo Energy Oasis and EMU

		သွားသင့်သည်။		

၇။ အဖွဲ့အစည်းဆိုင်ရာအစီအစဉ်



အရင်းအမြစ်။ မြန်မာ့သယံဇာတနှင့် ပတ်ဝန်းကျင် ကုမ္ပဏီလီမိတက်

ပုံ ၇.၂။ အထက်ဘီလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်းအတွက် စောင့်ကြည့်လေ့လာခြင်းအစီအမံနှင့် ပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုအစီအစဉ် ပြီးစီးအောင်ဆောင်ရွက်ခြင်းအတွက် အဆိုပြုထားသော အဖွဲ့အစည်း ဖွဲ့စည်းတည်ရှိပုံ။

Chapter I Introduction

1.1 Background of the EIA Project

The Upper Baluchaung Hydropower Project will be one of the IPP hydropower projects implemented in Myanmar.

The Project site is located about 14.4 miles (23km) south-west of Nyaungshwe Town in Southern Shan State. The project consists of construction of two run-off river type hydropower plants utilizing the available natural head along the river before entering into the Inle Lake. Four rivers viz Nam Let Chaung, Heho (Negya Chaung), Kalaw (Ngot) Chaung and Upper Baluchaung drain into the Inle Lake from western side.

Inle (Inlay) Lake is a freshwater lake; the second largest in Myanmar with an estimated surface area of 44.9 square miles (116 km^2) and one of the highest at an attitude of 2900 ft. (880 m). The Inle (Inlay) lake catchment is important for economic, environmental and social reasons. The lake plays an important role as a natural reservoir for major hydropower stations down-stream (Baluchaung Hydropower Stations). The natural beauty and unique local culture attract many foreign and domestic tourists to visits the lake area.

One of the ethnic minorities, the Inthar lives on the lake. Inthar people move around by small boats, fish and grow vegetables on floating gardens in the lake. Their livelihoods depend largely on the natural resources of the lake.

Run-off river hydropower projects are less impact on the environment and recognize as renewable energy sources. Although Upper Baluchaung Hydropower Project is simply run-off river type hydropower project, but due to the existence of Inle (Inlay) lake downstream of the Project area, which has significant and unique natural environmental condition; this Environmental Impact Assessment is essential as part of the feasibility study of the Upper Baluchaung Hydropower Project.

The location of the Project is shown on the map in Figure 1.1-1. The Project consists of a dam and two run-off river power station. The catchment area of the Project is 21,955 km^2 (8477 square miles).

Figure 1.1-1: Location Map of Upper Baluchaung Hydropower Project.

Neo Energy Oasis Development Company Ltd. completed the Feasibility Study Report together with Environmental Study Report submitted to Ministry of Electric Power in June 2010. But the report corresponds in position to near "Screening" and MOECAF examined and suggested to complete full ESIA report according to the present status of Environmental Conservation Rules and Guidelines (e.g. Environmental Conservation Law, 2012 & Environmental Conservation Rule, 2014).

Neo Energy Oasis Development Company Ltd. has requested to Resource & Environment Myanmar (REM) for Preliminary Environmental Impact Assessment (EIA) report in accordance with *Environmental Conservation Rules of MOECAF (2014).* The preliminary EIA report was submitted to Environmental Conservation Department (ECD) in June 2016 and ECD had suggested to do full ESIA to fulfill the Environmental Impact Assessment Procedure that issued on 29 December 2015.

After preparation of this full ESIA report, Neo Energy Oasis will submit Full ESIA that compliance with EIA procedure.

1.2 Project Owner and Proponent

Project Owner – NEO ENERGY OASIS DEVELOPMENT Co.,Ltd.

Leading Organization - Ministry of Electricity and Energy (MOEE).

1.3 Environmental Consultant

Implementation of Preliminary EIA Assessment –

Leading Organization - Resource & Environment Myanmar Co., Ltd. (REM)

(REM) is located in the city of Yangon, Myanmar, in the country it is a leading resources and environment consulting firm that composed of geoscientists, engineers, biologist, botanist, socio-economic experts, cultural heritage experts, environmental engineers and physical resources management specialist.

Address	:	**Resource & Environment Myanmar Co., Ltd.** No. 702 B, Delta Plaza, Shwegonedaing Road, Bahan, Yangon.
Telephone	:	959-73013448
Facsimile	:	01-552901
Email	:	service@enviromyanmar.net
Contact Person	:	Mr. Thura Aung
Designation	:	General Manager

Secondary Organization – Sustainable Environment Myanmar Co., Ltd. (SEM)

SEM

Sustainable Environment Myanmar
Company Limited (SEM)

Address: B 503 Delta Plaza, Shwegondaing Road, Bahan, Yangon

Tel: +959 261328891

Email: services@sustainablemyanmar.com

The SEM provide Environmental & Social/Health Impact Assessment service for development projects in Myanmar. SEM has resources and capacity to handle environmental management issues as per the provisions of Environmental Conservation Laws 2012 including, EIA, ESMP, environmental monitoring and auditing.

1.4 Objectives of Study

The main objective of the study is to update the previous Preliminary Environmental and Social Impact Assessment report and to prepare an Environmental Management and Monitoring Plan (EMMP) for construction and operation of two run-off type hydropower project in Nyaungshwe Township. The scope of work will include but not limited to:

- Review of preliminary ESIA report
- Visits to relevant governmental and other institutions to collect information and undertake interviews.
- Undertake necessary field studies, as supplements to previous studies and to fulfil special requirements of Environmental Conservation Department
- To identify and evaluate potential environmental impacts which may arise as a result of the project activities
- To recommend suitable and practical mitigation measures to manage the potential impacts within acceptable levels; and
- Prepare recommendation for full ESIA report accordance with Ministry of Natural Resources and Environmental Conservation (MONREC) guidelines.

1.5 Participants of Environmental Impact Assessment

The following table shows list of participants involved in the present ESIA study of Upper Baluchaung Hydropower Project. Details personal profile of participants are provided in Appendix 8.

Table 1.5-1: Resource and Environment Myanmar Project Team Member.

No.	Name	Position	Organization	Responsibility
1	U Thura Aung	GM/Principal Consultant	Resource & Environment Myanmar Ltd.	Physical Environment, Environmental Baseline Data
2	U Ngwe Moe	Principal Consultant	Resource & Environment Myanmar Ltd.	Environmental, Health and Safety
3	U Zaw Naing Oo	MD/Principal Consultant	Sustainable Environment Myanmar Ltd.	Environmental Impact Assessment & Environmental Management
4	U Than Oo	GM/Principal consultant	Sustainable Environment Myanmar Ltd.	Hydropower Analyst
5	U Zay Maung Thein	Principal Consultant	Sustainable Environment Myanmar Ltd.	Avifauna
6	Dr. Tin Tin Khaing	Principal Consultant	Sustainable Environment Myanmar Ltd.	Vegetation and Flora
7	Daw Swe Wut Hmone	Consultant	Sustainable Environment Myanmar Ltd.	Vegetation
8	Daw Naing Naing Win	Senior Consultant	Sustainable Environment Myanmar Ltd.	Wild Life
9	Daw Than Than Htay	Senior Consultant	Sustainable Environment Myanmar Ltd.	Entomologist
10	Daw Myat Thet Khaing	Consultant	Sustainable Environment Myanmar Ltd.	Aquatic Ecology
11	U Chit Myo Lwin	Senior Consultant	Sustainable Environment Myanmar Ltd.	Environmental Geology
12	U Myat Ko Ko Hein	Consultant	Sustainable Environment Myanmar Ltd.	Forest
13	U Thet Naing Aung	Senior Consultant	Sustainable Environment Myanmar Ltd.	Avifauna
14	U Kyaw Naing Oo	Senior Consultant	Sustainable Environment Myanmar Ltd.	Herpetofauna
15	U Nyan Lin Maung	Consultant	Sustainable Environment Myanmar Ltd.	Water Quality
16	Daw Poe Mon Mon Kyaw	Consultant	Sustainable Environment Myanmar Ltd.	Environmental Engineer, EHS
17	Daw Phyo Khinzar Wint	Senior Consultant	Sustainable Environment Myanmar Ltd.	EIA report compilation
18	Daw Nu Yin	Senior Consultant	Sustainable Environment Myanmar Ltd.	SIA and Public Consultation
19	Daw Myat Thitsar Naing	Senior Consultant	Sustainable Environment Myanmar Ltd.	SIA and Public Consultation
20	Dr. Nyomie Razak	Principal Consultant	Sustainable Environment Myanmar Ltd.	SIA and Cultural
21	U Soe Yu Htun	Senior	Resource & Environment	Air and Noise

		Consultant	Myanmar Ltd.	
22	U De Hlaing Zaw	Consultant	Resource & Environment Myanmar Ltd.	Soil
23	U Nay Min Aung	Consultant	Resource & Environment Myanmar Ltd.	Water Quality

Chapter II Policy and Legislative Framework

2.1 National Environmental Policy of Myanmar

The Union of Republic of Myanmar adopted a series of policies in order to make rational use of water, land, forest, mineral resources, marine and other natural resources. Thus protect resources and prevent environmental degradation.

"The wealth of a nation is her people, cultural heritage, the environment and natural resources". According to the policies taken by the government of Myanmar, environmental factors should be comprehensively considered in the course of development, to make the environment harmony and balance from each aspect, and improve the quality of life of all people. Each country has the right on its own sovereignty to utilize natural resources on the basis of national environmental policy, but much care must be taken not to exceed its jurisdiction or harm the interests of other countries. For us and for future generations, every citizen have the duty to protect natural resources. "Environmental protection is always the first priority in the pursuit of development."

The above Policy was announced in the Government Gazette in accord with the Notification of the Government of Myanmar (Ref No 26/94) issued on December 5, 1994.

2.2 Government agencies

Ministry of Environmental Conservation and Forest (MOECAF) (now Ministry of Natural Resources and Environmental Conservation, MONREC) is the main sectoral agencies in the area of environmental protection and conservation. MONREC is broadly implementing the mainstream conservation activities related to land degradation (through Watershed Management and Greening Semi-arid Zone), biodiversity conservation (focusing on Protected Area System and Law enforcement) and sustainable use of forest resources (Sustainable Forest Management, Forest Plantation, Community Forestry & Law enforcement). Some of these activities are also conducive to the conservation of coastal areas such as mangrove rehabilitation and Coastal Watershed Management. MOH is the active agency in public health care, particular reference to reduction of the environmental health risk as guided by National Health Policy. The MOAI is also an important agency in influencing environmental matters relating to land use change and water resources, while Myanmar Agriculture Service (MAS) is delivering extension services for sustainable land use technology. The Water Resource Utilization Department and Irrigation Department under MOAI are concerned with improving water supply for agriculture.

Both Yangon and Mandalay City Development Committees (known as YCDC and MCDC) are major agencies for improving solid waste management systems. For the rest of the 328 urban areas and townships throughout the country, solid waste management and drinking water supply are the responsibility of the Department of Development Affairs (DDA) under the Ministry of Border Affairs (MOBA), National Races and Rural Development.

The National Environmental Conservation Committee (NECC) was reformed by including 21 members from 19 ministries and Sub-committees were formed eco-region wise under NECC in April, 2011.

Their main functions are:

i. to address the environmental problems due to unsustainable land use,

ii. to address the environmental problems in rivers and wetland areas,

iii. to implement environmental conservation activities in industrial zones and civil areas,

iv. to develop policies, principles, rules and regulations for environmental matters and

v. to strengthen the awareness of environmental matters.

2.3 Compliance of Laws and Regulations

2.3.1 Institutional Setting

Myanmar has 31 ministries under the Office of the President. The leading ministries in charge of environmental and social consideration are the Ministry of Natural Resources and Environmental Conservation (MONREC) and the Ministry of Social Welfare, Relief and Resettlement (MSWRR).

The present Project was reviewed and benchmarked against:

- Myanmar Environmental Conservation Law
- applicable international requirements with particular reference to the IFC PSs,

Legislation of Myanmar and international standards for the issues of interest are presented in the following sections in order to figure out a set of regulatory or reference limits and to address the best management practices for each considered environmental and social aspects relevant for the Project.

2.3.2 Myanmar Policies, Laws & Regulations Related to Environment

The followings are the Myanmar Policies, laws and Regulations related to the Environment.

Sector	Laws & Regulation
Environment	**National Environment Policies, 1994**
Finance & Revenue	The Myanmar Insurance Law, 1993 The State Law and Order Restoration Council (The Law amending the financial institutions of Myanmar Law, 1994)
Forestry	The Protection of Wild Life and Wild Plants and Conversation on Natural Areas Law, 1994 The Forest Law, 1992

Sector	Laws & Regulation
Health	The Prevention and Control of Communicable Diseases Law, 1995 The National Drug Law, 1992 The Union of Myanmar Public Health Law, 1972
Tourism	The Myanmar Hotel and Tourism Law, 1993
Industrial	The Factory Act, 1951 The Petroleum Act, 1934
Livestock & Fisheries	The Freshwater Fisheries Law, 1992 The Myanmar Marine Fisheries Law, 1990 (The Law Amending the Myanmar Marine Fisheries Law, 1993) The Law Relating to Aquaculture, 1989
Mining	The Myanmar Mines Law, 1994 The Land Acquisition (Mines) Act, 1885
Transportation	The Highways Law, 2000 The Motor Vehicles Law, 1964 (The Law Amending the Motor Vehicles Law of 1964 enacted in 1989) The Island Steam Vessels Act, 1917 The Ports Act, 1908 The Defile Traffic Act, 1905
Electricity	The State Law and Order Restoration Council (The Law Amending the Electricity Law, 1990) Electricity Law (2015)

2.4 International Environmental Convention, Protocol and Agreement

Myanmar as one of the parties signed more than 30 international and regional conventions and protocols. Refer to Table 2.4-1 for details.

Table 2.4-1: Myanmar's Commitment to International Agreements on Environmental Issues

No.	*International Environmental Conventions/ Protocols/ Agreements*	*Date of Signature*	*Date of Ratification*	*Date of Member*	*Cabinet Approval Date*
Regional					
1	Plant Protection Agreement for the South-East Asia and the Pacific Region, Rome, 1956		4-11-1959 (Adherence)	4-11-1959	
2	Agreement on the Networks of Aquaculture Centers in Asia and the Pacific, Bangkok, 1988		22-5-1990 (Accession)		
3	Southeast Asia Nuclear Weapon Free Zone Treaty, Bangkok, 1995	15-12-1995	16-7-1996 (Ratification)		
4	ASEAN Agreement on the Conservation of Nature and Nature Resources, Kuala Lumpur, 1985	16/10/1997			

5	ASEAN Agreement on Transboundary Haze Pollution	10/6/2002	13-3-2003 (Ratification)		7/2003 27-2-03
International					
1	Treaty Banning Nuclear Weapons Test in the Atmosphere in Outer Space and Under Water, Moscow, 1963	14/8/1963	15-11-1963 (Ratification)		
2	Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction on the Sea-Bed and Ocean Floor and in the Subsoil there of, London, Moscow, Washington, 1971	11/2/1971			
3	Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons, and on their Destruction, London, Moscow, Washington, 1972	10/4/1972			
4	International Convention for the Prevention of Pollution from Ships, London, 1973	(Accession)	undertakes to give effect to this Convention under para 1 & 2 of Article 1 of the Protocol of 1978		
5	Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, London, 1973		4-8-1988 (Accession)	Except for Annexes III, IV and V of the Convention	
6	United Nations Convention on the Law of the Sea, Montego Bay, 1982	10/12/1982	21-5-1996 (Ratification)		
7	United Nations Framework Convention on Climate Change, New York, 1992 (UNFCCC)	11/6/1992	25-11-1994 (Ratification)		41/94 9-11-94
8	Convention on Biological Diversity, Rio de Janeiro, 1992	11/6/1992	25-11-1994 (Ratification)		41/94 9-11-94
9	Treaty on the Non-Proliferation of Nuclear Weapons, London, Moscow, Washington, 1968		2-12-1992 (Accession)		
10	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and their Destruction, Paris, 1993	14-1-1993			
11	International Tropical Timber Agreement (ITTA), Geneva, 1994	6-7-1995	31-1-1996 (Ratification)		
12	Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985		24-11-1993 (Ratification)	22-2-1994	46/93
13	Montreal Protocol on Substances that Deplete		24-11-1993	22-2-	46/93

	the Ozone Layer, Montreal, 1987		(Ratification)	1994	
14	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London, 1990		24-11-1993 (Ratification)	22-2-1994	46/93
15	The Convention for the Protection of the World Culture and Natural Heritage, Paris, 1972		29-4-1994 (Acceptance)		6/94 9-2-94
16	ICAO ANNEX 16 Annex to the Convention on International Civil Aviation Environmental Protection Vol. 1 Aircraft Noise	(Accession)			
17	ICAO ANNEX 16 Annex to the Convention on International Civil Aviation Environmental Protection Vol. II Aircraft Engine Emission	(Accession)			
18	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies (Outer Space Treaty), London, Moscow, Washington, 1967	22-5-1967	18-3-1970 (Ratification)		
19	Agreement on the Networks of Aquaculture Centres in Asia and the Pacific, Bangkok, 1988		22-5-1990 (Accession)		
20	South East Asia Nuclear Weapon Free Zone Treaty, Bangkok, 1995	15-12-1995	16-7-1996 (Ratification)		
21	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and / or Desertification, Particularly in Africa, Paris, 1994 (UNCCD)		2-1-1997 (Accession)	2-4-1997	40/96 4-12-96
22	Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, D.C., 1973; and this convention as amended in Bonn, Germany,1979 (CITES)		13-6-1997 (Accession)	11-9-1997	17/97 30-4-97
23	Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, New York, 1994		21-5-1996 (Accession)		
24	Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, Rome, 1973		8-9-1994 (Acceptance)		
25	Catagena Protocol on Biosafety, Cartagena, 2000	11/5/2001			13/2001 22-3-01
26	International Treaty on Plant Genetic Resources for Food and Agriculture, 2001		4-12-2004 (Ratification)	29-6-2004	
27	Kyoto Protocol to the Convention on Climate Change, Kyoto, 1997		13-8-2003 (Accession)		26/2003 16-7-03

28	Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	18-4-2004 (Accession)	18-7-2004	14/2004 1-4-04

Source: NBSAP Myanmar

2.5 Major Law and Rules Related to the present Project

The laws related to the present Hydropower Project are described in Table 2.5-1.

Table 2.5-1: Legal Framework related to the present project.

Title	Brief Description
National Environmental Policy (1994)	To establish sound environmental policies in utilization of water, land, forest, mineral resources, and other natural resources in order to conserve the environment and to preserve it degradation. It is the responsibility of every citizen to preserve its natural resources in the interests of present and future generations. Environmental protection should always be the primary objective in seeking development.
Myanmar Agenda (1997)	Agenda encourages on mobilization and focus national efforts to achieve sustainable development and facilitation the incorporation of environmental considerations in the development process of the economic and social sectors.
The 2008 Constitution	Governments' commitment to protect and preserve natural environment.
Environmental Conservation Law (2012)	Provision of basic guidance to integrate environmental conservation in sustainable development, ministry's responsibility to develop relevant guideline and regulation, setting up monitoring system, waste management, conservation of natural resource and cultural heritage.
Environmental Conservation Rule (2014)	The principle of this rule is to support the execution conducted by ministry as required by environmental conservation law.
EIA Procedures (2015)	Description of categories of project to conduct EIA and IEE requirement, content of EIA, submission and approval principle, environmental certificates, responsibilities of ministry and project proponent.
National Environmental Quality (Emission) Guidelines (2015)	MOECAF formulated the National Environmental Quality (Emission) Guidelines (NEQG) in coordination with ADB in December 2015. The NEQG determines the guideline values for general emission such as air emissions, wastewater, noise levels, odor, and those for sector-specific emission such as emission from forestry, agribusiness/food production, chemicals, oil and gas, infrastructure, general manufacturing, mining, and power.
The Forest law (1992)	To implement forest policy and environmental conservation policy, to promote the sector of public cooperation in implementing these policies, to develop the economy of the State, to prevent destruction of forest and biodiversity, to carry out simultaneously conservation of natural forests and establishment of forest plantations and to contribute to the fuel requirements of the country.
The protection of wildlife, wild plant and Conservation of Natural Area Law (1994)	To protect wildlife, wild plants and conserve natural areas, to contribute towards works of natural scientific research, and to establish zoological gardens and botanical gardens. Law describe (a) to implement the policy of protecting wild life and wild plants of the Government,(b)To implement the policy of conserving the natural areas of the Government,(c) To carry out in accordance with International Conventions adopted by the State in respect of the preservation of wild life and wild plants, living and non-living organisms and migratory birds (d) To protect wild life and wild plants

Title	Brief Description
	liable to the danger of extinction and the habitats thereof(e)To contribute towards works of natural scientific research.
The protection of preservation of Cultural Heritage Region Law (1994)	Obligation not to carry out any of the following in the cultural heritage region (a) Destroying an ancient monument; (b) Willfully altering the original ancient form and structure or original ancient workmanship of an ancient of a monument; (c) Excavating to search for antiques; (d) Exploring for petroleum, natural gas, precious stones or minerals.
Land Acquisition Act (1894)	Enacted in 1894 during British Colony time, this act highlights the process and duty of government to acquire the land for sake of country with notification to owners, compensation for land and damage to land.
Farmland Law and Rule 2012	The law provides the rights of farmers to a certain extent than the similar laws in the last 50 years. There is significant improvement in this law with regard to the right of farmers such as right to sell the land and ownership. Any form of acquiring farm land to convert to investment project for sake of country shall be strictly followed in accordance with these law and rule.
The Myanmar Citizen Investment Law (2013)	The New Citizens Investment Law was enacted in 2013, repealing the Myanmar Citizens Investment Law of 1994. This law is to promote the inducement of domestic investment so as to lead to promotion of production and exports by the private sector.
The Electricity Law (2015)	Generally, set forth the principle of permission required by relevant authorities to installation, generation, transmission, distribution and inspection tasks. Permission might be withdrawn under the circumstance that licensed organization infringe the requirements stipulated in agreement. Projects are divided into three categories as small, medium and large.
The Conservation of Water Resources and River Law (2006)	This law aims at protection of water resources and river, avoidance of environmental impact, enhancement in navigation and safe water way and contribution to State economy.
The Conservation of Cultural Heritage Objects Law (2015)	Generally, set for steps to adhere in the event of discovering objects which are judged as culturally valuable. Types of cultural heritage objects and reporting process are also listed.
Protection and prevention of ancient buildings (2015)	This law aims at conservation of historically valuable buildings deemed under the law.
The Prevention of Hazard from Chemical and Related Substances Law (2013)	The Prevention of Hazard from Chemical and Related Substances Law, the central law of chemicals management in Myanmar enacted in 2013, stipulates that when chemicals and related substances is to be transferred, stored, used, or disposed, operating approval certificate should be obtained in accordance with the regulations based on the international treaties.
Social Security Law (2012)	The Social Security Law, enacted in 1012, was amended the Social Security Act in 1954. It stipulates the formation and implementation of social security system.
Workmen's Compensation Act (1923)	It stipulates that employer is required to make payments to employees who become injured or who die in any accidents arising during and in consequence of their employment. Such compensation

Title	Brief Description
	also must be made for disease which arise as a direct consequence of employment, such as carpal tunnel syndrome.
The Minimum Wage Law (2013)	The law was replaced the 1949 Minimum Wage Act. The Law provides a framework for minimum wage determination, the presidential office establishing a tripartite minimum wage committee shall decide minimum wage with industrial variation base on a survey on living costs of workers possibly every two years. This also stipulates equal payment.
Employment and Skill Development Law (2013)	The law aims to facilitate employment which is appropriate to the age and ability of the job seeker and to help workers obtain employment and to provide stability of employment and skills development for employees and also too help employers obtain appropriate employees.
The Leave and Holiday Act (1951)	This act has been used as the basic framework for leaves and holidays for workers with minor amendment in 2006 and 2014. This defines the public holidays that every employee shall be granted with full payment. It also defines the rules of leaves for workers including medical leave, earned leave and maternity leave.
The Labour Organization Law (2011)	The Labour Organization Law replaced the Trade Union Act enacted in 1927 for protecting the rights of the workers, having good relations among the workers or between the employer and the worker, and for forming and carrying out the labour organizations systematically and independently. Under the law, the labour organization has the right to carry out freely in drawing up their constitution and rules. It has the right to negotiate and settle with the employer if the workers are unable to obtain the right of the workers contained in the labor laws. On the other hand, the employer shall recognize the labour organizations and assist as much as possible if the labour organizations request for help for the interest of his workers.
The Labour Dispute Settlement Law (2012)	This law was enacted for safeguarding the right of workers or having good relationship between employer and workers and making peaceful workplace or obtaining the rights fairly, rightfully and quickly by settling the dispute of employer and worker justly. It stipulates that employer in which more than 30 workers are employed shall form the workplace coordinating committee consisting of the representatives of workers and the representatives of employer.
The Protection and Preservation of Antique Objects Law (2015)	It aims to implement the policy of protection and preservation of the perpetuation of antique objects and to protect and preserve antique objects so as not to deteriorate due to natural disaster or man-made destruction.
Motor Vehicles Law (2015)	It aims to drive safely motor vehicles in public area through registration according to official rules and regulations, to provide driving license, to protect the road users from the road risks and vehicles perils, to avoid traffic congestion and to use high technology transportation systems.
Export and Import Law (2015)	It aims to implement the economic principles of the State successfully, to lay down the policies to export and import that support the development of the State, and that are to be in conformity with the international trade standards.

Title	Brief Description
The Explosive Substances Act (1908)	The Explosive Substance Act stipulates the prohibitions on production, possession and use of explosives without permission.
The Myanmar Citizen Investment Law (2013)	The New Citizens Investment Law was enacted in 2013, repealing the Myanmar Citizens Investment Law of 1994. This law is to promote the inducement of domestic investment so as to lead to promotion of production and exports by the private sector.
Shan State Municipal Act (Shan State Parliament Law No. 10/2013)	This municipal act aim to protect the environment and supervise the discharge of solid waste and municipal waste.

2.6 Environmental Impact Assessment

At present, MOECAF has already issued the Environmental Conservation Law (ECL) on 30th March 2012. A set of Environmental Conservation Rules has been issued on 6th June 2014 by the Ministry of Environmental Conservation and Forestry) based on Environmental Conservation Law no. 42 (A).

These state that:

Chapter 11 of the Rules concerns Environmental Impact Assessment and described in detail at its sections 51 until 61. According to the rules, the department "Environmental Conservation Department" would be assigned by the ministry "Ministry of Environmental Conservation and Forestry". The ministry will state types and sizes of projects, business development and other development works that requires environmental impact assessment (EIA) and there requires initial environmental examination (IEE) for the remaining types of works.

According to the Section 52 of the rules, any ministry, government department, organization or person who to conduct projects, business activity, service or work in Myanmar has to:

(a) Conduct Environmental Impact Assessment for its project/work

(b) Report to the Ministry in advance that who of the third party organization/persons is selected to conduct EIA for the project

(c) Submit EIA report to the Ministry

The projects, business activity and work conducted before the approval of the Rules on 6th Jun 2014 which are in line with the work required EIA and IEE in present Rules, have to prepare environmental management plan (EMP) and require to formulate approved EMP and schedule by the Ministry.

2.7 Environmental Quality Standard

According to the Environmental Conservation Law, MOECAF shall set standards of environmental qualities as agreed by the Union Government and the Environmental Conservation Committee.

Standards to be set by MOECAF are as follows:

(a) standard quality of water related to the use of inland water available to public places, dams, ponds, swamps, flooded land, channel, creeks and rivers

(b) standard quality of water at coastal regions and delta area

(c) standard quality of groundwater

(d) standard quality of air

(e) standard of noise and vibration

(f) standard of odor and emission gas

(g) standard of wastewater

(h) standard of soil and leachate from solid waste

(i) other standard environment qualities set by the Union Government

So far, these standards have not been set yet. Therefore, the Project proponent set quantitative target levels on ambient air quality, water temperature, and water quality in operation phase, noise and vibration in construction and operation phases. These are elements which may cause adverse impact to surrounding environment, thus quantitative target levels were set. Each quantitative target level to be applied for the Project is described below.

2.7.1 Ambient air quality standard

Ambient air quality will be in line with IFC`s *Environment, Health and Safety General Guidelines (2007)*. Currently, ECD has issued National Emission (Quality) Guideline on 29th December 2015. On the other hands, most of the countries in south-east Asia as well as Japan have the ambient air quality standard to receptors.

International standard is also available in the Environmental, Health, and Safety (EHS) Guidelines prepared by International Finance Cooperation (IFC). Table 2.7.1-1 shows the ambient quality standards in Southeast Asia (e.g., Thailand, Vietnam), Japan, Myanmar and World Health Organization (WHO), which the Environmental, Health, and Safety (EHS) Guidelines by International Finance Corporation (IFC) applies as reference.

Table 2.7.1-1: Air quality standard National Environmental Quality (Emission) Guideline and IFC.

Item	Averaging period	Myanmar (NEQG)*	IFC** (WHO Guideline)
SO2	10 min	0.5 mg/m^3	0.5mg/m3
	1hour		

	24hours	0.02 mg/m^3	0.125mg/m3(InterimTarget-1)
			0.05mg/m3(InterimTarget-2)
			0.02mg/m3(Guideline)
	1 year		-
NO2	1hour	0.2 mg/m^3	0.2mg/m3
	24hours		-
	1 year	0.04mg/m3	0.04mg/m3
NOx	1hour		
	24hours		
CO	1hour		-
	8hours		-
	24hours		-
TSP	1hour		-
	24hours		-
	1 year		-
PM10	24hours	0.05 mg/m^3	0.15mg/m3(InterimTarget-1)
			0.10mg/m3(InterimTarget-2)
			0.07mg/m3(InterimTarget-3)
			0.05mg/m3(Guideline)
	1 year	0.02 mg/m^3	0.07mg/m3(InterimTarget-1)
			0.05mg/m3(InterimTarget-2)
			0.03mg/m3(InterimTarget-3)
			0.02mg/m3(Guideline)
SPM	1hour		-
	24hours		-
PM2.5	24hours	0.025 mg/m^3	0.075mg/m3(InterimTarget-1)
			0.05mg/m3(InterimTarget-2)
			0.0375mg/m3(InterimTarget-3)
			0.025mg/m3(Guideline)
	1 year	0.01 mg/m^3	0.035mg/m3(InterimTarget-1)
			0.025mg/m3(InterimTarget-2)
			0.015mg/m3(InterimTarget-3)
			0.01mg/m3(Guideline)
Ozone	1hour		-
	8hourdaily	0.1 mg/m^3	0.16mg/m3(InterimTarget-1)
	maximum		0.1mg/m3(Guideline)
	1 year		-
Ox	1hour		-
Pb	24hours		
	1 month		
	1 year		

Source: * National Emission (Quality) Guideline, 29 -12-2015

** Environmental, Health, and Safety Guidelines, General EHS Guidelines, IFC, 2007

2.7.2 Water Quality

Ministry of Natural Resources and Environmental Conservation has already issued National Environmental Quality (Emission) guideline on 29 December 2015. Waste water discharge effluent guideline value is determined by MONREC as shown in Table 2.7.2-1 and 2.7.2-2. In this Project, the Project proponent follows the NEQ guidelines values.

Table 2.7.2-1: Limit Values for Discharge of Wastewaters during Construction Phase (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 bacteria4	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

SU[a] = Standard Unit

Table 2.7.2-2: Limit Values for Discharge of Wastewaters during Construction and Operation Phases Water Runoff, Effluent and Sanitary Discharges (General Application)

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/l	50
Ammonia	mg/l	10
Arsenic	mg/l	0.1
Cadmium	mg/l	0.1
Chemical oxygen demand	mg/l	250
Chlorine (total residual)	mg/l	0.2
Chromium (hexavalent)	mg/l	0.1
Chromium (total)	mg/l	0.5
Copper	mg/l	0.5
Cyanide (free)	mg/l	0.1
Cyanide (total)	mg/l	1

Fluoride	mg/l	20
Heavy metals (total)	mg/l	10
Iron	mg/l	3.5
Lead	mg/l	0.1
Mercury	mg/l	0.01
Nickel	mg/l	0.5
Oil and grease	mg/l	10
pH	S.U.a	6-9
Phenols	mg/l	0.5
Selenium	mg/l	0.1
Silver	mg/l	0.5
Sulphide	mg/l	1
Temperature increase	°C	<3b
Total coliform bacteria	100 ml	400
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50
Zinc	mg/l	2
Total coliform bacteria	100 ml	400

2.7.3 Noise

(1) Construction Phase

Currently, there is no noise standard of construction activities to receptors in Myanmar. Therefore, the target noise level at construction stage is set based on the standard in the other foreign countries. Table 2.7.3-1 shows noise standard at construction stage in the other countries. In the south-east Asia countries, only Singapore has the noise standard of construction activities to receptors categorized as quiet area, residential area, and the other areas. Thus, target noise level is set with following the standard in Singapore.

Table 2.7.3-1: Noise Standard at Construction Stage in the Various Countries

	Items	Day time (Leq)	Night time (Leq)
Japan	Using heavy equipments with high noise level (piling, excavating etc.)	85 dB (Maximum)	-
Singapore	Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	60 dB (7am – 7pm, 12hrs)	50 dB (7pm – 7am, 12hrs)
	Residential buildings located less than 150mfrom the construction site where the noise is being emitted	75 dB (7am – 7pm, 12hrs)	60 dB (7pm – 10pm, 3hr) 55 dB (10pm – 7am, 9hr)
	Other Buildings	75 dB (7am – 7pm, 12hrs)	65 dB (7pm – 7am, 12hrs)
UK	In rural, suburban and urban areas away from main road traffic and industrial noise.	70 dB (8:00-18:00)	-
	Urban areas near main roads	72 dB (8:00-18:00) -	-
USA	Residential	80 dB (8hrs)	70 dB (8hrs)
	Commercial	85 dB (8hrs)	85 dB (8hrs)
	Urban Area with high ambient noise level (>65 dB)	Ambient Noise Level +10dB	

Source: Noise Regulation Act, Japan (Law No.98, 1968, Amended No.33, 2006)

Environmental Protection and Management Act in Singapore (Chap.94A, Section 77, revised)

(2) Operation Phase

Currently, there is no ambient noise standard to receptors in Myanmar. On the other hands, most of the countries in south-east Asia as well as in Japan have the ambient noise standard to receptors categorized land use or requirement of quiet as shown in Table 2.7.3-2. International standard is also available in the EHS Guidelines prepared by IFC. On the basis of the existing standards in other countries, target noise level is set with following consideration and target ambient noise level.

Table 2.7.3-2: Ambient Noise Standard at Operation Stage in South-East Asia Countries

Items		Day time (Leq)	Night time (Leq)
Indonesia	Noise standard for sensitive areas such as residences hospitals, schools and places of religious worships	55 dB	
	Noise standard for office and commercial	65 dB	
	Noise standard for commercial and service	70 dB	

Malaysia	Sensitive Areas/ Low Density Residential Areas	55 dB (7am – 10pm,15hrs)	50 dB (10pm – 7am, 9hrs)
	Sub Urban Residential	60 dB (7am – 10pm, 15hrs)	55 dB (10pm – 7am, 9hrs)
	Urban Residential	65 dB (7am – 10pm, 15hrs)	60 dB (10pm – 7am, 9hrs)
	Commercial and Business	70 dB (7am – 10pm, 15hrs)	60 dB (10pm – 7am, 9hrs)
Singapore	Sensitive Areas	60 dB (7am – 7pm, 12hrs)	50 dB (10pm – 7am, 9hrs)
	Residential Areas	65 dB (7am – 7pm, 12hrs)	55 dB (10pm – 7am, 9hr)
	Commercial Areas	70 dB (7am – 7pm, 12hrs)	65 dB (7pm – 10pm, 3hr) 60 dB (10pm – 7am, 9hr)
Thailand	Noise standard	70 dB (24hrs)	
Japan	Sensitive Area (Class AA)	50 dB (6am – 10pm, 16hrs)	40 dB (10pm – 6pm, 8hrs)
	Residential Area (Class A and Class B)	55 dB (6am – 10pm, 16hrs)	45 dB (10pm – 6pm, 8hrs)
	Commercial and Industrial Area (Class C)	60 dB (6am – 10pm, 16hrs)	50 dB (10pm – 6pm, 8hrs)
IFC	Residential; institutional, educational	55 dB (7am – 10pm, 15hrs)	45 dB (10pm – 7am, 9hrs)
	Industrial; commercial	70 dB (7am – 10pm, 15hrs)	70 dB (10pm – 7am, 9hrs)

Source: Noise Standard in Indonesia (KEP-48/MENLH/11/1996)

Effect of Traffic Noise on Sleep: A Case Study in Serdang Raya, Selangor, Malaysia, Environment Asia, 2010.

Environmental Protection and Management Act in Singapore (Chap.94A, Section 77, revised in 2008).

Notification of Environmental Board No. 15 B.E.2540 (1997) under the Conservation and Enhancement of National Environmental Quality Act B.E.2535 (1992) dated March 12, B.E.2540 (1997) and Notification.

Neo Energy Oasis Company Ltd. will comply the above laws and regulations during construction and operation of the present project.

Besides, Neo Energy Oasis Company Ltd. will comply the NEQ regulations for noise during construction and operation of the present project.

Noise prevention and mitigation measures should be taken by all projects where predicted or measured noise impacts from a project facility or operation exceed the applicable noise level guideline at the most sensitive point of reception. Noise impacts should not exceed the levels shown below, or result in a maximum increase in background levels of three decibels at the nearest receptor location off-site.

Table 2.7.3-3: Ambient Noise Standard during Construction and Operation (NEQ, 2015)

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

Equivalent continuous sound level in decibels

Chapter III Project Description

3.1 Objectives and Beneficiaries of the Project

The Government of the Republic of the Union of Myanmar is working hard for national industrialization in its bids to improve the economic sector. Development in electric sector is at the center of the process and implementing electric power projects one after another for raising the electric power sector to secure sustainable energy supplies.

In general, the objectives of hydropower development are as follows,

- Providing the basic energy needs for Myanmar
- Choosing the optimum maximum of energy resources to meet the energy requirements at the minimum costs for the national economy.
- Optimization of available energy resources to promote socio-economic development of the country
- Conserving energy resources and developing, managing local environments
- Ensuring continuity of energy supply and the energy price stability

The objectives of the project development are to be carried out by the way of thinking mentioned above and in addition, to contribute to local development.

In Myanmar, electricity is chronically short by the supply inadequacy, and in addition the growth of the electricity demand is so remarkable that Myanmar government concentrates on hydropower development, in particular.

Therefore, this Project is put into implementation and is aimed for the supply to the local community and country main power transmission line and also contributes to regional economy.

3.2 Description of the Project

3.2.1 Background of the Project

The Upper Baluchaung Hydropower Project was initially identified by Kansai Electric Power Corporation in cooperation with the Myanmar Electric Power Enterprise (MEPE), and planned in the pre-feasibility study (Pre-FS) report in May 2001. According to the report, firstly, Upper Baluchaung Hydropower Project was planned with installed capacity of 16.0 MW and annual generation power of 79GWh.Neo Energy Oasis Development Co., Ltd. (NEO) is formed of Myanmar National young developers which is under the mother company, Minanawyahtar Group of Companies Ltd. (MGC). MGC and Department of Hydropower Implementation, Ministry of No.1. Electric Power (MOEP.1 now

MOEE) signed Memorandum of Understanding (MOU) on (5.11.2009) to implement Upper Baluchaung Hydropower Project by (B.O.T) system.

As per agreement between MGC & MOEP.1 (now MOEE), (NEO), one of the companies under MGC started the investigation works on topographic survey, geological investigation by core drilling and hydrology data collection together with the assigned consultants of Nippon Koei Co., Ltd., Japan. The Feasibility Study Report was submitted to MOEP.1 in August 2010.

The Memorandum of Agreement (MOA) was signed between MOEP (1) (now MOEE) and NEO 17th January 2011, to implement the Upper Baluchaung Hydropower Project by (B.O.T) system. Since then the project was started.

3.2.2 Location of the Project

The Project site is located about 14.4 miles 23km south-west of Nyaungshwe Town in Southern Shan State and it is also located in one inch topographic map of 93 D, Grid co-ordinate 15255810. The project area is also situated between North latitude 20º 27’ and 20º 30’ and East longitude 96º 45’ and 96º50’. The project consists of construction of two run-off river type hydropower plants utilizing the available natural head along the river before entering into the Inle Lake. Four rivers viz Nam Let Chaung, Heho (Negya Chaung), Kalaw (Ngot) Chaung and Upper Baluchaung drain into the Inle Lake from western side.

Location Map of the Upper Baluchaung Project is shown in Figure 3.2.2-1.

Figure 3.2.2-1: Location Map of the project area.

3.2.3 Upper Baluchaung Hydropower Project

There are three large streams flow down to Inle Lake from western mountain range, the Yepe (Heho), Thandaung (Kalaw) & Upper Baluchaung. Among them, Upper Baluchaung is the largest one with the biggest catchment (836 sq.km) and perennial flow.

Upper Baluchaung river originates at about 2miles west of Pinlaung Township, and flows from south to north, then turns through to the east flat plain crossing the Aung Pan – Loikaw road and running through the west of Inle Lake via Indein village. Before flowing to the Inle Lake, the river flows through the west escarpment of Inle Lake forming waterfalls and cascades, so that it becomes riches of hydropower resources. Along the river, between Saungwun & Indein village about 17.5 km length, the natural head difference occurs about 320m.

Two run-off river type hydropower projects are planned at a place near Minlone village, about 5 km upstream of Indein village. One with installed capacity 20.4 MW and annual generation of 90.1 GWh, and the other one with installed capacity 10MW and annual generation of 44.5 GWh.

The Upper Baluchaung Hydropower Project was planned to implement by two phases. Phase I(UB-1) included concrete dam (Weir type), Intake Structure, Intake Channel, Sand Settling Basin, Headrace Channel, Head Tank, Penstock and Powerhouse. Installed Capacity was designed 20.4 MW (10.2 MW x 2Nos). Phase II (UB-2) was planned without head up dam, it will take with direct link from Tail race channel of UB-1 to the Head race channel of UB-2 then to the Head Tank, Penstock and Powerhouse. Installed Capacity of UB-2 is 10 MW (5MW x 2 Nos.).

The general layout plan of the project is shown in Figure 3.2.3-1, inundation area map is shown in Figure 3.2.3-2 and river profile and profile of two power station is shown in Figure 3.2.3-3, Figure 3.2.3-4.

The Upper Baluchaung HPP is located in the area of about 7 km west of Inle Lake. **Inle Lake**, also known as **Inle Sap**, is a freshwater lake located in the Nyaungshwe Township of Taunggyi District of Shan Region. It is the second largest lake in Myanmar with an estimated surface area of 44.9 square miles (116 km^2), and one of the highest at an elevation of 2,900 feet (880 m). During the dry season, the average water depth is 7 feet (2.1 m), with the deepest point being 12 feet (3.7 m), but during the rainy season this can increase by 5 feet (1.5 m). The watershed area for the lake lies to a large extent to the north and west of the lake. The lake drains through the Nam Pilu or Balu Chaung on its southern end. There is a hot spring on its northwestern shore.

In June 2015, Inle Lake was officially designated as Myanmar's first biosphere reserve under UNESCO's Man and the Biosphere (MAB) programme. The wetland ecosystem of this freshwater Inle Lake is home to diverse flora and fauna. It is home to 267 species of birds, out of which 82 are wetland birds. The Inle Lake is nesting place for globally endangered Sarus crane. It also has 43 species of freshwater fishes of which 9 species of fish are found nowhere else in the world. Apart from its ecological importance, Inle Lake is also having unique for the way the local inhabitants have adapted their life style to their environment.

Presently, the lake gets funding from the government of Norway for conservation purpose under the framework of the Inle Lake Conservation and Rehabilitation project. The relationship of the hydropower project and Inle Lake (MAB) is shown in Figure 3.2.3-2.

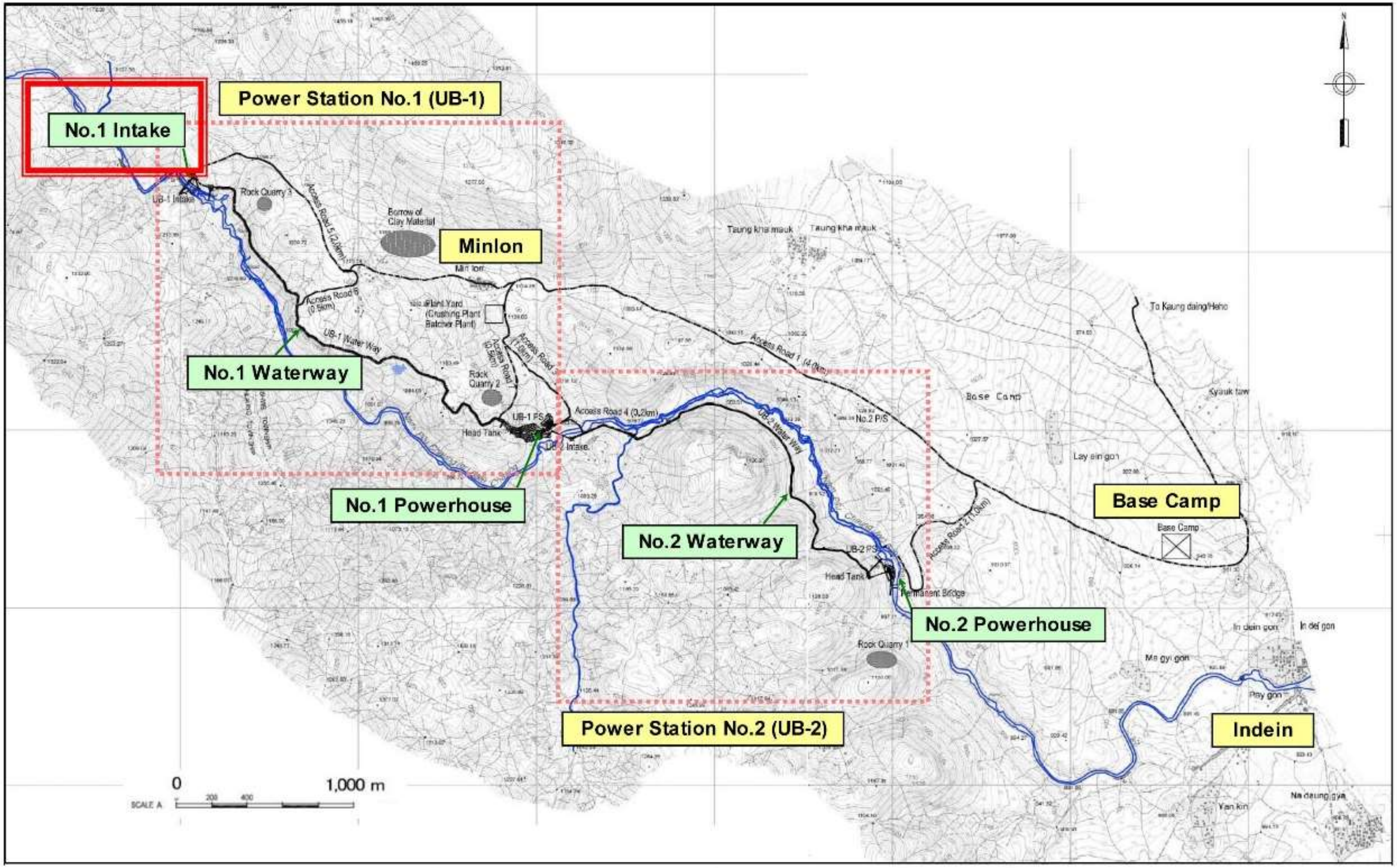


Figure 3.2.3-1: General Layout Plan of the Upper Baluchaung Hydropower Project.

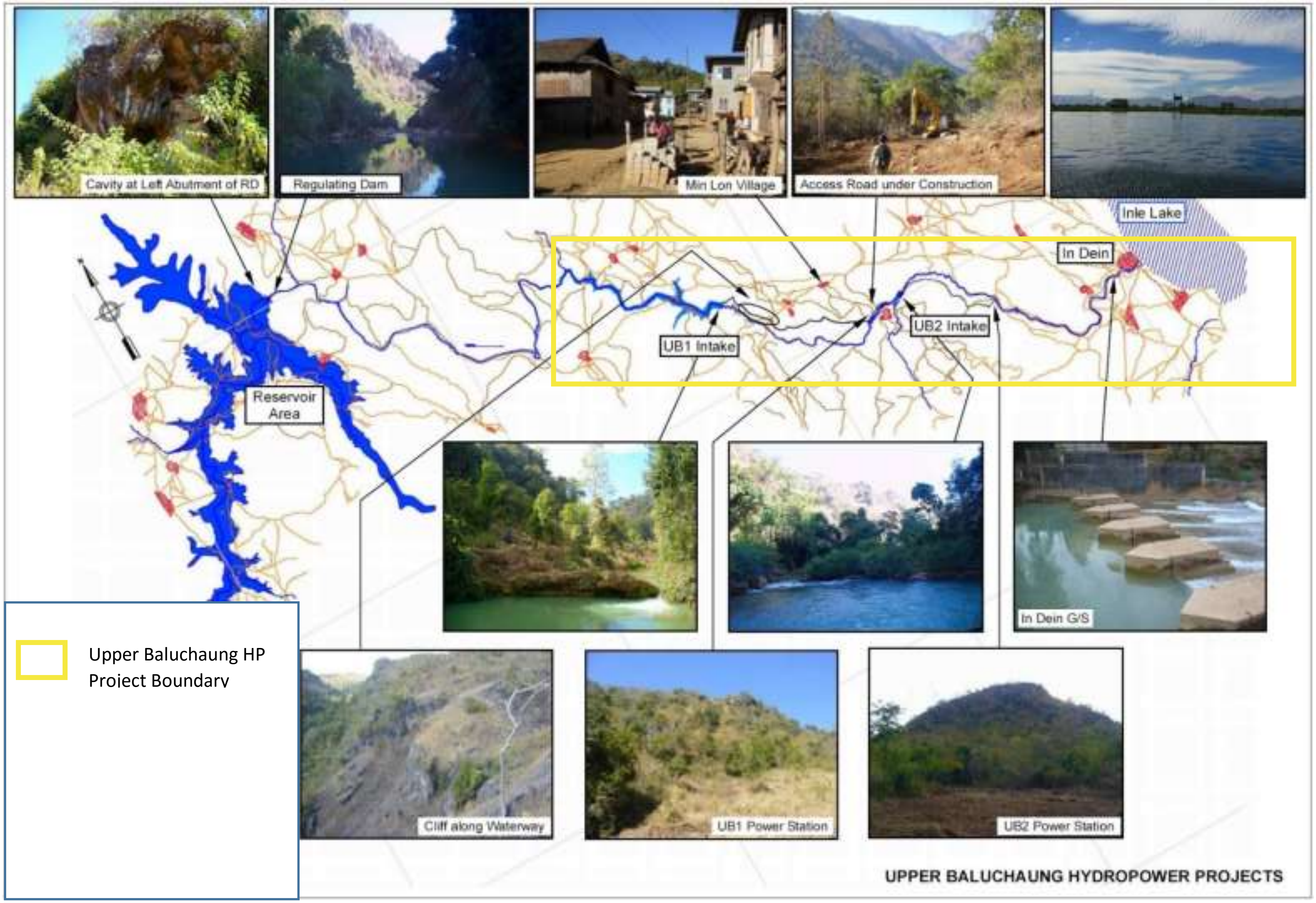


Figure 3.2.3-2: Upper Baluchaung HPP with relationship to the Inle Lake.

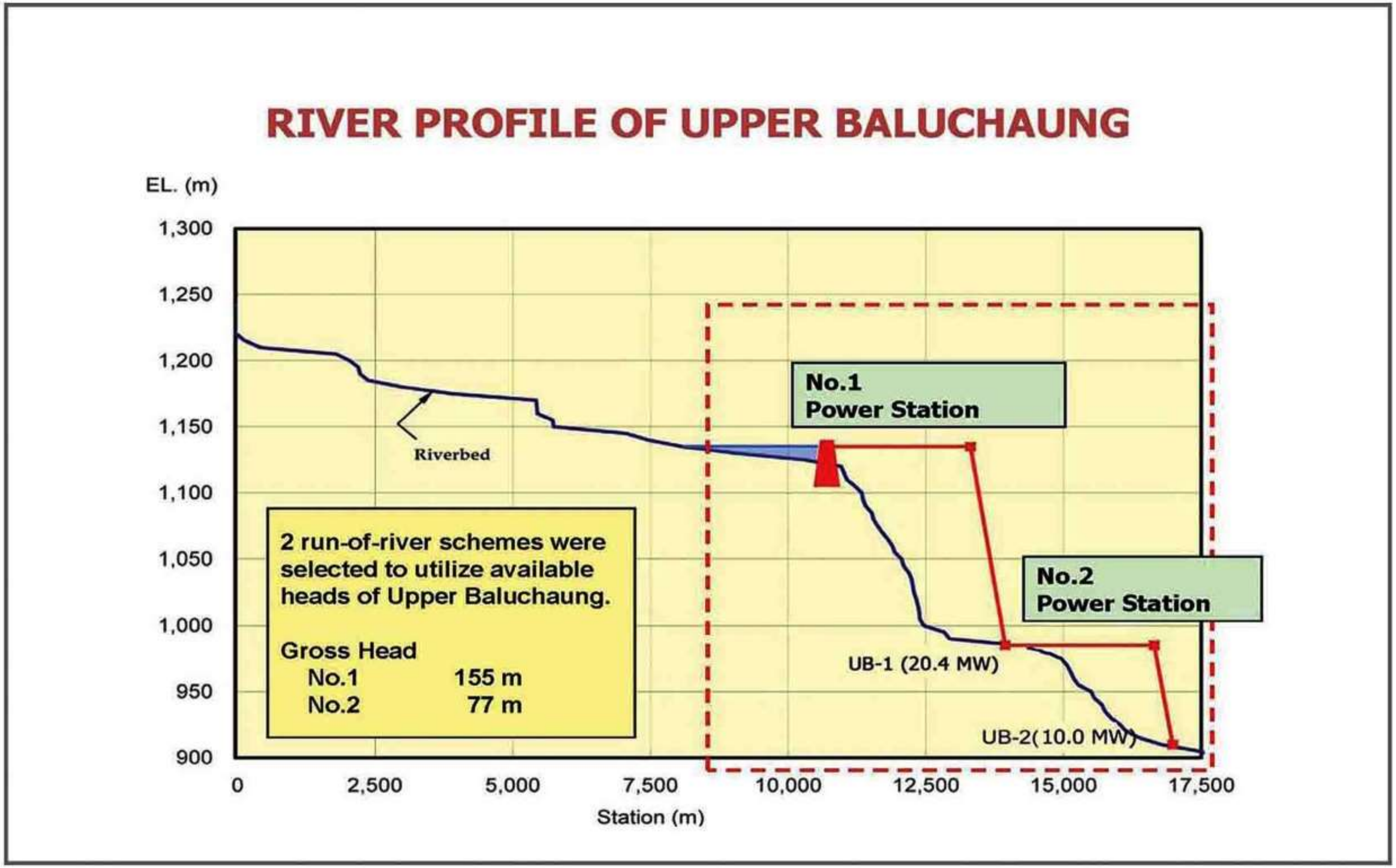


Figure 3.2.3-3 River profile of upper Baluchaung river.

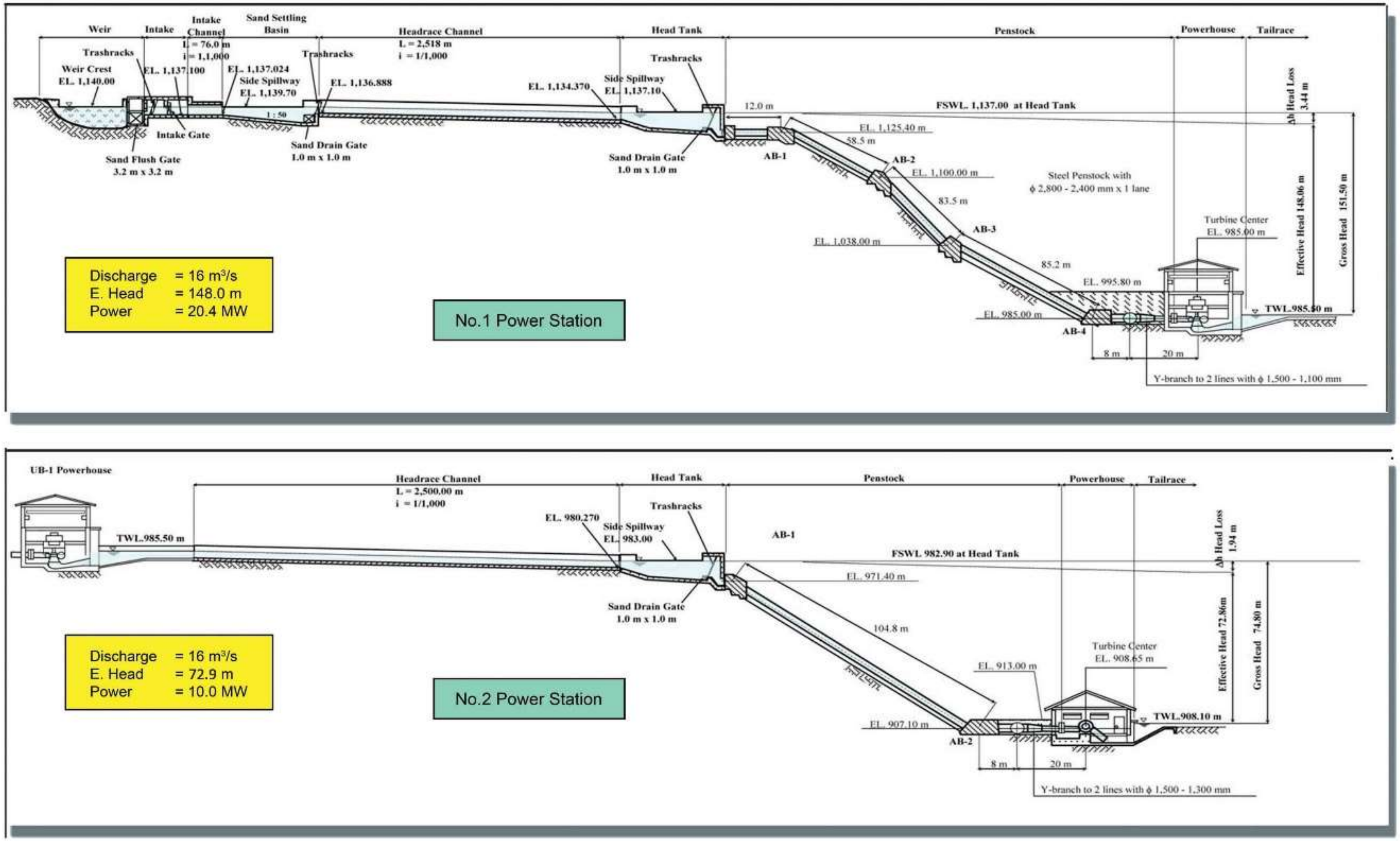


Figure 3.2.3-4 Layout plan of No.1 and No.2 Power Stations.

3.3 Main Feature of the Project

Table 3.3-1: Salient Features of the Project

Item	unit	UB-1	UB-2	Total
1. Basic Site Information				
Catchment area	km^2	802	822	
Annual mean discharge	m^3/s	11.06	11.06	
Full supply water level	m	1,137.0	982.9	
Tail water level	m	985.5	908.1	
Design flood for dam/weir	m^3/s	1,415	625	
2. Power Output				
Installed capacity	MW	10.2 x 2 = 20.4	5.0 x 2 = 10.0	30.4
Max. plant discharge	m^3/s	16.0	16.0	
90% dependable power	MW	3.22	1.72	
Effective head	m	148.0	72.9	
Annual energy	GWh	90.1	44.5	134.6
3. Main Structure				
Intake dam/weir	type	Concrete gravity	-	
height	m	35	-	
volume	m^3	42,000	-	
Waterway		open channel	open channel	
width x length	m	3.2 x 2,600	3.2 x 2,530	
Penstock				
diameter x length	m	265 x (2.8 - 1.1)	135 x (2.8 - 1.3)	
Powerhouse		open type	open type	
	m	18.5(w)x34.4(l)x24.3(h)	16.5(w)x51.0(l)x19.6(h)	
Generating equipment				
turbine		vertical Francis	horizontal Francis	
		10,600 kW x 2	5,200 kW x 2	
		600 rpm	500 rpm	
generator		3 phase conventional	3 phase horizontal	
		10,200 kW x 2	5,000 kW x 2	
main transformer		outdoor type	outdoor type	
		11,300 kVA x 2	11,200 kVA x 1	
		11/66 kV	11/66 kV	
Switchgear		66 kV/400 A	72.5 kV/400 A	
4. Construction Plan & Cost Estimate				
Construction period	month	31	29	
Direct construction cost	US$	29.8	15.3	45.0
Administration cost	US$	0.7	0.4	1.1
Engineering service cost	US$	2.1	1.1	3.2
Physical contingency	US$	2.4	1.2	3.5
Total	US$	35.0	17.9	52.8
5. Economic & Financial Evaluation				
EIRR	%	14.2	13.5	14
Discount rate	%	10.0	10.0	10.0
FIRR	%	9.2	8.7	9.0
WACC	%	8.5	8.3	8.5

3.4 Project Optimization Study

This Chapter presents the optimization of the project scale. Through the optimization study, the optimum size of the Upper Baluchaung Hydropower Project is concluded as follows:

Installed capacity	: 30.4 MW
Annual Power Generation	: 134.6 GWh
Maximum Plant Discharge	: 32 m^2 /s
Maximum Water Level (MWL)	: EL.1146.0 m
Minimum Operation Level (MOL)	: EL. 1143.0 m
Peak Duration Time	: 8 hours

3.4.1 Basic Conditions

(1) Plant Discharge

The daily discharges for 40 years from 1970 to 2009 simulated by the Tank Model are used for the optimization study to select the maximum plant discharge and installed capacity. The excess probability is given in Table 3.4.1-1. Note that the maintenance flow of 0.5 m^3/s is deducted from the daily discharge.

The following three alternatives are examined for comparison.

Table 3.4.1-1: Discharge Used

Excess Probability	Discharge (%)	Deducted by 0.5 m^3/s
Min	159.7	159.2
10%	22.3	21.8
25%	13.0	12.5
50%	8.4	7.9
75%	5.6	5.1
90%	3.7	3.2
95%	2.8	2.3
100%	1.9	1.4
Average	11.1	10.6

Table 3.4.1-2 Alternatives for Optimization

UB-1		UB-2	
FSWL at Intake	1,140.0	FSWL at Intake	985.0
FSWL at Head Tank	1,137.0	FSWL at Head Tank	983.0
TWL	985.5	TWL	908.3
Min. Discharge	40%	Min. Discharge	40%

	UB-1					UB-2				
Case	Max. Plant Discharge (m3/s)	Effective Head (m)	Max. Output (MW)	Annual Energy (GWh)	Plant Factor (%)	Max. Plant Discharge (m3/s)	Effective Head (m)	Max. Output (MW)	Annual Energy (GWh)	Plant Factor (%)
1	12	149.5	15	82	62.4	12	73.7	7.4	40.8	62.9
2	14	148.8	17.4	87	57	14	73.3	8.6	43.1	57.2
3	16	148	19.8	90.1	51.9	16	72.9	9.8	44.5	51.9

(2) Full Supply Water Level

One of the major constraints to be considered for the construction is workability of the rock excavation along the steep slopes formed on the left bank of the No.1 waterway. The practical range to enable open excavation will be between EL. 1,140 m and EL. 1,145 m.

On the other hand, the core boring revealed that the foundation rock at the No.1 Intake would be about 16 m deep from the ground surface. The FSWL at EL. 1,145.0 m will require an intake weir of 40 m high. This will most likely cause leakage through caves and/or large cavities/openings developed on the limestone layers upstream of the No.1 Intake, even if the clay blanket is utilized to cover the openings of rocks.

It is important to note that the water level at the intake is governed by the flow through the open channel. Therefore, the intake weir does not function as a dam to utilize the drawdown of the reservoir.

 **Steep Slope on Right Bank**	 **Cavity Upstream of No. 1 Intake**

Taking into account the risk due to leakage and workability of the waterway excavation, an FSWL of 1,140 m at the No.1 Intake is selected based on engineering judgment. The following shows the summary of the water levels applied:

Table 3.4.1-3: Water Levels Applied

Structure	Water Level	Elevation
UB-1	FSWL at Intake	1,140.0
	Tail water level	985.5
UB-2	FSWL at Intake	985.0
	Tail water level	908.1

(3) Conditions for Evaluation

The following conditions are applied to the optimization study:

Table 3.4.1-4: Other Applied Conditions

Conditions	Value
Disbursement period for construction	3 years
Disbursement ratio	30%(1st), 50%(2nd), 20%(3rd)
Project life	50 years for civil structures
	33 years for EM works (90% for replacement)
Contingency	Physical contingency of 10%(civil) & 5%(E&M)
O&M cost	0.5%(civil) & 1.5%(E&M) of initial cost
Energy sales price	5 cent/kWh
Discount rate	10%
Alternative thermal plant	Gas combined cycle
- Power value	138.79 US$/kW
- Energy value	6.064 cent/kWh
Firm capacity	90% dependable power
Index for Evaluation	Maximize economic NPV (B-C) for (UB1+UB2)

3.4.2 Evaluation of Power Optimization

The optimum plant discharge is selected so that the net benefit is maximized. In addition, the upward trend of fuel price is also taken into account. Table 3.4.2-1 and Figure 3.4.2-2 show the results of the analysis:

Table 3.4.2-1: Results of Optimization

UB-1

Power Value: 138.79 US$/kW — Energy Value:

								Fuel Price at Present 6.064 US¢/kWh		30% Increase 7.747 US¢/kWh		50% Increase 8.869 US¢/kWh	
Q m^3/sec	E.Cost M.US$	P MW	E GWh	Pfirm kW	Efirm GWh	P.F. %	E.Cost US$/kW	PV(B-C) mi.US$	IRR %	PV(B-C) mi.US$	IRR %	PV(B-C) mi.US$	IRR %
12.0	26.12	15.00	82.01	3,592	28.32	62.41	1,741	20.88	19.6%	32.16	24.5%	39.69	27.8%
14.0	28.38	17.40	86.95	3,381	26.66	57.04	1,631	20.99	18.9%	32.95	23.8%	40.93	26.9%
16.0	30.21	19.80	90.09	3,221	25.39	51.94	1,526	20.63	18.3%	33.03	23.0%	41.29	26.1%

UB-2

Power Value: 138.79 US$/kW — Energy Value:

								Fuel Price at Present 6.064 US¢/kWh		30% Increase 7.747 US¢/kWh		50% Increase 8.869 US¢/kWh	
Q m^3/sec	E.Cost M.US$	P MW	E GWh	Pfirm kW	Efirm GWh	P.F. %	E.Cost US$/kW	PV(B-C) mi.US$	IRR %	PV(B-C) mi.US$	IRR %	PV(B-C) mi.US$	IRR %
12.0	17.45	7.40	40.79	1,817	14.33	62.92	2,359	6.34	14.5%	11.95	18.3%	15.70	20.7%
14.0	18.89	8.60	43.12	1,715	13.52	57.24	2,197	6.08	14.0%	12.01	17.7%	15.97	20.1%
16.0	20.01	9.80	44.53	1,715	13.52	51.87	2,042	5.74	13.6%	11.87	17.2%	15.96	19.6%

UB-1 and UB-2

Power Value: 138.79 US$/kW — Energy Value:

								Fuel Price at Present 6.064 US¢/kWh		30% Increase 7.747 US¢/kWh		50% Increase 8.869 US¢/kWh	
Q m^3/sec	E.Cost M.US$	P MW	E GWh	Pfirm kW	Efirm GWh	P.F. %	E.Cost US$/kW	PV(B-C) mi.US$	IRR %	PV(B-C) mi.US$	IRR %	PV(B-C) mi.US$	IRR %
12.0	43.57	22.40	122.80	5,409	42.64	62.58	1,945	27.22	17.6%	44.12	22.1%	55.38	25.0%
14.0	47.27	26.00	130.07	5,096	40.18	57.11	1,818	27.07	17.0%	44.97	21.4%	56.90	24.2%
16.0	50.22	29.60	134.62	4,936	38.92	51.92	1,696	26.37	16.4%	44.90	20.7%	57.25	23.5%

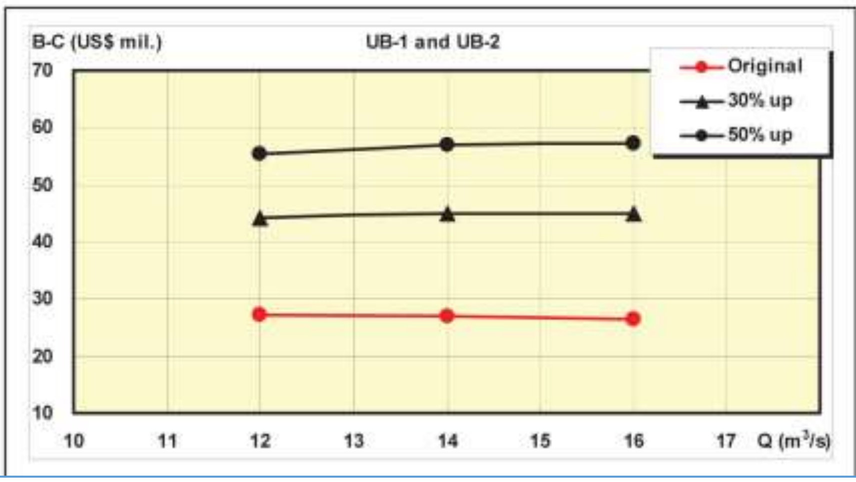


Figure 3.4.2-1: Result of Optimization

The following points should be taken into account for the power optimization:

(1) Under the current fuel price level, the net benefit will be maximized when power plant discharge of 14 m^3/s is applied. However, the differences are nominal.

(2) Assuming the fuel price on the upward trend, the optimum plant discharge will become larger.

(3) On the other hand, smaller plant discharge will give higher EIRR.

(4) It may be assessed that share of the fixed cost including that for the intake dam and waterway excavation, which is not affected directly by the plant discharge, is relatively large in the cost side, while the energy increase by applying larger plant discharge is not so significant in the benefit side, as shown in Figure 3.4.2-2.

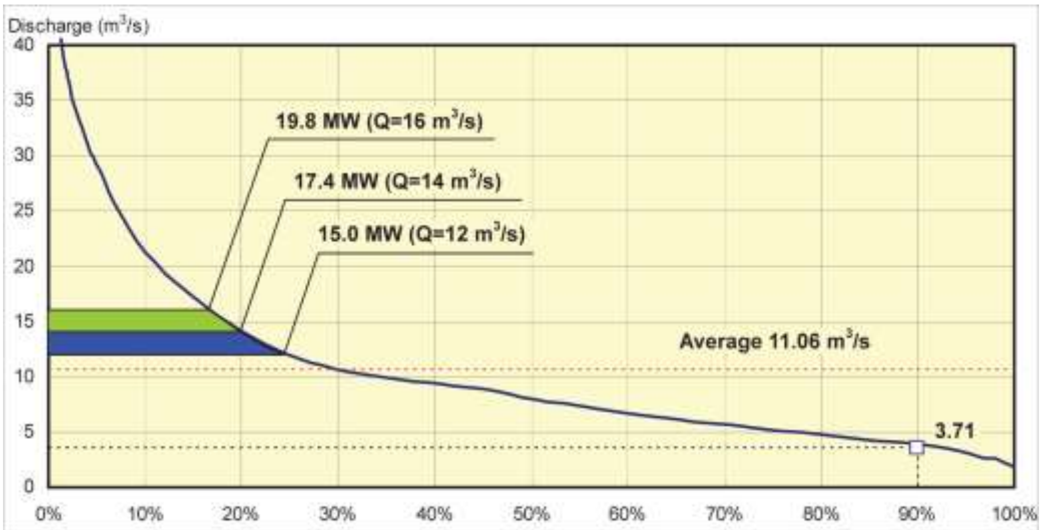


Figure 3.4.2-2: Energy Increase by Plant Discharge.

(5) Judging from the above considerations, the optimum range of power discharge will be between 14 and 16 m^3/s. It is concluded that the plant discharge of 16 m^3/s should be selected taking into account the upward trend of the fuel price.

(6) For estimating the annual energy, a combined efficiency of 85% was applied taking into account abrasion of the equipment after commercial operation during its lifetime, in which the maximum power output is 19.8 MW for UB-1 and 9.8 MW for UB-2, when the maximum plant discharge is 16 m^3/s. On the other hand, it is realistic and reasonable to apply a combined efficiency of 88% for 5 – 10 MW/unit class generating equipment as part of the specifications for fabricating the machine. Consequently, the installed capacity is determined to be 20.4 MW for UB-1, and 10.0 MW for UB-2.

3.4.3 Cost

Condition for Estimate

- Total implementation period is three years including the preparatory works. Net construction period is 31 months for UB-2 and 29 months for UB-1.
- Construction costs are estimated based on the basic design and relevant work quantities calculated, cost data collected and analyzed in the field survey, and the construction plan and schedule
- Costs (in US$) are estimated for the following items:

  1) Direct construction cost

     - Preparatory works
     - Civil works
     - Hydro-mechanical works
     - Transmission and distribution lines
     - Telecommunication system

  2) Administration services cost
  3) Engineering services cost
  4) Physical contingency
  5) Fiscal year starts from April and ends in March.

- Fiscal year starts from April and ends in March.
- Exchange rate : Kyats 1,000 = US$ 1.0
- Base year for the cost estimate is in April 2010.
- The costs of access roads and base camp are estimated by NEO, and 50% each for preparatory works is allocated for UB-1 and UB-2, respectively.
- For estimates of the unit construction cost applied for each work item, the following project samples were referred to:
  - Heho Hydropower Project, Myanmar, 2002
  - Keng Tawng Hydropower Project, Myanmar, 2008
  - Moragahakanda Dam Project, Sri Lanka, 2010
  - Nam Ngum-1 Power Station Expansion Project, Laos, 2009
  - Nam Lik 1 Hydropower Project, Laos, 2008
  - Asahan 3 Hydropower Project, Idonesia, 2008

- Costs for hydro-mechanical and electro-mechanical equipment are estimated on the basis of the consultant's database in relation to recent international bid prices in similar projects.
- Administration cost of NEO is estimated at 2.5% of direct construction cost based on the consultant's experience.
- Engineering services cost for consultant (which covers feasibility study, basic design, tender documents preparation, construction supervision and environmental management) is estimated at 7% of direct construction cost based on the consultant's experience.
- Physical contingency is estimated at 10% and 5% for civil works and H&M works, respectively.
- No price contingency is included taking into account the short construction period of two years.

3.4.3.1 Financial Cost for the Project

The summary of the financial and direct construction cost is shown in Table 3.4.3.1-1.

Table 3.4.3.1-1: Construction Cost

Item No.		Cost items	UB-1 Cost	UB-2 Cost	Total, UB-1 + UB-2
			(US$)	(US$)	(US$)
A	Direct Construction Cost				
	I	Preparatory Works	750,040	750,040	1,500,080
	II	Environmental Mitigation Cost	163,407	72,429	235,835
	III	Civil works	16,340,683	7,242,853	23,583,536
	IV	Hydro mechanical Equipment Works	1,919,828	450,855	2,370,683
	V	Generating Equipment Works	9,587,000	6,728,000	16,315,000
	VI	Transmission line, switchgear, and D/lin	979,400	0	979,400
	VII	Telecommunication System	40,000	10,000	50,000
	Sub Total		2,829,134	1,449,147	4,278,281
B	Administration and Engineering cost				
	I	Administration Cost <1	744,509	381,354	1,125,863
	II	Engineering Services Cost <2	2,084,625	1,067,792	3,152,417
	Sub Total		2,829,134	1,449,147	4,278,281
C	Contingency				
	I	Physical Contingency <3	2,351,724	1,165,975	3,517,699
	Total, A+B+C		**34,961,216**	**17,869,298**	**52,830,514**

Note <1 2.5 % of direct construction cost

<2 7% of direct construction cost to cover for detail design, preparation of tender documents and construction supervision

<3 10 % of total cost of item no. A-1, II, III, and 5 % item no. A-IV, V, VI VII as physical contingency US$ 1.0 = Kyats 1,000

3.5 Basic Design

3.5.1 Main Civil Works of UB-1

3.5.1.1 Intake Weir

(1) Hydraulic Features

The full supply water level (FSWL) at UB-1 intake weir is selected at EL. 1,140.00 m in order to accommodate the waterway within a workable range along the cliff at the left bank as explained in Section 4.2.1. On the other hand, the foundation rock was confirmed through core drilling no. BH-5 at around EL. 1,105 m in the middle of the river. Consequently, the intake weir will be 35 m high with concrete volume of 42,000 m^3. However, it is important to note that the intake weir is designed without having reservoir capacity, but to function as a weir in order to take the river flow under run-of-river scheme.

Hydraulic features of the intake weir were designed through the following concepts:

Table 3.5.1.1-1: Hydraulic Features for UB-1 Intake Weir

No.	Facilities	Description
1	Spillway	Design Flood of 440 m^3/s (1/100 year) to be released through the overflow weir section of 40 m wide on EL. 1,140 m.
		1/1,000-year flood of 1,415 m^3/s to be released through: 1) the overflow weir section, 2) both abutments on EL. 1,143 m, and 3) Sand Flush Gate of 3.2m square.
		The top level of the intake facilities is set at EL. 1,145.0 m not to be inundated when 1/1,000-year flood occurs.
2	Stilling Basin	The stilling basin with a roller bucket is designed applying 1/100-year flood of 440 m^3/s to dissipate its energy safely.
		The side walls are provided to pass the peak flood of 440 m^3/s below the crest level at EL. 1,122 m.
3	Bottom Outlet	The bottom outlet is provided at EL. 1,125 m to lower the reservoir surface when such requirements arise.
		It will take about seven days to lower the reservoir water level from 1,140 m to 1,125 m, assuming an inflow of 4.7 m3/s (75% dependable discharge).
		The bottom outlet consists of φ 1,000 jet flow gate and guard gate. The operation is made at the downstream face of the intake dam.

4	Sand Flush Gate	The sand flush gate is provided at around EL. 1,134 m to remove the sediment deposited upstream of the intake.
		The sand flush gate consists of a 3.2 m wide x 6.5 m high gate and a stop-log.

The reservoir volume and area curves are given in Figure 5.1.1. Assuming sediment yield of 121 m^3/km^2 /year and sediment trap ratio of 0.91 %, it will take 18.7 years for the sediment level to reach FSWL of 1,140.0m.

(2) River Diversion

For the river diversion during construction, a two-stage diversion system is applied, consisting of: 1) the upstream cofferdam with crest EL. 1,124.2 m and 4.2 m high embankment with random materials, 2) first stage river diversion channel on the right bank, and 3) temporary river diversion conduit with 3.0 m square provided at EL. 1,120 m in the left side of the weir body, as shown on the relevant drawings. A two-year design flood, with peak discharge of 42 m^3/s during the dry season, is applied for the river diversion system. It means that overtopping on the concrete surface should be allowed during the wet season. The concrete lift schedule should be prepared in the detailed design stage in order to minimize the risk against overtopping. After the completion of the diversion work, a stoplog will be lifted down along the upstream face from the weir crest by a truck crane, and the conduit will be plugged with concrete in a span length of 17.5 m.

(3) Stability of Intake Weir

The stability of the intake weir was analyzed in which several properties were assumed as shown in Table 3.5.1.1.2. However, it is important to note that the in-site test should be carried out at the detailed design stage of the Project in order to determine the shear strength and internal friction angle of the foundation rock.

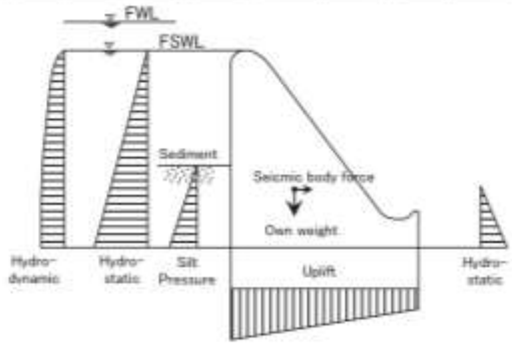
Table 3.5.1.1-2: Stability Analysis of UB-1 Intake Weir

Conditions

Section Name		Spillway Overflow Sectio	
Water Level			
	Full Supply Water Level	FSL	1140.00
	Design Flood Water Level (FWL)	FWL	1143.00
Dam Propaties			
	Top of Triangle	TPEL	1145.00
	Crest Level	TEL	1140.00
	Upstream Base Level	DZEL	1105.00
	Downstream Base Level	DKEL	1105.00
	Base Deepest Level	ZEDL	1105.00
	Upstream slope factor	n	1 : 0.00
	Downstream slope factor	m	1 : 0.80
	Fillet Slope factor	nf	1 : 0.00
	Top of fillet	FEL	1105.00
	Crest Width	TB	4.00
Design Propaties for Stability Calculation			
	Sedimendation Water Level	SDL	1120.00
	Wave Run-up Height	WDH	0.00
	Wave Height due to earthquake	edh	0.00
	Tail Water Level	TWL	1121.30
	Coefficient of Earthquake	k	0.15
	Coeffcient of Earth Pressure	CE	1.00
Other Structure			
Rock Conditions			
	Internal friction angle of rock mass	ϕ =	45
	Shear strength of rock mass	τ_0=	200
		qa =	200
Material Conditions			
	Concrete Unit Weight	WC	2.30
	Water Unit Weight	WW	1.00
	Sedimentation Unit Weight	WS	1.00

Results

Item	Case			
	Case 1(at FSL)	Case 2 (at FSL+EQ)	Case 3 (at FWL)	Case 4 (at Empty)
Weight (t)	1,527.4	1,527.4	1,555.3	1,449.0
Water pressure (t)	514.5	514.5	451.8	0.0
Seismic force (t)	0.0	217.4	0.0	-108.7
Dynamic w/p (t)	0.0	107.2	0.0	0.0
Silt pressure (t)	112.5	112.5	112.5	112.5
Uplift (t)	-560.0	-560.0	-637.3	-373.3
Total V (t)	967.4	967.4	917.9	1,075.7
Total H (t)	627.0	951.5	564.3	3.8
Total M (t/m)	16,317.8	20,636.0	14,824.0	14,824.0
1) Sliding (>4)				
Safety factor	**11.8**	**7.7**	**13.0**	**1954.4**
check	OK	OK	OK	OK
2) Overturning				
e (m)	**-0.868**	**-5.331**	**-0.944**	**2.219**
L/6 or L/3 (m)	5.333	10.667	5.333	10.667
check	OK	OK	OK	OK
3) Bearing Stress				
q1(t/m2)	**25.311**	**0.013**	**23.608**	**47.601**
q2 (t/m2)	**35.151**	**60.449**	**33.763**	**19.629**
qa (t/m2)	200.000	200.000	200.000	200.000
check	OK	OK	OK	OK



(4) Countermeasure Against Potential Leakage

One of the major risks involved in the intake weir is potential leakage through caves and/or large cavities/openings that are developed on the limestone layers upstream of No.1 Intake. Therefore, soil blanket work using clay materials is essential to minimize leakage, in which the riverbed and both banks are layered in order to cover cavities/openings. It is planned that the blanket should be applied in the river stretch which is approximately 700 m upstream the intake weir. This will require 130,000 m^3 of clay materials for UB-1. Instead, curtain grouting at the intake weir can be omitted.

The Intake weir design including general plan, upstream elevation, overflow sections, cross sections and joint details is shown in Appendix-2.

3.5.1.2 Waterway

(1) Comparison with Tunnel Waterway

Taking into account topographic features along both banks, the waterway route for UB-1 should be on the left bank and UB-2 on the right bank. Also, whether an open channel or a tunnel is selected was not taken into account.

In addition to construction costs and when considering tunneling works, it is required to examine a lot of factors such as tunnel experiences in Myanmar, procurement of civil works under LCB, necessity for import of tunneling equipment including steel forms from foreign markets, parallel construction with UB-2, additional core boring along the tunnel route, etc. In excavating a tunnel of this scale, it will take 20 months for UB-1 if a progress rate of 50 m/month from both sides of the portal is assumed.

An open channel waterway was selected from the considerations above.

(2) Power Intake

The power intake is designed to smoothly take the maximum river flow of 16 m^3/s and lead the water to the waterway, for which the velocity should be controlled at around 0.5 m/s. Skimmer wall is placed at the entrance to block drift woods or floating debris from entering. In addition, trash-racks are installed downstream. The river outlet valve with φ 400 mm is provided to release a river maintenance flow of 0.5 m^3/s into the river.

The water taken from the power intake flows through the intake channel with 3.2 m (width) x 4.0 m (height) x 76 m (length) culvert, and then reach the sand settling basin. The sand settling basin has the following functions: 1) to enable sediment grain size larger than 1 mm to settle, and 2) to spill excessive discharge entering into the waterway during a flood. The designed dimensions are 12 m (width) by 4.5 m (depth), which control flow velocity below 0.3 m/s in order to settle sediments with the target grain size.

When the reservoir surface rises up to FWL 1,143.0 m, excessive water that will enter the intake is estimated at about 30 m^3/s, which will then be discharged over the side spillway provided along the sand settling basin. The required crest length of the side spillway is estimated at 47 m in order to spill 30 m^3/s, with overflow depth of 0.5 m. A sand drain gate of 1 m^2 is provided in order to flush sediments that were deposited in the basin.

The necessity for the sand settling basin may be argued since most of the harmful sediments may be deposited in the reservoir. However, the sediment level is assumed to reach the FSWL after 18 years of operation, and therefore the sand settling basin was planned to be provided at this stage.

It is therefore recommended to investigate grain sizes in the river water particularly during the wet season for further assessment.

Table 3.5.1.2-1: Hydraulic Features of Sand Settling Basin

Parameters:	Unit	Value	Criteria	Judge
Discharge (Q)	m^3/s	16.00		
Excessive discharge during flood (Qf)	m^3/s	30.00		
Length of basin	m	27.00		
Width of basin	m	12.00		
Water depth on average (H)	m	4.50		
Overflow depth on crest of side spillway (h)	m	0.50		
Max. velocity in the basin (u)	m/s	0.30	< 0.3 m/s	OK
Sedimentation rate (vg)	m/s	0.10	< 0.1 m/s	OK
Required length of the basin (L)	m	26.67	> 2 x H x u/vg	OK
Required length of side spillway (B)	m	46.12	$Qf = 1.84 \times B \times h^{1.5}$	

(3) Headrace Channel

It is shown in Table 5.1.5 that the energy head is 3.083 m (=2.935 + 0.148) even if the roughness coefficient is at a level of 0.019. Finally, the UB-1 headrace channel was designed to run the power water in a uniform flow condition, with dimensions of 3.2 m (width) x 3.2 m (height) x 2,518 m (length).

Box culvert type waterway is applied in the section at relatively steep slope wherein falling debris may be anticipated. Meanwhile, open channel type waterway is suitable for sections at flat areas. An access road of 4 m width is provided along the waterway for construction and maintenance purposes. The typical sections of waterways are shown in Figure 3.5.1.2-1.

Cross drains (as shown in Figure 3.5.1.2-1) should be provided at the section crossing a valley wherein flood and/or debris flows during rainfall.

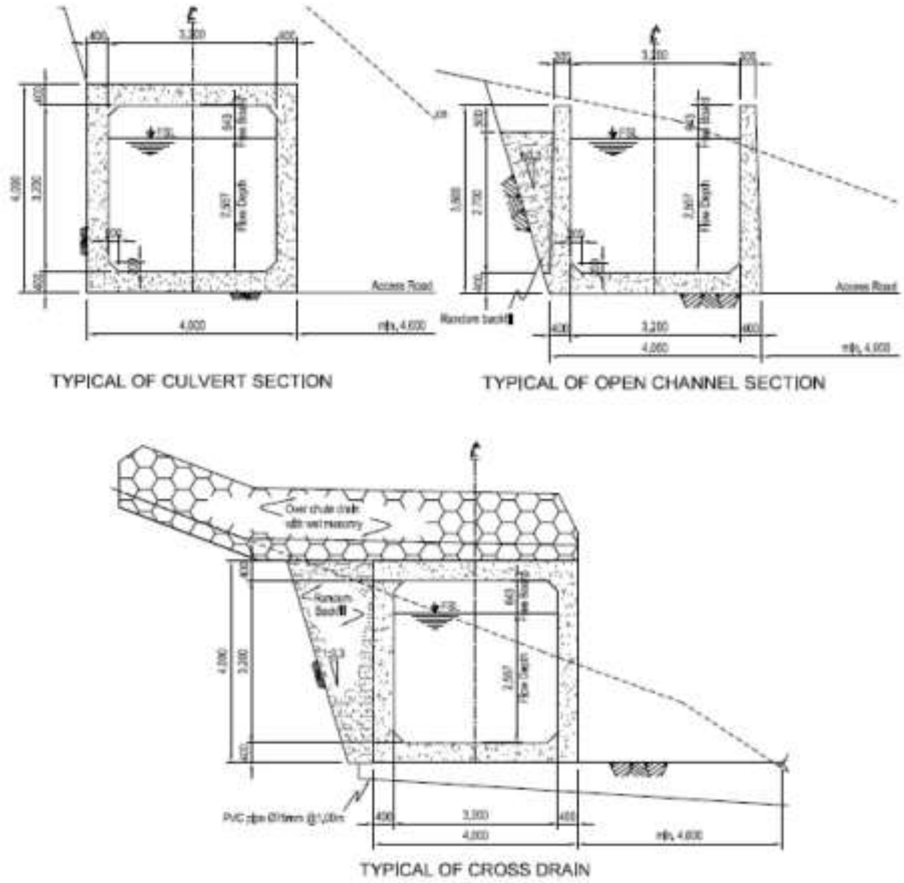


Figure 3.5.1.2-1: Typical Water Sections

(4) Head Tank

The head tank with dimensions of 8 m (width) x 6 m (depth) x 40 m (length) is provided as a terminal structure of the open channel waterway to connect with the steel penstock under pressure flow condition. It has three functions: 1) to divert the flow in case of load rejection, 2) to supply emergency water in case of unexpected lowering of water level, and 3) to serve as a sand trap basin.

The head tank should have sufficient capacity to supply water within the time that generating equipment can complete its stopping operation in response to abnormal drawdown of water level in the waterway. Dimensions required for the head tank were determined as shown in Table 3.5.1.2-2.

Table 3.5.1.2-2Requirements for Head Tank (UB-1)

Item	Unit	Value	Criteria
FSWL	m	1,137.00	
Width	m	8.00	
Length	m	40.00	
Area	m^2	320.00	> 10 x Q (rule of thumb)
Drawdown for 1st warning	m	3.00	within 60 secs for normal stop

Drawdown for 2nd warning	m	1.00	within 20 secs for quick stop
Drawdown for emergency	m	2.00	within 40 secs for emergency stop
1st warning level	m	1,134.00	
2nd warning level	m	1,136.00	
Emergency level	m	1,135.00	

3.5.1.3 Steel Penstock

One lane of steel penstock is provided along the ridge behind the head tank, and bifurcates into two branch pipes in front of the powerhouse. The steel penstock is of exposed type with 265 m (length) x ID 2.8m ~ 1.1m, which is supported by four anchor blocks and rocker type ring girders at 18-m intervals.

Water hammer analysis shows a 48% pressure rise on the static pressure head at the turbine under the conditions of full load rejection, assuming a closing time of 3.0 sec.

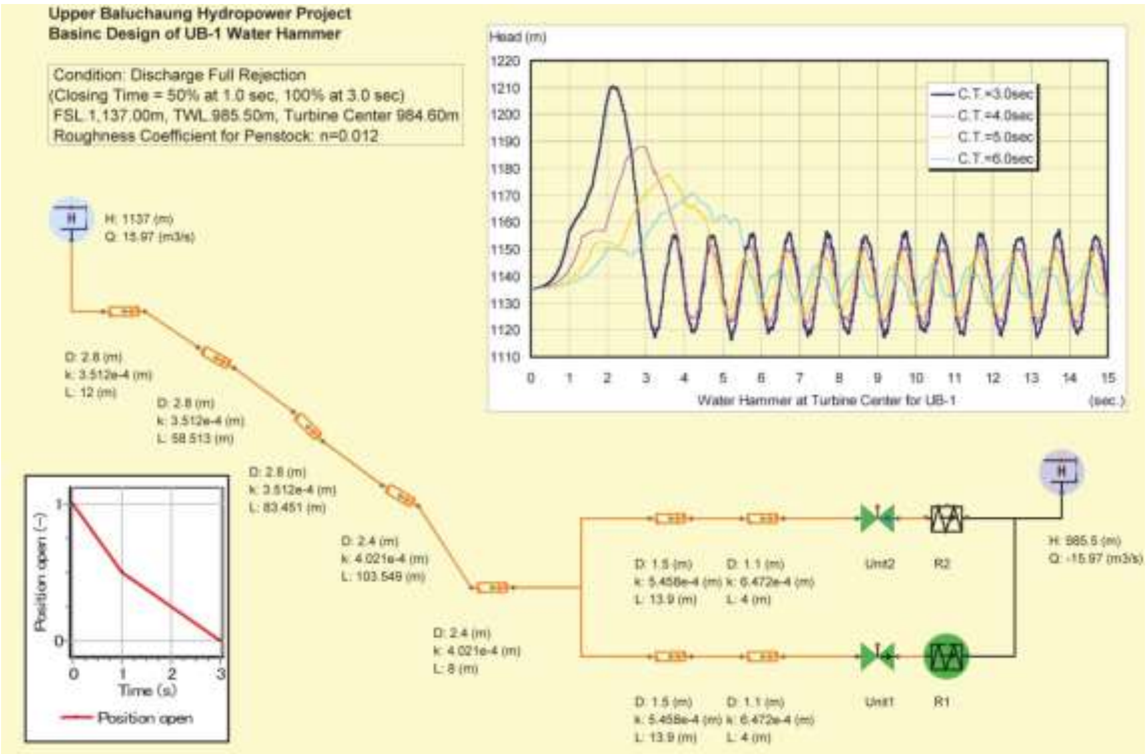


Figure 3.5.1.3-1: Water Hammer Analysis (UB-1)

3.5.1.4 Powerhouse

Powerhouse No.1 is located at the bottom of the penstock slope which faces the left bank of Upper Baluchaung. The powerhouse was designed to accommodate two units of generating equipment including vertical-shaft Francis turbines with installed capacity of 20.4 MW (10.2 MW x 2). The TWL was set at EL. 985.5 m from the existing river water level, based on which the turbine center level at EL. 985.0 m and the powerhouse yard at EL.995.8 m were determined. Figure 3.5.1.4-1 shows the rating curve at the estimated tailrace by applying non-uniform flow analysis downstream of the UB-1 powerhouse. As shown in the rating curve, the powerhouse yard will not be inundated even if a 1/1,000-year flood occurs.

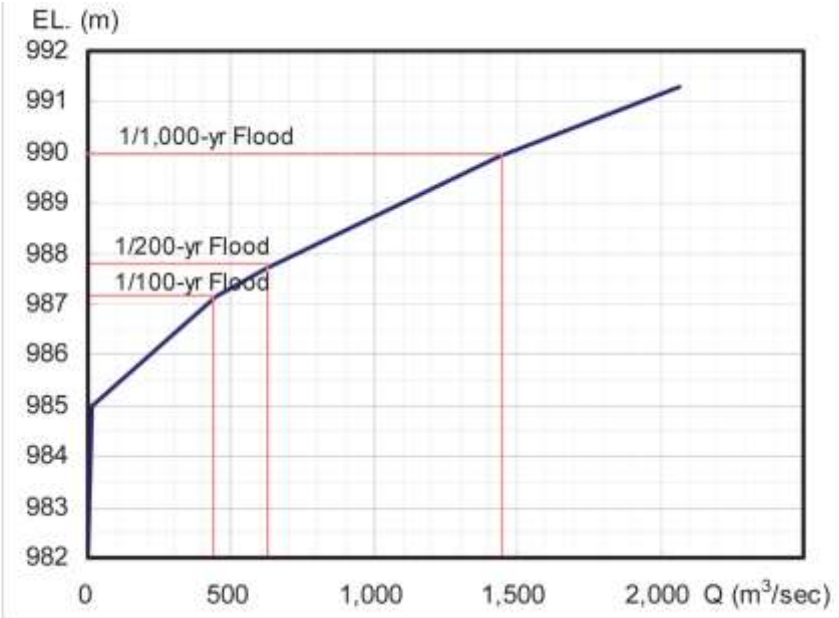


Figure 3.5.1.4-1: Rating Curve at UB-1 Tailrace

Dimensions of the powerhouse are 18.5 m (width) x 34.4 m (length) x 24.3 m (height). The powerhouse building is structurally split into two parts: 1) sub-structure below EL. 996.0 m, and 2) super-structure above EL. 996.0 m. The sub-structure is made of reinforced concrete in terms of structural requirements and water-tightness. On the other hand, H-beam frame structure is applied to the super-structure in order to enable earlier installation of the overhead traveling crane which will be along the critical path of powerhouse construction and erection of generating equipment.

The outdoor switchyard is located about 50 m downstream of the powerhouse. A conventional type of switchgear is arranged in the yard at 40.7 m x 36.5 m on EL. 992.0 m.

3.5.2 Main Civil Works of UB-2

3.5.2.1 Intake Weir

(1) General

Two options are conceived for the intake facilities of UB-2. One option is to utilize independent intake structures such as intake weir, power intake and sand settling basin in order to take power water released from UB-1 Powerhouse and the river flow. The other option is the direct connection of UB-1 tailrace with UB-2 waterway by construction of culvert and open channel.

Both designs are explained hereunder to compare their costs, schedules, etc., which are related to the construction of the final selection. The basic concept of UB-2 Intake Weir is shown in Figure 3.5.2.1-1.

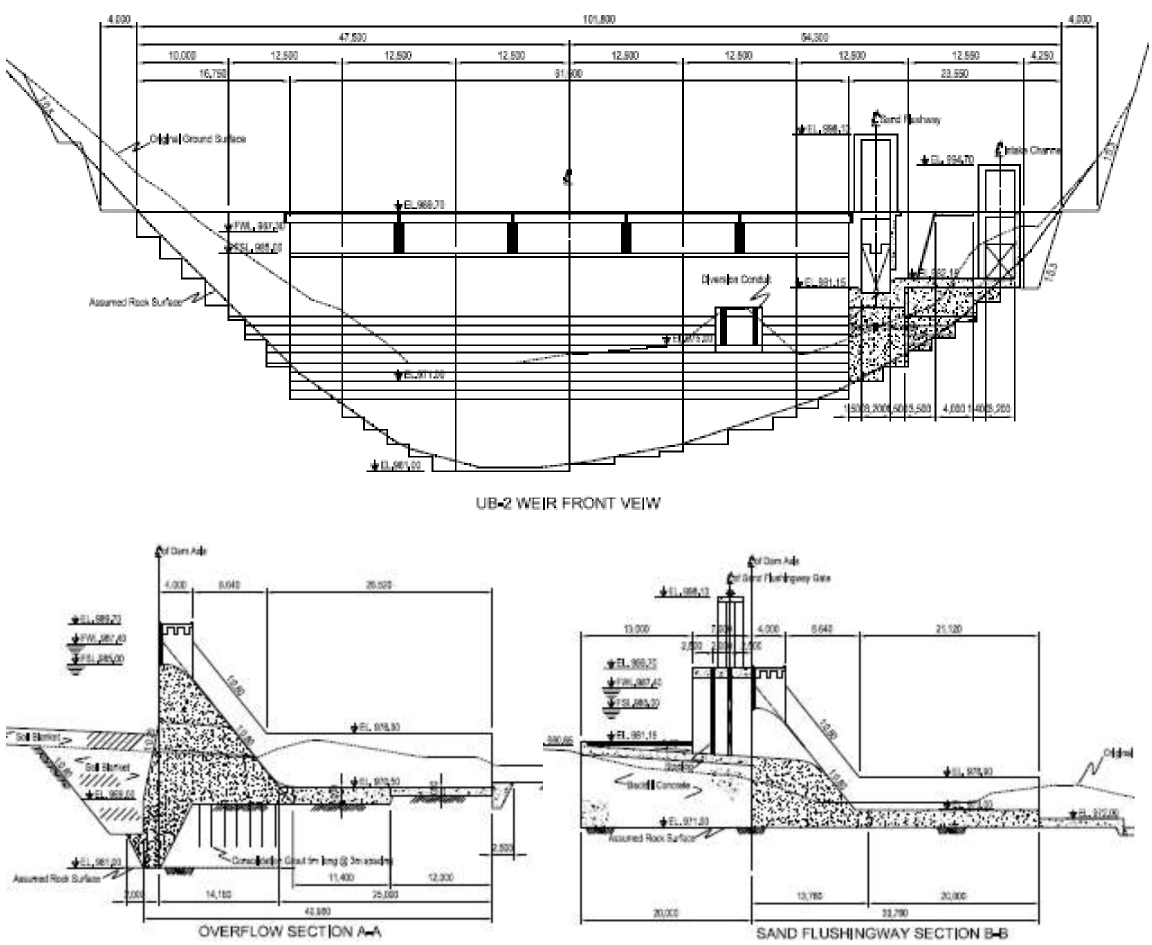


Figure 3.5.2.1-1 **The basic concept of UB-2 Intake Weir**

(2) Hydraulic Features

The FSWL at UB-2 Intake Weir is selected at EL. 985.00 m in order to minimize the head loss for a distance of 700 m between UB-1 tailrace and UB-2 intake. On the other hand, foundation rock was confirmed through core drilling (No. BH-1) at around EL. 961 m in the middle of the river.

It is assessed that the foundation of river deposit can bear a concrete weir with height of 15-16 m; however the cut-off wall should be placed on the rock foundation at EL. 961 m in order to secure water-tightness against seepage through the river deposit. In addition, soil blanket is required in the river section between UB-1 tailrace and UB-2 Intake Weir, similarly to UB-1 reservoir. Consequently, the intake weir will be 24 m high, which includes the cut-off wall portion and 16 m height on the river deposit foundation.

The hydraulic features of the intake weir were designed through the concepts as shown in Table 3.5.2.1-1.

Table 3.5.2.1-1: Hydraulic Features for UB-2 Intake Weir

No	Facilities	Description
1	Spillway	Design Flood of 451 m^3/s (1/100 year) to be released through the overflow weir section of 57.5 m wide (= 11.5m x 5 spans) on EL. 985 m, keeping a freeboard of 1.5 m below the bridge.
		1/200-year flood of 625 m^3/s to be released through: 1) the overflow weir section, and 2) Sand Flush Gate of 3.2 m square.
		The top level of the intake facilities is set at EL. 989.7 m not to be inundated when 1/200-year flood occurs.
2	Stilling Basin	The stilling basin with concrete apron is designed applying a 1/100-year flood of 451 m^3/s to dissipate its energy safely.
		A 25-m long concrete apron is provided for the section where the hydraulic jump occurs.
3	Sand Flush Gate	The sand flush gate is provided at around EL. 980 m to remove the sediment deposited upstream of the intake.
		The sand flush gate consists of a 3.2 m wide x 6.5 m high gate and a stop-log.

(3) River Diversion

For river diversion during the construction, a two-stage diversion system was planned. This system consists of the following: 1) upstream cofferdam, 2) first stage river diversion channel on the left bank, and 3) temporary river diversion conduit with 3.0 m square provided at EL. 975 m in the right-side weir body, as shown on the relevant drawings. The two-year flood design with peak discharge of 42 m^3/s during the dry season was applied for the river diversion system. It means that overtopping on the concrete surface should be allowed during the wet season; the concrete lift schedule should be prepared in the detailed design stage in order to minimize the risk of overtopping. After the completion of the diversion work, the conduit will be plugged with concrete.

(4) Stability of Intake Weir

Stability of the intake weir was analyzed by assuming several properties as shown in Table 3.5.2.1-2.

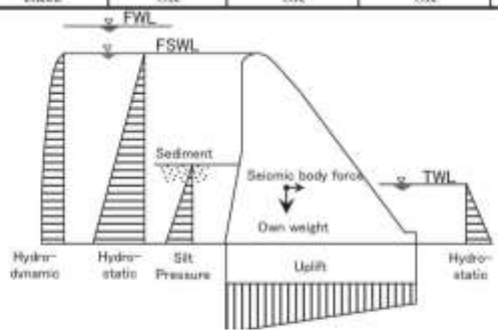
Table 3.5.2.1-2 Stability Analysis of UB-2 Intake Weir

Conditions

Section Name		Spillway Overflow Section	
Water Level			
	Full Supply Water Level	FSL	985.00
	Design Flood Water Level (FWL)	FWL	987.70
Dam Propaties			
	Top of Triangle	TPEL	988.00
	Crest Level	TEL	985.00
	Upstream Base Level	DZEL	969.00
	Downstream Base Level	DKEL	969.00
	Base Deepest Level	ZEDL	969.00
	Upstream slope factor	n	1 : 0.00
	Downstream slope factor	m	1 : 0.80
	Fillet Slope factor	nf	1 : 0.20
	Top of fillet	FEL	978.00
	Crest Width	TB	2.56
Design Propaties for Stability Calculation			
	Sedimendation Water Level	SDL	975.00
	Wave Run-up Height	WDH	0.00
	Wave Height due to earthquake	edh	0.00
	Tail Water Level	TWL	971.00
	Coefficient of Earthquake	k	0.15
	Coefficient of Earth Pressure	CE	1.00
Rock Conditions			
	Internal friction angle of rock mass	ϕ=	25
	Shear strength of rock mass	τ_0=	30
		qa =	50
Material Conditions			
	Concrete Unit Weight	WC	2.30
	Water Unit Weight	WW	1.00
	Sedimrntation Unit Weight	WS	1.00

Results

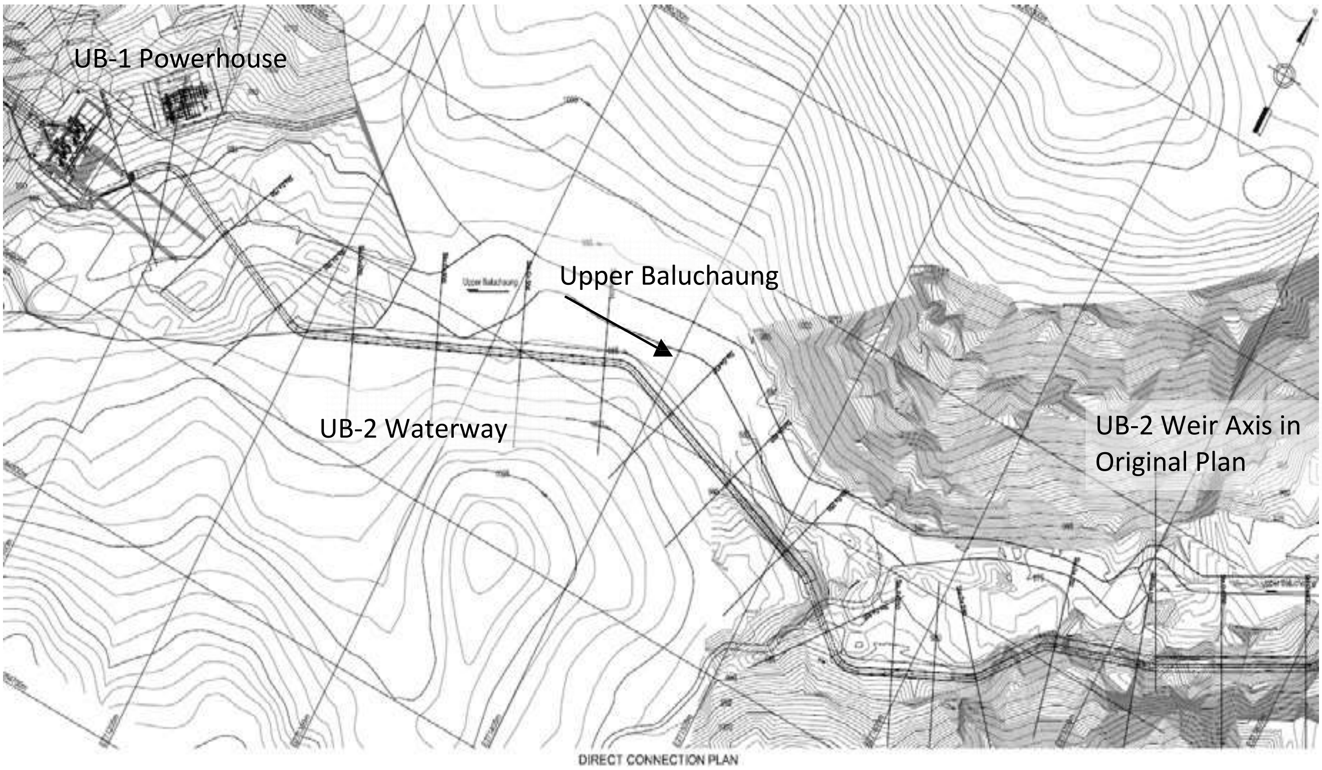
Item	Case			
	Case 1(at FSL)	Case 2 (at FSL+EQ)	Case 3 (at FWL)	Case 4 (at Empty)
Weight (t)	372.7	372.7	373.9	348.4
Water pressure (t)	128.0	128.0	169.2	0.0
Dynamic w/p (t)	0.0	22.4	0.0	0.0
Seismic force (t)	0.0	52.3	0.0	-26.1
Silt pressure (t)	18.0	18.0	18.0	18.0
Uplift (t)	-74.4	-74.4	-82.1	0.0
Total V (t)	298.3	298.3	295.4	352.0
Total H (t)	146.0	220.7	187.2	-8.1
Total M (t/m)	2,557.8	3,011.0	2,890.0	1,622.9
1) Sliding (>4)				
Safety factor	**7.9**	**5.2**	**6.1**	**146.2**
check	OK	OK	OK	OK
2) Overturning				
e (m)	**0.005**	**-1.514**	**-1.202**	**3.969**
L/6 or L/3 (m)	**2.860**	**5.720**	**2.860**	**5.720**
check	OK	OK	OK	OK
3) Bearing Stress				
q1(t/m2)	**17.414**	**8.181**	**9.981**	**48.974**
q2 (t/m2)	**17.353**	**26.585**	**24.452**	**-7.953**
qa (t/m2)	50.000	50.000	50.000	50.000
check	OK	OK	OK	OK

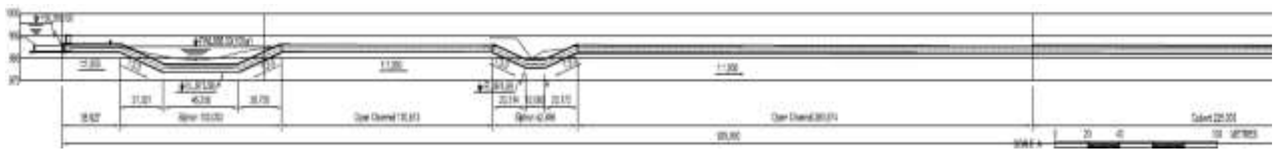


3.5.2.2 Direct Connection

This is an alternative plan to construct the waterway using box culvert and open channel in order to connect the UB-1 tailrace to UB-2 waterway without constructing UB-2 intake structures as shown on Figure 5.2.2. The independent intake option has an advantage when it comes to continuous power operation during suspension of UB-1. But on the other hand, geological investigation revealed that the rock foundation would be relatively deeper. Consequently, it will require a weir height of 24 m at the cut-off section, and 16 m on the river deposit foundation, which will lead to higher costs.

The direct connection plan is aimed at minimizing construction costs as well as the schedule. In addition, it will contribute to the improvement of the UB-2 scheme's financial feasibility, which is a bit lower than that of UB-1. It can omit the work items of intake weir, power intake, sand settling basin, related hydro-mechanical works, and the soil blanket upstream of UB-2. Instead, construction of the additional waterway, including an inverted siphon, open flume, and box culvert, should be added.





Profile of Waterway of Direct Connection of UB-1 and UB-2

Figure 3.5.2.2-1: Direct Connection of UB-1 and UB-2

The conceived alternative plans are:

Original plan: Construction of an intake weir, an intake, a sand settling basin in UB-2

Alternative-1 Direct connection between UB-1 tailrace and UB-2 headrace without a

φ1,050 mm bypass pipe

Alternative-2 Direct connection between UB-1 tailrace and UB-2 headrace with a φ1,050 mm bypass pipe and a jet flow gate branching from the UB-1 penstock to release 8 m3/s during maintenance of the UB-1 generating equipment.

The original and alternative plans were compared from the viewpoints of construction costs and power generation benefits, as follows:

(1) Construction cost

The construction costs of each alternative are shown in Table 3.5.2.2-1.

Table 3.5.2.2-1 Cost Comparison of Each Alternative

Unit (US$ million)

Item	Original	Alt-1 Direct Connection without	Alt-2 Direct Connection with
Total Cost of UB-2 including additional cost to UB-1 Powerhouse	22.39	17.87	19.09
Difference from Original		-4.52	-3.30

The difference between the original and alternative plans due to additional and cancelled works are tabulated below.

Table 3.5.2.2-2 Breakdown of Costs for Alternatives 1 & 2

Unit (US$ million)

No.	Item	Alt-1 Direct Connection without	Alt-2 Direct Connection with
A.	**Direct Construction Cost**		
II	Environmental Mitigation	-0.03	-0.03
III	Civil Works		
1&2	Intake weir	-4.03	-4.03
3	Waterway		
3.1A	Bypass in UB-1 Powerhouse	0.00	0.25
3.1	Intake	0.00	0.00
3.2	Headrace Channel	1.29	1.29
3.3	Sand Settling Basin and Spillway	-0.48	-0.48
	Total III	-3.23	-2.97
IV	Hydro-Mechanical Works		
	Bypass pipe in UB-1 Powerhouse	0.00	0.80
	Others	-0.55	-0.55
	Total IV	-0.55	0.25
	Total A.	**-3.81**	**-2.75**
B.	**Administration and Engineering Cost**	**-0.36**	**-0.26**
C.	**Contingency**	**-0.35**	**-0.29**
D.	**Grand Total**	**-4.52**	**-3.30**

The major cost differences from the original plan consist of the additional cost of the waterway between UB-1 powerhouse and UB-2 waterway and the bypass facility of UB-1 powerhouse, and the reduced cost of intake weir, sand settling basin and hydro-mechanical works (gates and trash racks) in UB-2.

(1) Power generation

The differences of head and power generation between the original and alternative plans are as follows:

Table 3.5.2.2-3 Hydraulic Features for Alternatives 1 & 2

Unit (US$ million)

Item	Original	Alt-1 Direct Connection without	Alt-2 Direct Connection with
Average River Flow (m^3/s)	11.34	11.06	same as Alt-1
FSL at Intake (EL.m)	985.00	985.00	same as Alt-1
FSL at Head pond (EL.m)	982.90	982.80	same as Alt-1
TWL at Tailrace (EL.m)	908.10	908.10	same as Alt-1
Gross head (m)	74.80	74.70	same as Alt-1
Effective head (m)	72.56	72.46	same as Alt-1
Installed Capacity (MW)	5.0 x 2 unit = 10.0	5.0 x 2 unit = 10.0	same as Alt-1
Annual Energy (GWh)	44.46	43.82	same as Alt-1

(2) Construction schedule of UB-1 and UB-2

There will be no difference between the total construction period of the original and alternative plans, because the critical path is on the UB-1 construction.

(3) Operational merit and demerit

The merits and demerits regarding the operation for each alternative are listed below in Table 3.5.2.2-4.

Table 3.5.2.2-4: Merit and Demerit on Operation for Each Alternative

Case	Original	Direct Connection	
		Alt-1 without Bypass	Alt-2 with Bypass
1. General	UB-2 can be operated independently from UB-1.	Operation of UB-2 depends on UB-1 discharge from turbines.	Operation of UB-2 depends on UB-1 discharge from turbines and
2. Accident on UB-1 waterway	UB-2 can be operated by directly taking water from the river released at	UB-2 cannot be operated.	UB-2 cannot be operated.
3. One unit of UB-1 under maintenance	UB-2 can be operated by directly taking water from the river released at UB-1 dam and turbine.	One unit of UB-2 will be operated by taking water released from UB-1 turbine.	Two units of UB-1 will be operated by taking water released from UB-1 turbine and bypass.
4. Delay of construction of UB-1 waterway	UB-2 can be operated by directly taking water from the river.	UB-2 cannot be operated until UB-1 is completed.	UB-2 cannot be operated until UB-1 is completed.
5. Delay of construction of UB-1 generators	UB-2 can be operated by directly taking water from the river.	UB-2 cannot be operated until UB-1 is completed.	One unit of UB-2 cannot be operated. One unit can be operated with the

Simplified operational merits and demits are shown below in Table 3.5.2.2-5.

Table 3.5.2.2-5: Evaluation for Each Alternative

Case	Original		Direct Connection			
			Alt-1 without Bypass		Alt-2 with Bypass	
	Unit-1	Unit-2	Unit-1	Unit-2	Unit-1	Unit-2
1. General	✔	✔	△	△	△	△
2. Accident on UB-1 waterway	✔	✔	X	X	X	X
3. One unit of UB-1 under maintenance	✔	✔	✔	X	✔	✔
4. Delay of construction of UB-1 waterway	✔	✔	X	X	X	X
5. Delay of construction of UB-1 generators	✔	✔	X	X	✔	✔

Legend; ✓: Operational, △: Operational subject to condition, X: Not operational

Note: Unit 1 and Unit 2 above are those of UB-2

(4) Financial evaluation

Financial evaluation of the original and alternative plans is made on B-C ratio and FIRR in cases of normal and other expected conditions listed below and shown in Figure 3.5.2.2-2.

- Case A Original Plan
- Case B Alt-1 without Bypass

Condition of UB-1 power generation

B0: Normal condition

B1: No operation due to minor accident in waterway for 10 days every year

B2: No operation due to serious accident in waterway for 90 days once in 20 years

B3: No operation of one unit for maintenance each for 12 days per year

B4: No operation due to delay of construction works for 6 months

B5: No operation due to delay of generating equipment installation works for 6 months

- Case C Alt-2 without Bypass

Condition of UB-1 power generation

C0: Normal condition

C1: No operation due to minor accident in waterway for 10 days every year

C2: No operation due to serious accident in waterway for 90 days once in 20 years

C3: No operation of one unit for maintenance each for 12 days per year

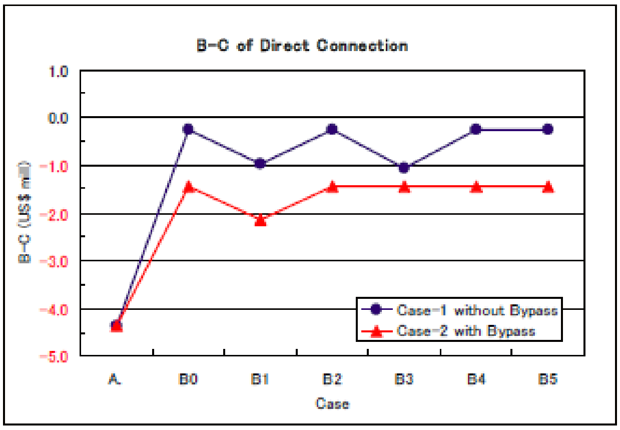
C4: No operation due to delay of construction works for 6 months

C5: No operation due to delay of generating equipment installation works for 6 months

The B-C ratio and FIRR evaluation in each case are shown in Table 3.5.2.2-6, Table 3.5.2.2-7, and Figure 3.5.2.2-3.

Table 3.5.2.2-6 B-C Ratio and FIRR of Original and Alternative Plans

Case	Condition	PV(B-C)(US$ million)			FIRR		
		Case A	Case B	Case C	Case A	Case B	Case C
		Original	Alt-1 without	Alt-1 with Bypass	Original	Alt-1 without	Alt-1 with Bypass
0	Original Design	-			6.91%		6.91%
1	Normal condition		-0.27	-1.44		8.78%	8.17%
2	No operation due to minor accident in waterway for 10 days every year		-0.98	-2.15		8.38%	7.78%
3	No operation due to serious accident in waterway for 90 days once 20 years		-0.27	-1.44		8.78%	8.17%
4	No operation of one unit for maintenance		-1.07	-1.44		8.33%	8.17%
5	No operation due to delay of construction		-0.27	-1.44		8.78%	8.17%
6	No operation due to delay of generating equipment installation works for 6 months		-0.27	-1.44		8.78%	8.17%



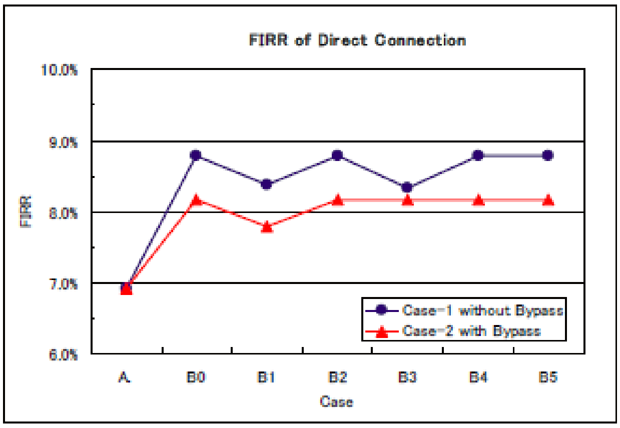


Figure 3.5.2.2-2: B-C and FIRR of Original and Alternative Plans

Table 3.5.2.2-7: B-C and FIRR for Alternative 1 & 2

Case B Direct Connection without Bypass

Case	Condition	UB-2 Operation	No operation (Days)	Frequency	Project Cost (US$ million)	Power (kW)	Energy (GWh/year)	Energy affected (GWh/year)	Energy loss (GWh/yr)	Sale loss (US$million)	PV (B-C) (US$million)	FIRR	Development cost (US$/kW)
A.	Original Design	2	0	0	22.39	9,671	44.46	44.46	0.00	0.00	-4.37	6.91	2,315
B0	Normal condition	2	0	0	17.87	9,657	43.82	43.82	0.00	0.00	-0.27	8.78	1,850
B1	No operation due to minor accident in waterway for 10 days every year	0	10	every year	17.87	9,657	43.82	41.98	-1.84	-0.09	-0.98	8.38 %	1,850
B2	No operation due to serious accident in waterway	0	90	20 years	17.87	9,657	43.82	32.38	-11.44	-0.57	-0.27	8.78	1,850
B3	No operation of one unit for maintenance each for 12 days per year	1	24	every year	17.87	9,657	43.82	41.74	-2.08	-0.10	-1.07	8.33 %	1,850
B4	No operation due to delay of construction works	0	0	1st year	17.87	9,657	43.82	43.82	0.00	0.00	-0.27	8.78	1,850
B5	No operation due to delay of generating equipment installation works for 6 months	0	0	1st year	17.87	9,657	43.82	43.82	0.00	0.00	-0.27	8.78 %	1,850

Case C Direct Connection with Bypass

Case	Condition	UB-2	No operation (Days)	Frequency	Project	Power	Energy (GWh/year)	Energy affected (GWh/year)	Energy loss	Sale loss	PV(B-C)	FIRR	Develop me nt cost (US$/kW
A	Original Design	2	0	0	22.39	9,671	44.46	44.46	0.00	0.00	-4.37	6.91%	2,31
C0	Normal condition	2	0	0	19.09	9,657	43.82	43.82	0.00	0.00	-1.44	8.17%	1,97
C1	No operation due to minor accident in waterway for 10 days every year	0	10	every year	19.09	9,657	43.82	41.98	-1.84	-0.09	-2.15	7.78%	1,97 7
C2	No operation due to serious accident in waterway	0	90	20 years	19.09	9,657	43.82	32.38	-11.44	-0.57	-1.44	8.17%	1,97
C3	No operation of one unit for maintenance each for 12 days per year	2	0	every year	19.09	9,657	43.82	43.82	0.00	0.00	-1.44	8.17%	1,97 7
C4	No operation due to delay of construction works	0	0	1st year	19.09	9,657	43.82	43.82	0.00	0.00	-1.44	8.17%	1,97
C5	No operation due to delay of generating equipment installation works for 6 months	0	0	1st year	19.09	9,657	43.82	43.82	0.00	0.00	-1.44	8.17%	1,97 7

The direct connection of UB-1 and UB-2 without bypass (Alternative-1) will have the following advantages:

- The Project cost will be reduced by US$4.52 million from the original plan, which is equivalent to 20% of the total original cost of UB-2.
- Financial status of UB-2 will be improved when Alternative-1 is adopted, in which FIRR is evaluated at 8.78% and WACC is at 8.93%.
- B-C will be balanced in Alternative-1, whilst it is US$-4.37 million in the original plan of UB-2.
- It is assessed that energy loss when power water is disrupted by accidents, maintenance, and/or delay of UB-1 commissioning, will not be so significant as compared with the merit for cost reduction.

Consequently, it is recommended that:

(1) Direct connection of UB-1 and UB-2 without bypass (Alternative-1) should be adopted instead of constructing UB-2 intake facilities.

(2) Subsequent preparation of tender documents and detailed design should follow Alternative-1.

(3) The topographic map with a scale of 1/500 should be prepared to enable the preparation of the detailed design.

3.5.2.3 Waterway, Penstock and Powerhouse

The basic concept and dimensions are the same as those of UB-1 waterway facilities. The specific features of UB-2 are summarized below.

The waterway route is located on relatively gentler slopes at the right bank, wherein debris and boulders together with the top soil are observed. Accordingly, it is considered that excavation works are relatively easier, but it will require more maintenance costs as compared with that of UB-1. Particularly, shoulders of the access road are likely to be eroded easily; therefore, protection by wet rubble masonry or gabion will be inevitable. Such works should be examined to select the suitable one in due course of the construction.

The steel penstock is of exposed type with 135 m (length) x ID 2.8m ~ 1.3m, which is supported by two anchor blocks and rocker type ring girders at 16.5 m intervals. Figure 3.5.2.3-1 shows water hammer analysis for UB-2 penstock (maximum pressure rise of 42% on the static pressure head at the turbine under the conditions of full load rejection, assuming a closing time of 3.0 sec.

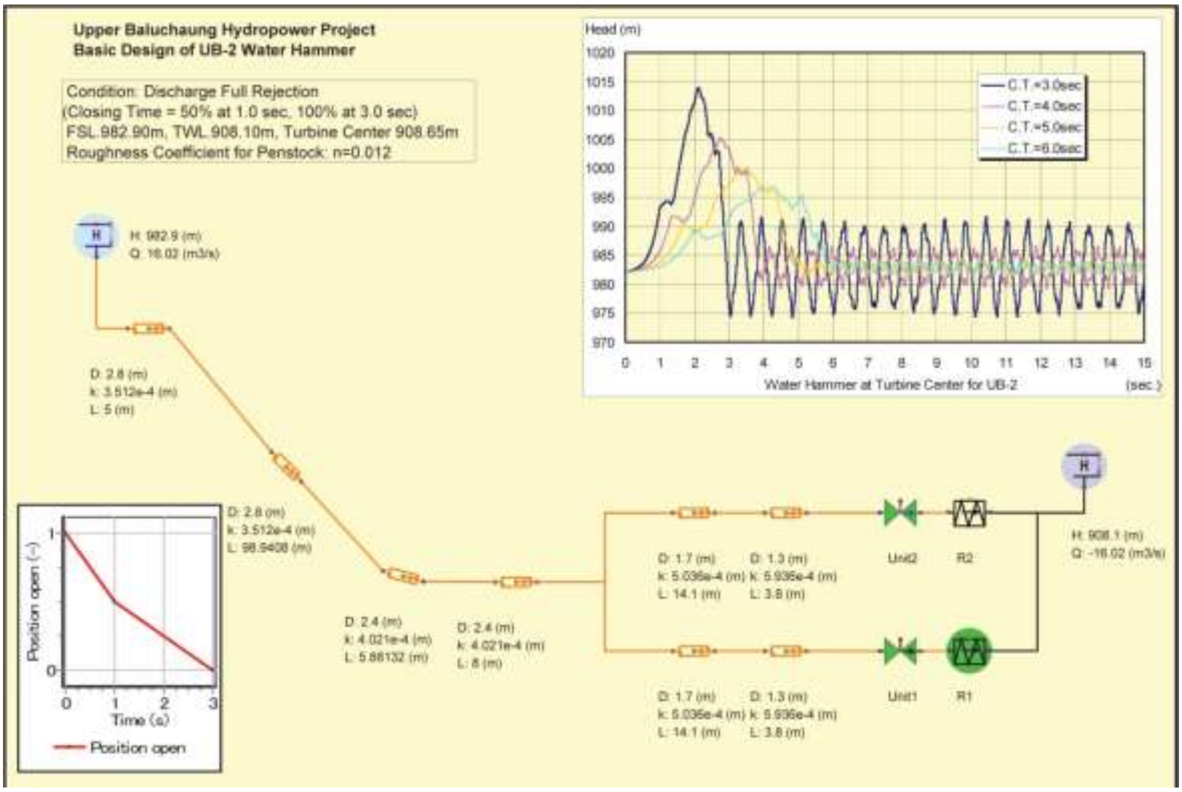


Figure 3.5.2.3-1: Water Hammer Analysis (UB-2)

The steel penstock is bent clockwise at anchor block no. 2 in order to accommodate the outdoor switchyard to fit the topography at the left side of the powerhouse.

Powerhouse No. 2 is located at 3.5.2.3-1the bottom of the penstock slope facing the right bank of Upper Baluchaung. The powerhouse yard level was determined at EL. 913.00 not to be inundated even if a 1/200-year flood occurs. Figure 3.5.2.3-2 shows the rating curve at the tailrace estimated by applying non-uniform flow analysis:

Figure 3.5.2.3-2: Rating Curve at UB-2 Tailrace

Powerhouse No.2 is located at the bottom of the penstock slope which faces the right bank of Upper Baluchaung. The powerhouse was designed to accommodate two units of generating equipment including horizontal-shaft Francis turbines with installed capacity of 10.0 MW (5.0 MW x 2). The TWL was set at EL. 908.1 m from the existing river water level, based on which the turbine center level at EL. 908.65 m and the powerhouse yard at EL.913.0 m was determined. Figure 5.2.6 shows the rating curve at the estimated tailrace by applying non-uniform flow analysis downstream of the UB-2 powerhouse. As shown in the rating curve, the powerhouse yard will not be inundated even if a 1/200-year flood occurs.

Dimensions of the powerhouse are 16.5 m (width) x 51.0 m (length) x 19.6 m (height). The powerhouse building is structurally split into two parts: 1) sub-structure below EL. 996.0 m, and 2) super-structure above EL. 996.0 m. The sub-structure is made of reinforced concrete in terms of structural requirements and water-tightness. On the other hand, H-beam frame structure is applied to the super-structure in order to enable earlier installation of the overhead traveling crane which will be along the critical path of powerhouse construction and erection of generating equipment.

The outdoor switchyard is located at the left side of the powerhouse. A conventional type of switchgear is arranged in the yard at 26.2 m x 20.0 m on EL. 913.0 m.

3.5.2.4 Hydro-Mechanical Equipment Works

The project, being a run-of-river type power development scheme, has principal features of hydro-mechanical equipment works (hereinafter HMW) to be provided at the intake weir, power intake, sand settling basin, head tank, steel penstock and powerhouse for UB-1 & UB-2. These are presented in

Table 3.5.2.4-1 (UB-1: Outline of Hydro-Mechanical Equipment Works) and Table 3.5.2.4-2 (UB-2: Outline of Hydro-Mechanical Equipment Works).

The following are brief explanations on providing the HMW at each structure, whilst Table 3.5.2.4-1 shows the design concept and outline for HMW of UB-1.

(1) UB-1 Intake Weir

- One sand flush gate (SFG), 3.2m (width) by 6.146 m (height), is provided to flush out sediments deposited in the reservoir. The gate has an overflow chute to flush out floating trash from the gate top. However, when water level rises further, the gate will be opened in order to control discharge under partial opening or eventually opened fully.
- One stop-log (SL) is provided in front of SFG for maintaining and/or repairing the said gate. This SL is utilized for power intake at UB-1 and UB-2, because their clear spans are unified as 3.2 m.
- One river discharge facility with internal diameter (ID) of 0.4 m is provided in order to supply maintenance river water of 0.5 m^3/s.
- One bottom outlet facility, with ID of 1.0 m, comprising main jet flow gate, guard gate and steel conduit, are provided to lower the reservoir water level when required. Inside of the steel conduit is stainless steel clad which is maintenance-free.
- One diversion closure gate with a 3.0 m square dimension is provided in order to commence impounding of the reservoir after completion.

(2) UB-1 Power Intake

- Two trash racks are provided in front of the power intake in order to prevent trash from entering the waterway.
- One trash raking equipment with a 1.70 m wide prong is provided at the power intake in order to rake trashes (in weight of 0.70 tons) at the intake trash rack surfaces. Raked trash are dropped on the belt conveyor beneath the rake body, and then brought up to the trash pit, wherein maintenance river water will be poured so as to flush these to downstream of the intake weir.
- One intake gate, 3.2 m (width) by 2.6 m (height), is provided at the power intake in order to control water flow (Q=16 m^3/s) into the waterway.
- One guide frame is provided in front of the intake gate to insert SL for maintenance.

(3) UB-1 Sand Settling Basin

- One sand drain gate with 1.0 m square is provided in order to remove sand deposited in the sand settling basin.
- Two trash-racks are provided in order to protect trash, persons or animals from dropping into the waterway.

(4) UB-1 Head Tank

- One sand drain gate with 1.0 m square is provided in order to remove sand deposited in the structure.
- Two trash-racks are provided in order to protect trash, persons or animals from dropping into the waterway.

(5) UB-1 Steel Penstock

- One lane of surface type steel penstock is provided between the head tank and powerhouse in order to flow a discharge of Q=16 m^3/s.
- The exposed type steel penstock will be supported mainly by rocker type ring girders at 18 m intervals.
- The penstock bifurcates to 2-branch pipes near the powerhouse.

(6) UB-1 Tailrace

- Two gates are provided at each tailrace outlet respectively, which are to be used for construction works, future maintenance of turbines, etc.
- These gates are handled by a monorail hoist hung beneath the monorail which is fixed to the powerhouse structure.

It is noted that the design concept and outline for HMW of UB-2 are similar to those of UB-1 as mentioned above, except for the following:

1) Equipment for intake facilities are not required for UB-2 since direct connection is applied, instead of provision of independent intake structures.
2) Supporting span of ring girders of the steel penstock will be at 16.5 m intervals in order to fit the profile of the penstock line.

It will be required to separately provide an 11-KV distribution line (D/L) along the access roads in order to supply electricity to each structure of each site. An emergency diesel engine-driven generator set will be better provided for UB-1 Power Intake in case the D/L fails to supply electricity due to some reason. Suitable communication means will be required between the power intake, sand trap basin, or head tank and powerhouse in order to operate and control HMW confidently and efficiently.

Table 3.5.2.4-1: UB-1: Outline of Hydro-Mechanical Equipment Works

No.	Particulars	Type	Q'ty (set or lot)	Clear Span (m)	Clear Height (m)	Design Head (m)	Driving Mechanism	Spec / Remarks
INTAKE DAM:								
1	Sand flush gate (SFG) and hoist	FWG (Fixed-wheel gate), having overflow chute and 3-corners front seal	1	3.2	6.146	6.146 (FSL 1140.0+1.0m-Sill 1134.854m)	Motorized wire-rope stationary hoist at Deck EL. 1153.1m.	(1) Overflow chute in 2.6m wide by 1.0m high at its top, to flush floating trashes at the fully closed position. (2) Gate will be operated partially when water level rises than FSL+1.0 m(overflow depth), and kept its
2	Stoplog for SFG	Slide type. comprising 4 pcs	1	3.2	6.0 (4 @ 1.5m H)	5.979 (FSL 1140+1.0-Sill 1135.021)	NA	(1) 1 set of stoplog comprising 4 pieces will be used for the Intake Gate in common, upon handling by a mobile truck crane. (2) This S/L is used for SFG/Intake of UBC No. 2, too. (3) Up to Deck EL. 1145.0m.
3	River discharge facilities	Steel pipe Discharge gate Steel pipe	1 1	ID 0.4 ID0.4 ID 0.6	L in 5m	5 ditto ditto	Driven by manual single-stem spindle hoist	(1) To discharge and regulate Q=0.5 cms, for river maintenance flow. (2) Cast iron-slide gate (3) Water intakes behind the Intake trashrack, and supplies up to trash disposal pit of the Intake raking
4	Bottom outlet facilities JFG: Jet flow gate HPSG: High pressure slide gate	Main: JFG Guard: HPSG Steel pipe+ inlet screen (pitch = 100	1 1 1	ID 1.0 ID 1.0 ID 1.0		18 ditto ditto	Motorized single-stem spindle hoist ditto	(1) Facilities provides in the valve chamber at EL 1125.0m, which locates at pipe-end part. (2) DH: FWL 1143 - Sill EL 1125.0m = 18.0m. (3) Requires 1 set of inlet screen (in rough mesh), to attach the bell-mouth at the pipe inlet.
5	Diversion closure gate	Slide gate Guide frame	1 1	3.0 3.0	3.0 Twice of gate's H	23.0 (under FWL)		(1) For commencing reservoir impounding, after completion. (2) Gate will be closed when river water surface is low, by means of truck crane, etc.
POWER INTAKE:								
6	Guide frame for Intake Stoplog	Guide frame	1	3.2	7.85	5.85 (under FWL 1143m)		(1) GF height = Deck EL. 1145m - Sill EL. 1137.15m = 7.85 m (2) Stoplog is brought from a storage pit near the Intake Dam.
7	Intake trashracks	Fixed type	2	5.0	8.127	3.0 in head difference	NA	Vertical H = 7.85 m, Slant= 75 deg., bar pitch = 75 mm
8	Intake trash raking system	Movable car type raking equipment, and conveyer system	1	Rake width 1.7m	NA	Capacity 0.7 ton	Mobile car type with conveyer, to suit to the Intake Trashracks	(1) Automatic and manual operation (2) Trashes raked by the raking equipment, will be dumped into the trash disposal pit, so as to return them into the Baluchaung river through power of river discharge water.
9	Intake gate and hoist	FWG, having 4-corners front seal	1	3.2	2.6	5.85 (FWL 1143.0-Sill 1137.15)	Wire rope-wound, stationary hoist at Deck EL. 1150.0m.	(1) To be capable of shutting off the full flow (Q=16 cms) by dead weight for emergency closure. <It abandons rack-type spindle hoist, considering a Chinese maker might be unable to timely supply>
SAND SETTLING BASIN:								
10	Sand drain gate (SDG) and hoist	FWG, having 4-corners front seal	1	1	1	5.512	Motorized single-stem spindle hoist at Deck EL. 1141.0m.	(1) Bottom window part to be clad by steel, due to sand flushing operation at 5.512m (under FSL 1139.7m-Sill 1134.188 m)
11	Inlet trashracks	Fixed type	2	5.5	3.934	1.5 in head difference	NA	Vertical H = 3.8 m, Slant= 75 deg., bar pitch = 150 mm
HEAD TANK:								
12	Sand drain gate (SDG) and hoist	FWG, having 4-corners front seal	1	1	1	8.418 (=1137-1128.582)	Motorized single-stem spindle hoist at Deck EL. 1138.0m.	(1) Bottom window part to be clad by steel, due to sand flushing operation at 9.0m (under FSL 1137m-Sill 1128.582 m)
13	Inlet trahracks	Fixed type	2	3.5	7.765	1.5 in head difference	NA	Vertical H = 7.5 m, 75 deg., Bar pitch = 150 mm

STEEL PENSTOCKS								
14	Steel penstocks	Surface type	1	Dia: 2.8 - 2.4 - 2.76 -	CL:278.3	DH: 236.22	NA	(1) SH=1137-985m=152.0m; Δh=55% =83.82m; Materials: 400N/mm^2 class (2) Y type bifurcation; Dia 2.76m
TAILRACE:								
15	Draft tube gate and monorail hoist	Slide gate type, handling by	2	3.0	1.9	5.7 (TWL 988.0m-Sill EL.	Monorail crane	2-gates for 2 guide frames, which are handled by a monorail crane

Table 3.5.2.4-2 UB-2: Outline of Hydro-Mechanical Equipment Works

No.	Particulars	Type	Q'ty (set or lot)	Clear Span (m)	Clear Height (m)	Design Head (m)	Driving Mechanism	Spec / Remarks
	POWER INTAKE:							
1	Intake trashracks	Fixed type	1	3.2	5.235	1.5 in head difference	NA	Vertical H = 5.057 m, Slant= 75 deg., bar pitch =150 mm
2	Intake gate and hoist	FWG, having 4-corners front seal	1	3.2	4.257	4.257 (FWL 987.2-Sill 982.943)	Wire rope-wound, stationary hoist at Deck EL. 993.0 m.	(1) To be capable of shutting off the full flow Q=16 cms by dead weight for emergency closure. <It abandons rack-type spindle hoist, considering a Chinese maker might be unable to timely supply>
	HEAD TANK							
5	Sand drain gate (SDG) and	FWG (Fixed-wheel gate),	1	1	1	8.4 (=FSL982.9 - Sill EL.	Motorized single-stem spindle	(1) Bottom window part to be clad by steel, due to sand flushing operation at 8.4m (under FSL 982.9m)
6	Inlet trahracks	Fixed type	2	3.5	7.765	1.5 in head difference	NA	Vertical H = 7.5 m, Slant= 75 deg., Bar pitch = 150 mm
	STEEL PENSTOCKS							
7	Steel penstocks	Surface type	1	Dia: 2.8 - 2.4 - 2.76 - 1.7	CL:135.0	DH: 117.6m	NA	(1) SH=982.9-907.1m=75.8m; Δh=55% = 41.7m; Materials: 400N/mm^2 class (2) Y type bifurcation; Dia 2.76m
	TAILRACE:							
8	Draft tube gates and monorail hoist	Slide gate type, transferring by a monorail crane	2	2.5	1.9	3.4 (=TWL908.1-Sill EL.904.7)	Monorail crane	2-gates for 2 guide frames, which are handled by a monorail crane

3.5.3 Generating Equipment

3.5.3.1 Power Station No.1

Basic design conditions of the generating equipment for UB-1 are summarized below:

- Full supply level of head tank : EL. 1137.00 m
- Minimum operating level : EL. 1136.50 m
- Maximum plant discharge : 16.0 m^3/sec (two units operation)
- Tailrace level for maximum plant discharge : EL. 985.50 m
- Rated head : 148.0 m

Two units of Francis turbines with vertical axis (FV type) were selected for UB-1 due to the following reasons:

1) In the initial stage of the feasibility study, the application of Francis turbine with horizontal axis (FH type) was considered as an option because several manufacturers have track records in fabricating/supplying the same class of machines. However, an FH type turbine with 10 MW (Q=8 m^3/s and 150 m head) is on the marginal range of its application. The advantage of an FH type turbine is that it allows for the earlier construction of the powerhouse. A vertical shaft type of turbine requires less space than that for horizontal type, but several floors are indispensable.

2) Manufacturers in China are the prospective bidders for the procurement of generating equipment at this stage. From the interview of prospective bidders done by a NEO mission to China in June 2010, it was revealed that one of the prospective bidders is currently manufacturing the same class of machine. However, that particular bidder was still concerned about some unexpected troubles such as vibration or bearing defects which may occur after the operation.

3) On the other hand, FV type turbines have been widely applied for 10-MW class hydro projects. It was judged that the construction of UB-1 Powerhouse would inevitably take a longer period, but the risk of post-operation troubles for an HV type turbine would be less than that of an FH type.

Each unit is connected to the penstock through a bi-plane type inlet valve with a diameter of 1.1 M.

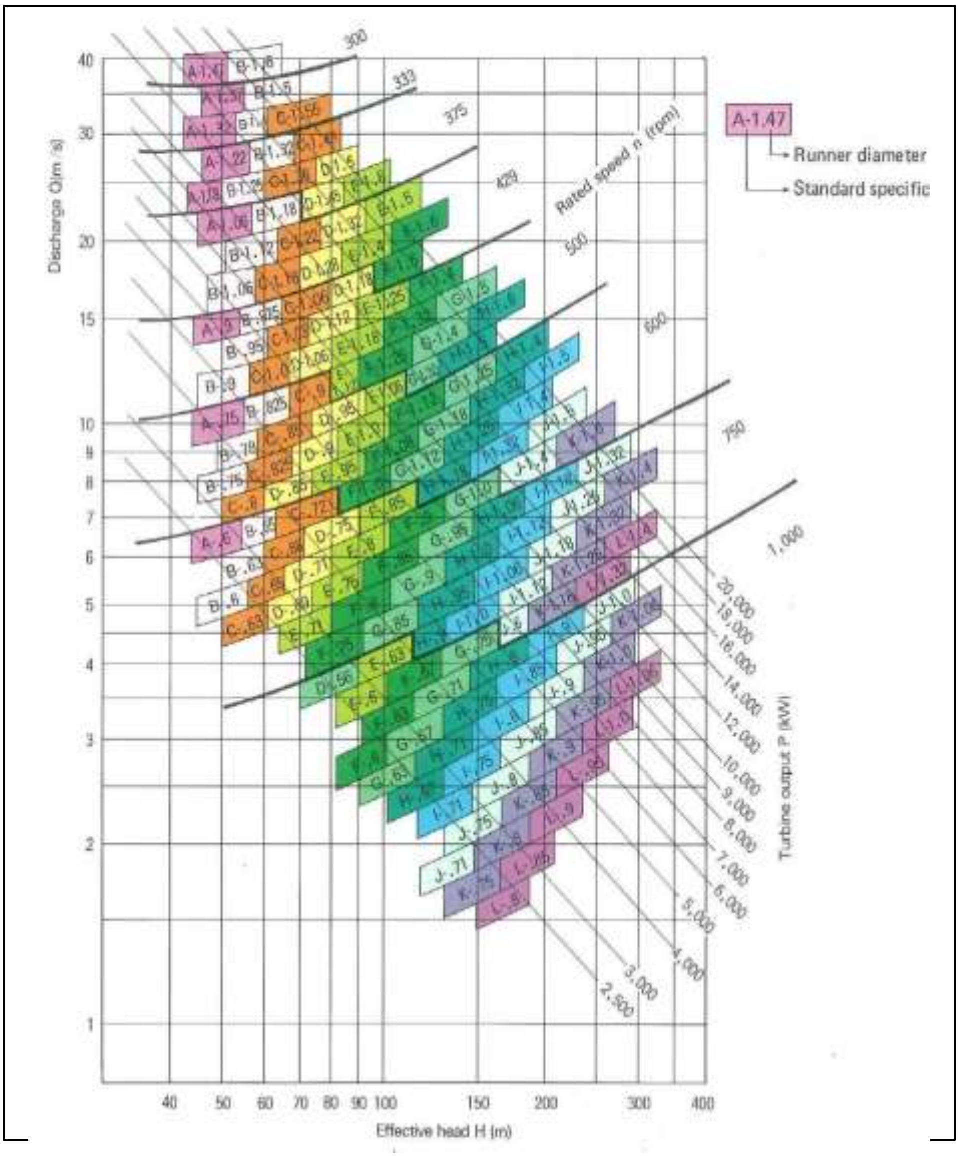


Figure 3.5.3.1-1: Sample of Turbine Selection Chart for FV

Generator voltage is to be stepped up with a unit transformer to 66 kV in order to connect with the outdoor switchyard of No. 1 power station, where both power stations of UB-1 and UB-2 will be integrated with the existing power system via 66 kV transmission line voltage. A conventional type 66-kV air insulated switchgear will be constructed in the switchyard area. Generated energy from both UB-1 and UB-2 will be injected to the cement factory and the nearest substation, which is operated by MEPE.

One 1,250 kVA local transformer is also provided for local service supply of 11 kV towards the intake facilities of No. 1 power station and vicinity villages for replacement of the existing small hydropower sources. The principal features of the generating equipment of No.1 hydropower station are as follows:

Hydraulic turbine

- Number of Units:	2
- Type:	Vertical shaft Francis
- Rated net head:	148.0 m
- Maximum plant discharge for each unit:	8.0 m^3/sec
- Rated output:	10,600 kW
- Rated speed:	600 rpm

Generator

- Number of unit:	2
- Type:	Three-phase, conventional type Synchronous generator with AC Exciter
- Rated capacity:	11,300 kVA
- Rated voltage:	11 kV
- Rated frequency:	50Hz
- Rated power factor:	0.9
- Electrical output:	10,200 kW

Main transformer

- Number of unit:	2
- Type:	Outdoor use, natural cooled(ONAN)
- Rated capacity:	11,300 kVA
- Voltage ratio:	11/66 kV

66 kV Switchgear

- Rated voltage:	66 kV
- Rated continuous current:	400 A
- Rated rupturing current:	25 kA

Major auxiliary equipment of the power station includes the following:

- One 30-ton overhead traveling crane with auxiliary hoist for handling miscellaneous equipment
- One set of diesel engine generator for emergency power supply to the auxiliary equipment

3.5.3.2 Power Station No. 2

Basic design conditions of the generating equipment are summarized below:

No. 2 Power Station

- Full supply level of head tank : EL. 983.00 m
- Minimum operating level : EL. 982.60 m
- Maximum plant discharge : 16.0 m^3/sec (two units operation)
- Tailrace level for maximum plant discharge : EL. 908.10 m
- Rated head : 72.9 m

The number of units was determined as well as for No. 1 power station. UB-2 will be operated with cascade of No.1 power plant.

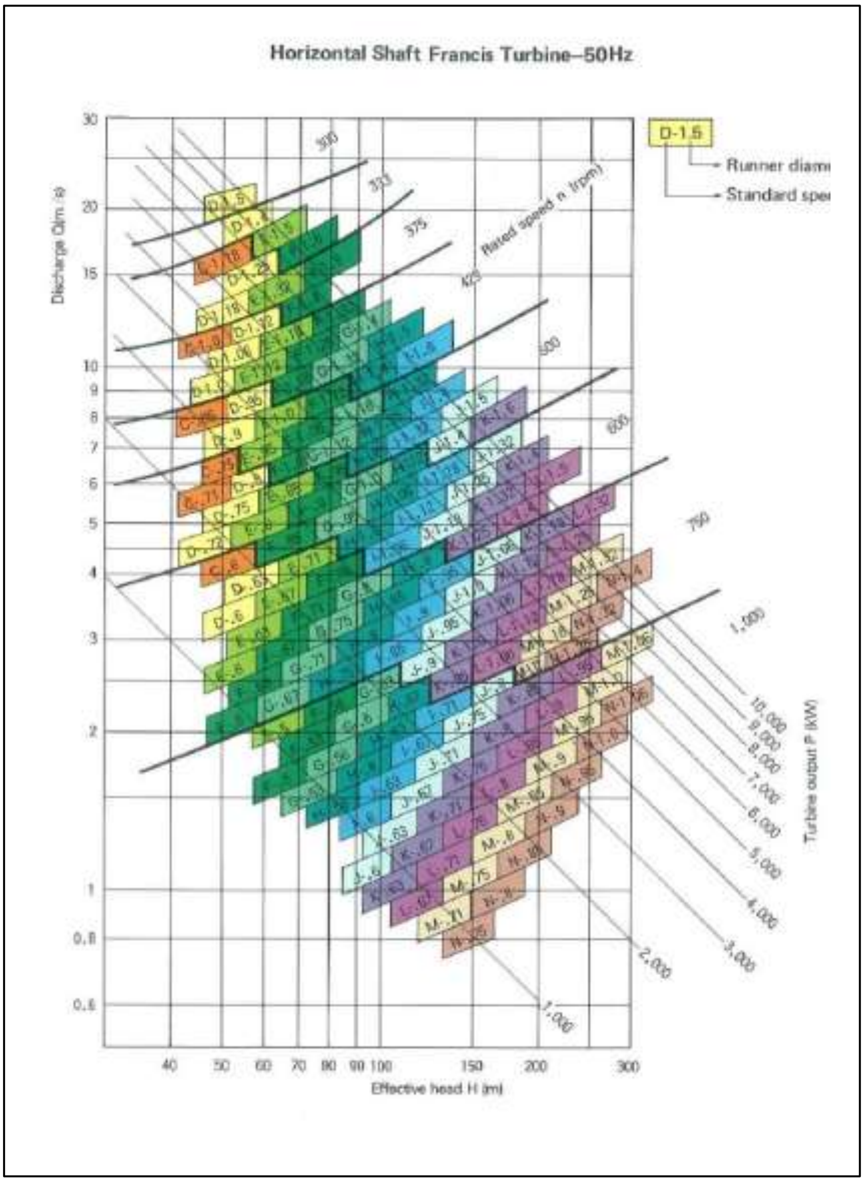


Figure 3.5.3.2-1: Sample of Turbine Selection Chart for FH

A Francis horizontal type turbine was selected based on the head and discharge available for power generation. After placement of the machine bay floor, erection work for generating equipment can commence in parallel with the rest of the civil works. The hydraulic turbine is connected to the penstock through a bi-plane type inlet valve with a diameter of 1.3 m.

Horizontal-shaft pedestal-bearing supporting-type synchronous generator is selected corresponding to the type of hydraulic turbine.

Two units of generators will be combined with a 11-kV common bus in the generator cubicles and connected with one step-up transformer in order to minimize the main transformer cost instead of unit system.

The 66-kV switchgear in UB-2 is designed from a 66 kV conventional air-insulated type in order to send power to UB-1.

One 1,250 kVA local transformer is also provided for local service supply of 11 kV towards the base camp and vicinity villages.

The principal features of the generating equipment of UB-2 hydropower station are as follows:

Hydraulic turbine

- Number of Units:	2
- Type:	Horizontal shaft Francis
- Rated net head:	72.9 m
- Maximum plant discharge for each unit:	8.0 m^3/sec
- Rated output:	5,200 kW
- Rated speed:	500 rpm

Generator

- Number of unit:	2
- Type:	Three-phase, horizontal type Synchronous generator of with AC Exciter
- Rated capacity:	5,600 kVA
- Rated voltage:	11 kV
- Rated frequency:	50 Hz
- Rated power factor:	0.9
- Electrical output:	5,000 kW

Main transformer

- Number of unit:	1
	- Type: Outdoor use, Natural cooled (ONAN)
- Rated capacity:	11,200 kVA

- Voltage ratio: 11/66 kV

66 kV Switchgear

- Rated voltage: 72.5 kV
- Rated continuous current: 400 A
- Rated rupturing current: 25 kA

Major auxiliary equipment of the power station includes the following:

- One 20-ton overhead traveling crane with auxiliary hoist for handling miscellaneous equipment

3.5.4 Hydrology

3.5.4.1 River Basin Topography

The Upper Baluchaung River originates from the peak of a hill at EL.1,625 m, about 2 km west of Pinlaung Town, and flows from south to north through the forest and mountainous areas. After joining the Thande-chaung River at about 6 km north of Tigyit Town and flows through the cultivated or glassland flat plateau area, the Upper Baluchaung River enters into the gorge at around EL. 1,212 m near the Saung Wun Village, and eventually flows to Inle Lake via Indein Village at around EL. 900 m.

Figure 3.5.4-1: Flow of Upper Baluchaung through the Gorge.

The maximum altitude of the Upper Baluchaung River is at EL. 1,625 m, located at the south of the river basin. Its total river length is about 95 km to Inle Lake with a total head of 700 m approximately at the UB-2 Powerhouse. At the Indein Village near Inle Lake, the Upper Baluchaung River has a total catchment area of 836 km^2.

The proposed locations of the main components are summarized as follows:

Component	Latitude	Longitude	Catchment
Regulating Dam UB-1 Intake	20°30'57"N	96°43'40"E	767 km^2
UB-2 Intake	20°29'03"N	96°47'03"E	802 km^2

The Inle Lake, the second largest lake in Myanmar, flows south into the Nam Pawn River, and then reaches the Mobye Dam reservoir, which was constructed to utilize the abundant hydro potential for power generation through a series of historical Baluchaung Hydropower Projects.

3.5.4.2 Climate Conditions

The project site is located in a monsoon climate area where the climate is characterized by a distinct dry season in the winter and a rainy season with southwest monsoon in the summer months. The meteorology in the project area is influenced by the northeast monsoon, with the wet season from May to October and dry season from November to April as shown in Figure 3.4.2. Mean annual rainfall at each gauging station largely varies from area to area. It is generally indicated that there are more rainfalls at higher altitudes in the catchment area. Temperatures reach their maximum towards the end of the dry season, in April.

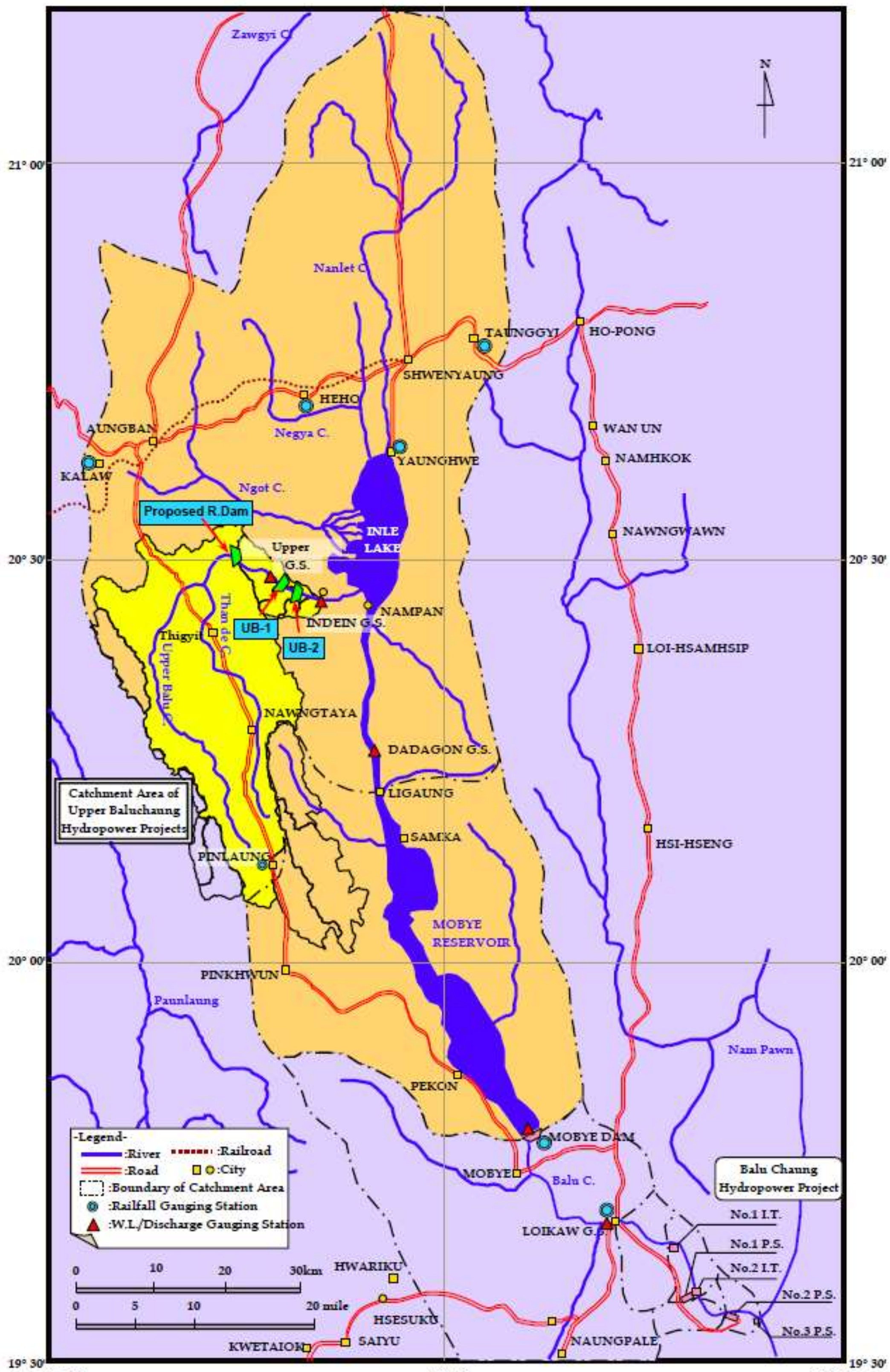


Figure 3.5.4-2: Location Map of the Upper Baluchaung River Basin

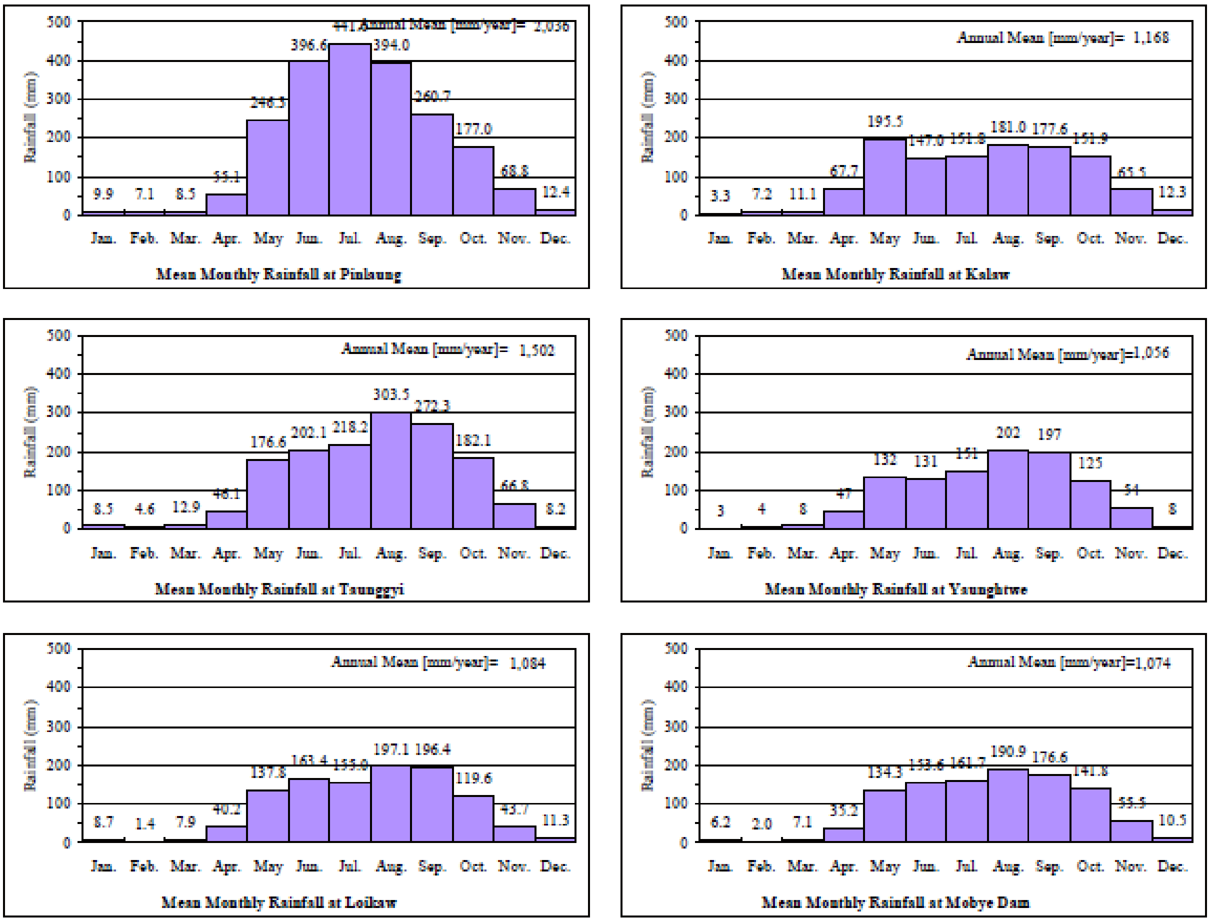


Figure 3.5.4-3: Monthly Mean Rainfall in the River Basin

3.5.4.3 Catchment Area

The catchment areas at the UB-1 intake site and the Indein water level gauging station estimated in the previous studies are shown in the table below:

Table 3.5.4-1: Catchments Area in the Previous Study

Source	Catchment Area [km^2] at UB-1 Intake site	Catchment Area [km^2] at Indein Gauging Station
Pre-F/S (2002)	820	-
Dr. Furuichi (2008)	-	813

In this study, the catchment area was reviewed and re-measured using 1/50,000 maps covering the whole area. The results of the estimate after being reviewed are shown below:

Table 3.5.4-2: Catchment Areas After Review

Location	Remaining Basin Area (km^2)	Catchment Area (km^2)
Regulating Dam	767	767
No.1 Intake	36	802
No.1 Powerhouse	14	816
No.2 Intake	6	822
No.2 Powerhouse	5	828
Indein G/S	8	836

3.5.5 Transmission Line

The power generated at UB-1 and UB-2 power stations will be transmitted to the power network of MEPE, setting the terminal point at the circuit breaker of 66 kV outgoing feeder of UB-1. To receive the generated power, MEPE will construct a 66-kV transmission line from their network to UB-1.

Therefore, a 66-kV single circuit transmission line from UB-1 to UB-2 is to be constructed by NEO. The transmission line has a distance of approximately 3.9 km.

The route of the transmission line is selected along the access road in order to avoid the precipitous riverside route, the purpose of which is to enable easy access for construction and maintenance.

ACSR Wolf with nominal cross-section of 183.4 mm^2 is selected to have 379 A at 75 °C (maximum ambient temperature of 40°C + a temperature rise of 35°C). Therefore, the transmission line capacity at 66 kV is 39 MW (p.f=0.9) which is sufficient for transmitting power generated from UB-2.

The particulars of the conductor and OPGW are tabulated as follows:

CONDUCTOR		OPGW	
Type of conductor	ACSR	Nominal cross section (mm^2)	70
Nominal cross section (mm^2)	183.4	Number of optic fibers (nos.)	24
Max. temperature of conductor (°C)	75	Type of fiber	Multiple
Allowable current carrying capacity (A)	379		
Transmission capacity (MVA)	43.3		

The supports of the transmission lines are made of self-supporting and broad-base galvanized steel lattice-type tower with single circuit construction. On top of the tower, one earth-wire is strung to protect the power conductor from direct lightning stroke. The earth-wire shall be of OPGW with optic fibers in the core, which are for optic signal communication.

Five units of 250 mm porcelain or toughened glass insulator disk per insulator string are designed, which takes into account the expected switching surge voltage of 165 kV and the commercial frequency's highest possible voltage of 86.4 kV.

The transmission line route is shown in Figure 3.5.5-1.

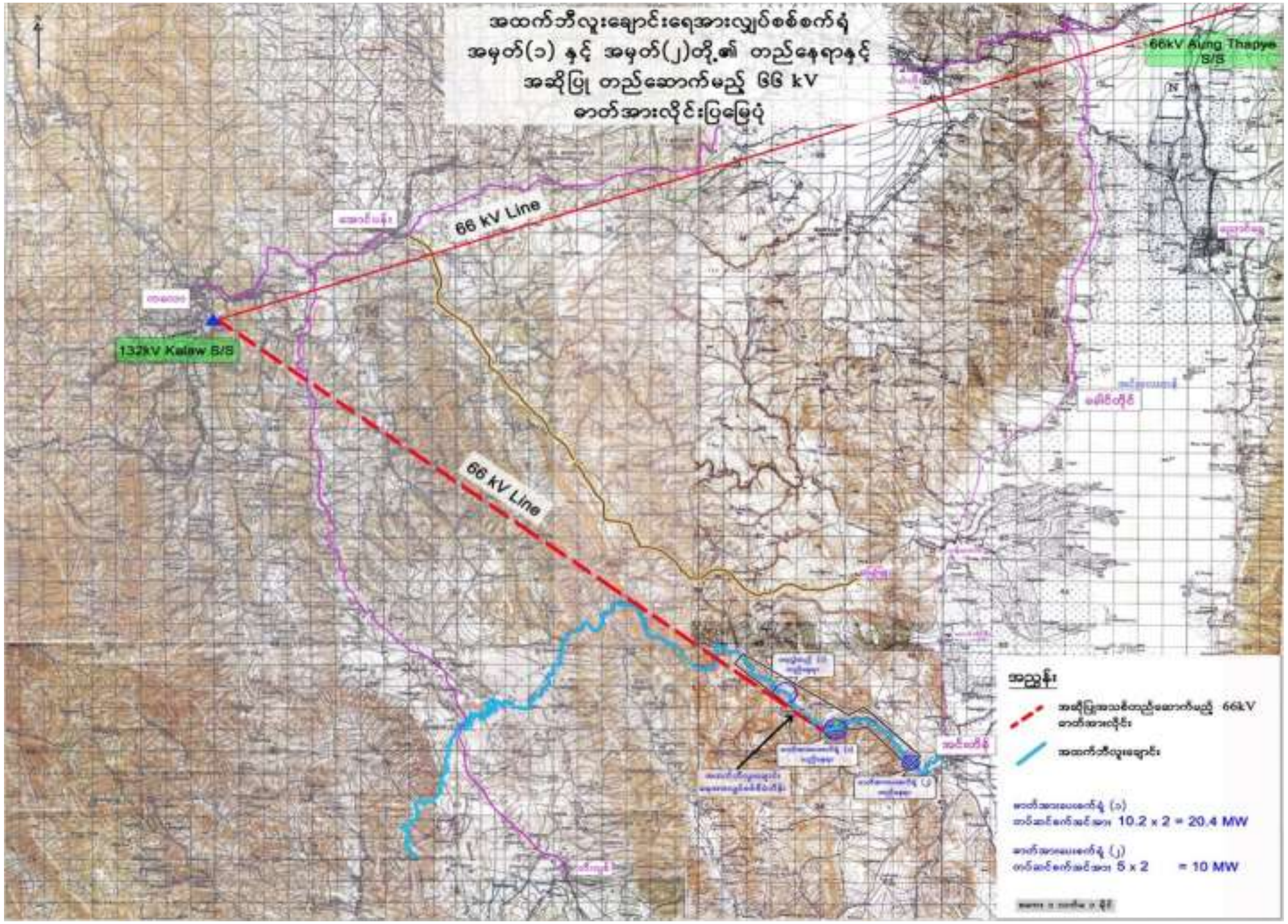


Figure 3.5.5-1 Route Map of Transmission and Distribution Lines.

3.6 Analysis of Alternatives

3.6.1 Project Type

The construction of Upper Baluchaung HPP is planned to be performed by Neo energy Oasis Co., Ltd. The feasibility study of the Upper Baluchaung HPP project has been prepared by Nippon Koei Co., Ltd. including the geotechnical report. These reports were completed in August 2010. The proposed project was determined to be economically and technically feasible.

3.6.2 Project Location and Size

The outline of UB-1 consists of an intake located about 7 km downstream of the RD, from which the river water will be taken to flow through the open channel waterway with about a length of 2.6 km along the left bank. The head tank will be provided at the downstream end of the waterway to lead the water through the steel penstock of approximately 280 m long, along the ridge to the powerhouse to be constructed at the left bank of the river.

The outstanding issue for UB-1 is the technical feasibility for the construction of an open channel waterway along the cliff developed on the left bank. This is examined in the study through field reconnaissance, referring to the topographic map with a scale of 1/2,000 as well as the cross-section survey along the waterway route.

The basic concept of UB-2 is the same as that of UB-1. The intake is located at about 700 m downstream of the UB-1 powerhouse, and the power water is conveyed through the open channel headrace with a length of about 1.8 km along the right bank, and through the steel penstock of about 135 m long eventually reaching the powerhouse on the right bank. The flow of Upper Baluchaung (06 Jan. 2010) near the No.2 Powerhouse.

An annual energy of 135 GWh is going to be produced at Upper Baluchaung HPP.

3.6.3 Consideration for Intake Weir, Headrace and Powerhouse

3.6.3.1 Intake Weir

<u>**UB-1**</u>

(1) Hydraulic Features

The full supply water level (FSWL) at UB-1 intake weir is selected at EL. 1,140.00 m in order to accommodate the waterway within a workable range along the cliff at the left bank. On the other hand, the foundation rock was confirmed through core drilling no. BH-5 at around EL. 1,105 m in the middle of the river. Consequently, the intake weir will be 35 m high with concrete volume of 42,000 m3. However, it is important to note that the intake weir is designed without having reservoir capacity, but to function as a weir in order to take the river flow under run-of-river scheme.

Hydraulic features of the intake weir were designed through the following concepts:

Table: Hydraulic Features for UB-1 Intake Weir

No.	Facilities	Description
1	Spillway	Design Flood of 440 m^3/s (1/100 year) to be released through the overflow weir section of 40 m wide on EL. 1,140 m.
		1/1,000-year flood of 1,415 m^3/s to be released through: 1) the overflow weir section, 2) both abutments on EL. 1,143 m, and 3) Sand Flush Gate of 3.2m square.
		The top level of the intake facilities is set at EL. 1,145.0 m not to be inundated when 1/1,000-year flood occurs.
2	Stilling Basin	The stilling basin with a roller bucket is designed applying 1/100-year flood of 440 m^3/s to dissipate its energy safely.
		The side walls are provided to pass the peak flood of 440 m^3/s below the crest level at EL. 1,122 m.
3	Bottom Outlet	The bottom outlet is provided at EL. 1,125 m to lower the reservoir surface when such requirements arise.
		It will take about seven days to lower the reservoir water level from 1,140 m to 1,125 m, assuming an inflow of 4.7 m3/s (75% dependable discharge).
		The bottom outlet consists of φ 1,000 jet flow gate and guard gate. The operation is made at the downstream face of the intake dam.
4	Sand Flush Gate	The sand flush gate is provided at around EL. 1,134 m to remove the sediment deposited upstream of the intake.
		The sand flush gate consists of a 3.2 m wide x 6.5 m high gate and a stop-log.

The reservoir volume and area curves are given in Figure. Assuming sediment yield of 121 m3/km2/year and sediment trap ratio of 0.91%, it will take 18.7 years for the sediment level to reach FSWL of 1,140.0 m.

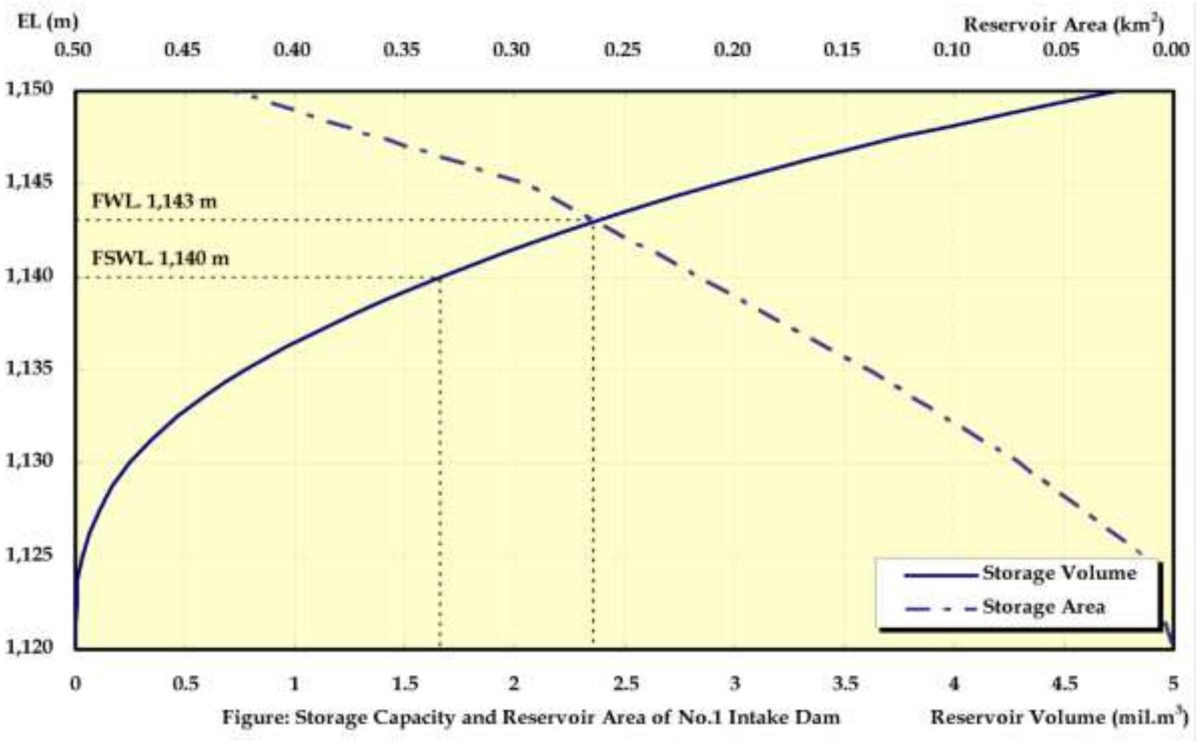


Figure: Reservoir Volume and Area Curve

(2) River Diversion

For the river diversion during construction, a two-stage diversion system is applied, consisting of: 1) the upstream cofferdam with crest EL. 1,124.2 m and 4.2 m high embankment with random materials, 2) first stage river diversion channel on the right bank, and 3) temporary river diversion conduit with 3.0 m square provided at EL. 1,120 m in the left side of the weir body, as shown on the relevant drawings. A two-year design flood, with peak discharge of 42 m3/s during the dry season, is applied for the river diversion system. It means that overtopping on the concrete surface should be allowed during the wet season. The concrete lift schedule should be prepared in the detailed design stage in order to minimize the risk against overtopping. After the completion of the diversion work, a stoplog will be lifted down along the upstream face from the weir crest by a truck crane, and the conduit will be plugged with concrete in a span length of 17.5 m.

(3) Stability of Intake Weir

The stability of the intake weir was analyzed in which several properties were assumed as shown in Table. However, it is important to note that the in-site test should be carried out at the detailed design stage of the Project in order to determine the shear strength and internal friction angle of the foundation rock.

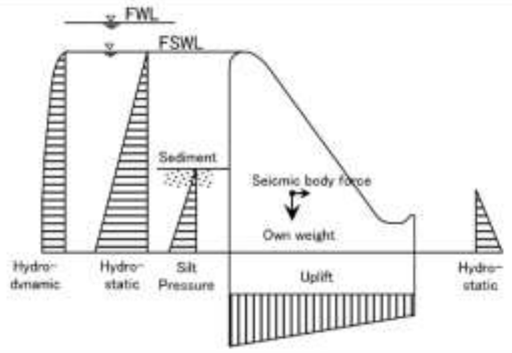
Table: Stability Analysis of UB-1 Intake Weir

Conditions

Section Name		Spillway Overflow Sectio	
Water Level			
	Full Supply Water Level	FSL	1140.00
	Design Flood Water Level (FWL)	FWL	1143.00
Dam Propaties			
	Top of Triangle	TPEL	1145.00
	Crest Level	TEL	1140.00
	Upstream Base Level	DZEL	1105.00
	Dounstream Base Level	DKEL	1105.00
	Base Deepest Level	ZEDL	1105.00
	Upstream slope factor	n	1 : 0.00
	Downstream slope factor	m	1 : 0.80
	Fillet Slope factor	nf	1 : 0.00
	Top of fillet	FEL	1105.00
	Crest Width	TB	4.00
Design Propaties for Stability Calculation			
	Sedimendation Water Level	SDL	1120.00
	Wave Run-up Height	WDH	0.00
	Wave Height due to earthquake	edh	0.00
	Tail Water Level	TWL	1121.30
	Coefficient of Earthquake	k	0.15
	Coefficient of Earth Pressure	CE	1.00
Other Structure			
Rock Conditions			
	Internal friction angle of rock mass	ϕ =	45
	Shear strength of rock mass	τ_s =	200
		qa =	200
Material Conditions			
	Concrete Unit Weight	WC	2.30
	Water Unit Weight	WW	1.00
	Sedimntation Unit Weight	WS	1.00

Results

Item	Case			
	Case 1(at FSL)	Case 2 (at FSL+EQ	Case 3 (at FWL)	Case 4 (at Empty)
Weight (t)	1,527.4	1,527.4	1,555.3	1,449.0
Water pressure (t)	514.5	514.5	451.8	0.0
Seismic force (t)	0.0	217.4	0.0	-108.7
Dynamic w/p (t)	0.0	107.2	0.0	0.0
Silt pressure (t)	112.5	112.5	112.5	112.5
Uplift (t)	-560.0	-560.0	-637.3	-373.3
Total V (t)	967.4	967.4	917.9	1,075.7
Total H (t)	627.0	951.5	564.3	3.8
Total M (t/m)	16,317.8	20,636.0	14,824.0	14,824.0
1) Sliding (>4)				
Safety factor	**11.8**	**7.7**	**13.0**	**1954.4**
check	OK	OK	OK	OK
2) Overturning				
e (m)	**-0.868**	**-5.331**	**-0.944**	**2.219**
L/6 or L/3 (m)	5.333	10.667	5.333	10.667
check	OK	OK	OK	OK
3) Bearing Stress				
q1(t/m2)	**25.311**	**0.013**	**23.608**	**47.601**
q2 (t/m2)	**35.151**	**60.449**	**33.763**	**19.629**
qa (t/m2)	200.000	200.000	200.000	200.000
check	OK	OK	OK	OK



(4) Countermeasure Against Potential Leakage

One of the major risks involved in the intake weir is potential leakage through caves and/or large cavities/openings that are developed on the limestone layers upstream of No.1 Intake. Therefore, soil blanket work using clay materials is essential to minimize leakage, in which the riverbed and both banks are layered in order to cover cavities/openings. It is planned that the blanket should be applied in the river stretch which is approximately 700 m upstream the intake weir. This will require 130,000 m3 of clay materials for UB-1. Instead, curtain grouting at the intake weir can be omitted.

From the above consideration, the core boring revealed that the foundation rock at the No.1 Intake would be about 16 m deep from the ground surface. The FSWL at EL. 1,145.0 m will require an intake weir of 40 m high. This will most likely cause leakage through caves and/or large cavities/openings developed on the limestone layers upstream of the No.1 Intake, even if the clay blanket is utilized to cover the openings of rocks.

It is important to note that the water level at the intake is governed by the flow through the open channel. Therefore, the intake weir does not function as a dam to utilize the drawdown of the reservoir.

Taking into account the risk due to leakage and workability of the waterway excavation, an FSWL of 1,140 m at the No.1 Intake is selected based on engineering judgment.

(5) Ecology Resources, Flora and Fauna

The Project Area lies within the West Inle Sparse Forest. Along the Upper Baluchaung river evergreen trees with clusters of bamboo are found. At the higher elevation, due to the limestone formation with shallow vegetation no big trees are found, only shrubs and bushes are existed. Around the UB1 Intake Weir, there is no large trees, some patches of shrubs and cluster of bamboo are found.

Due to the sparse forest and human settlements in the project area, wildlife in the area is just common to the animals which are found elsewhere in the other area of the country such as monkeys, wild cat, rabbit, barking deer etc. Large amount of human settlement in project area is one of the factor migrate the wildlife animal to other area. According to the interview from local villager, there is no threatened species around the project area but occasionally found during the rainy season. This location is more suitable to construct the UB1 Intake Weir and less harm to the ecological value.

UB-2

Two options are conceived for the intake facilities of UB-2. One option is to utilize independent intake structures such as intake weir, power intake and sand settling basin in order to take power water released from UB-1 Powerhouse and the river flow. The other option is the direct connection of UB-1 tailrace with UB-2 waterway by construction of culvert and open channel.

Both designs are explained hereunder to compare their costs, schedules, etc., which are related to the construction of the final selection.

According to the Feasibility study and Baseline data from field survey, some trees, shrubs and clusters of bamboo are found around the UB2 intake weir site. The UB-1 tailrace connects to UB-2 waterway without constructing UB-2 intake structures. There is no land clearance for construction work of UB2 intake weir because UB1 tailrace is directly connect to the UB2 waterway and ecological value at this area will not harm severely. There is no endanger species of flora and fauna are not recorded around the UB2 intake weir site.

3.6.3.2 Headrace Route

UB-1

Taking into account topographic features along both banks, the waterway route for UB-1 should be on the left bank and UB-2 on the right bank. Also, whether an open channel or a tunnel is selected was not taken into account.

Cost comparisons between open channel and tunnel waterway are shown in Table. Note that the construction cost for open channel waterway includes the access road provided adjacent to the waterway.

Table: Comparison of Tunnel Waterway and Open Channel

Structure	Open Channel			Tunnel		
	Length (m)	Unit Price (US$/m)	Amount (US$)	Length (m)	Unit Price (US$/m)	Amount (US$)
UB-1	2,580	1,592	4,107,360	2,060	3,000	6,180,000
UB-2	1,722	1,369	2,357,418	1,450	3,000	4,350,000
Total			6,464,778			10,530,000

In addition to construction costs and when considering tunneling works, it is required to examine a lot of factors such as tunnel experiences in Myanmar, procurement of civil works under LCB, necessity for import of tunneling equipment including steel forms from foreign markets, parallel construction with UB-2, additional core boring along the tunnel route, etc. In excavating a tunnel of this scale, it will take 20 months for UB-1 if a progress rate of 50 m/month from both sides of the portal is assumed.

The river flow of Upper Baluchaung contains high concentration of calcium, which is likely to adhere on concrete and/or steel walls as seen in existing waterways constructed in the river basin. Thick layers of calcium sedimentation were observed on the riverbed. It is likely that the roughness coefficient of the waterway will deteriorate in the long run, and the sectional area may be reduced.

For planning/design of UB-1/UB-2 waterways, roughness coefficients n=0.016 for concrete and n=0.013 for steel penstock were applied. In addition, a freeboard for open channel waterway is checked by using n=0.019, which was applied in Baluchaung No.2 Project.

Table: Flow Conditions of Headrace Channel

Discharge (m3/s)	16.0
Width of waterway (m)	3.2
Slope of waterway	1/1,000

Roughness coefficient		0.014	0.016	0.019
Uniform depth	m	2.301	2.557	2.935
Velocity	m/s	2.173	1.955	1.704
$V^2/2g$	m	0.241	0.195	0.148
Freeboard	m	0.502	0.474	0.454
Wall height required	m	2.803	3.031	3.389
Wall height designed	m	3.200		

It is shown in Table that the energy head is 3.083 m (=2.935 + 0.148) even if the roughness coefficient is at a level of 0.019. Finally, the UB-1 headrace channel was designed to run the power water in a uniform flow condition, with dimensions of 3.2 m (width) x 3.2 m (height) x 2,518 m (length).

Box culvert type waterway is applied in the section at relatively steep slope wherein falling debris may be anticipated. Meanwhile, open channel type waterway is suitable for sections at flat areas. An access road of 4 m width is provided along the waterway for construction and maintenance purposes. The typical sections of waterways are shown in Figure. Cross drains (as shown in Figure) should be provided at the section crossing a valley wherein flood and/or debris flows during rainfall.

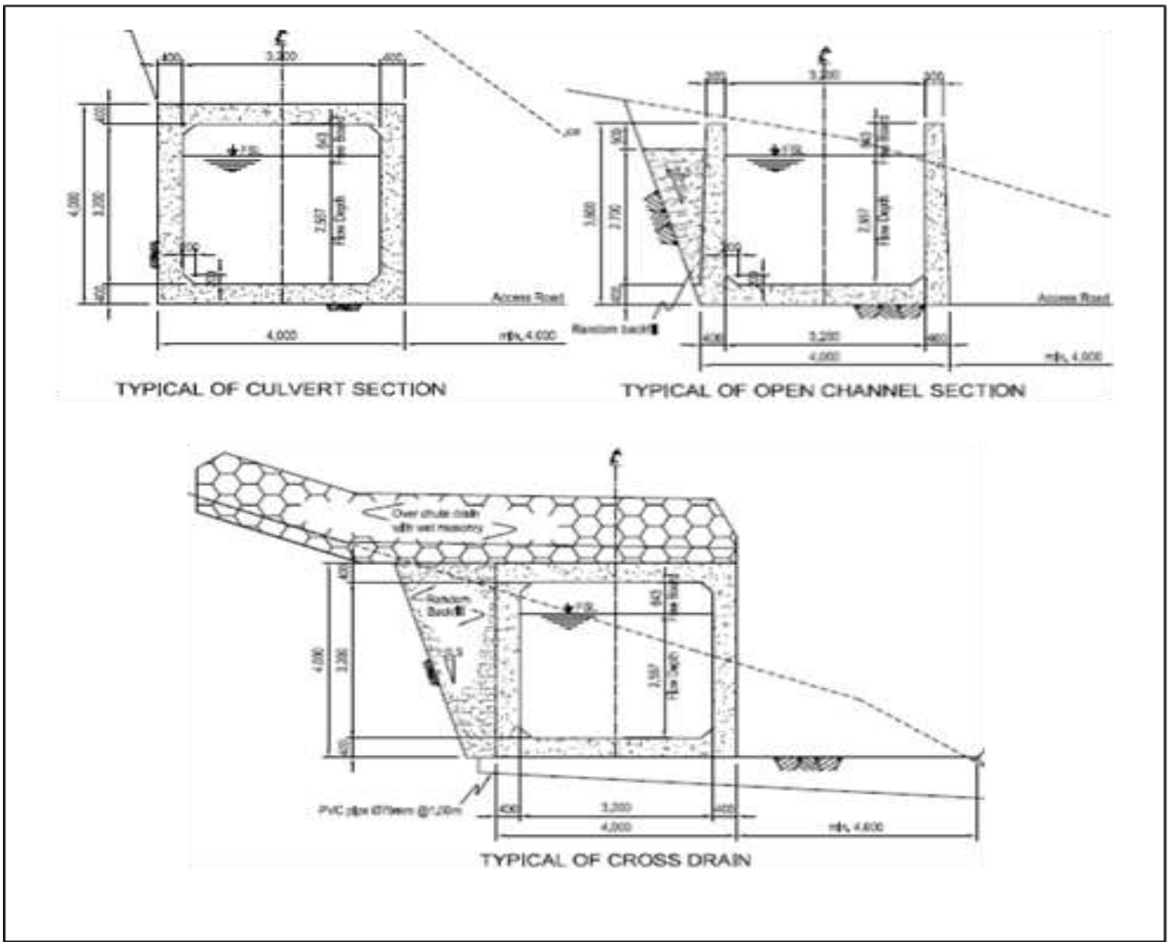


Figure: Typical Waterway Sections

Ecology Resources, flora and fauna

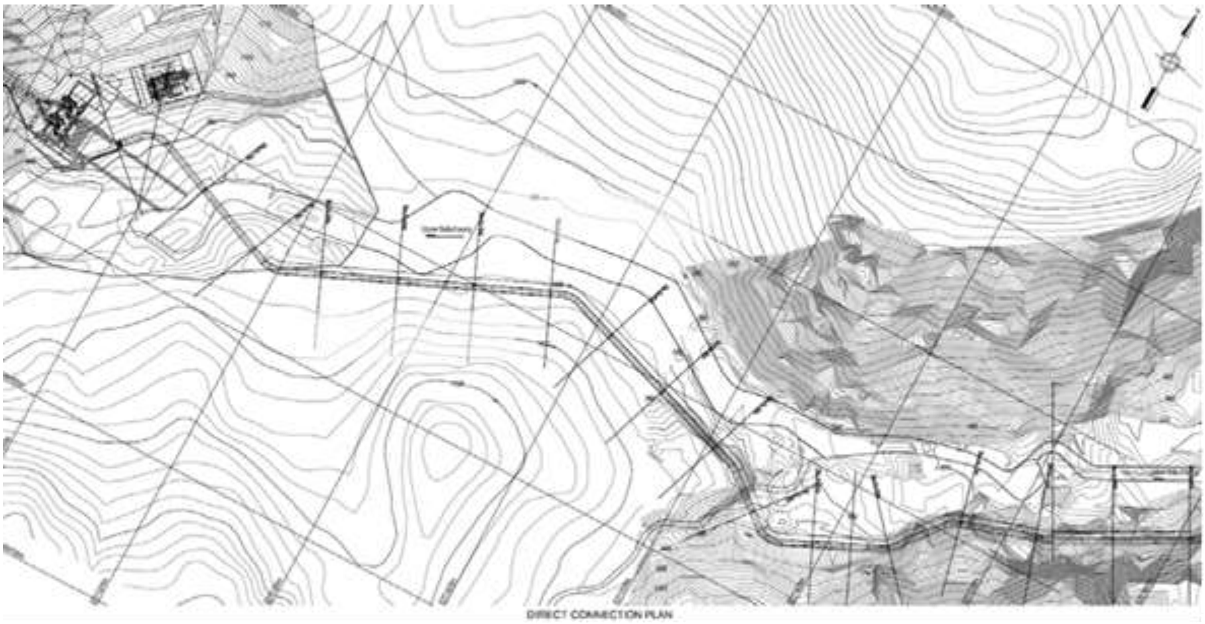
The UB-2 waterway consists of a 0.8-km long intake channel (direct connection channel), a 1.7-km long headrace channel, and a head tank. Major works and their corresponding work volume for UB-2 waterway are excavation work and concrete work. For the use of Direct Connection Channel Alternative, it may reduce the adverse impact like inundation, habitat destruction etc. and there is no more intake weir at UB2 site. But excavation work may affect the biodiversity at this area in some extent. According to feasibility study and field survey, there is no endangered species of flora and fauna around the UB2 site.

Therefore, a headrace route design was selected from the considerations above.

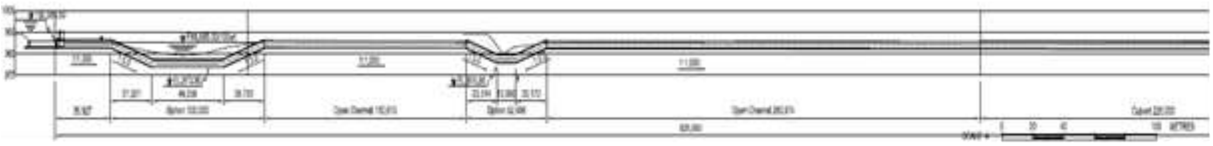
UB-2

This is an alternative plan to construct the waterway using box culvert and open channel in order to connect the UB-1 tailrace to UB-2 waterway without constructing UB-2 intake structures as shown on Figure. The independent intake option has an advantage when it comes to continuous power operation during suspension of UB-1. But on the other hand, geological investigation revealed that the rock foundation would be relatively deeper. Consequently, it will require a weir height of 24 m at the cut-off section, and 16 m on the river deposit foundation, which will lead to higher costs.

The direct connection plan is aimed at minimizing construction costs as well as the schedule. In addition, it will contribute to the improvement of the UB-2 scheme's financial feasibility, which is a bit lower than that of UB-1. It can omit the work items of intake weir, power intake, sand settling basin, related hydro-mechanical works, and the soil blanket upstream of UB-2. Instead, construction of the additional waterway, including an inverted siphon, open flume, and box culvert, should be added.



Plan of Direct Connection



Profile of Waterway of Direct Connection of UB-1 and UB-2

Figure: Direct Connection of UB-1 and UB-2

Ecology Resources, flora and fauna

The UB-2 waterway consists of a 0.8-km long intake channel (direct connection channel), a 1.7-km long headrace channel, and a head tank. Major works and their corresponding work volume for UB-2 waterway are excavation work and concrete work. For the use of Direct Connection Channel Alternative, it may reduce the adverse impact like inundation, habitat destruction etc. and there is no more intake weir at UB2 site. But excavation work may affect the biodiversity at this area in some extent. According to feasibility study and field survey, there is no endangered species of flora and fauna around the UB2 site.

3.6.3.4 Powerhouse

UB-1

Powerhouse No.1 is located at the bottom of the penstock slope which faces the left bank of Upper Baluchaung. The powerhouse was designed to accommodate two units of generating equipment including vertical-shaft Francis turbines with installed capacity of 20.4 MW (10.2 MW x 2). The WL was set at EL. 985.5 m from the existing river water level, based on which the turbine center level at EL. 985.0 m and the powerhouse yard at EL. 995.8 m were determined. Figure shows the rating curve at the estimated tailrace by applying non-uniform flow analysis downstream of the UB-1 powerhouse. As shown in the rating curve, the powerhouse yard will not be inundated even if a 1/1,000-year flood occurs.

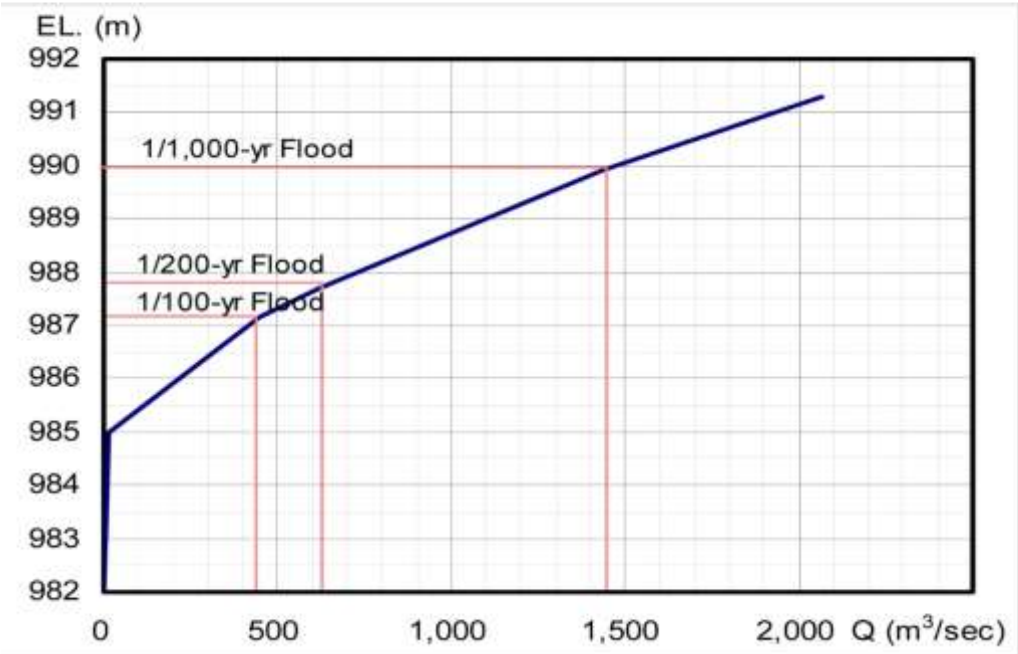


Figure: Rating Curve at UB-1 Tailrace

Ecology Resources, flora and fauna

Based on field survey, area around the power station No.1 grown with shrubs and some patches of tree and there is no big tree around the power station No.1. According to ecology baseline data, there is no endangered species of flora and fauna species around the power station No.1.

UB-2

Powerhouse No. 2 is located at the bottom of the penstock slope facing the right bank of Upper Baluchaung. The powerhouse yard level was determined at EL. 913.00 not to be inundated even if a 1/200-year flood occurs. Figure shows the rating curve at the tailrace estimated by applying non-uniform flow analysis:

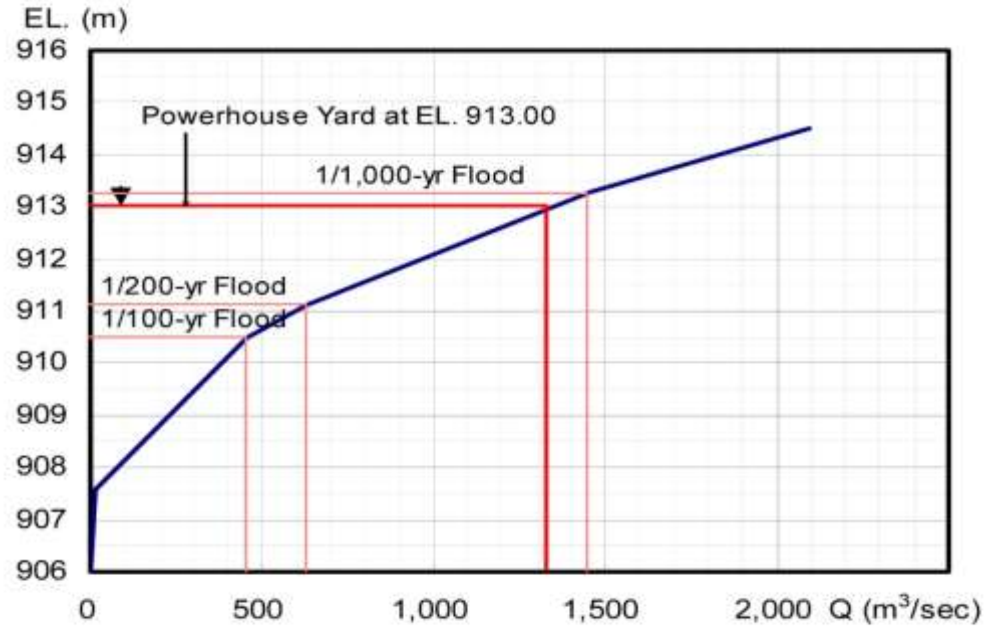


Figure: Rating Curve at UB-2 Tailrace

The powerhouse was designed to accommodate two units of generating equipment including horizontal-shaft Francis turbines with installed capacity of 10.0 MW (5.0 MW x 2). The TWL was set at EL. 908.1 m from the existing river water level, based on which the turbine center level at EL. 908.65 m and the powerhouse yard at EL. 913.0 m were determined. Figure shows the rating curve at the estimated tailrace by applying non-uniform flow analysis downstream of the UB-2 powerhouse. As shown in the rating curve, the powerhouse yard will not be inundated even if a 1/200-year flood occurs.

Ecology Resources, flora and fauna

UB-2 is planned as a run-of-river type power station with an installed capacity of 10.0 MW. The water released from the UB-1 powerhouse is directly taken by the UB-2 intake with a maximum plant discharge of 16 m3/s to convey through the open channel waterway located along the right bank slope, and via the head tank and the penstock. Based on field survey, area around the power station No.2 grow trees with cluster of bamboo and shrubs and there is no big tree are found around the power station No.2. According to ecology baseline data, there is no endangered species of flora and fauna species around the power station No.2.

3.6.4 Conclusion

In conclusion, the Project is economically and financially feasible, and will contribute to the country by supplying 30.4 MW maximum power and 135 GWh/year, through utilization of available hydro potential in the area.

A run-of-river scheme was selected to minimize the environmental impacts to the Project area as well as to the river basin, including the downstream community, in terms of irrigation water supply and boat transportation. Countermeasures such as maintaining the river flow of 0.5 m3/s between the intake and the powerhouse, and mitigation for adverse effects to the vicinity of the Project area during construction, will be incorporated in the work item. In addition, improvement for the local community will be undertaken by the Project.

CHAPTER IV DESCRIPTING OF THE EXISTING ENVIORNMENT

4.1 Natural Conditions

4.1.1 Meteorological Condition

The Republic of the Union of Myanmar lies north and south, the weather is considerably different by an area, basically, the central part to southern part belongs a tropical-zone climate, so from November to April during the dry season there is little precipitation and average minimum temperature is lower than 20°C but in wet season, there is high temperature and high humidity.

The northern part does not have much precipitation by a temperate-zone climate. Because of the flat ground zone and the Shan Plateau zone, there is a big difference in the climate of Taunggyi that is located near the Project site. There is little precipitation of the flat zone, and temperature in summer is extremely high. The average temperature of Taunggyi is 20.30 °C and maximum is 23.4 °C in April. The total annual precipitation is 1486 mm.

Table 4.1.1-1: Climate Data in Taunggyi (Year 2001 to 2010)

	24-hr Average Temperature (°C)	Average Rainfall (mm)
January	16.5	7
February	18.2	6
March	21.2	8
April	23.4	45
May	22.2	226
June	21.8	145
July	21.3	215
August	21.3	299
September	21.4	259
October	20.9	202
November	18.8	52
December	16.7	13
Year	20.30 (Average)	1486 (Total)

Source: Statistical Year Book 2011.

The climate of the area is influenced by Southwest monsoon, which bring rain from June to October and the dry Northeast monsoon from November to May. The earlier months of the north-east monsoon are cooler months reaching sometime to 5-10˙C during December, January, but temperatures rise during March, April and May and often exceed 40˙C. Annual rainfall over the whole catchment varies 2036 mm at Pinlaung and 1056 mm at Nyaungshwe.

Table 4.1.1-2 Annual Rainfall in and around the Project Area

Location	Altitude (m.a.s.l)	Average Rain Fall (mm)	Data-Period
Pinlaung	1478	2036	1967-2009
Kalaw	1315	1168	1909-1938, 1954-2009
Nyaungshwe	895	1056	1909-1938
Taunggyi	1425	1502	1954-2009, 1951-2009

Rainfall Guaging Stations

The locations of rainfall gauging stations in and around the Upper Baluchaung River basin are shown in Figure 4.1.1-1. The monthly and daily rainfall data collected to date are attached in the upporting Report. The *Thiessen*'s polygon with a factor for each rainfall gauging station is shown in Figure 3.4.3. The double mass curves were prepared and shown in the Supporting Report to see the relationship of the annual rainfall between each two gauging stations. It reveals that there are no significant deviations among the data in the six rainfall gauging stations.

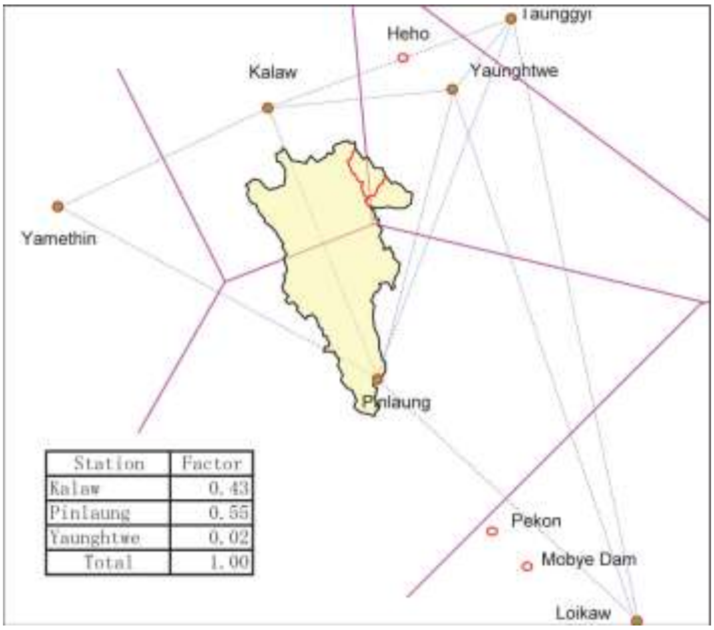


Figure 4.1.1-1: Thiessen Polygon of Rainfall

Basin Mean Rainfall

The Thiessen's coefficient is used to estimate the mean rainfall at the Project area. The annual mean rainfall is estimated at 1,575 mm at the UB-1 site as shown in Figure 4.1.1.-2

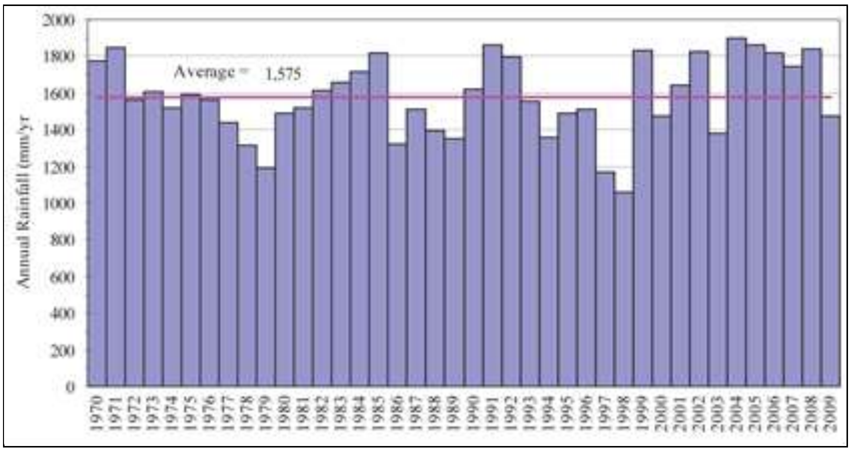


Figure 4.1.1-2: Annual Mean Rainfall at UB-1 Site

4.1.2 Runoff Data

Water Level Records

The water Level and discharge measurement have been undertaken to date.

1) WL Gauging Station near the UB-1 Intake (MEPE)

A water level gauge was installed by MEPE in August 2000 near the UB-1 intake site (catchment area = 802 km^2). The daily water level was measured by the villages three times a day from 26 August 2000 to 31 May 2002. The observed water level gauge heights record is attached in the Supporting Report.

2) WL Gauging Station at Indein Village (Dr. Furuichi/ Forest department

A water level gauge with an automatic pressure sensor was installed at the Indein irrigation weir by Dr. Furuichi, in cooperation with the Forest Department in October 2004. The hourly water level was observed from 16 October 2004 to 2 June 2006.

WL Gauging Station at Indein (Dr. Furuichi)

WL Gauging Station at Indein (NEO)

3) WL Gauging Station at Indein Village (NEO)

A water level gauge was installed upstream of the existing irrigation intake in Indein (Catchement area = 836 km^2) by NEO. The daily water level is being measured three times a day since 05 January 2010.

Discharge Measurement

1) WL Gauging Station near the UB-1 Intake (MEPE)

The discharges measured by MEPE near the UB-1 intake site area as shown below:

Table 4.1.1-3 Discharges Measured Near the UB-1 Intake Site (MEPE)

No.	Date	Gauge Height (m)	Measured Discharge (m^3/s)	No.	Date	Gauge Height (m)	Measured Discharge (m^3/s)
1	27-Aug-2000	2.00	14.9	10	30-Jun-2001	1.76	10.6
2	29-Aug-2000	1.75	10.3	11	30-Jul-2001	2.20	23.5
3	29-Nov-2000	1.84	13.7	12	30-Aug-2001	2.06	15.1
4	30-Dec-2000	1.82	11.0	13	30-Sep-2001	1.90	11.5
5	30-Jan-2001	1.81	9.52	14	29-Oct-2001	*2.01*	19.1
6	28-Feb-2001	1.81	9.24	15	28-Nov-2001	1.90	8.49
7	31-Mar-2001	1.70	3.35	16	28-Feb-2002	1.80	9.00
8	30-Apr-2001	1.69	7.84	17	31-Mar-2002	1.75	8.24
9	31-May-2001	1.85	14.2	18	30-Apr-2002	1.74	6.86

Source : MEPE (rounded data)

2) WL Gauging Station at Indein Villa (Dr. Furuichi/Forest Department)

The discharges measured by Dr. Furichi/Fores Department at the Indein WL gauge station are as shown below:

Table 4.1.1-4 Discharges Measured at Indein (Dr. Furuichi)

Date	Time	State (m)	Discharge (m^3 /sec)
10.08.2005	14:30 -16:00	1.230	26.7
19.05.2006	13:00-14:00	0.593	6.05
21.05.2006	15:00-16:00	0.587	6.05
03.06.2006	15:00-15:00	0.655	6.49

Source: "Catchment Processes and sedimentation in Lake Inle, Southern Shan State, Myanmar" A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental studies, The Australian National University, 8 March 2008.

3) WL Gauging Station at Indein Village (NEO)

The discarges measured by NEO at the new water level gauge station in Indein from January 2010 area shown below:

Table 4.1.1-5: Discharge Measured at Indein (NEO)

Date	Time	WlL. Gauge Height (cm)	Measured Discharge (m^3/s)
2010/1/5	15:30-15:50	84	5.91
2010/1/6	11:00-11:30	84	5.92
2010/2/21	15:30-16:00	80	5.20
2010/3/16	13:30-14:05	85	6.39

3) Discharge Rating Curve

1. WL Gauging Station near the UB-1 Intake (MEPE)

The equation showing the relationship between discharge and gauge height at the water level gauging station site (MEPE) is given below:

$$Q = 18.905 \text{ x } (H - 1.0914)^2$$

Where, Q: discharge (m^3/s) *H:* gauge height (m)

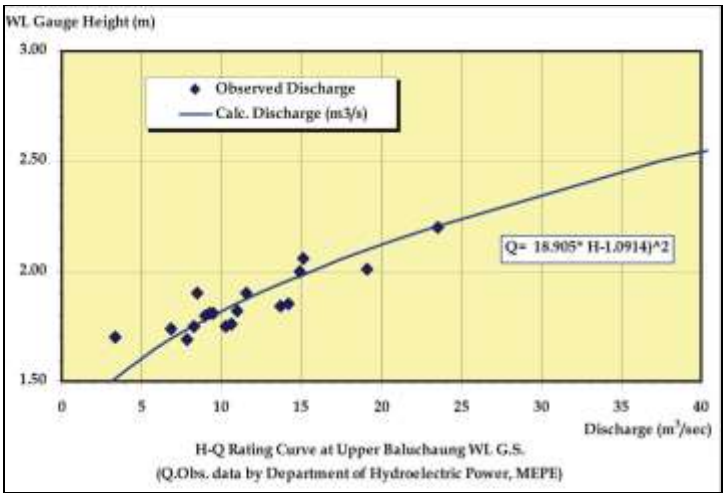


Figure 4.1.1-3: Rating curve near the UB-1 Intake Site (MEPE)

2. WL Gauging Station at Indein Village (Dr.Furuichi/Forest Department)

The relationship between discharge and gauge height at the water level gauging station site is derived by Dr. Furuichi as shown in the equation below:

$$Q = 17.156 \text{ x } H^{2.0572}$$

Where, *Q*: discharge (m^3/s) *H:* gauge height (m)

According to Dr. Furuichi’s report, the reliable range for extrapolation of the H-Q rating curve is given between 2.42 m^3/s and 53.30 m^3/s.

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

3. WL Gauging Station at Indein Village (NEO)

The equation showing the relationship between discharge and gauge height at the water level gauging station site (NEO) is given below:

$$Q = 0.002 \text{ x } (H\text{-}29.126)^2$$

Where, Q: discharge (m^3/s) H: gauge height (m)

It is noted that the available data are limited to establish the rating curve. Accordingly, the above H-Q equation at the Indein new gauging station (NEO) needs to be updated by incorporating additional data.

4. Daily Discharge

A. WL Gauging Station near the UB-1 Intake (MEPE)

Discharges can be obtained from water levels and the discharge rating curve. The daily discharges at the UB-1 Intake site (MEPE) were calculated as shown Figure 4.1.1-4, and the complete data are attached in Volume-III: Supporting Report (1/2).

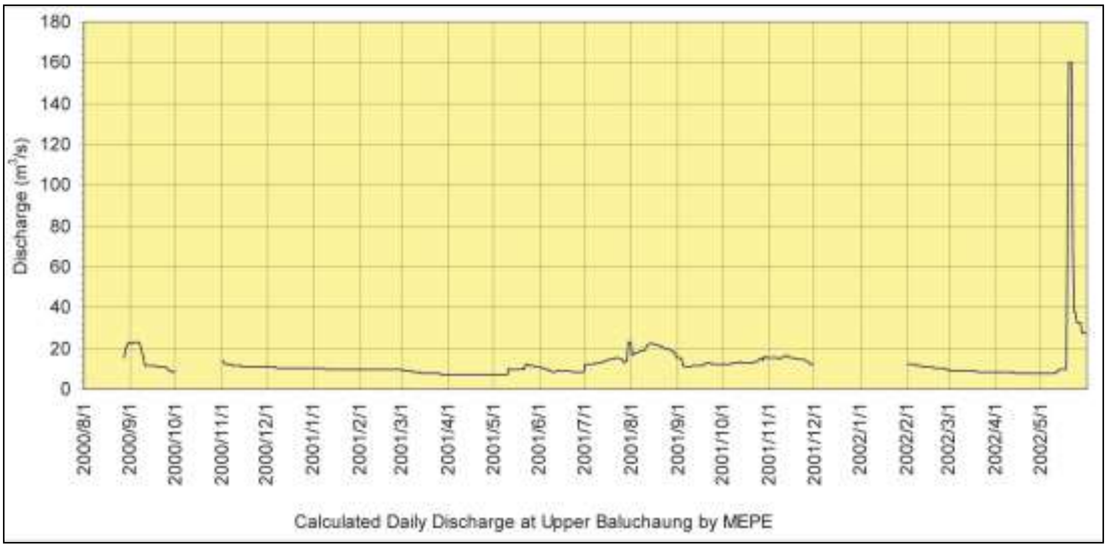


Figure 4.1.1-4 Daily Discharge near the UB-1 intake site (MEPE)

B. WL Gauging Station at Indein Village (Dr. Furruichi/ Forest Department)

The hourly discharges at Indein gauging station determined by Dr. Furuichi are shown in Figure 4.1.1-5.

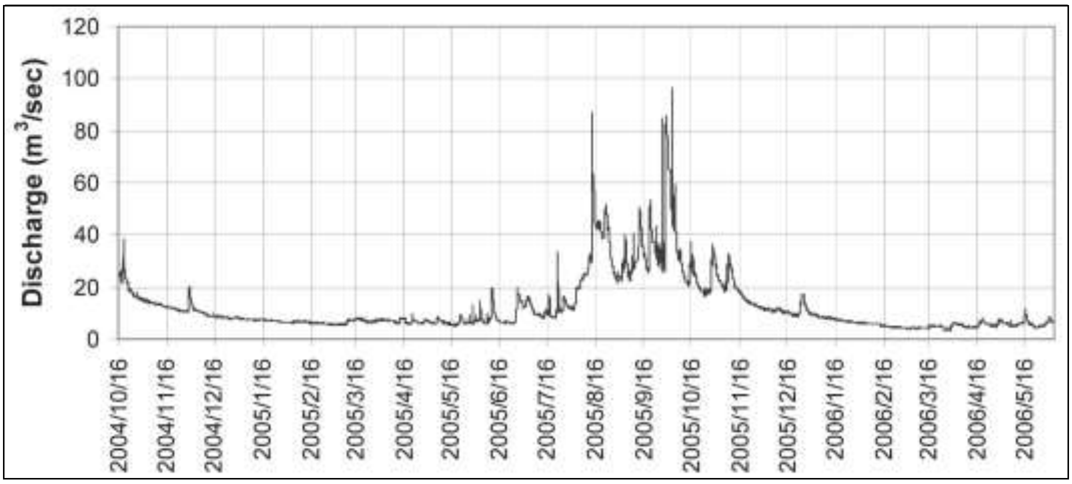


Figure 4.1.1-5: Hourly discharge measured at Indein (Dr. Furuichi)

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

The monthly runoff at Indein from November 2004 to May 2006 is shown in Table 4.1.1-6.

Table 4.1.1-6: Monthly discharge measured at Indein (Dr. Furuichi)

Month	Mean Discharge (m^3/s)	Monthly Runoff (mcm)	Monthly Runoff Height (mm)	Monthly Ratio to Annual Discharge in 2005 (%)	Monthly Basin Rainfall (mm)
2004.11	12.9	33.5	40.1		35
2004.12	9.4	25.3	30.3		0
2005.01	7.4	19.7	23.6	4.1%	0
2005.02	6.5	15.7	18.8	3.3%	0
2005.03	6.9	18.4	22.0	3.8%	33
2005.04	7.0	18.2	21.8	3.8%	71
2005.05	6.7	18.0	21.5	3.8%	95
2005.06	8.8	22.7	27.2	4.7%	356
2005.07	11.5	30.9	37.0	6.4%	263
2005.08	32.3	86.5	103.5	18.0%	477
2005.09	35.2	91.2	109.1	19.0%	297
2005.1	30.2	81.0	96.9	16.9%	131
2005.11	18.4	47.8	57.2	10.0%	34
2005.12	11.0	29.5	35.3	6.2%	48
Annual 2005	15.2	479.6	573.7		1,805
2006.01	7.7	20.7	24.8		0
2006.02	5.4	13.0	15.6		0
2006.03	4.5	12.1	14.5		20
2006.04	5.6	14.6	17.5		140
2006.05	6.0	16.2	19.4		171
		C.A.at Indein [km^2]=	836		
		Runoff Coefficient in 2005 =	0.32		
		Specific Discharge of 2005 =	1.81	m^3/sec/100 km^2	

Source: *Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

4.1.3 Erosion and Sedimentation

Erosion and sedimentation in the Inle catchment has been recognized local and national communities as an urgent environmental issue for the survival of Inle Lake.

Four small rivers joined into the Inle Lake from the north, Namlet Chaung and Negya Chaung (Heho), Kalaw Chaung (Ngot) and Upper Baluchaung from the West. From eastern side, only a few short and steep small rivers also joined into the Inle Lake.

Large area of fluvial floodplains, deltaic floodplain, deltaic marsh of the western side four rivers were identified around the lake side and on the eastern shore of the lake, both fluvial and deltaic floodplains are less developed, suggesting that the main source of sediments in the lake is from the four western rivers.

Dr.T. Furuichi estimated that, out of about 277300 ton/yr of total sediment carried by four western rivers, about 99300 ton/yr (about 36%) is carried by Upper Baluchaung River at Indein.

"Although, sedimentation is serious problem for water transportation; the farmers want to expand paddy fields in the lower land where water depth is deeper than that suitable for paddy. They want the sediments, to raise the land level. Together with adding fertility from sediments, this situation generally forms the basis of their perspective on sedimentation; the farmer consider sedimentation as a benefit rather than a problem. The farmers are however, clearly concerned about sedimentation problem for water transportation in the streams and river mouth. The agriculture products are carried through the water transportation system in the lake area."*

*T. Furuichi "Catchment Processes and Sedimentation in Inle Lake, Southern Shan State Myanmar"

4.1.4 Reservoir Evaporation

The evaporation rate from the reservoir surface water (lake evaporation losses) was estimated, based on the monthly pan-evaporation measured at the Mobye Dam meteorological station. Actual evaporation loss from a reservoir surface is generally known to be less than that from a pan because of the relatively large thermal inertia of the lake and susceptibility of the pan to heat gains from radiation.

Pan coefficients generally lie in the range from 0.7 to 0.8, while 0.85 is applicable for humid regions. In this study, a pan coefficient of 0.8 was applied to estimate the monthly evaporation from the reservoir as follows:

Table 4.1.1-7: Reservoir Evaporation

Station: Mobye Dam (unit:mm/day)

year	MONTH												Annual mean
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Average Daily Pan Evaporation	3.84	5.22	6.96	7.60	6.56	4.48	4.40	3.70	3.81	3.96	3.91	3.97	4.86
Pan Coefficient	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
Average Daily Reservoir	3.07	4.18	5.57	6.08	5.25	3.58	3.52	2.96	3.05	3.17	3.13	3.18	3.89

Source: Baluchaung Hydroelectric Project No.1 Power Station, O&M Manual Vol.II, NEWJEC, 1993

4.1.5 Reservoir Sedimentation

According to the research by Dr. Furuichi on sedimentation in Inle Lake, the annual suspended sediment yield at Indein in 2005 is estimated at 12a ton/km^2 /year as shown in Table 4.1.1-8.

Table 4.1.1-8: Monthly Sediment Yields at Indein

Month	Sediment yield (t/mon)	Sediment yield (t/yr)	Monthly ratio to annual yield in 2005 (%)
2004.11	2,421		
2004.12	1,163		
2005.01	604		0.6
2005.02	399		0.4
2005.03	523		0.5
2005.04	524		0.5
2005.05	499		0.5
2005.06	1,175		1.2
2005.07	2,025		2.1
2005.08	37,253		37.9
2005.09	31,814		32.4
2005.10	16,683		17.0
2005.11	5,100		5.2
2005.12	1,694		1.7
Total 2005		98,293	
2006.01	703		
2006.02	260		
2006.03	186		
2006.04	312		
2006.05	395		
	C.A. at Indein =	813 km^2	
	Annual Sediment Yield (2005) =	121 t/km^2/yr	

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

Assuming a bed load yield of 20% and average bulk density of the sediment at 1.20 t/m^3, the annual sediment yield from the Upper Baluchaung is estimated at 121 m^3/km^2/year. Using the catchment area of 767 km^2 at the RD site, and assuming a trap efficiency of 91.3% determined from *Brune*'s curve, the 100-year sediment volume at the proposed RD site is estimated at 8,480,000 m^3 as shown below.

Annual Suspended Sediment Load Yield from Upper Baluchaung	121	t/km^2/yr	*1
Assumed Bed Road Yield	20%		
Assumed Bed Road Yield (assumed 20% of suspended load)	24.2	t/km^2/yr	
Total Annual Sediment Yield from Upper Baluchaung	145.2	t/km^2/yr	
Average Bulk Density of Sediment Load	1.20	t/m^3	
Total Annual Sediment Yield (Volume) from Upper Baluchaung	121	m^3/km^2/yr	
Catchment Area of Proposed Regulating Dam	767	km^2	
Annual Sediment Yield (Volume) at Proposed Regulating Dam	92,807	m^3/yr	
(*C*) Reservoir Gross Storage Capacity Volume by H-A-V curve	62	$x10^6$ m^3	
Mean Annual Discharge at Proposed Dam Site	10.58	m^3/s	
(*I*) Mean Annual Inflow Volume in Reservoir	333.57	$x10^6$ m^3	
Reservoir Capacity Volume/Mean Annual Total Inflow Ratio (C/I)	0.19		
Assumed Sediment Trap Efficiency by *Brune*'s Curve	91.3%		
Annual Sediment Trap at Proposed Regulating Dam	84,800	m^3/yr	
Total Reservoir Sedimentation after 100 year	**8,480,000**	**m^3**	

Source *1: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*",
Takahisa Furuichi, Center for Resource and Environmental Studies,
The Australian National University, A final report submitted to Forest Department, Myanmar, 08 March, 2008

4.1.6 Hydrology

River Basin Topography

The Upper Baluchaung River originates from the peak of a hill at EL.1,625 m, about 2 km west of Pinlaung Town, and flows from south to north through the forest and mountainous areas. After joining the Thade-chaung River at about 6 km north of Tigyit Town and flows through the Upper Baluchaung River enters into the gorge at around EL. 1,212 m near the Saung Wun village, and eventually flows to Inle Lake via Indein Village at around EL. 900m.

The maximum altitude of the Upper Baluchaung River is at EL. 1,625 m, located at the south of the river basin. Its total river length is about 95 km to Inle Lake with a total head of 700 m approximately at the UB-2 Powerhouse. At the Indein Village near Inle Lake, the Upper Baluchaung River has a total catchment area of 836 km^2.

The Inle Lake, the second largest lake in Myanmar, flows south into the Nam Pawn River, and the reaches the Mobye Dam reservoir, which was constructed to utilize the abundant hydro potential for the generation through a series of historical Baluchaung Hydropower Projects.

Climate Conditions

The project site is located in a monsoon climate area where the climate is characterized by a distinct dry season in the winter and a rainy season with southwest monsoon in the summer months. The meteorology in the project area is influenced by the northeast monsoon, with the wet season from May to October and dry season from November to April. Mean annual rainfall at each gauging station largely varies from area to area. It is generally indicated that there are more rainfalls at higher altitudes in the catchment area. Temperatures reach their maximum towards the end of the dry season, in April.

4.1.7 Topography

Topography of the whole region on the plateau consists of rolling hills and karstic features include plains and gullies. The vast stretches of plains with deep dissected gullies are observed especially, along the Baluchaung River and other large streams. The rolling hill and small mountains are trending generally north northwest to south southeast. The general elevation ranges from 900 meter to 1200 meter.

The Project site is located west of Taunggyi and occupied by the part of Nyaungshwe plain, west of Inle Lake. The topographic map of the project area and it surrounding is shown in Figure 4.1.7-1.

The Upper Baluchaung area lies where river starts to enter into the western escarpment of the Inle Lake. Within these stretch, river forms numerous rapids and falls having about 320m elevation differences within 17.4 km stretch. The valley around the project area is narrow, the surrounding hills rising sharply to over el 1600 m. Most of the river bank slope are steep and rocky.

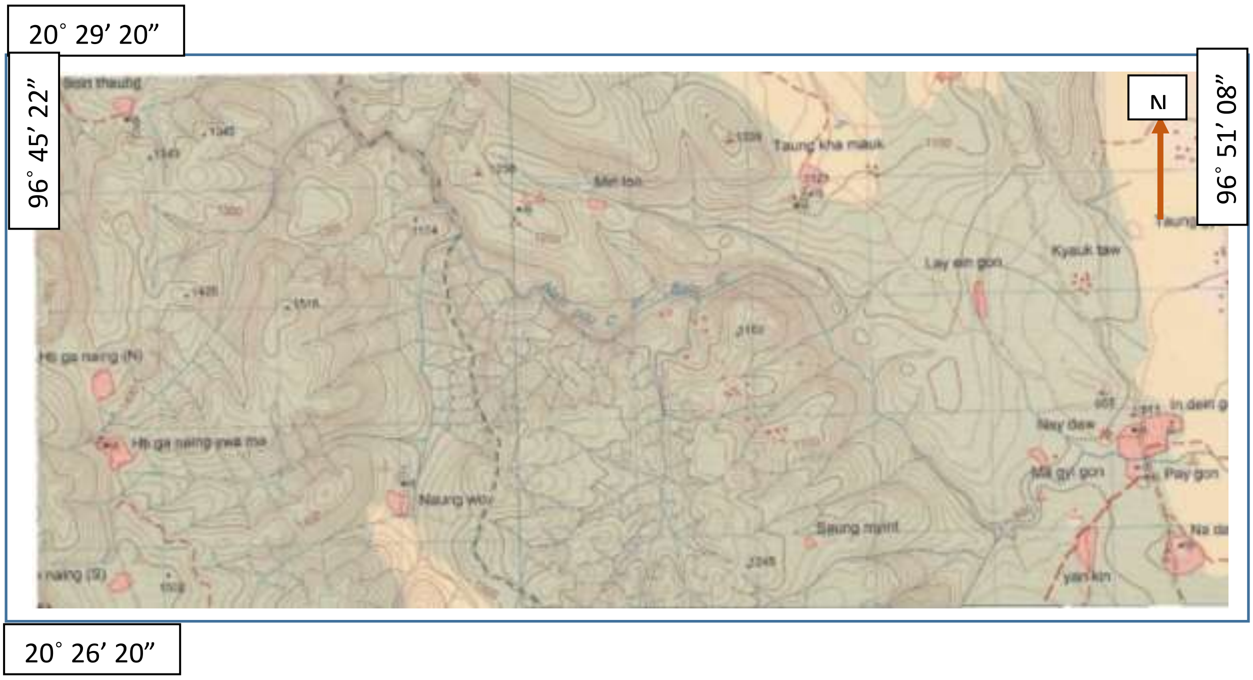


Figure 4.1.7-1 Topographic Map of the Upper Baluchaung Hydropower Project Area.

4.1.8 Geology

The project area is located in Shan Plateau especially west of Inlay Lake and south of Pindaya Range. Geology of the project area was studied mainly based on previous literatures, such as Chhibber (1934) and Bender (1983), and technical reports of the geoscientists from the University of Rangoon (Yangon) and Department of Geological Survey and Mineral Exploration. Field ground-checking was also conducted in conjunction with the soil and water survey of the present EIA project during site visit. Regionally, the area is occupied by the Upper Paleozoic Rocks and Mesozoic Rocks (Bender, Geology of Myanmar.).

The older rock unit exposed in the project area is Ordovician Unit that consists of bedded limestone, siltstone and minor dolomitic limestone unit. The second widely exposed rock unit is Plateau Limestone Group. This Group consists of thick and widespread dolomite and limestone unit of Late Paleozoic age. Another formation is Jurassic clastic rocks chiefly consists of sandstone and shale.

Within the Project area, Dolomitic Limestone of Plateau Limestone Group is widely distributed in uphill and along the water way of Upper Baluchaung river. The rock is massive, compact, highly brecciated and jointed, widely displaying karstic features such as steep cliffs and solution caverns. Ridge sides are commonly steep and vertical and surface of the formation is extremely irregular, lacking surface drainage; swallow holes are common. In contrast, where the formation has been dolomitized, it forms a gently rolling landscape of open grassland and some shrubs but very few trees. In the course of the river, travertine limestone (tufa) unit is well exposed.

Some small patches of sedimentary rocks. (Mudstone, Siltstone and Sandstone) are also observed in the project area.

Downstream from Indein, the river starts to flow into its delta. The delta was formed largely by two streams: Ywama Chaung in the north and Indein chaung in the south. A characteristic feature of the delta is that large areas along the two streams were aggraded and become fluvial floodplains. The width of the Indein Chaung through the floodplain is around 20 m and only about 0.5 m deep in the dry season.

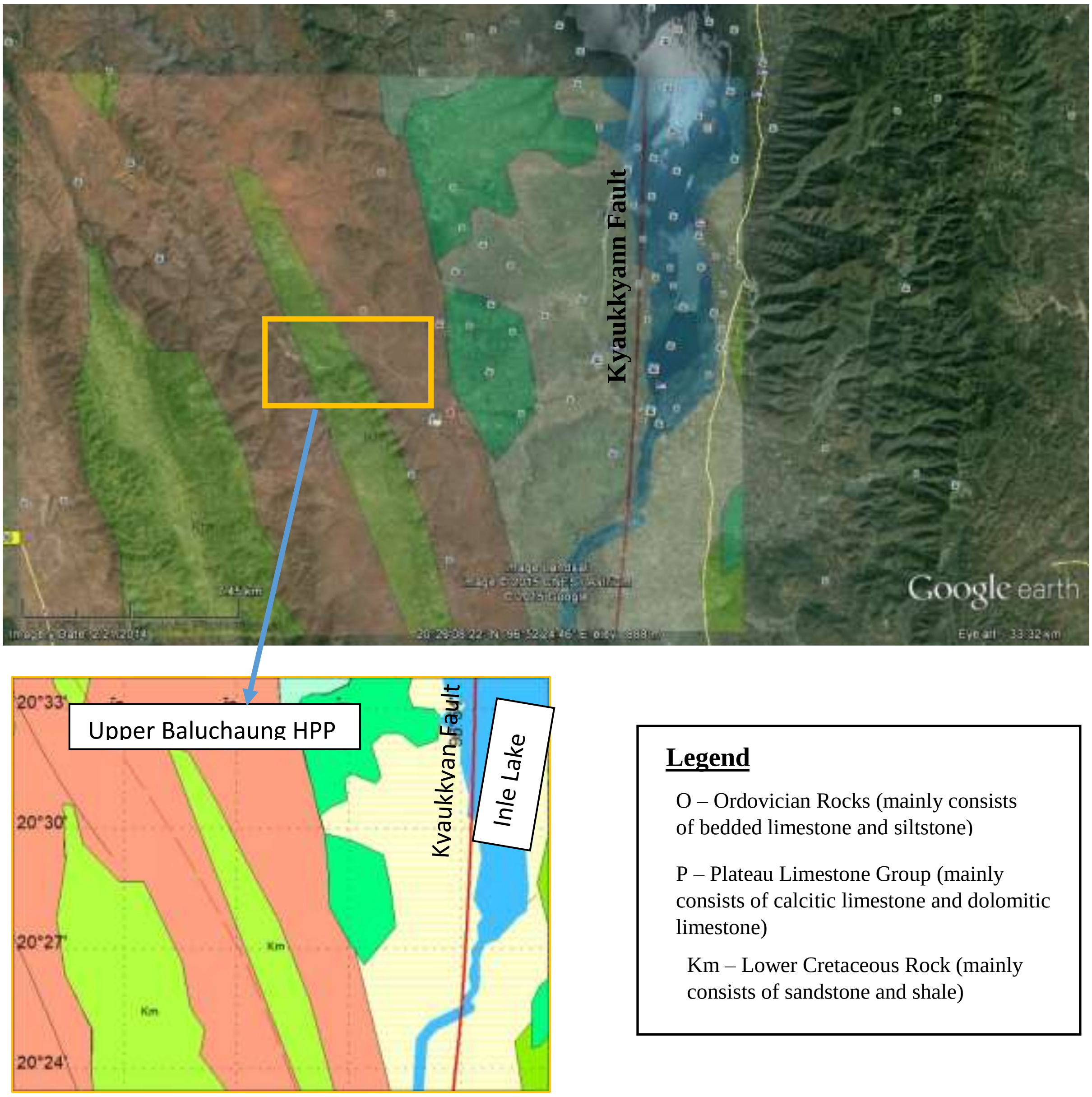


Figure 4.1.8-1 Geological Map of the Upper Baluchaung Area

4.1.9 Ecology Resources, Flora and Fauna

4.1.9.1 Fisheries

Regarding the fish species which are found in the project area (in the Upper Baluchaung river as well as in the downstream of Inle Lake), two sets of data were collected from the local authorities viz. Shan State Fisheries Department, Taunggyi and Administrator's Office of the Inle Lake Wildlife Sanctuary under the Forest Department of Nyaungshwe Township.

Although; several species of fishes are found in the Inle Lake, the commercial fishery do not exist and the villagers (fishermen) are catching fish for their daily subsistence and for individual selling at local markets.

"In Inle Lake, there is a number of endemic species, over twenty species of snails and nine species of fish are found in the nowhere in the world, like, *Sawbwa replenden* and *Microrashora erythromicron*.

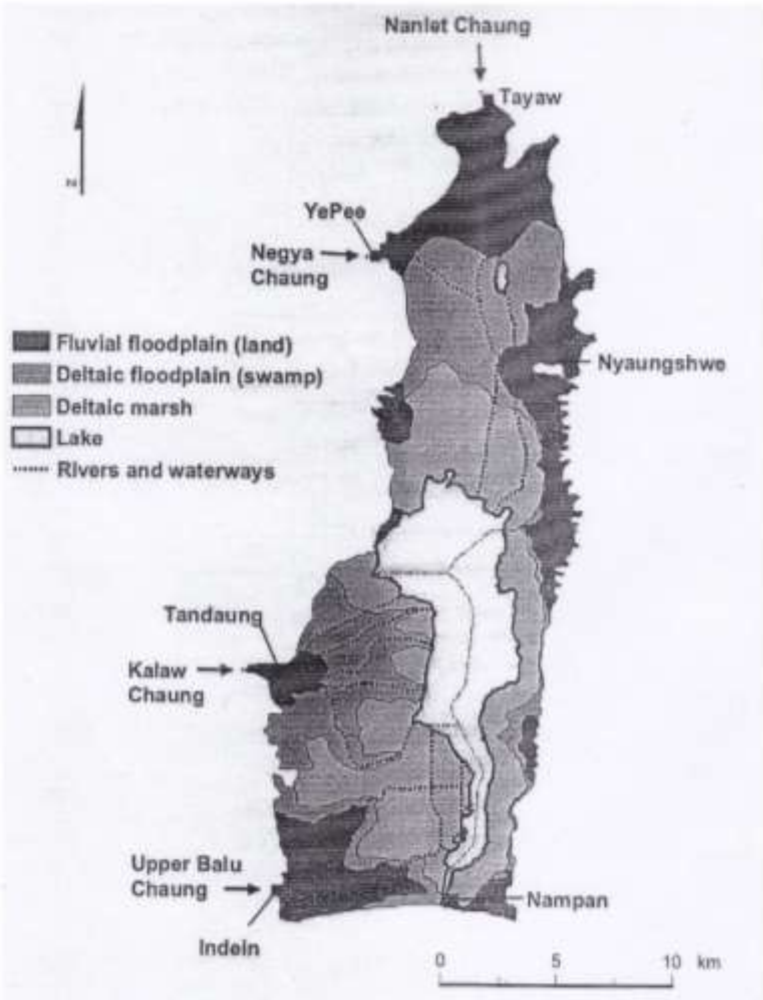


Figure 4.1.9-1: Land classification of the lake area Inle catchment.

Source: Takahisa Furuichi, Final Report, March2008.

According to the villagers from Minlon village only two species *Cyprinus inthar* (Nga Hpein) and *Puntius schanicius* (Nga yit) are found in the Upper Baluchaung river. They used to stay and breed underwater between rock boulders and during rainy season, they come up to the river surface because of the muddy water so fishing becomes easier.

4.1.9.2 Forest

The Project Area lies within the West Inle Sparse Forest.

Along the Upper Baluchaung river evergreen trees with clusters of bamboo are found. At the higher elevation, due to the limestone formation with shallow vegetation no big trees are found, only shrubs and bushes are exist.

A list of species of Plant, herb and orchid, which are found around the Project Area is obtained from Botany Department of Taunggyi University.

Among the Orchid (2) native species Moe lone maing (*Van da coerulea* Griff.ex lind) and Tha put (*Phains tankervilleae* Banks ex L'lter) Bl are listed Near Threatened.)*

* **Zoology Department, University of Taunggyi**

Figure 4.1.9.2-1: Vegetation condition of project area.

4.1.9.3 Wildlife

Due to the sparse forest and human settlements in the project area, wildlife in the area is just common to the animals which are found elsewhere in the other area of the country such as monkeys, wild cat, rabbit, barking deer etc.

During the site reconnaissance in Jan 2010, Minlone villagers reported that a hunter was attacked by a leopard, while hunting in night time.

4.1.9.4 Protected Area

In 1985, the Forest Department established Inle Lake Wetland Wildlife Sanctuary: a legally protected area for conservation of the wetland ecosystem. The northern marsh of the Lake, near Nyaungshwe town is specifically designed as a bird presentation area. The marsh around the lake provides habitats for native birds as well as migratory birds including “near threatened” and “vulnerable” species, near threatened species include Ferruginous Pochard and Black Bellied Tern. Vulnerable species include Eastern Sarus Crane, Baer’s Pochard, Indian Skinmer, Greater Spotted Eagle and Oriental Darter.**

Inle Lake was designated as the first biosphere reserve of Myanmar on 9th June 2015, becoming the part of the World Network of Biosphere Reserves (WNBR) under the UNESCO Man and the Biosphere (MAB) Programs.

Covering a total area of 489,721 hectares, the Inle Lake biosphere reserve is situated in Taunggyi of Shan State. The wetland ecosystem of this freshwater lake is home to 267 species of birds, out of which 82 are wetland birds, 43 species of freshwater fishes, otters and turtles. Diverse flora and fauna species are recorded and the lake is reported to be the nesting place for the globally endangered Sarus crane (Grusantigone). Inle Lake and its watershed provides several ecosystem services on which local people depend, including clean air, clean water, a cooler climate, fish stocks and other resources. Inle Lake is the second largest inland body of water in the country. Encircled by mountains, the lake and its surroundings provide as picturesque landscape for local and foreign travellers.

4.2. Economic Development

4.2.1. Transportation System

Yangon-Taunggyi highway passes through the Project Area at Taung-le-lone which is 21miles (33.6Km) north from the Project Area. Between Taung-le-lone and Khaungdaing, a place where there are several hotels for tourist visiting to Inle Lake and a famous hot-spring, an all-weather public road is connected. The road is tarred, 10.5miles (17Km) long and about 13ff (4m) wide.

From Khaungdaing, there are two ways of transport to Indein village. One way is through Inle Lake by boats. This way is usually used by tourist to visit Indein and villagers for transporting agricultural product. It takes about 45 minutes. The other way, a dry weathered road is connected between Khaungdaing and Indein. It is hard to travel by car. The road section was near abandoned and maintenance work not carried out for so long. There are several large and small timber bridges across the small streams on the road section which needs reconstruction. During dry season, motorcycles or Troller-G (Chinese made low speed vehicle with carrier attachment) are used to travel along this road for transporting agricultural product. In the lake area, the villagers are used to travel along Indein Chaung by motorized boats.

Between Indein and Minlon a small village in the Project Area there is a dry weather road about 3.1miles (5km) long.

4.2.2 Water Supply

Minlone villagers are using water from nearly spring and pumped water from the Baluchaung for domestic and drinking purpose. The river water is pumped up to the higher ground level around Minlone monastery and stored in the concrete tanks and from there, gravity system plastic pipes supply water through several waters taps along the road of Minlone village. This water supply scheme was said to be financed by UNDP.

At the downstream of the Project Area, Indein villagers are using four water wells and Upper Baluchaung river water for their domestic use. Near the road bridge across the river at the foothill of the Pagoda, people used to have bath in the river.

4.2.3 Power Supply

Electricity is supply to the villages around the Project Area by micro hydropower stations, constructed by villagers themself with the technical assistance from private technicians. The investment for the power stations and transmission lines were used to share among the villagers. The electricity is only supply during night time from 6pm to morning 6am. In order to pay the salary of operator, some villages collected 500 Kyats per month per 40w fluorescent lamp and 1000 Kyats per month per TV Set. The list of the micro hydropower stations is shown in Table 4.2.3.-1 and Figure 4.2.

Table 4.2.3-1 List of micro hydropower stations around the Project Area

No.	Name of Hydropower Station	Installed Capacity (kw)	Household electrified (Nos)	Remarks
1.	Pat tu bauk	5	50	Lighting
2.	Saung wun	20	85	Lighting
3.	Nan yok	50	180	Lighting + TV
4.	Hti ganaing	20	150	Lighting
5.	Naung wo	20	60	Lighting
6.	Sein thaung	5	35	Lighting
7.	Min lone	7.5	35	Lighting
8.	Indein gon	30	120	Lighting + TV
9.	Taung-gye	50+100	150	Lighting + TV
10.	Indein-lepyin	100	500	-Under construction short of fund
11.	Tone-le	400	200	-Under construction and suspended

4.2.4 Tourism Facilities

Indein village located on the west bank of the lake is one of hot spot of tourism around Inle lake due to the existence of ancient complex of pagoda on the hill south west to the Indein village. A buddha image has enshrined at a whitewashed stupa, which is summit of a hill. Below the stupa and the hill are cluster of hundreds of ancient stupa (The nos of about 1054) most ruins, overgrown with bushes. During the tourist season, more than 100 nos. of foreign tourist are used to visit this pagoda complex daily. From the foot hill there is a stair way about 0.75km long. Along the stair way many shops selling antique, traditional product like Inle bag, fabrics, wood curvings attracted the visiting tourist. (Figure 4.2.4-2)

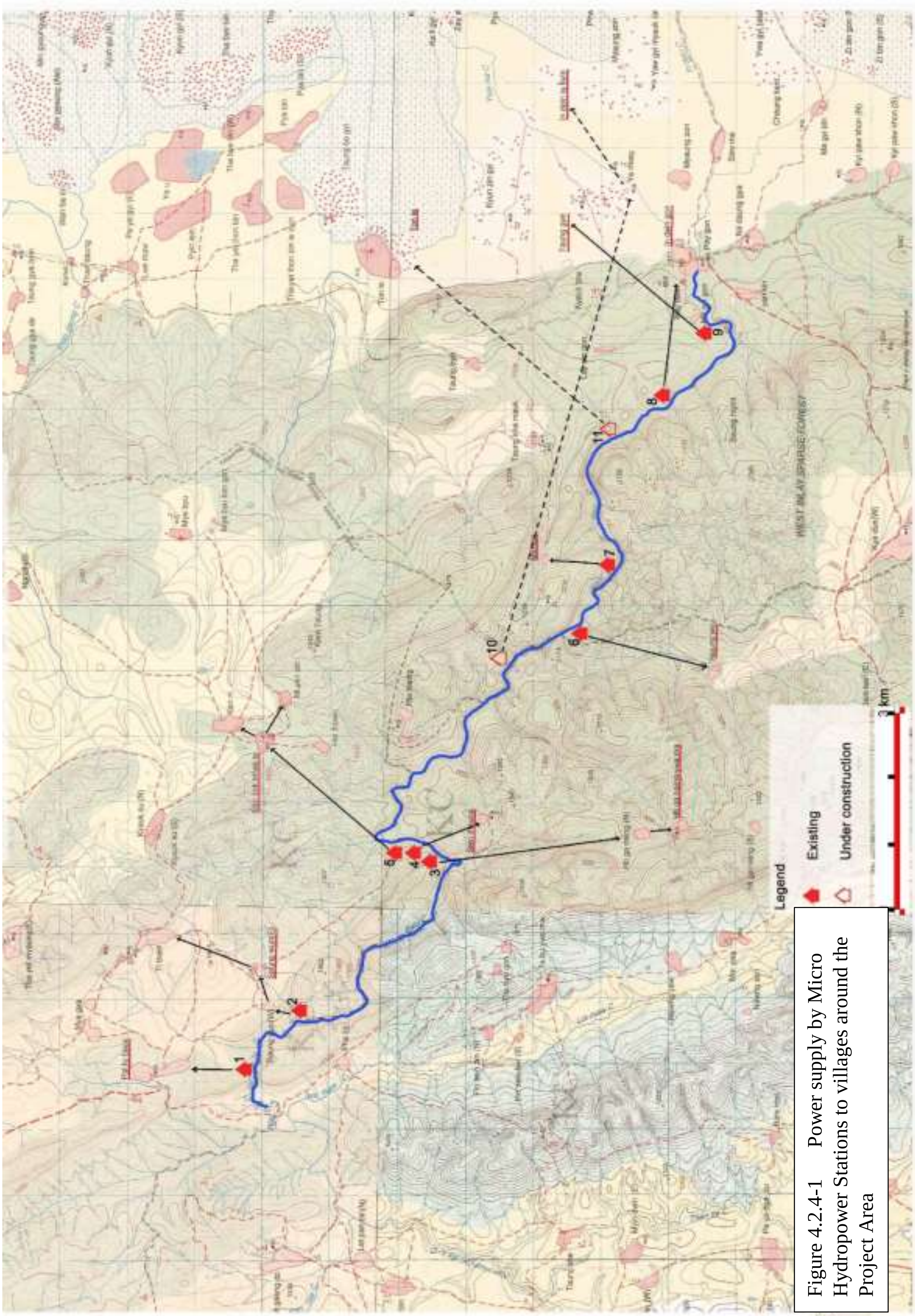


Figure 4.2.4-1 Power supply by Micro Hydropower Stations to villages around the Project Area

Figure 4.2.4-2: Pagoda of Indein Village and tourist attractive traditional products.

4.2.5 Agriculture

Within the upland area of the Project, taung ya is main livelihood of the villagers. Cheroot leaf plantation is seen around Minlone village at the plain area and other crops such as soya bean, pulse, turmeric plantations are seen at mountain slope.

Downstream from Indein the fluvial floodplains with network of irrigation canals, are used extensively for paddy cultivation. Just upstream of Indein, an irrigation concrete weir was constructed since about 1910 for supplying irrigation water to downstream cultivated land.

Figure 4.2.5-1: Main cultivation of the local people around the project area.

According to the local Agricultural Services Department, about 5000 acres of paddy land are using Baluchaung (Indein chaung) water for cultivation of summer paddy (second crop). The water requirement by months for summer paddy are shown as follows:

Month	Water Requirement	
	(Acre-ft)	(Cum/sec)
Jan - Feb	2000	0.57
Feb - Mar	15500	3.70
Mar - May	8500	1.42
May - June	400	0.15

Apart from the water supplied by the upstream weir, the farmers used Indein Chaung water by constructing temporary farmers' weir whenever they need additional water at specific time. Cultivated area and crop by villages are shown in Table 4.2.5-1.

Table 4.2.5-1 Cultivated Area and Crop

Village	Cultivated Area (Acre)	Crop
Minlone	203	Bean, Cheroot Leaf,
Kyauk taw	48.5	Bean
Indein	161	Paddy, Bean,
Floodplain downstream of Indein	5000	Paddy

Figure 4.2.5-2: Downstream water usage for summer paddy field from Upper Baluchaung River.

4.3 Social and Cultural Resources

4.3.1 Population and Communities

The Most favourable condition of the Upper Baluchaung Project is no affected peoples due to the project location and inundation due to flooding of reservoir.

Within the Project area only Minlone village is located on the road to the Project site. The village is 1Km away from UB-1 power station. The village is scattered into two parts; main village at about el 1125m and another part around Minlone Buddhist monastery at much higher elevation of about el 1210m. The villagers are Da-nu of ethnic Shan minority. They are Buddhist and farmers.

Another small village “Kyauktaw” is located at the junction of Khaungdaing – Indein road and Indein – Project Area road. The proposed project base camp is just south of Kyauktaw village. Indein is the largest village around the project located on the bank of Upper Baluchaung. The main source of livelihood are paddy farming and trading. It is a gateway to Inle Lake area from the Project area. Indein village is one of the hotspot of tourism due to the existence of ancient Indein pagoda complex, many local and foreign tourist are visiting to Indein, therefore various shops are exist at the village.

Indein is one of the market place around Inle Lake In lake area there is a custom that markets are not open everyday but on every fifth day. Although there are several villages around the Lake, there are only five markets Nam Pan, Thandaung, Mong pyo, Mong Thauk and Indein. The market serves most common shopping needs and is held daily but the location of the event rotates through five different villages.

One day in advance of market day, the villagers from nearby villages, somes far from the hills arrived at designated market place (Indein market) with the product to sell at market. The market used to start very early morning. In the market they also used to buy for their needs for another 4 days and returned back to their villages.

Figure 4.3.1-1 Indein Market that held one time in each fifth day period.

Table 4.3.1-1 Detailed data of the villages around Project area.

Name of villages	Population (Nos)	Household (Nos)	No of houses (Nos)	Nationalities
Minlone	171	34	34	Danu
Kyauktaw	100	30	31	Danu-Taung yoe
Indein	478	140	113	Pa-O, In tha & Taung yoe

Figure 4.3.1-2: House style of Indein village.

4.3.2. Health

Disease and nutritional deficiencies pose a serious problem to most of the rural residents of Myanmar. Available information suggests that the major health problems are related to water and mosquito borne diseases.

The main problem is the lack of suitable quality and quantity of domestic water supply system. None of the villages in the Project area have a treated water supply system and more severely most of the villages are situated on the higher elevation except Indein. None of the villages have more than rudimentary sanitation facilities.

Malaria: is the most common disease in the Project area. Another type of disease which was found in the Project area during field trips is severe renal colic due to stone in the urethra; the cause of which may be drinking of untreated river water of high lime content.

At Minlone one midwife is taking care for maternity treatment. One rural health care center with one midwife and one public health worker exist in Indein village. The patients from the villages around the Project area had to travel by boat to Ywama village about 5Km away, where there is a 20-bed hospital.

Table 4.3.2-1 Health Facilities around Project Area

No.	Village	Public health worker	Midwife	Hospital
1.	Minlone	-	1	-
2.	Kyauk taw	-	-	-
3.	Indein	1	1	-

4.3.3 Education

Education level around the Project area is much lower to the average level of the villages elsewhere in the country. Only two primary school (up to grade 4) exit for 3 villages. Indein primary school is also teaching up to Grade 7, although the school is not officially sanctioned for middle school. The villagers collected the fund for upgrading such as buildings and salary of additional teachers. After passing Grade 7, some students attend the high school at Ywama, 5Km away by boat.Most of the young villagers are middle school dropout, can speak and read Myanmar language but elderly speak only their native language. (Pa-O, Da-nu)

Figure 4.3.3-1: Basic Primary School at Minlone Village.

Chapter V Environmental Baseline Field Survey

5.1 Outline

The environmental baseline data collection field study was done during 9th June to 15th June 2015. The survey area is the hydropower project situated at upper Baluchaung River, Shwe Nyaung Township in Southern Shan State. There are total of three water quality surveyed points and two air and noise quality monitoring points. The locations of sampling points are shown in Figure 5.1.1-1.

5.1.1 Meteorology and Air Quality

Survey Item

Parameters for air quality survey were determined by referring environmental quality standard for air in Japan, and IFC as shown in Table 5.1.1-1. As for CO and NO_2, the standards in Japan were applied. And SO_2, PM 2.5 and PM 10, the standards in IFC were applied.

Table 5.1.1-1: Survey Parameters for Air Quality

No.	Parameter	Unit	Environmental Standard (24 hr)	
			Japan	IFC
1	Sulfur dioxide (SO_2)	ppm	-	20 µg/m^3
2	Carbon monoxide (CO)	ppm	<10 ppm	-
3	Nitrogen dioxides (NO_2)	ppm	<0.04~0.06 ppm	-
4	Particle matter 2.5 (PM2.5)	mg/m^3	-	25 µg/m^3
5	Particle matter 10 (PM 10)	mg/m^3	-	50 µg/m^3

Source: Notification of National Environmental Board No.10, B.E 2538 (1995); No. 24, B.E. 2547 (2014); and No.28, B.E 2550 (2007), Environmental Quality Standard for Air in Japan (1973, 1978).

Summary of sampling points

The locations of air quality monitoring points in detail are shown below.

Table 5.1.1-2: Locations of air quality monitoring station

Sampling Points	Coordinates	Description of Sampling Point
UBAQN-1	20°29'3.41"N 96°46'59.09"E	Near dam axis of Upper Balu Chaung River, Nyaung Shwe Township, Southern Shan State
UBAQN-2	20°28'3.29"N 96°49'55.81"E	At Base camp of Neo Energy Co., Ltd, northwest of Indein Village, Nyaung Swhe Township, Southern Shan State

Figure 5.1.1-1: Location map of the sampling point

Figure 5.1.1-2: Location map of air quality monitoring locations.

UBAQN-1

UBAQN-1 was measured near the intake dam axis on the left bank of the Upper Balu Chaung River that is entering to the Inle Lake; fresh water and second largest lake in Myanmar, Nyaungshwe Town, and Southern Shan State. The river is generally draining from southwest to northeast and hilly topography at sampling point. The sampling location was covered with the two abutments; with trees in hilly ranges though, the wind speed was moderately high. The mostly emitted pollution source might be come from the degraded secondary forest.

Figure 5.1.1-3: Air quality monitoring at UBAQN-1

UBAQN-2

The location was surveyed at the base camp of Neo Energy Co., Ltd. in Nyaungshwe Town, Southern Shan State. UBAQN-2 was fared away about 165 m from the road; Aungban _Indein car road. The location was generally flat terrain with small grass land. The possible mostly emitted population source might be come from the human activities, and vehicles and motor bikes from the road.

Figure 5.1.1-4: Air quality monitoring at UBAQN-2

Survey Period

Air quality monitoring was daily conducted from 11^{st} to 13^{rd} June, 2015 and 20^{th} to 22^{nd} August, 2016. The measurement duration is shown in the following table.

Table 5.1.1-3: Sampling duration for air quality survey

Sampling Point	Survey Period (first time)	Survey Period (Second time)
UBAQN-1	11^{st} – 12^{nd} June, 2015	21^{st} – 22^{nd} August, 2016
UBAQN-2	12^{nd} – 13^{rd} June, 2015	20^{th} – 21^{st} August, 2016

Source: Resource & Environment Myanmar Co., Ltd.

Survey Method

Sampling and analysis of ambient air pollutants was conducted by referring to the recommendation of United States Environmental Protection Agency (U.S. EPA). The Haz-Scanner EPAS Wireless Environmental Perimeter Air Station was used to collect Ambient Air Monitoring data. The characteristics of the instrument are:

- Portable direct reading
- Configure up to 14 simultaneous air measurements including U.S. EPA criteria air pollutants
- Standard configuration measures PM10 or TSP particulates, NO_2, CO, temperature, and relative humidity

Table 5.1.1-4: Sampling and analysis method for air quality

No.	Parameter	Analysis Method
1	Carbon monoxide (CO)	On site reading
2	Nitrogen dioxides (NO_2)	On site reading
3	Nitric acid (NO)	On site reading
4	Particle matter 2.5 (PM2.5)	On site reading
5	Particle matter 10 (PM10)	On site reading
6	Relative humidity (RH)	On site reading
7	Sulfur dioxide (SO_2)	On site reading
8	Temperature	On site reading

Source: Resource &Environment Myanmar Co., Ltd.

Survey Result (first time)

UBAQN-1

Ambient gaseous levels were presented in Table 5.1.1-5. All of the average ambient gaseous level during 24 hours monitoring were lower than the environmental standard (1-day) in Japan and IFC standards. It indicated the area had few particulate matters and emission sources which were not higher than the standard in the baseline data measurements.

Table 5.1.1-5: Ambient gases levels at UBAQN-1

No.	Date	Time	CO	NO2	NO	PM 2.5	PM 10	RH	SO2	Tmp C
D.M.Y		hours	ppm	ppm	ppm	µg/m3	µg/m3	%	µg/m3	Deg. C
Maximum		24	2.25	0.44	3.80	71.00	420.00	94.00	30.20	0.04
Average		24	0.16	0.05	0.27	10.40	40.10	73.63	2.20	0.02
Minimum		24	0.00	0.00	0.00	1.00	2.00	40.00	1.00	0.02
Target Value		24	10	<0.06	-	25	50	-	20	-
Standard			Japan	Japan		IFC	IFC		IFC	

Source: Resource & Environment Myanmar Co., Ltd.

UBAQN-2 (first time)

Ambient gaseous levels were presented in Table 5.1.1-6 All of the average ambient gaseous level during 24 hours monitoring are lower than the environmental standard (1-day) in Japan and IFC standards. It indicated the area had only few particulate matters and emission sources in the baseline data measurements.

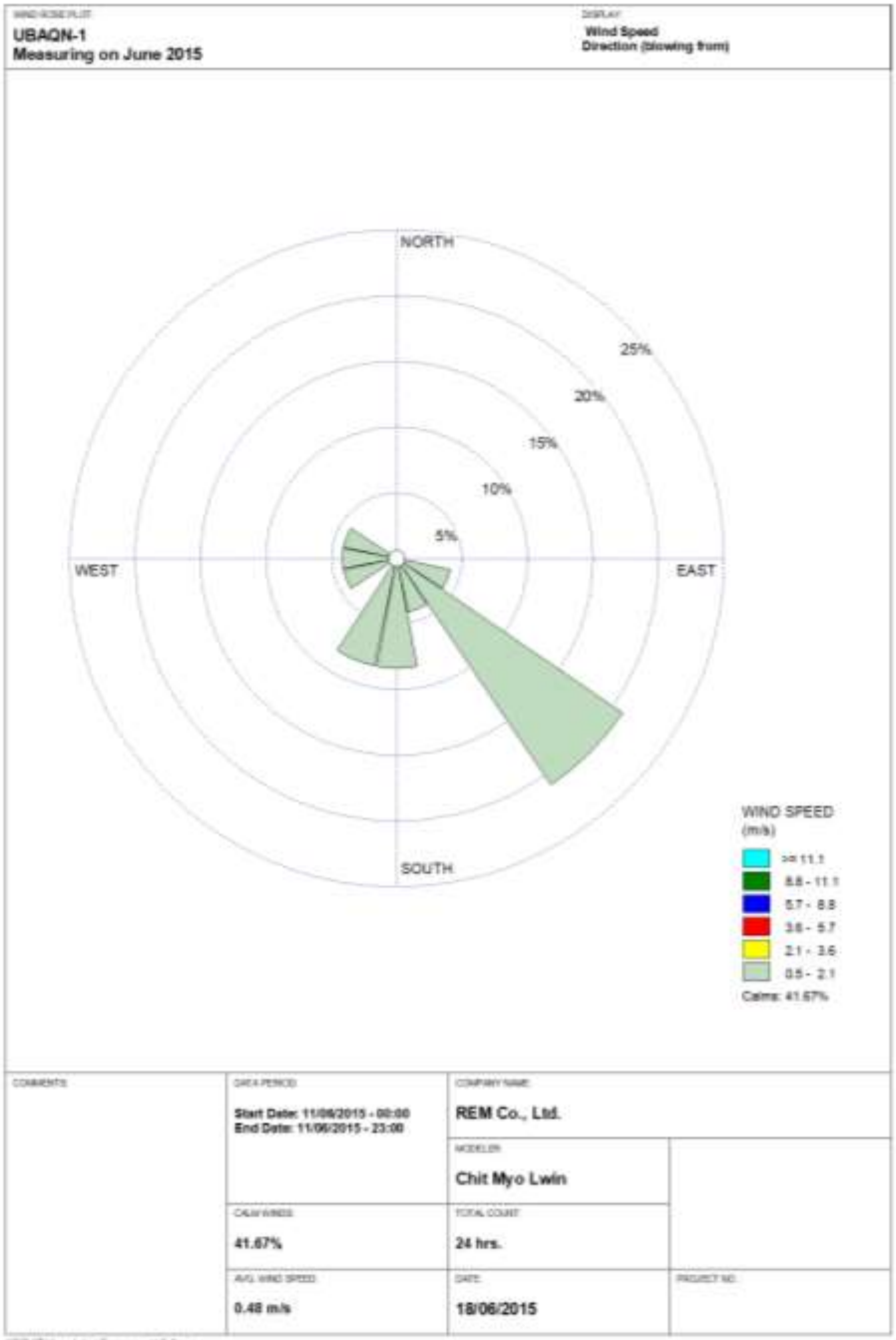
Table 5.1.1-6: Ambient gases levels at UBAQN-2

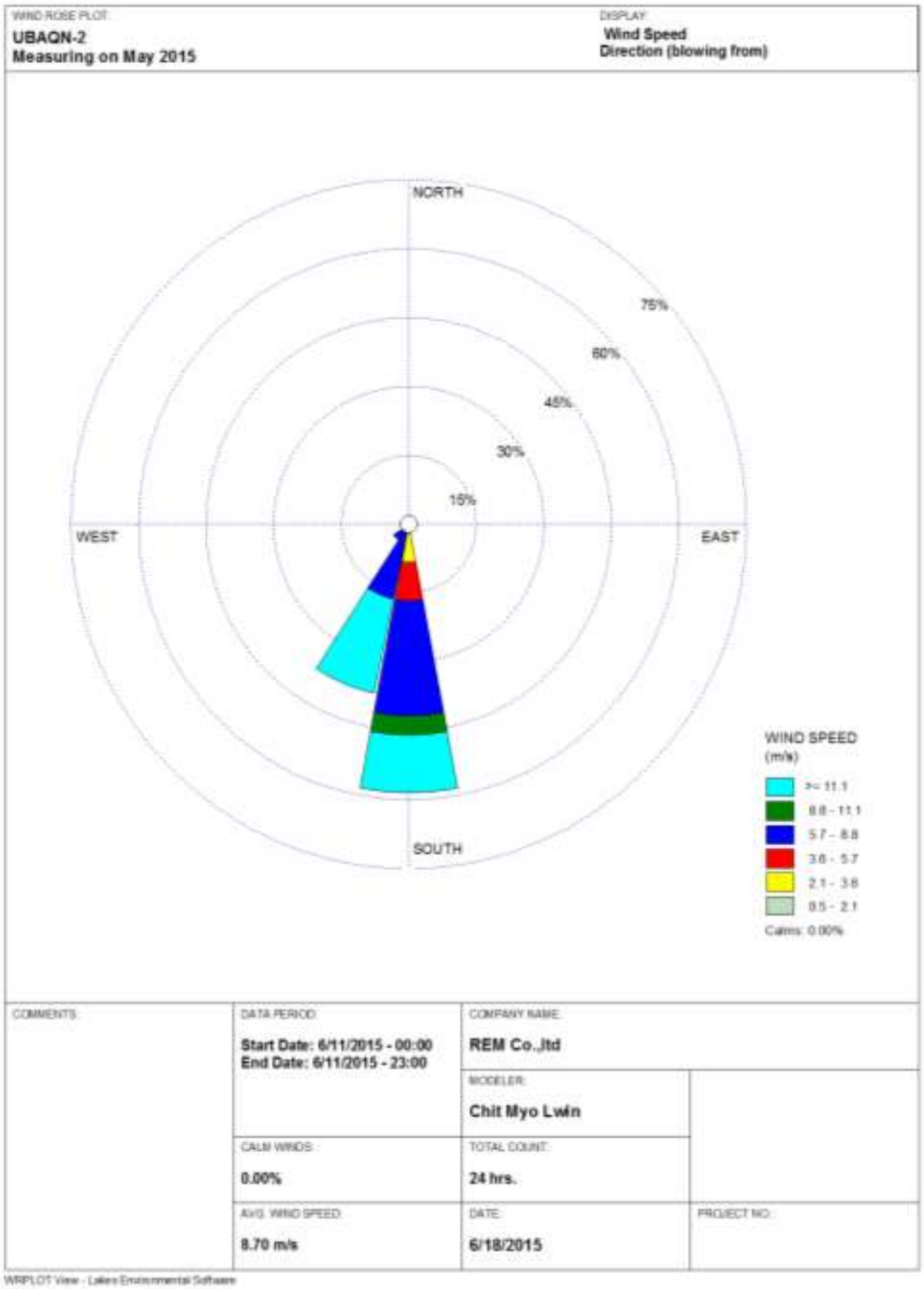
No.	Date	Time	CO	NO2	NO	PM 2.5	PM 10	RH	SO2	Tmp C
D.M.Y		hours	ppm	ppm	ppm	µg/m3	µg/m3	%	µg/m3	Deg. C
Maximum		24	0.19	0.08	4.00	42.10	62.10	94.00	52.00	0.04
Average		24	0.11	0.03	0.19	18.44	35.21	73.63	2.63	0.02
Minimum		24	0.00	0.00	0.00	2.00	1.00	40.00	1.00	0.02
Target Value		24	10	<0.06	-	25	50	-	20	-
Standard			Japan	Japan		IFC	IFC		IFC	

Source: Resource & Environment Myanmar Co., Ltd.

The wind speed and wind direction during monitoring time is presented in the following figures.

Wind Speed and Direction (first time)





Survey Result (second time)

UBAQN-1

Ambient gaseous levels were presented in Table 5.1.1-7. All of the average ambient gaseous level during 24 hours monitoring were lower than the environmental standard (1-day) in Japan and IFC standards. It indicated the area had few particulate matters and emission sources which were not higher than the standard in the baseline data measurements. A few particulate and emission sources may be come from vehicle truckout during the survey periods.

Table 5.1.1-7: Ambient gases levels at UBAQN-1

No	Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y		24 hours	ppm	ppm	ppm	µg/m3	µg/m3	%	µg/m3	Deg.C
Maximum		24 hours	0.16	0.04	0.00	34.00	37.45	98.45	54.41	30.11
Average		24 hours	0.07	0.02	0.00	18.06	22.86	79.71	14.62	22.34
Minimum		24 hours	0.00	2.00	0.00	1.43	4.88	53.43	1.00	18.00
Target value		24 hours	10	<0.06		25	50		20	
Standard			Japan	Japan		IFC	IFC		IFC	

Source: Resource & Environment Myanmar Co., Ltd. Shaded area shows higher than the standard.

UBAQN-2

Ambient gaseous levels were presented in Table 5.1.1-8. All of the average ambient gaseous level during 24 hours monitoring are lower than the environmental standard (1-day) in Japan and IFC standards. It indicated the area had only few particulate matters and emission sources in the baseline data measurements. A few particulate and emission sources may be come from vehicle truckout during the survey periods.

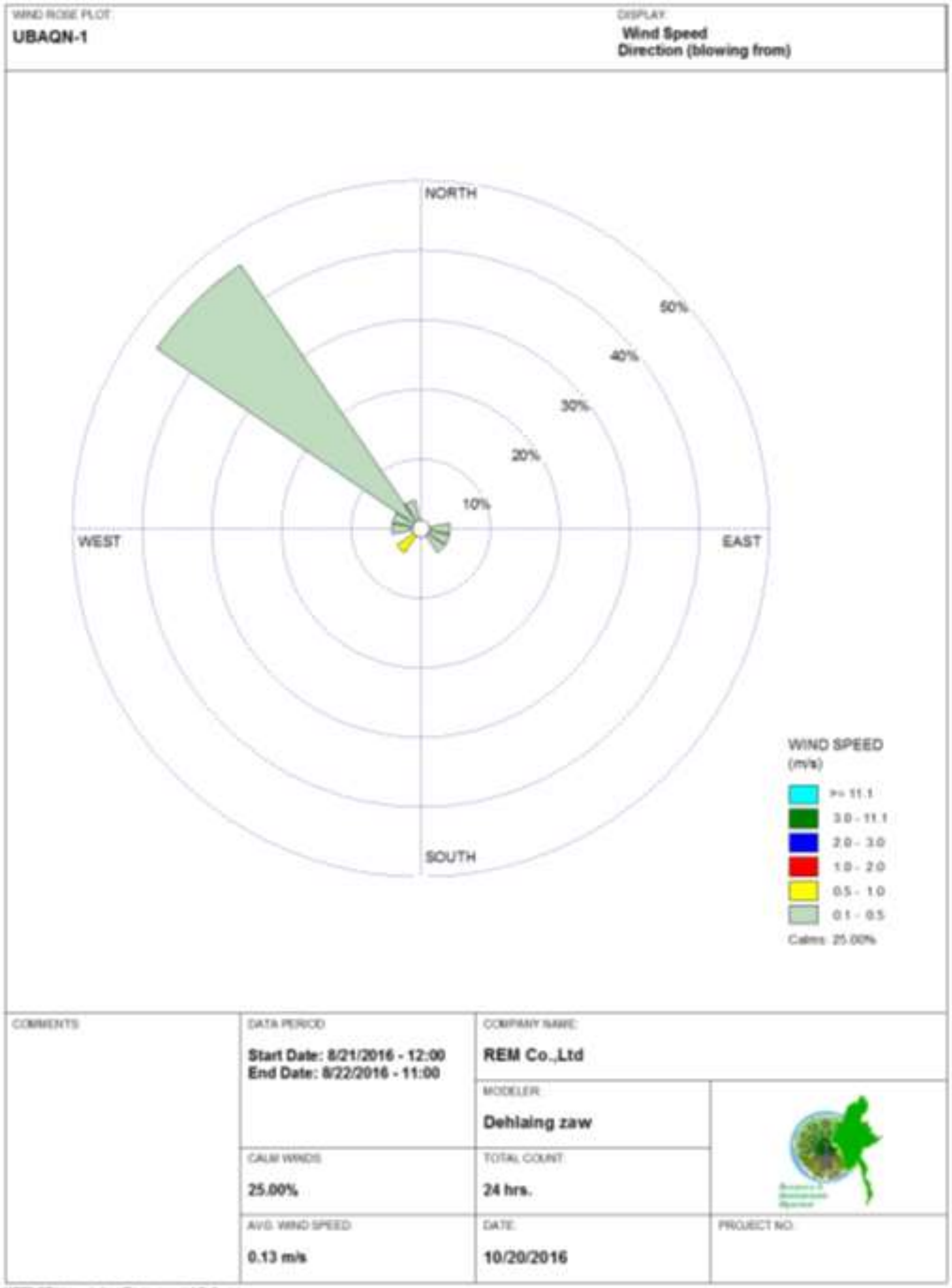
Table 5.1.1-8: Ambient gases levels at UBAQN-2

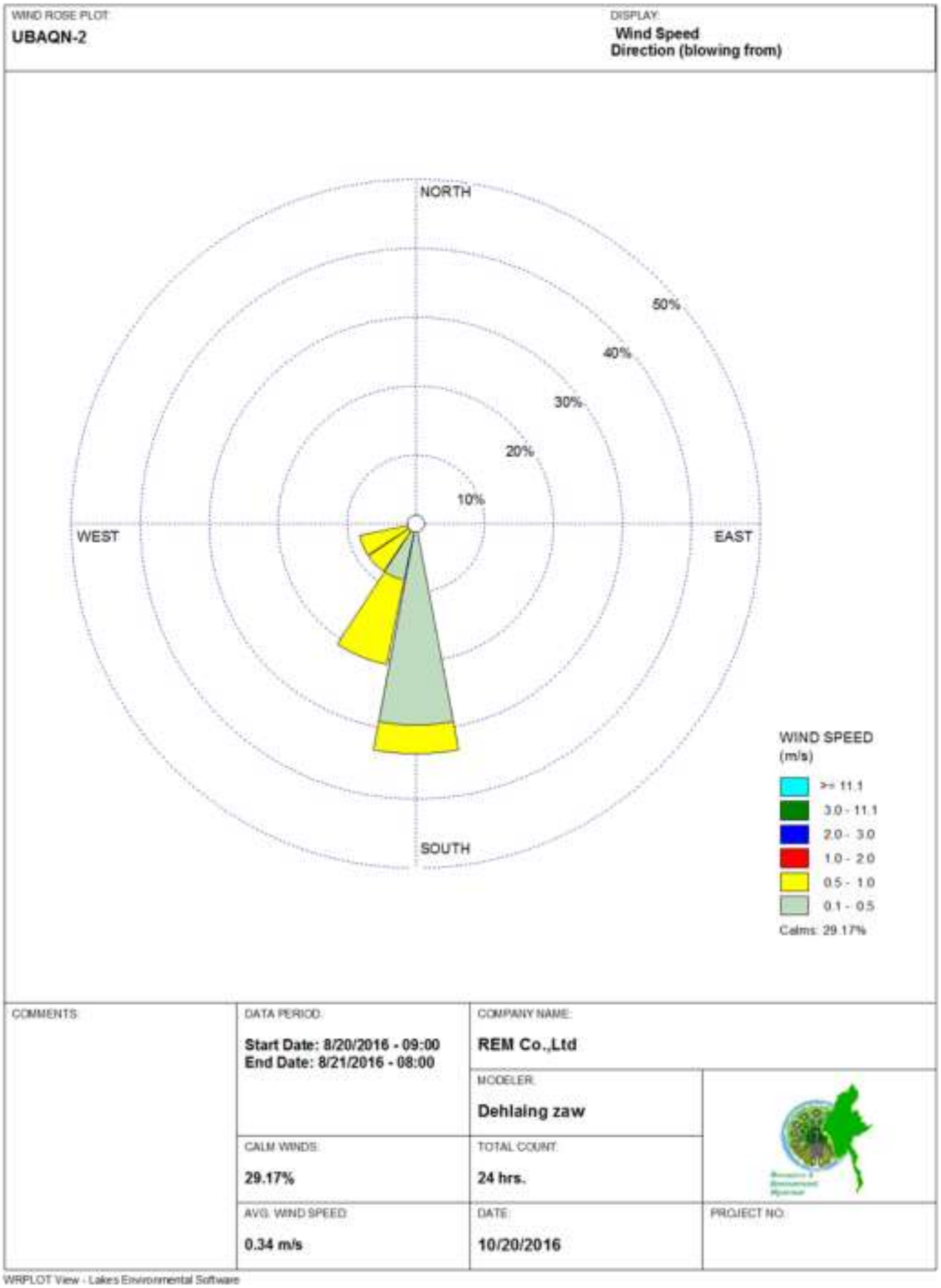
No	Date	Time	CO	NO2	NO	PM2.5	PM10	RH	SO2	TmpC
D.M.Y		24 hours	ppm	ppm	ppm	µg/m3	µg/m3	%	µg/m3	Deg.C
Maximum		24 hours	0.21	0.14	0.08	26.15	34.07	100.00	7.03	25.38
Average		24 hours	0.15	0.05	0.00	15.84	17.70	88.80	1.51	21.52
Minimum		24 hours	0.10	0.00	0.00	2.53	2.37	69.05	1.00	20.00
Target value		24 hours	10	<0.06	-	25	50	-	20	-
Standard			Japan	Japan	-	IFC	IFC	-	IFC	-

Source: Resource & Environment Myanmar Co., Ltd. Shaded area shows higher than the standard.

The wind speed and wind direction during monitoring time is presented in the following figures.

Wind Speed and Direction (second time)





5.1.2 Noise Level

Survey Item

Parameter for noise level survey was determined by referring the environmental quality standards in Japan as shown in Table 5.1.2-1.

As there are no environmental standards for noise level in Republic of Myanmar, the survey result was evaluated by comparing with the environmental standards and request limit for road noise in Japan.

Table 5.1.2-1: Survey Parameters for Noise Level

No.	Parameter	Unit		Environmental Standard	Request limit for road noise
				Japan	
				Living Environment	Along Road
1	A-weighted loudness equivalent (LAeq)	dB	Daytime (6:00-22:00)	55	75
			Nighttime (22:00-6:00)	45	70

Note) Environmental Quality Standard for Noise (Category B, Residential Area) in Japan

Survey Location

The survey locations of noise measurement were as same as the air quality measuring locations.

Survey Period

Noise level survey was conducted on 24 hours. The measurement duration was also as same as the air quality monitoring survey.

Table 5.1.2-2: Sampling duration for noise survey

Sampling Point	Survey Period (first time)	Survey Period (Second time)
UBAQN-1	11st – 12nd June, 2015	21st – 22nd August, 2016
UBAQN-2	12nd – 13rd June, 2015	20th – 21st August, 2016

Survey Method

Measurement of environmental sound level was conducted by referring to the recommendation of International Organization for Standardization (ISO), ISO 1996-1:2003 and ISO 1996-2:2007. The instrumentation used for noise quality survey is shown in Table 5.1.2-3.

Table 5.1.2-3: Instrumentation for Noise Level Survey

Instrumentation	Description
Sound level meter	Sound level meter with SD Card, Model SL-4023SD

Survey Result (first time)

Noise levels (L_{Aeq}) of the monitoring points were presented in Table 5.1.2-4. One day L_{Aeq} was calculated by using the following array formula in the excel sheet. This formula is firstly used for hourly L_{Aeq} and then for the 24 hours L_{Aeq}.

10*LOG10(AVERGAE(10^((RANGE)/10)))

By means of the calculated results, 24 hours noise levels encountered at UBN-1 monitoring point is as 46 dB(A) at day time L_{eq} and 42 dB(A) at night time L_{eq} while 24 hours noise levels encountered at UBN-2 monitoring point is as 52 dB(A) at day time L_{eq} and 41 dB(A) at night time L_{eq}. All of the noise levels found lower than the request limit of noise in Japan.

Table 5.1.2-4: Hourly L_{Aeq} value in noise monitoring stations (First Time)

Unit: dB

Time	UBN-1 (LAeq)	UBN-2 (Laeq)
6:00-7:00	43	38
7:00-8:00	52	37
8:00:9:00	49	49
9:00-10:00	53	47
10:00-11:00	52	81
11:00-12:00	52	58
12:00-13:00	53	59
13:00-14:00	43	56
14:00-15:00	41	58
15:00-16:00	43	48
16:00-17:00	44	53
17:00-18:00	41	58
18:00-19:00	43	60
19:00-20:00	43	43
20:00-21:00	43	40
21:00-22:00	42	42
Day L_{Aeq}	46	52

22:00-23:00	43	42
23:00-24:00	43	38
24:00-1:00	45	41
1:00-2:00	43	40
2:00-3:00	40	46
3:00-4:00	41	48
4:00-5:00	40	38
5:00-6:00	42	37
Night L_{Aeq}	42	41

Survey Result (second time)

Noise levels (LAeq) of the monitoring points were presented in Table 5.1.2-5. One day LAeq was calculated by using the following array formula in the excel sheet. This formula is firstly used for Hourly LAeq and then for the 24 hours LAeq.

10*LOG10 (AVERGAE (10^ ((RANGE)/10)))

By means of the calculated results, 24 hours noise levels encountered at UBN-1 monitoring point is as 64 dB(A) at day time Leq and 65 dB(A) at night time Leq while 24 hours noise levels encountered at UBN-2 monitoring point is as 52 dB(A) at day time Leq and 41 dB(A) at night time Leq . According the results, noise level of UBAQN-1 found higher than the request limit of noise in Japan. The unusual noise may be come from the construction activities during the daytime and unusual stream flowing around the monitoring station. But, the noise level result of UBAQN-2 found lower than the standard.

Table 5.1.2-5: Hourly L_{Aeq} value in noise monitoring stations (Second Time)

Unit: dB

Time	UBAQN-1(Laeq)	UBAQN-2 (Laeq)
7:00-8:00	67	40
8:00:9:00	66	35
9:00-10:00	61	38
10:00-11:00	62	45
11:00-12:00	63	44

12:00-13:00	66	45
13:00-14:00	63	49
14:00-15:00	63	55
15:00-16:00	65	53
16:00-17:00	65	48
17:00-18:00	64	43
18:00-19:00	64	43
Day L_{Aeq}	64	45
19:00-20:00	64	47
20:00-21:00	64	42
21:00-22:00	65	44
22:00-23:00	65	41
23:00-24:00	65	52
24:00-1:00	65	44
1:00-2:00	65	40
2:00-3:00	65	38
3:00-4:00	65	41
4:00-5:00	65	40
5:00-6:00	72	45
6:00-7:00	65	41
Night L_{Aeq}	65	43

5.1.3 Water Quality

Survey Item

Parameters for water quality survey are determined so as to cover the parameters of existing environmental standards.

Table 5.1.3-1: Survey Parameters for Water Quality Survey

No.	Parameter	Unit	Environmental Standards	
			Japan1)	Vietnam2)
1	Temperature	ºC	-	-
2	pH	-	6.0~8.5	5.5〜9
3	DO	mg/L	>=2	>=4
4	EC	µS/cm	-	-
5	Total Dissolved Solid	ppm	-	-
6	COD	mg/l	5	30
7	BOD5	mg/l	8	15
8	Total Nitrogen	mg/l	-	-
9	Oil & grease	mg/l	-	-
10	Total phosphorous	mg/l	-	-
11	Total Suspended Solid	mg/l	100	50
12	Ammonia Nitrogen	mg/l	-	-
13	Total Hardness	mg/l	-	-
14	Total Alkalinity	mg/l	-	-
15	Carbonate	mg/l	-	-
16	Chloride	mg/l	-	-
17	Fluoride	mg/l	-	-
18	Lead	mg/l	0.01	0.05
19	Arsenic	mg/l	-	-
20	Nitrate	mg/l	10	-
21	Total Coliform	MPN/100ml	-	7500

Note 1) Applied the standard "Agricultural use" and Health impact standard.

2) Applied the standard "Agricultural use"

Summary of sampling points

The locations of sampling points are shown in Table 5.1.3-2 and Figure 5.1.3-1. The detail of each sampling points is described as below.

Table 5.1.3-2: Sampling and survey points of surface water quality survey

Category	Sampling Point	Coordinates	Description of Sampling Point
Surface Water	UBSW-1	20°29'4.81"N 96°46'46.49"E	Near dam axis of Upper Balu Chaung River, Nyaung Shwe Township, Southern Shan State
Surface Water	UBSW-2	20°28'20.88"N 96°48'8.98"	At east of UB-2 power station in Upper Balu Chaung River, Nyaung Shwe Township, Southern Shan State
Surface Water	UBSW-3	20°27'25.85"N 96°49'59.66"E	At Upper Balu Chaung River, southwest of Indein Village and west of Shwe Indein pagodas, Nyaung Shwe Township, Southern Shan State

Figure 5.1.3-1: Location map of surface water quality survey points.

UBSW-1

UBSW-1 was surveyed and collected about 292 m south of dam axis, just upstream of the Upper Balu Chaung River, Nyaung Shwe Twonship, and Southern Shan State. The topography of location is covered with the hilly terrain. The river is generally flowing from northwest to southeast with the 18 m width and 0.5 m depth. The turbidity is high at sampling point.

Figure 5.1.3-2: Water quality survey at UBSW-1

UBSW-2

The water was collected and measured at just east of UB-2 in Upper Balu Chaung River, Nyaungshwe Town, and Southern Shan State. The river at this location is generally draining from southwest to northeast with high turbidity. The water of river in this location is utilized as washing and swimming for Minlon Village and fishing are occurred occasionally and seasonally in the river.

Figure 5.1.3-3: Water quality survey at UBSW-2

UBSW-3

UBSW-3 was surveyd at the downstream of the river and 915m far at southwest of the Indein village and 350 m far at west of Shwe Indein pagodas, Nyaungshwe Town, Sothern Shan State. The turbidity is moderately high and running from southwest to northeast at the sampling point. The river is generally draining with 12 m wide and 0.7 m depth. The water is utilized as domestic and drinking water for some people who are living the river nearby and plantation as well.

Figure 5.1.3-4: Water quality survey at UBSW-3

Survey Period

In the sampling and measuring the surface water in this area, the duration was from 11st – 13rd June, 2015 (first time) and 20th – 22nd August, 2016 (second time).

Survey Method

Water samples were taken by Alpha horizontal water sampler and collected in sterilized sample containers. All sampling was in strict accordance with recognized standard procedures. The parameters as pH, temperature, dissolved oxygen (DO), electrical conductivity (EC) and total dissolved solid were measured at each site concurrently with sample collection. Tide conditions were also noted. All samples were kept in iced boxes and were transported to the laboratory and stored at 2-4 °C refrigerators (Table 5.1.3-3 and 5.1.3-4)

Table 5.1.3-3: Field Equipment for surface water quality survey

No.	Equipment	Manufacturer	Originate Country	Model
1	SMART TROLL@ MP _Multi parameter for water	In_Situ Inc.	USA	-

2	Alpha Bottle (Water Sampler)	Wildlife Supply Company®	Indonesia	-

Table 5.1.3-4 Container and preservation method for water samples

No	Parameter	Container	Preservation
1	Oil and Grease	1000 ml glass bottle	Sulfuric acid, Refrigerate
2	COD	500 ml plastic bottle	Sulfuric acid, Refrigerate
3	BOD_5	1,800 ml plastic bottle	Refrigerate
4	Heavy metals	3000 ml plastic bottle	Refrigerate
5	Coliform Group	1000 ml glass bottle	Refrigerate
6	Others	2,800 ml polyethylene bottle	Refrigerate

The following table provides the test method for water quality.

Table 5.1.3-5: Analysis Method for Water Samples

No	Item	Analysis method
1	pH	SMART TROLL@MP _Multi parameter for water (pH sensor)
2	Dissolved oxygen (DO)	SMART TROLL@MP _Multi parameter for water (DO sensor)
3	EC	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
4	Total Dissolve Solid	SMART TROLL@MP _Multi parameter for water (EC/TDS sensor)
5	Total Suspended Solids	Based on standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012;4500-NH3B.C
6	Chemical oxygen demand(COD)	Dichromate method
7	Biochemical oxygen demand(BOD5)	Direct inoculation method
8	Total Nitrogen	Based on standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 4500-N_{org} C
9	Oil & grease	Based on Standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd 3ed, 2012 ; 5520B
10	Total Phosphorus	Laboratory manual for the Physico-chemical analysis of soil, water and plant; Phototmetric (Ascorbic) method

11	Ammonia Nitrogen	Based on standard methods for the examination of water & waste water APHA, AWWA & WEF, 22nd ed, 2012; 4500-NH3 B, C
12	Total Hardness	EDTA titrimetric method
13	Total Alkalinity	Titration method
14	Carbonate	Titration method
15	Chloride	Argentometric method
16	Fluoride	-
17	Lead (Pb)	AAS – Graphite Furnace Method
18	Arsenic	Arsenic test (highly sensitive)test kit
19	Nitrate ($N.NO_2$)	-
20	Coliform Group	AOAC Petrifilm Method

Survey Result (first time)

Laboratories

Water samples were sent to the ISO Tech Laboratory, and both SGS laboratories in Myanmar and Thailand.

Water quality results are shown in following Table 5.1.3-6. The detailed results are attached in Appendix-1.

Table 5.1.3-6: In-Situ Measurement and laboratory analysis of Surface Water Quality

No.	Item/Sample Name	Unit	UBSW-1	UBSW-2	UBSW-3
1	**Date /Time**	-	11.06.2015 11:41 am	12.06.2015 08:47 am	13.06.2015 10:28 am
2	**Weather**	-	Sunny	Sunny	Sunny
3	**Transparency**	-	Low	Low	Low
4	**Temperature _Water**	°C	24.13	24.14	24.59
5	**Temperature_ Air**	°C	34.00	31.20	30.20
6	**pH**	-	8.03	8.05	8.01
7	**DO**	mg/l	7.33	7.19	7.30

8	**EC**	µs/cm	398.9	419.7	385.9
9	**TDS**	ppm	259.31	272.79	250.82
10	**COD**	mg/l	32	32	32
11	**BOD**	mg/l	10	8	8
12	**Total Nitrogen**	mg/l	ND	ND	ND
13	**Oil & grease**	mg/l	ND	2.2	1.9
14	**Total Phosphorus**	mg/l	ND	ND	ND
15	**Total Suspended Solid**	mg/l	247	128	139
16	**Ammonia Nitrogen**	mg/l	ND	ND	ND
17	**Total Hardness**	mg/l	186	188	192
18	**Total Alkalinity**	mg/l	212	212	196
19	**Carbonate ($CaCO_3$)**	mg/l	Nil	Nil	Nil
20	**Chloride**	mg/l	4	5	5
21	**Fluoride**	mg/l	0.2	0.2	0.2
22	**Lead**	mg/l	Nil	Nil	Nil
23	**Arsenic**	mg/l	Nil	Nil	Nil
24	**Nitrate ($N.NO_3$)**	mg/l	Nil	Nil	Nil
25	**Coliform Bacteria**	cfu per ml	1	2	ND
26	**Escherichia Coli (E.Coli)**	cfu per ml	1	ND	ND

Survey Result (second time)

Laboratories

Water samples were sent to the ISO Tech Laboratory, and both SGS laboratories in Myanmar and Thailand.

Water quality results are shown in following Table 5.1.3-7. The detailed results are attached in Appendix-2.

Table 5.1.3-7: In-Situ Measurement and laboratory analysis of Surface Water Quality

No.	Item/Sample name	Unit	UBSW-1	UBSW-2	UBSW-3
1	Date / Time	-	21.08.2016	21.08.2016	22.08.2016

			12:09 PM	13:09PM	10:30 Am
2	Weather	-	Sunny	Sunny	Sunny
3	Transparency	-	Medium	Low	Medium
4	Temperature _Water	°C	23.83	24.06	22.6
5	Temperature_ Air	°C	27	31.5	25.3
6	pH	-	7.74	8.02	7.79
7	DO	mg/L	7.73	6	7.48
8	EC	µs/cm	250.6	272.7	256.3
9	TDS	ppm	166	180.18	174.39
10	Flow	m/s	1	0.7	0.6
11	BOD	mg/L	0.6	1.5	0.3
12	Total Nitrogen	mg/L	0.7	6	6
13	Oil & Grease	mg/L	1	<1.0	1
14	Total Suspended Solid	mg/L	303	447	<5.0
15	Total Alkalinity	mg/L	150	158	145
16	Nitrate	mg/L	6	0.46	0.36
17	Total Coliform	MPN/100mL	79	490	110
18	Fecal Coliform	MPN/100mL	49	79	68
19	E.coli	MPN/100mL	>23	>23	>23
20	COD	mg/L	16	17	16.4
21	Total Phosphorous	mg/L P	0.02	0.1	0.02
22	Ammonia Nitrogen	mg/L NH_3-N	0.14	0.2	0.15
23	Total Hardness	mg/L $CaCO_3$	168	170	166
24	Carbonate	mg/L $CaCO_3$	0	0	0
25	Chloride	mg/L Cl^-	ND	ND	ND
26	Fluoride	mg/L F^-	0.11	0.13	0.12
27	Lead	mg/L Pb	ND	ND	ND
28	Arsenic	mg/L	0.0044	0.0032	0.0029

5.1.4 Biological Environment

5.1.4.1 Introduction

Construction of major development project like hydropower project causes adverse impacts on the natural environment along with the positive impact on the economy of the country. The proposed upper Baluchaung hydropower project may cause the habitat loss and biodiversity degradation caused by construction of power house, assess road, small scale dam and temporary occupation of construction related activities. Diverse plants and animals may be adversely affected due to habitat loss, and degradation. The possible impacts of the proposed hydropower project on the natural environment and biodiversity were studied so that the adverse impacts could be minimized.

An ecological assessment is part of an EIA study for a designated project which may have an impact on the natural environment including existing flora, fauna and wildlife habitats. The term "ecology" includes both marine and terrestrial ecology. The main objective of ecological assessment is to provide sufficient and accurate ecological data to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. The methodology used may vary from case to case depending on the natural environment to be affected and the nature and scale of the project.

5.1.4.2 Study Area

There are three large streams flow down to Inle Lake from western mountain range, the Yepe (Heho), Thandaung (Kalaw) & Upper Balu Chaung. Among them, Upper Balu Chaung is the largest one with the biggest catchment (836 sq.km) and perennial flow. Upper Baluchaung River originates at about 2miles west of Pinlaung Township, and flows from south to north, then turns through to the east flat plain crossing the Aung Pan – Loikaw road and running through the west of Inle Lake via Indein village. Before flowing to the Inle Lake, the river flows through the west escarpment of Inle Lake forming waterfalls and cascades, so that it becomes riches of hydropower resources. Along the river, between Saungwun & Indein village about 17.5 km length, the natural head difference occurs about 320m. The distance of Study boundary is 1km radius from both side of the Upper Baluchaung River.

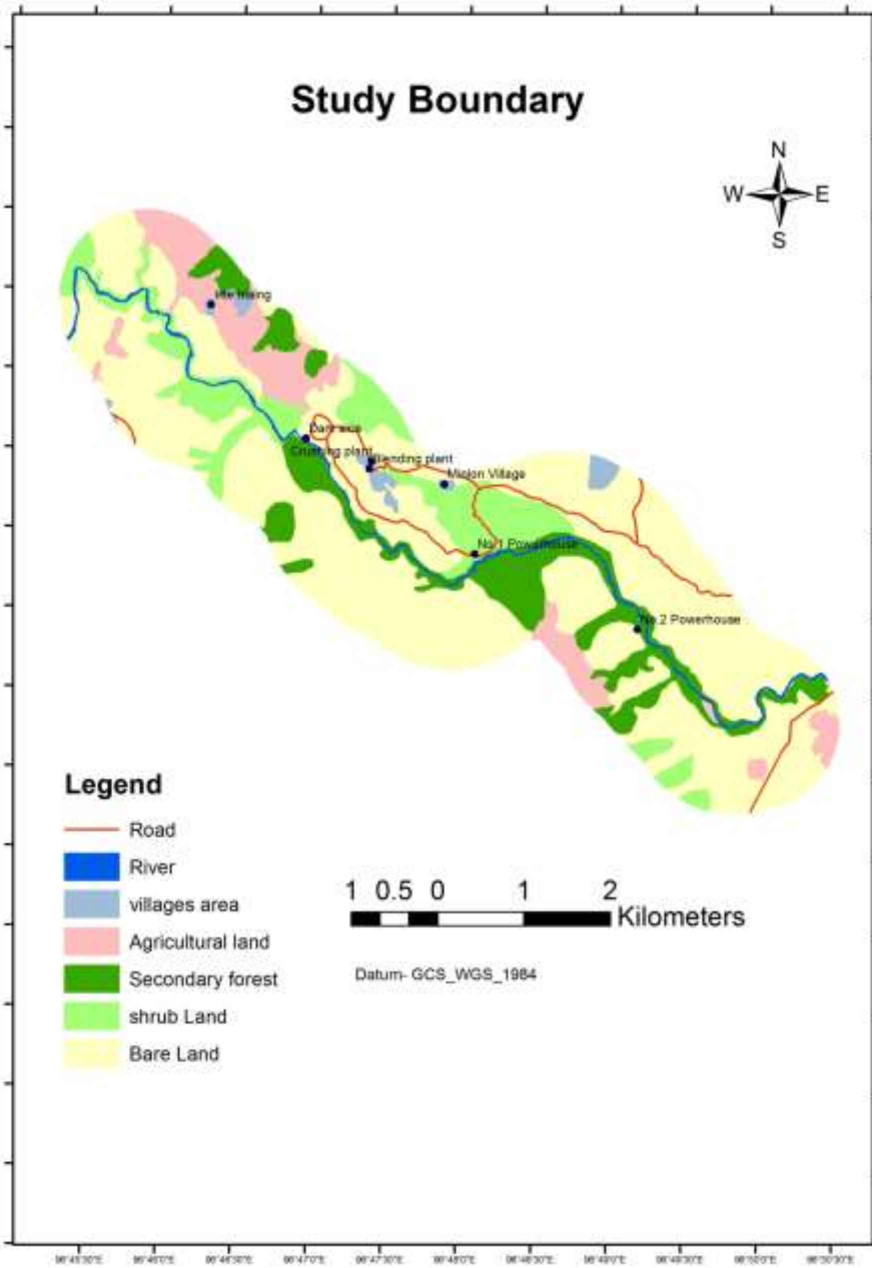


Fig 5.1.4-1: Figure of the study area and boundary of upper baluchaung hydropower project

5.1.4.3 The Scope and Content of Ecological Assessment

An ecological assessment shall consist of 5 parts of equal importance:

1. provision of comprehensive and accurate information on the ecological baseline;
2. identification and prediction of potential ecological impacts;

3. evaluation of the significance of the impacts identified;
4. recommendations of effective and practicable alternatives and mitigation measures; and
5. recommendations of the need for and the scope of an appropriate monitoring and audit programme.

5.1.4.4 Desktop Survey

Publicly available sources of information were analysed to build an outline of known and likely ecological values for the Study Area. Aerial imagery was used to build a more complete spatial understanding of the pattern of vegetation communities and human uses on the site, and to map access routes and internal tracks. All information sources with an explanation of how that information was used and any known limitations associated with its use in this context. In addition, ecologists with experience of the Study Area were consulted where possible to obtain information about species known to be present or previously recorded from the site, and other ecological values considered by them to be relevant. Where information in this report is reliant on this information, the source has been acknowledged.

5.1.4.5 Site Reconnaissance

A targeted site reconnaissance was conducted 20th August, 2016 to ground-truth information gathered during the desktop survey stage, and supplements it with site observations, data and photographs. The site reconnaissance targeted the following specific ecological and legislative/organizational objectives:

• To name, describe and map vegetation communities and habitats present within the Project Area at a suitable scale, using existing community nomenclature where possible;

• To identify, describe and map other ecologically sensitive areas within the Project Area such as springs, watercourses and other water bodies;

• To the extent possible within the survey time frame and season, determine if species of conservation significance known or predicted likely to be present in the Study Area are actually present within the Project Area;

• To ascertain the suitability of habitats present for flora and fauna species of conservation significance known or predicted likely to be present in the Study Area;

• To identify pest and weed species and other threatening ecological processes present within the Study Area, and to map occurrences within the Project Area at a broad scale;

• To identify opportunities for future ecological monitoring and enhancement within the framework of the proposed project.

In addition, where possible local people were consulted about the species known to utilize the Study Area, and how the Study Area is affected by seasonal variations (e.g. flooding levels, whether water bodies dry up in driest seasons, etc.). This anecdotal information has been acknowledged where it is included in this report.

5.1.4.6 Vegetation Communities

The Project Area lies within the West Inle Sparse Forest. Along the Upper Baluchaung River evergreen trees with clusters of bamboo are found. At the higher elevation due to the limestone formation with shallow vegetation no big trees are found, only shrubs and bushes are existed.

Table 5.1.4-1: Vegetation Community Description

Community name	Land form	Description
Shrub Land	Occurs in moist low-lying areas and along a narrow zone adjacent to streams.	Shrub land habitats contain thickets of shrubs and young trees mixed with scattered grasses and wildflowers.
Bushland	Land which is disturbed but still retains a predominance of the original floristic and structure.	Bushland provides a number of ecosystem services including the protection of water quality, stopping erosion, acting as a windbreak, and trapping nutrients. Bushland is prone to bushfires. This presents a challenge to authorities as infrastructure and habitations encroach into bushland areas.

5.1.4.7 Survey Items

Survey items for flora and fauna survey are as follows;

1. Vegetation
2. Inhabitants
3. Important species
4. Biodiversity and Ecosystem

5.1.4.8 Survey period

Flora and fauna survey was conducted on 11st June, 2015 and 20th August, 2016.

5.1.4.9 Methodology

(a) Field Observation

(1) Flora

A Global Positioning System was used to navigate and mark coordinates between sample plots around the study area. Field observation was conducted in and around the project area. In order to obtain essential ecological data for predicting flora of shrubs and herbs, 2m x 2m quadrats were laid down and observed. In each plot, every plant species was listed and counted. For the tree species 15mx15m quadrats were subjectively chosen and observed. In each sample plot every living tree of girth at breast height (GBH) ≥10cm was measured, listed and counted. In each subplot along the belt transect every plant species were listed and counted. Care has been taken to cover different elevation, slope, aspects, drainage and density gradients to study overall spectrum of species diversity. In addition, all trees, shrubs, herbs and cultivated crops were recorded and listed. Identification of plants and animal species was conducted with assistances of skilled local people. The identified species were translated to scientific name with assistance of the senior researcher at Yangon University. The families were identified by using key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994). Specimen identification was performed with the use of literatures by Backer *et a*l., 1963, and Kress *et al*. 2003 and confirmed at Herbarium in Department of Botany, University of Yangon.

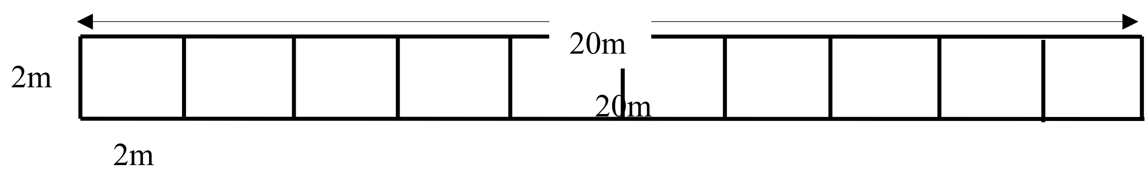


Fig 5.1.4-2: Lay out design of the belt transect

<u>(2) Habitat Map</u>

To obtain the habitat map, firstly we designate the 3km buffer zone, there is combination between field observation and secondary image from Google Earth and generate it applying in GIS software. At first, the field observations were performed for habitat survey at site collecting the data with the Garmin GPS and upload it in Map Info Software. On the other hand, the Google image was visually digitized based on the primary field survey. Finally, the habitat map was analyzed based on both of field survey and secondary image data using the Map Info software.

Sources & Tools

- Google Earth Images
- Map Info 11.0 and Discover
- Garmin GPS 62 cx
- Field survey

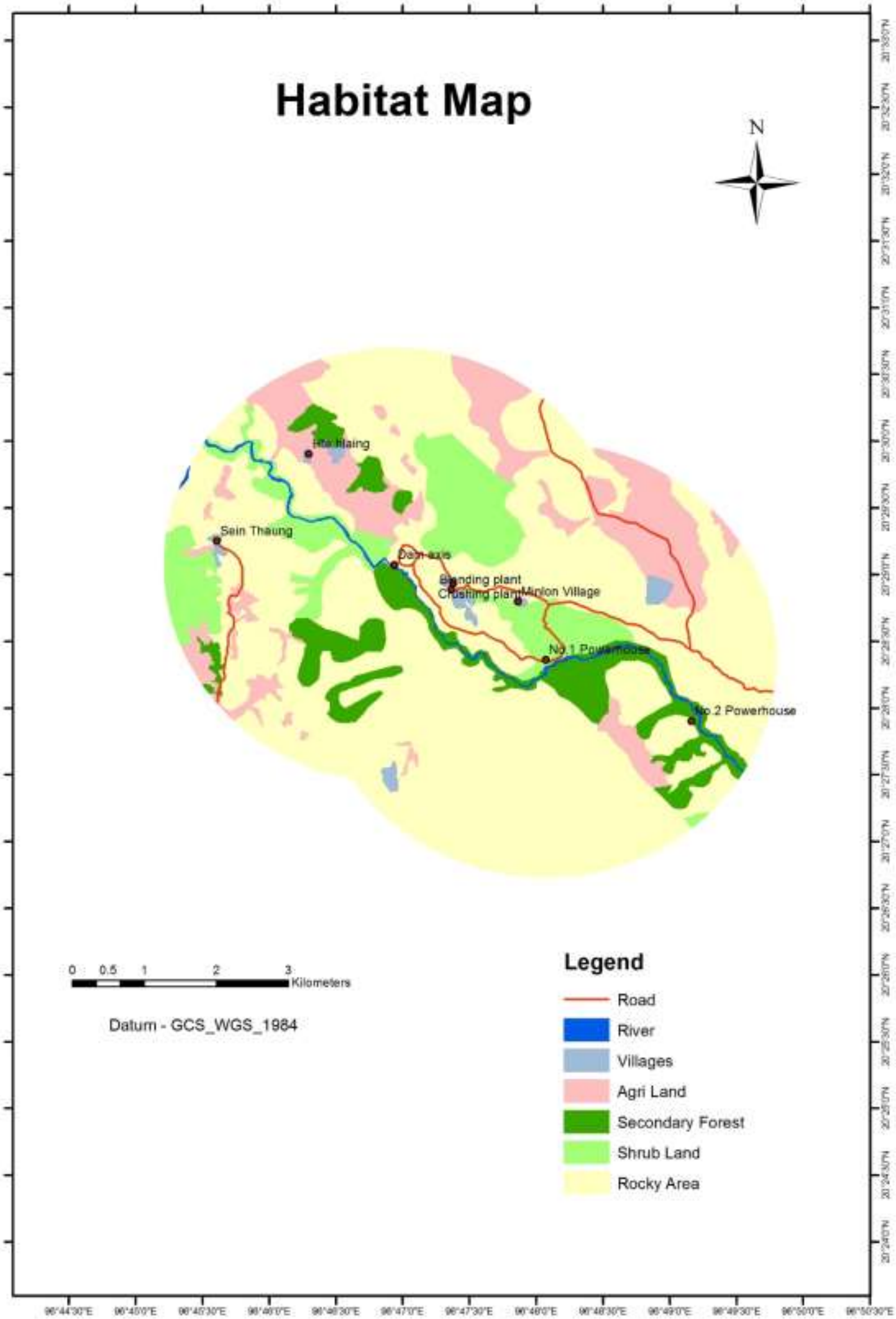


Fig 5.1.4-2: Habitat Map of the Upper Baluchaung Hydropower Project

(3) Fauna

Herpecto fauna were mainly collected by walking around in survey area. To identify the amphibian and reptile species, we took photos and capturing by hand. Some species were interviewed from local people. Butterflies species were collected by aerial net along the trail and collected species are packed by the trasipaper (triangle paper) and moth ball is placed in plastic box to keep the sample for long-life. Some Butterflies cannot identify in field so that we took photo and sample to identify the species with reference book. To study and identify the bird species, we use binocular and camera to take photos because some bird species cannot identify in field and then we check out the species with photos and reference book. When conduct the base line survey for bird species, we use the point count method in selected habitat. The species recorded from point count method, we use again the reference book to identify the species and listed in table to produce a complete species list. Interview survey from local people was used for mammal because some mammal lived in this area during past but they are not found in current. Mammal presence or absence in survey area was confirmed by interviewing from local people who are already being familiar with the forest. All data recorded in the survey area were collected in the field data sheet.

(4) Aquatic Fauna

Interviewed with local fisherman from the study area were conducted during the collection of the specimen. Fishermen were interviewed with regard to fishery process including kinds of gear used, number of fishing time per day, target species. The fishing gears are trap, hook and line and gill nets. The water body of the irrigation canal was studied for aquatic fauna. The fishes were collected with the help of the fishermen during the survey period. Traps were also used to get various types of fish like surface dwellers and bottom dwellers. The fishes were photographed soon after the collection and measurements were also taken for key characteristics. The fishes were then preserved in 10% formalin solution for further identification in the laboratory. The fishes were then identified according to Jayaram (1981) and Talwar and Jhingram (1991).

(b) Interviewing and literature survey

In addition to the field observation, secondary data was also surveyed by interviewing from local residents and literature reviewing. In the interview survey, the surveyor visited the residents in and around the survey area and interviewed the name of plants and animals existing in and around the area. Also, the past situation of flora and fauna, and the change on biodiversity and ecosystem in the area was interviewed for examination.

Fig 5.1.4-4: Interview survey from local people

5.1.4.10 Survey Result

(a) Flora

(1) Habitat

In the Area of upper baluchaung hydropower, four major habitat types were observed namely (1) patches of mixed vegetation with scattered trees, (2) cultivated land, (3) shrub land and (4) human habitation area. Habitat Map of upper baluchaung hydropower project area is already shown in Figure 3 and Sceneries of the Survey Area are shown in Figure 5.1.4.-5.

Fig 5.1.4-5: Sceneries of the survey area

(2) Survey Area

The survey area is shown in Figure 5.1.4-6.

Fig 5.1.4-6: Survey area

(3) Survey Result

There were 122 plant species identified in the survey area. The identified species were classified into 7 groups; they are tree, small tree, shrub, herb, creeper, climber and grass. List of identified plant species in the survey area was presented in table 2. During the field survey period that conduct on rainy seasons and dry seasons, species are recorded which based on the biodiversity of the Inle Wildlife Sanctury studied by the Natural and Wildlife Conservation Division (Nyaung Shwe). Primary data from field survey and secondary data of the NWCD are listed in Appendix A.

Table 5.1.4-2: List of plant species in survey area

No.	Family Name	Scientific Name	Common Name	Habitat	Distribution	IUCN 2015 ver.4.0	Remark
1	Annonaceae	*Annona squamosa*	Awzar	Small Tree	Cultivated	NL	
2	Moraceae	*Ficus religiosa*	Bawdi-nyaung	Tree	Cultivated	NL	
3	Asteraceae	*Chromolaena odorata*	Bezat	Shrub	Wide	NL	
4	Mimosaceae	*Mimosa rubicaulis*	Biat-hti-ka-yone	Herb	Yangon	NL	
5	Fabaceae	*Phaseolus vulgaris*	Bo-sa-pe	Climber/ Creeper	Cultivated	NL	
6	Rosaceae	*Prunus cerasoides*	Cherry	Tree	Chin, Kachin, Magway, Mandalay,	NL	

					Shan		
7	Euphorbiaceae	*Flueggea leucopyrus*	Chinya-phyu	Shrub	Kachin, Sagaing, Shan	NL	
8	Lythraceae	*Lawsonia alba*	Dan	Shrub	Cultivated	NL	
9	Caesalpiniaceae	*Cassia italia*	Dan-gywe	Shrub	Wide	NL	
10	Meliaceae	*Soymida febrifuga*	Dant-tagu	Tree	Bago, Mandalay	NL	
11	Bombacaceae	*Bombax insigne*	Didok	Tree	Wide	NL	
12	Anacardiaceae	*Spondias pinnata*	Gwe	Tree	Reported from Myanmar	NL	
13	Sapindaceae	*Schleichera oleosa*	Gyo	Tree	Wide	NL	
14	Lauraceae	*Persea americana*	Htaw-bat-thi	Tree	Cultivated	NL	
15	Pinaceae	*Pinus khasya*	Htinyu	Tree	Bago, Chin, Kachin, Mandalay, Sagaing, Shan	NL	
16	Dipterocarpaceae	*Shorea siamensis*	In-gyin	Tree	Wide	LC	
17	Asparagaceae	*Asparagus filicinus*	Ka-nyut	Herb	Chin, Kachin, Magway, Mandalay, Sagaing, Shan	NL	
18	Hypoxidaceae	*Curculigo orchioides*	Kanyut-net	Herb	Chin, Yangon	NL	
19	Apocynaceae	*Carissa carandas*	Khan	Small Tree	Cultivated	NL	
20	Solanaceae	*Solanum indicum*	Khayan-kazaw	Shrub	Bago, Mandalay, Shan, Yangon	NL	
21	Buxaceae	*Sarcococca pruniformis*	Khwe-ei-pok	Shrub	Chin, Kachin, Mandalay	NL	
22	Fabaceae	*Mucuna pruriens*	Khwele-ya	Climber	Bago, Bago, Chin, Kayin, Kayin, Mandalay, Mandalay, Sagaing, Sagaing, Shan, Yangon	NL	
23	Mimosaceae	*Acacia concinna*	Kinmun-gyin	Climber/ Creeper	Cultivated	NL	
24	Mimosaceae	*Albizia lebbek*	Kokko	Tree	Reported from Myanmar	NL	

25	Arecaceae	*Areca catechu*	Kunthi-pin	Small Tree	Cultivated	NL	
26	Poaceae	*Bambusa bambos*	Kyakat-wa	Bamboo	Reported from Myanmar	NL	
27	Malvaceae	*Hibiscus mutabilis*	Kyet-shaw	Small Tree	Cultivated	NL	
28	Euphorbiaceae	*Ricinus communis*	Kyetsu	Small Tree	Culivated	NL	
29	Euphorbiaceae	*Jatropha curcas*	Kyet-su-gyi	Small Tree	Cultivated	NL	
30	Euphorbiaceae	*Jatropha gossypifolia*	Kyetsu-kanako	Shrub	Cultivated	NL	
31	Verbenaceae	*Tectona grandis*	Kyun	Tree	Wide	NL	
32	Apocynaceae	*Beaumontia grandiflora*	La-pan	Climber/ Creeper	Kachin, Yangon	NL	
33	Zingiberaceae	*Boesenbergia parvula*	Malar pan	Herb	Shan	NL	
34	Asclepiadaceae	*Calotropis gigantea*	Mayo-gyi	Shrub	Magway, Mandalay	NL	
35	Asteraceae	*Tithonia rotundifolia*	Mexican sunflower	Shrub	Cultivated	Nl	
36	Brassicaceae	*Cardamine hirsuta*	Monnyin	Herb	Chin, Kachin, Shan	NL	
37	Anacardiaceae	*Lannea coromandelica*	Nabe	Tree	Bago, Kayin, Mahdalay, Rakine, Shan, Taninthayi, Yangon	NL	
38	Bromeliaceae	*Ananas comosus*	Nanat	Herb	Cultivated	NL	
39	Mimosaceae	*Acacia farnesiana*	Nan-lon-kyaing	Small Tree	Cultivated	NL	
40	Zingiberaceae	*Curcuma longa*	Nanwin	Herb	Cultivated	NL	
41	Lauraceae	*Cinnamomum nitidum*	Nasha-gyi	Tree	Kayin, Mon, Taninthayi, Yangon	NL	
42	Solanaceae	*Capsicum annuum*	Ngayok	Shrub	Cultivated	NL	
43	Caesalpiniaceae	*Cassia fistula*	Ngu	Tree	Wide	NL	
44	Zigiberaceae	*Hedychium coronarium*	Ngwe-pan	Herb	Cultivated	NL	
45	Sapindaceae	*Sapindus rarak*	Nwapadi	Tree	Mandalay, Sagaing, Shan	NL	
46	Fabaceae	*Sesbania cannabina*	Nyan	Herb	Wide	LC	

47	Moraceae	*Ficus obtusifolia*	Nyaung-gyat	Tree	Wide	NL	
48	Moraceae	*Ficus virens*	Nyaung-shin	Tree	Bago, Kachin, Mandalay, Taninthayi, Yangon	NL	
49	Lauraceae	*Litsea glutinosa*	Ohdon	Tree	Wide	NL	
50	Zingiberaceae	*Alpinia officinarum*	Padegaw-gale	Herb	Bago, Yangon	NL	
51	Caesalpiniaceae	*Bauhinia acuminata*	Palan	Small Tree	Wide	NL	
52	Meliaceae	*Melia composite*	Pan-tama	Tree	Bago, Chin, Kachin, Magway, Shan, Sagaing, Yangon	NL	
53	Fabaceae	*Butea monosperma*	Pauk	Tree	Ayeyarwady, Bago, Magway, Mandalay, Sagaind, Shan, Yangon	NL	
54	Araceae	*Colocasia affinis*	Pein	Herb	Cultivated	NL	
55	Moraceae	*Artocarpus heterophyllus*	Peinne	Tree	Cultivated	NL	
56	Rosaceae	*Eriobotrya bemgalensis*	Pet-sut	Tree	Chin	NL	
57	Costaceae	*Costus specious*	Phalan taung hmwe	Herb	Yangon, Sagaing, Mandalay, Bago, Shan, Kachin	NL	
58	Verbenaceae	*Clerodenrum squamatum*	Phetka	Shrub	Cultivated	NL	
59	Bignoniaceae	*Heterophragma adenophylla*	Phet-than	Tree	Wide	NL	
60	Euphorbiaceae	*Macaranga denticulata*	Phet-Wun	Small Tree	Ayeyarwady, Bago, Kachin, Mandalay,Mon, Sagaing, Taninthayi, Yangon	NL	
61	Lamiaceae	*Ocimum basilicum*	Pin-Sein	Herb	Cultivated	NL	
62	Moraceae	*Morus alba*	Po-sa	Tree	Cultivated	NL	
63	Poaceae	*Ripidium arundinaceum*	Pyaung	Grass	Reported from Myanmar	NL	
64	Poaceae	*Zea mays*	Pyaung-bu	Grass	Cultivated	NL	

65	Rutaceae	*Clausena excavata*	Pyin-daw-thein	Shrub	Wide	NL	
66	Oleaceae	*Linociera terniflora*	Sanse	Tree	Ayeyarwady, Bago, Kachin, Shan, Mandalay, Rakhine, Sagaing, Yangon	NL	
67	Smilacaceae	*Smilax perfoliata*	Sein-nabaw	Climber/ Creeper	Reported from Myanmar	NL	
68	Sterculiaceae	*Sterculia angustifolia*	Shaw	Tree	Wide	NL	
69	Cucurbitaceae	*Cucurbita maxima*	Shwe-payon	Climber/ Creeper	Cultivated	NL	
70	Menispermaceae	*Stephania venosa*	Sin-don-na-nwe	Climber	Wide	NL	
71	Mimosaceae	*Albizia procera*	Sit	Tree	Reported from Myanmar	NL	
72	Mimosaceae	*Acacia rugata*	Sue-bauk-new	Climber/ Creeper	Reported from Myanmar	NL	
73	Simaroubaceae	*Harrisonia perforata*	Sugyin	Small Tree	Bagi, Chin, Mandalay, Mon, Saging, Yangon	NL	
74	Mimosaceae	*Acacia pennata*	Suyit	Climber/ Creeper	Reported from Myanmar	LC	
75	Vitaceae	*Cissus discolor*	Tabindaing-myanan	Climber/ Creeper	Reported from Myanmar	NL	
76	Rutaceae	*Zanthoxylum acanthopodium*	Tabu	Small Tree	Bago, Chin, Kachin, Magwe, Sagaing, Shan, Yangon	NL	
77	Poaceae	*Thysanolaena maxima*	Ta-myet-si	Grass	Bago, Mandalay, Shan, Yangon	NL	
78	Combretaceae	*Terminalia tomentosa*	Tauk-kyant	Tree	Wide	NL	
79	Mimosaceae	*Albizia odoratissima*	Taung-magyi	Tree	Wide	NL	
80	Apocynaceae	*Alstonia scholaris*	Taung-mayo	Tree	Bago, Kachin, Mandalay, Shan, Taninthayi, Yandon	LC	
81	Meliaceae	*Cedrela serrata*	Taung-tama	Tree	Chin, Mandalay, Shan, Sagaing,	NL	

					Kachin		
82	Arecaceae	*Livistona speciosa*	Taw-htan	Tree	Bago, Kayin, Mandalay, Taninthayi	NL	
83	Elaeocarpaceae	*Elaeocarpus robustus*	Taw-ma-gyi	Tree	Reported from Myanmar	NL	
84	Musaceae	*Musa sp.*	Taw-nget-pyaw	Herb	Chin, Kachin, Magway, Mandalay, Shan, Sagaing	NL	
85	Lamiaceae	*Leucas aspera*	Taw-pin-sein	Shrub	Bago, Mandalay, Shan, Yangon	NL	
86	Rutaceae	*Clausena excavata*	Taw-pyindaw-thein	Small Tree	Mandalay, Yangon	NL	
87	Mytraceae	*Syzygium fruticosum*	Taw-thabye	Small Tree	Wide	NL	
88	Anacardiaceae	*Mangifera caloneura*	Taw-tha-yet	Tree	Bago, Mon, Taninthayi, Yangon	NL	
89	Malvaceae	*Hibiscus panduriformis*	Taw-yon-padi	Shrub	Yangon	NL	
90	Euphorbiaceae	*Phyllanthus maderaspatensis*	Taw-ziphyu	Shrub	Mandalay	NL	
91	Tiliaceae	*Grewia tiliifolia*	Ta-yaw	Tree	Bago, Mandalay, Sagaing, Shan, Yangon	NL	
92	Euphorbiaceae	*Euphorbiaceae antiquorum*	Tazaung-gyi	Small Tree	Wide	NL	
93	Ebenaceae	*Diospyros burmanica*	Te	Tree	Bago, Mandalay	NL	
94	Cucurbitaceae	*Momordica macrophylla*	Tha-byet	Climber/ Creeper	Wide	NL	
95	Sapotaceae	*Achras zapota*	Tha-gya	Tree	Cultivated	NL	
96	Poaceae	*Bambusa burmanica*	Thaik-wa	Bamboo	Bago, Kachin, Magway, Mandalay, Mon, Sagaing, Shan, Taninthayi	NL	
97	Boraginaceae	*Cordia dichotoma*	Thanat	Tree	Kachin, Kayah, Mandalay, Shan, Yangon	NL	

98	Bignoniaceae	*Stereospspermum grandiflorum*	Thande	Tree	Wide	NL	
99	Fabaceae	*Alysicarpus vaginalis*	Than-ma-naing-kyauk-ma-naing	Shrub	Bago, Mandalay, Mon, Sagaing, Shan, Yangon	NL	
100	Moraceae	*Ficus clavata*	Tha-phan	Shrub	Chin, Kachin, Kayin, Rakhine	NL	
101	Bixaceae	*Bixa orellana*	Thidin	Small Tree	Culticated	NL	
102	Sapotaceae	*Sideroxylon burmanicum*	Thit-cho	Tree	Chin, Magway, Shan	NL	
103	Mimosaceae	*Albizia lebbekoides*	Thitmagi	Tree	Mandalay, Sagaing	NL	
104	Fabaceae	*Dalbergia kurzii*	Thitpok	Tree	Bago, Chin, Yangon	LC	
105	Combretaceae	*Terminalia bellerica*	Thit-seint	Tree	Bago, Magway, Mandalay	NL	
106	Dipterocarpaceae	*Shorea obtusa*	Thit-ya	Tree	Bago, Kayah, Kayin, Mandalay, Taninthayi, Yangon	LC	
107	Poaceae	*Dendrocalamus calostachyus*	Wa-bo	Bamboo	Chin, Kachin, Mandalay, Sagaing, Shan, Taninthayi	NL	
108	Zingiberaceae	*Globba hookeri*	Waso	Herb	Mandalay, Sagaing, Yangon	NL	
109	Malvaceae	*Pavonia rigida*	Wetchi-pane	Herb	Bago, Kayin, Mandalay	NL	
110	Euphorbiaceae	*Ostodes paniculata*	Ye-badon-gale	Tree	Chin, Kachin,Mon, Sagaing, Shan, Taninthayi	NL	
111	Euphorbiaceae	*Flueggea virosa*	Ye-gyin-yar	Small Tree	Wide	NL	
112	Verbenaceae	*Gmelina arborea*	Yemane	Tree	Bago, Kachin, Mandalay, Shan, Yangon	NL	
113	Moraceae	*Ficus glomerata*	Ye-thapan	Tree	Bago, Kachin, Mandalay, Yangon	NL	
114	Fabaceae	*Dalbergia cultrata*	Yindaik	Tree	Wide	NT	
115	Fagaceae	*Quercus helferiana*	Yingu-akyi	Tree	Kachin, Mandalay, Unknon	NL	
116	Meliaceae	*Chukrasia velutina*	Yin-ma	Tree	Wide	NL	

117	Combretaceae	*Anogeissus acuminata*	Yon	Tree	Bago, Chin, Mandalay, Yangon	NL	
118	Fabaceae	*Abrus precatorius*	Ywe	Cl/Cr	Wide	NL	
119	Lythraceae	*Lagerstroemia villosa*	Zaungbale	Tree	Mandalay, Shan, Yangon	NL	
120	Rhamnaceae	*Ziziphus jujuba*	Zi	Tree	Cultivated	LC	
121	Euphorbiaceae	*Emblica officinalis*	Zibyu	Tree	Wide	NL	
122	Orchidaceae	*Spathoglottis plicata*		Herb	Reported from Myanmar	NL	

NL = Not Listed

LC = Least Concerned

NT = Near Threatened

Taxonomy

Kingdom	**Phylum**	**Class**	**Order**	**Family**
Plantae	Tracheophyta	Magnoliopsida	Fabales	Leguminosae

Scientific Name: ***Dalbergia cultrata***

Species Authority: Graham ex Benth.

Infra-specific Taxa Assessed:

See Dalbergia cultrata var. cultrata

Common Name(s): English – Burma Blackwood

Synonym(s): Dalbergia fusca Pierre

Assessment Information

Red List Category & Criteria: Near Threatened ver 3.1

Year Published: 2012

Date Assessed: 2010-06-22

Assessor(s): Contu, S.

Reviewer(s): Hilton-Taylor, C.

Justification:

The distribution range extends over a wide area at present, but the species has been described as decreasing over the past (no figures about population reduction are currently available), due to the severe reduction of forest areas in the countries where it occurs and to the overexploitation of the timber (Oldfield et al. 1998). Deforestation has contributed to the increasing fragmentation of the forested areas, which might also lead to reduced genetic diversity and genetic flow between Dalbergia cultrata subpopulations. It is believed that it is of conservation concern and that further research and studies on population size, distribution and trends should be carried out in the near future to better define the conservation status as it may warrant a higher rating.

Geographic Range

Range Description: Dalbergia cultrata occurs in Cambodia, China (Yunnan province), Lao PDR, Myanmar, Thailand, Viet Nam and it has been introduced to India.

Countries occurrence:

Native: Cambodia; China (Yunnan); Lao People's Democratic Republic; Myanmar; Thailand; Viet Nam.

Introduced: India

Habitat and Ecology

Habitat and Ecology: D. cultrata is a medium sized (up to 20-30 m high) deciduous tree which grows in humid deciduous, evergreen and evergreen mixed with pine, forests. In open forest, in bamboo forest, in dry dipterocarp forest and in dry mixed deciduous forest. Pollination is by wind and the winged seed is dispersed by wind. Germination rate is quite high, about 70% (Lao Tree Seed Project). Flowering is in June to August and fruiting is in September to November.

Systems: Terrestrial

Threats

Major Threat(s): Deforestation is one of the most serious threats to biodiversity in the countries where the species is known to occur. The natural vegetation has been reduced and fragmented for the conversion to agricultural land and settlements. Illegal logging has been a serious problem, and even though there are programs of management of forest resources, the level of forest reduction has not stopped (i.e. in Thailand since 1992 there is a strict logging ban in all natural forests, but it hasn't been able to stop deforestation in the country). The species has been overexploited for the timber and this has been identified as the main cause of the population decline of the variety cultrata (Oldfield et al. 1998).

Dalbergia cultrate **(Yin-daik)**

Note: Range map for *Dalbergia cultrate* (Yin-daik) was not available from IUCN source.

(b) Fauna

(1) Habitat

In the Area of Upper Baluchaung Hydropower Projcet, four major habitat types were observed namely (1) patches of mixed vegetation with scattered trees, (2) cultivated land and (3) aquatic habitat and (4) human habitation area.

(2) Survey Area

The survey area is shown in Figure 5.1.4-7.

Fig 5.1.4-7: Fauna Survey Area

(3) Survey Result

There were 58 species of Butterfly, 64 species of Bird, 14 species of mammal and 5 species of amphibians and 11 species of reptiles and 26 fishe species identified in the survey area. List of identified animal species in the survey area was presented in the following tables. All the species were identified by interviewing from residents, Literature and field observation.

(i) Butterfly

In Myanmar, Butterfly species are 1197 Species (Kinyon 2014). The Survey Area of Butterflies Species are 58species, Family 5 and Sub–family are 10 under order Lepitoptera were observed. Papilionidae (11species of 4 genera), Pieridae (18 species of 10 genera), Nymphalidae (24 species of 12 genera), Lycaenidae (3 species of 3 genera), Hesperiidae (2 species of 2 genera). The richest species were observed family Nymphalidae and the least species were observed in family Hesperidae.There is no threatened species of IUCN red list in (2015-ver3.1). Myanmar have six rarest of butterfly species, among in this area occurrence of only one rarest species Troides aeacus (Golden birdwing).

Methodology

Survey applying standard method was conducted randomly around the survey area and along the trails or pathways in the survey area. Identification of butterfly species was primarily made directly in the field. In some cases, if the encountered butterflies were not identified directly in the field, they were collected by using the long-handled aerial nets (140 cm PVC pipe, net patch 1 millimeter, ring size 15 inches' diameter made with aluminium - local made). And then at the camp the collected specimens were observed and recorded for their morphological characters such as patterns, spots, stripes and colour. The mouth parts were carefully examined and the body and wing's length, measured. And photos were taken by photo record. After that, the specimens were released back into the original place. Unidentified species were kept separately in the triangle envelopes and the collection date and the location of collected points (GPS coordinates by using Garmin GPS map 78s) were recorded on the envelopes. All separated envelopes were preserved in the airtight plastic containers to avoid humidity and also put mothballs inside containers to prevent from the growth of mould.

Table 5.1.4-3: List of butterfly species in survey area

Sr.	Family Name	Subfamily Name	Scientific Name	Common Name	IUCN/Status
1	Papilionidae	Papilioninae	*Papilio polytes*	Common Mormon	Not List
2	Papilionidae	Papilioninae	*Papilio demolion*	Banded Swallowtail	Not List
3	Papilionidae	Papilioninae	*Papilio paris*	Paris Peacock	Not List
4	Papilionidae	Papilioninae	*Papilio demoleus*	Lime Butterfly	Not List
5	Papilionidae	Papilioninae	*Papilio prexaspes*	Blue Helen	Not List
6	Papilionidae	Papilioninae	*Papilio nephelus*	Black and White Helen	Not List
7	Papilionidae	Papilioninae	*Papilio helenus*	Red Helen	Not List
8	Papilionidae	Papilioninae	*Triodes aeacus*	Golden Birdwing	Not List

9	Papilionidae	Papilioninae	*Pachliopta aristolochiae*	Common Rose	Not List
10	Papilionidae	Papilioninae	*Graphium sarpedon*	Common Bluebottle	Not List
11	Papilionidae	Papilioninae	*Papilio palinurus*	Banded Peacock	Not List
12	Pieridae	Coliadinae	*Eurema andersonii*	Anderson's Grass Yellow	Not List
13	Pieridae	Coliadinae	*Eurema laeta*	Spotless Grass Yellow	Not List
14	Pieridae	Coliadinae	*Eurema ada*	Scalloped Grass Yellow	Not List
15	Pieridae	Coliadinae	*Eurema simulatrix*	Hill Grass Yellow	Not List
16	Pieridae	Coliadinae	*Eurema sari*	Chocolate Grass Yellow	Not List
17	Pieridae	Coliadinae	*Eurema blanda*	Three Spot Grass Yellow	Not List
18	Pieridae	Coliadinae	*Eurema hecabe*	Common Grass Yellow	Not List
19	Pieridae	Pierinae	*Leptosia nina*	Psyche	Not List
20	Pieridae	Pierinae	*Pieris canidia*	Cabbage white	Not List
21	Pieridae	-	*Colias fieldi*	Dark Clouded Yellow	Not List
22	Pieridae	-	*Delias acallis*	Redbreast Jezebel	Not List
23	Pieridae	Pierinae	*Pareronia valeria*	Common Wanderer	Not List
24	Pieridae	Coliadinae	*Catopsilia scylla*	Orange Emigrant	Not List
25	Pieridae	Coliadinae	*Catopsilia pomona*	Lemon Emigrant	Not List
26	Pieridae	Pierinae	*Appias lalassis*	-	Not List
27	Pieridae	Pierinae	*Appias lalage*	Spot Puffin	Not List
28	Pieridae	Pierinae	*Ixias pyrene*	Yellow Orange Tip	Not List

29	Pieridae	Pierinae	*Hebomoia glaucippe*	Great Orange Tip	Not List
30	Nymphalidae	Danainae	*Danaus genutia*	Common Tiger	Not List
31	Nymphalidae	Danainae	*Danaus chrysippus*	Plain Tiger	Not List
32	Nymphalidae	Danainae	*Euploea core*	Common Crow	Not List
33	Nymphalidae	Danainae	*Euploea crameri*	Spotted Black Crow	Not List
34	Nymphalidae	Danainae	*Euploea mulciber*	Striped Blue Crow	Not List
35	Nymphalidae	Danainae	*Euploea radamanthus*	Magpie Crow	Not List
36	Nymphalidae	Danainae	*Parantica agleoides*	Dark Glassy Tiger	Not List
37	Nymphalidae	Satyrinae	*Ypthima lisandra*	Straight Five-ring	Not List
38	Nymphalidae	Satyrinae	*Melanitis phedima*	Dark Eveninng Brown	Not List
39	Nymphalidae	Satyrinae	*Melanitis leda*	Common Evening Brown	Not List
40	Nymphalidae	Satyrinae	*Lethe sura*	Lilafork	Not List
41	Nymphalidae	Satyrinae	*Orsotriaena medus*	Nigger	Not List
42	Nymphalidae	Nymphalinae	*Junonia lemonias*	Lemon Pansy	Not List
43	Nymphalidae	Nymphalinae	*Junonia almana*	Peacock Pansy	Least Concern
44	Nymphalidae	Nymphalinae	*Junonia orithya*	Blue Pansy	Not List
45	Nymphalidae	Nymphalinae	*Junonia hierta*	Yellow Pansy	Least Concern
46	Nymphalidae	Nymphalinae	*Junonia iphita*	Chocolate Pansy	Not List
47	Nymphalidae	Heliconiinae	*Cethosia cyane*	Leopard Lacewing	Not List
48	Nymphalidae	Heliconiinae	*Cethosia hypsea*	Malay Lacewing	Not List

49	Nymphalidae	Heliconiinae	*Cethosia penthesilea*	Plain Lacewing	Not List
50	Nymphalidae	Heliconiinae	*Hypolimnas bolina*	Great Eggfly	Not List
51	Nymphalidae	-	*Neptis zaida*	Pale Green Sailer	Not List
52	Nymphalidae	-	*Neptis spp.*	-	Not List
53	Nymphalidae	Charaxinae	*Polyura athama*	Common Nawab	Not List
54	Lycaenidae	Lycaeninae	*Athene lycaenina miya*	Pointed Ciliate Blue	Not List
55	Lycaenidae	Lycaeninae	Lonolyce helicon	Pointed Line Blue	Not List
56	Lycaenidae	Lycaeninae	Chilades pandava	Cycad Blue	Not List
57	Hesperiidae	Hesperiinae	Udaspes folus	Grass Demon	Not List
58	Hesperiidae	Hesperiinae	Lambrix stellifer	Starry Bab	Not List

Triodes aeacus (Golden Bird Wing) Rare Species of Myanmar

Polyura athama (Common Nawab)

Graphium sarpedon (Common Bluebottle)

Junonia hecabe (Common Grass Yellow)

Papilio paris (Paris Peacock)

Cethosia cyane (Leopard Lacewing)

Melanitis phedima (Dark Evening Brown)

Fig 5.1.4-8: Some butterfly species found in survey area

(ii) Bird

Bird's species from species under families (33) was recorded. The richest two species arerecorded from the family Pycnonotidae and Hirundinidae. The poorest species are recorded from the family

Accipitridae, Psittacidae. Around the Upper Baluchaung and around the Inlelake total of (64) birds Species.There are cannot be seen migratory birds because this season is rainy season. During the survey, a total of (64) bird species were recorded out of which was found out to be least concern (LC) and one Near Threatened (NT) species. The team managed to cover a relatively large area.

Methodology

Birds Survey was carried out according to the following methods:

The team conducted by using boats to cover selected sites in the lake as well as on foot along the river banks. Birds were observed in different habitats such as creek, lake, secondary forest, scrub land, paddy fields, Cultivation. Birds recorded were noted down together with GPS locations and also significant facts such as habitats and number of birds. Random recordings were also made along the waterways and embankment. Visual sighting with binoculars and auditory surveys were conducted along the banks and waterways. Each bird identified was noted down and the quantity was also recorded.

Table 5.1.4-4: List of bird recorded in survey area

No	Family	Scientific Name	Common Name	IUCN/Status
1	Phasianidae	*Francolinus pintadeanus*	Chinese Francolin	LC
2	Turnitidae	*Turnix suscitator*	Barred Button Quail	LC
3	Megalaimidae	*Psilopogon lineatus*	Lineated Barbet	LC
4	Megalaimidae	*Psilopogon asiaticus*	Blue-throated Barbet	LC
5	Coraciidae	*Coracias benghalensis*	Indian Roller	LC
6	Meropidae	*Merops orientalis*	Little-Green Bee -eater	LC
7	Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	LC
8	Cuculidae	*Cuculus canorus*	Common Cuckoo	LC
9	Cuculidae	*Phaenicophaeus tristis*	Green –billed Malkoha	LC
10	Psittacidae	*Psittacula finschii*	Grey-headed Parakeet	NT
11	Columbidae	*Streptopelia orientalis*	Oriental Turtle-Dove	LC
12	Columbidae	*Streptopelia chinensis*	Spotted Dove	LC
13	Laniidae	*Lanius cristatus*	Brown Shrike	LC

14	Laniidae	*Lanius schach*	Long-tailed Shrike	LC
15	Corvidae	*Corvus macrorhynchos*	Large-billed Crow	LC
16	Oriolidae	*Oriolus xanthornus*	Black-hooded Oriole	LC
17	Campephagidae	*Pericrocotus flammeus*	ScarletMinivet	LC
18	Dicruridae	*Dicrurus leucophaeus*	Ashy Drongo	LC
19	Dicruridae	*Dicrurus aeneus*	Bronze Drongo	LC
20	Aegithinidae	*Aegithina tiphia*	Common Iora	LC
21	Turdidae	*Myophonus caeruleus*	Blue-whistling Thrush	LC
22	Muscicapidae	*Eumyias thalassina*	Verditer Flycatcher	LC
23	Muscicapidae	*Copsychus saularis*	Oriental Magpie- Robin	LC
24	Muscicapidae	*Saxicola caprata*	Pied Bushchat	LC
25	Sturnidae	*Sturnus contra*	Asian-pied Staling	LC
26	Sturnidae	*Sturnus burmnnicus*	Venous –breasted Myna	NL
27	Sturnidae	*Acridotheres tristis*	Common Myna	LC
28	Sturnidae	*Acridotheres fuscus*	Jungle Myna	LC
29	Sturnidae	*Acridotheres albocinctus*	Collared Myna	LC
30	Hirundinidae	*Hirundo rustica*	Barn Swallow	LC
31	Hirundinidae	*Hirundo daurica*	Red-rumped Swallow	LC
32	Pycnonotidae	*Pycnonotus melanicterus*	Black-crested Bulbul	LC
33	Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	LC
34	Pycnonotidae	*Pycnonotus aurigaster*	Sooty-headed Bulbul	LC
35	Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	LC
36	Cisticolidae	*Prinia hodgsonii*	Grey-breasted Prinia	LC
37	Timaliidae	*Chrysomma sinensis*	Yellow-eyed Babbler	LC
38	Timaliidae	*Heterophasia melanoleuca*	Dark-backed Sibia	LC
39	Passeridae	*Passer rutilans*	Russet Sparrow	LC
40	Passeridae	*Passer montanus*	Eurasian Tree Sparrow	LC
41	Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	LC
42	Motacillidae	*Motacilla alba*	White Wagtail	LC
43	Accipitridae	*Accipiter badius*	Shikra	LC
44	Ciconiidae	*Anastomus oscitans*	Asain Openbill	LC

45	Ardeidae	*Mesophoyx intermedia*	Intermediate Egret	LC
46	Ardeidae	*Egretta garzetta*	Little Egret	LC
47	Ardeidae	*Bubulcus coromandus*	Eastern Cattle Egret	NL
48	Ardeidae	*Nycticorax nycticorax*	Black -crowned Night Heron	LC
49	Ardeidae	Ardeola grayii	Indian Pond Heron	LC
50	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	LC
51	Scolopacidae	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC
52	Accipitridae	*Elanus caeruleus*	Black –shouldered Kite (or)Black –winged Kite	LC
53	Phalacrocoracidae	*Phalacrocorax niger (or) Microcarbo niger*	Little Cormorant	LC
54	Ardeidae	*Ixobrychus sinensis*	Yellow Bittern	LC
55	Estrildidae	*Lonchura atricapilla*	Chestnut Munia	LC
56	Columbidae	*Columba livia*	Rock Pigeon (or) Rock Dove	LC
57	Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher(or) White breasted Kingfisher	LC
58	Cuculidae	*Centropus sinensis*	Greater Coucal	LC
59	Upupidae	*Upupa epops*	Common Hoopoe	LC
60	Sturnidae	*Sturnus nigricollis*	Black-collared Starling	LC
61	Sturnidae	*Acridotheres grandis*	White-vented Myna	LC
62	Megalaimidae	*Psilopogon haemacephalus*	Coppersmith Barbet	LC
63	Zosteropidae	*Zosterops palpebrosus*	Oriental White Eye	LC
64	Motacillidae	*Anthus hodgsoni*	Olive-backed Pipit	LC

LC = Least concerned

NT = Near Threatened

NL = Not Listed

Conservation Status: Reference to IUCN Red list (2016 Ver 3.1), one species of globally threatened species was recorded in this study.

Near threatened (NT)

Grey-headed Parakeet (*Psittacula finschii)*

Only one birds flying across the Baluchaung were recorded. The species is widely captured for the cagebird trade and is locally kept as a pet, for example in Laos and China (J. W. Duckworth *in litt*. 2013, M. Zhang *in litt*. 2013). (By internet).

Grey-headed Parakeet (*Psittacula finschii)*

Asian Open Bill(Inle Lake)

Barn Swallow

Black- collared Starling

Dark-backed Sibia

Grey-headed Parakeet

Little Cormorant (Inle Lake)

Oriental Turtle Dove

Venous-breasted Myna

Fig 5.1.4-9: Some bird species recorded in survey area

(iii) Mammals

A total of 14 mammal species belonging to 14 genera, 10 families and 5 orders were captured and recorded in the Upper Baluchaung, during the survey period of seven days. These are one species of Primates, five species of Carnivores, Five species of Rodents and one species of Lagomorphaand one species of red muntjac. There is no endemic species. According mammal species to the IUCN Red list (2016 ver. 4.0), nine species are Least Concern (LC), three species are Not list and One species are near threatened (NT) species.

Five species are interviewed information to Local People from nearly village at Upper Baluchaung, eight species were recorded (Scat, Skin Skull, alive) around the Upper Baluchaung (Downstream and Upstream).

Methodology

The data collection was randomly conducted in four ways:

(1) Capturing mammals;

(2) Observing mammals in the field;

(3) Observation of track and signs such as footprints, scats feeding signs in their natural habitats, and

(4) Interview survey. The method of observing mammals in the field was conducted for the species of arboreal mammals such as squirrels and tree shrews. Track and sign observation was used for some small carnivores. All encountered signs and footprints were examined, photographed and measured on width and length by using venire caliper. The presence or absence of the very well-known mammal species was confirmed by interviewing local people already familiar with the forest. All data collected in the survey area were recorded in the field data sheets.

Table 5.1.4-5: List of mammals recorded in survey area

No.	Order Name	Famiy Name	Scientific Name	Common Name	IUCN/Status	Observation/Status
1	Primates	Cercopitbhecidae	*Macaca mulatta*	Rhesus Macaque	LC	Interviewed
2	Carnivora	Viverridae	*Viverra Zibetha*	Large indian Civet	LC	Sighting (skin)
3	Carnivora	Viverridae	*Prionodon pardicolor*	Spotted Linsang	LC	Interviewed
4	Carnivora	Felidae	*Prionailurus bengalensis*	Leopard Cat	LC	Scat (sighting)
5	Carnivora	Felidae	*Pardofelis marmorata*	Marbled Cat	NT	Interviewed
6	Rodentia	Sciuridae	*Callosciurus erythraeus*	Pallas's Squrriel	NL	Sighting

7	Rodentia	Spalacidae	*Menetes berdmorei*	Indochineseground Squrriel	LC	Sighting
8	Rodentia	Spalacidae	*Rhizomys pruinosus*	Hoary Bamboo Rat	LC	Interviewed
9	Rodentia	Hystricidae	*Hystrix brachyura*	Malayan Porcupine	LC	Body part
10	Rodentia	Muridae	*Mus musculus*	Asian house mouse	NL	Sighting
11	Lagomorpha	Leporidae	*Lepus peguensis*	Burmese hare	LC	Sighting
12	Carnivora	Herpestiidae	*Herpestes javanicus*	SmallAsian Mongoose	NL	Sighting
13	Carnivora	Viverridae	*Paradoxurus hermaphroditus*	Common Palm Civet	LC	Interviewed
14	Cetartiodactyla	Cervidae	*Muntiacus muntjak*	Red Muntjac	LC	Interviewed

NL = Not Listed

LC = Least Concerned

Conservation Status: Reference to IUCN Red list (2016 Ver. 4.0), one species of globally threatened species was recorded in this study.

Near threatened (NT)

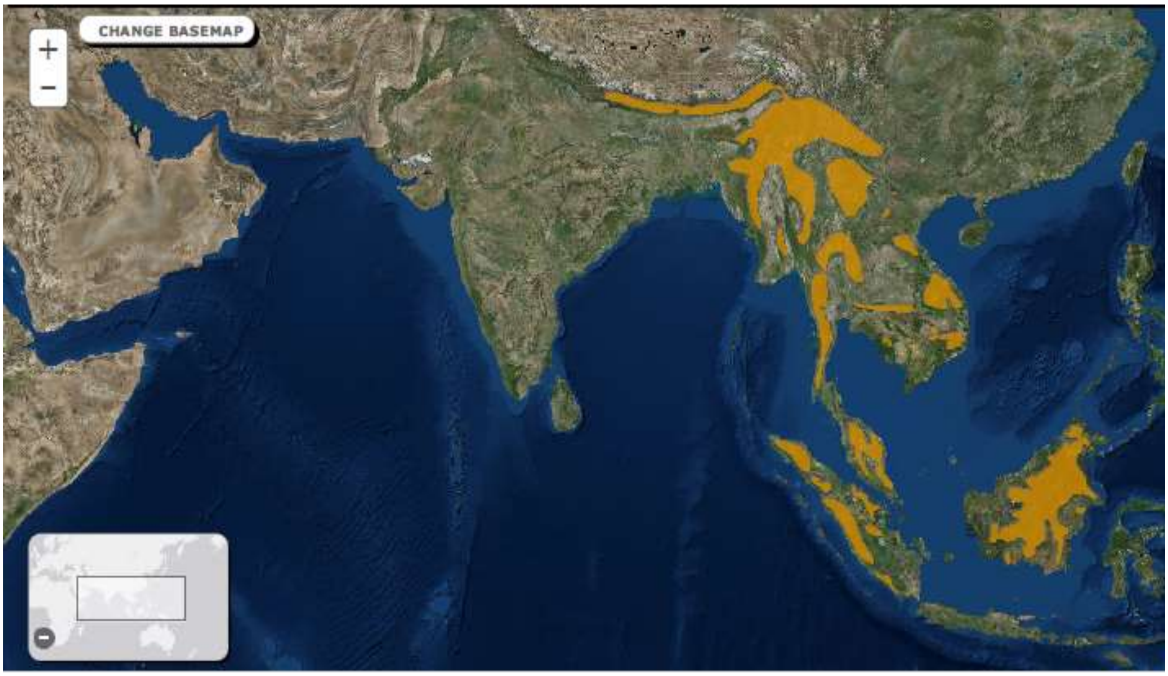
Marbled Cat (*Pardotelis marmorata)*

This species is Interviewed information from Local People at Min tone Village. Local people have been found about five years. Nowadays, this species cannot be found because this area is noising of mine. These species are migrating from other place.

Threat of Mammal

A variety of threats are impacting mammal species around the Upper Baluchaung. To better understand the threatening processes affecting mammals, the assessment process recorded known threats to each species using a standardized list (IUCN Threats Classification Scheme) of major threat. By far the most significant threat to mammals is habitat loss and noise and overhunting.

Marbled Cat (*Pardofelis marmorata)*



Interview From Local People

Leopard Cat (Scat)

Malayan Porcupine (Body Part)

Red Muntjac's Skull(Min tone Village, 2010)

Indochinese ground Squirrel

Burmese Hare (Scat)

Fig 5.1.4-10: Photo of observations in survey area

(iv) Reptile and amphibian

Herpetofauna includes amphibians and reptiles. Amphibians include frogs, caecilians and salamanders. And reptiles include lizards, geckos, skinks, snakes, crocodiles, water monitors, turtles and tortoises. Reptiles and amphibians occupy a diverse range of habitats and microhabitats, i.e. they are found from desserts to grasslands from forests to oceans and from hills to own house

A total of (16) species of amphibian and reptiles were captured, interviewed information and observed. Five species of Frogs, one tortoise, one species of Skink, 2 Lizards, 4 Snakes, 3 species of Gecko. According to the Conservation Status by IUCN red list (2016 ver. 4.0). One tortoise (*Manouria impressa*) Vulnerable and other are Least Concern and Not list. There is no endemic species. This tortoise species was also listed as Appendix II in CITES (2016 ver. 4.0).

Methodology

Reptiles and Amphibian Species were captured and observed around the Upper Baluchaung and interviewed information from local people.

Table 5.1.4-6: List of reptile species recorded on survey Area

No.	Order Name	Family Name	Scientific Name	Common Name	IUCN/Status	Observation/Status
1	Squamata	Agamidae	*Calotes emma*	Forest Crested Lizard	NL	Sighting
2	Squamata	Agamidae	*Calotes chincollium*	Collared Forest Lizard	LC	Sighting
3	Squmata	Colubridae	*Ptyas mucosa*	Indian Rat Snake (or) Oriental Rat Snake	NL	Sighting
4	Squamata	Colubridae	*Ahaetulla fronticincta*	River Vine Snake	LC	Sighting
5	Squamata	Gekkonidae	*Gekko gecko*	Tokay Gecko	NL	Sighting
6	Squamata	Elapidae	*Naja sp.*	Cobra?	NL	Interviewed information
7	Squamata	Natricidae	*Opisthotropis typica*	Corrugated Water Snake	LC	Information
8	Squamatta	Gekkonidae	*Hemiphyllodactylus typus*	Common Worm Gecko	NL	Sighting
9	Squamata	Gekkonidae	*Hemidactylus frenatus*	Common house Gecko	LC	Sighting
10	Squmata	Scincidae	*Eutropis macularis*	Common Sun Skink	NL	Sighting
11	Testudines	Testudinidae	*Manouria impressa*	Impressed tortoise	VU	Information (shell)

LC = Least Concerned

NL = Not Listed

VU = Vulnerable

Ptyas mucosa (Indian Rat Snake (or) Oriental Rat Snake)

Fig 5.1.4-11: Species recorded in survey area

Table 5.1.4-7: List of Amphibian Species recorded in survey Area

No.	Order Name	Family Name	Scientific Name	Common Name	IUCN/Status
1	Anura	Ranidae	*Hylarana erythraea*	Common Green Frog	LC
2	Anura	Microhylidae	*Kaloula pulchra*	Banded Bullfrog	LC
3	Anura	Microhylidae	*Microhyla heymonsi*	Arcuate-spotted Pygmy Frog	LC
4	Anura	Dicroglossidae	*Fejervarya limnocharis*	Asian Grass Frog	LC
5	Anura	Bufonidae	*Bufo melanostictus*	Common Indian Toad	NL

LC = Least concerned

NL = Not Listed

Fejervarya limnocharis (Asian GrassFrog)

Kaloula pulchra (Banded Bullfrog)

Manouria impressa (Impressed tortoise)

Microhyla heymonsi (Arcuate-spotted Pygmy Frog)

Hemidactylus frenatus (Common House Gecko)

Bufo melanosticus (Common Indian Toad)

Fig 5.1.4-12: Some species recorded in survey area

(v) Aquatic Fauna

The fish species which are found in the project are (in the Upper Baluchang river as well as in the downstream of Inle lake). Twenty-one species of fishes are found in the Baluchang river. The commercial fisheries do not exist and the villagers (fishermen) are catching fish for their daily subsistence and for individual selling at local market.

Table 5.1.4-8: Lists of aquatic species of survey area

Sr. No	Family	Species	Common Name	IUCN/Status
1	Notopteridae	*Notopterus notopterus*	Grey feather-back	LC
2	Cyprinidae	*Catla catla*	Catla	NL
3	Cyprinidae	*Cirrhinus mrigala*	Mrigal	LC
4	Cyprinidae	*Labeo angra*	Angra labeo	LC
5	Cyprinidae	*Labeo rohita*	Rohu	LC
6	Cyprinidae	*Labeo boga*	Boga Labeo	LC
7	Cyprinidae	*Labeo microphthalmus*	Murree Labeo	LC
8	Cyprinidae	*Labeo stoliczkae*	Moulmein Labeo	NL
9	Cyprinidae	*Cyprinus intha*	Inle carp	EN
10	Cyprinidae	*Crossocheilus latia*	Minor carp	NL
11	Channidae	*Channa punctatus*	Spotted snakehead	LC
12	Channidae	*Channa orientalis*	Asiatic snakehead	NL
13	Channidae	*Channa harcourtbutleri*	Burmese snakehead	NT
14	Clariidae	*Clarias batrachus*	Magur	LC
15	Mastacembelidae	*Macrognathus aral*	Spiny eel	LC
16	Mastacembelidae	*Macrognathus zebrinus*	Zebra spiny eel	LC
17	Bagridae	*Mystus corsula*	Catfish	

18	Cobitidae	*Lepidocephalus thermalis*	Indian Spiny Loach	LC
19	Cichlidae	*Oreochromis spp*	Talapia	
20	Gobiidae	*Glossogobius giuris*	Tank goby	NL
21	channidae	Channa gachua	Dwarf snakehead	LC

NT = Near Threatened

LC = Least Concerned

EN = Endangered

Threatened Species

Twenty-one species are found in the Upper Baluchang river during the study period. Among two species are threatened species. They are *Cyprinus intha* (Endangered) and Channa *harcourtbutleri* (Near Threaten).

Family Name - Cyprinidae

Species Name - *Cyprinus intha*

Habitat - Found in shallow zone of river, in area with dense submerged vegetation and muddy.

IUCN criteria - Endangered B lab (iii, v) ver. 4.0

Cyprinus intha (Inle Carp)

Family Name **- Channidae**

Species Name **- *Channa harcourtbutleri***

Habitat - Freshwater lake and benthic

IUCN criteria - Near Threatened ver. 4.0

Note: Photo was not available for this fish species.

Labeo microphthalmus *Notopterus notopterus*

Fig 5.1.4-13: Some fish species recorded in survey area

5.1.5 Socio-Economic Baseline

Socio-economic study is important to understand the existing socio-economic condition of local people/communities and to predict the adverse impacts to be induced from the project development. This socio-economic survey was carried out based on a desktop review of publicly available information and on the collection of primary data through a visit to the Project site. Primary data were collected through stakeholder meeting and key informant interviews and Household surveys (for a total of 145 households).

The proposed Upper Baluchaung Hydropower Project, consisting of No.1 Power Station (UB-1) and No.2 Power Station (UB-2), is a run-of-river type located about 40 km southwest of Taunggyi in Southern Shan State. The socio-economic baseline survey was carried out in six villages, namely Inn Tein Kone, Kyauk Taw, Taung Kha Mauk, Tone Lel, Min Lone and Naung Woe. The collected information will be used to develop mitigation measures from the respective impacts.

5.1.5.1 Political and Administrative Structure

Myanmar is divided into twenty-one administrative subdivisions, which includes:

- seven states;
- seven regions (Note that regions were previously referred to as "divisions", prior to August 2010);
- five self-administered zones;
- one self-administered division; and
- one union territory.

The administrative subdivisions are detailed in the following Table.

Myanmar Administrative Subdivisions

Name	Capital	Population	Area Km2
Ayeyarwady Region	Pathein	6,663,000	35,138
Bago Region	Bago	5,099,000	39,404
Chin State	Hakha	480,000	36,019
Kachin State	Myitkyina	1,270,000	89,041
Kayah State	Loikaw	259,000	11,670
Kayin State	Pa-an	1,431,377	30,383
Magway Region	Magwe	4,464,000	44,819
Mandalay Region	Mandalay	7,627,000	37,021
Mon State	Mawlamyaing	2,466,000	12,155
Rakhine State	Sittwe	2,744,000	36,780
Sagaing Region	Sagaing	5,300,000	93,527
Shan State	Taunggyi	4,851,000	155,801
Tanintharyi Region	Dawei	1,356,000	43,328
Yangon Region	Yangon	5,560,000	10,170
Naypyidaw Union Territory	Naypyidaw	925,000	N/A
Danu Self-Administered Zone	Pindaya	N/A	N/A
Kokang Self-Administered Zone	Laukkai	N/A	N/A
Naga Self-Administered Zone	Lahe	N/A	N/A
Pa-O Self-Administered Zone	Hopong	N/A	N/A
Pa Laung Self-Administered Zone	Namhsan	N/A	N/A
Wa Self-Administered Division	Hopang	N/A	N/A

States and regions are divided into districts. Districts consist of townships, which are composed of towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is defined in the Constitution.

Each region and state has a Regional/State Government, consisting of a Chief Minister, Ministers and an Advocate General. Legislative authority resides with the State/Regional "Hluttaw" (a parliament or legislative body), which are made up of elected civilian members and representatives of the military.

The constitution states that Naypyidaw is a Union Territory under the direct administration of the President. The Naypyidaw Council, led by a Chairperson, carries out general functions on behalf of the President. The Chairperson the Naypyidaw Council is appointed by the President, and includes civilians and representatives of the military.

Self-Administered Zones and Self-Administered Divisions are administered by a Leading Body, which is headed by a Chairperson, and has executive and legislative powers. The Leading Body consists of elected State/Regional Hlutttaw members and military personnel.

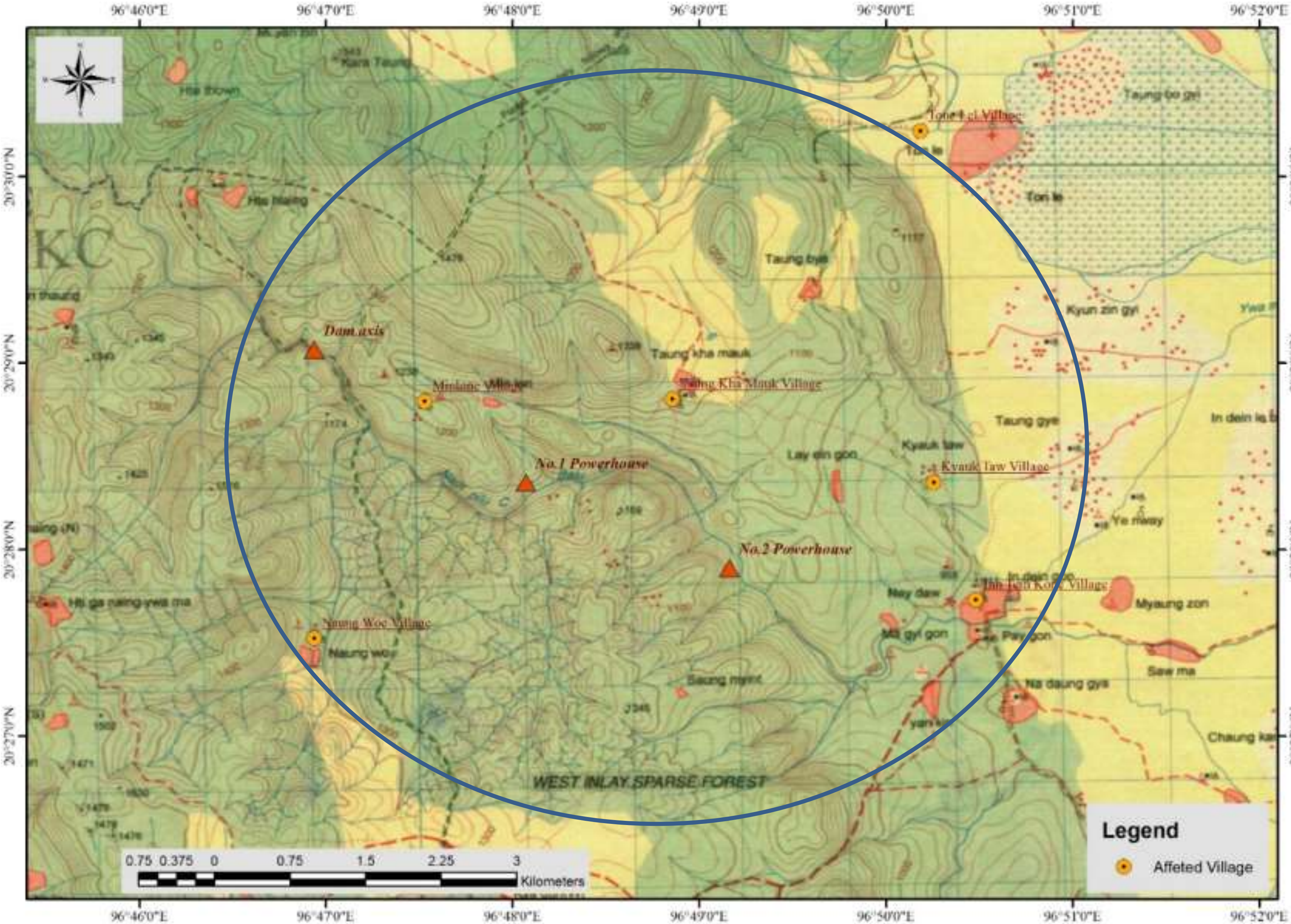
The Project site is located about 14.4 miles (23km) south-west of Nyaungshwe Town. Nyaung Shwe is a town in the Taunggyi District of Southern Shan State. Taungyi city is the capital of Shan State and fifth largest city in Myanmar. Shan State, almost a quarter of the total area of Myanmar, is the largest of the 14 administrative divisions by land area bordering China to the north, Laos to the east, and Thailand to the south. Shan State is the hilly region, which together with the higher mountains in the north and south forms the Shan Hills system. Thanlwin (Salween/Namhkong) River cuts across the state. The road to Taunggyi via Kalaw and Aungban branches off at Thazi from the main Yangon-Mandalay Road; another road via Ywangan and Pindaya branches off from Kyaukse south of Mandalay. The railhead stops short of Taunggyi at Shwe Nyaung, again from Thazi junction, and nearby Heho has an airport.

Inle Lake, second largest lake in Myanmar, Myanmar's first designated place of World Network of Biosphere Reserves, is located in the Nyaungshwe Township. Then the leg-rowing Intha people live in floating villages, in the famous Inle Lake, in the Nyaungshwe Plain of Taunggyi District of Shan State. Nyaungshwe is the tourist hub for visiting Inle Lake and Inlay Lake Wetland Sanctuary. Bawrithat Pagoda lies in the southern part of the town. Many ancient stupas are observed in Nyaungshwe Township. At Indein village, Nyaungshwe Townshinp, a Buddha Image is enshrined inside a white-washed stupa, on the summit of a hill. Below the stupa around the hill is a cluster of hundreds of ancient stupas. Many of them are ruined and overgrown with bushes.

5.1.5.2 Location and Size of the Socio-economic Study

Upper Baluchaung Hydropower Project was planned to be undertaken by the Neo Energy Oasis Development Co., Ltd to supply the electricity which is one of the basic needs of local community. Project consists of construction of two run-off river type hydropower plants utilizing the available natural head along the river before entering into the Inle Lake. Hydropower project site is located near Minlone village, under Tone Lel village tract, 1kilometer away from UB-1 power station and it is situated 5 kilometers above the stream of Inn Tein village and 23 kilometers (14.4 miles) away from the Nyaungshwe Town, Southern Shan State.

The objectives of the socio-economic study and public consultation meeting are to assess the information related with the socio-economic resources condition and concerns and opinions of the people living in and around the project area. Locations of villages, in which socio-economic survey and public consultation meetings are carried out, are described in the following map.


Dam axis
No.1 Powerhouse
No.2 Powerhouse
Tone Lel Village
Minlane Village
Taung Kha Mauk Village
Kyauk Taw Village
In Dein Kone Village
Naung Woe Village
WEST INLAY SPARSE FOREST
Legend
Affeted Village
0.75 0.375 0 0.75 1.5 2.25 3
Kilometers
96°46'0"E
96°47'0"E
96°48'0"E
96°49'0"E
96°50'0"E
96°51'0"E
96°52'0"E
20°30'0"N
20°29'0"N
20°28'0"N
20°27'0"N

5.1.5.3 Population and Demography

The Baluchaung Hydropower project site is located in Nyaungshwe Township, Taunggyi District, Shan State. Shan state is located in the middle eastern part of Myanmar with the population of 3718706. Houses and households in Nyaungshwe Township are 2036 houses in total and 2343 households in total of 8 quarters of urban area. 445 villages of rural area are 29801 houses in total and 33609 households in total. The distribution of total population by households, gender and age is provided in following tables.

Total Houses/ Households of Nyaungshwe Township, 2016

Subject	Houses	Households	Wards	Village Tracts	Villages
Urban	2036	2343	8	-	-
Rural	29801	**33609**	**-**	**35**	**455**
Total	**2451**	**25754**	**8**	**35**	**455**

The total population of Nyaung Shwe Township is 8% in urban area and 92% in rural area. Residents under 18 years old are 4348 in urban area and 9312 in rural area.

Total population of Nyaung Shwe Township

Subject	Under 18 years old			Over 18 years old			TOTAL POPULATION		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban (8%)	2228	2120	4348	4394	4918	9312	6622	7038	13660
Rural (92%)	29694	29041	58735	48481	50372	99353	78675	79413	158088
TOTAL	**31922**	**31161**	**63083**	**52975**	**55290**	**108665**	**85297**	**86451**	**171748**

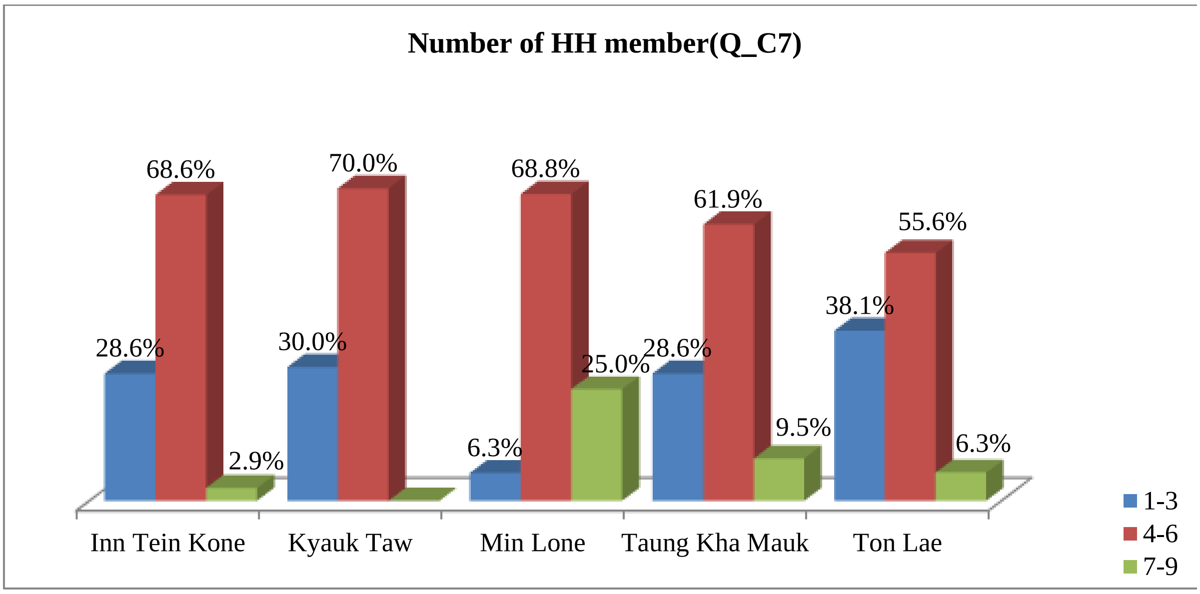
The studied villages are situated in Nyaungshwe Township, Taunggyi District, Shan State. Only residential area of Minlone (Upper) village is located very closely to the project site. Villages namely Inn Tein Kone (Inn Tein village tract), Kyauk Taw (Tone Lel village tract), Taung Kha Mauk (Tone Lel village tract), Tone Lel and Minlone villages (Tone Lel village tract) around project area were selected for socio-economic survey. Most of the villagers of these villages are Shan tribes and they are Buddhist. Twenty-five percent of total households are selected and interviewed in these villages. There are 145 respondents in socio-economic survey and the survey focused to measure the potential impacts of the project on surrounding residential area. All villages are agricultural villages and plantation is the main source of livelihood for the villagers. Rivers are found as their main water source. Some of the villagers work at the village. The local education is just poor and only primary schools are found in these villages but one high school in Inn Tein Kone village. Good health services are not observed in there. The following tables are population, households and sample size of field study for environmental and social impact assessment (ESIA).

No. of Houses, No. of Households, Total Population and Sample Size

Sr. no.	Township	Village Tract	Village	No. of Houses	No. of Household	Population	Sample Size
1.	Nyaung Shwe	**Inn Tein**	**Inn Tein Kone**	113	140	478	35
2.	Nyaung Shwe	**Tone Lel**	**Kyauk Taw**	28	30	126	10
3.	Nyaung Shwe	**Tone Lel**	**Taung Kha Mauk**	81	86	346	22
4.	Nyaung Shwe	**Tone Lel**	**Tone Lel**	210	246	838	62
5.	Nyaung Shwe	**Tone Lel**	**Min Lone**	45	45	191	16 (11+5)
6	Naung Ta Yar	**Lwe Maw**	**Naung Wo**				

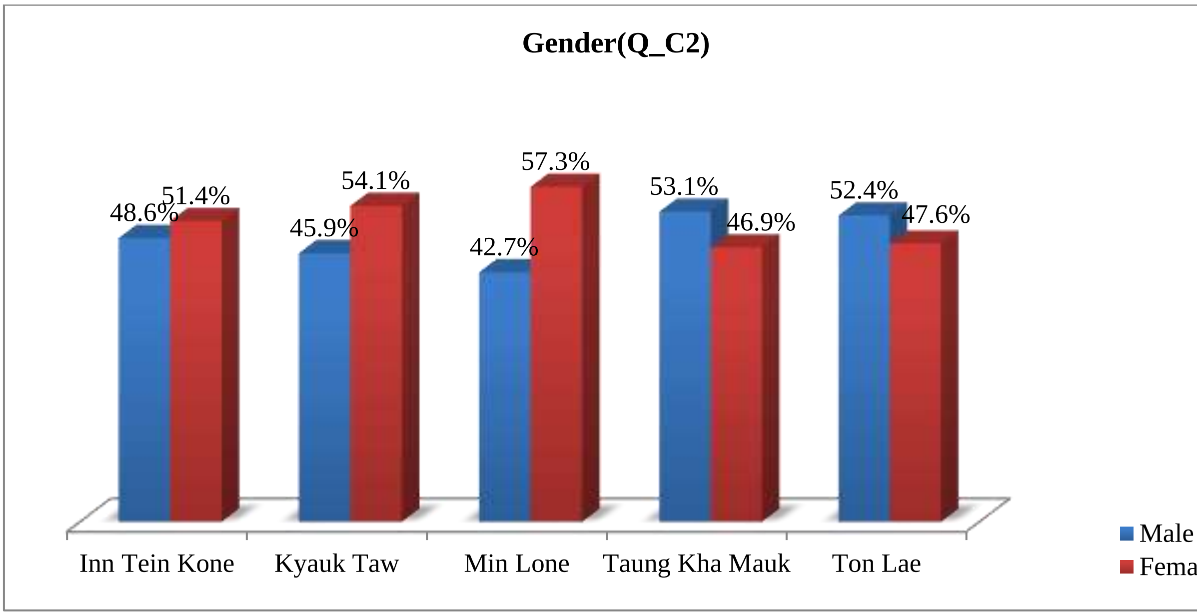
In the number of household member, respondents of survey villages are found in between one and three, between four and six, and between seven and nine. In Inn Tein Kone village, 68.6 percent of respondents are between four and six members. In Kyauk Taw, Min Lone, Taung Kha Mauk and Ton Lae villages, 70.0 percent, 68.8 percent, 61.9 percent and 55.6 percent in each are also between four and six members.

Number of household member



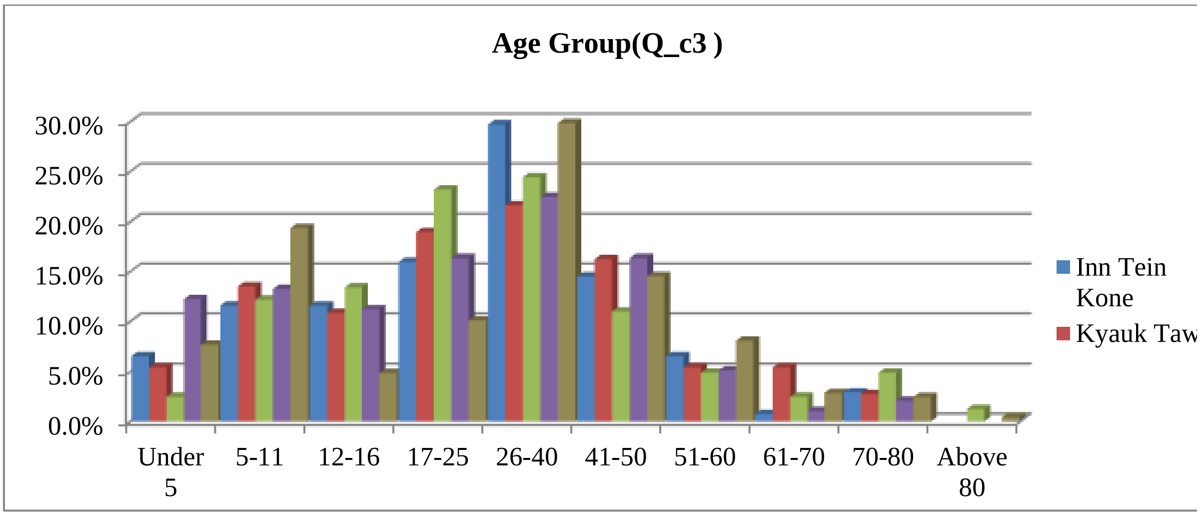
5.1.5.4 Gender

The data from the Table 1 presents the distribution of respondents by gender. The survey finding shows that 48.6% and 51.4% of respondents were male and female, respectively found in Inn Tein Kone and 45.9% and 54.1% were male and female of Kyawk Taw village, 42.7% and 57.3% male and female were Min Lone village, 53.1% and 46.9% male and female in Taung Kha Mauk and 52.4% and 47.8% male and female in Ton Lae village. The percentage of genders in survey villages is shown in the table.



5.1.5.5 Age Group

As shown in table, respondents on semi-structured interviews mainly represented age group under than 5 to over 80 years old. Most of the respondents belong to age group of within 26 – 40 years old in all five villages. Most of the respondents are middle aged (41- 50), elder people, 4.9% in Min Lone village which is the highest percentage.



5.1.5.6 Ethnicity and Religion

Myanmar which is comprised by a rich ethnically diversity has 135 ethnic groups. The ethnic groups like Kachin, Kayah, Kayin, Chin, Mon, Burma, Rakhine, Shan are regarded as major ethnic groups.

According to the 2016 updated data of Nyaung Shwe Township General Administrative Department office, it is discovered that all major ethnic races like Kachin, Kayah, Kayin, Chin, Mon, Burma, Rakhine, Shan inhibit in Nyaung Shwe. As Nyaung Shwe is situated in Shan state, the other ethnic groups under Shan race such as Inn, Paoh, Danu, Taungyoe, Leesue are mostly discovered. The largest ethnic group is formed by Inn, accounting for 69.2% of the total population. The second largest ethnic group is Paoh, accounting for 13.7% of the total population. Another section of population is composed by foreigners and it is described in the following table in details.

Ethnic groups of Nyaung Shwe Township

No.	Nationality	Population	%
1	Inn	118265	69.2
2	Paoh	23425	13.7
3	Shan	11546	6.8
4	Burma	9836	5.8
5	Taungyoe	3869	2.3
6	Danu	3008	1.8
7	Leesue	542	0.3
8	Kayar	301	0.2
9	Kayin	38	0.02
10	Chin	13	0.01
11	Rakhine	11	0.01
12	Kachin	8	0.004
13	Mon	3	0.001
14	Other	121	0.07
Total		170984	100

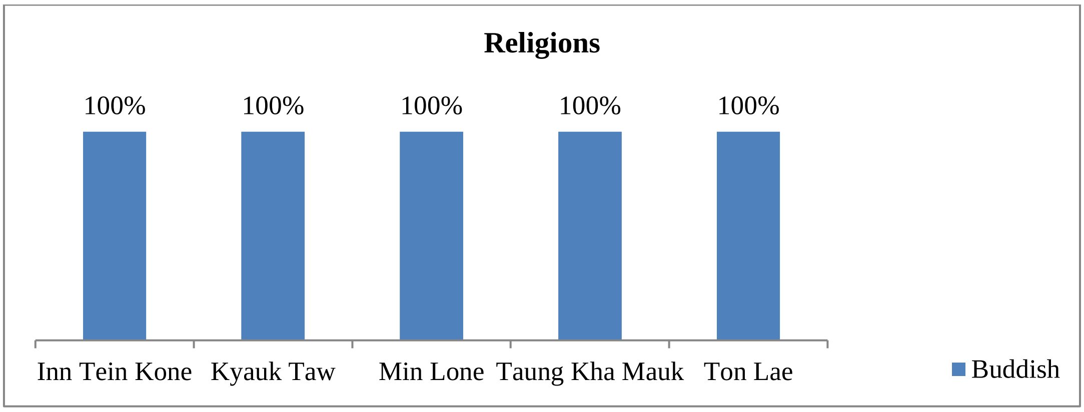
According to the field survey, respondents of the affected area are mostly found as Inn and others are Bamar, Shan, Pao, Danu and Taung Yoe. Percentage of respondents is described in the following table in details.

5.1.5.6.1 Ethnic groups of the studied area

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%
What is your ethnic group?	Burma	8.6%				
	Shan	2.9%				
	Pao	14.3%	40.0%	6.3%	95.2%	
	Danu	20.0%		93.8%	4.8%	
	Inn	54.3%	10.0%			100.0%
	Taung Yoe		50.0%			

Buddhism is the major religion in Myanmar so most of the people in Nyaungshwe practice in Theravada Buddhism. Other religions like Christianity, Hinduism and Islamic can be found but around the studied area, only Buddhism is observed according to the field survey.

5.1.5.6.2 Religions in the affected area



Methodology and Approaches

Data collections for the use of socio-economic baseline and social impact assessment is derived from both of secondary and primary sources. The procedure is:

(1) Secondary data compilation on

- Legal framework and Institution Setting relevant to social context
- Villages in the project area

- Number of households
- Number of population
- Ethnic Group
- Infrastructure
- Occupation
- Household Income and Expenditure

(2) Primary data compilation on

- Site Survey
- Stakeholder Meeting
- Public Consultation Meeting
- Semi-structured Interviews
- Questionnaire Distribution

Data Collection

Secondary data are gathered from Township General Administrative Department, Nyaung Shwe, government responsibilities in respective villages, project plan and record from the developer.

Direct conversation, questionnaire distribution, photograph records, stakeholder meetings and consultation with local villagers were made during field observation from 24, August, 2016 to 2, September, 2016.

There are 6 members in survey team and the members met ministers, government responsibilities, village supporting committee members, officers, monks, village heads and local villagers who live in affected villages, for discussion, consultation and question distribution about the project.

Qualitative interpretation and examination are applied to assess socio-economy of villagers in the project area.

Public consultation sessions for Upper Baluchaung Hydro Power Project were systematically organized during this study. The approaches of public consultation are as follow:

- Target area: Inn Tein Kone, Kyauk Taw, Taung Kha Mauk, Tone Lel, Min Lone and Naung Woe areas which will be close to the project
- Target group: related village heads, village committee members, women, youth, members of health services, monks and elderly group
- Methodology: visit, consultation and surveying, etc.

The information about a wide variety of them in affected area are collected with the help of questionnaire survey, through direct observation, individual and focused group discussion, stakeholder consultation meetings, semi-structured interviews to cover representatives from the General Administrative Department, administrators of villages and village tract, key informants such as 100 hundred households head, 10 household heads and village leaders, local people, non-governmental organizations (NGOs), and civil society organizations (CSOs) around project area.

Basic household information, socio-economic information, housing information, health, cultural heritage, water, fishing, forest, traffic in the community, personnel, general facts, employment, gardens and livestock, water and sanitation, education, development and leadership are studied through questionnaire.

Ten percent representative of population in affected area are interviewed through questionnaire survey.

5.1.5.7 Socio-Economic Structure

Socio-economic structure reflects the condition and living status of a certain country or town or village. Traditional agriculture represents one of the driving sectors of the local economy, providing most of the employment to its residents in most of Myanmar. Shan State is famous for its gardening of all sorts of fresh fruit and vegetables. Mining is also observed in Shan State and silver, lead and zinc are mined, notably at the Bawdwin. Border trading centres along the Shan State are Muse, the biggest border trading centre along the Myanmar China border and Tachileik, another important trading centre between Myanmar and Thailand. Inle Lake, Myanmar's first designated place of World Network of Biosphere Reserves is located in Shan State and it is a major tourist attraction.

5.1.5.7 Economy and Livelihood

The major business of the villages is agriculture. Some people do private business like grocery store, restaurant, and carpentry etc. Most of the people own orchard, Le (low land), Yar (up land), Kyun Myaw (Floating island), Kaing and mainly cultivate corn, paddy, tomato, groundnut and chilli. Very few people choose their career as government staff and some are private staffs, casual labours. Some of the household in the villages do livestock. Most of the houses have pigs for both business and household consumption, about almost quarter of house hold own cattle for their own business and few households do fishery only for their household consumption. However, there is no industry in the villages. Five Day Market is their major market for them to sell their crops.

5.1.5.7.1 Occupations in the affected area

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%
Occupation	Dependent	36.4%	37.1%	22.5%	27.9%	34.9%
	Livestock	1.6%				
	Fishing					0.4%
	Agriculture	18.6%	54.3%	67.5%	66.3%	45.9%
	Trade	19.4%	2.9%	1.3%		2.2%
	Government Staff	3.9%		3.8%	1.2%	3.5%
	Private's staff	5.4%		5.0%	1.2%	2.2%
	Skill worker	5.4%			1.2%	1.7%
	Casual labour	3.9%	5.7%		2.3%	9.2%
	Service	1.6%				
	Vendor	3.9%				

5.1.5.8 Agriculture

Based on a survey conducted in August and October, 2016, the major business of the affected villages is the agriculture. The corn cultivation is the most common and is widely practiced as Yar. Other different kinds of cultivations are mainly paddy, soybeans, crops (sesame, sunflower, and ground nut), tomato, chilli, gourd, marrow, onion, bamboo, coffee, Thanat, flower, ginger, snake gourd, eggplant, pumpkin and turmeric. The major long term crops are Teak and Pine.

Twenty-one kinds of plants for Agriculture are conducted in studied households. Paddy, corn, tomato, chili, gourd, marrow, onion, groundnut, bamboo, soybean, sunflower, sesame, turmeric, coffee, thanat, flower, ginger, chayote, snake gourd, eggplant and pumpkin are cultivated for agricultural sector.

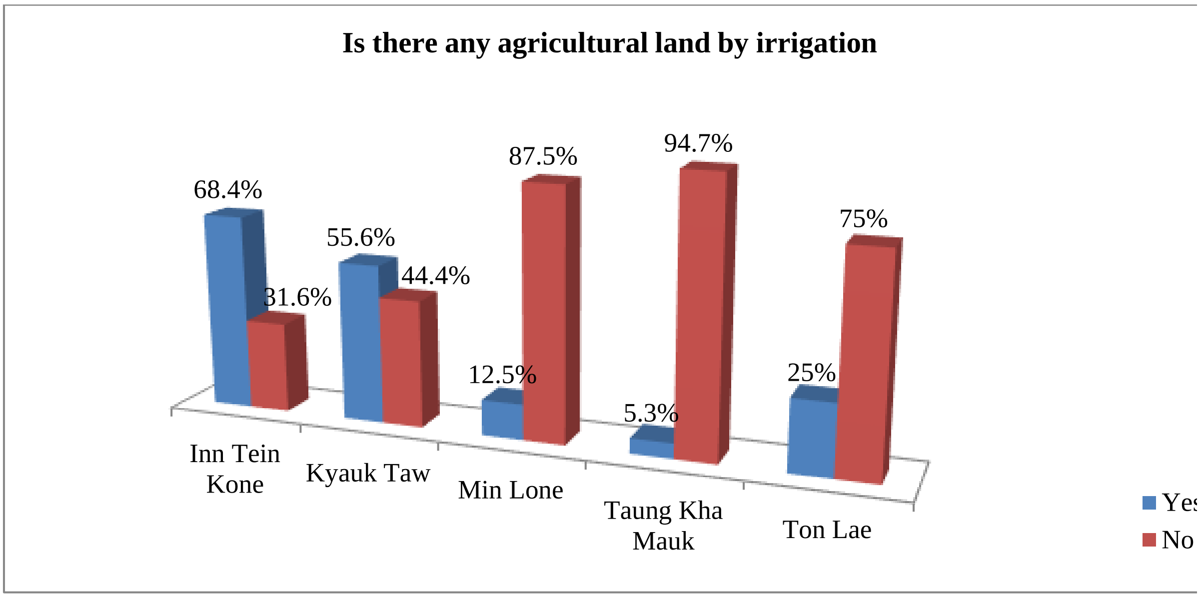
Households in Inn Tein Kone, Kyauk Taw, Min Lone, and Taung Kha Mauk villages mostly grow corn in 53%, 67%, 94%, and 79% respectively. Households in Tone Lae village mostly grow tomato in

87%.

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100%	100%	100%	100%	100%
Kind of Plant	Paddy	42%	44%	13%	37%	19%
	Corn	53%	67%	94%	79%	
	Tomato					87%
	Chilli					37%
	Gourd					23%
	Marrow					17%
	Onion	26%	11%			2%
	Groundnut	37%	11%	56%	53%	4%
	Bamboo	11%	11%	6%		2%
	soybean	11%				
	sunflower	5%		6%	37%	
	sesame	5%			32%	
	Turmeric			75%		
	Coffee			6%	5%	
	Thanat			69%		
	Flower			6%		
	Ginger					2%
	Chayote					2%
	Snake gourd					2%
	Eggplant					10%
	Pumpkin					2%

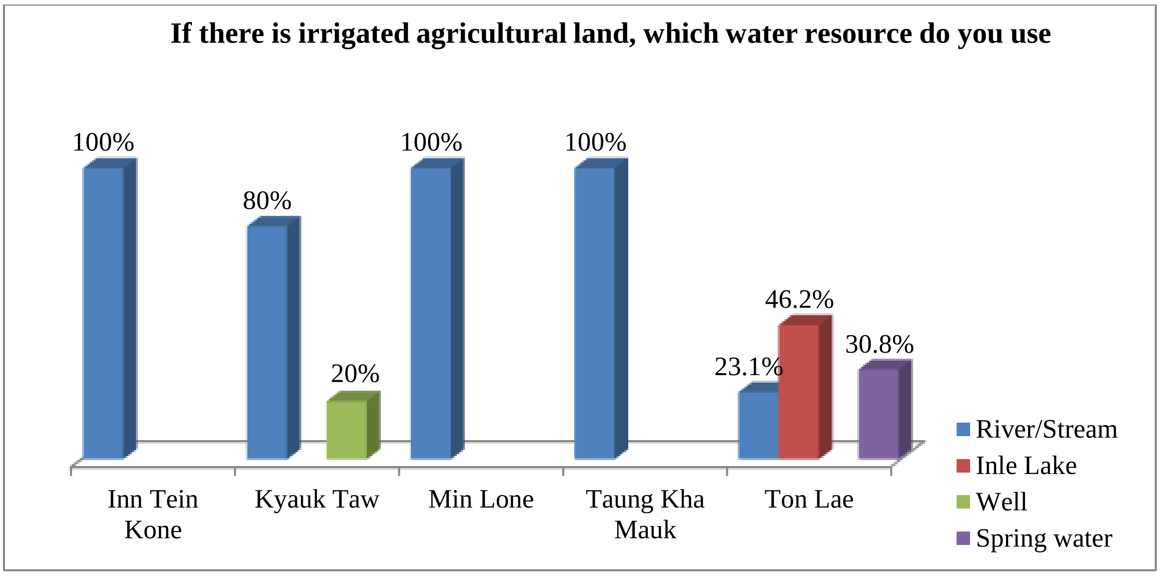
Households can be divided into two categories; those work agricultures by irrigation or those do not. Households in Inn Tein Kone village work agriculture by irrigation in 68.4% and in Kyauk Taw village also work in 55.6%. Households in Min Lone village do not work agriculture by irrigation in 87.5%, those in Taung Kha Mauk are 94.7% and those in Ton Lae are 75.0%.

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%
Is there any agricultural land by irrigation?	Yes	68.4%	55.6%	12.5%	5.3%	25.0%
	No	31.6%	44.4%	87.5%	94.7%	75.0%



Households in Inn Tein Kone, Kyauk Taw, Min Lone, and Taung Kha Mauk villages mostly use river/stream in 100%, 80%, 100%, and 100% respectively. Households in Tone Lae village mostly use Inle Lake in 46.2%.

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%
If there is irrigated agricultural land, which water resource do you use?	River/Stream	100.0%	80.0%	100.0%	100.0%	23.1%
	Inle Lake					46.2%
	Well		20.0%			
	Spring water					30.8%



Agricultural Practices

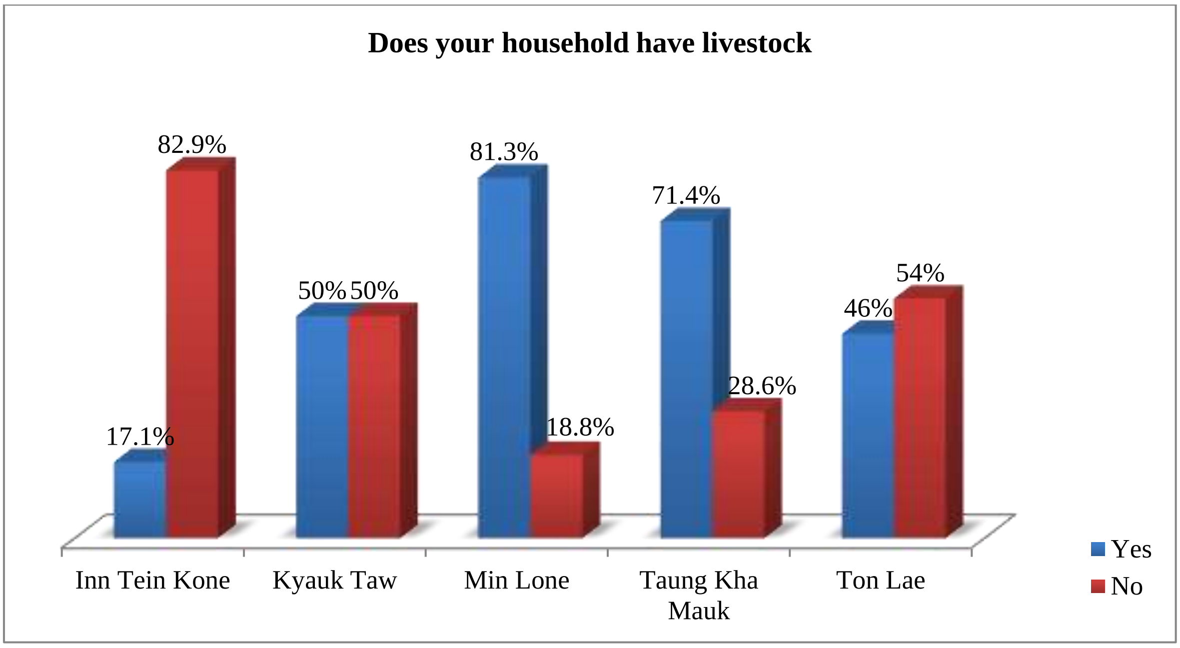
5.1.5.9 Livestock

There is no major livestock in the villages. Villagers in affected villages are raising cows, pigs, and breed chicken. The households raise pigs and poultry such as chicken and ducks, for their own consumption and for occasional sale. In general, buffalo and cow are used as draught animals in rice paddies.

Households in Inn Tein Kone village do not have livestock in 82.9%. Those in Kyauk Taw village have livestock in the same percentage of 50.0%. Those in Min Lone village have livestock on 81.3% and in Taung Kha Mauk one has in 71.4%. Those in Tone Lae village do not have livestock in 54.0%.

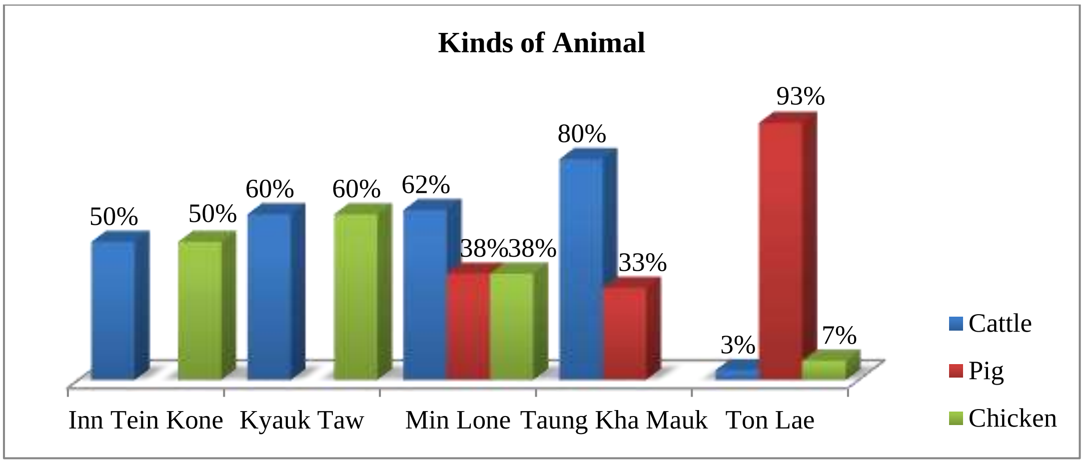
		Village				
		Inn Tein Kone	**Kyauk Taw**	**Min Lone**	**Taung Kha Mauk**	**Ton Lae**
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%

Does your household have livestock?	Yes	17.1%	50.0%	81.3%	71.4%	46.0%
	No	82.9%	50.0%	18.8%	28.6%	54.0%



Households in Inn Tein Kone village farm cattle and chicken in the same percentage of 50. Those in Kyauk Taw village also farm cattle and chicken in the same percentage of 60. Those in Min Lone village farm cattle in 62% and in Taung Kha Mauk one in 80%. Those in Tone Lae village farm pig in 93%.

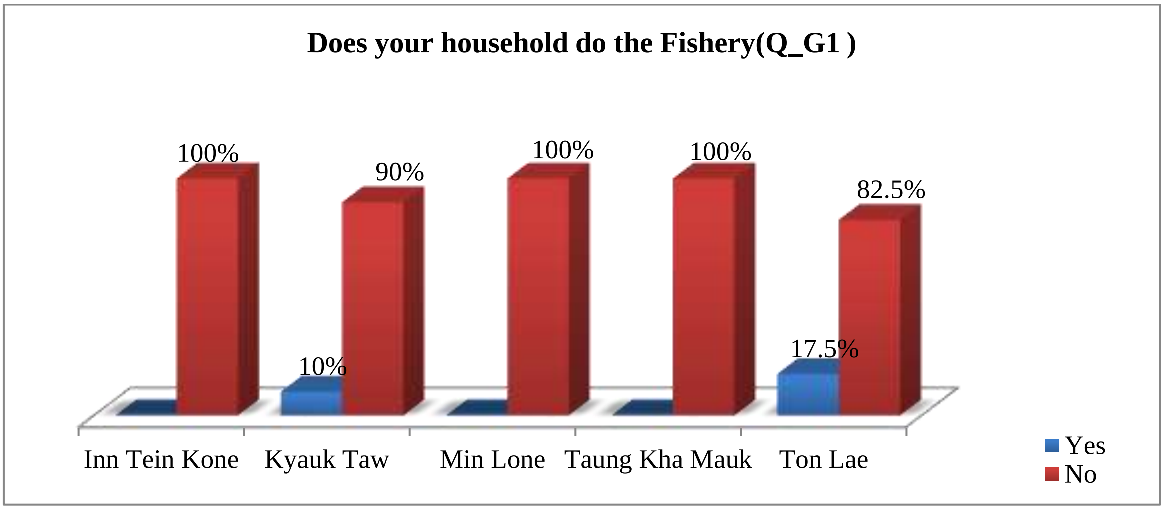
		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100%	100%	100%	100%	100%
Kinds of Animal	Cattle	50%	60%	62%	80%	3%
	Pig			38%	33%	93%
	Chicken	50%	60%	38%		7%



Livestock Practices

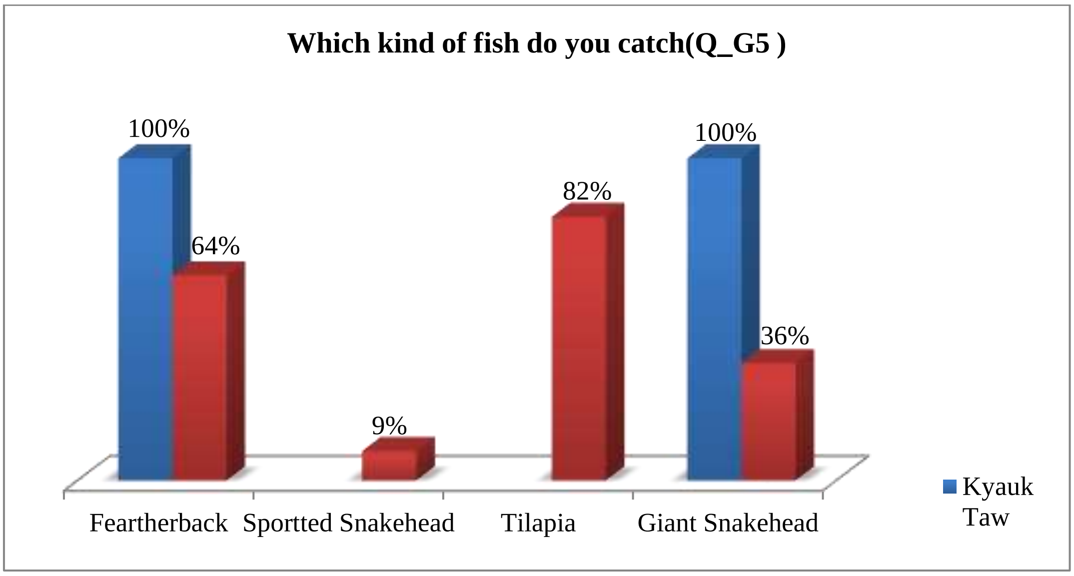
5.1.5.10 Fisheries

Agriculture mostly farming is the primary livelihood in Nyaung Shwe Township and fishing is not so important livelihood. Households studied in Inn Tein Kone, Min Lone, and Taung Kha Mauk villages totally do not work for fishing. Those in Kyauk Taw and Tone Lae villages usually do not work for fishing in 90% and 82% in each.



Feartherback, sported snakehead, tilapia and giant snakehead fishes are observed as farming fishes in studied households. Households studied in Kyauk Taw village catch feartherback and giant snakehead fishes in the same percentage of 100. Those in Tone Lae village mostly catch tilapia in 82%.

		Village	
		Kyauk Taw	Ton Lae
TOTAL	Col %	100%	100%
Kinds of Fish	Feartherback	100%	64%
	Sportted Snakehead		9%
	Tilapia		82%
	Giant Snakehead	100%	36%



5.1.5.11 Infrastructures and Social Facilities

Nyaungshwe Township is a township of Taungyi District in the Shan State of Myanmar. The principal town is Nyaungshwe. Inle Lake, a popular tourist site and an inland fresh water lake, is in the south of Nyaungshwe Town. There are thirty-six administrative departments in Nyaungshwe Town. The town is comprised by eight wards and thirty-five number of village tract with 445 villages. Four government hospitals, five health centre, twenty-six health percenters, nine private clinics, a post office, six jetties, schools and several government offices are observed in Nyaungshwe Township. The followings are the government departments within the Nyaungshwe Township.

Government Offices in Nyaungshwe Township

Sr. no.	Name of Government Department	Remark
1	General Administration Department (Nyaungshwe)	
2	Nyaungshwe Police Office	
3	Nyaungshwe Police Station	
4	Nanpan Police Station (Branch)	
5	Department of Planning	
6	Township Law Office	
7	Township Justice Office	
8	Department of Immigration	
9	Audit Office	
10	Department of Rural Development	
11	Department of Internal Revenue	
12	Department of Public Health	
13	Department of Agricultural Office	
14	Department of Agriculture Land Management and Statistics	
15	Department of Irrigation	
16	Department of Forestry	
17	Township Department Committee	
18	Roads Department Office	
19	Department of Education	
20	Township Cooperative Department	
21	Department of Information and Communication	
22	Religious Affairs	
23	Department of Office of Electrical Engineer	
24	Department of Sports and Physical Education	
25	Department of Fire Force	
26	Culture Museum (Nyaungshwe)	
27	Department of Fishery (Nyaungshwe)	
28	Nature and Wildlife Conservation Division (NWCD)	
29	Department of Hotel and Tourism	

30	(a) Myanma Post Office (Post Office), Nyaungshwe (b) Myanma Post Office (Telegram Office), Nyaungshwe (c) Myanma Telecommunication Enterprise, Nyaungshwe	
31	Myanma Agricultural Development Bank	
32	Myanma Economic Bank	
33	Township Election Commission	
34	Information Police Force	
35	Tourism Police	
36	Department of Livestock Breeding and Veterinary	

Civil Society Organizations (CSO) and Non-Governmental Organizations (NGO)

Sr. no.	Name of Organizations	Remark
1	ICDO (Integrated Inle Lake Conservation and Development Organization	
2	SAVE THE INLE LAKE	
3	Mine Thauk Charity House	
4	Inn Literature and Cultural Development Organization	
5	Mine Thauk Youth Organization	
6	HnaLoneHla Inn Maung/Mal	
7	City Development Committee	

The study of infrastructure in the project area includes houses, schools, pagodas and monastery. Most of the lanes of villages are dirt road and few are observed as coal tar roads. Cobbled roads are mostly found and transportation is by motor bike. Public bus is only used to Indein - Nyaungshwe and Indein - Aungpan. Most of the houses are built of bamboo. Some are wooden and some brick nocking houses are also observed. Almost all villages have monasteries and a few pagoda and Buddha images are also found in monastery compound. A Buddha Image which is enshrined inside a white-washed stupa, on the summit of a hill, is found in Indein village. Below the stupa aroud the hill is a cluster of hundreds of ancient stupas.

5.1.5.12 Social Facilities in the studied area

Sr no.	Village Name	Health Care Facilities		Education Service			Monastery
		Health Care Center	Health care sub center	Pre-School	Primary School	High School	
1	Inn Tein Kone	-	-			1	3
2	Kyauk Taw	-	-	-	2	-	-
3	Taung Kha Mauk	-	-	-	1	-	1
4	Tone Lel	-	1	1	1	-	1
5	Min Lone (Upper)		-	-	1	-	1
6	Naung Hoe	-	-	-	1	-	2

Education

Education is the improvement and development of the society and schools take part as fundamental things of education. Nyaungshwe Township hosts government high, middle and primary schools. Following Table shows the number of education structure present in the township.

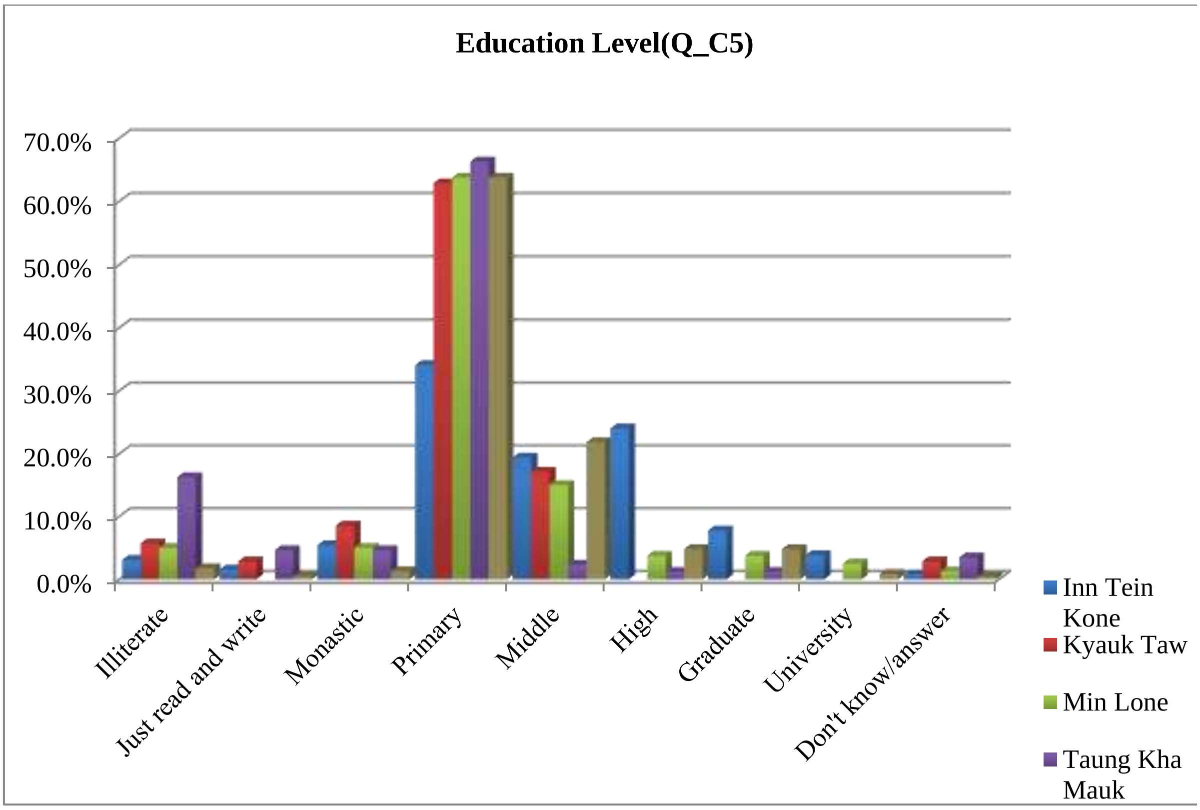
Education Structure in Nyaungshwe Township

No	Type of School	No. of School
1	High School	21
2	Middle School	24
3	Primary School	192
4	Pre-school	16
Total		253

The education in the project area is assumed to poor. Fifty-seven percent of the village is at primary level and few learnt from monastery. Only primary schools are observed in the project area. The students who has finished these schools in the villages are found in studying at Nyaungshwe and Aung Ban.

Education Structure in Nyaungshwe Township

No.	Villages	Types of school		
		High School	**Primary School**	**Pre-school**
1	Inn Tein Kone Village	1	-	-
2	Kyauk Taw Village		2	
3	Taung Kha Mauk Village		1	1
4	Tone Lel Village		1	
5	Minlone Village		1	
6	Naung Woe Village			1
Total		1	5	2



Education Services

5.1.5.13 Health

Health and well-being play an important role in community. So, health facilities are vital to community. The affected area is located in Nyaungshwe Township and the township hospital under Taunggyi General Hospital head to supply the health activities in affected area.

Health Services in Nyaungshwe Township

No.	Type	No. of Public Health Care Centers	Ratio of Medical Staff
1	Government Hospital	4	
2	Health Centre	7	
3	Health Precentre	26	
4	Private Clinise	9	
5	Doctors		1:21468
6	Nurses		1:5367
7	Health Assistants		1:28624

Health services are poor in affected area. In nearly all sample villages around the project area such as Inn Tein Kone, Kyauk Taw, Min Lone and Taung Kha Mauk villages, there is no hospital or health care center. Only one village around the project affected area, Tone Lel village, has sub-rural health care center. There is no doctor in there but one mid-wife and two nurses are observed. If there is normal illness, people go to that center or ask the nurse for coming to the village. One man who is holding medical certificate is found in Taung Kha Mauk village and some villagers gets treatment from him if there are normal cases. People normally go to Nyaungshwe Hospital for serious medical issues or in the event of emergency by motorbike. Most child deliveries take place at their house and Sub Rural Health Care Centre. Incidence of HIV/AIDS has not recorded in there. Flu are commonly occurred in that area. Although there is not found any special diseases, flu which was occurred in children is observed in the villages in the past, within the last few years.

In Kyauk Taw and Taung Kha Mauk villages, only one-fifth (20% percent of total) of the respondents' household members occurred diseases during last 5 years. According to the respondents' answers, it can be concluded that these two villagers are healthy. Family members of respondents in Inn Tein Kone village and Tone Lel village suffered from nearly all kinds of diseases. According to the respondents of Min Lone village, Malaria, Flu, Respiratory disease, Typhoid, Illness, Tumor, Lung, Kidney diseases are suffered. Family members of respondents in Taung Kha Mauk suffered mainly from Flu, Bone disease, Torn muscles, Ankles arthritis and Kidney. In these four villages, namely Inn Tein Kone, Tone Lel, Min Lone and Taung Kha Mauk villages, Influenza is mostly suffered by percentage (about 20%, 33%, 40% and 38% of total respectively). In Kyauk Taw village, respondents' family members suffered from mainly the three kinds of disease; Heart attack, Liver disease and Stomach ache.

Condition of suffering from diseases in projected affected areas during last 5 years

		Village				
		Inn Tein Kone	**Kyauk Taw**	**Min Lone**	**Taung Kha Mauk**	**Tone Lel**
TOTAL	Col %	100%	100%	100%	100%	100%
Kinds of Disease	Cholera	7%				3%
	Flu	47%	33%	67%	50%	63%
	Hypertension	7%				7%
	Heart Attack		33%			
	Respiratory Disease	13%		17%		3%
	Liver Disease	7%	33%			3%
	Paralyzing	7%				3%
	Bone disease, Torn muscles, ankles arthritis	7%	33%			
	ill	7%			25%	17%
	Tumor			17%		
	Stomach				25%	
	Female disease					3%

Health Services

5.1.5.14 Water Use and Water Supply

Myanmar is a country endowed with abundant water resources. The catchment area of Myanmar's ten principal river basins comprises about 737800 km². Potential water resources volume is about 1082 km³ for surface water and 495 cubic km for groundwater as well constitute national water resources annually. With the increase of population and enhanced need for water for economic activities, there is increasing pressure on use of surface water and extraction of groundwater. Control and management of surface water and groundwater is therefore important for sustainable development of the country in future.

The percentage of people cover by safe drinking water and sanitation facilities are still very low in the country compared to the global status. In Myanmar, rural water supply activities were started in 1952 to provide safe drinking water and implement environmental sanitation works for the rural populace. At present, with the assistance of international organizations, several water supply and sanitation projects are being implemented. Up to the end of August 1995 Government implemented, various rural water supply activities covering for 12.5 million of the population.

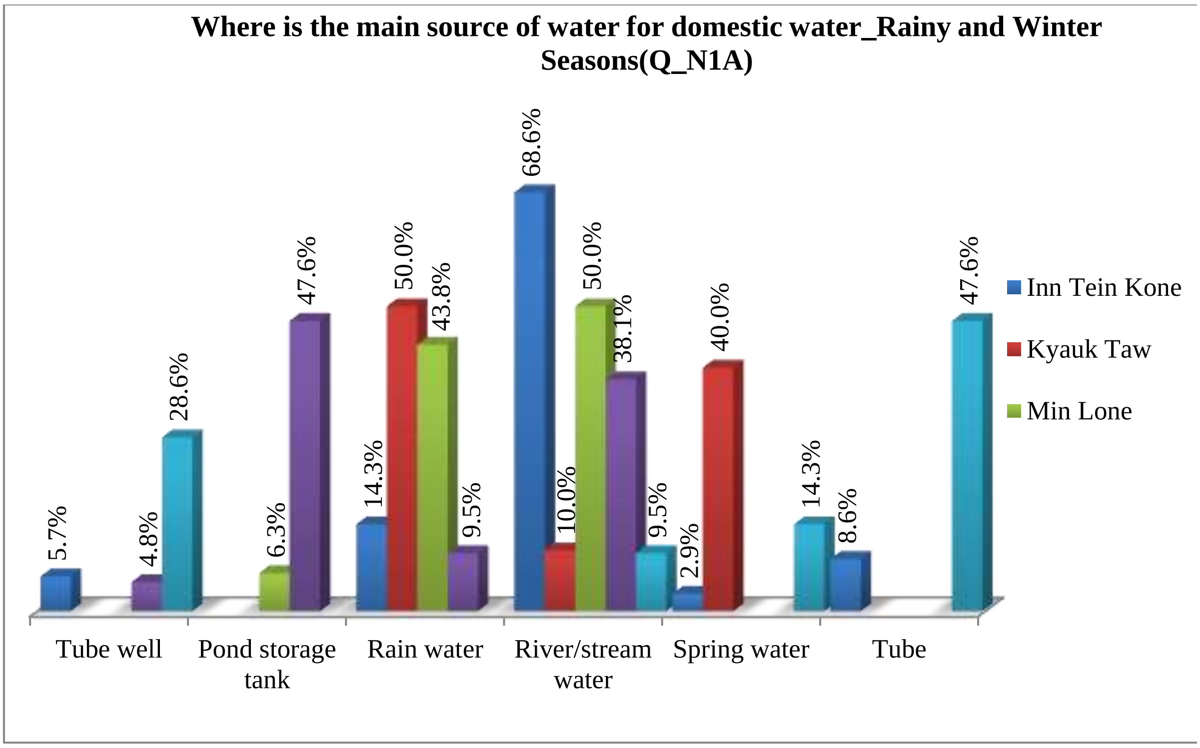
In Myanmar, the responsibility is divided between municipalities in urban areas and the Union government in rural areas. The responsibility for drinking water provision is shared by the Department of Rural Development (DRD) under the Union Ministry of Livestock, Fisheries and Rural Development and the municipalities together with the Department of Municipal Affairs (DMA), which is part of the Regional Ministry of Development Affairs.

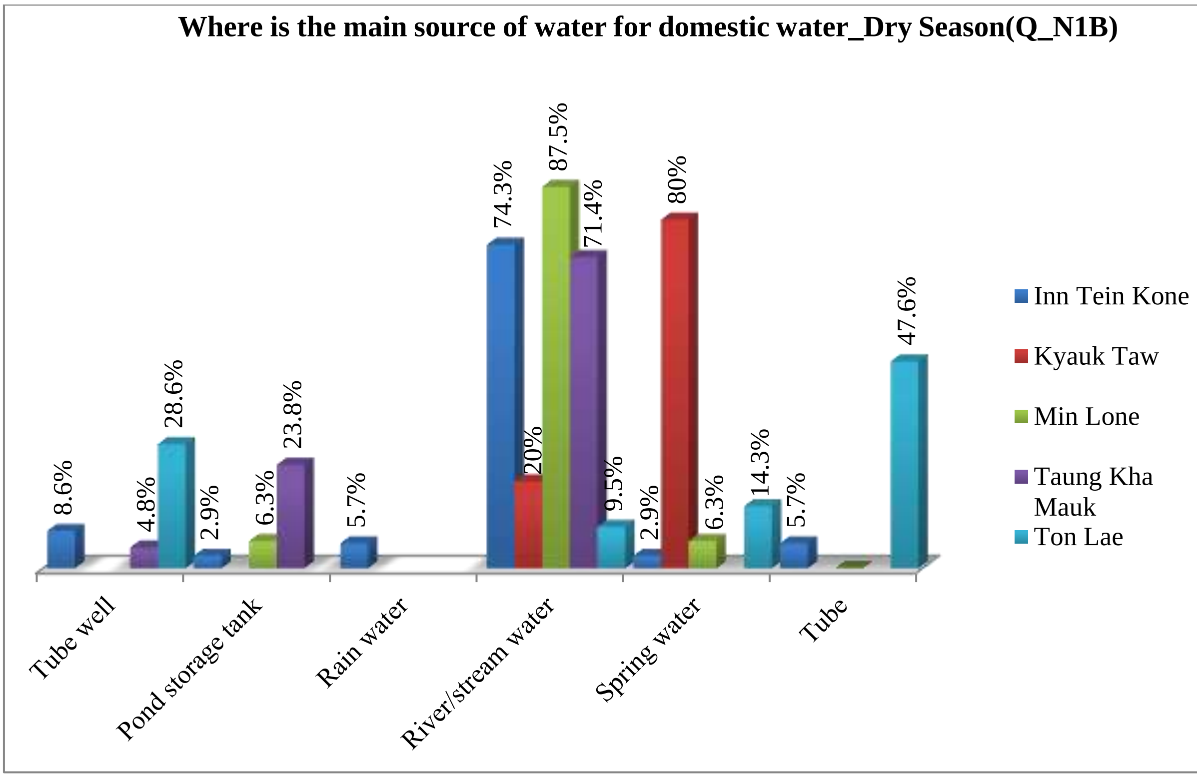
Water is the most important in life. The main sources of drinking and domestic water in the studied villages are tube wells, streams and rain water. Streams are the most common. Traditionally, the stream water is settled the silt and cloth filtering is used for making treatment for drinking water. In Inn Tein Kone, only one-third of respondents' households treat drinking water. Boiling and cloth filtering methods are used to purify water in all villages. Cloth filtering is mainly used in all villages. A few people in Inn Tein Kone and Tone Lel villages use also settlement of water.

In Inn Tein Kone village, stream water is the main source of domestic usage at both normal season and dry season. For drinking water, purified water is mainly used in normal season and stream water is mainly used in dry season. In Kyauk Taw village, main water sources for both domestic usage and drinking are rain water and spring water during raining season and spring water in dry season. In Min Lone village, for domestic usage, rain water and stream water are the main sources at normal season and stream water is also the main source during dry season. For drinking water, half of the respondents' households use rain water at normal season and most of the respondents' households use stream water at dry season. In Taung Kha Mauk village, main water resources for both domestic usage and drinking water are pond storage tank and stream water at normal season and stream water at dry season. In Tone Lel village, main water resource is tube well for domestic usage and drinking water at both normal and dry seasons. In Kyauk Taw, Min Lone, Taung Kha Mauk and Tone Lel villages except Inn Tein Kone, nearly all respondents' households treat water for purification of drinking water. Following tables describe sources of domestic and drinking water and treatment of drinking water in percentage.

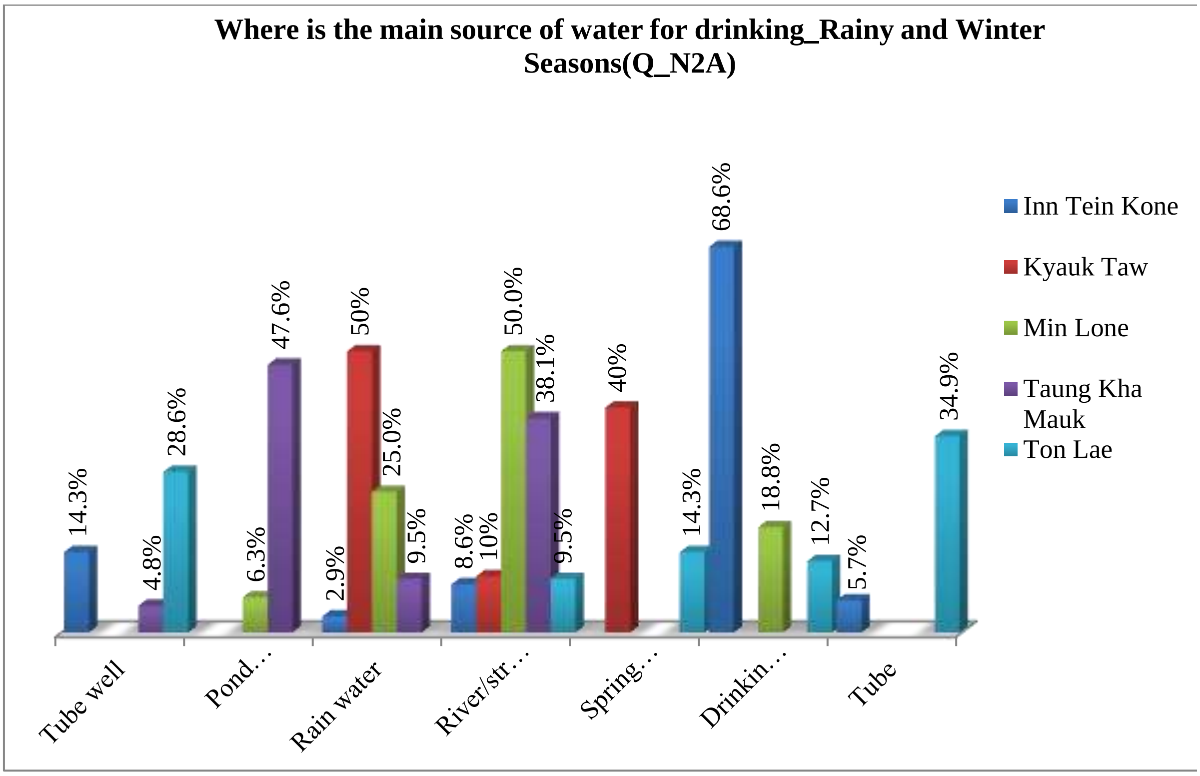
Followings describe sources of domestic and drinking water and treatment of drinking water in percentage.

Sources of domestic water at normal season Sources of domestic water at dry season

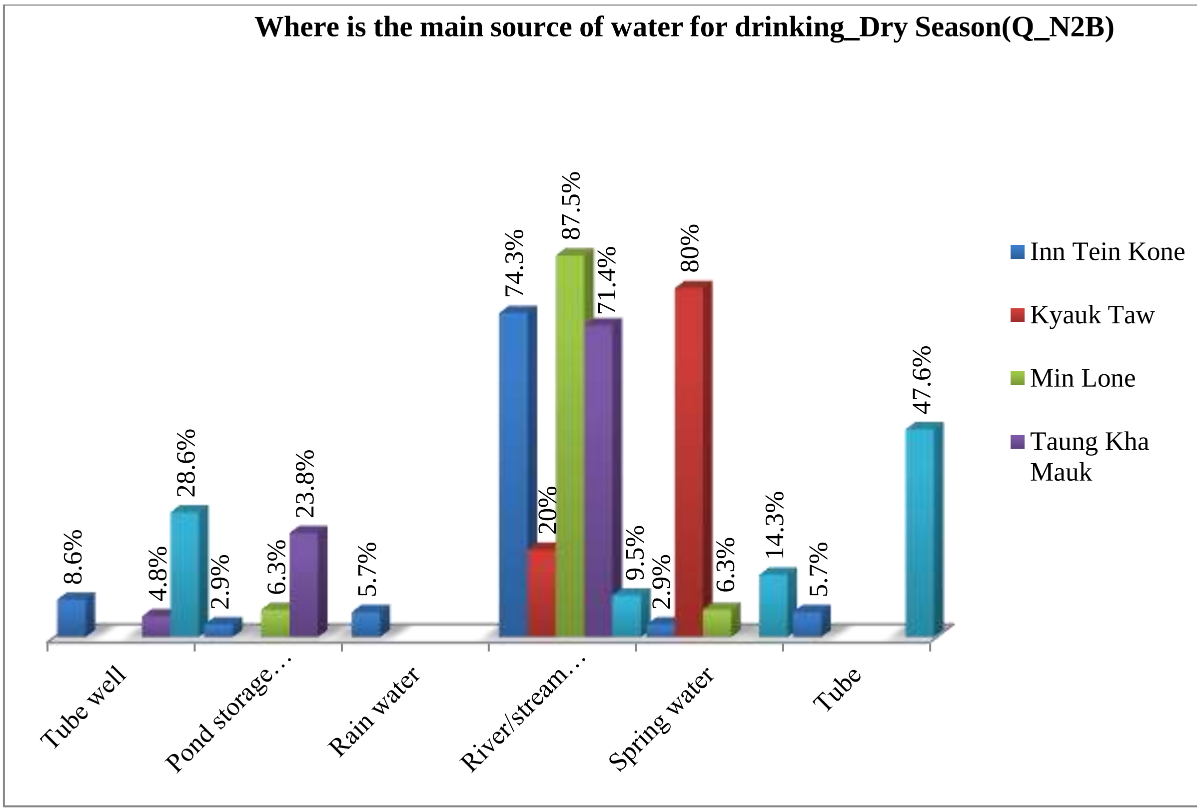




Sources of drinking water at normal season



Sources of drinking water at dry season



Water Use and Water Supply

5.1.5.15 Electricity

Within Nyaungshwe Township electricity is still not available for some of the population and households with access to electricity are concentrated in the urban area. Government electricity is not Private micro hydroelectric power stations are observed in studied area and most of the electricity accessed in the villages is from these stations. Candles are still the source of lighting, even if power generators, batteries and solar panels are quite common. Firewood is the main source of heating for cooking, while electricity is limited to the township area, even if with few cases. Some households are still using charcoal.

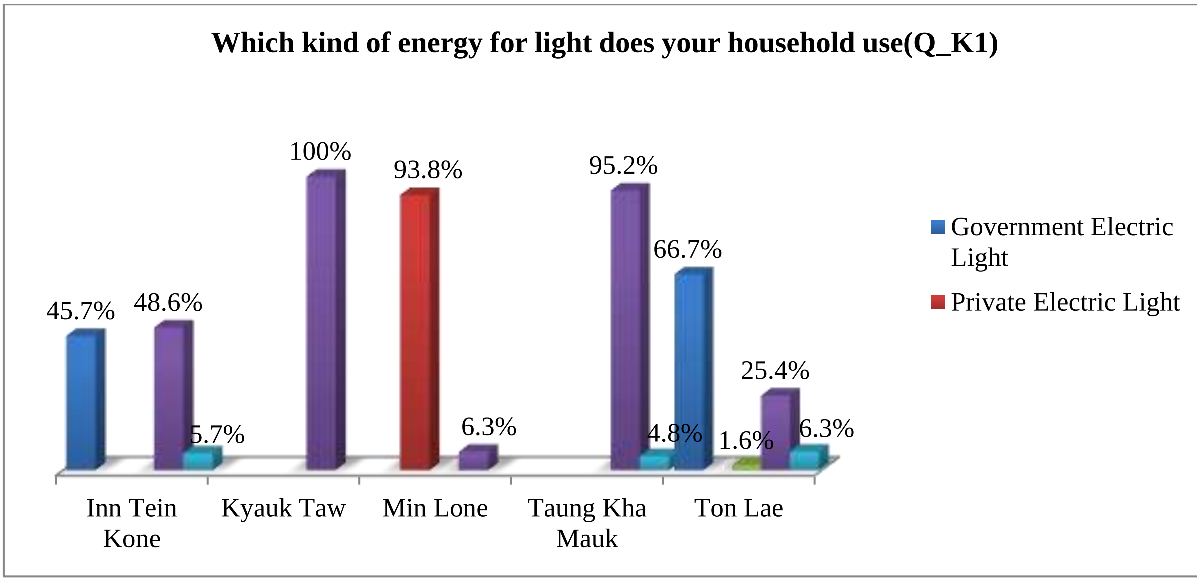
Currently, the project site area has not enough electricity according to the field survey. Electricity is supply to the villages around the Project Area by micro hydropower stations, constructed by villagers themselves with the technical assistance from private technicians. The investment for the power stations and transmission lines were used to share among the villagers.

The households in the studied area are observed using electric power or light from government electricity, private electricity, candle, solar energy and battery. Households studied in Inn Tein Kone village use solar energy in 48.6%, in Kyauk Taw one in 100.0% and in Taung Kha Mauk one in 95.2%. Those in Min Lone use private electric light in 93.8%. Households studied in Tone Lae village get electric power from government in 66.7%.

Sources of electricity used in the studied area

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%
Which kind of energy for light does your household use?	Government Electric Light	45.7%				66.7%
	Private Electric Light			93.8%		
	Candle					1.6%
	Solar	48.6%	100.0%	6.3%	95.2%	25.4%
	Battery	5.7%			4.8%	6.3%

Kind of energy used in studied area

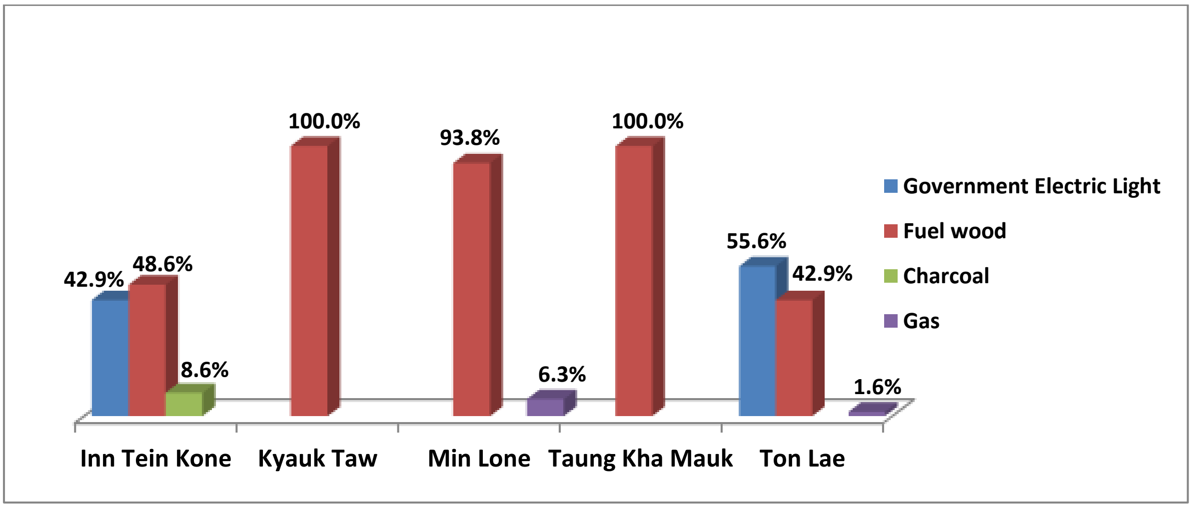


The households studied in the project area use government's electricity, fuel wood, charcoal and gas for cooking. Those in Inn Tein Kone, Kyauk Taw, Min Lone, and Taung Kha Mauk villages use fuel wood in 48.6%, 100%, 93.8% and 100% respectively. Households in Tone Lae village get government's electricity in 55.6%.

Sources of energy for cooking

		Village				
		Inn Tein Kone	Kyauk Taw	Min Lone	Taung Kha Mauk	Ton Lae
TOTAL	Col %	100.0%	100.0%	100.0%	100.0%	100.0%
Which kind of energy for cooking does your household use?	Government Electric Light	42.9%				55.6%
	Fuel wood	48.6%	100.0%	93.8%	100.0%	42.9%
	Charcoal	8.6%				
	Gas			6.3%		1.6%

Sources of energy for cooking



Village Energy Sources

5.1.5.16 Industry

Myanmar is still a predominantly agricultural country. The agricultural sector employs more than 60 per cent of the labour force and contributes about 50 per cent of GDP. Industrialization is an essential element of the whole development of a country. Economic development had often been equated with the progress of industrial sector. The number of industries in Myanmar has been increasing since the Country has recently opened its market to foreign investors. In Shan State, southern Myanmar, the cottage weaving industry of the Inle area is famous for the lotus robes.

The major livelihood and economy of Nyaungshwe Township is depending on agriculture and tourism but no important industry sector is observed in the studied area. Some small shops are found in the villages for the purpose of domestic use. Indein village located on the west bank of the lake is one of hot spot of tourism around Inle lake due to the existence of ancient complex of pagoda on the hill south west to the Indein village.

Local Business

5.1.5.17 Transportation

Public roads, railway and airline are observed in Shan State. Four airlines, Heho Airport, Lashio Airport, Tachileik Airport and Kengtung Airport are serving in Shan State. The major transportation of Nyaungshwe Township is car road and this township is located in the Southern Shan State near the marvellous Inle Lake. Inle Lake is situated in Nyaungshwe Township and this town is the main transfer port to Inle Lake by ferry boats.

In the project area, the main transportation is motor bike. There is also public transportation to Nyaungshwe township and Aungban Township. For small business, using public transportation is found according to the field survey. The road condition on the villages is dirt surface about 3 meter wide. Public transportation is characterized by the following alternatives:

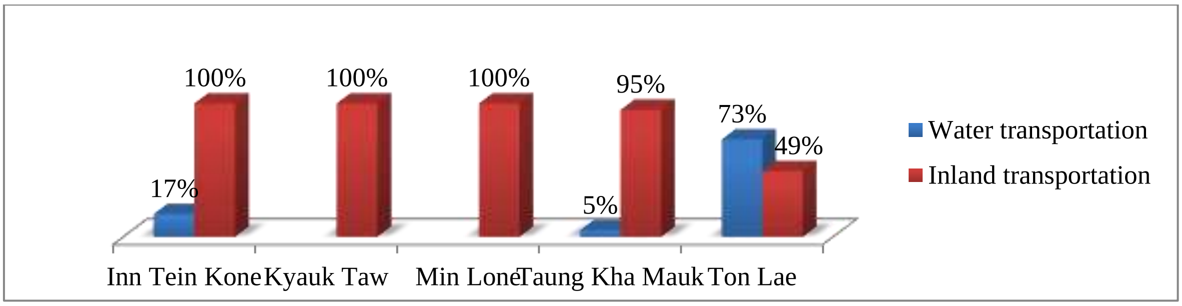
- motorboat services from Indein village/to Inle Lake
- bus services from Indein to Nyaungshwe and Indein to Aungban

There are some areas which can be reached only via motorbike or by foot. So, accessibility can be assumed weak. Motorbikes are the most widely used means of transport in the Project area.

Households studied use transportation by water and inland. Those in Inn Tein Kone, Kyauk Taw, Min Lone, and Taung Kha Mauk villages use inland transportation in 100%, 100%, 100% and 95% respectively. Households in Tone Lae village use transportation by water in 73%.

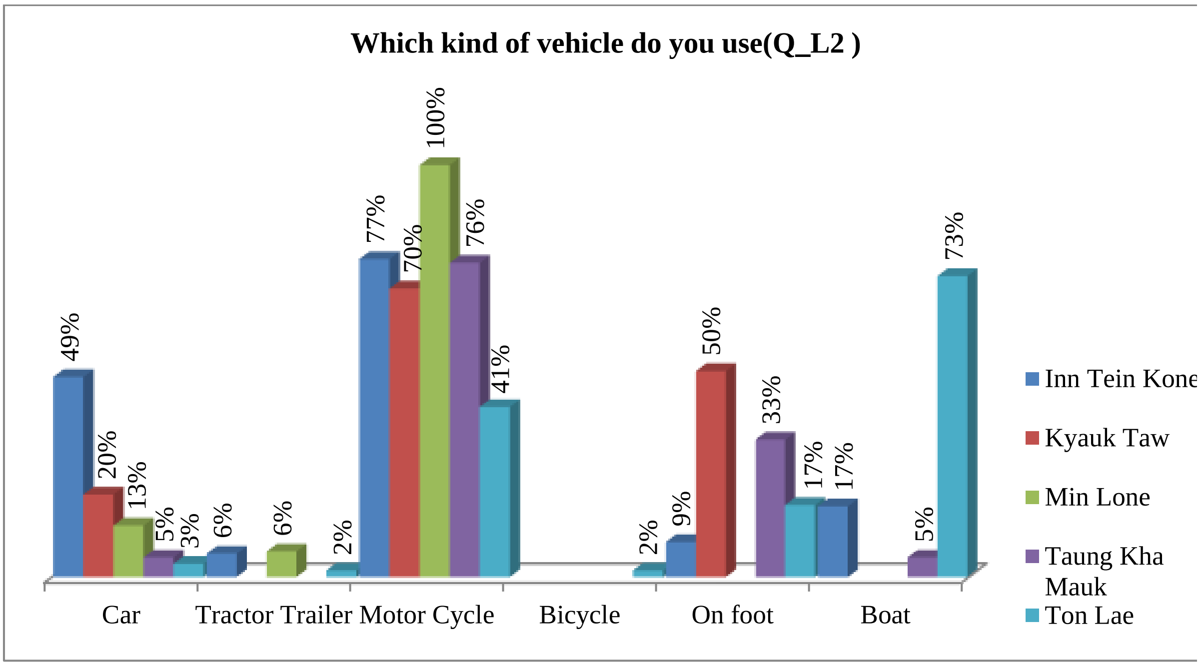
Transportation in studied area

		Village				
		Inn Tein Kone	**Kyauk Taw**	**Min Lone**	**Taung Kha Mauk**	**Ton Lae**
TOTAL	Col %	100%	100%	100%	100%	100%
Kinds of transportation	Water transportation	17%			5%	73%
	Inland transportation	100%	100%	100%	95%	49%



The transportation by the households in the studied area is observed by car, tractor trailer, motor cycle, bicycle, on foot, and boat. Those in Inn Tein Kone, Kyauk Taw, Min Lone, and Taung Kha Mauk villages use motor cycle in 77%, 70%, 100% and 76% respectively. Households in Tone Lae village use boat in 55.6%.

Kind of vehicles observed in studied area



5.1.6 Cultural Resources

The majority of the people in the project area are Shan and the project is located in Shan State. In some characterizations of Theravada Buddhism, Shan beliefs and practices may be considered unorthodox. Nevertheless, Shan identify themselves as Theravada Buddhists. Although they are Buddhist, the worldview of the Shan centres on the idea of "power protection" and its unequal distribution. As religious practitioners, there are Buddhist monks, novices, and nuns; temple lay readers; traditional curers; and caretakers of the cadastral-spirit altar. All except the caretaker of the cadastral-spirit altar draw on the power associated with Buddhism. There are temple festivals celebrating events in the Buddha's life, such as the anniversaries of his birth, his enlightenment, his first sermon, and his death; other festivals entail the construction of sand pagodas, and the firing of rockets before or after the rainy season and to honour the end of the retreat during the three months of rain. Wealthy villages and temples celebrate more of these events than do poorer ones. However, all villages at least hold a festival after the end of the rains' retreat. Once a year villages as a whole invite monks to chant to remove misfortune and to renew the village and its constituent households' barriers against misfortune. The village cadastral spirit is also feasted at least once a year. Households may sponsor a range of ceremonies including Buddhist ordinations, funerals, merit making for the dead, marriages, first bathing ceremonies for infants, and invitations for monks to chant in the house.

Mostly these are impermanent decorations such as carved and decorated fruit offered to the Buddha image or monks and elaborately decorated coffin carriers, money trees, and pagodas celebrating the end of the rains' retreat. Shan still weave traditional shoulder bags and carve small objects such as Buddha images from marble and jade. Shan in Chiang Mai were known for their silverwork.

Shan accept and use Western medicine where available and when the ailment responds to such treatment. They also use the four elements—earth, water, wind, and fire—together with hot and cold to diagnose and treat illness. Buddhist verses are important in curing, either being blown over the patient or recited over water for the patient to drink.

Funerals occur three to seven days after death. In Thailand, everyone is cremated, although in the recent past people dying "bad deaths" were buried. Shan in Myanmar and China still bury people who die a "bad death." Buddhist monks officiate at funerals; Shan believe that only monks can transfer merit from the living to the dead. After a short period, during which the spirit may remain waiting for people to make merit for it, it is reborn.

Cultural Structures

The baseline data collection survey identified the following cultural heritage sites in Nyaung Shwe Township within the 3km radius from the project site.

Inn Tein Kone Village

Inn Tein Kone is the largest village around the project located on the bank of Upper Baluchaung. Inn Tein Kone village is one of the hotspot of tourism due to the existence of ancient Inn Tein pagoda complex, many local and foreign tourist are visiting to Inn Tein village. Religious structures can be seen as follows.

Minlone Village

Within the Project area only Minlone village is located on the road to the Project site. The village is 1Km away from UB-1 power station. A Buddhist monastery exit at Minlone village at higher elevation. The building was said to be built around 1836 and it is an old wooden structure with corrugated sheet roof. During the visit to the monastery an antique brass bell with dated 1836 was found. The bell was said to be in commemoration of the completion of the monastery.

Chapter VI Potential Environmental and Social Impact Assessment, Mitigation and Enhancement Measures

6.1 Conceptual Study on Environmental Impacts Assessment and Management Plan

6.1.1 Conceptual Approach

Overall Indicative Concept

The overall purpose is to develop an Environmental Impact Assessment (EIA) report including its management plans to ensure that all adverse impacts by project during construction and operation are taken into account. To reach that goal, the following main activities are deemed necessary:

- Carry out a survey and site investigation to assess the environmental and social prevailing conditions (physical-chemical, biological, social, economic and cultural) of the selected project area and adjacent areas that may be affected by the project.
- Predict and analyze the significant environmental impacts (both adverse and beneficial) of the project.
- Determine the appropriate and most suitable environmental management measures to avoid, prevent or mitigate the adverse impacts.
- Ensure that all potentially affected people receive assistance to enable them to improve or retain their living standards and be able to participate and share the benefits of the development.
- Determine appropriate and most suitable environmental management plan, watershed management plan, sustainable community development plan, indigenous people's plan (if required) thereby ensuring that all environmental and social issues are well managed.
- Conduct a public consultation process for providing information related to the project detail and possible impacts as well as for receiving opinion on and an input to planning and implementation of the project.

Study Approach on Environmental and Impact Assessment (EIA) and Management Plan

The ESIA of the Upper Baluchaung HPP Project should be studied covering the upstream reservoir construction, downstream, waterways, two power stations and access road areas. The ESIA Study will review all related laws and guidelines of the Republic of Union of Myanmar including other international guidelines applicable to the preparation of the Upper Baluchaung Project Full ESIA, and EMMP.

The present hydropower project will provide economic and social benefits for local communities to get the electricity for their development. The local communities living around the Baluchaung HP project are mainly farmers and the project will bring opportunities for employment and the major positive impact is to provide the electricity to the villages that located around Inle Lake for development including tourism and infrastructural development.

6.1.2 Assessment Methodology

The assessment of environmental impacts is carried out in two steps: identification and evaluation of impacts.

Identification of Impacts

The identification of positive and negative impacts, caused by project implementation, is based on an analysis of the effects that result from interactions among the affected environmental components and the various equipment or activities to be carried out.

The approach used to assess the project's environmental impacts determines the **Intensity**, **Extent**, and **Duration** of the anticipated positive or negative impact. These three qualifiers are grouped under one synthesis indicator, the **Significance** of the impact. This indicator provides an overall assessment of the anticipated impacts on a given environmental component.

Intensity of Impacts

The Intensity of an impact expresses the relative importance of the consequences attributable to a change in an environmental component. The Intensity of an impact is an integration of the component's Environmental Value with its Degree of Disturbance and can be either positive or negative. The **Intensity** of the impact results from the interaction of the three **Degrees of Disturbance** (High, Medium and Low) with the three classes of **Environmental Value** (High, Medium and Low).

Extent of the Impact

The **Extent** of the impact expresses the spatial influence of the effects produced by an intervention on the environment. This refers either to a distance or an area over which a component will undergo changes. It could also refer to the portion of the population that will be affected by these changes.

The three levels of extent are:

- **Regional**, when an impact affects a large geographic area or a number of components located a significant distance from the project, or when it is experienced by the entire population or by a significant portion of the population in the study area;

- **Local**, when the impact affects a relatively restricted area located within, near, or at a limited distance from the project site or when it is experienced by a limited portion of the population in the study area;
- **Site-Specific**, when the impact affects only a very restricted area in the proximity of the project site or is experienced by only a small number of individuals in the study area.

Duration of the Impacts

The **Duration** of the impact describes the period of time during which a component undergoes changes due to the impact. **Duration** is not necessarily equivalent to the period of time during which the direct source of impact is active. It must also take frequency into consideration when the impact is intermittent.

Duration is characterized as:

- **Long**, when the effects are experienced continuously for the life of the facility, or even beyond, if the effect is irreversible;
- **Medium**, when the effects are experienced over a relatively prolonged period of time, but less than the duration of the life of the facilities;
- **Short**, when the effects are experienced over a limited period of time, generally corresponding to the period of construction, the start-up period, or a single season.

Significance of the Impacts

The interaction between the **Intensity**, **Extent**, and **Duration** defines the **Significance** of an impact on a given environmental component. Table 6-1 presents the grid for determining **Significance,** and differentiates between five levels of significance, ranging from very high to very low.

The final assessment phase consists of determining the residual significance of the impact after all mitigation measures are taken in consideration. The issue here, then, is to clarify how the mitigation measure changes one or several of the inputs in the impact assessment process described above.

In general, significant level of impacts is predicted in connection with impact Intensity, Extent and duration and sensibility of the receptors. Categories of significance are classed as very low, low, medium, high and very high. Where possible, the degree of significance is determined by comparing the predicted outcome with performance standard or industrial guideline. In many instances, professional judgment has prevailed in assessing the potential of individual impact.

Impacts assessed as very low and low significance, usually does not require any additional mitigation measure. This means those identified impacts are within acceptable level because they are very unlikely to happen and/or their sensitivity of receiving environment is very low and /or project designs have installed sufficient control mechanisms. In any case, implementing additional control measures will help remain the impacts as acceptable in the failure of inherent control measures.

Impacts evaluated as medium significance, deemed as significant impacts, require additional mitigation measures to reduce the impacts at acceptable levels. These impacts can be minimized in order to reach negligible or low levels that are also deemed as acceptable level of impacts (using effective control measures).

Impact assessed as very high and high significance cannot be reduced by implementing mitigation measures. In this case, further option has to be considered in order to avoid any critical significance driven by project. That is known as analysis of alternative strategy.

Table 6-1: Grid for Determining Impact Significance.

Intensity	Extent	Duration	Significance
	Regional	Long Medium Short	Very High Very High Very High
Very High	Local	Long Medium Short	Very High Very High High
	Site-specific	Long Medium Short	Very High High High
	Regional	Long Medium Short	Very High High High
High	Local	Long Medium Short	High High Medium
	Site-specific	Long Medium Short	High Medium Medium
	Regional	Long Medium Short	High Medium Medium
Medium	Local	Long Medium Short	Medium Medium Low
	Site-specific	Long Medium Short	Medium Low Low
	Regional	Long Medium Short	Medium Low Low

Low	Long	Local Medium Short	Low Low Very low
	Site-specific	Long Medium Short	Low Very low Very low

6.2 Potential Impacts on Physical Environment

The environmental impact analysis is based on the project components and activities as described in Chapter III, and the environmental baseline conditions as described in Chapter V.

The impacts of the project activities are evaluated on three basic environmental components: the physical, biological, and socioeconomic environments. Also, the potential impacts of the environmental conditions on the Project itself are addressed where appropriate. Generally, the impacts are identified and discussed for construction and operation phases. The assessment includes the quantification of losses, where possible, by the project structures and reservoir.

Impacts were analyzed with the state of the art techniques including; predictive mathematical models, geographic information systems (GIS), remote sensing applications, and professional judgment of experts based on their relevant knowledge and experience. For the evaluation of the impacts (impact significance), related Myanmar Legislation, national and international standards and guidelines, professional knowledge of similar projects regarding the anticipated impacts, and opinions and experience of interdisciplinary teams of experts were the major means of assessment. The map showing the identified impact area of the Upper Baluchaung HPP Project is given in Figure 6-1. This area was the main study area throughout the ESIA studies regarding establishing the baseline and assessing the impacts.

The impacts of the project activities and components on the physical environment and the effects of the physical environment on the project are analyzed in this section. All impacts, beneficial and adverse, during construction and operation phases are discussed in the following subsections. The environmental impact analysis and assessment generally follow the outline of the previous chapter in order to address the impacts based on the baseline data/information provided.

This section is divided into six main headings as physiography, geology and soils, climate, hydrology, air quality impacts, and noise.

6.2.1 Physiography

During the construction phase, changes in the topography can be observed.

Principally, landform will be changed as a result of the activities for mainly dam construction, construction areas, access roads, and other services to be brought onsite.

The area of physical land take by the Project includes the reservoir area and the footprint of the construction facilities (dam site, powerhouse site, camp facilities and access roads). The reservoir water volume is about 42,000 m^3 and covers an area of 0.21 km^2, so the overall land take including

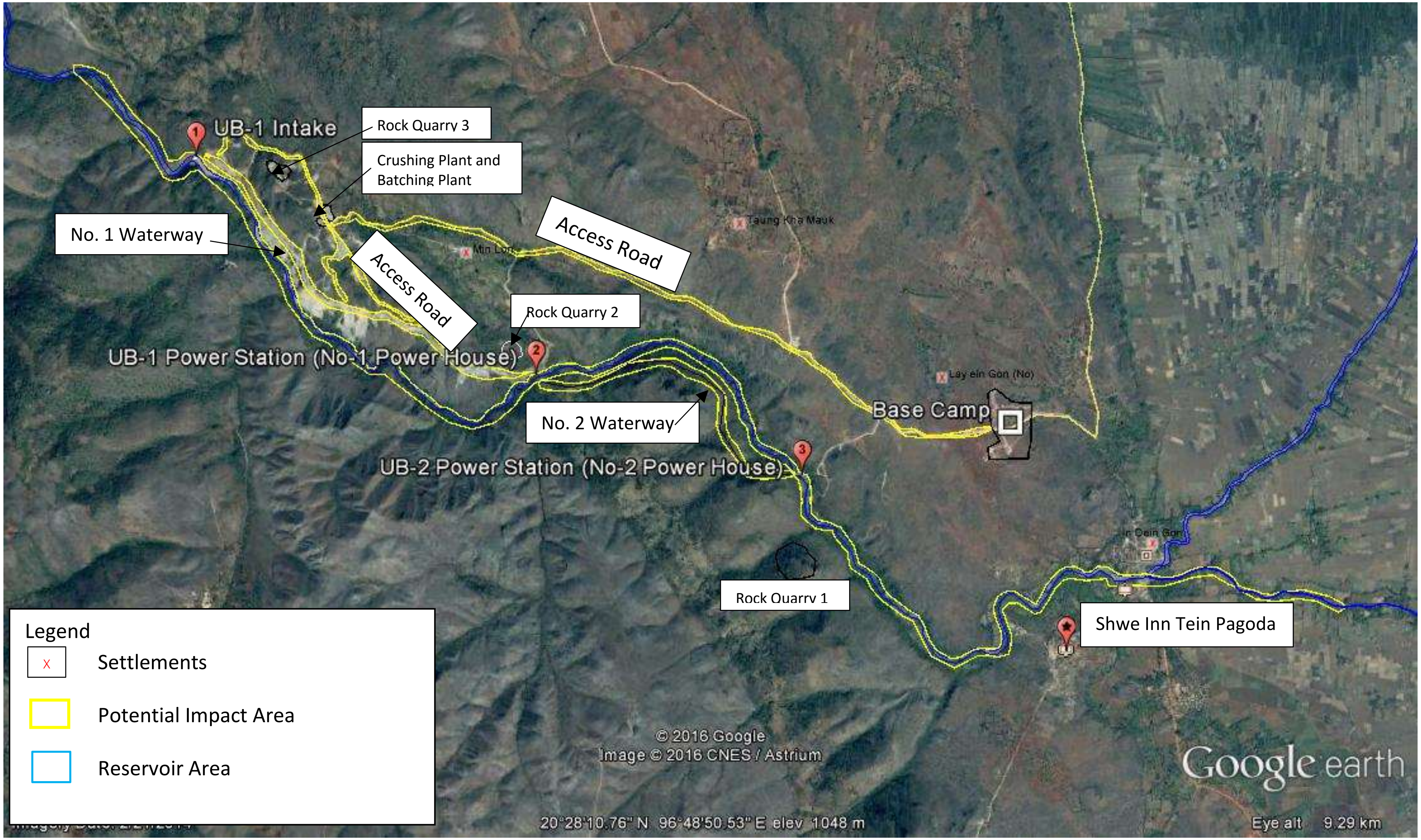


Figure 6-1: Potential Impact Areas of Upper Baluchaung HPP

all the project facilities will be less than 1 km^2. Only about 0.1 km^2 of this area is arable land and the rest is mainly composed of shrubby forms along the river and barren land.

Potential impacts related to physiography (Impact on Landscape) during operation period will discuss in item 6.4.1.10.

6.2.2 Geology and Soils

Geological investigations show that the geological formation at the project site will provide adequate support as the bedrock for the dam.

Geological Component

Geological components distributed in the project site are listed in Table 6-2.

Table 6-2: Geological Components in the Project Site

Mark	Geology
ts	Top Soil
d	Debris deposit
se	Calcite deposit
b	Boulders (River Deposit)
c	Cobbles (River Deposit)
p	Pebbles
S	Siltstone
LS	Limestone

Bedrock at the project site consists mainly of Limestone and siltstone, which is distributed on the UB-1 Powerhouse site. Surficial deposits covering the bedrock comprise of residual deposit, river deposit, calcite deposit, debris deposit, and top soil. The residual soil is completely made of weathered siltstone, consisting of reddish brown compact soil. The river deposit consists of boulders, cobbles, pebbles, and sand, intercalated with calcite sediment.

The calcite deposit is formed by a chemical deposit from calcareous river water, like stalactite. It is yellowish to brownish light gray in color and consolidated, but is mostly porous and can be excavated using an excavator. The deposit is distributed on the riverbed and riverside, being intercalated with river deposit.

The debris deposit is distributed on gentle slopes, and is grayish to reddish dark brown in color, consisting of clayey to silty soil with rock fragments of various sizes. The deposit is loose in general and can be easily excavated using an excavator.

The top soil is widely distributed on gentle slopes, and is dark brown in color, consisting of mainly silty soil, containing organic matters such as plant roots. The deposit is generally thin, varying from 10 cm to 20 cm thickness. At some flat areas however, it is relatively thick with 2 m thickness or more.

UB-1 Intake Site

The result of site reconnaissance in the preliminary study indicates that rocks on both abutments on the original weir axis are loosened. Accordingly, a relatively big amount of rock excavation was foreseen. Consequently, an alternative axis, located about 100 m downstream of the original axis, was selected for drilling investigation as shown in Figure 6-2.

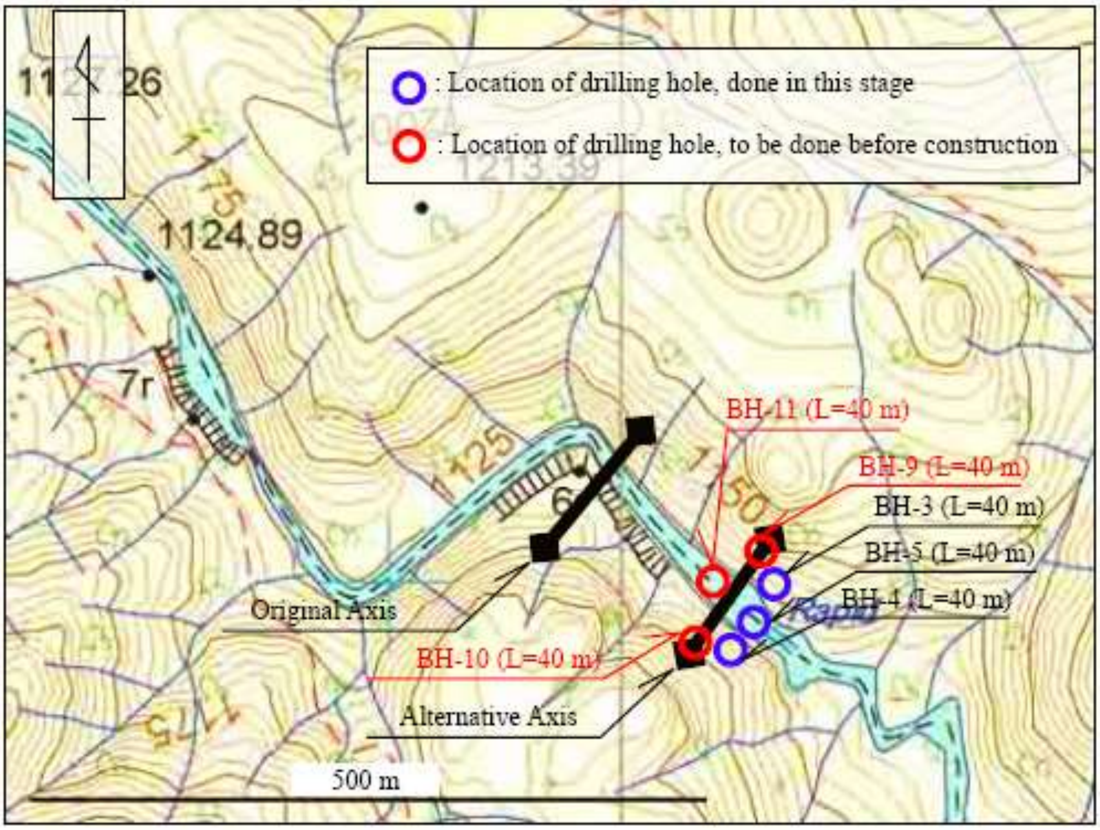


Figure 6-2 Location Map of UB-1 Intake Axis and Drill Holes.

The results of the drilling are as follows:

- The rock foundation is stiff and weathering is not intense. Core samples are not taken at some sections which seem to be densely jointed. Although no test result is available so far to determine strength, it is assumed that the shear strength of the LS, which is C=1.5 MPa and Φ=43°, seems to be sufficient for the foundation of the concrete weir of about 35 m high.

- Surficial deposits overlaying the rock foundation consist of top soil, debris deposit, calcite deposit, and river deposit. Calcite deposit is consolidated while others are loose. These deposits do not seem to have enough strength to serve as foundation of the concrete weir of about 35 m high. Thus, it is recommended to remove these deposits at the location of the weir foundation.

 Permeability of the rock foundation has not been clarified. There is a possibility that LS cavities exist at sections where drilled core samples are not taken. If LS cavities exist in the rock foundation, grouting seems to be not effective to ensure water tightness in the impounding area.

Engineering studies showed that the geological characteristics of the site and the dimensions of the reservoir area are durable for construction as it is determined that the weight of the reservoir water will not pose any risk. The dam axis will be located on a foundation of stiff rocks which has been found of adequate strength.

Based on the further findings regarding this issue, all necessary actions (such as building a cut-off wall, or curtain grouting, if found necessary) will be taken to improve impermeability for the probable high permeability zones present in the dam axis area.

Thus, it is recommended to clarify the following issues through additional investigation before the construction of the UB-1 weir, in order to ensure the reliability and safety of the weir structure:

 Strength of foundation of the weir (both LS and calcite deposit)

 Permeability of the foundation (both LS and calcite deposit)

The additional investigation will consist of drilling with in-situ permeability tests and laboratory tests on physico-mechanical properties.

UB-2 Intake Site

The result of site reconnaissance in the preliminary study indicates that there is no serious problem on the original weir axis in terms of topography and geology. An alternative axis, located about 50 m downstream of the original axis, seems to be of similar condition to that of the original site. Considering the ease of river diversion work during construction, geological investigation was done at the alternative axis as shown in Figure 6-3.

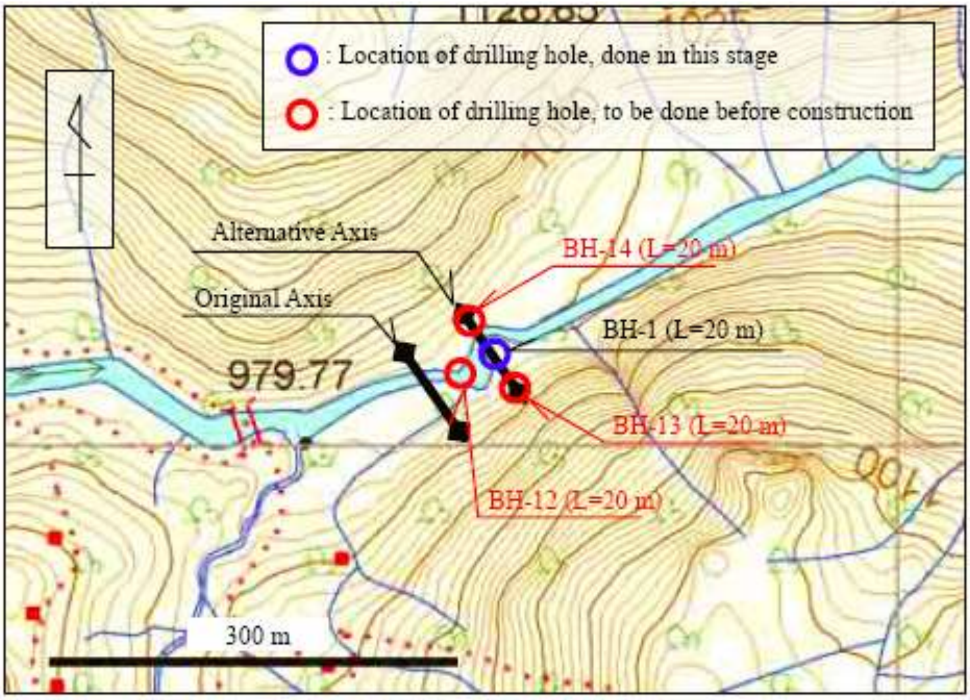


Figure 6-3 Location Map of UB-2 Intake Axis and Drill Holes.

Drilling investigation was carried out at BH-1 on the riverbed of the UB-2 Intake axis. The result indicates that the rock foundation located at a depth of 13.0 m is suitable for the concrete weir.

The characteristics of the foundation of the weir are as follows:

 The rock foundation is stiff and weathering is not intense. Although no test result is available so far in terms of strength, it is assumed that the shear strength of the LS which is C=1.5 MPa and Φ=43°, seems to be enough to serve as foundation of the concrete weir of about 25 m high.

 Surficial deposits overlaying the rock foundation consist of top soil, debris deposit, calcite deposit, and river deposit. The top soil and debris deposit are loose, and should be removed from the location of the weir foundation. Calcite deposit is consolidated, and may have enough strength to serve as foundation of the concrete weir of about 15 m high. Stability will be checked with detailed calculation, using the tentative shear strength of C=0.25 MPa and Φ=30°.

 Permeability of the foundation has not been clarified. Even if the concrete weir structure is set on LS, watertight measure is required to prevent leakage through LS cavities. The watertight measure will be to provide clay blanket.

 In case the concrete weir structure is set on calcite deposit, watertight measure will be applied against leakage through LS cavities and river deposit, intercalated in calcite deposit. To prevent leakage through LS cavities, clay blanket will be applied as mentioned above. Meanwhile, to prevent leakage through the river deposit, a cut-off trench with concrete filling along the weir axis will be applied.

The cut-off trench will be extended up to the rock foundation. Similar to UB-1, the following issues should be clarified through additional investigation:

- Strength of foundation of the weir (both LS and calcite deposit)
- Permeability of the foundation (both LS and calcite deposit)

The additional investigation will consist of drilling with in-situ permeability tests and laboratory tests on physico-mechanical properties. Geological and geotechnical site survey showed that erosion motivated landslides might occur in the region, though they are not expected to be at a large scale. For this reason, pre-construction, construction and operation phases will be implemented pursuant to relevant geo-hazard precautionary measures.

For some zones on the route of the headrace tunnel rock-fall and/or soil-fall seems possible based on the geological studies. In order to prevent low strength argillite zone originated probable swelling and/or such fall hazards, the tunnel will be supported with lining along its cross-section. According to the geological characteristics of the headrace tunnel route, water ingress might be seen during tunnel construction. Detailed geotechnical site investigation report is attached in Appendix-3.

6.2.3 Seismic Risk and Reservoir Induced Seismicity

Generally, the seismicity of the region is connected to active faults of the area which has designated Sagaing Fault, right lateral strike slip fault that located about 70 km far from the present hydropower project and Kyaukkyan Fault, with the exception of one earthquake occurred in the year of 1912. This earthquake was connected to the so-called Kyaukkyan Fault.

The magnitude of the strongest earthquake of the region was recorded as M=8.2 (in 1912). This earthquake took place at about 120 km north of the project area.

The European Earthquake Standard, Eurocode 8 (FS ENV 1998:1994) can be applied as guidance for the definition of a design spectrum for the project. The design will be matching the appropriate design criteria for earthquake loads and resistance of structures in accordance with the applicable standards and regulations.

Regarding fault tectonics, as Upper Paleozoic sandstone and Limestone of the present HPP project area have apparent faults and fissures, the dam related structures (especially the headrace tunnel) will have appropriate design specifications matching the media characteristics, national regulations and international standards.

There is no historical earthquake occurred within a radius of 50 km from the dam site and only earthquakes of 8.2 M have occurred over 100 km north of the present project area. Therefore, no significant seismic risk is anticipated for the Upper Baluchaung Hydropower Project area.

It is generally accepted that impoundment of large reservoirs can induce seismicity, but only in systems that are already near failure. In the Upper Baluchaung Hydropower Project, the reservoir covers an area of less than 0.21 km^2 and the dam is not intended for storage, but for the diversion of the water to the powerhouse through a headrace tunnel. Therefore, reservoir induced seismicity due to the present

Project is highly unlikely.

6.2.4 Landslides and Erosion

The impact of the project on landslides should be considered during the construction and operation phases. Construction activities may increase the potential of occurrence of landslides and erosion in various ways, which include destabilization of rock masses by cuts in slopes, improper stockpiling of materials, destruction of vegetative cover during site clearing and uncontrolled surface off (slope wash) during storms. However, risk of damage caused by the current landslides and rock-falls will be reduced by increasing the level of the road above the dam level.

The erosion geohazard seems insignificant through the surface of headrace tunnel. Even at limited zones, the presence of highly fractured - low strength rocks and the angle between the tunnel route and the course of the bedrocks along the route sets favourable conditions for soil-fall, rock-fall, swelling and block-fall hazards. Thus, an optimal tunnel lining technology will be implemented during tunnel boring construction stage.

Prior to the start of the construction; special measures will be taken to prevent stones or blocks from falling from the steep, precipitous slopes around the waterway and construction site.

6.2.5 Impact due to diversion of river water for power generation

Since the Project is of the run-off river nature, the river flow will be diverted at the No.1 Intake into the headrace power channel. The river section of about 2.9 km form Intake No.1 to Power Station No.1 at UB-1 and 1.8 km section from Intake No.2 to power Station No.2 at UB-2 will be dried-up, without river water during most of the period. Only during the rainy season, when the river discharge exceeds the maximum design discharge of 16 m^3/sec. the excess discharge will spill out through the weirs into the river sections.

Counter measures to be undertaken is as follows:

- (a) The river outlet valves of suitable dimension should be incorporated in the weirs of UB-1 and UB-2 in order to release the river maintenance flow of 0.5 m^3/sec (about ~ 5% of the mean annual discharge of 11.06 m^3/sec.) to the river.
- (b) The existing power supply to the 3 villages and under construction for 2 villages should maintained from the nearest UB-1 or UB-2 Power Station.

At both power stations, there will a local low voltage feeder each in order to supply the project area requirements, from these feeders the power supply can be made to these villages. But the electricity tariff should be subsidized to the affordable level to the villagers.

- (c) Water supply outlet of suitable diameter should be incorporated in the design of Forebay the UB 1 in order to supply water to Minlone village.

6.2.6 Impacts on Local and Regional Climate

The concern regarding the impacts of dam and reservoir projects on local climate is microclimate changes. The significance of this change is related to the surface area and volume of the reservoir and to the prevailing climatic conditions in the area. The phenomenon is generally storing energy of the reservoir from solar radiation received during summer in the upper water body and dissipating this stored heat during the winter. This is a general moderating effect causing a trend of milder conditions resulting in increases in humidity and increased average winter temperatures and less hot conditions in summer. The effect of colder air from the slopes meeting the relatively warmer reservoir water surface might also result in a tendency to mist and fog occurrence especially in winter.

The Upper Baluchaung Hydropower Project will have a very small reservoir (only 0.21 km^2), so it will not lead to a significant change in the climate of the area or the region.

6.2.7 Greenhouse Gas Emissions from Upper Baluchaung Reservoir

Carbon dioxide (CO_2) and methane (CH_4) cause global warming and thus they are commonly denoted as greenhouse gases (GHG). Despite generating electricity without the use of fossil fuel, also reservoir-fed hydropower plants (having reservoirs of large volume and area) may be a significant source of greenhouse gas (GHG) emissions. Both gases are emitted from reservoirs due to decay of inundated vegetation, soils and organic sediments formed by aquatic biomass and particulate or dissolved organic carbon inflows from the catchment. Thus, hydropower plants have their own global warming potential (GWP).

In particular; shallow, tropical reservoirs with high volumes of residual organic compounds in the flooded reservoir, intensive aquatic primary production and high influx of organic material by their tributaries are of concern in this respect. Upper Baluchaung reservoir area however, is very small and only sparsely covered with vegetation, has a weak soil cover and low influx of organic material. Furthermore, the climate of the project area of Upper Baluchaung Hydropower Project is not favorable for contribution to the greenhouse gas emissions. As a result, Upper Baluchaung Hydropower Project will not contribute to the climate change.

6.2.8 Hydrology

Hydropower projects have impacts on the hydrology of the project area and the watershed, upstream and downstream of the dam, during both construction and operation periods. Such changes affect water quality and the seasonal flow pattern of a river. Project area impacts are analyzed in the extent of affected local resources.

The impacts of the Upper Baluchaung Hydropower Project will be less than those caused by hydroelectric projects storing water in large reservoirs. Because of the small size of the reservoir, hydrological impacts upstream of the Upper Baluchaung Hydropower Project will be minimal. The major hydrological impact of the Upper Baluchaung Hydropower Project will be a decrease in flow in the section of the Upper Baluchaung River bypassed by the headrace/power tunnel. The tunnel will bypass a 27-km section of Upper Baluchaung River in which UB-2 Power Station and downstream of Inle Lake at distances of about 10 km downstream of the UB-2 Power Station. Thus, the present Project will alter the river hydrology mainly in the above said section, affecting both water quality and seasonal flow patterns. These impacts are discussed in more detail below.

6.2.8.1 Water Quality (*Impacts of construction of base camp, construction facility yards, and other temporary facilities, construction of intake weirs, headrace channels, head ponds, powerhouses and construction and operation of quarry and/or crushing and batching plants*)

Impacts of Project Construction

Construction of temporary facilities would cause water pollution (turbidity) from heavy equipments while embankment and buildings construction, would also occur. Scattering of construction wastes including garbage and effluent might generate, which might also cause water pollution of the river. Construction of these permanent facilities would cause almost the same impacts as those of construction of temporary facilities mentioned above. In addition, concrete works would cause water pollution with high alkali water.

An increase in turbidity and sedimentation resulting from the construction activities will be seen in the waters downstream of the project. Excavation of the foundation, construction of roads, processing aggregate, and batching concrete activities are expected to result in turbid or sediment laden wastewaters during construction period. Without treatment, the discharge of such wastewater into a watercourse can adversely affect the downstream water quality for irrigation, and physically harm aquatic biological resources and their uses. Water-related recreational activities in the downstream, such as boat transportation, can also be adversely affected. Thus, in the construction site drainage system and clarification/sedimentation process will be used for preventing turbid wastewaters to reach the river.

Concrete dams require wastewater treatment in terms of neutralization as well, since in concrete works, the water required to wash aggregate, batch and cure the concrete typically results in highly basic wastewaters with a pH greater than 10.5.

For the treatment of wastewaters from concrete operations, concentrated acid can be used as a buffer to reduce the pH close to neutrality. Clarification and neutralization processes will be applied to prevent pollution in the construction phase of the Project.

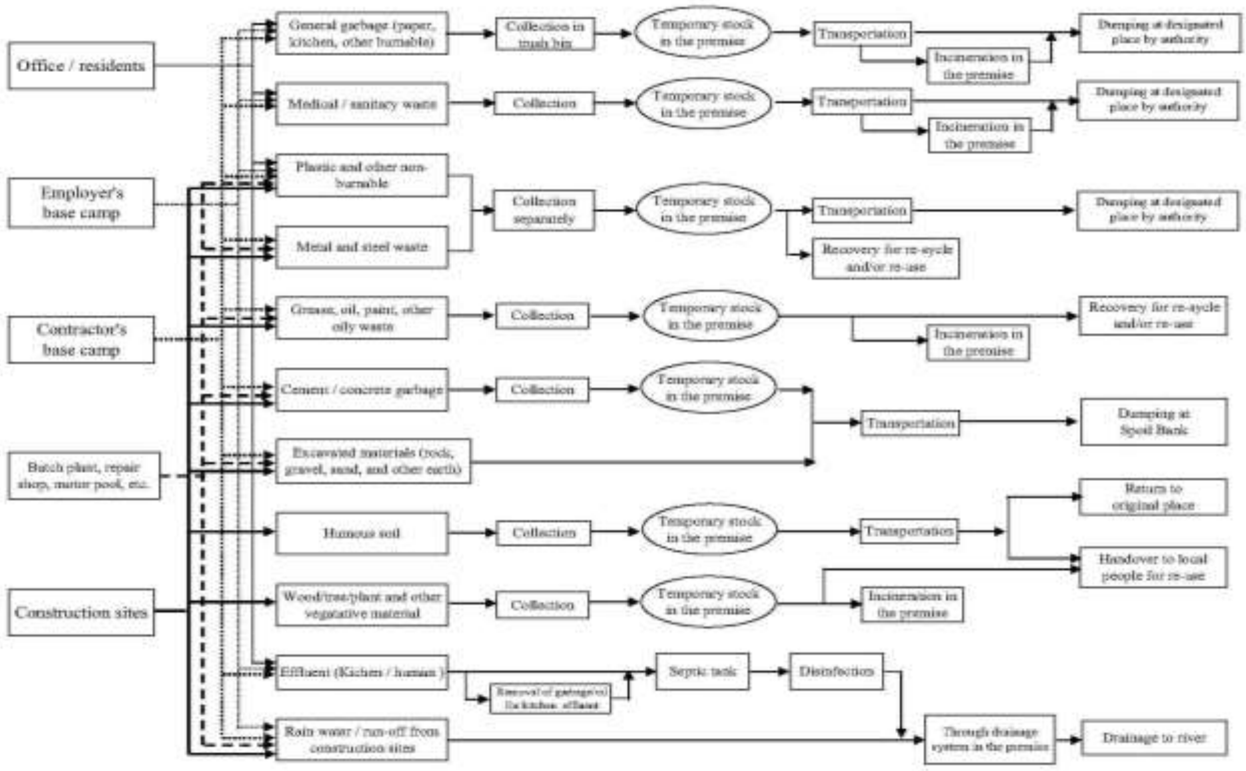


Figure 5.1 Proposed Waste Treatment System during Construction Works of the Project

Figure 6-4: Proposed Waste Treatment System during Construction Work of the Project.

Figure 6-4 shows the waste treatment system using during construction of Upper Baluchaung HPP and all related facilities and the following are the main mitigation measures during construction phase.

- Vegetation covering after denudation of land due to cutting of soil, embankment, etc. in timely manner,
- Installation of effective sediment/retaining pond to prevent turbid water and high alkali water discharges, if necessary,
- Installation of waste effluent treatment system in base camp, contractor's camp and office, ect.,
- Installation of rain water drainage system to prevent sheet erosion that cause turbid water discharge into rivers,
- Planting trees/bushes after finishing usage of temporary facility sites,

Potential impacts on water quality during operation period will not be foreseen and the appropriate management plan for water quality with monitoring work will be implemented.

6.2.8.2 Impact due to sedimentation (During Operation Period)

Although the function of the intake weir of UB-1 is to divert the water, taking into account the workability of the water way construction, the intake weir of 35m high is necessary to construct and a pond of about 1.7 million m^3 capacity will form in-front-of the weir at UB-1. The area of the pond at maximum flood water level of el 1145m is about 0.21 sqkm and at normal full supply level of el 1140 m is about 0.21sqkm.

However, it is important to note that the intake weir No 1 is designed without considering the reservoir capacity, but to have a function as a weir to take the river flow under run-of-river scheme. The sediment carried by the Upper Baluchaung will be deposited at the reservoir of UB-1 Intake weir and downstream power station will release only near clear water into the river. The reservoir at UB-1 Intake weir can accommodate the sedimentation up to 17 years after the start of operation.

The Upper Baluchaung River carries rather small amount of suspended and bedload sediment to the Upper Baluchaung Dam axis and since the capacity of the Reservoir is very small, the water detention time in the reservoir will be insufficient for the settling of clay and silt which generally comprise about 80% of the sediment load.

Therefore, sedimentation in the Upper Baluchaung Reservoir will not of significant concern with regard to downstream water quality.

Downstream from Indein, the river starts to flow into its delta. The delta was formed largely by two streams: Ywama Chaung in the north and Indein chaung in the south. A characteristic feature of the delta is that large areas along the two streams were aggraded and become fluvial floodplains. The width of the Indein Chaung through the floodplain is around 20 m and only about 0.5 m deep in the dry season.

Although the farmers downstream of Indein plain, who used to take the fertile sediment to form new paddy land will be affected but, generally this impact will be positive to overall sedimentation problem of the Inle Lake’s downstream area.

Having a dam only to serve for diversion of water to the headrace tunnel and not for water storage, the Upper Baluchaung Hydropower Project will not significantly hinder the transport of sediment, thus nutrients and alluvium to the Indein plain. Therefore, sedimentation in the Upper Baluchaung Reservoir would neither affect the downstream water quality nor Inle Lake itself.

6.2.8.4 Impacts of Flow Diversion in the Bypass Reach (Operation Period)

The Upper Baluchaung Hydro Power Project will be operated in a run-of-river mode, with very limited water storage. The inflow will be diverted to the powerhouse by a power tunnel, bypassing approximately a 10 km reach of downstream River.

During periods of operation when the flow of Upper Baluchaung River exceeds the rated discharge amount for the turbines (11.06 m^3/sec), excess amount of water will bypass the power tunnel and directly provided to the bypass reach.

Requirement in Downstream River

Adverse effects to the following activities caused by the power generation must be avoided or minimized:

1) Boat transportation in Indein

2) Irrigation in Indein

The river discharge during the dry season is lowered to 4 – 5 m^3/s, (Low Flow Period) which may be the minimum requirements for the above activities. Boats easily stuck in the river due to shallow water, and hence, sediment dredging is sometimes undertaken locally.

Estimate of Long-Term Runoff at UB-1 and UB-2 Intake Site

Using the simulation model for UB-1 established above, the daily mean discharges at the UB-1 intake site are estimated for 40 years from 1970 to 2009. The annual mean discharge at the UB-1 intake site (catchment area of 802 km^2) is estimated at 11.1 m^3/s (435 mm/annum = specific yield of 1.38 m^3/sec/100 km^2), with the runoff coefficient of 0.27 (= MAR/MAP = 435/1,575). Note that the daily discharge simulated for 40 years from 1970 to 2009 are shown in the Supporting FS Report.

A run-of-river scheme was selected to minimize the environmental impacts to the Project area as well as to the river basin, including the downstream community, in terms of irrigation water supply and boat transportation. Countermeasures such as maintaining the river flow of 0.5 m^3/s between the intake and the powerhouse, and mitigation for adverse effects to the vicinity of the Project area during construction, will be incorporated in the work item. In addition, improvement for the local community will be undertaken by the Project.

It should be noted that 0.50 m^3/s for the river maintenance flow between the intake and the powerhouse was deducted from the available discharge for the above estimate.

From the flow data derived for the Upper Baluchaung, minimum flow to be maintained in the riverbed to sustain the minimum conditions for the ecosystem are calculated. This minimum flow to be provided in the by-pass reach is calculated as 0.5 m^3/sec (5% of the average flow) by taking flow data for the period of 1964-1973, to cover a 10 year period of reliable record, which is also used for design purposes. This is greater than the annual mean discharge of 0.21 m^3/s to be stored in the reservoir.

As the projects are of run-off-river plants the power output in the dry season becomes low at a level of 4-5 MW for the UB-1, and 2.3 MW for the UB-2. In order to maintain the power output as high as possible during the dry season peak power operation of about 4 hours is considered by regulating daily discharge at the Intake Dam of UB-1. Although this option of maintaining the peak power seemed economical viable, the boat transportation along the Indein stream and irrigation downstream of Indein will be affected. Therefore, in order not of have adverse effects on the downstream water requirement the option of maintaining peak power has abandoned.

The above potential impacts that predicted in preliminary ESIA study will be mitigated and the mitigation measures and management plan are presented in Chapter VII.

6.2.8.5 Potential Impact on Inle Lake

Project area is located in the area of West Inle Sparse forest. There are mountain ranges formed of Limestones, with thin cover of soil around the surrounding area. No large trees found and only covered with bushes and wild weeds. Some large bamboo and trees were found along the banks of river on both sides.

Dam and hydroelectric power plant projects do not cause significant pollution, although they cause considerable direct and indirect effects on the environment.

In the case of large reservoirs designed for water storage, the major change caused by impoundment is the transformation of the riverine and the surrounding terrestrial habitats into a lentic environment. The Upper Baluchaung Reservoir will cover an area of 0.21 km2 and is intended for diverting the water to the powerhouse through the power tunnel and not for water storage. Having such a small intake pond/reservoir, the main impacts of the Upper Baluchaung Hydropower Project will be on the 17-km long section of the Upper Baluchaung River to be by passed by the power tunnel. It should also be noted that the main area is 10 km distance of downstream from the UB-2 Power House to downstream of Inle Lake.

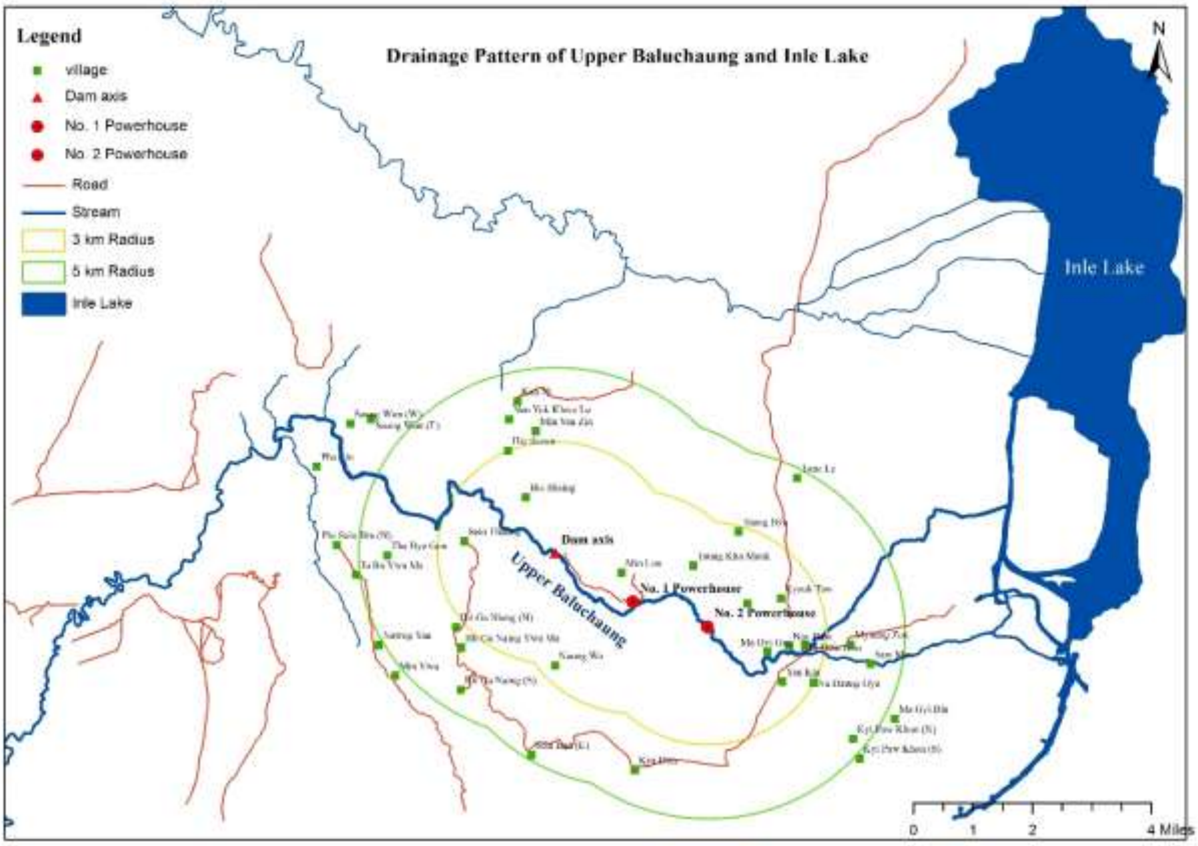


Figure: Project location and drainage pattern of Upper Baluchaung and Inle Lake

Construction of temporary facilities would cause water pollution (turbidity) from heavy equipment while embankment and buildings construction, would also occur. Scattering of construction wastes including garbage and effluent might generate, which might also cause water pollution of the river.

Without treatment, the discharge of such wastewater into a watercourse can adversely affect the downstream water quality for irrigation, and physically harm aquatic biological resources and their uses. Water-related recreational activities in the downstream, such as boat transportation, can also be adversely affected. Thus, in the construction site drainage system and clarification/sedimentation process will be used for preventing turbid wastewaters to reach the river.

For the treatment of wastewaters from concrete operations, concentrated acid can be used as a buffer to reduce the pH close to neutrality. Clarification and neutralization processes will be applied to prevent pollution in the construction phase of the Project.

In the catchment area at the upstream of the Project, there are some plain area on both sides of the river and plantation were done. In the plain area around the Aung Pan –Loikaw Road, wide range of agricultures are developed. Paddy, beans, corns, chili, vegetables and some cash crops. Perennial crops such as mango, oranges & pears are also planted. On the mountainous ranges, some of the shifted cultivations are also found. Because of such kinds of cultivation works in the catchment area, sediment transport of Upper Baluchaung to the Inle Lake is estimated annually about 98,293 ton by the report of Dr. Takahisa Furuichi, Kyoto University.

In UB-1 project, 35-meter-high, head up concrete dam will be provided and can be stored 1.7 million cu-m of water at the upstream of dam. It will keep water only in the first in ponding period, and in the later period, will take only the upper part of natural flow of the river. Therefore, starting from the beginning of hydropower operation period, up to about 19 years, the project will keep the sediment transport of Upper Baluchaung to Inle Lake, which is a part of conservation of Inle Lake.

Therefore, sedimentation in the Upper Baluchaung Reservoir will not of significant concern with regard to downstream water quality.

Downstream from Indein, the river starts to flow into its delta. The delta was formed largely by two streams: Ywama Chaung in the north and Indein chaung in the south. A characteristic feature of the delta is that large areas along the two streams were aggraded and become fluvial floodplains. The width of the Indein Chaung through the floodplain is around 20 m and only about 0.5 m deep in the dry season.

Although the farmers downstream of Indein plain, who used to take the fertile sediment to form new paddy land will be affected but, generally this impact will be positive to overall sedimentation problem of the Inle Lake's downstream area.

Having a dam only to serve for diversion of water to the headrace tunnel and not for water storage, the Upper Baluchaung Hydropower Project will not significantly hinder the transport of sediment, thus nutrients and alluvium to the Indein plain. Therefore, sedimentation in the Upper Baluchaung Reservoir would neither affect the downstream water quality nor Inle Lake itself.

Downstream of dams, marked changes in fish populations occur as a consequence of blockage of migration routes, disconnection of the river and floodplain and changes in flow regime, physiochemical conditions (e.g. temperature, turbidity and dissolve oxygen), primary production and channel morphology. These changes may benefit some primary production and channel morphology.

Upper Baluchaung Hydropower Project would provide water for increased food production and also generate electric power without releasing atmospheric pollutants or greenhouse gases. It would provide more drinking water for human beings during dry season and also watering wildlife. The reservoir itself, however, may serve as a source of water during the dry season or drought, to wildlife such as, deer, civet etc. living within the range. And may also create new habitat for some species of Water birds and may improve navigation in that area. It can be reduced the sedimentation load which deposit to the Inle Lake because of its regulation dam.

Short-term impacts would occur during the decommissioning phase in the creation of noise, dust and vibration, and the release of emissions. These impacts would arise due to demolition of power houses, offices, camps and other infrastructures, use of machinery and general construction works. Impacts should be contained within the construction zone.

Irrigation and boat transportation in Indein

Near Indein village, there was constructed a concrete weir by Nyaungshwe Rajah (Saobwa) during the period of Shan Rajahs(Saobwas), about 1940. That weir was still functioning well and maintained by the Irrigation Department, Ngaungshwe and it can irrigate 5000 acres of summer paddy. It is also planned not to disturb on irrigation water by Upper Baluchaung Hydropower Project.

The river discharge during the dry season is lowered to 4 – 5 m3/s, which may be the minimum requirements for the boat transportation in Indein. Boats easily stuck in the river due to shallow water, and hence, sediment dredging is sometimes undertaken locally.

6.2.8.6 Sediment Transport of Upper Baluchaung

In the catchment area at the upstream of the Project, there are some plain area on both sides of the river and plantation were done. In the plain area around the Aung Pan –Loikaw Road, wide range of agricultures are developed. Paddy, beans, corns, chili, vegetables and some cash crops. Perennial crops such as mango, oranges & pears are also planted. On the mountainous ranges, some of the shifted cultivations are also found.

Because of such kinds of cultivation works in the catchment area, sediment transport of Upper Baluchaung to the Inle Lake is estimated annually about 98,293 ton by the report of Dr. Takahisa Furuichi, Kyoto University.

In UB-1 project, 35 meter high, head up concrete dam will be provided and can be stored 1.7 million cu-m of water at the upstream of dam. It will keep water only in the first in ponding period, and in the later period, will take only the upper part of natural flow of the river. Therefore, starting from the beginning of hydropower operation period, up to about 19 years, the project will keep the sediment transport of Upper Baluchaung to Inle Lake, which is a part of conservation of Inle Lake.

6.2.8.7 Some Benefits by the Project

i). A kind of remedy from siltation.

- Catchment area at U/S of Dam = 802 Sq.km.

- Specific Sediment Load = 121 m^3/km^2/year.

- Sediment Trap Ratio = 90%

- Annual Sediment Transport,

= 802 km^2 x 121 m^3/km^2/year x 90%

= 87338 m^3 (30840 Sud)

= Sediment maintained in the dam, after 19 years.

= 87338 m^3 x 19

= 1659422 m^3 (585960 Sud)

6.2.9 Impact on Air Quality

Impacts on air quality are of concern basically during the construction phase of the dam. This is because of the fact that during operation there would not be any significant emission source associated by the project. Thus, the following subsections deal mainly with the impacts on air quality during the construction phase.

The main impact on air quality due to construction activities will be the effect of dust and other (exhaust) gas emissions, especially under windy conditions.

Therefore, these emissions are estimated and their consequences/effects are assessed in this section.

Construction Phase

According to mobilization of heavy equipment and construction materials, dump truck, concrete pump car and agitator truck will be mobilized. The number of these cars to be mobilized will be roughly estimated to be 100 nos. in total. The transportation activities by these cars will cause several negative impacts to atmospheric emissions.

During the construction phase, emissions of air pollutants at the UB-1, UB-2, water way and Crushing Plant are mainly associated to transportation (i.e. vehicle movement), earth works, foundation works, dismantling, construction and site clearance activities. These activities are expected to occur over a period of about 24 months.

Construction phase activities will generate the following main types of air emissions:

- combustion and exhaust emissions generated from the construction equipment, generators and vehicles; and
- fugitive dust generated by earthworks including excavation, backfilling, grading, equipment movement, material piling, loading and unloading, and demolition of decommissioned buildings.

No.	Potential impact	Impact Description
1.	Impacts of improvement and new construction of roads including bridges on air pollution, soil erosion, waste, noise and vibration	Improvement and new construction works of access roads would cause air pollution including dust, noise and vibration while cutting of slope and embankment, soil erosion and water pollution (turbidity) unless an appropriate measure to prevent erosion over the denuded slope is taken. These negative impacts might result bad perception with the Project.
2.	Impacts of construction of base camp, construction facility yards, and other	Construction of these temporary facilities would cause air pollution including dust, soil erosion and from the denuded area if no

	temporary facilities on air pollution, soil erosion, water pollution, noise and vibration, construction waste	appropriate measures are taken. Water pollution (turbidity), noise and vibration from heavy equipments while embankment and buildings construction, would also occur. Scattering of construction wastes including garbage and effluent might generate, which might also cause water pollution of the river.
3.	Impacts of construction of intake weirs, headrace channels, head ponds, powerhouses and other permanent facilities on the same environmental elements as those of temporary facilities (above)	Construction of these permanent facilities would cause almost the same impacts as those of construction of temporary facilities mentioned above. Construction of headrace channel would cause noise and vibration as the excavation of channel is done by blasting. It would also bring about industrial waste (residual rocks) during excavation works. In addition, if these negative impacts are not appropriately mitigated, bad perception with the Project would occur. In addition, concrete works would cause water pollution with high alkali water.
4.	Impacts of construction and operation of quarry and/or crushing and batching plants on the same environmental elements as those of (above)	Construction and operation of quarry and/or crushing, batching plant would cause almost the same impacts as those of construction of headrace channel mentioned above. In this regard, crushing of rocks at crushing plant would cause intense noise.
5.	Impacts of utilization of spoil bank on dust, soil erosion, turbid water discharge, noise and vibration, construction waste, soil contamination and social unrest.	Utilization of spoil bank would cause air pollution especially dust generation while dumping, earth collapse from dumped rock/gravel materials. It would also bring about water pollution (turbidity) if the collapsed materials reach into the river, noise and vibration due to dumping, residual rock waste scattering, and soil contamination if excavated rocks contain heavy metal components. In addition, if these negative impacts are not appropriately mitigated, social unrest and bad perception with the Project would occur.

These potential impacts are negative impacts, which are to be brought about by dump trucks with heavy loads, especially during dry periods as for the dust generation. This impact will disturb daily life of local people, and it will bring about respiratory disease due to suspended particulate matters contained in the dust to the residents living along the roads in the worst case.

In order to minimize dust generation along the road especially when earth materials (soil, rock, gravel) is transported, watering in needed during dry season in particular. The watering should be done not only on roads but also the vehicle itself when it is muddy/dusty. Covering of load of trucks by a sheet is another way to prevent from dust generation.

Quantitative impact prediction of air pollution, i.e., numerical simulation of air pollutants parameters are difficult to conduct because it is necessary to give accurate assumption of emission gas levels of heavy equipments for construction works as well as wind conditions. As for noise and vibration level, it is necessary to provide accurate number and its distribution of heavy equipments for construction works.

In the case of this Project, the accurate number of heavy equipments are not provided and the data on wind conditions are not obtained at this moment. Therefore, the impact of air pollution and noise are evaluated referring to the analogous cases of similar projects from neighbouring countries.

The tables below indicate the emission gas level, dust concentration and noise level due to construction works based on the analogous case, from similar project from Indonesia.

Compared analogous cases with environmental standard, it is estimated that dust concentration will exceed the environmental standard value at a distance of 10 m from pollution source. This is rough estimation because the detail conditions (volume of crushing, topographic and wind conditions, etc.) are not clear. However, this analogous case implies that the dust concentration would be significantly affect in the vicinity of crushing plant.

Methodological Approach

Air pollutants emissions during construction phase are essentially due to equipment exhausts gases.

The emissions into air caused by construction-site equipment were assessed starting out from standard emission factors reported in literature. These factors recommend the specific emissions of the single pollutants (NOx, SOx, and Particulate Matter) for each item of equipment on the basis of its typology. The estimate of the emissions produced by the whole equipment was calculated by multiplying the emission factor by the number of items of that type of equipment and by repeating this calculation for each type of equipment used on site during the construction phase.

The vehicles expected to be used during the construction phase and the emission factors, derived from the Air Quality Dispersion Modelling (AQDM) study for diesel engines, are showed in the following Tables, for preparation works and excavation, concrete works, structure installation and assembling and commissioning respectively. For each type of vehicle, a typical output power in kW was indicated, to which reference was made for assessing the emission factor.

Table 6-3: Upper Baluchaung HPP Construction Equipment, Emission Factors AQDM Preparation Works and Excavation

Typology	Power (kW)	No. of equipment	NOx [kg/h]	SOx [kg/h]	Particulate Matter [kg/h]
Backhoe excavator	95.5	3	1.0068	0.0017	0.0514
mini-excavator	40.9	1	0.1022	0.0001	0.0076
Wheeled loader	154	4	1.6394	0.0035	0.0532
Dump truck	220	9	5.7749	0.0109	0.2059

Table 6-4: Upper Baluchaung HPP Construction Equipment, Emission Factors AQMD Concrete Works

Typology	Power (kW)	No. of equipment	NOx [kg/h]	SOx [kg/h]	Particulate Matter [kg/h]
Forklift	37	1	0.0600	0.0001	0.0042
Forklift (5t)	83	1	0.1054	0.0002	0.0079
Forklift	110	1	0.1559	0.0003	0.0085
Forklift	83	1	0.1054	0.0002	0.0079
Truck crane (25t)	206	2	0.7505	0.0011	0.0259
Truck crane (50t)	247	1	0.5351	0.0008	0.0193
Truck crane	230	1	0.5351	0.0008	0.0193
Crane	230	1	0.5351	0.0008	0.0193
Crane	206	2	1.0702	0.0016	0.0386
Crawler crane	242	1	0.5351	0.0008	0.0193
Crane	206	1	0.5351	0.0008	0.0193
Concrete mixer truck	202	6	3.8499	0.0073	0.1372
Wheeled loader	154	4	1.6394	0.0035	0.0532
Dump truck	220	9	5.7749	0.0109	0.2059
Concrete pump truck	300	2	1.2833	0.0024	0.0457
Earthmover	160	2	0.8095	0.0016	0.0269
Rotary drilling machine	300	2	0.6969	0.0028	0.0213

Table 6-5: Upper Baluchaung HPP Construction Equipment, Emission Factors AQMD Structure Installation and Assembling

Typology	Power (kW)	No. of equipment	NOx [kg/h]	SOx [kg/h]	Particulate Matter [kg/h]
Forklift	37	1	0.0600	0.0001	0.0042
Forklift (5t)	83	1	0.1054	0.0002	0.0079
Forklift	110	1	0.1559	0.0003	0.0085
Forklift	83	1	0.1054	0.0002	0.0079
Truck crane (25t)	206	2	0.7505	0.0011	0.0259

Truck crane (50t)	247	1	0.5351	0.0008	0.0193
Truck crane	230	1	0.5351	0.0008	0.0193
Crane	230	1	0.5351	0.0008	0.0193
Crane	206	2	1.0702	0.0016	0.0386
Crawler crane	242	1	0.5351	0.0008	0.0193
Crane	206	1	0.5351	0.0008	0,0193
60t crane	132	1	0.3028	0.0004	0.0171
Flat truck	300	1	0.6417	0.0012	0.0229
Flat truck	120	1	0.3894	0.0006	0.0216

Table 6-6: Upper Baluchaung HPPP Construction Equipment, Emission Factors AQMD Commissioning

Typology	Power (kW)	No. of equipment	NOx [kg/h]	SOx [kg/h]	Particulate Matter [kg/h]
Forklift (5t)	83	1	0.1054	0.0002	0.0079
Forklift	83	1	0.1054	0.0002	0.0079
Truck crane (50t)	247	1	0.5351	0.0008	0.0193
Wheeled loader	154	4	1.6394	0.0035	0.0532

The maximum level of air pollutants emission during the construction phase is expected during a medium advancement stage of the works when the above ground concrete works at the areas will overlap to the earthworks and the demolition works. This period of construction, which will entail different concurrent activities on site and involve a higher number of different heavy equipment for construction and earth moving, was therefore considered to estimate the maximum expected emission of air pollutants rate from the construction site and related air concentrations at increasing distances from the site.

Estimated Impacts

In the following Table, a summary of the total emission for NOx, SOx, Particulate Matter during each of the identified construction phases is summarized.

Table 6-7: Pollutants Discharged into the Air by the Equipment used during the Construction Activities

Construction Phase	Total Number of Equipment	NOx (kg/h)	SOx (kg/h)	Particulate Matter (kg/h)
Excavation	16	8.5232	0.0163	0.3181
Concrete Works	32	18.9766	0.0359	0.6800

Structure Installation & Assembling	7	6.2566	0.0097	0.2512
Commissioning	6	2.3852	0.0046	0.0883
Demolition Works	5	2.3398	0.0046	0.0846

Table 6-8: Air Pollution from Emission Gas and Dust due to Crushing

Study cases		Concentration (ug/m3)			
Analogous Case*	Distant(m)	NO_2	SO_2	CO	Dust
	10	94.30	31.40	62.90	236.00
	25	71.80	23.90	47.80	189.00
	50	63.60	21.20	42.40	144.00
	75	59.10	19.70	39.40	127.00
	100	47.10	15.70	31.40	118.00
	150	41.00	13.70	27.40	94.20
	200	38.10	12.60	25.40	82.10
	250	34.80	11.60	23.20	76.20
	300	31.90	10.60	21.30	69.50
Environmental Standard**		200	20	10,000	230

Note) *: Source: Survey result of Poigar No.2 and 3 Hydro-Electric Power Construction Project, North Sulawesi, Indonesia.

**: Ambient Air Quality Standard according to Indonesian Government Regulation No. 41/1999.

As shown, the most critical phases occur while earth moving and concrete works are carried out and in particular while preparing the areas and during construction of foundations.

In any case, it should be noted that these emissions are concentrated in a limited period of time and occur inside the project boundary. The repercussions are entirely acceptable and will only affect the project area. The intensity of impacts are medium, extend is site-specific and short duration (only construction period). **The associated impacts are** therefore **expected to be low and** in any case **reversible**.

Overall, during construction phase there will be impacts on air quality due to construction site equipment. However, the adoption of the proposed mitigation measures will allow reducing the impacts to an acceptable level, especially as they are limited to the construction phase.

During the construction activities, atmospheric dust levels are anticipated by the movement of trucks and vehicles transporting construction material and equipment. The amount of dust generated by the activity is difficult to estimate at this stage because no information on the overall amount of materials to be excavated has been provided; however, the occurrence and significance of the dust generation depend upon meteorological and ground conditions at the time and location of the civil works activities.

In any case, under normal meteorological conditions, dust impacts should be limited to within several hundred meters around the project boundary.

The main environmental concern associated with dust generation is then likely to be limited to occupational health risk and irritation to humans (i.e. construction workers and nearby local community). Therefore, it has to be noted that the dust production during construction is concentrated within a limited period of time. The repercussions, which may be assumed to be low and affecting only the project boundary and low density of local community area, will not affect sensitive areas or receptors. **The associated impact, of a temporary nature, is** therefore **considered to be** low and, in any case, **reversible**.

As concern traffic, in general, an overall increase in traffic and heavy machinery movement is foreseen during the construction phase with an increase in dust emission levels. Such emissions together with exhaust emissions coming from the equipment used during the construction phase are likely to result in marginal increases in levels of SOx and NOx. However, **the overall impact on air quality** due to these emissions c**an be considered as low**, due to the limited duration of the construction period (around 24 months). Furthermore, some emissions sources and activities, such as earth moving, land clearing and installation works, **are estimated to be short term duration**, therefore **the related impacts are expected to be low and** in any case **reversible**.

Mitigation and Monitoring Measures

With the purpose to *reduce the emissions of gaseous pollutants during the construction phase from the equipment used* both for the UB-1 and UB-2, the following mitigation measures and good practice are taken into account:

- vehicle engines and other machinery will be kept turned on only if necessary, avoiding any unnecessary emission;
- machines and equipment will be periodically checked and maintained to ensure their good working condition;
- all equipment and machines must be maintained and tested for compliance with standards and technical regulations for the protection of the environment and have appropriate certifications;
- activities will be conducted trying to use the minimum required number of means at the same time;
- electric small-scale mechanization and technical tools will be used when available and feasible; and
- repair and maintenance of construction equipment and vehicles will be performed outside of the construction site by at specialized enterprises.

Concerning *dust control methods and measures*, the following actions are recommended to reduce the generation of dust:

- watering or increase of the moisture level of the open materials storage piles to reduce dust levels (especially during dry season);
- enclosure or covering of inactive piles to reduce wind erosion;
- loads in all trucks transporting dust-generating materials will be sprayed with water to suppress dust, as well as wheels of means moving inside and outside of the construction site;
- speed reduction for the means travelling inside the construction site; and
- stabilization and re-vegetation of cleared areas that are no longer needed as soon as practicable during construction.

Environmental monitoring activities will have to be performed in order to monitor the air pollution during construction activities in the surroundings of the site and, in particular, at the residential buildings located close to the site boundaries. The monitoring program to be conducted at the project site will be developed according to the following considerations:

- dust concentration (PM2.5 and PM10) will be monitored considering that it represents the main pollutant discharged into the air during construction phase and its relatively high concentrations in rural areas as resulting from the baseline assessment (air emission in the area are mostly generated by mobile sources – vehicles traffic on unpaved road);
- monitoring points will be located in the residential areas surrounding the project site; and
- air monitoring activities will be conducted on a quarterly basis. In particular, with reference to the Access Road, environmental monitoring activities would have to be performed in order to monitor the air pollution during construction activities at the residential areas located close to the corridor of Access road.
- In order to minimize dust generation along the road especially when earth materials (soil, rock, gravel) is transported, watering in needed during dry season in particular. The watering should be done not only on roads but also the vehicle itself when it is muddy/dusty. Covering of load of trucks by a sheet is another way to prevent from dust generation.

Operation Phase

During operation period the air pollution is expected to be very limited, and the main source will be vehicle emissions and dust from traffic on unpaved roads. In addition, there might be some dust from construction sites before they are properly re-vegetated. The monitoring program during operation phase is prepared in Item7.6 in Table 7-7.

Closure Phase Impacts

Short-term impacts would occur during the decommissioning phase in the creation of noise, dust and vibration, and the release of emissions. These impacts would arise due to demolition of power houses, offices, camps and other infrastructures, use of machinery and general construction works. Impacts should be contained within the construction zone. Nature of impact is short term, site specific and intensity if low so the significant of impacts are defined as low.

Quantitative impact prediction of air pollution, i.e., numerical simulation of air pollutants parameters are difficult to conduct for decommissioning phase because it is necessary to give accurate assumption of emission gas levels of heavy equipment for decommissioning works as well as wind conditions. As for noise and vibration level, it is necessary to provide accurate number and its distribution of heavy equipment for decommissioning works.

In the case of this Project, the accurate number of heavy equipment are not provided and the data on wind conditions are not obtained at this moment. Therefore, the impact of air pollution and noise are evaluated referring to the analogous cases of similar projects from neighbouring countries.

The tables below indicate the emission gas level, dust concentration and noise level due to construction works based on the analogous case, from similar project from Indonesia.

Compared analogous cases with environmental standard, it is estimated that dust concentration will exceed the environmental standard value at a distance of 10 m from pollution source. This is rough estimation because the detail conditions (volume of crushing, topographic and wind conditions, etc.) are not clear. However, this analogous case implies that the dust concentration would be significantly affect in the vicinity of crushing plant.

6.2.10 Noise and Vibration Impacts

Noise will be of concern during the construction phase of the dam. By the start of land preparation, noise will be generated due to the works performed during all construction period for dam and HPP. The noise impact will be of concern mainly due to the construction machines and activities.

Construction Phase

The construction activities of the present Hydropower Project (construction of base camp, construction facility yards, and other temporary facilities) will likely generate noise and vibration levels that could potentially elevate the baseline condition possibly causing disturbance or damage to nearby surrounding communities.

As long as driving trucks and other vehicles, it is inevitable to generate automobile noise and vibration. However, it is effective to operate the vehicles politely, specifically avoiding unnecessary speeding up, acceleration, etc. for alleviating it. To realize this, it is necessary to educate truck drivers on the driving manner. Paying attention should be secure at such locations as road sections near school, public health center, and near the settlement area.

Consequently, conducting these countermeasures properly in combination and timely manner could minimize the potential negative impacts.

Construction and operation of quarry and/or crushing, batching plant would cause almost the same impacts as those of construction of headrace channel mentioned above. In this regard, crushing of rocks at crushing plant would cause intense noise.

As for noise, due to construction works (heavy equipments), it is predicted that the noise level will exceed the environmental standard value in the settlement area when the construction works are conducted in nearby area (less than approx. 300m). Regarding the noise level to be caused by blasting, the distance between the quarry site where blasting will be conducted and nearest settlement area (Minlone) is more than 500m at least, it is predicted not to cause significant impact.

Table 6-9: Noise Level Prediction due to Heavy Equipment and Blasting Unit: of Noise Level (dB(A))

Study case	Distant(m)	10	50	100	150	200	250	300	350	500	1,000
Analogous case*	Heavy Equipment	84	70	64	61	58	56	55	54	51	41
	Blasting	115	91	80	74	70	66	63	61	56	45
AMDAL*		42-50									
Environmental Standard**		70 (for Industry area), 55 (for Residential area)									

Note) *: Source: Survey result of Poigar No.2 and 3 Hydro-Electric Power Construction Project, North Sulawesi, Indonesia.

**: Noise Level Standard of NEQ

In any case, the construction phase is characterized by intermittent noise emissions and they generally not expected to be continuously operational during the entire construction period. Overall, the nature of construction noise impacts is characterized by temporary short- term reversible impacts as they cease to exist once the construction activities will be completed.

Mitigation of Noise and Vibration Impacts

As long as driving trucks and other vehicles, it is inevitable to generate automobile noise and vibration. However, it is effective to operate the vehicles politely, specifically avoiding unnecessary speeding up, acceleration, etc. for alleviating it. To realize this, it is necessary to educate truck drivers on the driving manner. Paying attention should be secure at such locations as road sections near school, public health center, and near the settlement area.

Consequently, conducting these countermeasures properly in combination and timely manner could minimize the potential negative impacts.

The protection, mitigation and monitoring measures foreseen in order to minimize and reduce the impacts related to the noise emissions during the construction phase of the Upper Baluchaung Hydropower Project are:

- to select adequate equipment (fit with noise mufflers);
- to minimize machinery and equipment unused conditions with engines in action;
- to maintain machinery and equipment in good conditions;
- to locate noise sources in concealed areas with respect to acoustic receptors, consistent with the needs of the construction site (if possible);
- to maintain an active community consultation and positive relations with local residents that will assist in alleviating concerns that might arise and resolve any potential noise complaints;
- to post warning signs within the vicinity of the impact and all personnel shall be provided with personal protective equipment. For example, workers operating equipment that generates noise should be equipped with the appropriate noise protection gear; and
- to restrict the construction activities that will generate disturbing sounds to normal working hours.
- Good maintenance of dump trucks, other vehicles and heavy equipments,
- Polite driving/operation of vehicles and heavy equipments, and reducing the velocity near the sensitive facilities such as clinic, school, if necessary,
- Education of driver and operator to keep polite driving and operation manner,
- Effective socialization to local residents about the methodology, implementation schedule of construction works which might cause noise and vibration, especially due to blasting, crushing and batcher plants,
- Adjusting the amount and frequency of explosive of blasting considering noise vibration levels,
- Monitoring of noise and vibration targeted for heavy equipment, blasting crushing and batching, etc.

Operation Phase

The only noise source of the Project foreseen in operation phase will be generator and turbines located in the powerhouse. However, there will not be any considerable noise nuisance since they will be located in a closed building. In addition, it will be somewhat an isolated facility since it will be located at a distance of 1000 m to Minlone Village, which is the nearest settlement.

6.3 Impacts on Biological Environment

Dam and hydroelectric power plant projects do not cause significant pollution, although they cause considerable direct and indirect effects on the environment.

In the case of large reservoirs designed for water storage, the major change caused by impoundment is the transformation of the riverine and the surrounding terrestrial habitats into a lentic environment. The Upper Baluchaung Reservoir will cover an area of 0.21 km^2 and is intended for diverting the water to the powerhouse through the power tunnel and not for water storage. Having such a small intake pond/reservoir, the main impacts of the Upper Baluchaung Hydropower Project will be on the 17 km long section of the Upper Baluchaung River to be by passed by the power tunnel. It should also be noted that the main area is 10 km distance of downstream from the UB-2 Power House to downstream of Inle Lake.

6.3.1 Impacts on Aquatic Species

The major impacts of the realization of the Upper Baluchaung Hydropower Project will be on the existing aquatic fauna along the bypass reach where present flow patterns will be altered by project operation. Impacts due to the inundation of riverine habitats will be limited to only approximately 3.5 km segment of the Upper Baluchaung River and a considerable small surface area (totally 0.5 km^2). Water quality in the Upper Baluchaung Reservoir and the releases from the Upper Baluchaung Hydropower Project, however, will not be significantly different than that of the Upper Baluchaung River owing to the small size and operational characteristics of the reservoir. Some fish are adapted to both lotic and lentic habitats. Consequently, the transformation of a river to a reservoir often results in the extirpation of resident river species. Downstream of dams, marked changes in fish populations occur as a consequence of blockage of migration routes, disconnection of the river and floodplain and changes in flow regime, physiochemical conditions (e.g. temperature, turbidity and dissolve oxygen), primary production and channel morphology. These changes may benefit some primary production and channel morphology.

6.3.1.1 Effects of Reservoir on the Aquatic Biota

The dams, in general, regulate the downstream flow based on the size of the reservoir established. Upper Baluchaung Project will not have such a considerable regulating function since it is a run-of-river project with a very small reservoir.

The changes in aquatic habitats and biota due to the formation of the Upper Baluchaung Reservoir will be to a limited extent, in accordance with its small size. Regarding their shorter detention times due to the mode of operation, reservoirs do not act like natural lakes. The topography is also influential on reservoir behavior.

Therefore, the water and the nutrients are retained for shorter periods in reservoirs, compared to natural lakes. This is true especially for the Upper Baluchaung Reservoir to be operated as run-of-river with a low detention time.

Most of the fish species identified are adaptable to living in lakes as well as rivers. Thus, formation of a very small reservoir, which will develop slightly lentic conditions will not have a significant impact on the fish species of the river.

Among the fish species *Cyprinus intha* (Inle carp) is a sensitive species to water quality and river habitat. This species was not observed in the vicinity of the project area, but it was determined from literature that it can be found in the tributaries joining the Upper Baluchaung River. This species mainly prefers cold stream and rivers as habitats. Therefore, stagnant water body (reservoir) is not a suitable habitat for this species. However, since it is reported to be living in the higher elevations of the tributaries the small reservoir of Upper Baluchaung will not have a considerable effect on this species.

Macrognathus aral (Spiny eel) that was observed in the project area is a fish that prefers calm (slow running) rivers. Thus, it can adapt to the lake environment, especially since the Upper Baluchaung Reservoir will not be a typical big scale reservoir, but will provide calm waters. In addition, for the species that prefer to spawn on the stones and gravels at the riverbed of the rapidly flowing streams *such as Lepidocephalus thermalis* (Indian Spiny Loach) there is available sections in the upstream of the future reservoir and in the tributaries both upstream and downstream of the dam site.

6.3.1.2 Effects of Headrace/Power Tunnel on the Aquatic Biota

In the Upper Baluchaung Project, water is diverted to the powerhouse through a 9.6 km long power tunnel. The power tunnel will bypass the Upper Baluchaung River between the dam site and the powerhouse. This characteristic will alter the present flow pattern and quantity along the bypass reach, which in turn will affect the habitat characteristics and hence the aquatic biota. Thus, the main river reach of concern regarding the by-pass is the first 10 km downstream of the dam axis (till the southern tip of Inlay Lake).

Twenty fish species (Grey feather-back, Catla, Mrigal, Boga Labeo, Mourree Labeo, etc.,) identified in the project area are listed in table 5.1.4-8. Accordingly, these species should be protected in such a manner that the project will not be detrimental to the survival of affected populations of these species. Without a minimum flow in the bypass reach to maintain their resting, feeding and breeding habitats, the reduced flows would likely cause the loss of the populations of these fish species from the bypass reach. The habitats of these species include stony and sandy bottoms, which form the river bottom of the Upper Baluchaung River throughout the project area. Due to the presence of these types of habitats evenly throughout the bypass reach, it is expected that this situation will not be altered significantly during the operation of Upper Baluchaung Project, as long as the critical flow is maintained.

To mitigate the adverse impacts described above and maintain the habitats for the fish species in the bypass reach, a minimum flow will be provided in the bypass reach at all times by a water release from the Upper Baluchaung Dam. This minimum flow was estimated as described in Section 6.2.8.4 and the minimum release from the Upper Baluchaung Dam is accepted as the minimum flow to be maintained in the river reach to be on the safe side. This implies that in a very big part of the year there will be much more flow than the calculated minimum flow in the by-pass reach.

6.3.1.3 Effects of Releases on Downstream Biota

The effects of impoundment on the downstream water quality depend largely on reservoir size and mode of operation. In large reservoirs, stratification and the consequent changes in temperature, dissolved oxygen (DO) and nutrient content may take place. The relation of the depth of the thermo-cline to the depth of the water intake will affect the downstream biota. Depending on season, the existing fauna might change due to the temperature and DO content of water released by the project. If water is drawn from the epilimnion, the downstream release may be equivalent to, or warmer than, normal river temperatures, and will have DO levels near air-saturation. If drawn from the hypolimnion, the downstream release will be colder than normal river temperature, and may have reduced levels of DO. These physical changes affect the seasonal distribution and abundance of downstream aquatic species.

Such conditions related to thermal stratification do not develop in smaller reservoirs that do not have long detention times or large surface areas exposed to solar heating. These reservoirs usually have a relatively high inflow with respect to the total storage capacity and are operated as run-of- river, like the Upper Baluchaung Reservoir.

As mentioned in the Water Quality section, it is highly unlikely that thermal stratification will occur in the Upper Baluchaung Reservoir, which has a surface area of only 0.5 km^2 and a maximum depth of approximately 25 m. Therefore, Upper Baluchaung Reservoir is expected to remain isothermal throughout the year and will not pose any adverse impacts on the water quality and the aquatic biota downstream of the powerhouse.

6.3.2 Impacts on Flora and Terrestrial Fauna

In water development projects, the major impacts on the terrestrial fauna are related to those on the flora. The vegetation at and around the dam site and other construction areas will be destroyed by the construction activities and the plant populations below the high-water level of the reservoir will be lost. The destruction of the vegetative cover in turn affects the terrestrial fauna that depends on these habitats.

The construction of access roads, diversion and power tunnels and the dam can have negative impacts on wildlife, as existing habitat in and around these areas would be degraded to some extent. Most medium to large mammals and birds will leave the area, due to noise, dust, and human activity of construction. Such activities, however, will take place in a limited area and therefore will affect a limited population in the project area. In addition, since the vegetative cover is rather homogeneous and evenly distributed throughout the project area, the destruction of vegetation at tunnel edits will not cause the loss of any critical habitat for the wildlife living in the area.

During the baseline studies 147 plant species were identified in the study area. Also, 1 of 80 species (*Dalbergia cultrata*) are categorized in IUCN lists. Based on these findings and the project characteristics, the impacts of the project on flora species would be insignificant.

In the development of water resource projects, feeding, breeding, resting and dwelling habitats of terrestrial animals are destroyed by construction activities and inundated by the filling of the reservoir. In most cases, self-rehabilitation takes place since terrestrial fauna elements escape to suitable habitats in the vicinity after impoundment. This in turn, may push the carrying capacity of the receiving sites to its limits, overloading the ecosystems for a certain period of time. As the area to be inundated by Upper Baluchaung dam is only 50 hectares, impacts on both the terrestrial fauna and the flora will be quite limited. In addition, the proposed reservoir is only 3 km long and, hence will not pose a significant obstruction for terrestrial animals to cross to the other side of the river.

Different types of habitats are formed along the shoreline of a reservoir, depending on the topographical conditions and the annual drawdown in the reservoir. The annual fluctuation in the reservoir surface elevation usually results in a lack of aquatic vegetation in the drawdown zone. The Upper Baluchaung Project will be operated as run-of -river and therefore no significant changes in surface elevation of the Upper Baluchaung Reservoir are anticipated. The development of water dependent vegetation along the shoreline, which may occur in hollows and depressions, is beneficial for water birds and some mammals. For wildlife, this water dependent vegetation will serve as a nesting place and feeding area.

Due to the limited inundation area of the Upper Baluchaung Reservoir, the effects on the birds observed in the project area, most of which are passerines inhabiting the dense thickets, will be minimal. Birds, such as kingfisher, dipper, wren, yellow wagtail and gray wagtail that nest on the ground near rivers may face partial loss of habitat. However, those birds may continue to use the reservoir margins, as well as the bypass reach, for nesting. Moreover, none of the bird species observed in the project area depend solely on riverine habitat.

Water birds, such as grey herons, ruddy shelduck, mallards, moorhens and coots, mostly observed at the delta, are the bird species that would benefit from the Project. Formation of a reservoir, though small in size, would provide these species an alternative habitat. Many water birds, such as waders and waterfowl, while facing the danger of losing their natural habitats, namely, marshes and ponds, make use of artificial reservoirs and ponds for breeding, resting and migration.

Negative Impacts

In the construction of reservoirs, the clearing of vegetation, movement of earth and rock, the presence of humans and machinery, bringing in construction materials, use of explosives, noise, and reducing and cutting off river flow and increasing turbidity, will affect the biodiversity. Removal of forests or other vegetation over a wide area, excavation, earth and rock movement and reduction in river flow are the most significant.

Positive Impacts

Upper Baluchaung Hydropower Project would provide water for increased food production and also generate electric power without releasing atmospheric pollutants or greenhouse gases. It would provide more drinking water for human beings during dry season and also watering wildlife. The reservoir itself, however, may serve as a source of water during the dry season or drought, to wildlife such as, deer, civet etc. living within the range. And may also create new habitat for some species of Water birds and may improve navigation in that area. It can be reduced the sedimentation load which deposit to the Inle Lake because of its regulation dam.

Mitigation Measures for Wildlife

- Riparian vegetation and its bordering waters provide critical habitat for birds, waterfowl, and small and large mammals. When a hydroelectric project results in inundation of a free-flowing river, the nesting, forage, and cover provided by these areas is temporarily or permanently lost.
- When habitat is lost, animals are forced to move to higher ground or other areas where habitat conditions may be less suitable, predators are more abundant, or the territory is already occupied. As an example, ground birds like pheasant and grouse require cover and cannot successfully move to higher, more open, ground.
- In cases where water levels stabilize at a new height, vegetation in riparian zones can re-emerge and species can re-populate an area. With storage projects, the riparian zone that re-emerges has conditions that now reflect that of a reservoir or lake rather than a free-flowing river. When such conditions occur, certain species will begin to decline, others will become more abundant, and some will populate these areas for the first time.
- Ducks and geese are examples of waterfowl that are strongly attracted to the habitat conditions found in reservoirs. For some of these species, reservoirs are providing an important alternative to the wetland areas that they formerly occupied. Canada geese are one example of birds that now frequent reservoirs as part of their migration pattern.

6.3.3 Impacts on Species of International Concern

6.3.3.1 Flora Species

The list of plant species identified in the study area is given in Annex- A. The conservation and distribution status of each species is also indicated in this table.

In the study area 147 species were identified. Among these 147 species, 1 species "*Dalbergia cultrate* (Yin-daik) is Near Threatened according to the IUCN Red Lists. The major factors of this species are deforestation, illegal logging and the natural vegetation have been reduced and fragmented for the conversion to agricultural land and settlements. Since the Upper Baluchaung Reservoir will inundate a very small area, the Project will affect only a limited number of species.

6.3.3.2 Terrestrial Fauna Species

Amphibian, reptile, bird and mammal species identified in Upper Baluchaung Project area are listed in the relevant tables (Table 5.1.4-3,4,5,6,7,8). In these tables, the status of these species is specified according to the IUCN categories.

In the study area 58 species of Butterfly, 74 species of Bird, 14 species of mammal and 5 species of amphibians and 11 species of reptiles identified in the survey area. There is no endemic species in these areas. Mammal, Amphibian, Butterfly and Birds were no endangered species and threatened species. According to the Conservation Status by IUCN red list (2016 ver. 4.0). One tortoise impressed tortoise (*Manouriaimpressa*) vulnerable species. This tortoise species was also listed as Appendix II in CITES (2016 ver.4.0).

6.3.3.3 Impact of Impressed tortoise (Manouriaimpressa)

Hunting, at least of deer, probably took place mainly during the dry season and likely involved setting fire to the dry grass and leaf litter to drive the quarry. Some of the ethnic minorities practice slash-and-burn agriculture in addition to hunting and collection of forest produce. Burning of vegetation certainly appears to be a national pastime at present. Certainly, such undergrowth fires have some beneficial effects: they clear the forest floor so people can walk easily, they make mineral nutrients available to encourage grass growth which in turn benefits grazing animals, and fires eliminate tick larvae, which can otherwise occur in plague-like numbers.

Yet as we currently understand it, the overall effects of regular forest litter fires are mainly negative. Numerous small animals perish or get scarred in the flames, while those that survive have to deal with an absence of food, shade and shelter and are easily spotted by predators. Tortoises, especially juveniles, find this a difficult time. The effects of fire on forest structure are more insidious. Fires started by natural causes such as lightning strikes occur on average every twenty years, and occasional leaf litter burns in dry evergreen and mixed deciduous forests can be tolerated by individual trees.

The human impacts on freshwater turtles were and are completely different and, apart from direct collection and the development of crop cultivation near settlements, of much more recent occurrence. The impact of this loss of wetlands on turtle species is hard to gauge. If we look at wetland birds, we know that several species have disappeared from the region, while others have adapted to the new landscape created by humans and thrived.

Due to limited size of impact area, Upper Baluchaung Project could potentially have an effect on only a small number of individuals of ERL/IUCN, Bern-listed and GRDB species. Some of these may lose some habitat. However, none of these species are confined to the impacted portions of the project area, and would move to suitable nearby habitats. A few Bern-listed species, mainly some water birds, mostly observed at the downstream of Upper Baluchaung River, may benefit from the presence of the Upper Baluchaung Reservoir.

Mitigation Measure Impressed tortoise

- To the extent possible project features should be located in previously disturbed areas or outside of impressed tortoise habitat.
- Vehicle use should be limited to existing or designated routes to the extent possible.
- Area of new construction or disturbance should be flagged or marked on the ground prior to construct. All construction workers should strictly limit their activities and vehicles to area that have been marked. Construction personnel should be trained to recognize markers and understand the equipment movement restrictions involved.
- Construction of schools, factories, power plants, office building and other permanent or long-term project in moderate to high density tortoise habitat should be enclosed with desert tortoise barrier fencing to prevent tortoise from wandering onto the project site where they may be subject to collection, death or injury.

6.3.3.4 Aquatic Fauna Species

None of the fish species identified in the project area is endemic for Myanmar. There are two fish species (***Cyprinus intha*** and ***Channa harcourtbutleri)*** of international concern according to IUCN Red List that will be impacted by Upper Baluchaung HPP Project. As described in section v of fauna survey result, these species' spawning and maintenance habitats in the section of Upper Baluchaung River to be bypassed needs to be maintained. To maintain these habitats, water will be released from Upper Baluchaung Dam so as to provide a minimum flow in the bypass reach. The minimum flow needed in the bypass reach, and the minimum water release from the dam, are calculated and provided in the discussed in Section 6.2.8.4. Thus, by the provision of the minimum flow the necessary habitats for these species would be maintained in the by-pass reach in addition to the available habitats in the tributaries in this section of the river.

Mitigation Measure for Aquatic Fauna (*Cyprinus intha)*

Several measures have been suggested to mitigate the adverse impacts of a hydropower project. There may be a lack of water effect downstream during the dry season due to the flow diversion and damming of the river. The effect is local and can be overcome to some extent by releasing compensation flow downstream. Fish passes play an important role in the conservation of the native fish resource. Some fish utilize gravel bed areas for spawning. Adequate attention must be given to the protection of the spawning and nursery gravel beds. Additional measures should be taken;

- Depositing gravel to increase the spawning habitat

- Manipulating angular and large boulders to create pools for spawning and as an escape cover for resident fish during low water levels

- Using large boulders to alter the flow pattern downstream

- Keeping gravel and boulders together to create spawning riffles to attract resident stock to rapids

- Releasing flushing discharge to rewater exposed gravel beds to maintain spawning gravel quality

- Enhancing the habitat by tree planting to increase shelter cover, shade and drift food.

A reservoir associated hatchery should produce seed of important native fish which are most affected by dam projects. Stocking the reservoir and tail water will replenish the losses resulting from the disappearance of the natural spawning grounds and from secession of migrations

A **fish ladder**, also known as a **fish way**, **fish pass** or **fish steps**, is a structure on or around artificial and natural barriers (such as dams, locks and waterfalls) to facilitate diadromous fishes' natural migration. Most fish ways enable fish to pass around the barriers by swimming and leaping up a series of relatively low steps (hence the term ladder) into the waters on the other side. The velocity of water falling over the steps has to be great enough to attract the fish to the ladder, but it cannot be so great that it washes fish back downstream or exhausts them to the point of inability to continue their journey upriver.

There are six main types of fish ways:

- Pool and weir
- Baffle fish way (Denil, Larinier, Alaskan Steeppass, or other baffle configuration)
- Fish elevator
- Rock-ramp fish way
- Vertical-slot fish passage
- Fish siphon

Fish ladders have a mixed record of effectiveness. They vary in effectiveness for different types of species, with one study showing that only three percent of American Shad make it through all the fish ladders on the way to their spawning ground. Effectiveness depends on the fish species' swimming ability, and how the fish moves up and downstream. A fish passage that is designed to allow fish to pass upstream may not allow passage downstream, for instance, though fish passages do not always work to protect affected species, not including any fish passage ensures that they cannot migrate at all.

6.3.4 Impact Zone

Impacts may occur around the UB-1 Intake, No.1 power station, No.2 power station and along the route of water channel due to the construction works and operation activities of the power stations. Summary of Key Potential Impacts of Construction and Operation Works are described below.

The impact identification table highlights:

♦ sources of impact (development activities);

♦ potential impacts;

♦ receptors for these impacts.

Table 6-10: Summary of Identification of Key Potential Impacts of flora and fauna – Construction Phase

Flora and Fauna			
Component	**Project Activities**	**Potential Impacts from project activities**	**Mitigation Measures**
Aquatic Ecology	**Site Preparation**	• change in species composition and displacement of sensitive species • habitat loss • loss of conservation value • reduction in ecological diversity	♦ phasing of construction work to minimize disturbance to aquatic fauna at sensitive times of the year, such as fish spawning seasons, or when young are being raised; ♦ restoration plans should incorporate measures to improve the ecological status of the site;
	Construction Activities	• works in proximity to watercourse may result in bank instability and compaction which may disturb/destroy aquatic communities • increased sediment load in watercourses may lead to aquatic impacts due to increased turbidity	

		• change in species composition and displacement of sensitive species • loss of conservation value • reduction in ecological diversity	
Terrestrial Ecology	**Site Preparation**	• felling of trees. • loss of conservation value • change in terrestrial community • change in species composition and displacement of sensitive species from general site preparation.	♦ sensitive terrestrial habitats and trees should be avoided during construction work; ♦ further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential of the site; ♦ restoration plans should incorporate measures to improve the ecological status of the site;
	Construction Activities	• change in species composition and displacement of sensitive species by noise or other disturbance from general construction activities and by temporary workers' accommodation • risk of damage from spills or leaks of fuel, oil, and chemicals from materials stores • delivery of materials may lead to casual damage of roadside vegetation, or by road upgrading for special equipment deliveries.	

Table 6-11: Summary of Identification of Key Potential Impacts of flora and fauna – Operation Phase

Flora and Fauna			
Component	**Project Activities**	**Potential Impacts from project activities**	**Mitigation Measures**
Aquatic Ecology	**Hydroelectric Plant Operation (turbines, downstream volume outflow, etc.)**	♦ Changes to local species breeding and Spawning grounds	♦ The aquaculture sector in the region shall be encouraged to enhance the fisheries sector ♦ Compensatory breeding of young fish is encouraged in the first five years after the operation In order to ensure no impact on the growth of fisheries and no affect to aquatic habitants
		♦ Decreased number of economic valuable species	♦ Economical valuable fishes are promoted and fish stocking shall be implemented for population restoration ♦ Assist in promotion of fish breeding and stocking to enhance productivity of decreased fish populations.
		♦ Changes to local species breeding and Spawning grounds and	♦ Promote regional aquaculture program ♦ Educate local people on proper harvesting methods and techniques
Terrestrial Ecology	**Hydroelectric Plant Operation (turbines, downstream volume outflow, etc.)**	♦ Impact to ecosystems, downstream habitants and agricultural areas	♦ Maintenance of downstream flows based on approved reservoir operation procedures ♦ Implement regular water sampling and analysis to evaluate sediment downstream of dam

6.4 Impacts on Socio-Economic Environment

The principal impacts of the Upper Baluchaung Hydropower Project will be on the physical and the biological environments rather than on the socio-economic environment due to its characteristics. There are settlements and agricultural areas in the close vicinity of the dam axis. However, none of those settlements will be adversely affected from the construction activities. There exist no settlements within the area to be flooded; therefore, no relocation activities are foreseen. There will not be any significant impact on the transportation network either. Only a very small area of agricultural land loss will take place. In this section, potential socio-economic impacts are discussed.

Scope of Social General Impact Categories and Study Approach

The term "Social Impact" means all social and cultural consequences, including changes of people's lives, production, social relations and organization pattern, brought about by any private or public activity, as well as cultural impacts, including changes of people's behavior, the view of value and religion.

The objective of a Social Impact Assessment (SIA) is to assess the possible social impacts that may be brought about by a development project, to understand, manage and control changes, to formulate, implement mitigation measures to minimize adverse social impacts or prevent from extension. In the assessment, the most important key is to carry out social intervention to settle, mitigate and eliminate the adverse impacts and manage the social impacts rationally.

Upper Baluchaung Hydroprower Project is a development project, which is aiming at electricity production. According to the international standards (generally based on relevant World Bank policies), all people affected by the project and all the impacts on their livelihood associated with the project must be identified and evaluated beforehand in order to develop necessary mitigation measures if any significant adverse impact is foreseen. Typical effects of development projects may include breaking up of communities and social support networks; loss of dwellings, farm buildings, and other structures (wells, boreholes, irrigation works, and fencing); loss of agricultural lands, trees, and standing crops; impeded or lost access to community resources such as water resources, pasture, forest and woodland, fisheries; loss of business; loss of access to public infrastructure or services; and reduced income resulting from these losses.

In light of above-mentioned information, it is necessary to address and mitigate any of the effects associated with the project in the relevant communities including increased pressure on land, water, natural vegetation (forests, woodlands, grasslands, etc.), plantations, or other common property resources, public infrastructure, and services. These communities should be informed and consulted as a part of the planning process of the subject development projects.

Consultation involving representatives of the communities helps to build familiarity and resolve disputes that inevitably arise during and after the implementation of the project.

The impact categories for the project with respect to the project affected persons (PAPs) are first theoretically established in accordance with the relevant international policies (EBRD, WB). Thus, based on these international requirements and the project characteristics, the following theoretical impact categories were identified:

· The PAPs whose sources of livelihood are affected.

· The PAPs whose living conditions are affected positively/negatively.

The studies showed that most of the possible affected households (HHs) are living in Inn Tein Kone, Kyauk Taw, Taung Kha Mauk, Tone Lel, Min Lone and Naung Wo villages due to their location with respect to project area.

Thus, based on the screening for affected populations, these six villages are found to be affected by the Upper Baluchaung Hydropower Project. The studies concentrated on these six settlements. The objectives of the participatory social impact assessment were defined to provide basis for governments and the project owners to solve the social impacts that are left over because of the hydropower development, and to provide a channel for the affected people or communities to participate in decision making process as well. In this regard a Public Consultation and Disclosure Plan was also prepared and provided in Chapter 8 of this report.

6.4.1 Social Impacts and Issues

The major source of social and cultural existence of humankind is to overcome the environmental scantness. To be aware of the new conditions brought in the long and short term by environmental, socio-cultural and socio-economic change is meant to convert the change into a human development.

Change, an enchanting word today, conveys a totally positive meaning. However, “change” is positive if it brings about universally accepted progress and development. Therefore, it is a must to consider the negative impacts of the change planned to be made in environment, social and cultural spheres, in the long and short terms, and to minimize these impacts. In addition, it is necessary to maximize the positive impacts of the planned change in daily lives. Such an approach to plan a change would be a step further for development of social and cultural existence of mankind.

For the projects in which an environmental change is held during the construction and the operating stages, it is necessary to consider the environmental impacts together with socio-cultural and socio-economic impacts. For instance, if construction/operation activities require change to spatial or environmental indicators, not only the changing environmental conditions should be observed but also changed socio-economic and socio-cultural structures should be analyzed. Similarly, just the opposite of the case should be regarded as well, because environmental and socio-economic impacts cannot be thought independently.

Regarding the Upper Baluchaung Hydropower Project, the positive and negative impacts to the socioeconomic and socio-cultural (that is to say; daily lives) conditions of the people living in project affected villages are assessed in this Section.

6.4.1.1 Demographic Impacts

The impacts on demography will be of concern mainly for construction phase and would be related with the mobility of the population. Considering the construction phase, it is possible to speak of two different kinds of population mobility. Former is the forthcoming workers coming for construction and other staff. Latter is the population mobility due to the construction in the area.

During construction period, large number of construction workers, including staff of contractor, consultants, engineers, skilled/non-skilled workers, will be mobilized to Upper Baluchaung Hydropower Project. The number of construction workers is estimated to be approx. 500 consisting of 100 staffs of contractors and 400 of laborers, most of which are outside workers. But many of them are laborers employed from local people. Outside workers will be accommodated in Company's base camp, contractors base camp and around the Project area.

The required staff will first be chosen among local people. For the rest of the staff, worker dormitory, engineer dormitory and guesthouse will be constructed nearby. For the workers to be selected among local people, the impact of migration mobility will be limited. In addition, those who will come to work in the construction will be directed to work in the determined parts of the project; and this will also reduce the negative impact of migration mobility. The low rate of workers coming from outside compared to local population will additionally decrease the impact on the socio-cultural structure of the region. It is not expected that there will be migration to or from the area resulting from positive or negative effects of the project. Since the construction activities will be held in a limited area, and there is no loss of settlements, local people are not forced to emigrate. Therefore, the impact of the project on the demography and any migration movement is extremely low, which can be called as insignificant.

In addition to this, the migration movement that takes place in the operation phase is different from those in construction phase. Within the operation phase, the number of workers will be just 10% of all workers employed in the construction.

Considering the low number of staff at the operation phase, no significant impact on the local population is anticipated.

6.4.1.2 Economic Impacts

As the workers and staff coming to the region for construction activities would increase, the demand for the goods and such is also expected to increase. Thus an increase in demand might cause an increase of prices for certain goods at the regional level. However, the limited incoming population and the economically integrated character of region to the bigger settlement areas are predicted to reduce the inflationist impact resulting from demand increase and finally would remain at low level. On the other hand, this would bring the opportunity for trade in the area. The goods and services needed during project activities will be purchased from the region. Therefore, trade in the region will increase as a result of construction activities. If all activities are conducted simultaneously, a significant increase in the economy of the region is expected. In addition, transportation infrastructure for the project activities within the region will be improved and this will allow local people to reach easily to the district centers. As a result, the economic integration will increase, which is a positive impact.

Recruitment of local people for construction works would cause increase of job opportunity, which will bring about income increase and enhance their livelihood. Due to the intrusion of outside workers, the business opportunity would increase for local people, such as not only sales increase of existing shops and restaurants, but opening new shops and restaurants, accommodation and transportation services, etc. , which will stimulate local economy.

The number of local people to be hired is estimated to be more than 100, who will be hired for labors for construction works and the recruitment of local people will contribute to income increase, which will stimulate local economy for enhancing livelihood of villagers.

The number of outside workers is estimated to be approx. 400 if included the families, the figure is also quite a big as well. According to interview survey, local residents of the Project area has a concern and unrest that daily life of local people will be disturbed.

As the agricultural land loss due to project activities constitutes a very small percentage of the total agricultural lands, it is expected that the households doing agriculture will not lose their economic gains. In addition, the areas to be used by project facilities are not utilized by animal husbandry activities either. No one living in the region will lose his/her house, job, and social networks because of project activities. On the contrary, project activities will create a source of job opportunities and enable people to participate more actively to the social networks, and finally social integration will increase. In addition to that, the improved transportation network will additionally give increase to the dynamic social structure. Within and across region, the interaction will be increased. With the realization of the project, local people are expected to join and participate to the civil society related with the project (See Appendix 4 for Public Consultation and Disclosure Plan). It is expected that individual and cumulative social relations will positively influence the region.

6.4.1.3 Land Loss Compensation

There are some cultivated lands inside the Project Area which was authorized and transfered to Neo Energy Oasis Development Co., Ltd. from the Government for development. Although these cultivated lands are in the area restricted by Forest Department for cultivation, NEO offered compensations to the concerned farmers with the prevailing rate per unit area approved by local authorities.The detailed land compensation list by Neo Energy Oasis Development Company Ltd. can be seen as follows.

(20th May 2015)

No	Name	Land Used by Project (acre)	Compensation (10 lakhs per 1 acre)	Total (Kyat)
1	U Thein Swe	0.25	1,000,000	50,000
2	U Win	0.04	1,000,000	40,000
3	U Aung Thaw	0.74	1,000,000	740,000
4	U Aung Tun	0.76	1,000,000	760,000
5	U Aung	0.97	1,000,000	970,000
6	U Aung Kaung	0.85	1,000,000	850,000
7	U San Phay	4.47	1,000,000	4,470,000
8	U Win	0.59	1,000,000	590,000
9	U Tin	6.65	1,000,000	6,650,000
10	U Thein	2.74	1,000,000	2,740,000
11	U Phyu	4.04	1,000,000	4,040,000
12	U Phoo	3	1,000,000	3,000,000
13	U Maung Ngwe	0.41	1,000,000	410,000
	Total	25.51	1,000,000	25,510,000

(5th October 2016)

No	Name	ID Number	One Acre Prize (Kyat)	Land (Acre)	Total (Kyat)
1	U Ohn Maung	13/Nya ya Na(N)093017	2,700,000	2.94	7,938,000
2	U Myein	13/Nya ya Na(N)021892	2,700,000	1.77	4,779,000
3	U Aung	13/Nya ya Na(N)021888	2,700,000	5.8	15,660,000
4	U Aung Nyo	13/Nya ya Na(N)021910	2,700,000	4.38	11,826,000
5	Daw Nan Yee		2,700,000	0.55	1,485,000
6	Daw War War Win	13/Nya ya Na(N)117774	2,700,000	0.11	297,000
7	U Thein Aung(or) U Than Aung	13/Nya ya Na(N)093822	2,700,000	0.19	513,000
8	Monastery		2,700,000	3.59	9,693,000
9	U Khun Nan Na	13/Nya ya Na(N)117502	2,700,000	3.18	8,586,000
10	U Maung Khan	13/Nya ya Na(N)057063	2,700,000	0.21	567,000
11	U Chit Sein	13/Nya ya Na(N)091626	2,700,000	0.09	243,000
12	U Aung Mya	13/Nya ya Na(N)021908	2,700,000	4.27	11,529,000
13	U Lam	13/Nya ya Na(N)051562	2,700,000	5.94	16,038,000
14	U Than Htun	13/ Nya ya Na(N)021897	2,700,000	7.62	20,574,000
15	U Aung Phyu	13/ Nya ya Na(N)073650	2,700,000	1	2,700,000
16	U Tun Ngwe	13/ Nya ya Na(N)099683	2,700,000	2.13	5,751,000
17	U Thaung Swe	13/ Nya ya Na(N)097577	2,700,000	4.24	11,448,000

18	U Aung Soe	13/ Nya ya Na(N)117747	2,700,000	1.75	4,725,000
19	U Naung	13/ Nya ya Na(N)121053	2,700,000	2.34	6,318,000
20	Daw Swe Lay		2,700,000	0.47	1,269,000
21	U Htar	13/ Nya ya Na(N)093807	2,700,000	0.44	1,188,000
22	U Tun Myint(or) U Thaw	13/ Nya ya Na(N)093823	2,700,000	1.45	3,915,000
23	U Thein Win	13/ Nya ya Na(N)094747	2,700,000	1.87	5,049,000
24	Daw Tin Hla	13/ Nya ya Na(N)117769	2,700,000	0.24	648,000
25	U Pen Sein(or) Tue Tue	13/ Nya ya Na(N)091606	2,700,000	2.39	6,453,000
26	U Htwa(or) U Aung Htwa	13/ Nya ya Na(N)105181	2,700,000	1.3	3,510,000
			Total	60.26	162702000

6.4.1.4 Impacts on Social Structure

In the respect of construction of Upper Baluchaung Hydropower Project, the social network would receive a limited impact. The selection of workers from the local people and the construction of houses in the construction area for workers coming from outside will reduce this impact. The labor accommodation plan is presented in Chapter VII.

The transportation facilities made up for construction will additionally give rise to a more dynamic social structure. Within and across region interaction will be increased. With the start of the project, local people are expected to join and participate to the civil society organizations related with the project. Within the project, the improvement of the transportation infrastructure in the construction and operation phases and the increase in the environmental and social awareness will be effective in the formation of active participation of local people to the social life. It has been analyzed that improved social relations will positively influence the region.

General Evaluation

Generally speaking, despite the limited loss of agricultural land due to the project, project activities will affect the economy of the region positively and the income levels of the local people will increase. When these two factors are taken into account, it can be concluded that the economic impacts of the construction activities will be positive in the region. This in turn will be due to the purchase of the good and services from the area/region for the project.

Public participation is a key issue regarding the contribution of the project to social environment and minimizing any impact together with the project affected persons. With the ESIA studies the public consultation and information sharing process was started and positive reactions of the locals regarding the project has already been received. In this context, the locals had a chance to ask questions and to raise their opinions. For example, one of the frequently asked questions by the PAPs is whether the project will cause an accident or not. By providing information regarding the features of the project and construction activities answers for this question were provided during the surveys and consultations with the PAPs. In order to address such concerns, public would be frequently informed about project activities in the following stages of the project as well.

It could be stated that the public participation will increase by sharing information with the public. This transparency will naturally increase the public's positive approach to the project and give the chance to determine likely negative social and environmental project impacts and to take necessarily mitigation measures on time.

6.4.1.5 Impacts on Water Use

Mainly springs and river in the area are used for domestic and agricultural purposes in the villages. The project area lies in a mountainous region and agricultural land is limited. The major agricultural product in this area is corn.

The river is used by the fauna species and agriculture. In addition, both of spring and river are found in domestic use of water but there is no significant use by livestock living in the area. The purified water is observed in the use of drinking water. Since Upper Baluchaung Hydropower Project will have a small reservoir, the change in groundwater level will be negligible around the reservoir after impoundment. The most severe impact on water use will be in the bypass reach, and the aquatic biota and assimilative capacity will be maintained in that reach with the release of a minimum flow to the bypass reach.

A number of alluvial water wells used for irrigation purpose were identified on the left bank of Upper Baluchaung River in the downstream of dam axis approximately 9.2 km away. The level of water table downstream of the dam axis might decrease to some extent, especially before the confluence of xxx River and xx River, but it is not expected to adversely affect the amount of water taken from the wells.

As a conclusion, taking the project characteristics and purpose into consideration; the impacts of the project on water use issue is expected to be insignificant. This is mainly due to the small reservoir to be formed (and used just for electricity generation) and the presence of flow gains from joining tributaries to the by-pass reach together with the minimum flow to be released to this reach from the dam.

6.4.1.6 Impacts of the increase of outside workers on conflict and security

Increase of outside workers might cause quarrel, conflict, fight and even crime between outside workers and local community. These impacts will cause not only security problem but also social unrest, which might spawn bad perception on Upper Baluchaung Hydropower Project. Regarding the measures to minimize this negative impact, only education or instruction to construction workers does not always work because the quarrel, conflict or crime is not spawn from a simple cause such as bad manner or unrespect to another person. Accordingly, countermeasures should be more oriented for strict control and security maintenance in collaboration with local authority, if necessary.

6.4.1.7 Impacts of inappropriate waste treatment on public sanitation and water quality

Inappropriate waste treatment of garbage and construction waste might cause scattering of garbage in road and settlement area. Effluent from constructor's camp and construction facility sites, etc. might also cause water pollution in the Upper Baluchaung River if wastewater treatment is not properly done.

The following countermeasures for garbage and construction waste should be taken for the impact:

- Establishing the waste treatment system shown on Figure,
- Establishing regular collection, stock and transportation system of ordinary garbage from offices, kitchen garbage, and other burnable garbage, for incineration at an incinerator, or dumping at designated place by authority,
- Strict prohibition of waste dumping in the surrounding areas such as nearby mountain, vacant space in settlement area, mainstream and tributaries, and other public area,
- The collection system mentioned above should be made separating the industrial waste (construction waste) and other general garbage from base camps. Industrial waste, further divided into the following:
  - Residual rock, gravel, sand and other earth material from quarry site: dumped in the spoil bank,
  - Humus soil: once stocked in the premise of construction site and later utilized as a source for farmlands,
  - Plastics: once stocked and recovery for re-cycle/re-use, or dumped in the waste dumping site designated by authority,
  - Steel and other metal: once stocked and properly recycled /re-used later,
  - Grease, paint, other oil material: once stocked and properly recycled later,
  - Wood and other burnable material: once stocked and transported to incineration, or handover to local people for re-use
- Giving education and instructions to construction workers including:
  - Established waste treatment system mentioned above,
  - Obligation of following up the waste treatment system.

These instructions should be described in technical specification of the contract of the construction work. The waste treatment system above is to be followed by all the construction workers including employers, consultant engineers and Contractors.

6.4.1.8 Impacts of outside workers on public health

Increase of outsider workers might cause proliferation of infectious diseases including HIV/AIDS among construction workers and local people.

Countermeasures for the impact on public health are as follows:

- Education on public health for prevention of endemic diseases such as malaria, dengue fever, including method of precaution, cure and treatment,
- Regarding HIV/AIDS in particular, the following measures should be provided to conduct and monitor a health protection program, including:
  - Educations on public health and sanitation to contractor and workers,
  - Situation survey and regular health check for workers before and during construction phase,
  - Providing information and education to construction workers on HIV / AIDS and other sexual diseases, etc.

In conclusion, conducting these countermeasures properly in combination and timely manner could minimize the potential negative impacts.

6.4.1.9 Increase of construction related traffic volume and impact on traffic safety

Taunglelone- Khaungdaing Car Road section which is under maintenance of the Public Work should be widen and improved in order to accommodate additional traffic volume. Placing traffic officers to control construction-related traffic at the entrance point from local road to construction site should also be done.

The increase of construction-related vehicles might cause the disturbance of local traffic, especially of daily life of local people, school children, public transportation. According to the increase of traffic volume due to construction works, traffic safety will be decreased, or the possibility of traffic accidents will increase. Due to the increase of construction-related traffic, traffic noise and vibration will increase, which cause negative impacts on settlement area along the roads, especially in Khaungdaing village.

These potential impacts are negative impacts, which are to be brought about by dump trucks with heavy loads, especially during dry periods as for the dust generation. This impact will disturb daily life of local people, and it will bring about respiratory disease due to suspended particulate matters contained in the dust to the residents living along the roads in the worst case. Noise to be caused by construction-related vehicles would heavily disturb if it continues for long period and if it happens at night. These impacts should be paid attention and mitigated by the countermeasures described as follows.

Therefore, drivers of truck and other vehicles should be educated and instructed on safety driving code for transportation vehicles. Owing to these measures, the impact of transportation on local traffic and its safety can be minimized.

6.4.1.10 Impacts on Landscape

Project area is in a geographical area that is surrounded with low isolated limestone hill with sparse vegetation and low to medium high north-west to south-east trending mountains. Typical continental climate (hot and arid summer, warm and rainy winter) is observed in the area.

Anthropological stress is not of concern in the project area and its vicinity.

However, the most significant formations that affect the natural landscape characteristics are the Upper Baluchaung HPP which is at a distance of approximately 8 km in the downstream of Upper Baluchaung HPP and limited agricultural and animal husbandry activities that compose the sources of income of the locals.

Natural landscape elements are observed at the headworks and powerhouse areas of the Upper Baluchaung HPP. Some of the landscape characteristics will be altered temporarily with the construction period, while some of them will be irreversibly changed by the formation of the reservoir and starting of the operation period. The alteration of the landscape characteristics are dependent on:

- Topographical changes
- Change in surface cover (in terms of surface water)
- Vegetation cover that will be removed (to a limited extent)
- Project units to be constructed and other uses
- Change in land use pattern

There would be visual disturbance during the construction phase of the project due to construction operations. This impact, which would be experienced close to the construction sites, will only be local. However, this impact will be temporary, such that disturbances on local population would be only during the construction phase.

In order to compensate the small amount of the vegetation lost at construction sites and to prevent erosion as well as to provide a better visual scene, plantation activities will be performed around the project units including the dam, powerhouse, switchyard, sites and other relevant facilities.

The most significant visual change in the area will be formation of a reservoir, even if small. The change of river to reservoir formation with a small surface area will have a positive visual impact as the most remarkable landscape structure is Upper Baluchaung River in the area. The reason for considering this change as a positive impact is the small surface area of the reservoir to be formed. Furthermore, reservoir formation will not change the landscape characteristics of the surrounding area significantly.

There are no houses in the immediate downstream of the dam site, whose views would be blocked due to the dam. Therefore, no settlements would be affected due to the blocking of the view by the dam body. The transmission line would be built for connecting the electricity produced to the national system. Also, a switchyard would be constructed for connecting to the transmission lines. The switchyard would be a new structure in the landscape. The visual impacts of the transmission line would not be significant, since the route is selected to be as far from settlements as possible considering the vegetation and land use characteristics. The switchyard will be located at a rather visible site, but would be a part of the power plant structure and the visual impact would be permanent, but local.

The Upper Baluchaung Hydropower Project is not located within any areas of designated landscape importance, such as landscape protection area, at either a local or regional/national/international scale. The impact on landscape would not be significant since the reservoir is rather small. In fact, water bodies, such as lakes or reservoirs, may be considered to create pleasant scenery.

6.4.1.11 Cultural Heritage

The proposed Upper Baluchaung Hydropower Project is located about 14.4 miles (23km) south-west of Nyaungshwe Town and 5 miles away from Inn Tein Kone village. Inn Tein Kone village is a gateway to Inle Lake area from the Project area. Although Inn Tein village is one of the hotspot of tourism due to the existence of ancient Inn Tein pagoda complex, the proposed project site is far from it and even the road use concerned with vehicles used by construction and operation period would not be performed by the project. The planned project will be realized quite away from the cultural sites, thus **no impact on any cultural heritage site is expected**.

The **worker's camp** construction is just for surface interventions and vegetation removal with very limited ground excavations. The area which will be used for this purpose does not have historical and archaeological importance and thus **the risk of encountering historical finds is negligible**.

The **construction of power houses and transmission line** will follow areas with no archaeological importance: it is an area characterized by the presence of grass and shrub lands, agricultural land and part of degraded mixed forest and, therefore the risk of **encountering historical finds is very low**.

In conclusion, taking into account the surveys performed and the literature documentation examined, there are no potential ancient above ground resources in the Project area which may be impacted during the construction works. In any case, a Chance Find Procedure shall be developed for the Project to be applied in case unknown cultural heritage sites/remains will be found during construction activities. The objective is to protect previously unrecorded cultural heritage sites, objects, or features from

Project-related damage and unexpectedly discovered during excavation works. The procedure, in accordance with national and international requirements in this field, has to outline roles, responsibilities and the response times for project staff in case unknown heritage resources are encountered, clear instructions to deal with the findings (including the possible involvement of an expert) and potential work stoppages that could be required.

Standard provisions in construction contracts in Myanmar foresee the following steps in case of chance finds:

- to interrupt the construction activities in the area of the chance find;
- to delineate the discovered site or area;
- to secure the site to prevent any damage or loss of removable objects;
- to notify the supervisory Engineer who in turn will notify the responsible local authorities;
- responsible local authorities and the relevant Ministry would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures;
- decisions on how to handle the finding shall be taken by the responsible authorities and the relevant Ministry (this could include changes in the layout, conservation, restoration and salvage);
- implementation for the authority decision concerning the management of the finding shall be communicated in writing by the relevant Ministry;
- construction work could resume only after permission is given from the responsible local authorities and the relevant Ministry concerning safeguard of the heritage.

In this framework, the Client HSE Manager shall conduct routine inspections of site activities to assess the potential for chance finds at work sites. He/she will also supervise sites where chance finds were unearthed to ensure that the correct control procedures and engagement activities were performed. Induction training will be organized to Project staff and contractors to disseminate the Chance Find Procedure.

Chapter VII Environmental Management Plan

7.1 Introduction

The primary objective of an Environmental and Social Management Plan (ESMP) is to safeguard the environment, site staff and the local residence from site activity which may cause harm or nuisance. This ESMP for the Upper Baluchaung Hydropower Project is intended to provide a framework to ensure transparent and effective monitoring, prevention, minimisation, mitigation, off-setting and enhancement measures to address the environmental and social impacts associated with the Project.

The implementation of the ESMP ensures that environmental, health and safety (EHS) and social performance is in accordance with international standards (including the relevant International Finance Corporation (IFC) Performance Standards, Environmental Conservation Law of Myanmar, 2012 and best practice.

This ESMP will be updated and/or revised for both construction and operation phases to make the measures bespoke to the prevailing conditions as monitored during both construction and operation periods.

Since mitigation forms a vital part of the Project an Environmental Management Unit (EMU) will be established by the Neo Energy to implement the Environmental Management Plan (EMP) for the Upper Baluchaung HPP. Management should also include the education of employees and locals in environmental issues. For example, workshops on mitigation should first of all be set up for all mitigation workers with the help of experts and run by forest officers. Secondly local people should be better informed of mitigation strategies and methods so that they understand the nature of how land and soil loss problems are handled. Furthermore, the importance of controlling grazing and wood collection on re-vegetated sites must be enforced. All these issues will be covered by an Environmental Awareness Campaign.

Environmental Protection training and awareness, and capacity building of institutions are essential elements of the EMP.

7.2 Environmental and Social Action Plan

Environmental and social action plan (ESAP) is mainly based on mitigation and performance improvement measures and actions that address the identified social and environmental issues, impacts and opportunities. Within the scope of the plan, mitigation measures and actions are identified at all the stages of the project (i.e. pre-construction, construction, operation) in compliance with the relevant Myanmar Legislations.

The major purpose of ESAP is "to document key environmental and social issues, the actions to be taken to address them adequately, as well as any actions to maximize environmental or social benefits, the schedule and person/unit responsible for implementation and monitoring, and an estimate of the associated costs". The details of the plan are presented in this chapter.

In Table 7-1 and Table 7-2 (given at the end of this chapter) ESAP for construction and operation phases of the project in addition to relevant monitoring activities are provided.

7.3 Organization and Implementation

Ministry of Electricity and Energy (MOEE) is the Executing Agency (EA) for the Project and has the overall responsibility for ensuring that all environmental standards and procedures are followed. The environmental law and rules are set by the Ministry of Natural Resources and Environmental Conservation (MONREC). The Neo Energy Oasis Co., Ltd. is responsible for implementing and environmental monitoring. Prior to the project construction, the MOEE will set up an environmental management unit (EMU) for environmental management and operation, including environmental supervision of contractors. The EMU will ensure implementation of the environmental management plan and the environmental monitoring plan during construction of the Project. The EMU will be staffed by a project manager and with technical personnel. During operation the Power Plant Operator will be responsible for the implementation of the EMP.

The EMU will coordinate all environmental monitoring activities as given in the EMP. The EMU will ensure that the EMP is updated periodically during the construction period. An independent environmental supervision consultant, as part of the Implementation Supervision Consultant, will supervise and monitor environmental procedures. The EMU will submit environmental monitoring reports (including physical data) to the MONREC twice annually during construction and annually, after completion of construction.

7.4 Mitigation Plan

A number of impacts are unavoidable, some can be minimized and some losses can be replaced. Thus, mitigation measures may take different forms. The mitigation activities required to avoid or reduce the adverse environmental impacts of the project are presented in this section and the proposed mitigation measures for each phase of project development including dam and transmission line are outlined.

7.4.1 Catastrophic Failure

Upper Baluchaung Dam is not intended for storage, but for the diversion of the water to the powerhouse through a power tunnel, and has a reservoir area of about 0.21 km^2.

Failure of the dam is very unlikely. Nonetheless, although a small structure, Upper Baluchaung Dam will be monitored with regard to dam safety and seismicity through the use of installed instrumentation.

In addition, a draft Emergency Action Plan is prepared and given in Appendix 5. in order to ensure public safety downstream of the reservoir and the powerhouse, as well as the camp facilities. It will establish criteria for various stages of emergency, the actions to be taken at each stage, and the procedures for ensuring that no event at the Project, whether an increase in risk or some sort of failure, endangers the public or the project staff.

7.4.2 Construction Phase

In the context of mitigation planning construction phase covers the construction of the project in accordance with the final project design, using proper management means, implementing the action plans already prepared, improving and detailing these plans when necessary, sustaining cooperation and coordination between the responsible stakeholders and the public. In the following sections mitigation measures are presented addressing the various impacts.

7.4.2.1 Erosion and Sedimentation

Erosion can be observed in the area due to the removal of the vegetation cover in construction and operational periods, stripped top soil and slope. Mitigation measures will be taken to reduce erosion and sediment load to the river and other surface waters from construction activities and earthworks. For this purpose the following framework Erosion and Sediment Control Plan is provided.

Erosion and Sediment Control Plan (especially in the reservoir area, along the water way and power houses)

In accordance with the framework of best practice applications, erosion and sediment control plan is prepared for the construction phase. Precautions as outlined below shall be taken prior to any excavation to reduce erosion and sedimentation risk. The implementation will be monitored to ensure that control measures are in place. Main elements of this plan are:

- Stockpiles, including construction materials, such as concrete aggregates, filter material and sand will be properly handled.

- Materials excavated from open and underground excavations, which are unsuitable for use in other areas, or that are surplus to such requirements, shall be disposed in proper disposal areas. Materials suitable for roads, slope protection, embankment and riprap shall be stockpiled separately from disposal areas for later use.

- Any topsoil excavated that is above the reservoir level shall be stockpiled in a suitable location to be removed and utilized for reforestation and implantation. All stockpiles and disposal area shall be arranged, including provision of drainage and erosion control measures.

- The height of material stockpiles shall be defined on site in accordance with topographic conditions and stockpiles and the disposal area shall not be located in floodway zones.

• Appropriate cut-off ditches on the uphill side will be provided to prevent erosion in the disposal site and stockpiles.

• Flatter surfaces will be obtained at slopes and terraces will be formed in areas where erosion risk occurs and these places will be vegetated. This effort will decrease the flow of soil to the surface water and also will increase the economic life of the dam since it reduces the sediment transport to the reservoir.

• To protect the reforested areas the required signboards will be placed and to limit the entrance to these areas fences or natural barriers will be placed at the required places. While performing reforestation, the dominant vegetation of the region will be taken into consideration and the tree species that will be used in reforestation activities will be selected according to the vegetation.

• Insemination works (before reforestation) will be performed at the places where erosion occurs extensively since they spread rapidly and hold the soil.

7.4.2.2 Landscaping and Top Soil Utilization

The construction activities at the adits and construction sites will disturb the visual appearance of these sites. The construction site will be inundated by the reservoir, which will form a new landscape in the area. The construction activities outside the future reservoir area will be the regulator construction activities, headrace tunnel and powerhouse construction. These sites will be restored and landscaped after the completion of construction.

To minimize the impacts on the fertile topsoil, at any construction site the soil will be carefully removed and stored in a manner to avoid deterioration taking the weather conditions into consideration. Also, the subsoil that provides the formation of the topsoil will be stripped and stored to protect its horizons. While stripping the topsoil, the impurities will be removed from the soil. In order to preserve soil fertility, the piles will be lightly compacted and covered with organic material or green seeding with pioneer plant species. Moreover, the surface of the vegetal soil will be protected against erosion and drying, and will be covered with vegetation like grass, pasture plants etc. to maintain its activity. The stripped vegetal soil will be used at the landscape repair works and at the vegetal landscape arrangement of the recreation areas.

Storage Areas and Landscape

The excavation materials will be extracted from the open channel and stored in valley formations close to the channel. 70% of the excavated materials shall be used for bridge, road construction and river rehabilitation activities, whereas the rest of it (30% of the excavation materials) shall be permanently stored. The storage of excavation materials shall be implemented in line with the natural landscape characteristics by considering the environment and human health. Within this scope, the excavation materials will be stored in appropriate side slopes and those areas will be vegetated. The valley formation that will be used for storage of excavation materials from open channel is presented in Figure 7.4-1. Sliding and rolling of rocks in the storage areas shall be prevented. The storage areas shall be isolated from the surface and rain water in order to prevent dispersion and further, sedimentation will be controlled by considering the side slope stability. Stability will be enhanced by insertion of large materials against the flow direction of water while with smaller materials behind large materials.

Erosion and sediment transport are two significant impacts that will be observed in the storage areas of excavated materials. For that reason, physical stability of the storage areas shall be improved. Rocks and smaller materials that are piled during the construction activities shall be compressed and appropriate side slopes will be obtained by taking the environment into consideration. In order to perform landscape activities and provide the stability of the excavation materials without any other precautions, the appropriate slope shall be 3:1 (horizontal distance: vertical height). Vegetation activities shall be implemented after attaining the appropriate slope of the storage area.

The stripped topsoil shall be applied with a thickness of 40-50 cm on the storage areas. If the existing topsoil will not be sufficient, necessary amount of soil shall be purchased. In order to prevent erosion and landslide, temporary slope breakers shall be used. The slope breakers shall be perpendicular to the direction of the slope in order to reduce the speed of soil flow from upper levels. Furthermore, the breakers shall be constructed appropriately in order to prevent the erosive effect of soil flow until formation of a permanent vegetative cover. Temporary slope breakers shall be on site until the stability of the vegetative cover is ensured.

Original cover will be gained after stability of the cover is ensured so as to prevent soil losses, by natural processes.

Figure 7.4-1: View of the Valley Formation that shall be used for Storage of Excavated Materials.

7.4.2.3 Air Quality

Adverse air quality impacts that could affect the health of construction workers and be a nuisance for nearby settlements will be mitigated. Dust emitting activities during construction works are excavation works, works performed in concrete batch plant, movements of construction equipment in roads, loading of excavated material to trucks and unloading of trucks and storage of excavated material.

The effects of the pollutants are dependent on the concentration and exposure time. There are limit values similar to WHO Ambient Air Quality Guidelines and National Environmental Quality (Emission) Guideline for pollutants.

Concentrations of all pollutants calculated from the model are well below the limits of WHO Ambient Air Quality Guidelines. Moreover, these emission values were calculated considering the worst case scenario. Accordingly, the distributed emission concentrations of Upper Baluchaung Hydroelectric Power plant in construction phase will be much lower. Therefore, the air quality modeling studies revealed that the construction activities will not have significant adverse impacts on the close by settlements due to the fact that they are at a distance that the impacts of emissions and dust will be insignificant. Despite, an emissions and dust control plan will be implemented and within this scope some mitigation measures are proposed.

Emissions and Dust Control Plan

Fugitive dust from site disturbances and emissions from vehicles and plants (e.g. concrete batching) have the potential to negatively affect air quality in the vicinity of the construction sites and access roads. Prevention methods shall be implemented to control dust resulting from construction related activities.

• Water sprays will be used to reduce particulate matter emissions from dust generating activities (from unpaved roads when construction equipment is active, in areas of major earth excavation, and any other areas, which produces dust), where applicable and justified.

• At the temporary storage areas material, shall be graded, moistened and compacted to prevent the material from being carried away by wind. Wetting the material will depend on the seasonal conditions to maintain its optimum moisture level. Upper layers will be kept with moisture content of 10%.

• Dust generation during excavations and fills will be significantly prevented by wetting the material. Loading and unloading will be carried out with care and without scattering.

• While travelling to and from the site, and on public roads trucks that carry particles greater than 10 mm in size will be covered with canvas and there will be a speed limit for trucks.

• Tires of the trucks will be cleaned where necessary to prevent dirt being carried onto the roads.

• Modern equipment and vehicles shall be selected and used for construction such that they will comply with the relevant emission standards.

• The machinery and vehicles shall be inspected with regard to their exhaust systems and emission levels and adjusted to comply with relevant international requirements, and to protect the health of the workers.

• Wind breaker panels will be put or trees will be planted in the area.

For all underground works mechanical/forced ventilation systems shall be installed, to keep the air in underground works in a condition suitable for the health of the workers, as required by the technical specifications and civil engineering works. Respirators will be supplied for the workers who are directly exposed to particulates and the equipment used in construction will be examined periodically for the protection of the health of workers. This will be also in accordance with the health and safety plan for construction activities.

7.4.2.4 Noise

Based on the baseline noise data for construction activities it was estimated that even under the worst-case assumptions the noise generated will be within the allowable limits (55 dBA limit for construction works) at the nearest settlements.

Figure 7.4-2: Noise and Air Sources for the nearest settlement.

The results of modeling were compared with General EHS Guidelines: Environmental Noise Management of International Finance Corporation and it was seen that limit values are satisfied at approximately 55 m distance. On the other hand, the closest settlements Min Lone (West) and Min Lone

(East) Villages to the noise sources head works, quarry and powerhouse areas are distances of 1000 m and 2240 m, respectively. The corresponding noise levels at those locations are found to be 41 (from equipment source) and 45 dBA (from blasting). Under worst-case conditions, the calculated cumulative noise levels (existing noise + construction activity noise) in the nearest settlements that are 53.6 and 50.96 dBA, are found to be below the maximum noise level (55 dBA). Although the expected noise levels due to construction activities are calculated to be low, further preventive measures are proposed in Noise Control Plan as follows.

Noise Control Plan

The following is a summary of the noise control measures that will be applied to stationary and mobile equipment:

• Fitting and maintaining effective silencing equipment.

• Silenced equipment will be used including enclosures, mufflers and other noise reducing features.

• Operating fixed equipment within enclosed structures, to the extent practicable.

• Operating machinery within the designed parameters for efficiency.

• All construction workers shall be provided with adequate hearing protection to be used in the areas. Workers will be trained and instructed accordingly.

7.4.2.5 Water Quality and Water Use

During construction there will not be any significant adverse impact on water use in the study area. The impact on water quality may be due to wastewaters from construction activities and domestic uses.

At the construction phase of the project the water usage will be due to concrete preparation, washing the concrete aggregate material, preventing dust and the domestic uses of the workers. The water required for the concrete batch plant, washing the aggregate material and preventing dust would be taken from Upper Baluchaung River. Drinking water will be supplied from the groundwater sources of the villages in the vicinity; otherwise, the water will be purchased and brought to the project site. In order to calculate the daily water consumption for domestic uses of the workers, it is assumed that the daily water consumption is 200 L/day-capita . As it is considered that 500 workers will be employed in the construction phase of the project, the daily water requirement for domestic purposes will be 100 m^3 Additionally, daily water consumption for washing aggregate material and concrete mixers is calculated. In this respect, the daily concrete production in each plant is calculated as 200 m^3 when it is considered that the capacity of each plant is 25 m^3/h and the plants will be operated 8 h/day. In order to calculate the daily water consumption, it is assumed that for production of each cubic meter of concrete, 0.13 m^3 of water is utilized (Chini and Mbwambo, 1996). Therefore, daily water consumption for washing aggregate material and concrete mixers is 26 m^3 in each plant.

Furthermore, water consumption for dust prevention is also considered. In this scope, the amount of water required to prevent the dust formed during the construction activities can change with the surface geometry of the transported material, the meteorological conditions of the environment before and after watering and the topographical conditions of the excavated area. For this purpose, water consumption will be in accordance with the requirement of “10% moisture will be maintained at the topsoil layer”. As a result of these activities; wastewater will be produced from the mixer inside the concrete batch plant and the washing of the mixers of the vehicles carrying ready-mixed concrete and the concrete aggregate. If it is accepted that the whole of the water required for the domestic usage of the workers will be converted to domestic wastewater, the daily generation of the domestic wastewater will be 50 m^3. Throughout the construction phase due to washing the concrete aggregate and mixers, 52 m^3 of wastewater that has high suspended solid amount will be produced daily.

In operation period, domestic wastewater will be produced as a consequence of water consumption by the workers. In this respect, when it is considered that 50 workers will be employed in the operation phase and water consumption per capita is 200 L/day-capita, overall water consumption for domestic purposes will be 10 m^3/day.

Wastewater produced during construction and operation phases will be treated and discharged to Upper Baluchaung River in line with IFC’s Environmental, Health, and Safety (EHS) Guidelines on Environmental Wastewater and Ambient Water Quality. The relevant parameters and limit values are presented in Table 7-1 below. Furthermore, by complying with the discharge limits of IFC, the status of Upper Baluchaung River will be maintained in accordance with the requirements of National Environmental Quality (Emission) Guideline, 2015.

Table 7-1: Limit Values for Discharge of Wastewaters during Construction Phase (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 bacteria4	100 ml	400
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50

SU[a] = Standard Unit

Table 7-2: Limit Values for Discharge of Wastewaters during Construction and Operation Phases Water Runoff, Effluent and Sanitary Discharges (General Application)

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/l	50
Ammonia	mg/l	10
Arsenic	mg/l	0.1
Cadmium	mg/l	0.1
Chemical oxygen demand	mg/l	250
Chlorine (total residual)	mg/l	0.2
Chromium (hexavalent)	mg/l	0.1
Chromium (total)	mg/l	0.5
Copper	mg/l	0.5
Cyanide (free)	mg/l	0.1
Cyanide (total)	mg/l	1
Fluoride	mg/l	20
Heavy metals (total)	mg/l	10
Iron	mg/l	3.5
Lead	mg/l	0.1
Mercury	mg/l	0.01
Nickel	mg/l	0.5
Oil and grease	mg/l	10
pH	S.U.[a]	6-9
Phenols	mg/l	0.5
Selenium	mg/l	0.1
Silver	mg/l	0.5
Sulphide	mg/l	1
Temperature increase	°C	<3[b]
Total coliform bacteria	100 ml	400
Total phosphorus	mg/l	2
Total suspended solids	mg/l	50
Zinc	mg/l	2
Total coliform bacteria	100 ml	400

As a consequence, wastewater management plan has been prepared to be implemented during construction for minimizing the potential adverse environmental impacts from wastewater discharges.

Wastewater Management Plan

Within the scope of the wastewater management plan, the following mitigation measures will be taken in order to minimize the adverse impacts of wastewaters:

• Water contaminated by concrete, paint, oil or solvents, or silt shall not be discharged overland, and shall not allowed to flow into any river or drainage line, or to infiltrate into the soil.

• The necessary collection facilities shall be constructed to prevent water pollution from construction activities.

• During the road construction drainage facilities will be provided with stilling pools to trap any sediment carried with surface runoff as well as runoff from any in-situ concrete mixing activities.

• Trans mixers delivering concrete shall be washed on a designated area.

• The wastewaters from concrete operations (from aggregate washing, batching concrete, etc.) will be reused for the same purpose after a pretreatment in a settlement pond. The remaining water clarified by settlement pond and neutralized to prevent water pollution can be discharged to Upper Baluchaung River. The settlement pond will provide physical treatment for the wastewater originating from washing aggregate. In general, neutralization is not considered to be necessary, however, the outlet pH level will be monitored and if the pH is high, neutralization with acid is recommended.

• The domestic wastewater due to the workers, the wastewater formed at the construction phase will be treated by a package treatment plant that will be constructed at the construction site and contain physical and biological processes. The treated water will be discharged to Upper Baluchaung River in line with relevant Legislations (i.e. Water Act) and international requirements.

• Water taken from the concrete batch plant and sedimentation pond will be analyzed and the treatment plant will be controlled. When any substance (dye, oil etc.) is spilled or leaked to Upper Baluchaung River, the required precautions will be taken according to the Emergency Action Plan and the required analysis will be performed.

7.4.2.6. Waste Management

The wastes generated basically during construction phase will be managed according to related Municipal Legislation, and the Prevention of Hazard from Chemical and Related Substances Law (2013). Solid wastes to be generated during construction can be classified as sanitary (domestic) wastes, construction rubble and waste excavated material, hazardous waste. To handle these wastes properly during construction solid waste and spoil, and hazardous management plans have been prepared.

Solid Waste Management Plan

In order to calculate daily solid waste production due to workers the statistics provided by the EU is considered. In this respect, daily municipal waste production is approximately 1.43 kg/day-capita in similar hydropower projects according to 2007 statistics (Eurostat News Release, 2009). To be on the safe side, the daily solid waste production is taken as 1.5 kg/day-capita. Considering the numbers of employees in construction and operation phases are 500 and 150, total daily solid waste production is calculated as 750 kg/day and 225 kg/day, respectively.

• Waste shall be systematically collected and all types of waste will be separated for (lumber, scrap metal, etc.) proper handling and disposal.

No waste shall be disposed of or buried on the site. Illegal dumping, either at the construction camp, along public roads or in the surrounding areas, or into the river shall not be allowed.

• It shall be ensured that construction campsite and surroundings are kept in clean and neat conditions at all times and that windblown litter is cleared on a daily basis.

• Separate waste containers (drums, bins, skips or bags) shall be provided for different types of waste.

• Waste containers shall be provided with lids or netting to prevent wastes being carried around by scavengers or the wind and to prevent animals to be attracted to the waste.

• Domestic solid wastes will be collected and disposed properly by the nearest municipality to the designated disposal site after agreement with the municipality.

• Suitable excavated material will be temporarily stored for further use in fills in other construction activities. Stockpiles of the fine material such as sand, topsoil material, cement, etc. shall be protected from rain runoff and wind.

Excess waste excavated material will be disposed to the designated disposal site and any further effect on the environment will be prevented.

• At these disposal sites drainage channels and culverts will be incorporated so that the stored material is not washed out. In this way, both the material will be kept stabilized in place and the river water will be protected against sedimentation.

• Wherever possible, production of construction waste and other solid waste will be minimized by reusing and recycling leftover materials where possible and also through proper planning and design.

• If scrap metal occurs, these scraps either will be reused or will be sold to companies whose main business activity is dealing with scraps.

• Wood and cardboard wastes will be reused if possible.

• Potentially hazardous waste will be segregated from non-hazardous construction site waste and domestic waste. This will be accomplished through training of the project personnel on the types of wastes.

• Construction workers will be instructed in proper construction waste and other solid waste storage and handling procedures.

Hazardous Waste Management Plan

• Hazardous wastes that can be originated due to construction activities can be lubricants, oils, dyes and tyres etc.

• There shall be a register of all hazardous substances present on the site.

The register shall detail the type of substance, quantity, storage procedures and pollution prevention measures, handling, and eventual disposal of all potentially hazardous substances.

• There shall be collection systems (i.e. trays or impervious linings) under machinery or equipment (i.e. generators and pumps) that may dispense or leak hazardous substances (i.e. machine oils).

• Handling, temporary storage and final disposal of hazardous wastes shall be carried out in accordance with relevant Georgian Legislation.

• After temporary storage, hazardous wastes will be collected by a licensed company and proper disposal will be applied in accordance with relevant legislation and all records shall be kept.

• Routine maintenance and repairs to vehicles, machinery or equipment shall be undertaken on site when all the measures are taken against any spillage or leaking.

The areas for refueling shall be established by proper containment against possible spills and/or tank overfills.

• In the event of a hazardous spill, whether accidental, deliberate or through negligence, on site or during transportation of these substances to/from the site, contractor shall immediately implement actions to stop or reduce and contain the spill.

• Emergency action plan is established for dealing with spills or release of these substances and ensure that relevant construction personnel are familiar with these emergency procedures (see Appendix 5).

Contractor shall comply with all relevant national legislation with regard to safe handling, storage, transport, use and disposal of petroleum, chemical, harmful and hazardous substances and materials.

• The advice of the manufacturer shall be obtained with regard to the safe handling of such substances and materials and also material safety data sheets.

• Construction workers will be instructed in proper collection and segregation of hazardous wastes.

7.4.2.7 Management of Biological Environment

To determine the general floristic and faunistic structure of the area literature studies were conducted, locals were communicated, and field surveys were carried out in the scope of ESIA studies. The results of the studies provide the main features of the floristic and faunistic characteristics of the project area.

Furthermore, the potential adverse impacts on these species due to construction, impoundment and operation have been assessed. The details of floristic and faunistic survey and the potential adverse impacts are given in Chapters VI.

According to the results of the studies, population loss in flora and vegetation types is expected in the small reservoir area and construction sites, however, due to limited inundation area, no significant impact on the flora species or the vegetation cover is expected.

During the studies/surveys it is observed that the habitats used by the fauna species consist of riverine habitats along the river, and cultivated lands close to these areas. It was seen that they mainly prefer using the habitats in the project area for feeding and wandering.

The major impacts of the realization of the Upper Baluchaung Hydropower Project will be on the existing aquatic fauna along the bypass reach where present flow patterns will be altered by project operation. Impacts due to the inundation of riverine habitats will be limited to only approximately 3.5 km segment of the Upper Baluchaung River and a considerable small surface area (totally 0.5 km^2).

Most of the fish species identified are adaptable to living in lakes as well as rivers. Thus, formation of a very small reservoir, which will develop slightly lentic conditions will not have a significant impact on the fish species of the river.

Among the fish species *Cyprinus intha* (Inle carp) is a sensitive species to water quality and river habitat. This species was not observed in the vicinity of the project area, but it was determined from literature that it can be found in the tributaries joining the Upper Baluchaung River. This species mainly prefers cold stream and rivers as habitats. Therefore, stagnant water body (reservoir) is not a suitable habitat for this species. However, since it is reported to be living in the higher elevations of the tributaries the small reservoir of Upper Baluchaung will not have a considerable effect on this species.

Macrognathus aral (Spiny eel) that was observed in the project area is a fish that prefers calm (slow running) rivers. Thus, it can adapt to the lake environment, especially since the Upper Baluchaung Reservoir will not be a typical big scale reservoir, but will provide calm waters. In addition, for the species that prefer to spawn on the stones and gravels at the riverbed of the rapidly flowing streams *such as Lepidocephalus thermalis* (Indian Spiny Loach) there is available sections in the upstream of the future reservoir and in the tributaries both upstream and downstream of the dam site.

During the baseline studies 147 plant species were identified in the study area. Also, 1 of 80 species (*Dalbergia cultrata*) are categorized in IUCN lists. Based on these findings and the project characteristics, the impacts of the project on flora species would be insignificant.

In the construction of reservoirs, the clearing of vegetation, movement of earth and rock, the presence of humans and machinery, bringing in construction materials, use of explosives, noise, and reducing and cutting off river flow and increasing turbidity, will affect the biodiversity. Removal of forests or other vegetation over a wide area, excavation, earth and rock movement and reduction in river flow are the most significant.

The list of plant species identified in the study area is given in Annex A. The conservation and distribution status of each species is also indicated in this table.

In the study area 58 species of Butterfly, 74 species of Bird, 14 species of mammal and 5 species of amphibians and 11 species of reptiles identified in the survey area. There is no endemic species in these areas. Mammal, Amphibian, Butterfly and Birds were no endangered species and threatened species. According to the Conservation Status by IUCN red list (2016 ver. 4.0). One tortoise impressed tortoise (*Manouriaimpressa*) vulnerable species. This tortoise species was also listed as Appendix II in CITES (2016 ver.4.0).

The identified fauna species are generally species that are common in the Shan State and they have high reproduction potential. None of these species has a protection status. They can be found in the region and out of the region in Myanmar. Thus, even though the population of these species would be affected from the project the species survival will not be significantly affected. None of the fish species indicated is endemic for Myanmar. These species' spawning and maintenance habitats in the section of Upper Baluchaung River to be bypassed would be eliminated by decreased flow unless relevant mitigation measures are taken. To maintain these habitats, water will be released from Upper Baluchaung Dam so as to provide minimum flow in the bypass reach.

Biological environment in the region might be affected from dust and noise caused by construction activities as well. During construction period, most of the terrestrial fauna species are expected to leave the area that surrounds the construction region and move temporarily to similar areas. These impacts will be seen only during construction and will end by the completion of construction activities. In the meantime (during construction) implementation of relevant management plans (emissions and dust control and noise control plans) will minimize the associated adverse impacts on the wildlife as well.

In order to avoid any unnecessary disturbance of biological environment during construction, the movement of machinery and workers will be limited to the designated construction sites and camp facilities. The construction sites will be secured by temporary fencing, which will also prevent the entrance of fauna elements into these areas. In addition, potential impacts of construction activities on vegetation and habitats will also be mitigated through the measures taken for other components of environment. Some examples of these are; proper disposal of solid wastes and establishing wastewater treatment facilities, which will minimize the potential adverse impacts on aquatic and terrestrial habitats during construction.

There are two fish species (***Cyprinus intha*** and ***Channa harcourtbutleri)*** of international concern according to IUCN Red List that will be impacted by Upper Baluchaung HPP Project. As described in Chapter 5 of fauna survey result, these species' spawning and maintenance habitats in the section of Upper Baluchaung River to be bypassed needs to be maintained. To maintain these habitats, water will be released from Upper Baluchaung Dam so as to provide a minimum flow in the bypass reach. The minimum flow needed in the bypass reach, and the minimum water release from the dam, are calculated and provided in the discussed in Section 6.2.8.4. Thus, by the provision of the minimum flow the necessary habitats for these species would be maintained in the by-pass reach in addition to the available habitats in the tributaries in this section of the river.

A **fish ladder**, also known as a **fish way**, **fish pass** or **fish steps**, is a structure on or around artificial and natural barriers (such as dams, locks and waterfalls) to facilitate diadromous fishes' natural migration. Most fish ways enable fish to pass around the barriers by swimming and leaping up a series of relatively low steps (hence the term ladder) into the waters on the other side. The velocity of water falling over the steps has to be great enough to attract the fish to the ladder, but it cannot be so great that it washes fish back downstream or exhausts them to the point of inability to continue their journey upriver.

7.4.2.7.1 Rehabilitation Plan

The plant species identified for rehabilitation plan shall be planted using pitting technique. The pit size will be either 45 cm x 45 cm x 45 cm or 60 cm x 60 cm x 60 cm.

Bigger pit size will be considered at marginal and poor quality soil. Soil used for filling the pit should be mixed with well decomposed farm yard manure at the rate of 3.6 kg (on dry weight basis) for 60 cm x 60 cm x 60 cm size pits respectively. The pitting technique are described below:

- Dig a hole, which is substantially bigger than the spread and depth of roots on the tree to be planted.
- Break up and loosen the bottom and sides of the hole, to improve drainage and to encourage future root development. This is especially important in heavy soils.
- If support is necessary, drive a stake into the base of the pit so that it will be on the prevailing windward side of the tree.
- Position the tree so that the ground level at the stem will correspond to that at which it was growing in the nursery, this can be recognized by a dark mark left on the tree at ground level.
- Back fill the pit preferably with help to hold the tree in position.
- Firm down the soil around the roots by treading. It is appropriate to mix in fertilizer and or mulch if available with the back fill.
- Water the pit area well.

Selection of Plants for Rehabilitation

Project area is located in the area of West Inle Sparse forest. There are mountain ranges formed of Limestones, with thin cover of soil around the surrounding area. Selection of plants for rehabilitation must be suitable for soil type of this area. While making choices of plant species for cultivation, weightage has been given to the natural native species which can be grown as per normal horticultural practices. Plant species identified for rehabilitation development, considering depend on ecology baseline data, bio-climatic and soil condition are listed below:

Recommended Plant Species for Rehabilitation Development

Plant Species	**Habit**	**Tolerance Limit**	**Mode of Regeneration**
Chukrasia tabularis	**Tree**	Tolerant	Seeds
Gmelina arborea	Tree	Tolerant	Seeds
Terminalia tomentosa	Tree	Tolerant	Seeds

Neo Energy should consider to plant priority of those kind of tree such as *Chukrasia tabularis, Gmelina arborea, Terminalia tomentosa* and other native fast growing trees for rehabilitation plan.

7.4.2.8 Socio-economy

Field studies and literature survey have been carried out related to the socioeconomic conditions in the project area. Key informant surveys were conducted during field studies through questionnaire survey and Focus Group Discussion. In addition, public consultation and information disclosure activities have been conducted. Details of the public consultation and participation activities are provided in Chapter 8.

The project area is located within a rural area with no industrial facilities and low population density. The main adverse impacts due to the construction activities would be caused by dust and noise generation. The baseline data and assessment studies showed that these impacts will not be significant on the close by settlements and the control measures to be taken as provided in the previous sections (such as emissions and dust control and noise control plans) will ensure the minimization of these impacts.

In addition, some agricultural areas, approximately 86 acres, that belong to nearby settlements have been compensated by the company. There are no buildings or other structures in the area to be expropriated in accordance with the Land Acquisition Act of Myanmar. None of the PAPs are affected such that they would be physically or economically displaced, so there is no resettlement due to the project.

Construction activities for the project will also have positive impacts on PAPs.

Firstly, most of the 500 workers to be employed in the construction phase are planned to be selected from local residents. In construction and operation activities that do not require high skills or special training, local residents would be hired and trained, if necessary. Apart from employment opportunities, equipment and vehicles that will be required during construction activities will be provided from the region, influencing the economy of the region positively. In addition, the newly constructed and improved roads are going to help in transportation of farm products to markets, positively affecting the existing production and incomes.

7.4.2.9 Cultural and Historical Assets

There are no known archeological or cultural protection sites in the project area. If any archeological or cultural resources are found during construction, the Ministry of Culture, will be informed, in accordance with the protection of preservation of Cultural Heritage Region Law (1994). Necessary actions to protect these resources will be undertaken by the Ministry of Culture.

7.4.2.10 Health and Safety

The project activities should be carried out in accordance with the relevant health and safety issues that are in the scope of Relevant Myanmar Law and IFC Standards and Requirements.

Furthermore, Labour Law of Myanmar stated in Chapter II also includes the significant issues regarding health and safety of workers. For that purpose, the following health and safety plan is presented.

Health and Safety Plan

• Occupational health and safety measures shall be implemented according to Labour Law of Myanmar and requirements of IFIs and shall be communicated to all employees before commencement of and during construction.

• On-site medical/first-aid facilities shall be designed for construction phase to cater for primary health care needs of personnel.

• An ambulance shall be available on-site for emergency situations.

• Workers shall be selected from the workforce and given additional training in occupational health and first aid to form teams of three personnel at each work site. These workers shall be under the supervision of the person responsible for occupational health and safety.

• Personal protective equipments for workers shall be provided, when necessary to minimize health and safety risks.

• Appropriate health and safety signs such as “Danger”, “Entrance Prohibited” shall be placed in proper places.

To minimize the risk of fire and to ensure that incidents are effectively confined, contractor shall implement the following fire management measures.

• All necessary precautions shall be taken to ensure that fires are not started as a result of construction activities on site. Uncontrolled fires shall not be permitted on or off site.

• Smoking shall not be permitted in those areas where there is a fire hazard.

Such areas shall include the workshop and fuel storage areas and any areas where there is a potential risk of fire.

• All necessary precautions shall be taken to prevent fires or spills at the fuel store. No smoking shall be allowed inside the stores and within the storage area.

• It shall be ensured that there is adequate and appropriate fire-fighting equipment at the fuel store, in workshops, and camp areas at all times.

• All equipment shall be maintained in good operating order.

• It shall be ensured that all sub-contractors and construction workers are aware of the procedures to be followed in the event of a fire.

• Emergency teams (fire, first aid, communication and rescue) shall be appointed who shall be responsible for ensuring immediate and appropriate actions in the event of a fire.

• A water pump will be available at the site at all the time.

7.4.2.10.1 Worker Accommodation Plan

Upper Baluchaung Hydropower Project Plan of Labour (500 Nos) Accomodation Plan

During construction period, large number of construction workers, including staff of contractor, consultants, engineers, skilled/ non-skilled workers, will be mobilized. The number of construction workers is estimated to be approximate. 500 consisting of 100 staffs of contractors and 400 of laborers, most of which are outside workers. But many of them are laborers employed from local people. Outside workers will be accommodated in Company's base camp, contractors base camp and around the Project area.

Survey results indicate that the existing public facilities such as school, are not even facility, Even exit for the local people. Increase of population due to the intrusion of outside workers might need such facilities as school, clinic, sport ground, restaurant, etc.

The following facilities are to be constructed in the base camps of the Project, including:

(1) Accommodation: 50'x22'-6'' Barrack – 16No and 50'x18'-6'' – 3No Barracks for company staffs including guest house,

(2) Office (40'x24') – 1 No.

(3) Messing – 1 No.

(4) Water Tank (5'x5') -18 Nos

(5) Toilet Double – 40 Nos

(6) Market one unit

(7) Clinic: one unit (medical doctor and nurses with medical facilities)

(8) Sport facilities: soccer field (one unit), volley ball court (one unit),

(9) Other: repair shop, stores, etc.

(10) School: One Primary School.

(11) Day Care Center for infant.

These are exclusive facilities for staff and workers of the Project during the construction period and during operation for maintenance of the project facilities. Owing to this countermeasure, deficit or overuse of existing public facilities in Indein village will be alleviated. Plan of Labour (500 Nos) Accommodation Plan attached.

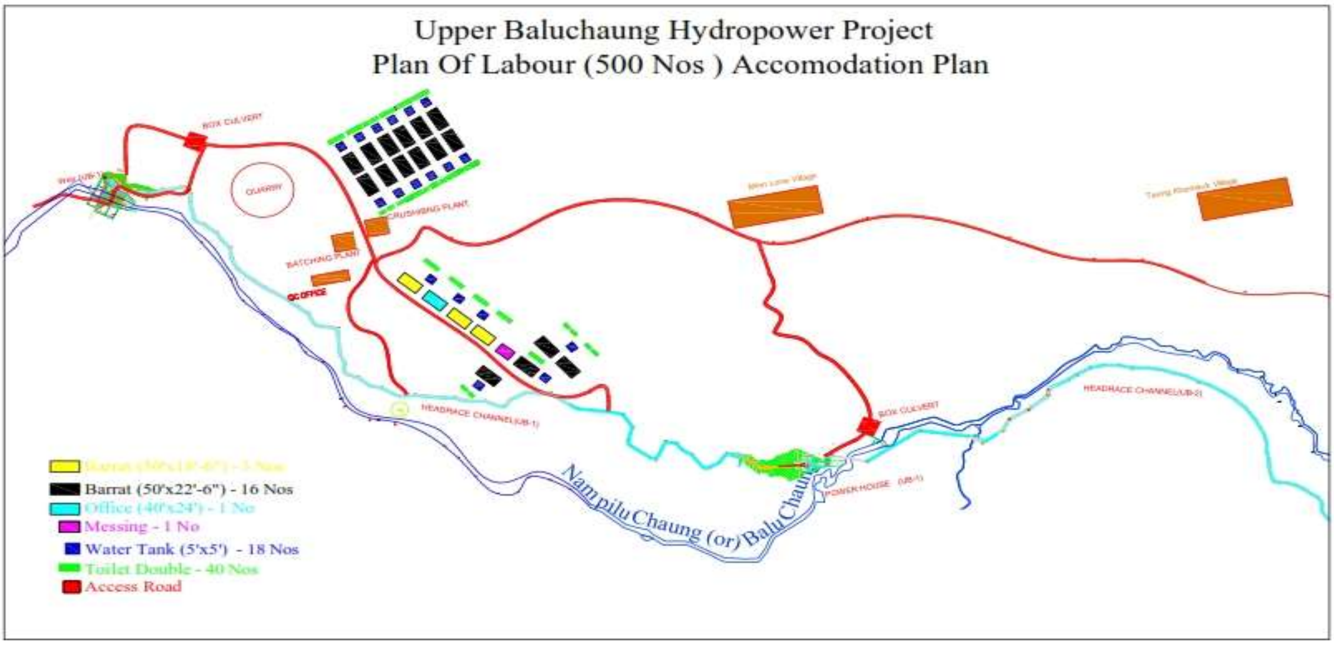


Figure 7.4-3: Plan of Labour (500 Nos) Accommodation Plan

7.4.3 Operation Phase (including Impoundment)

7.4.3.1. Erosion in the Catchment Area and Reservoir Sedimentation

Erosion may occur in the area on which powerhouse, switchyard and turbine will be constructed. In addition, economical life of the project would reduce if lots of sediments (due to erosion) reach the reservoir. Thus, measures are required for control of erosion in the catchment area of the reservoir. In this context, terraces will be built at the locations where breaches exist to prevent erosion in these areas, and afforestation and plantation activities will be executed.

Terraces will be constructed by putting up stonewalls and surface runoff will be prevented in order to prevent breach formation in the areas with slopes of 20 % and higher. This implementation is found appropriate for the areas where stone is abundant. Terraces will be constructed as half circles, and trees will be planted on the center.

Weir Sedimentation Management Plan

The Upper Baluchaung Hydropower Project was planned to implement by two phases UB1 and UB2. In the implementation of UB1 included 128m width and 35m height concrete dam (Weir type). In design calculation, about 150 million cubic feet sediment load will enter to the reservoir area above dam after the operation period of 19 years. Sediment will full till 1140m (Weir Full Tank Level). To regularly operate Hydropower Plants, sediment will remove from reservoir area before reach to the Weir Full Tank Level. Silt pump are used to pump the sediment while pumping the sediment at the reservoir area. The Project Area lies within the West Inle Sparse Forest. Along the Upper Baluchaung river evergreen trees with clusters of bamboo are found. At the higher elevation, due to the limestone formation with shallow vegetation no big trees are found, only shrubs and bushes are existed. In these fallow land, retaining wall are built to keep the sediment from the silt pumping and incorporate with local authorities to use these silt land for agriculture.

7.4.3.2 Water Quality

The small reservoir area of Upper Baluchaung HPP to be formed will cover approximately an area of 0.21 km^2 with a maximum depth of approximately 20 m. Therefore, no significant adverse impacts regarding water quality in the reservoir is of concern.

However, harvesting of the fields in the reservoir area before impounding will reduce the biomass to be left in the reservoir, which will positively affect the water quality. The villagers will be informed about the commencement date of impounding in advance and they will have a chance to harvest their products.

The villagers will also be allowed to cut and collect the trees in the reservoir area, which will allow the clearance of the vegetation cover to some extent. The remaining trees will be cleared in accordance with the Forest law (1992) and the timbers will be collected. On the other hand, if any vegetation is left in the project area it is not estimated that this will create an adverse impact of the water quality since there is not a significant reservoir area for Upper Baluchaung HPP project.

The reservoir water quality is going to be protected from release of pollutants from any source that might adversely impact the water quality. Domestic wastewaters will be discharged to Upper Baluchaung River by application of appropriate treatment techniques. The afforestation activities contribute to increasing the water quality by reducing the erosion in the watershed and hence prevent sediment loss to water.

The main impact on water quality will be in the by-pass reach of about 27 km between the headworks and powerhouse (the reach passed by headrace tunnel).

This will be due to the decrease of water in this reach by the diversion of flow by headworks. Thus, the minimum flow that shall be kept in this reach to preserve the water quality and assimilative capacity of this section as well as the aquatic life was estimated.

7.4.3.3 Waste and Wastewater Management

The wastes generated from hydropower plant operation will be managed according to the relevant Myanmar Legislation that stated in Chapter 2. Solid wastes to be generated during operation will be mainly domestic wastes and some hazardous wastes, mainly machine oils and fuels. To handle these wastes properly during operation relevant provisions of Waste and Hazardous Waste Management plans prepared will be implemented. The domestic wastes will be disposed to the appropriate sites to be specified by the nearest municipality. The other wastes including any hazardous waste will be temporarily stored and contractors will be commissioned for safe handling, treatment and disposal of these wastes.

Wastewaters that will be produced in the operation phase will be treated by the package treatment plant that will be constructed. The treated wastewaters will be discharged to Upper Baluchaung River.

7.4.3.4 Biological Environment

The reclamation and landscaping of the construction sites will provide new habitats for the wildlife species such as reptiles and small mammals and birds.

7.4.3.5 Health and Safety

Relevant health and safety measures will be followed as presented for the construction phase in accordance with the Myanmar Legislation and IFC requirements during operation as well. As examples of these measures personal protective equipment will be provided for workers, when necessary and warning signs (e.g. danger, entrance prohibited, etc.) will be placed at appropriate locations.

7.5 Monitoring Plan

7.5.1 Objectives

Monitoring is an important part of environmental and social management and coordination. In this regard, monitoring activities will provide information on the changes in the environmental conditions by the commencement of the project, the actual level of impacts that are previously estimated, the level of compliance with the mitigation plan and success of the mitigation activities to reduce the adverse impacts to acceptable levels.

By using the information collected through monitoring, environmental and social action plan can be improved when necessary (e.g. adapting mitigation measures to changing situations) throughout project construction and operation to ensure that the anticipated impacts are mitigated. While impact assessment attempts to encompass all relevant potential impacts to identify their significance and include appropriate responses for these impacts, still unanticipated impacts may arise, which can be managed or mitigated before they become a problem using the information obtained through monitoring.

Thus, monitoring will serve the aim of ensuring the implementation of the mitigation plans and optimizing environmental protection through good practice at all stages of the project.

Some of the monitoring requirements for construction and operation phases of the project were already identified during the engineering design studies. During project construction and operation, monitoring will be a part of ensuring compliance with all relevant legislation, contract requirements and effective implementation of mitigation measures.

In this section, the monitoring activities to be performed during construction and/or operation phases are described. The tabular representation of the monitoring plan is given in Table 7-7 at the end of this chapter, which include the responsible parties for the monitoring activities as well.

7.5.2 Environmental Monitoring Coordination

The success of the mitigation plan can be assessed by the quality of implementation. Within this scope, an environmental coordination unit to be established in JSC Caucasus Energy and Infrastructure will monitor the environmental and social issues discussed in mitigation and monitoring sections.

Consultants could also be employed. In this respect, coordination with the relevant agencies will be ensured either by the consultant(s) or the coordination unit.

Compliance with environmental regulations will also be rigorously followed and professional assistance may be obtained for this purpose.

According to the proposed mitigation plan, the adverse impacts defined for Upper Baluchaung HPP Project will be remedied or mitigated. All relevant items in the mitigation scenario become commitments of the developer and the monitoring of those are going to be performed according to the monitoring plan and related Myanmar Legislations.

During construction an environmental site manager will be designated, who will be responsible for the monitoring issues. During operation, an environmental coordinator will be assigned for this purpose. In case the findings of monitoring indicate any deviation from the implementation of the outlined plans aiming at the protection of the environment, or any environmentally unsatisfactory condition should be encountered the environmental site manager will advise corrective actions as necessary. Compliance with national environmental regulations will be strictly adhered to in all phases of the project and for monitoring activities independent consultants can also be employed, when necessary.

Monitoring records will be kept and regularly prepared by the environmental site manager/environmental coordinator. Generally, reports will be prepared biannually or annually to describe the monitoring activities and their results (including any need for improvement and the means of achieving this). These reports will be available to relevant governmental agencies, when required, and to the public as appropriate.

In addition to the above mentioned monitoring requirements, specialists from various ministries, including the Ministry of Environmental Protection and Natural resources may also inspect the project activities, beginning with the construction, till the end of the economic life of the Project. This monitoring will aim to verify whether or not the project activities are conducted in accordance with the requirements of relevant regulations.

Environmental and social action plan is shown in Table 7.3.

Table 7-3: Environmental and Social Action Plan.

No.	Action	Environmental Risks Liability/Benefits	Legislative Requirement/Best Practice	Investment Needs/Resource/ Responsibility	Timetable Action to be Completed by the End of Year	Target and Evaluation Criteria for Successful Implementation	Comments
Pre-construction Period							
1.	Preparation and submission of EIA	Compliance with Applicable Myanmar Law	Environmental Conservation Law, Rules and Environmental Impact Assessment Procedure	Administrative charges/project developer will be responsible	Before start of construction	Environmental Compliance Certificate obtained from Ministry of Natural Resources & Environmental Conservation	
Construction Period							
2.	Implementation of Emissions and Dust Control Plan	Compliance with relevant Myanmar Law and international requirements	National Environmental Quality (emission) Guideline, World Health Organization (WHO) Air Quality Guidelines	Dust sampling or dust measurement performed by the project developer or subcontractor	During construction period	Target: Protection of the social and biological environment from adverse impacts of emissions and dust Passing regular monitoring or inspections of relevant authorities successfully Receiving no complaints Positive results of monitoring reports regarding implementation of Emissions and Dust Control Plan	

3.	Implementation of Noise Control Plan	Compliance with Myanmar Law and International Law (IFC)	Best practice (General EHS Guidelines: Environmental Noise Management of IFC) and National Environmental Quality (emission) Guideline,	Noise level measurements performed by the project developer with necessary devices	During construction period	Target: Protection of the environment and workers' health, receiving no complaints Positive results of monitoring reports regarding implementation of Noise Control Plan	
4.	Implementation of Wastewater Management Plan	Compliance with the applicable Myanmar Law and international requirements	Law of The Conservation of Water Resources and River Law (2006) Best Practice (General EHS Guidelines: Wastewater and Ambient Water Quality of IFC)	Package treatment plant for domestic wastewater produced during construction activities supplied by the project developer Settlement pond for wastewaters from concrete batch plant	During construction period	Target: Maintaining of Upper Baluchaung River Water Quality Positive results of monitoring reports regarding implementation of Wastewater Management Plan	
5.	Implementation of Solid and Hazardous Waste Management Plans	Compliance with the applicable Myanmar Law	Law of The Prevention of Hazard from Chemical and Related Substances (2013), Township Municipal Act	Collection of different types of wastes separately (i.e. hazardous wastes, dyes, domestic wastes etc.) will be supplied by the project developer or subcontractor	During construction period	Target: Protection of the environment from adverse impacts of hazardous and non-hazardous wastes Positive results of monitoring reports regarding implementation of Solid and Hazardous Waste Management Plans	

6.	Implementation of Erosion and Sediment Control Plan	Compliance with the applicable Myanmar Law	International Best Practice	None	During construction period	Target: Protection of soil Positive results of monitoring reports regarding implementation of Erosion and Sediment Control Plan	
7.	Implementation measures to protect landscape	Reduction of Landscape impacts	Best practice	Management time and cost for soil protection	During construction	Target: Reduction of landscape impacts No complaints regarding landscape	
8.	Implementation of health and safety plan	Compliance with the applicable Myanmar Law and international requirements	Labour Laws of Myanmar	Protective equipment and necessary health and safety trainings conducted by the project developer or subcontractor	During construction	Target: Prevention of injuries and providing safe work place Positive results of monitoring reports regarding implementation of Health and Safety Plan	
9.	Monitoring cultural and historical assets	Compliance with the applicable Myanmar Law and international requirements	The Conservation of Cultural Heritage Objects Law (2015)	Proper management system established by the project developer	During construction period	Target: Protection of cultural assets Monitoring chance find during construction activities and informing Ministry of Culture, Monument Protection and Sports of Georgia	Myanmar signed international conventions indicated in Chapter II
10.	Implementation of Monitoring Plan	Compliance with the monitoring plan	Best Practice and National Environmental Quality (Emission) Guidelines, EIA Procedures	None	During construction period	Target: Successful implementation of management plans Monitoring reports	

Social Management							
11.	Finalisation of the Public Consultation and Disclosure Plan	Identification of tasks and responsibilities	Best Practice, IFCs requirements	Management time	By the end of ESIA process	Final EIA report	
12.	Setting up and operating grievance mechanism	Communication of public complaints regarding environmental and social issues of the project	Best practice	Operational cost of information	During construction and operation phases	Report of operating grievance mechanism	
Operation Period							
13.	Management of Biological environment	Ensuring the downstream water quality	The protection of wildlife, wild plant and Conservation of Natural Area Law (1994)	Monitoring release of minimum flow by flow meter	During operation period	Maintenance of downstream aquatic life	
14.	Implementation of health and safety plan	Compliance with the applicable Myanmar law and international requirements	Labour Laws of Myanmar	Protective equipment and necessary health and safety trainings conducted by the project developer or subcontractor	During operation period	Target : Prevention of injuries and providing safe work place Positive results of monitoring reports regarding implementation of Health and Safety Plan	
15.	Implementation of Monitoring Plan	Compliance with the monitoring plan	Best Practice and National Environmental Quality (Emission) Guidelines, EIA Procedures	None	During operation period	Target: Successful implementation of management plans Monitoring reports	

7.5.3 The Environmental Management Unit

Environmental Management Unit shall be formed under Ministry of Electric Power (MOEP) and an EMU will be responsible for the implementation and management of the Environmental Management Plan (EMP). Neo Energy Oasis Development Company Ltd. will form Health, Safety and Environment (HSE) team under Admin department and will be responsible for implementation of environmental management plan and monitoring plan. Regular environmental, health and safety rounds in the construction area will also be part of the responsibility of the EMU.

7.6 Management of Impacts: Environmental Management Plan

The following sub-sections address project construction and operational activities identifying specific mitigation and monitoring measures associated with environmental and social aspects where relevant and as required.

In order to alleviate/enhance the potential impacts of the Upper Baluchaung Hydropower Project, environmental action plan should be established. The environmental action plan consists of environmental management and monitoring activities with basically cover all the potential impacts described in Chapter 6.

Potential Impacts of Project are listed in the table below:

According to the potential impacts listed above environmental management (mitigation measures) and environmental monitoring activities are examined, and summarized in Table 7-4, 7-5 and table 7-6 respectively.

Table 7-4: Environmental Management for the impacts due to Project Facilities

No.	Potential Impact	Mitigation Measure	Necessary Action	Source of Cost
1.	Drying of river section between Intake Weir No.1 and Power Station No.2	River maintenance flow of $0.5m^3/sec$ to be permanently released from intake wire No.2	Incorporation of river out lets of $0.5m^3/sec$ at intake wire No.1 and No.2	Included in the project cost
2.	Demolition of distribution pipes of domestic water supply to Minlone village due to road improvement works.	- Repair of distribution pipe. (temporary) - Installation of permanent water supply system	- (Already completed) - Detail design of water supply system to Minlone village from No.1 Pondage. - Construction of the permanent water supply system	Included in the project cost. Include in the project cost

Table 7-5: Environmental Management for the impact during construction period

No.	**Potential Impact**	**Mitigation / enhancement measures**	**Necessary action**	**Source of cost**
Impact on mobilization of manpower during construction				
1.	Impact on population increase on public and economic facilities	Construction of public facilities within Base Camp of the Project to avoid deficit / overuse of existing facilities of local people.	- Detail design of necessary public facilities such as school, clinic park to be constructed in the Base Camp.	To be included in the project cost
			- Construction of these public facilities based on the detailed design.	
2.	Impact of outside workers on conflict and security	Education of construction workers on security and necessary to keep harmony with local people	Incorporation of the mitigation measures in the technical specification of the construction work.	
3.	Impact of outside workers on public health	- Education on public health to construction workers - Regular health to construction workers.	- Ditto -	
Impacts of transportation of heavy equipments and construction materials				
4.	- Increase of traffic volume	-Improvement of road widening -Placing of traffic control staff at critical locations -Education of vehicle drivers about the traffic safely manner.	Detailed Design of road improvement and new road construction (under construction) Frequent Briefing to the drivers by authority.	To be included in the Project Cost.
5.	Increase of duct	-Watering on road and vehicles -Assurance of shell covering on load of truck s	Incorporation of the mitigation measures in the technical specification of construction work	
6.	Noise and vibration	-Assurance of polite driving manner -Good maintenance of vehicles	- Do -	
Impacts of construction Works such as civil works / blasting				

7.	Air pollution (emission of gas and dust generation)	- Watering on construction sites especially near settlement area - Assurance of sheet covering on load of trucks - Good maintenance of heavy machine	Incorporation of mitigation measures in the technical specifications of the construction work.	To be included in the Project Cost
8.	Increase of soil erosion and earth-related disaster	Implementation of prevention works such as: - Retaining wall, - Retaining pond, - Vegetation covering, - Rainwater drainage system, - Terracing or bench system at soil bank,	- Incorporation of the mitigation measures in the technical specifications of the construction work, - Monitoring of soil erosion as described in Environmental Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measures should be made to minimized the impact	To be included in construction cost
9.	Water pollution (turbidity and high alkali water)	1) Implementation of prevention works such as: - Sediment/ retaining pond, - Waste water treatment system, - Rainwater drainage system, - Vegetation covering, etc.	- Incorporation of the mitigation measures in the technical specifications of the construction work, - Monitoring of water pollution in Upper Baluchaung River as described in Environmental Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measures should be made to minimized the impact.	To be included in construction cost

10.	Noise and vibration	- Good maintenance, polite and gently operation of heavy machine, - Education of operators of heavy machine for necessity of polite operation and maintenance	-Incorporation of the mitigation measures in the technical specifications of the Construction work. -Monitoring of noise and vibration as described in	To be included in construction cost
11.	Increase of waste generation	- Adjustment of amount and frequency of explosive for blasting. - Adjustment of location of crushing and batching plants so as to locate farther from settlement area, - Socialization on possibility of noise and vibration pollution prior to the construction works, - Establishment of waste treatment system. - Education of all the construction workers to follow the treatment system	- Environmental Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measure should be made to minimized the impact. - Incorporation of the mitigation measures in the technical specifications of the construction work,	To be included in construction cost
12.	Soil contamination due to excavated materials	- Establishment of waste treatment system for oily waste, - Monitoring of soil contamination due to effluent water, and dumping of excavated materials in spoil bank	- Incorporation of the mitigation measures in the technical specifications of the construction work, - Monitoring of water quality as described in Environment Monitoring Plan. As a result of monitoring, if critical negative impact occurred, remedial measures should be made to minimized the impact.	To be included in construction cost

Table 7-6: Environmental Management plan including mitigation and monitoring plan during operation period and some part of construction phase

Objective	Activity	Mitigation/Enhancement	Monitoring	Responsibility
Social				
Opportunities associated with Local employment benefits	Employment generation Procurement	• Disclosure of Recruitment Policy; • Localized disclosure of need for staff and labours in construction work	Disclosed Recruitment and Procurement Policies in Site Office and Administrative offices; • Village supporting committee meeting minutes; and • To be disclosed in employment offices and policy to be referred to in job adverts.	Neo Energy Oasis and EMU
Project commitment on workers' rights	Employment conditions	• Develop and implement a Human Resources Policy; • Issue each member of staff with an individual contract, of employment; • Insert clauses in contractors' agreements to ensure compliance with all policies, plans, procedures and identified mitigation measures. Also, include clauses to monitor and enforce safety plans and report accidents and incidents; and • Provide all workers with a summary of their service and training activities.	Payment of wages and bonuses on time; • Hours worked during period and hours lost; and • Fully described job descriptions for all roles.	Neo Energy Oasis and EMU
Protecting the workforce	Labour management	• Provide appropriate PPE (as identified through risk assessment); • Emergency Response Teams; • Emergency Preparedness and Response Plan (EPRP)	Neo Energy to review Contractors Hazard and Operability (HAZOPS) and EHS Plan to ensure continuity with company EHS requirements (including commitment to this ESMP).	Neo Energy Oasis and all contractors

		to be developed covering health and safety risks to workers in emergencies; • Incident and accident logs to be maintained; and • Review of primary supply chain for occupational health and safety (OHS) issues.		
Maintain the well-being of workers living in camps	Labour management	• Workers' Accommodation Plan.	• Worker camp audit reports, corrective measures and action plan, photographs demonstrating corrective measures implemented.	Neo Energy Oasis and all contractors
Inform workers of HIV/AIDS and sexually transmitted disease (STD) risks and protection to minimize risk of infection to workers and communities	Labour management	• HIV/AIDS and STDs awareness and prevention briefings	• Members of staff to receive brochure which raises HIV/AIDS awareness; • Staff to sign acknowledging receipt and understanding of brochure	Neo Energy Oasis and all contractors
Community Grievance Plan	Safeguarding community health, safety and security	• Project performance grievance mechanism; • Record water use baseline prior to construction activity of dam and; • Provide temporary and permanent community water solutions if downstream water user are affected; • Community health and safety campaign	• Maintenance of complaints log and resolution process; and	Neo Energy Oasis
Restrict access to sites, especially hazardous areas	Safeguarding community health, safety and security	Site security measures including: • Appropriate fencing; and • Signage around site perimeter and where	Provision / review of the following documentation: • Description / photographs of fencing / signage around site perimeter;	Neo Energy Oasis

		identified through risk assessment process	• company licenses and individual training records of security personnel proposed as per contract requirements; and • Site registry identification system.	
Cultural sharing and tolerance	Induced development, population changes and the potential for cultural tension	• Modifications to procurement practices; and • Training of all local and outside workers in cultural sensitivities.	• Staff to sign training sheet confirming attendance.	Neo Energy Oasis
Improved road condition and transport	Infrastructure work (roads and bridges).	• Road maintenance to leave a useful asset for communities after the construction phase.	• Monitoring of road conditions	Neo Energy Oasis
Redundancy of personnel	Project closure	• Develop Retrenchment Plan	• Implement Retrenchment Plan.	Neo Energy Oasis
Ecology and Biodiversity				
Management of Biodiversity issues Habitat conservation And management	Project footprint	• Production of a draft Biodiversity Action Plan (BAP); • Stakeholder consultation, suggest a series of one to one meetings and local communities' stakeholder workshops.	• BAP completed and circulated to all stakeholders and contractors; and • Approve the Neo's BAP by the Ministry of Environment (MOECAF).	Neo Energy Oasis, EMU and MOECAF
Minimise habitat loss and disturbance (terrestrial ecology)	Construction lay down, layout of associated infrastructure and temporary working areas	• Avoidance measures by design layout of associated infrastructure and location of laydown to take into consideration local environmental / ecological conditions; • Minimise size of temporary working area; • Develop Ecological Management Plan; and	• Monthly audit of construction areas; • MOECAF approval of the Ecological Management Plan developed by Neo Energy.	Neo Energy Oasis, EMU and MOECAF

Minimise hunting and poaching	Increased access to area; Construction workers	• Code of Conduct for construction workers banning hunting; and • Signage highlighting hunting ban in all Project areas.	• Hunting prevention measures to be included within Contractor's scope through acceptance of Neo EHS requirements.	Neo Energy Oasis
Minimise habitat loss and disturbance (aquatic ecology	In river construction works	• Minimum working areas; • Pollution prevention measures; • Sediment control • Fishing ban on construction workforce; and • No construction works during peak migration/spawning periods on the Baluchaung River.	• Daily monitoring and monthly audit of site preparation / Construction activities.	Neo Energy Oasis
Habitat conservation and management	Reinstatement of habitats	• Production of Habitat Management Plan; and • Land purchase or land agreement and planting for habitat creation.	• Annual review of success of created habitat areas; and • % of habitats reinstated to good condition within 12 months of the completion of works.	Neo Energy Oasis
Water Resources and Water Quality				
Protection of surface water quality for the environment	In dam construction works	• Good practice construction measures	• No contamination of any surface waters; • Regular visual water monitoring; and • Regular review of contractor activities and implementation of Construction EMP by Neo's Project Manager.	Neo Energy Oasis and EMU
Maintain sufficient water flow for boat users	Changed / lowered flow regime due to operation of dams	• Operate in with minimum flow requirements.	• Regular flow monitoring in line with that set out in the ESIA.	Neo Energy Oasis and EMU
Water irrigation and agricultural use	Changed / lowered flow regime due to operation of dams	• Operate in with minimum flow requirements. • Implement catchment management scheme to ensure long-term water supply to users.	• Regular flow monitoring in line with that set out in the ESIA.	Neo Energy Oasis and EMU

Maintain water supply to local villages	Impact on river sections between intake weirs and power stations due to diversion of water for power generation.	• Provide alternative supply to affected users'	• Annual monitoring of water flow	Neo Energy Oasis and EMU
Geology, Landslides and Seismic Risks				
Prevent soil erosion and transportation	Site preparation, excavation, construction of dams, water ways and access roads	• Good engineering practice shall be undertaken to mitigate or manage soil erosion.	• To be defined under Contractors Construction EMP requirements.	Neo Energy Oasis and EMU
Stability of slopes to prevent landslides	Road and Dam and water ways construction	• Where slope instabilities are of concern, then good engineering practice shall be undertaken to mitigate or manage slope movements so as to reduce the impact on the Project and local community.	• To be defined under Contractors Construction EMP requirements. • Plans and method statements to be reviewed and approved by EMU	Neo Energy Oasis and EMU
Minimize destabilization of slopes	Water ways	• The cuttings must be adequately supported / inclined according to good engineering practice; • Reduce where possible the amount of tree felling; and • Reinstate tree cover on cleared ground along side roads as soon as possible after water ways construction completed.	• To be defined under Contractors Construction EMP requirements. • Plans and method statements to be reviewed and approved by EMU	Neo Energy Oasis and EMU
Prevent soil erosion and landslide	Erosion of Water ways	• Maintain integrity of road surface through regular maintenance.	• Regular visual observation.	Neo Energy Oasis and EMU

Materials and Waste Management				
Minimization and safe disposal of waste	Spoil generated as a result of rock blasting	• Where possible, spoil material will be used as a construction material and for concrete batching; and • Other spoil will be disposed of in spoil disposal sites which have been identified at a number of locations within the Project area.	• Maintain records of amount of material disposed of to each spoil disposal site; and • Monitor spoil disposal sites for erosion	Neo Energy Oasis and EMU
Minimize pollution	Materials handling and storage	• Appropriately covered and bounded storage located away from sensitive receptors; • Appropriate spill kits nearby (as necessary for hazardous liquids); • Secure and protected from risk of theft or vandalism; • Easily accessible in a safe manner; and • Located next to any required PPE (as necessary for irritants and hazardous materials)	• Audit of Contractor's materials storage facilities by EMU; and • Number of pollution incidents.	Neo Energy Oasis and EMU
Noise and Vibration				
Avoid noise Nuisance generated by on-site plant and construction activities	Site preparation excavation and foundations, construction and blasting	• Restricted general hours of working to avoid sensitive periods; • Positioning of temporary site compounds as far as reasonably practicable from sensitive receptors; • Undertaking construction activities in accordance with good practice; • Maintaining equipment in good working order and fitting with appropriate noise control at all times; • Consider acoustic enclosures for compressors/generators if	• Requirement for contractors to implement mitigation as part of the contracts; • EMU to monitor noise levels using sound level meter at the nearest residential properties to construction activities for comparison against standards; and • Record noise complaints and investigate using sound level meter via the community grievance mechanism.	Neo Energy Oasis and EMU

		located near sensitive receptors; • Ensure deliveries arrive and depart so as not to disturb residents at inconvenient times; • Setting noise limits; • A regime of noise monitoring where appropriate; and • Providing the public with advance notice of planned noise-generating activities.		
Avoid noise nuisance generated by construction traffic	Site traffic movements to and from site including abnormal loads	• Maintaining equipment in good working order and fitting with appropriate noise control at all times; • Setting noise limits; and • A regime of noise monitoring where appropriate.	• Requirement for contractors to implement mitigation as part of the contracts; • EMU to monitor noise levels using sound level meter at the nearest residential properties to construction activities for comparison against standards; and • Record noise complaints and investigate using sound level meter via the community grievance mechanism.	Neo Energy Oasis and EMU
Air Quality				
Minimize dust emissions	Land clearing, quarrying, road construction, spoil deposition and general construction activities.	• Minimizing dust from material handling and storage sources by using covers and/or control equipment (water suppression); and • Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements.	• Environmental Manager to undertake daily visual checks; and • Number of dust complaints.	Neo Energy Oasis and EMU
Minimize dust emissions	Traffic and vehicle movements on site roads	• Restrict traffic to tarmac roads as far as possible. Speed limit for all off road traffic to be <20 km/hr. to minimize dust; and	• Environmental Manager to undertake bi-weekly visual checks of construction vehicles. (violation to be reported only);	Neo Energy Oasis and EMU

		• All vehicles should be tarped to prevent dust generation from the loads.	• Contractor to maintain servicing records for all vehicles; and • EMU to review Contractors servicing records at beginning of contract and thereafter on six monthly basis for those longer term contracts lasting more than six months	
Minimize construction machinery / vehicle emissions	Construction traffic and machinery	• Manage emissions from mobile sources as per IFC EHS guidelines for Air Emissions and Ambient Air Quality; and • Locate generators away from receptors (workers' camps and residents).	• Environmental Manager to undertake bi-weekly visual checks of construction vehicles. • Contractor to maintain servicing records for all machinery. And • EMU to review Contractors servicing records at beginning of contract and thereafter on six monthly basis for those longer term contracts lasting more than six months.	Neo Energy Oasis and EMU
Greenhouse Gases and Climate Change				
Reduce Greenhouse Gas (GHG) emissions	-Material Sourcing -Use of vehicles, construction plant and generators with emissions.	• Sourcing materials from local supplier's wherever possible to avoid potentially long distance travel for materials; and • Use of materials recovered at site (rock and aggregates) in preference to remote suppliers. • Using well maintained diesel generators and other plant to ensure the maximum efficiency and lowest fuel/energy consumption	• Inventory of materials to include source; and • Procurement Policy to include requirement for sourcing most geographically local materials whenever possible. • Record evidence of new plant being employed; • Monitor and record of plant maintenance; and • Monitor and record fuel consumption.	Neo Energy Oasis and EMU
Climate change mitigation	Forestry regeneration	• Plant new forestry to replace forestry removed for construction or lost through inundation to act as carbon sink reducing the carbon cost of construction.	• Number of trees planted.	Neo Energy Oasis and EMU

Landscape and Visual Amenity				
Reduce visual intrusion of construction activities and areas	Site clearance, Road construction and quarrying	• Construction sites to be kept tidy; • Clearing of vegetation around construction sites to be minimized; and • Landscape planting strategy to identify appropriate re-vegetation	• EMU to review Contractors CEMP; and • Environmental Manager to undertake bi-weekly visual checks of construction areas.	Neo Energy Oasis and EMU
Reduced visual footprint	Dams, powerhouses, roads etc.	• Landscape planting strategy with appropriate re-vegetation.	• Annual survey of re-forestation and re-vegetation.	Neo Energy Oasis and EMU
Flora and fauna rehabilitated areas		Enforcement of rules of the reserve and forest exploitation must be done. Monitoring (by guards) for illegal activities in forest around project areas and the imposing of sanctions as fines will be continued.	Project Area	Neo Energy Oasis and EMU

7.6.1 Impacts and Mitigation/Management Measures for Decommissioning Phase

Table is a summary of the potential environmental and social impacts presented as an Impact Matrix with the proposed mitigation measures to be managed with this EMP during the project decommissioning periods.

Table:7.6.1-1 Summary of the potential environmental and social impacts presented as an Impact Matrix with the proposed mitigation measures to be managed with this EMP

Potential Impacts	Impacts Area	Impact Duration	Impact Significance	Mitigation /Management Measures	Potential Residual Impact
Land					
Flood plain/swamp	Upper Baluchaung	After decommissioning	Potential minor positive impact	None required	No Significant Impact
Seismic	Project areas	During and after decommissioning	Potential minor negative impact	Minimize the potential effects of seismic events in the design of the decommissioning	No Significant Impact
Surface Water					
Flow Variation	Upper Baluchaung	After decommissioning	No change anticipated	None required	No Significant Impact
Noise					

Increasing traffic level	Project areas and nearby villagers	During decommissioning	Potential minor Negative impact	Adopting International standards on occupational Health and safety as well as noise minimization program	No Significant Impact
Blasting and removing dam and concrete infrastructure	Project areas	During decommissioning	Potential minor Negative impact	Blasting may affect aquatic animals. Other methods to be used.	No Significant Impact
Air quality					
Dust and air pollutants due to truck movement, removing dam and concrete infrastructure	Project areas and nearby villagers	During decommissioning	Potential minor Negative impact	Develop site management program for dust suppression prior to decommissioning.	No Significant Impact
Increasing transport network	Project areas and nearby villagers	During decommissioning	Potential minor Negative impact	Appropriate road engineering; good compacting and runoff design, reduce speed limits, developing watering schedule for all unpaved roads.	No Significant Impact
Biological/Ecological					
Fish migration	Upper Baluchaung	During decommissioning	Potential minor positive impact	Restore fish ability to move freely through the channel. Short-term negative impacts possible during dam removal until natural conditions are restored	Positive Impact
Terrestrial vegetation and wildlife	Project areas	After the project decommissioning	Potential minor positive impact	Restore original plant communities. Short-term negative impacts possible during dam removal until natural conditions are restored	Positive Impact
Endangered species	Project areas	After the project decommissioning	No Impact Anticipated	None required	No Significant Impact
Aquatic habitat	Upper Baluchaung	After the project decommissioning	Potential Minor Positive Impact	Restore aquatic habitat.	Positive Impact.
Human					
Employment	Project areas and nearby villages	During decommissioning	Potential Minor Positive Impact	Creating work and job opportunity	Positive Impact

		During decommissioning	Potential Minor Positive Impact	Apply the Social Management Plan during construction and operation	No Significant Impact, with long-term results of the Social Management Plan
Landscape	Project areas and nearby villages	After the project decommissioning	Potential Minor Positive Impact	Restore/rehabilitate visual landscape	Positive Impact
Tourism	Project areas and nearby villages	During and after the project decommissioning	No Impact Anticipated	None required	No Significant Impact

Table 7-7: Monitoring Plan

No.	Phase	What parameter is to be monitored?	Where is the parameter to be monitored?	How is the parameter to be monitored/ type of monitoring equipment?	When is the parameter to be monitored frequency of measurement or continuous?	Why is the parameter to be monitored?	Source of Budget	Start Date	Finished Date	Institutional Responsibility
1.	Construction	On-Site Erosion and Runoff	Construction sites	Visual observation	Continuous controls and monthly reporting	To reduce the risk of siltation of water courses comply with Erosion and Sediment Control Plan	Project Budget	Start of construction works	Completion Of construction works	HSE Department/EMU
2.		Proper storage and utilization of topsoil and excavation materials	Construction sites and storage areas	Visual observation	Weekly	To control the effectiveness of the relevant mitigation measures and ensure landscaping and formation of natural habitats	Project Budget	Start of excavation works and soil stripping	Completion Of construction works	HSE Department/EMU
3.		Air Quality (PM)	Construction sites, access	Sampling and analysis using	Every 6 months Upon complaint	To ensure compliance	Project Budget	Start of construction	Completion of construction	HSE Department/EMU

			roads, concrete batch plant, storage areas, close settlements	portable dust analyzer		with international requirements regarding air quality and occupational health and safety		works	works	
4.		Air Quality	Trucks and machinery exhausts	Inspection with exhaust measurement devices	Every 6 months	To ensure compliance with emissions and dust control plan	Project Budget	Start of construction works	Completion of construction works	HSE Department/EMU
5.		Noise	Near settlements	Measuring noise levels via portable sound level meters	Every 6 months and upon complaints by residents of nearby settlements	To ensure compliance with international requirements and noise control plan	Project Budget	Start of construction works	Completion of construction works	HSE Department/EMU
6.		Wastewater (Monitored Parameters are described in Table 7.2 and 7.3)	Effluent from construction site and concrete batch plant	Laboratory analyses of domestic wastewater and wastewater from concrete batch plant	Once in 3 months	To comply with the wastewater management plan	Project Budget	Start of construction works	Completion of construction works	HSE Department/EMU
7.		Health and Safety	All of work places	Observation and inspection	Daily, monthly	To ensure compliance with Health and Safety Plan	Project Budget	Start of construction works	Completion Of construction works	HSE Department/EMU

8.		Water Quality - Water temperature, pH, BOD, COD, DO, Total Coliform, Fecal Coliform, Oil and grease, Total Phosphorous (T-P), NO3-N, NH3-N.	In case of an accident, as a result of spilling waste oil, paint etc. to surface water and groundwater,	Laboratory analyses	When an accident such as spill and leakage is reported	To determine a potential contaminant and to comply with National Environmental Quality (Emission) Guidelines (2015)	Project Budget	Start of construction works	Completion of construction works	HSE Department/EMU
9.		Vegetative cover of project area (Cleaning of field)	Impoundment area	Observation	Before start of impoundment	To minimize amount of biomass concentration that affects water quality of impoundment area	No additional cost	Before the Impoundment period	Before the Impoundment period	HSE Department/EMU
10.		Chance finds of Cultural and Historical Assets	Project area	Visual inspection	During construction activities	To comply with IFC Guideline	No additional cost	Start of construction works	Completion of construction works	HSE Department/EMU
11.		Solid and Hazardous	Construction site	Visual investigation	Daily/Once in two days	To comply with Law of Georgia	Project Budget	Start of construction	Completion of construction	HSE Department/EMU

		Wastes (paint, waste oil)				On Compensation for Harm Caused by Hazardous Substances and Law of Myanmar on Hazardous Chemical Substances		works	works	
12.	Operation	Reservoir Sedimentation	Afforestation and plantation sites	Observation	Every 6 months	To reduce the risk of sediment accumulation in the reservoir and control erosion prevention measures	Project Budget	Start of operation	End of operation	HSE Department/EMU
13.		Depth of the sediment in the reservoir	Reservoir	Measurement	Annually	To determine the sediment load in the reservoir	Project Budget	Start of operation	End of operation	HSE Department/EMU
14.		Hydrology (minimum flow)	Downstream (bypass reach) of the reservoir	Measurement of, flow rate	Daily	To control flows, to sustain the minimum flow of 0.5 m^3/s in the by-pass reach	Project Budget	Start of operation	End of operation	HSE Department/EMU
15.		Water Quality (pH, conductivity,	Downstream of the reservoir (bypass reach)	Sampling and analyses of reservoir water	Monthly	To monitor changes in downstream	Project Budget	Start of operation	End of operation	HSE Department/EMU

		suspended solids, Ca, Mg, total phosphorus, PO_4-P, total nitrogen, NO_3, NH_4, coliform bacteria, oil and grease)								
16.		Health and Safety	All work places	Observation, inspection and reporting	Monthly	To ensure compliance with the Health and Safety Plan	Project Budget	Start of operation	End of operation	HSE Department/EMU
17.		Solid and Hazardous Waste	Powerhouse	Observation	Weekly	To ensure compliance with Law, of The Prevention of Hazard from Chemical and Related Substances Law (2013)	Project Budget	Start of operation	End of operation	HSE Department/EMU
18.		Noise	Powerhouse	Portable sound level meters for measuring noise levels	Once a month	To ensure compliance with Occupational Health and Safety requirements of IFC, National	Project Budget	Start of operation	End of operation	HSE Department/EMU

						Environmental Quality (Emission) Guideline				
19.		Flora and Fauna	Reservoir Area and project area	Observation	Every six month	To ensure compliance with Forest Law (1992) and the protection of wildlife, wild plant and Conservation of Natural Area Law (1994)				

7.7 Budget

The budget for the recommended mitigation measures and monitoring is shown in Table 7-8, in rounded figures. Costs for ordinary mitigation measures directly linked to the construction activity, such as erosion control measures at construction sites and access roads, are not included in the budget. These costs will be included in the construction costs.

Table 7-8 Budget for recommended environmental mitigation and monitoring

Item		Costs USD
A. Construction Periods		
Environmental Protection Measures		
a. Environmental Protection and Capacity Building		
i. Capacity Building for Protection and Guards		20,500
ii. Capacity Building for Institutions		6,000
iii. Environmental Awareness		4,500
b. Mitigation Cost (one time only)		85,835
Monitoring		
a. Monitoring during Project Construction		
i. Water Quality		5,500
ii. Air and Noise		18,000
Operating Cost of EMU		46,000
	Total (A)	**235,835**
B. Operation Period (Annual Cost)		
a. Water Quality		4,500
b. Air Quality		12,600
c. Fish Yield and Species		1,200
f. Community Based Watershed Protection		25,000
e. Forest Guards		6,000
	Total (B)	**49,300**

7.8 Corporate Social Responsibility

Though the project aimed for electrification of the region, the developer has to share its profit to nearby local people for development of the community and conservation of environment. Following are the potential plan to formulate as of corporate social responsibility and estimated cost.

According to the suggestions of the local people and stakeholders, the following activities are raised.

1. Improve school facilities, i.e. to upgrade Primary School to Middle School
2. Build clinics, and
3. Supply electricity.

Table 7-9: Proposed Corporate Social Responsibility Programme for Upper Baluchaung Hydropower Project

No.	Theme	Capital Cost (USD)	Annual Budget (USD)
1.	Upgrading Local Health (3 Clinics in villages in surrounding area)	70,590.0	105,000.0
2.	Upgrading Education (maintenance of the schools)	35,400.0	7,050.0
3.	Knowledge Development (3 libraries; books in Myanmar, Local Language)	88,235.0	46,500.0
4.	Subsiding for Power Development (Electricity) for villages and Inle Region	800,000.0	10,000.0
5.	Other CSR activities (athletics, education prizes, charities etc.)	0	235,200.0
6.	Improvement of existing car road	15,600	
	Total Cost in **USD**	994,225.0	403,750

Previous Investment for CSR and Development Program

1. Compensation for Loss of Land - 25,510,000 MMK

2. CSR program for surrounding villages - 735,139,100 MMK

3. Donation of tube well (6” x 400’) at inn Tein Gone Village Basic Primary School - 3,885,530 MMK

4. Road Renovation for 5 villages - 6,240,000 MMK

Total - 825,203,428 MMK (***687,670*** USD)

Detailed of CSR, Compensation and Supporting Fund to the local Communities are shown in Appendix 6.

Chapter VIII Stakeholder Engagement Plan (SEP)

Purpose of this Document

The SEP describes the Project strategy and procedures for interactions with stakeholders at local, regional and national level, with particular focus on Project Affected Parties (PAPs). The SEP also outlines a grievance mechanism to allow stakeholders to bring concerns to the Project attention. The SEP is designed to promote the Project objectives in the field of stakeholder engagement: by providing good public information, communicating well with all stakeholders, and developing positive relationships with local and regional communities, markets and clients, the Project enhances its reputation, brand, and ultimately, value but it also reduces the risks deriving from social instability improperly managed and impacting Project activities. By adopting this document, the project company shows its will to engage in fostering good stakeholder relations and communication with local and national groups.

The SEP is a 'living document' which, once endorsed, will be updated periodically by Neo Energy Oasis to summarize results achieved i.e. to record consultations undertaken, issues raised, actions taken; to describe lessons learned and any changes to the consultation process; and to update the stakeholder group list and outline the schedule for on-going and future interactions.

This document applies to all the phases and components of the Upper Baluchaung Hydropower Project, as showed in the following sections.

Legal and Institutional Framework

This section summarizes the regulatory national and international requirements pertaining to stakeholder engagement applicable to the Project.

Myanmar Legislation

The National Environment Policy of Myanmar 1994 is the basis of Myanmar's environmental statutory framework. This is supported by the 2008 Constitution that empowers Government to conserve Myanmar's natural environment and enables Parliament to enact environmental laws. Accordingly, the Ministry of Natural Resources and Environmental Conservation (MONREC) has recently enacted the 2012 Environmental Conservation Law and is charged with assessing compliance (see following Figure).

The 2012 Environmental Conservation (EC) Law is based on the "polluter pays principle", with compensation for environmental impacts to be paid to a fund to be set up by the MONREC. In addition to the framework Environmental Conservation Law, there are several laws with some form of obligations on operators in respect of pollution, disposal, and other harmful impacts on the environment and local society.

Figure 8-1: Myanmar National Environmental Conservation Organization Chart

The objectives of 2012 EC Law are mentioned in Section 3 of the Law and include:

- to enable to emerge a healthy and clean environment and to enable to conserve natural and cultural heritage for the benefit of present and future generations;
- to reclaim ecosystems as may be possible which are starting to degenerate and disappear; and
- to enable to manage and implement for decrease and loss of natural resources and for enabling the sustainable use beneficially.

Environmental Impact Assessment

The EIA procedure, issued on 29 December 2015, defines the requirements for the EIA and states that: "An EIA investigation shall consider all biological, physical, social, economic, health, cultural and visual-components of the environment, together with all pertinent legal matters relating to the environment (including land use, resources use, and ownership of and rights to land and other resources) that may be affected by the Project during all project phases including pre-construction, construction, operation, decommissioning, closure, and post-closure; and shall identify and assess all Adverse impacts and risks that potentially could arise from the project.

Three different steps are foreseen for the EIA process which is described in the following sections: (i) screening phase; (ii) scoping phase; and (iii) EIA Investigation and Report Preparation.

Screening Phase

The EIA process starts with the screening: the MONREC is empowered and has the exclusive authority to define the screening criteria for a project.

Guidance is provided as to which projects or activities should carry out an Initial Environmental Examination (IEE) or EIA, as presented in the Annex to the law. If, as a result of that determination, an IEE or an EIA is required, then the proponent of the project or activity has to prepare, obtain approval for, and implement an appropriate Environmental Management Plan (EMP) in respect of the proposed project or activity. Any appeal from such determination must be made in accordance with the EIA Procedure.

The Project Proponent might be required to submit a project proposal (completed in accordance with MOECAF's guidelines) to the EC department of MONREC for screening.

Within 15 days from receiving the complete project proposal, the MONREC shall determine the required type of environmental assessment (EIA, IEE, or none) and shall inform the Project Proponent in writing about its determination. In addition, the MONREC can change the status of an IEE Type Project to be an EIA Type Project if any of the above additional factors are relevant in this sense.

Scoping Phase

All EIA type projects are required to undergo the Scoping phase. The project proponent shall be responsible to ensure that the Scoping and the preparation of the Term of Reference (ToR) for the EIA report are undertaken in a professional manner and in accordance with any applicable guidelines issued or adopted by the MONREC. The scoping shall, in respect to the proposed project:

- define the study area, AoI, time boundaries, project phases, and potential stakeholders;
- start the process of understanding the applicable regulations and standards, and their context for project design and completion of the EIA;
- make a provisional identification of environmental, social and, if any, health impacts, focusing in particular on the environmental, social and health issues that need to be addressed in subsequent EIA studies;
- provide an indication of the required baseline data and information and methods to get them (although there is no need to actually collect any data at this stage);
- provide an opportunity for consultants, relevant authorities, project developers, interested and affected parties to express their views and concerns regarding the proposal before an EIA proceeds;
- enable an efficient and comprehensive assessment process that saves time, resources, costs and delays; and

- identify potentially affected communities and other stakeholders with an interest in the project.

As part of the scoping, the project proponent shall ensure that the following public consultation and participation process is carried out:

- disclose information about the proposed project to the public and civil society through local media, including by means of the prominent posting of legible sign boards and advertising boards at the Project Site which are visible to the public; and
- arrange the required complement of consultation meetings as advised by the MOECAF, with local communities, potentially PAPs, local authorities, community based organizations, and civil society.

The project proponent shall prepare a scoping report and ToR for the EIA investigations and submit the completed Scoping Report and ToR to the MONREC for review and approval.

EIA Investigation and Report Preparation

The Project Proponent has to ensure that the EIA investigation properly addresses all adverse impacts and is undertaken in accordance with the approved TOR. The EIA investigation shall consider all biological, physical, social, economic, health, cultural and visual components of the environment, together with all pertinent legal matters relating to the environment (including land use, resources use, and ownership of and rights to land and other resources) that may be affected by the Project during all project phases, including pre-construction, construction, operation, decommissioning, closure, and post-closure; and shall identify and assess all adverse impacts and risks for environment, social and, if relevant, health that potentially could arise from the Project.

The EIA Procedure does not address the social impacts of involuntary resettlement or which relate to indigenous people. Separate procedures shall be issued by responsible ministries, and in the absence of such procedures all such Projects shall adhere to international practice on involuntary resettlement and indigenous people.

The Project Proponent is obliged to use, comply with and refer to applicable national standards, international standards adopted by the Government and/or the MONREC, or, in the absence of relevant national or adopted international standards, such standards as may be agreed with the MONREC.

The EIA Report shall consider the views, concerns, and perceptions of stakeholders, communities and individuals that could be affected by the Project or who otherwise have an interest in the Project. The EIA should include the results of public consultations and negotiations with the affected populations on the environmental and social issues. Public concerns should also be taken into account in assessing impacts, designing mitigation measures, and selecting monitoring parameters. After completing all investigations and public consultation and participation processes required for EIA Type Projects, the Project Proponent shall submit the EIA Report to the MOECAF in both digital and hard copy, together with the required service fee.

The MONREC shall within 10 days after submission disclose the EIA Report to civil society, PAPs, concerned government organizations, and other interested stakeholders. The MONREC shall submit the EIA Report to the EIA Report Review Body for comment and recommendations and also arrange for public consultation meetings at national and State/ Regional/ local levels where the Project Proponent shall present the EIA Report. All received comments and recommendations, including those of the EIA Report Review Board, will be collected and reviewed by the MONREC prior to making a final decision on approval of the EIA Report.

The MONREC shall deliver its final decision within 90 days from the receipt of the EIA Report. All costs incurred in completing to the EIA Report disclosure and review, including the public participation process, shall be borne by the Project Proponent. Upon completion of its review of the EIA Report, the MONREC will issue an ECC or inform the Project Proponent of its decision to reject the EIA Report and publically disclose its decision.

Stakeholder Identification and Analysis

To develop a public information, consultation, and communication strategy, Neo Energy Oasis will identify and directly engage several groups of stakeholders. It recognizes as Project stakeholders various individuals, groups or communities who:

will be affected or are likely to be affected, positively or negatively, and directly or indirectly by the Project ("Project Affected Parties", PAPs), particularly those directly and adversely affected by Project activities, including those who are disadvantaged or vulnerable; or

may have an interest in the Project and/or the ability to influence its outcomes, either positively or negatively ("other influential/interested groups").

Neo Energy Oasis will identify and directly engage several groups of stakeholders, to develop a continuous public information, consultation and communication strategy. It will organize detailed stakeholder identification analysis that specifies and enumerates which groups are most affected by the Project, how, and to what degree. The proponent will map the key components, as follows:

- project activities, both on site and the surrounding area, that may result in local environmental or social impacts;
- impact zones (e.g. labor standards and employment, land use, soil/air/water pollution, etc.) for each component; and
- directly affected, indirectly affected, and vulnerable groups in the impacted zones.

Following a preliminary stakeholder mapping, based on field surveys and desktop study, the proponent will verify this analysis through direct consultation with stakeholders or credible and trustworthy representatives. The outcomes of this process will be collected in a Stakeholder Register, which will be continuously updated.

A Farming Land Acquisition Procedure in compliance with national legislation and international standards reporting will be adopted highlighting methods, timing, values for compensation and grievance mechanism to be properly disclosed to the affected land owners. Table 8-1. shows an overview of the main stakeholders.

Table 8-1: Overview of Key Project Stakeholders

Sub-Categories	Description	Potential Impact/ Involvement
AFFECTED PARTIES		
Land Owners and Land Users	Land owners and land users of the parcels affected by the construction of the access road, including owners and users with formal or informal right and claim on the land they occupy	Economic displacement due to land acquisition and compensation for the loss of assets.
Project Affected Communities	Inhabitants of the villages close to the project site	Receptors of direct/indirect and positive/negative social and environmental impacts; in particular, affected by project traffic, dust and noise during the construction phase
Vulnerable Groups	Any person/group who can be disproportionally affected by the Project construction (i.e., children, illiterate people, low income people, female-headed households, women, minority groups, elderly people, etc.).	Limited access to information on Project activities, impacts and mitigation measures, especially if affected by the land acquisition process or by Project traffic, noise and dust during the construction phase.
Local Government and Authorities of the Township affected by the Project	Local authorities of project area and District affected/involved by project activities (i.e., local health centers and service providers for education, trainings, emergency services).	Use of resources, services and infrastructures and providing some local permits and instructions.
Local Formal and Informal Leaders, Community Representatives and Opinion Makers	Influential persons within the community as opinion makers (e.g., local politicians, local religious leaders and wealthy persons from the community, NGOs); local delegations of political parties.	Influence on the community regarding the Project perceptions; informal collectors/ bearer of community opinions and complaints.
INFLUENTIAL/INTERESTED GROUPS		
National and Regional Government Bodies, Regulatory Agencies and Certification Authorities	Institutions, agencies, authorities involved in the permitting procedures and Project approvals, including Ministry of Natural Resources & Environmental Conservation, Ministry of Electricity & Energy, Ministry of Agriculture and Irrigation, Ministry of Labor	Responsible for the delivery of operation and construction permits, authorizations, certifications and involved in the land acquisition process.
Main National and Local NGOs and Associations	NGOs and associations mainly operating in Shan region, especially in the fields of human rights and social development.	Watch the Company and can provide early warning signals about

Sub-Categories	Description	Potential Impact/ Involvement
		emerging issues and community concerns.
Local and National Media	Television, Radio, Press (also via internet), social media	Disseminate information on ongoing and planned activities, shape public image of the Project and affect reputation positively or negatively

8.1 STAKEHOLDERS ENGAGEMENT AND CONSULTATION PLAN

Purpose and Objectives

The purpose of this SEP is to establish and maintain a constructive relationship with affected people and other interested parties over the life of the Project in order to obtain and maintain the "social license to operate" and broad public support. The objectives of stakeholder engagement are:

- to ensure the timely provision of relevant and understandable information;
- to create a process that provides opportunities for stakeholders to express their views, concerns and complaints, and allow Neo Energy Oasis to consider and respond to them;
- to maintain awareness of safety and environmental issues among communities in the vicinity of Project facilities;
- to monitor community attitude to the Project;
- to manage and monitor the effectiveness of any corrective actions implemented as a result of stakeholder concerns or complaints during Project activities;
- to manage and report on the closing out of stakeholder concerns or complaints; and
- to comply with IFC PS.

Stakeholder engagement will include an on-going communication process based on:

- public disclosure of appropriate information so as to enable meaningful, accessible and continued communication to consultation with stakeholders;
- meaningful consultation with potentially affected and interested parties; and
- a procedure by which people can make comments or complaints.

Engagement n Strategy and Methods

Neo Energy Oasis will keep ongoing consultations with all identified stakeholders. Consultation activities will not be limited to a single meeting with the interested parties but will entail a series of meetings, discussions, and opportunities for affected parties to learn about the Project details, be informed of the potential impacts, and of planned mitigation measures. They will be followed up with written records and agreements. These activities are valuable for Neo Energy Oasis to understand stakeholder concerns, gain feedback, identify potential risks and act pre-emptively to ensure positive outcomes. At the same time, the Neo Energy Oasis awareness of the local context will allow to better define and tailor community development activities.

Neo Energy Oasis will prepare information to be disclosed in advance and in a format adapted and suitable to the different public and groups. It will identify multiple and preferred communication channels to convey information on the Project activities and mitigation of identified impacts, or occurrence of new impacts, effectively so as to be fully transparent and informative. In addition, the venue and timing of meetings will be adapted to stakeholders' preference and needs.

Neo Energy Oasis will create a website with the main Projects' information and events of interest for the various stakeholders. The documents and information that will be disclosed in the website include, but are not limited to, the following:

- the SEP, that will be disclosed in English and Burmese;
- ESIA executive summary;
- information on the construction schedule and services disruption;
- stakeholder's consultations time, venues and minutes;
- grievance procedure;
- community development activities; and
- SEP Manager contact.

Considering the low percentages of internet users in the affected area, the Project disclosure through Neo Energy Oasis website will be mainly targeted, but not limited to, specific stakeholders (NGOs, national or regional stakeholders, authorities, Lenders, etc.).

In addition, given the particular setting of Project operational areas, possible methods to reach the target audience include, but are not limited, to:

- open meetings with residents of the affected communities (e.g., at schools, public/ religious or associations premises);
- separate meetings with land owners/land users, vulnerable groups, farmer's associations and local NGOs, as needed and appropriate;
- brochures, posters, informative leaflets at key communities' centers, and radio announcements, in particular to inform about the construction schedule, grievance mechanism and forthcoming

community meetings. Written information material should take in duly consideration the fact that there is a relevant number of illiterate people in the area; and

- social media: this method can be useful to keep ongoing communication with NGOs and other interested stakeholders.

Neo Energy Oasis will provide and publicise well in advance a schedule of the dates and locations of any planned consultation activities, including follow up and disclosure activities. A stakeholder engagement and disclosure plan detailing methods and content of engagement and disclosure for each type of stakeholder is presented in Table 8-2.

All meetings will be carefully documented and logged, minutes taken, and follow up activities recorded. A Public Grievance Sample Form and the Consultation Information Template are presented respectively in Appendix-7.

Disclosure plan

The disclosure plan, as preliminarily presented in Table 8-2, is mainly addressed to the construction and operation phases and only in very generic terms to the decommissioning phase, which at the moment appears unlikely to occur: in case any decommissioning will take place, this SEP will be updated accordingly and decommissioning will be treated in more detailed terms.

During the Project construction and operation phases Neo Energy Oasis will disclose information regarding ongoing Project activities or relevant changes in the Project through the following main methods:

- detailed publications in local newspapers or other media and radio spots, which allow to easily reach also illiterate people: this method is aimed at informing all Project stakeholders on the ongoing activities and future development plans, including the impacts and mitigation measures foreseen;
- notice boards in the main public spaces of the affected areas: this method addresses in particular all Project affected communities (residents) and land owners and users on the ongoing activities, including the impacts and mitigation measures foreseen, methods to present complains and comments;
- meetings with land owners and users to disclose the Farming Land Acquisition Procedure and the foreseen additional targeted assistance for vulnerable groups and, grievance mechanism;
- meetings with the stakeholders interested by the relocation of the religious site at the limestone quarry;
- meetings and events (with open or restricted participation), which allow to reach local and national authorities, residents of affected communities, NGOs and civil society associations to present

Project activities, including the impacts and mitigation measures foreseen, grievance mechanism, and discussion on relevant topics such as labour issues, environmental impacts, communities' health and safety, etc.;

Neo Energy Oasis webpage and SEP Manager contact, which will allow the distribution of information on Project impacts and mitigation measures, schedule of activities and plans, as well as the collection of grievances. Furthermore, it will represent a good channel to collect stakeholders' suggestions and concerns.

An internal and external grievance mechanism will be in place during all the Project phases.

Table 8-3 represents a tentative plan for stakeholder engagement according to the information available at the time on its preparation. Future updates will be done every time relevant modifications to the Project context are foreseen.

Grievance Mechanism

The purpose of the grievance mechanism is to ensure that all requests and complaints from individuals, groups and local communities throughout the Project life, from planning and design through construction, operations and decommissioning, are dealt with systematically in a timely manner with appropriate corrective actions being implemented and the complainant being informed of the outcomes.

As aforementioned, Neo Energy Oasis will establish several channels for grievance and information to enable the public to register any concern about the Project. Grievance mechanism will be in place throughout all Project stages and presented and discussed with the public during consultations. Channels to raise grievances will include:

- postal, electronic mail, and local telephone line reaching the administrative office of Neo Energy Oasis in the project site (to be specifically created);
- written or orally to the construction site manager; and
- written or orally during public events and meetings.

The grievance mechanism is responsibility of the staff appointed for the SEP implementation. All complaints will be logged and processed and addressed within a fixed time, communicated to the complainant, as shown in Appendix-3 by the processing grievances flowchart. The procedure is summarized below:

- grievances will be logged in a Grievance Register and an acknowledgement of receipt of complaint will be issued to the complainant within five working days;
- in case an immediate corrective action is not possible or sufficient, Neo Energy Oasis will inform complainant of the proposed long-term corrective action, specifying a deadline, or explain the reason why the action is not feasible within 10 working days;

- Neo Energy Oasis will identify responsibilities and internal deadline for corrective action(s);
- Neo Energy Oasis will follow up the implementation of the corrective measures;
- Neo Energy Oasis will inform the complainant in writing and in person of the corrective action and record the closure of the grievance; and

If the corrective action implemented is not accepted, it may be reviewed to identify alternative corrective actions. A revised resolution may be proposed. in case the resolution is then accepted by the stakeholder, the relevant grievance will be closed. On the contrary, if it will be not accepted, and no further improvements can be made, then external remedies may be pursued.

Complaints will be resolved within a period that will not exceed 30 days from their receipt and registration date.

As part of the grievance process, Neo Energy Oasis when receiving the complaint will log each grievance and document the action taken. It will regularly review the database of received grievances to identify and analyze any recurrent issues and trends.

A Public Grievance Sample Form is presented in Appendix- 7.

Monitoring and Evaluation

The SEP will be endorsed by the Neo Energy Oasis, who will have the responsibility for its implementation.

The Company SEP will be regularly updated, presenting changes in Project activities, stakeholders, as well as advice and inputs received, lessons learned and any change to the consultation process. As a minimum, the SEP will be updated before the start of the operation phase.

The Company will develop a programme to monitor the Project stakeholder engagement activities and public perception of the Project. The monitoring programme will detail key elements of the monitoring, such as monitoring parameters, modality and frequency. The Company will also describe how and when the results will be reported.

Stakeholder, consultation and grievance registers, recording relevant information in a tabular form, shall be updated on an on-going basis. Progress reports will be prepared on a quarterly basis during the construction period and on a biannual basis during the operation phase to include updates on the grievance process, with the number of grievances received and addressed/closed, most frequent types of grievances, and any recommendation or action taken to decrease the number of grievances.

As long as there will be open grievances, the SEP Manager will make a selection of a random sample of grievances biannually, and follow up with the complainants to ensure that appropriate corrective actions have been taken and that the outcomes are satisfactory. The reporting mechanism and responsibilities for stakeholder engagement are outlined in Table 8-2.

Table 8-2: SEP Reporting Mechanisms and Responsibilities

SEP Reporting Mechanism	Timing	Responsibility
Consultation Form	For each consultation or stakeholder contacted	SEP Manager
Stakeholder Identification and Consultation Register	Continued	SEP Manager
Grievance Register	Continued	SEP Manager
Grievance Monitoring	Quarterly during construction Biannual during the operation	SEP Manager
SEP Progress Reports	Quarterly during construction Biannual during the operation	
SEP Annual Report	Annually	

Resources and Responsibilities

Management Functions

The implementation of this SEP is responsibility of Neo Energy Oasis during all over Project phases. Neo Energy Oasis will appoint one SEP Manager in charge of all SEP activities (from the available staff or an external figure, for example from a local NGO or university, in both cases with appropriate professional background on stakeholder engagement in the local context).

Neo Energy Oasis staff involved in the Project will be briefed in order to be aware of the commitments taken by the Project and the Project approach in dealing with stakeholders. The SEP Manager will coordinate the implementation of the SEP activities and keeping ongoing contacts with the construction manager.

The SEP Manager will be based in project site and will take part to all the stakeholder engagement activities in the area. He/she has a general control function of the grievance mechanism process and collects, records and deals with grievances.

Budget

The budget for the SEP implementation will consider the following items throughout the Project construction and operation phase:

cost of human resources: the remuneration of the SEP Manager, if not identified within the internal Neo Energy Oasis staff, and of some short-term experts to carry out specific tasks, if necessary;

- training of the SEP Manager;
- specific consultation activities as outlined in the SEP;
- consultation materials and tools; and
- monitoring of the effectiveness of the SEP.

Table 8-3: Preliminary Stakeholder Disclosure Plan during Construction and Operation Phases

Project Information Dissemination Methods	Stakeholders Addressed	Information Disclosed	Timeline	Resources - Responsibilities
Face-to-face meetings with PAPs	Residents and representatives of the Project affected communities, vulnerable groups, local businesses	Information on planned activities, assessed positive and negative impacts and mitigation measures, presentation of the external grievance mechanism	Along the EIA approval process, before and the beginning of and during construction activity	Project staff with SEP Manager
Face-to-face meetings with landowners and users	Owners and users of Project affected land involved in the land acquisition process	Information on planned activities, Impacts and mitigation measures, dissemination of the Farming Land Acquisition Procedure (including compensation measures), grievance mechanism	Before the beginning of construction of the project facilities	SEP Manager with the Land Acquisition staff and institutions
Meetings with local level authorities and administrations, National Government Bodies involved in the authorization phases	Regulators (national, governorate, and local)	Project development, identified environmental and social impacts, schedule of activities, definition of the emergency response plan	According to the procedural and administrative needs	Neo Energy Oasis Managers with SEP Manager
Induction and staff trainings	Temporary and permanent workers	Working conditions, OHS induction, and code of conduct/ awareness raising on local customs, internal grievance mechanism	Immediately after hiring and later only when contractual changes occur	Neo Energy Oasis Human Resources
Publications/announcements in national and local media, social media, Neo Energy Oasis website	All identified stakeholders	Information on planned activities in each specific area, assessed positive and negative ES impacts and mitigation measures, presentation of grievance mechanism and Neo Energy Oasis points of contacts	Before the beginning of the construction phase; at the end of the of the construction phase	Project staff with SEP Manager
Notice boards in the main public spaces of the affected areas	People in the Project affected area (mainly residents), land owners and users	Information on the schedule of the forthcoming construction activities in each specific area, Impacts and mitigation measures, grievance mechanism, SEP Manager contacts	Before the beginning of the construction phase	SEP Manager

8.2 Summary of Already Conducted Public Consultation Activities

Introduction

Not only arranging the full participation at the early stage of project development play an important role but also full understanding and supports from the project affected people and another stakeholder are vital. Community participation and consultation were undertaken in respective places. These meetings enabled interested and affected parties to contribute their concerns (views and opinions on the proposed development). The aim was to ensure that all stakeholder interests were identified and incorporated in project development: at planning, implementation and operation phases. The consultation processes are as follow:

Identification of Stakeholders and Interested Parties

The stakeholders include all individual and groups with an interest in the project which can be divided into two categories as follow:

- Project affected persons in six villages such as Inn Tein Kone, Kyauk Taw, Taung Kha Mauk, Tone Lel, Min Lone and Naung Woe
- Public/ private agencies i.e., Government Authorities, Provincial Authorities, District Authorities etc.

Dissemination of Information

The information dissemination for project affected persons and concerned agencies are as follows;

- Project description and schedule
- General view and description of project setting
- Proposed Land Compensation
- Works of ESIA
- Other information as deemed necessary
- Public Consultation and Participation Activities
- Approach
- Based on participation approach, presentation, dialogue, leaflet and two way communications had been applied along the process of public consultation.

Public Consultations

Three main activities were conducted during field survey as follows:

- Meeting with state level authorized persons such as Minister of Electricity and Power, Director of Environmental Conservation Department, Officer of Irrigation Department i.e., project proponents, environmental experts and consultants was organized on 24 August 2016. The objectives were to inform the stakeholders about the overall project description, scope of EIA/SIA studies, including receiving opinions/ comments and suggestions on the project development.
- Meeting with Township Administrative Officer was organized on 24 August 2016. Discussion was on preparation for public consultation meeting for all affected areas.
- Consultation meetings with the provincial authorities, government authorities, different parties, company and NGOs, monks, village headmen, village committee members and interested persons in all project affected area during 29 August 2016 to 2 September 2016. These activities aimed to present project plans, benefits to the communities and the country, advantages and disadvantages of the project activities and obtaining public concerns.

Public Consultation Meeting Activities

Details of public consultation activities undertaken during field survey were summarized and presented as follows:

No.	Date	Activities	Participants
1.	24 August 2016	Pre-engagement meeting with relevant state authorities, project proponents and environmental expert and consultants	Minister of Electricity and Power, Director of Environmental Conservation Department, Officer of Irrigation Department Project Proponent, other project responsible persons and Environmental Expert and consultants
2.	24 August 2016	Pre-engagement meeting with Township Administrative Officer	Township Administrative Officer Project responsible persons and Environmental Expert and consultants
3.	29 August 2016	Stakeholder meeting with state level authorities, township level representatives from government, civil society, local communities	Minister of Electricity and Power, Minister of Government Officers, Local communities Project Proponent, other project responsible persons and Environmental Expert and consultants
4	30 August 2016 to 2 September 2016	Consultation meeting with representatives from government, civil society, local communities and project affected communities in six project affected villages, comprising: Inn Tein Kone Kyauk Taw Taung Kha Mauk Tone Lel	Monks, village headmen, village committee members, villagers in respective villages

		Min Lone Naung Woe	

Detailed activities and Issues Discussed in the Public Consultations

A number of meetings, discussions, briefings have been organized with concerned stakeholders, township authorities and village, as part of the EIA and SIA process.

Pre-engagement Meeting on 24 August 2016 (Taunggyi City)

Meeting was held at the Auditorium of Government Administrative Office, Taunggyi City, Shan State. State level authorities attended and participated the meeting. Details of the meeting are summarized as follows:

NEO Energy Oasis Development Co., Ltd presented about brief Explanation about NEO Energy Oasis Development Co., Ltd, about the project, ongoing process and

Resource and Environment Myanmar Co., Ltd explained about company profile, work of EIA as follows:

- Brief Explanation about Resource and Environment Myanmar Co., Ltd
- Scope of EIA work
- Approach for SIA
- Study Area and Environmental Examination
- Public Consultation and Social Impact Assessment (SIA)
- Along the study process, consultation with local people will conducted for their concerns
- Minister of Electricity and Power and state level authorities discussed on following issues:
- Environmental Monitoring plan
- Laws and regulations of Ministry of Natural Resources and Environmental Conservation
- Updated Information for Environmental Conservation Department in Shan State
- Background of Project Affected Persons, Communities from Inle Region, Villages, Public Participation, Problems, Alternative attitudes and historical background of the Proposed Project Area
- Expectation of Ministry of Electricity and Power, regarding mutual benefits, in both communities and company
- Preparation of land compensation and public consultation activities

Photos Records


Pre-engagement Meeting on 24 August 2016 (Nyaung Shwe Town)

Meeting was held at the meeting room of Township General Administrative Office, Nyaung Shwe in order to prepare public consultation meeting and social survey. Township Administrative Officer, representative persons of NEO Energy Oasis Development Co., Ltd and Resource and Environment Myanmar Co., Ltd discussed about the public consultation. Details of the meeting are summarized as follows:

- Scope of EIA work
- Public Consultation and Social Impact Assessment
- Study Area and Social Survey
- Project Affected Persons, Communities from Inle Region, Villages, Public Participation
- Meeting Agenda
- Land Compensation

Photo Records


Stakeholder Meeting on 29 August 2016

Meeting was held at the meeting hall of Township General Administrative Department, Nyaung Shwe in order to explain EIA works, to inform about the proposed project, to get the local communities' opinions, and prepare social survey in project affected area. State level authorities, township level representatives from government, civil society, local communities' discussed issues can be summarized as follows:

(1) NEO Energy Oasis Development Co., Ltd. presented

Brief explanation of NEO Energy Oasis Development Co., Ltd.

How the project affects the local communities and mutual benefits between communities and company

Project background, ongoing process, project construction phase, project duration

Project affected persons and land use

(2) Resource and Environment Myanmar Co., Ltd. explained

EIA works and Social Impact Assessment

Mitigation Measure, Environmental Management Plan and Monitoring plan

Project Description and Schedule

Study area and arrangement for public consultation meeting at village level

(3) State level authorities discussed as follows:

To get mutual benefits between communities and company

To emphasize the affected persons' concerns and the affected persons also must have mutual understanding to project proponent

To consider the Sustainability of Inle Lake especially

How to maintain the environmental impact by the project

To negotiate with local communities and

To make a successful project for all

(4) Township level representatives from government, civil society and local communities consulted as follows:

The advantages of local communities

How to assess the grievances of affected persons

How to maintain the environmental impact by the project

To make a good environmental management plan

Who has the responsibilities of monitoring plan?

The public participation of the project

How to perform CSR programs

Photo Records




Public Consultations at Village Level (30 August 2016 to 2 September 2016)

(1) Information Prepared for Public Consultation Meeting

Series of Public Consultations were organized in accordance with suggestions and discussions with government authorities' supportive ways. This activity was aimed to discuss and clarify about the project information, ESIA works and receive the comments from affected communities. Discussed issues covered:

The Upper Baluchaung Hydropower Project, consisting of No.1 Power Station (UB-1) and No.2 Power Station (UB-2), is a run-of-river type located about 40 km southwest of Taunggyi in Southern Shan State, harnessing a gross head of about 230 m high and maximum plant discharge of 16 m3/s.

A run-of-river scheme was selected to minimize the environmental impacts to the Project area as well as to the river basin, including the downstream community, in terms of irrigation water supply and boat transportation.

Countermeasures such as maintaining the river flow of 0.5 m3/s between the intake and the powerhouse, and mitigation for adverse effects to the vicinity of the Project area during construction, will be incorporated in the work item. In addition, improvement for the local community will be undertaken by the Project.

ESIA works mean to identify and evaluate environmental and social risks and impacts of the project, to adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.

To promote improved environmental and social performance of clients through the effective use of management systems and to ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.

Public Consultations

Public consultations were organized at six villages during 30 August 2016 to 2 September 2016 in order to inform and discuss about the project, effects, compensation and development, as prepared above including feedbacks from villagers. List of Public Consultations at village level were shown as the following table:

Public Consultation Meeting at The Village Level

No.	Date/Time	Village	Arranged by
1	30/8/2016, (13:15 hrs to 16:10 hrs)	Inn Tein Kone	Village Headman
2	31/8/2016, (11:00 hrs to 12:30 hrs)	Kyauk Taw	Village Headman
3	31/8/2016, (15:00 hrs to 17:30 hrs)	Taung Kha Mauk	Village Headman
4	1/9/2016, (9:00 hrs to 14:25 hrs)	Tone Lel	Village Headman
5	2/9/2016, (8:30 hrs to 12:30 hrs)	Min Lone	Village Headman
6	2/9/2016, (15:20 hrs to 16:25 hrs)	Naung Woe	Village Headman

Concerns from the Participants

Concerns from the participants from each village can be summarized as follows:

Inn Tein Kone Village

Worries concerned with irrigation are found because of the project construction. Project construction should be performed without disturbance of local resident, farming and agriculture. The proposed project should not interrupt local private hydropower plants operation.

CSR programs which needed in village should be arranged widely. Successful negotiation with affected persons also should be performed.

Most villagers agreed if there are not significant impacts on environmental and social impacts by the project and hope the local development.

Kyauk Taw Village

There are no special concerns about project. Their socio-economic conditions are not included in project construction.

Power planning is needed in such kind of village and they welcome the project.

It is assumed that project development is a kind of local community's development.

Villagers also want to take part in employment of the project.

Taung Kha Mauk

There is a matter whether the project will supply electricity in the future or not.

Transportation is better than before because the company conducted road construction.

The villagers are really glad for new road construction and it is really helpful for students because they have to go school in another village.

Tone Lel

There is same matter as Taung Khamout Village that whether the project will supply electricity in the future or not.

The villagers are really pleased for construction of new roads and better transportation than before.

Public meetings should be arranged by the company in the future.

How the project will affect the local community?

Min lone

This village is the nearest village of project. There are suspended land compensations and one family is found that the university student can't go on his education.

The vibration of crusher impact is affected in this village that some elder persons can't sleep well at night.

Impacts on cultivation are also found that some land are expropriate by the company for the project and the plants are damaged by the powder from the crusher. These powders affect the water for the village.

Worries about mining are also found and some can't work regularly because of mining.

Private hydropower existed and damaged by the project. Although the project supplies the electricity, it is only at night. (6pm to 11:30pm).

Most of the villagers are working in this project.

Naung Woe

Land compensations are suspended.

Private hydropower existed and damaged by the project. There is no more electricity supply after damaged. Is there any arrangement for electricity supply by the project in the future?

The detriment of existing water pump by the project is also observed. The crack of water tank by mining is also found and the villagers worry about it.

Worries about land expropriation for UB2 plant are also found.

Public meeting is needed and the updated information are required.

Concerns on Biodiversity

U Sein Tun, Director (Nature and Wildlife Conservation Division) suggested as follows:

The Upper Baluchaung Hydropower Project is well planned and supported to reduce Inle Lake's sedimentation in another way because it is designed with sand flush gate and it is assumed sediment yield of 121 m3/km2/year.

Wildlife can migrate during construction and operation phase because of noise pollution.

Cutting trees in the project area during construction phase cause deforestation and wildlife habitat loss. So, plantation plan should be provided in environmental management plan.

Photos Records








Chapter IX Conclusion

The Upper Baluchaung Hydropower Project, consisting of No.1 Power Station (UB-1) and No.2 Power Station (UB-2), is a run-of-river type located about 40 km southwest of Taunggyi in Southern Shan State. The Project is aimed at generating a maximum power output of 30.4 MW in total, harnessing a gross head of about 230 m high and maximum plant discharge of 16 m^3/s.

The Project cost was estimated at US$35.0 million for UB-1, US$17.9 million for UB-2, and US$52.8 million in total, including the direct construction cost, administration and engineering cost, and physical contingency. The average unit cost is US$1,738 /kW. It should be noted that the cost for the outgoing transmission line with 66 KV is not included.

The catchment area is 802 km^2 at the UB-1 site. The estimated annual mean discharge of 11.06 m^3/s was obtained from simulation using Tank-Model method, considering daily rainfall records for 40 years from 1970 to 2009. The peak flood discharges estimated at UB-1 site are 1,415 m^3/s for 1,000-year probable flood and 625 m^3/s for 200-year flood.

The Feasibility Study concluded that the optimum power output for UB-1 would be 20.4 MW (10.2 MW x 2), with a maximum plant discharge of 16 m^3/s and effective head of 148.0 m. For UB-2 meanwhile, the optimum power output would be 10.0 MW (5.0 MW x 2), with a maximum plant discharge of 16 m^3/s and effective head of 72.9 m. Both are based on a run-of-river scheme. The annual energy is estimated at 90.1 GWh for UB-1, 44.5 GWh for UB-2, and 134.6 GWh in total.

The power generated by both power stations will be supplied through the 66-kV outgoing feeder provided at UB-1 to a cement factory, which will be constructed near Ngoat Village. Meanwhile, the surplus electricity will be transmitted to the national grid of 66 kV line between Kalaw and Taunggyi.

A run-of-river scheme was selected to minimize the environmental impacts to the Project area as well as to the river basin, including the downstream community, in terms of irrigation water supply and boat transportation. Countermeasures such as maintaining the river flow of 0.5 m^3/s between the intake and the powerhouse, and mitigation for adverse effects to the vicinity of the Project area during construction, will be incorporated in the work item. In addition, improvement for the local community will be undertaken by the Project.

As the projects are of run-off-river plants the power output in the dry season becomes low at a level of 4-5 MW for the UB-1, and 2.3 MW for the UB-2. In order to maintain the power output as high as possible during the dry season peak power operation of about 4 hours is considered by regulating daily discharge at the Intake Dam of UB-1. Although this option of maintaining the peak power seemed economical viable, the boat transportation along the Indein stream and irrigation downstream of Indein will be affected. Therefore, in order not of have adverse effects on the downstream water requirement the option of maintaining peak power has abandoned.

Major potential environmental impacts from the Project include (i) soil erosion and landslide, (ii) loss of biodiversity, (iii) loss of river continuum because of the small dam; (iv) a downstream river reach with strongly reduced flow, and (v) daily water level fluctuations downstream of the power plant because of peaking. Measures have been developed to mitigate and regularly monitor the impacts. Based on the EIA and Environmental Monitoring Plan, the adverse environmental and social impacts of the Project can be minimized to acceptable levels by implementing adequately funded environmental and social management activities. Details of these activities are elaborated in the Full ESIA report including Environmental Management Plan and Monitoring Plan.

In conclusion, the Project is economically and financially feasible, and will contribute to the country by supplying 30.4 MW maximum power and 135 GWh/year, through utilization of available hydro potential in the area. However, it is indicated that the Project is relatively vulnerable in the financial aspect as an IPP project mainly due to the anticipated severe loan conditions. Therefore, it will be helpful if the Government supports the Project in terms of the financial aspect. Simultaneously, every effort should be made to reduce the construction cost to a level where the Project will be definitely feasible.

In addition, the Upper Baluchaung Hydropower Project will contribute to the social economy of Myanmar and quality of people’s life improvement by the energy created by the renewable and national resources of hydropower.

However, the following impacts to environment and socio-economy are expected by implementation of the Project.

There is no settlement on the outskirts of the Project site, therefore the exhaust gas, noise, and vibration due to the Project may not bring a big impact.

The water pollution due to the construction may be controllable impact at the minimum by taking appropriate measures.

The possibility of the water quality deterioration of the reservoir may be low, because the reservoir volume is quite small compared to the river inflow volume and the reservoir water will be frequently replaced with new river inflow in a year.

It is desirable to carry out monitoring of natural and social environment, such as the water quality, the ecosystem (including flora, fauna), the stability of slopes, and the resettlement activities under construction and/or implementation stage.

The project owner, Neo Energy Oasis Co., Ltd. will fully comply with Myanmar Laws relevant to this project (Described in Chapter 2) and will follow the Environmental Management Plan including mitigation measures, monitoring plan, CSR which describe in this ESIA report during construction and operation period.

The project owner, Neo Energy Oasis Co., Ltd. will also follow the item 63 of EIA procedure for ESIA report.

In addition, Neo Energy Oasis Co., Ltd. will commit the followings:

The local labors should be recruited permanently and temporarily both technical and non-technical posts. Some posts should be reserved for the local workers. This recruitment may help to reduce the poverty status of the whole study area.

Development of electric transmission and distribution line, priority of local and displaced people in providing electricity, priority in providing electricity for irrigation water pump for local people.

The compliance monitoring report along with the checklist should be indexed and annexed with the monthly and annual monitoring report. A format of compliance monitoring checklist shall be prepared during detail design stage. It may be required to submit the annual monitoring report to Department of

Environmental Conservation for renewing of the Environmental Clearance Certificate each year.

Neo Energy Oasis Co., Ltd. plan and reserve for cooperate social responsibility (CSR) (during operation period), two percent (2%) of yearly net profit of the project. The company has already donated for development of education and health for surrounding villages that located nearby the proposed project area.

Appendix 1

Laboratory Result

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd), Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

ISO 9001:2008 Cert. No.688283

W0615 243

WTL-RE-001
Issue Date - 01-12-2012
Effective Date - 01-12-2012
Issue No - 1.0/Page 1 of 2

WATER QUALITY TEST RESULTS FORM

Client	ESIA of Upper Balu Chaung Hydropower Project
Nature of Water	Surface Water (UBSW - 1)
Location	Upper Balu Chaung, Nyaung Shwe Township.
Date and Time of collection	11.6.2015
Date and Time of arrival at Laboratory	15.6.2015
Date and Time of commencing examination	17.6.2015
Date and Time of completing	22.6.2015

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

pH			6.5 - 8.5
Colour (True)		TCU	15 TCU
Turbidity		NTU	5 NTU
Conductivity		micro S/cm	
Total Hardness	186	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Calcium Hardness		mg/l as $CaCO_3$	
Magnesium Hardness		mg/l as $CaCO_3$	
Total Alkalinity	212	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Carbonate ($CaCO_3$)	Nil	mg/l as $CaCO_3$	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Iron		mg/l	0.3 mg/l
Chloride (as CL)	4	mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids		mg/l	
Dissolved Solids		mg/l	1000 mg/l
Manganese		mg/l	0.05 mg/l
Phosphate		mg/l	
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by
Signature: Hein
Name: **Zaw Hein Oo**
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by
Signature: SoeThit
Name: **Soe Thit**
M.E (Civil) 1980
Technical Officer
ISO TECH Laboratory

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg. (Civil), Dip S E (Delft) Lecturer of YIT (Retd), Consultant (Y.C.D.C), LWSE 001,
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W0615 243

WATER QUALITY TEST RESULTS FORM

Client: ESIA of Upper Balu Chaung Hydropower Project
Nature of Water: Surface Water (UBSW - 1)
Location: Upper Balu Chaung, Nyaung Shwe Township.
Date and Time of collection: 11.6.2015
Date and Time of arrival at Laboratory: 15.6.2015
Date and Time of commencing examination: 17.6.2015
Date and Time of completing: 22.6.2015

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)		°C	
Fluoride (F)	0.2	mg/l	1.5 mg/l
Lead (as Pb)	Nil	mg/l	0.01 mg/l
Arsenic (As)	Nil	mg/l	0.01 mg/l
Nitrate ($N.NO_3$)	Nil	mg/l	50 mg/l
Chlorine (Residual)		mg/l	
Ammonia (NH_3)		mg/l	
Ammonium (NH_4)		mg/l	
Dissolved Oxygen (DO)		mg/l	
Chemical Oxygen Demand (COD)	32	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20 °C)	10	mg/l	
Cyanide (CN)		mg/l	0.07 mg/l
Zinc (Zn)		mg/l	3 mg/l
Copper (Cu)		mg/l	2 mg/l
Silica (Si)		mg/l	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by

Signature: Hein

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature: Soe Thit

Name: Soe Thit
B.E (Civil) 1980
Technical Officer
ISO TECH Laboratory

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ISO TECH LABORATORY

ISO 9001:2008 Cert. No.688283

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg (Civil), Dip S.E (Delft) Lecturer of YIT (Retd), Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

W0615 244

WTL-RE-001
Issue Date - 01-12-2012
Effective Date - 01-12-2012
Issue No - 1.0/Page 1 of 2

WATER QUALITY TEST RESULTS FORM

Client	ESIA of Upper Balu Chaung Hydropower Project
Nature of Water	Surface Water (UBSW - 2)
Location	Upper Balu Chaung, Nyaung Shwe Township.
Date and Time of collection	12.6.2015
Date and Time of arrival at Laboratory	15.6.2015
Date and Time of commencing examination	17.6.2015
Date and Time of completing	22.6.2015

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

pH			6.5 - 8.5
Colour (True)		TCU	15 TCU
Turbidity		NTU	5 NTU
Conductivity		micro S/cm	
Total Hardness	188	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Calcium Hardness		mg/l as $CaCO_3$	
Magnesium Hardness		mg/l as $CaCO_3$	
Total Alkalinity	212	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Carbonate ($CaCO_3$)	Nil	mg/l as $CaCO_3$	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Iron		mg/l	0.3 mg/l
Chloride (as CL)	5	mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids		mg/l	
Dissolved Solids		mg/l	1000 mg/l
Manganese		mg/l	0.05 mg/l
Phosphate		mg/l	
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by
Signature: Hein
Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laborator

Approved by
Signature: Soe Thit
Name: Soe Thit
B.E (Civil) 1980
Technical Officer
ISO TECH Laborator

(a division of WEG Co.,Ltd.)

W0615 244

WATER QUALITY TEST RESULTS FORM

Client	ESIA of Upper Balu Chaung Hydropower Project
Nature of Water	Surface Water (UBSW - 2)
Location	Upper Balu Chaung, Nyaung Shwe Township.
Date and Time of collection	12.6.2015
Date and Time of arrival at Laboratory	15.6.2015
Date and Time of commencing examination	17.6.2015
Date and Time of completing	22.6.2015

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)		°C	
Fluoride (F)	0.2	mg/l	1.5 mg/l
Lead (as Pb)	Nil	mg/l	0.01 mg/l
Arsenic (As)	Nil	mg/l	0.01 mg/l
Nitrate ($N.NO_3$)	Nil	mg/l	50 mg/l
Chlorine (Residual)		mg/l	
Ammonia (NH_3)		mg/l	
Ammonium (NH_4)		mg/l	
Dissolved Oxygen (DO)		mg/l	
Chemical Oxygen Demand (COD)	32	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20 °C)	8	mg/l	
Cyanide (CN)		mg/l	0.07 mg/l
Zinc (Zn)		mg/l	3 mg/l
Copper (Cu)		mg/l	2 mg/l
Silica (Si)		mg/l	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by

Signature: Heine

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature: Soe Thit

Name: Soe Thit
B.E (Civil) 1980
Technical Officer
ISO TECH Laboratory

WATER QUALITY TEST RESULTS FORM

Client	ESIA of Upper Balu Chaung Hydropower Project
Nature of Water	Surface Water (UBSW - 3)
Location	Upper Balu Chaung, Nyaung Shwe Township.
Date and Time of collection	13.6.2015
Date and Time of arrival at Laboratory	15.6.2015
Date and Time of commencing examination	17.6.2015
Date and Time of completing	22.6.2015

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

pH			6.5 - 8.5
Colour (True)		TCU	15 TCU
Turbidity		NTU	5 NTU
Conductivity		micro S/cm	
Total Hardness	192	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Calcium Hardness		mg/l as $CaCO_3$	
Magnesium Hardness		mg/l as $CaCO_3$	
Total Alkalinity	196	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Carbonate ($CaCO_3$)	Nil	mg/l as $CaCO_3$	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Iron		mg/l	0.3 mg/l
Chloride (as CL)	5	mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids		mg/l	
Dissolved Solids		mg/l	1000 mg/l
Manganese		mg/l	0.05 mg/l
Phosphate		mg/l	
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by
Signature: Hein
Name: Zaw Hein Oo, B.Sc (Chemistry), Chemist, ISO TECH Laboratory

Approved by
Signature: Soe Thit
Name: Soe Thit, B.E (Civil) 1980, Technical Officer, ISO TECH Laboratory

No.18, Lanthit Road, Nanthargone Quarter, Insein Township, Yangon, Myanmar.
Ph: 01-640955, 09-73225175, 09-73242162, Fax: 01-644506, E-mail: isotechlaboratory@gmail.com, Website: weg-myanmar.com

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd), Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

ISO TECH LABORATORY

ISO 9001:2008 Cert. No.688283

W0615 245

WATER QUALITY TEST RESULTS FORM

Client	ESIA of Upper Balu Chaung Hydropower Project
Nature of Water	Surface Water (UBSW - 3)
Location	Upper Balu Chaung, Nyaung Shwe Township.
Date and Time of collection	13.6.2015
Date and Time of arrival at Laboratory	15.6.2015
Date and Time of commencing examination	17.6.2015
Date and Time of completing	22.6.2015

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)		°C	
Fluoride (F)	0.2	mg/l	1.5 mg/l
Lead (as Pb)	Nil	mg/l	0.01 mg/l
Arsenic (As)	Nil	mg/l	0.01 mg/l
Nitrate ($N.NO_3$)	Nil	mg/l	50 mg/l
Chlorine (Residual)		mg/l	
Ammonia (NH_3)		mg/l	
Ammonium (NH_4)		mg/l	
Dissolved Oxygen (DO)		mg/l	
Chemical Oxygen Demand (COD)	32	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20 °C)	8	mg/l	
Cyanide (CN)		mg/l	0.07 mg/l
Zinc (Zn)		mg/l	3 mg/l
Copper (Cu)		mg/l	2 mg/l
Silica (Si)		mg/l	

Remark: This certificate is issued only for the receipt of the test sample.

Tested by

Signature: Hein

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature: Soe Thit

Name: Soe Thit
B.E (Civil) 1980.
Technical Officer
ISO TECH Laborator.

SGS

ANALYSIS REPORT

ORIGINAL

Job Ref: 4695/2015
Date : 22.06.2015

Client Name	:	**RESOURCE AND ENVIRONMENT MYANMAR CO., LTD** B-702 Delta Plaza, Shwegondaing Rd, Bahan Township, Yangon, Myanmar
Project Name	:	ESIA of Upper Balu Chaung Hydropower Project
Sample Brought By	:	Client
Sample Received Date	:	15.06.2015
Analysed Date	:	16.06.2015

Results (mg/l)	Methods	Stations			Detection Limit
		(UBSW-1) 11.6.2015	(UBSW-2) 12.6.2015	(UBSW-3) 13.6.2015	
Lab Code	-	070/15	071/15	072/15	-
Commodity Name	-	Surface Water	Surface Water	Surface Water	-
Total Nitrogen (organic)	Based on Standard methods for the examination of water & waste water APHA ,AWWA & WEF,22nd ed, 2012; 4500-N_{org} C	Not Detected	Not Detected	Not Detected	0.6
Oil & Grease	Based on Standard methods for the examination of water & waste water APHA ,AWWA & WEF ,22nd ed, 2012 ; 5520 B	Not Detected	2.2	1.9	0.2
Total Phosphorus	Laboratory Manual For the Physico-Chemical Analysis of Soil, Water and Plant ; Phototmetric (Ascorbic) Method	Not Detected	Not Detected	Not Detected	0.05
Total Suspended Solid	Based on Standard methods for the examination of water & waste water APHA ,AWWA & WEF,22nd ed, 2012; 2540 D	247	128	139	2
Ammonia Nitrogen	Based on Standard methods for the examination of water & waste water APHA ,AWWA & WEF,22nd ed, 2012; 4500-NH_3 B , C	Not Detected	Not Detected	Not Detected	0.6

End of Report

SGS (Myanmar) Limited

(Nu Nu Yi)
Manager

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06- 1616/15
Page 1/1

1	Company's Name	: Resource and Environment Myanmar Co.,Ltd
2	Project Name	: ESIA of Upper Balu Chaung Hydropower Project
3	Address	: B-702, Delta Plaza, Shwegondaing Road, Bahan Township
4	Phone No.	: 09-73013448
5	Date Received	: 29.6.2015
6	Sample Number	: 1440/15
7	Product Name	: Water (UBS W-1)
8	Type of Test	: Micro Tests
9	Date of Issue	: 3.7.2015
10	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Coliform	(AOAC - 991.14)	1 cfu per ml
2	Escherichia Coli (E.coli)	(AOAC - 991.14)	1 cfu per ml

Remarks : ND = Not Detectable

cfu = Colony Forming Unit

3/7/2015

Sein Thaung Oo
Chairman
Management Committee
FIDSL

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06- 1617/15
Page 1/1

1 Company's Name : Resource and Environment Myanmar Co.,Ltd
2 Project Name : ESIA of Upper Balu Chaung Hydropower Project
3 Address : B-702, Delta Plaza, Shwegondaing Road, Bahan Township
4 Phone No. : 09-73013448
5 Date Received : 29.6.2015
6 Sample Number : 1441/15
7 Product Name : Water (UBSW-2)
8 Type of Test : Micro Tests
9 Date of Issue : 3.7.2015
10 Results

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Coliform	(AOAC - 991.14)	2 cfu per ml
2	Escherichia Coli (E.coli)	(AOAC - 991.14)	(ND) per ml

Remarks : ND = Not Detectable
cfu = Colony Forming Unit

3/7/2015

Sein Thaung Oo
Chairman
Management Committee
FIDSL

Myanmar Food Processors and Exporters Association (MFPEA)

Food Industries Development Supporting Laboratory (FIDSL)

UMFCCI Tower, 7th Floor, Room No.(4),No.(29), Minye Kyawswa Road,

Lanmadaw Township, Yangon, Myanmar

LABORATORY ANALYSIS REPORT

FIDSL - 06- 1618/15
Page 1/1

1	Company's Name	: Resource and Environment Myanmar Co.,Ltd
2	Project Name	: ESIA of Upper Balu Chaung Hydropower Project
3	Address	: B-702, Delta Plaza, Shwegondaing Road, Bahan Township
4	Phone No.	: 09-73013448
5	Date Received	: 29.6.2015
6	Sample Number	: 1442/15
7	Product Name	: Water (UBSW-3)
8	Type of Test	: Micro Tests
9	Date of Issue	: 3.7.2015
10	Results	

(This Laboratory analysis report is based solely on the sample(s) submitted by the customer.)

Sr. No	Test Parameter	Test Method	Result
1	Coliform	(AOAC - 991.14)	(ND) per ml
2	Escherichia Coli (E.coli)	(AOAC - 991.14)	(ND) per ml

Remarks : ND = Not Detectable

cfu = Colony Forming Unit

3/7/2015

Sein Thaung Oo
Chairman
Management Committee
FIDSL

SGS

Report No. : 2016-01133 / 001 (Page 1 of 1)

Issued date : September 21, 2016

CLIENT : **RESOURCE AND ENVIRONMENT MYANMAR CO., LTD.**
CONTACT : Ms. Toe Toe Hlaing
ADDRESS : B702 Delta Plaza, Shwegondaing Rd., Bahan, Yangon, Myanmar
Tel. +959-73013448 Fax. +951-552901
E-mail : toetoehlainggeo@gmail.com

Analysis Report

PROJECT NAME : Water Quality Monitoring for Upper Baluchaung Hydropower Project
SAMPLE DESIGNATED AS : Surface Water Quality
SAMPLING LOCATION : Upper Baluchaung, Nyaung Shwe Township
SAMPLING DATE : August 21-23, 2016
SAMPLING BY : Client

Parameters	**Units**	**LOQ**	**Results**		
			SW-1	**SW-2**	**SW-3**
Sampling Date	-	-	August 21, 2016	August 21, 2016	August 22, 2016
Biochemical Oxygen Demand (BOD)	mg/l	-	0.6	1.5	0.3
Total Suspended Solids	mg/l	5.0	303.0	447.0	<5.0
Oil & Grease	mg/l	1.0	1.0	<1.0	1.0
Total Nitrogen	mg/l	2.0	0.7	6.0	6.0
Nitrate (as N)	mg/l	0.02	6.00	0.46	0.36
Alkalinty (as $CaCO_3$)	mg/l	1.0	150.0	158.0	145.0
Total Coliform Bacteria	MPN/100mL	-	79	490	110
Fecal Coliform Bacteria	MPN/100mL	-	49	79	68
Escherichia Coli (*E.Coli*)	MPN/100mL	-	>23	>23	>23

Remarks : - Analysis Methods followed the Standard Methods for the Examination of Water and Wastewater endorsed by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF)
- LOQ = Limit of Quantitation

(Siriporn Imwilaiwan)
Environmental Monitoring Manager

(Thepson Yommana)
Technical Manager

SGS (THAILAND) LIMITED

TY/Client/JC/Cj

E 127457

UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY LIMITED

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3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

ANALYSIS REPORT

PROJECT	: UPPER BALUCHAUNG HYDORPOWER PROJECT
CUSTOMER NAME	: RESOURCE & ENVIRONMENT MYANMAR LTD. (REM)
ADDRESS	: B-702 DELTA PLAZA, SHWEGONDAING ROAD, BAHAN, YANGON, MYANMAR. TEL. 959 7301 3448 FAX 959 5196 758
SAMPLING SOURCE	: -
SAMPLE TYPE	: SURFACE WATER
SAMPLING DATE	: AUGUST 21, 2016
SAMPLING TIME	: -
SAMPLING METHOD	: PLANKTON NETS
SAMPLING BY	: REM
ANALYZED BY	: UAE
RECEIVED DATE	: AUGUST 31, 2016
ANALYZED DATE	: SEPTEMBER 1-29, 2016
ANALYSIS NO.	: LAQ478-LAQ481/2016
WORK NO.	: LAB3247/2016
REPORT NO.	: L18377/2016

PHYTOPLANKTON	**RESULT**		
	SW-1 **(UNITS/m^3)** 1/ **LAQ478/2016**	**SW-2** **(UNITS/m^3)** 1/ **LAQ479/2016**	**SW-3** **(UNITS/m^3)** 1/ **LAQ480/2016**
Division Cyanophyta			
Class Cyanophyceae			
Family Oscillatoriaceae			
Oscillatoria sp.*	71,000	48,000	42,000
Division Chlorophyta			
Class Chlorophyceae			
Family Scenedesmaceae			
Scenedesmus sp.	0	0	43,000
Family Desmidiaceae			
Closterium sp.	0	0	9,000
Class Euglenophyceae			
Family Euglenaceae			
Euglena sp.	0	0	16,000
Trachelomonas sp.	0	0	9,000
Division Chromophyta			
Class Bacillariophyceae			
Family Aulacoseiraceae			
Aulacoseira granulata *	0	7,000	0
Family Fragilariaceae			
Synedra rumpens	107,000	107,000	47,000
S. ulna	0	15,000	17,000
Family Eunotiaceae			
Eunotia sp.	23,000	0	0
Family Naviculaceae			
Gyrosigma sp.	24,000	6,000	21,000
Navicula sp.	164,000	122,000	159,000

PHYTOPLANKTON	RESULT		
	SW-1 (UNITS/m^3) 1/ LAQ478/2016	SW-2 (UNITS/m^3) 1/ LAQ479/2016	SW-3 (UNITS/m^3) 1/ LAQ480/2016
Family Surirellaceae			
Surirella sp.	7,000	4,000	0
TOTAL ABUNDANCE	**396,000**	**309,000**	**363,000**
AMOUNT OF SPECIES	**6**	**7**	**9**
SAMPLE CONDITION			
WATER'S COLOUR/TURBID	BROWN/TUBIDITY	BROWN/TUBIDITY	BROWN/TUBIDITY
SEDIMENT	REDDISH BROWN SUSPENSION	REDDISH BROWN SUSPENSION	REDDISH BROWN SUSPENSION

REMARK PLANKTON COUNTING TECHNIQUES IS NATURAL UNIT COUNT. REFERENCE: AMERICAN PUBLIC HEALTH ASSOCIATION, AMERICAN WATER WORKS ASSOCIATION ENVIRONMENT AND WATER FEDERATION (APHA, AWWA AND WEF). 2012. STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER. AMERICAN PUBLIC HEALTH ASSOCIATION WASHINGTON, D.C., U.S.A.

(UNITS/m^3) 1/ MEAN CELL/m^3 , * FILAMENT/m^3

Napaporn P.
....
(MISS NAPAPORN PURATAKO)

TECHNICAL MANAGEMENT

SEPTEMBER 29, 2016

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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

THAILAND
NSC - TISI - TIS 17025
TESTING 0207

ANALYSIS REPORT

PROJECT : UPPER BALUCHAUNG HYDROPOWER PROJECT
CUSTOMER NAME : RESOURCE & ENVIRONMENT MYANMAR LTD. (REM)
ADDRESS : B-702 DELTA PLAZA, SHWEGONDAING ROAD, BAHAN, YANGON, MYANMAR. TEL. 959 7301 3448 FAX 951 55 29 01
SAMPLING SOURCE : UPSTREAM (SW-1)
SAMPLE TYPE : SURFACE WATER
SAMPLING DATE : AUGUST 21, 2016
SAMPLING TIME : -
SAMPLING METHOD : -
SAMPLING BY : CUSTOMER
ANALYZED BY : MISS SAWITREE RIRANG

RECEIVED DATE : AUGUST 31, 2016
ANALYTICAL DATE : AUGUST 31-SEPTEMBER 22, 2016
ANALYSIS NO. : LAQ478/2016
WORK NO. : LAB3247/2016
REPORT NO. : L17879/2016

PARAMETER	UNIT	METHOD OF ANALYSIS	RESULT SW-1 LAQ478/2016	DETECTION LIMIT
*CHEMICAL OXYGEN DEMAND	mg/L	OPEN REFLUX METHOD (SM 2012:5220 B)	16.0	5.0
*AMMONIA-NITROGEN	mg/L NH_3-N	PHENATE METHOD (SM 2012:4500-NH_3 F)	0.14	0.04
*TOTAL HARDNESS	mg/L $CaCO_3$	EDTA TITRIMETRIC METHOD (SM 2012:2340 C)	168	4.0
*CHLORIDE	mg/L Cl^-	ARGENTOMETRIC METHOD (SM 2012:4500-Cl^- B)	ND	2.0
*FLUORIDE	mg/L F^-	SPADNS METHOD (SM 2012:4500-F^- D)	0.11	0.02
*CARBONATE ALKALINITY	mg/L $CaCO_3$	TITRIMETRIC METHOD (SM 2012:2320 B)	0	-
*ARSENIC	mg/L As	HYDRIDE GENERATION AAS METHOD (SM 2012:3114 C)	0.0044	0.0003

United Analyst and Engineering Consultant Co., Ltd.
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UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY LIMITED
Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

THAILAND
NSC -TISI -TIS 17025
TESTING 0207

PARAMETER	UNIT	METHOD OF ANALYSIS	RESULT SW-1 LAQ478/2016	DETECTION LIMIT
LEAD	mg/L Pb	IN-HOUSE METHOD UAE.TP.SW.01** (NITRIC ACID DIGESTION AND DIRECT AIR ACETYLENE FLAME METHOD); SM 2012:3030 E AND 3111 B	ND	0.010
*TOTAL PHOSPHORUS	mg/L P	PERSULPHATE DIGESTION AND ASCORBIC ACID METHOD (SM 2012:4500- P B AND 4500-P E)	0.02	0.01
SAMPLE CONDITION				
WATER'S COLOUR/TURBID			COLOURLESS/CLEAR	
SEDIMENT			YELLOW	

* "TEST MARKED "NOT TISI ACCREDITED" IN THIS REPORT ARE NOT INCLUDED IN THE TISI ACCREDITATION SCHEDULE FOR OUR LABORATORY"

** : BASED ON STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, APHA, AWWA, WEF, 22nd EDITION, 2012.

SM : STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, APHA, AWWA, WEF, 22nd EDITION, 2012.

ND : NON-DETECTABLE.

Manid. Ya.
(MRS MANIDA YAMYAI)
TECHNICAL MANAGEMENT
SEPTEMBER 30, 2016

Piyapat S.
(MRS PIYAPAT SUTTAMANUTWONG)
LABORATORY SUPERVISOR
SEPTEMBER 30, 2016

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ANALYSIS REPORT

PROJECT : UPPER BALUCHAUNG HYDROPOWER PROJECT

CUSTOMER NAME : RESOURCE & ENVIRONMENT MYANMAR LTD. (REM)

ADDRESS : B-702 DELTA PLAZA, SHWEGONDAING ROAD, BAHAN, YANGON, MYANMAR. TEL. 959 7301 3448 FAX 951 55 29 01

SAMPLING SOURCE : MIDDLE STREAM (SW-2)

SAMPLE TYPE : SURFACE WATER

SAMPLING DATE : AUGUST 21, 2016

SAMPLING TIME : -

SAMPLING METHOD : -

SAMPLING BY : CUSTOMER

ANALYZED BY : MISS SAWITREE RIRANG

RECEIVED DATE : AUGUST 31, 2016

ANALYTICAL DATE : AUGUST 31-SEPTEMBER 22, 2016

ANALYSIS NO. : LAQ479/2016

WORK NO. : LAB3247/2016

REPORT NO. : L17880/2016

PARAMETER	UNIT	METHOD OF ANALYSIS	RESULT SW-2 LAQ479/2016	DETECTION LIMIT
*CHEMICAL OXYGEN DEMAND	mg/L	OPEN REFLUX METHOD (SM 2012:5220 B)	17.0	5.0
*AMMONIA-NITROGEN	mg/L NH_3-N	PHENATE METHOD (SM 2012:4500-NH_3 F)	0.20	0.04
*TOTAL HARDNESS	mg/L $CaCO_3$	EDTA TITRIMETRIC METHOD (SM 2012:2340 C)	170	4.0
*CHLORIDE	mg/L Cl^-	ARGENTOMETRIC METHOD (SM 2012:4500-Cl^- B)	ND	2.0
*FLUORIDE	mg/L F^-	SPADNS METHOD (SM 2012:4500-F^- D)	0.13	0.02
*CARBONATE ALKALINITY	mg/L $CaCO_3$	TITRIMETRIC METHOD (SM 2012:2320 B)	0	-
*ARSENIC	mg/L As	HYDRIDE GENERATION AAS METHOD (SM 2012:3114 C)	0.0032	0.0003

UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY LIMITED

United Analyst and Engineering Consultant Co., Ltd.
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THAILAND
NSC -TISI -TIS 17025
TESTING 0207

PARAMETER	UNIT	METHOD OF ANALYSIS	RESULT SW-2 LAQ479/2016	DETECTION LIMIT
LEAD	mg/L Pb	IN-HOUSE METHOD UAE.TP.SW.01** (NITRIC ACID DIGESTION AND DIRECT AIR ACETYLENE FLAME METHOD); SM 2012:3030 E AND 3111 B	ND	0.010
*TOTAL PHOSPHORUS	mg/L P	PERSULPHATE DIGESTION AND ASCORBIC ACID METHOD (SM 2012:4500- P B AND 4500-P E)	0.10	0.01
SAMPLE CONDITION				
WATER'S COLOUR/TURBID			COLOURLESS/CLEAR	
SEDIMENT			YELLOW	

* "TEST MARKED "NOT TISI ACCREDITED" IN THIS REPORT ARE NOT INCLUDED IN THE TISI ACCREDITATION SCHEDULE FOR OUR LABORATORY"

** : BASED ON STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, APHA, AWWA, WEF, 22nd EDITION, 2012.

SM : STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, APHA, AWWA, WEF, 22nd EDITION, 2012.

ND : NON-DETECTABLE.

Manid. Ya.
(MRS MANIDA YAMYAI)
TECHNICAL MANAGEMENT
SEPTEMBER 30, 2016

Piyapat S.
(MRS PIYAPAT SUTTAMANUTWONG)
LABORATORY SUPERVISOR
SEPTEMBER 30, 2016

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United Analyst and Engineering Consultant Co., Ltd.
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THAILAND
NSC - TISI - TIS 17025
TESTING 0207

ANALYSIS REPORT

PROJECT	: UPPER BALUCHAUNG HYDROPOWER PROJECT		
CUSTOMER NAME	: RESOURCE & ENVIRONMENT MYANMAR LTD. (REM)		
ADDRESS	: B-702 DELTA PLAZA, SHWEGONDAING ROAD, BAHAN, YANGON, MYANMAR. TEL. 959 7301 3448 FAX 951 55 29 01		
SAMPLING SOURCE	: DOWNSTREAM (SW-3)		
SAMPLE TYPE	: SURFACE WATER	**RECEIVED DATE**	: AUGUST 31, 2016
SAMPLING DATE	: AUGUST 22, 2016	**ANALYTICAL DATE**	: AUGUST 31-SEPTEMBER 22, 2016
SAMPLING TIME	: -	**ANALYSIS NO.**	: LAQ480/2016
SAMPLING METHOD	: -	**WORK NO.**	: LAB3247/2016
SAMPLING BY	: CUSTOMER	**REPORT NO.**	: L17881/2016
ANALYZED BY	: MISS SAWITREE RIRANG		

PARAMETER	UNIT	METHOD OF ANALYSIS	RESULT SW-3 LAQ480/2016	DETECTION LIMIT
*CHEMICAL OXYGEN DEMAND	mg/L	OPEN REFLUX METHOD (SM 2012:5220 B)	16.4	5.0
*AMMONIA-NITROGEN	mg/L NH_3-N	PHENATE METHOD (SM 2012:4500-NH_3 F)	0.15	0.04
*TOTAL HARDNESS	mg/L $CaCO_3$	EDTA TITRIMETRIC METHOD (SM 2012:2340 C)	166	4.0
*CHLORIDE	mg/L Cl^-	ARGENTOMETRIC METHOD (SM 2012:4500-Cl^- B)	ND	2.0
*FLUORIDE	mg/L F^-	SPADNS METHOD (SM 2012:4500-F^- D)	0.12	0.02
*CARBONATE ALKALINITY	mg/L $CaCO_3$	TITRIMETRIC METHOD (SM 2012:2320 B)	0	-
*ARSENIC	mg/L As	HYDRIDE GENERATION AAS METHOD (SM 2012:3114 C)	0.0029	0.0003

PARAMETER	UNIT	METHOD OF ANALYSIS	RESULT SW-3 LAQ480/2016	DETECTION LIMIT
LEAD	mg/L Pb	IN-HOUSE METHOD UAE.TP.SW.01** (NITRIC ACID DIGESTION AND DIRECT AIR ACETYLENE FLAME METHOD); SM 2012:3030 E AND 3111 B	ND	0.010
*TOTAL PHOSPHORUS	mg/L P	PERSULPHATE DIGESTION AND ASCORBIC ACID METHOD (SM 2012:4500- P B AND 4500-P E)	0.02	0.01
SAMPLE CONDITION				
WATER'S COLOUR/TURBID			COLOURLESS/CLEAR	
SEDIMENT			YELLOW	

* "TEST MARKED "NOT TISI ACCREDITED" IN THIS REPORT ARE NOT INCLUDED IN THE TISI ACCREDITATION SCHEDULE FOR OUR LABORATORY"

** : BASED ON STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, APHA, AWWA, WEF, 22nd EDITION, 2012.

SM : STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, APHA, AWWA, WEF, 22nd EDITION, 2012.

ND : NON-DETECTABLE.

Manida. Yamyai

(MRS MANIDA YAMYAI)
TECHNICAL MANAGEMENT
SEPTEMBER 30, 2016

Piyapat S.

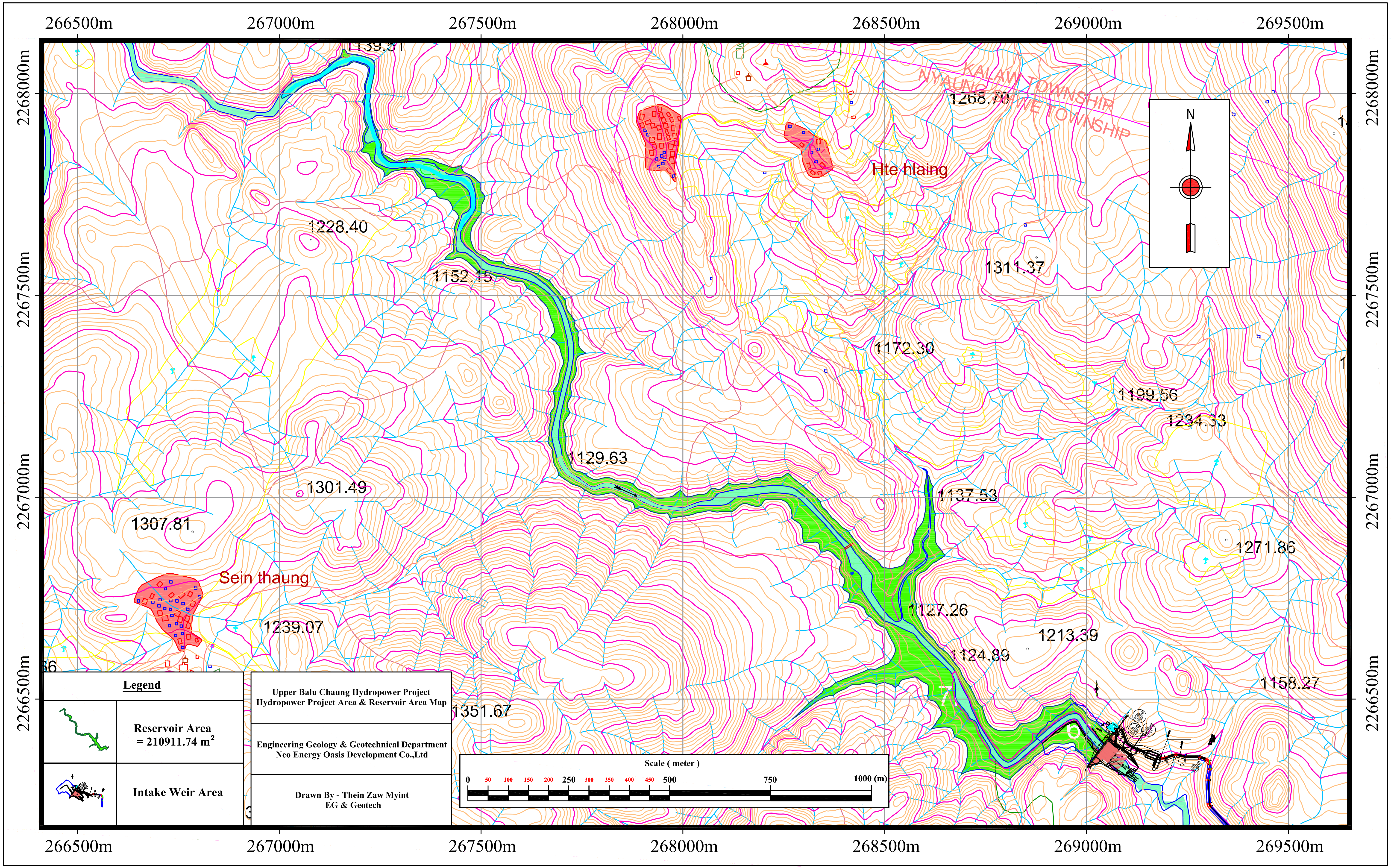
(MRS PIYAPAT SUTTAMANUTWONG)
LABORATORY SUPERVISOR
SEPTEMBER 30, 2016

- **DO NOT COPY PARTIAL OF THIS ANALYSIS REPORT WITHOUT OFFICIAL APPROVAL.**
- **REPORTED ANALYSIS REFERS TO SUBMITTED SAMPLE ONLY.**

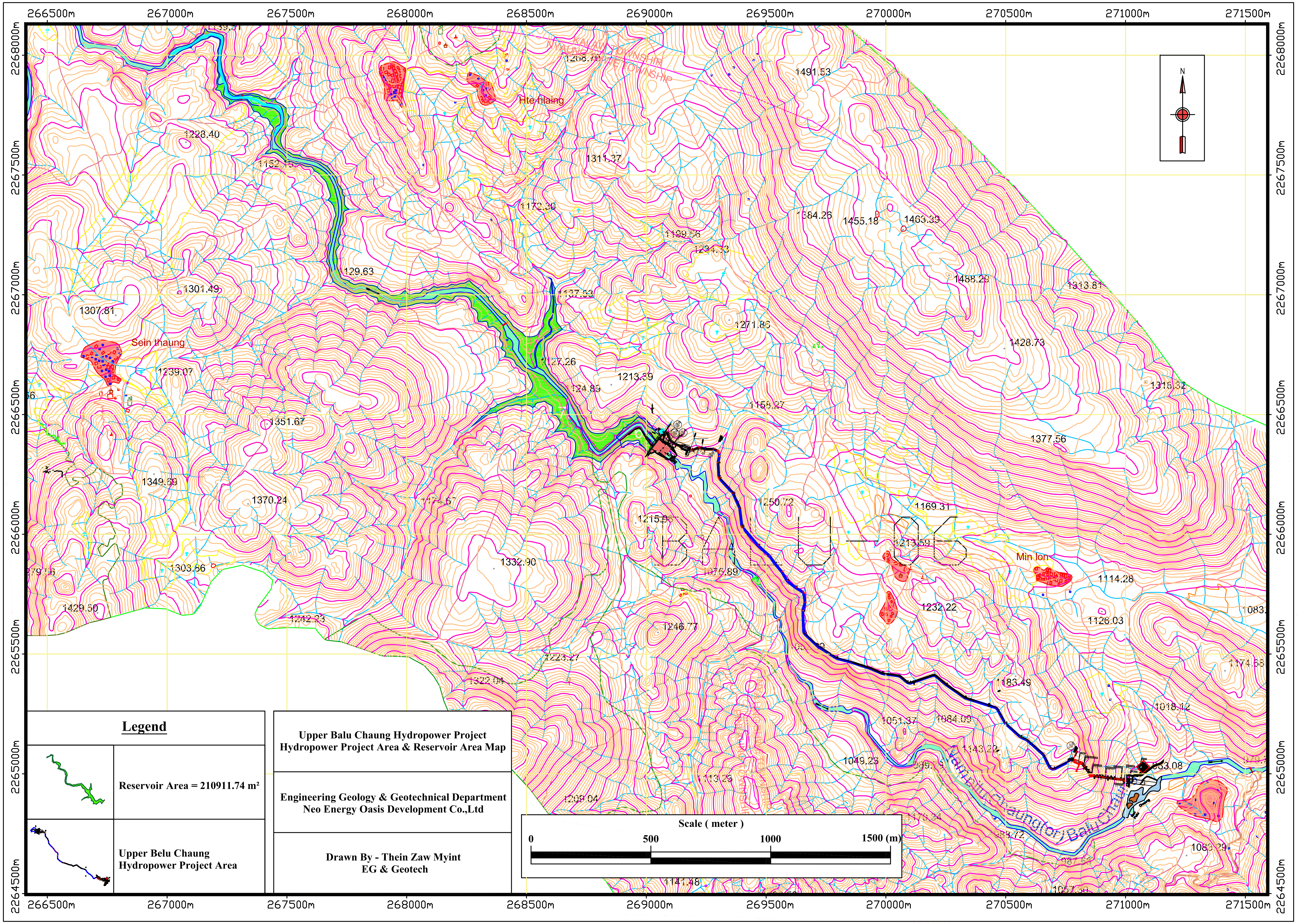
Appendix 2

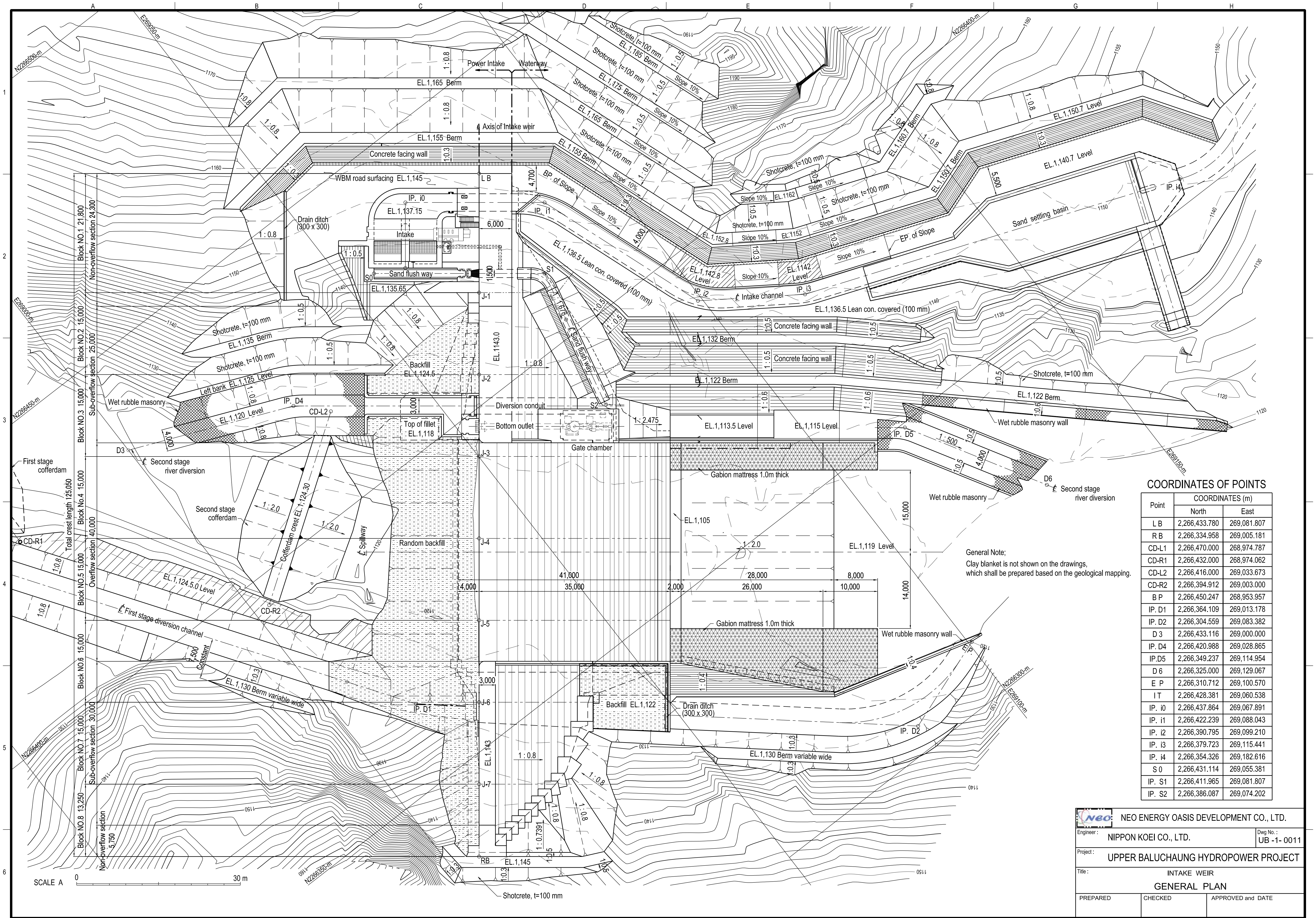
Drawing

အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်း ရေမြှုပ်ကွင်း ဧရိယာပြမြေပုံ



အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းဧရိယာနှင့် ရေမြုပ်ကွင်းဧရိယာပြမြေပုံ





General Note;
Clay blanket is not shown on the drawings, which shall be prepared based on the geological mapping.

COORDINATES OF POINTS

Point	COORDINATES (m)	
	North	East
L B	2,266,433.780	269,081.807
R B	2,266,334.958	269,005.181
CD-L1	2,266,470.000	268,974.787
CD-R1	2,266,432.000	268,974.062
CD-L2	2,266,416.000	269,033.673
CD-R2	2,266,394.912	269,003.000
B P	2,266,450.247	268,953.957
IP. D1	2,266,364.109	269,013.178
IP. D2	2,266,304.559	269,083.382
D 3	2,266,433.116	269,000.000
IP. D4	2,266,420.988	269,028.865
IP.D5	2,266,349.237	269,114.954
D 6	2,266,325.000	269,129.067
E P	2,266,310.712	269,100.570
I T	2,266,428.381	269,060.538
IP. i0	2,266,437.864	269,067.891
IP. i1	2,266,422.239	269,088.043
IP. i2	2,266,390.795	269,099.210
IP. i3	2,266,379.723	269,115.441
IP. i4	2,266,354.326	269,182.616
S 0	2,266,431.114	269,055.381
IP. S1	2,266,411.965	269,081.807
IP. S2	2,266,386.087	269,074.202

NEO ENERGY OASIS DEVELOPMENT CO., LTD.

Engineer: NIPPON KOEI CO., LTD.

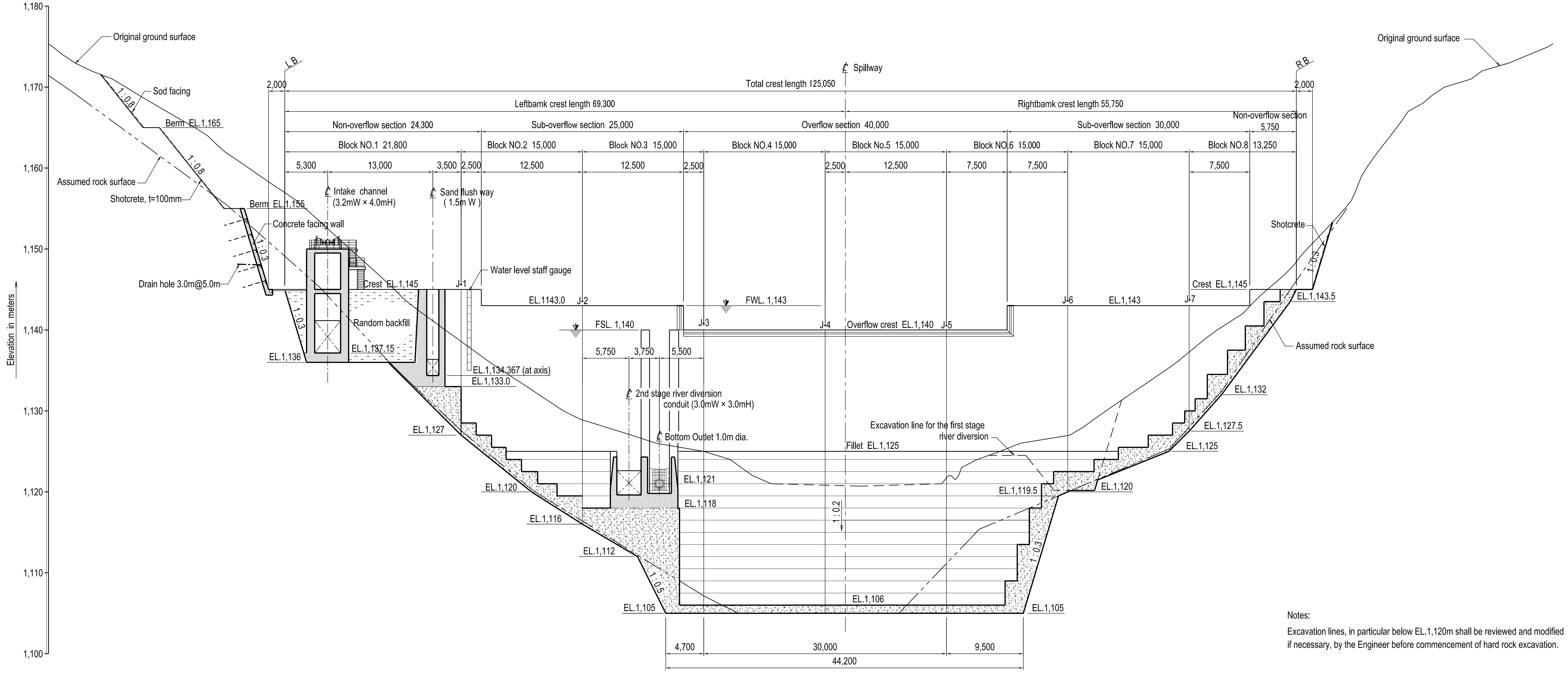
Dwg No.: UB -1- 0011

Project: UPPER BALUCHAUNG HYDROPOWER PROJECT

Title: INTAKE WEIR

GENERAL PLAN

PREPARED	CHECKED	APPROVED and DATE



Notes:

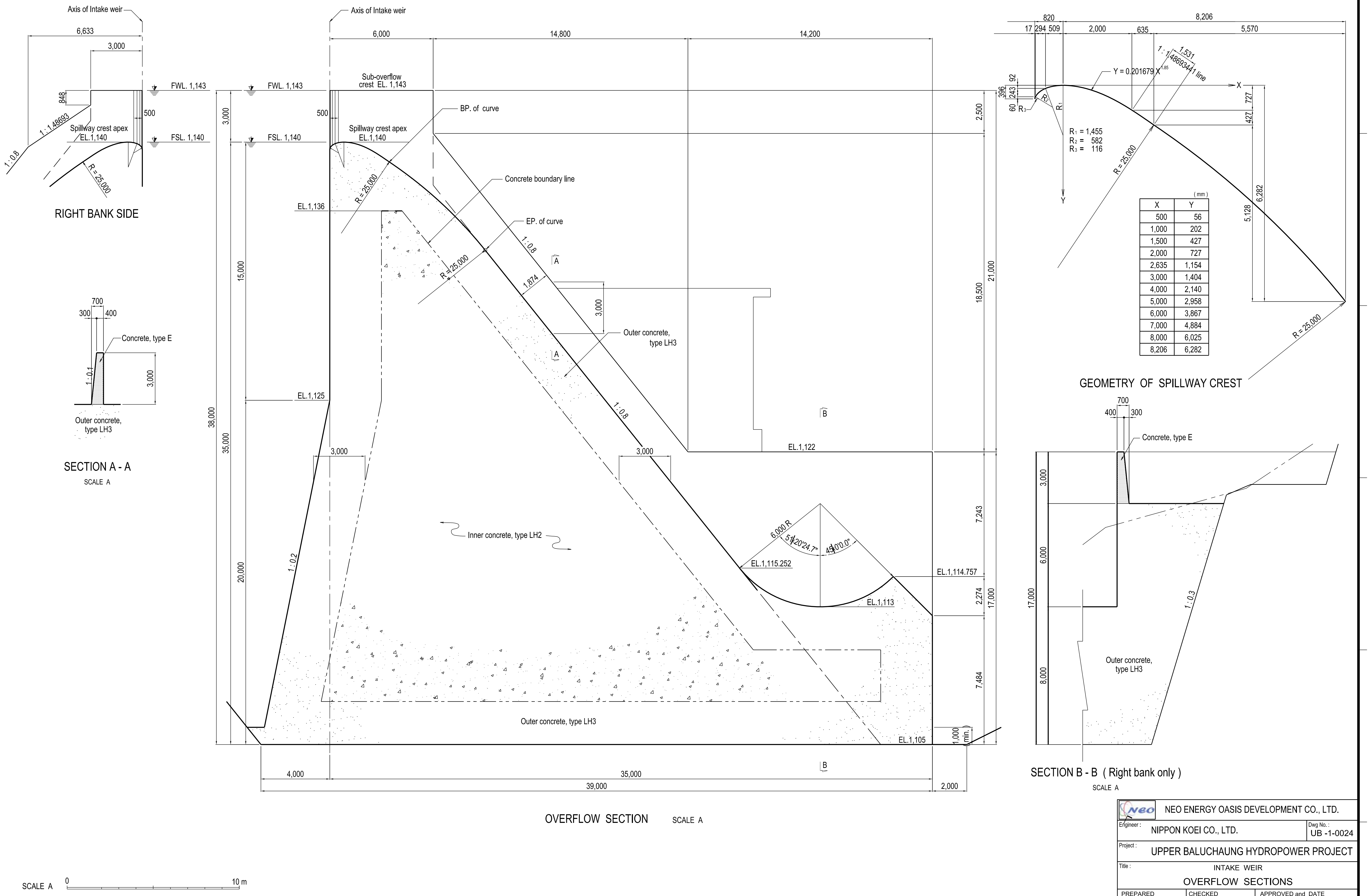
Excavation lines, in particular below EL.1,120m shall be reviewed and modified if necessary, by the Engineer before commencement of hard rock excavation.

UPSTREAM ELEVATION

SCALE A

SCALE A 0 25 m

NEO ENERGY OASIS DEVELOPMENT CO., LTD.	
Engineer : NIPPON KOEI CO., LTD.	Dwg No. : UB -1- 0021
Project : UPPER BALUCHAUNG HYDROPOWER PROJECT	
Title : INTAKE WEIR UPSTREAM ELEVATION	
PREPARED	CHECKED	APPROVED and DATE



(mm)

X	Y
500	56
1,000	202
1,500	427
2,000	727
2,635	1,154
3,000	1,404
4,000	2,140
5,000	2,958
6,000	3,867
7,000	4,884
8,000	6,025
8,206	6,282

NEO ENERGY OASIS DEVELOPMENT CO., LTD.

Engineer : NIPPON KOEI CO., LTD.

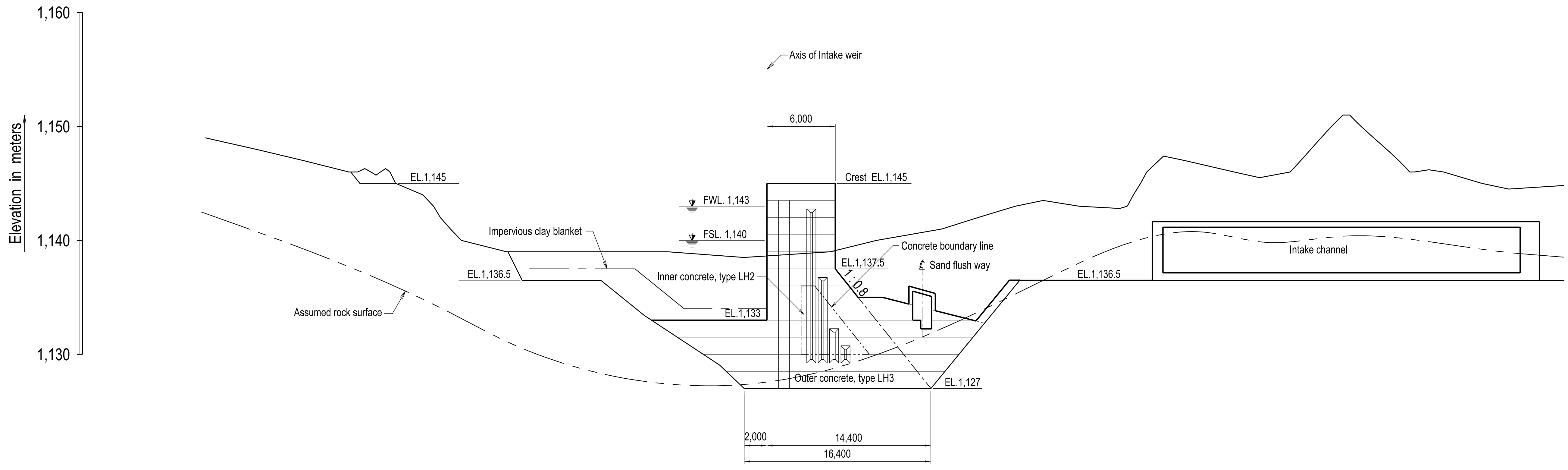
Dwg No. : UB -1-0024

Project : UPPER BALUCHAUNG HYDROPOWER PROJECT

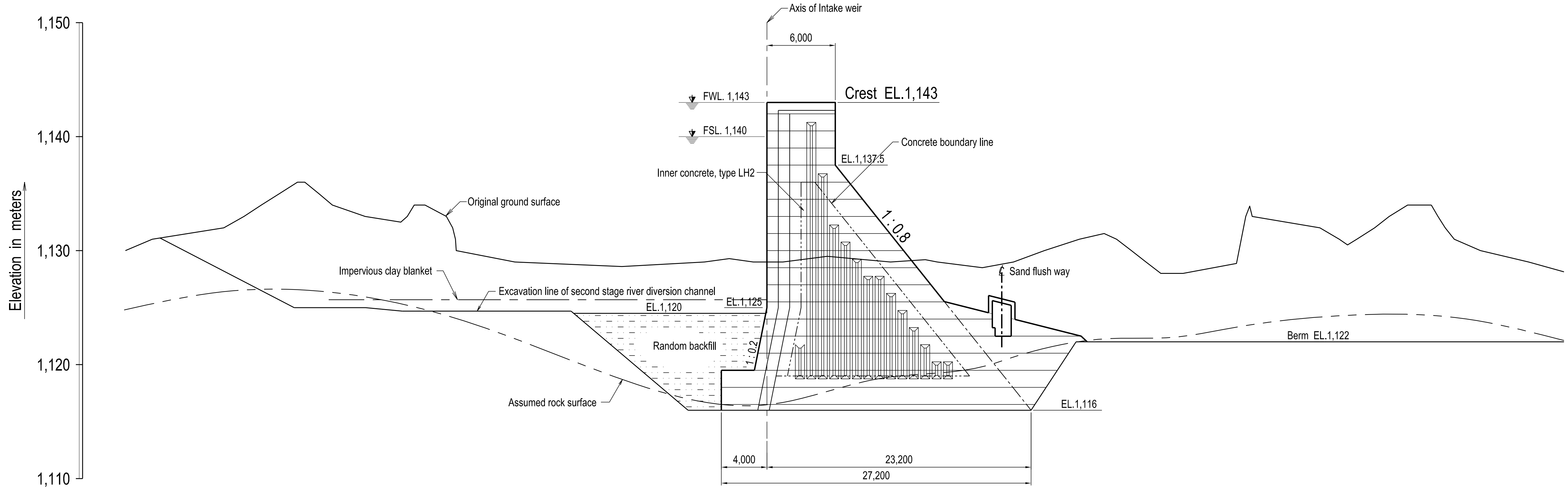
Title : INTAKE WEIR

OVERFLOW SECTIONS

PREPARED	CHECKED	APPROVED and DATE



SECTION AT J1



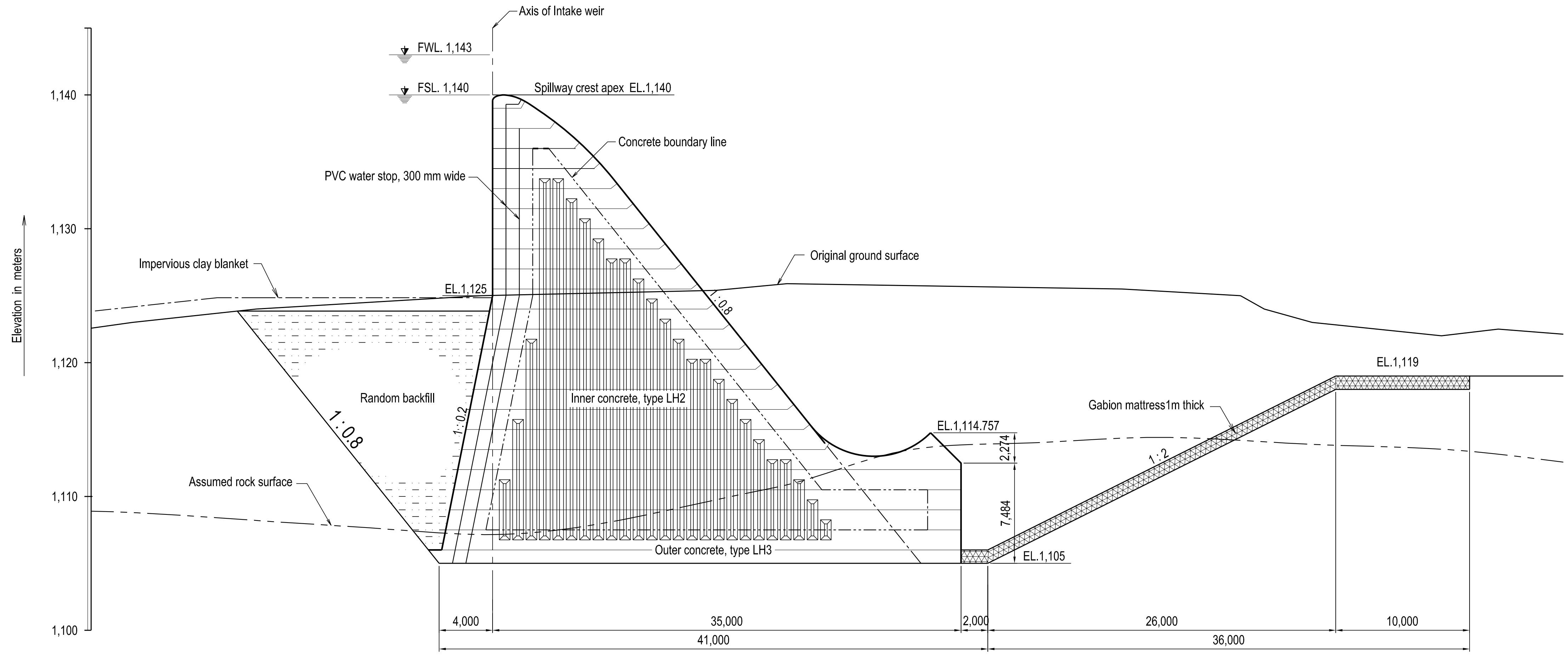
SECTION AT J2

SCALE A 0 20 m

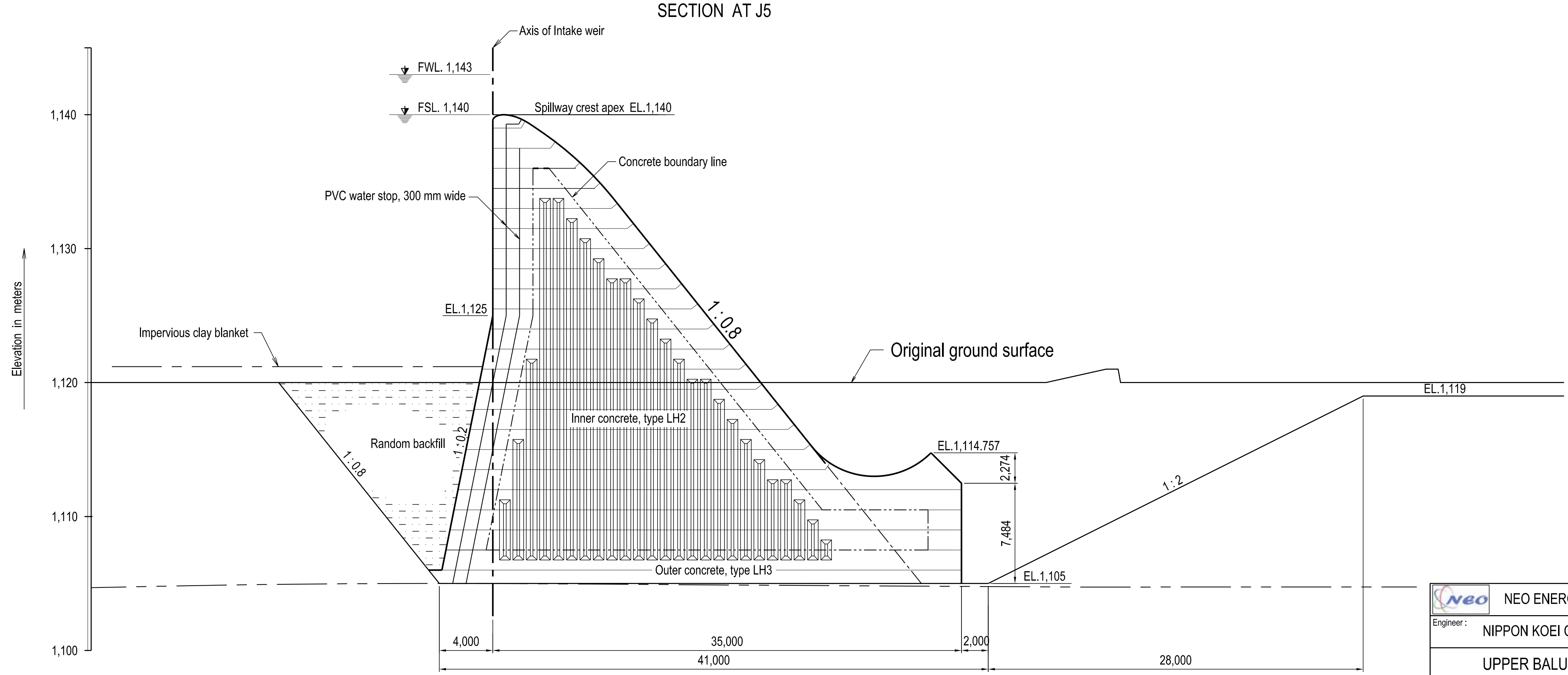
CROSS SECTION (1)

SCALE A

NEO ENERGY OASIS DEVELOPMENT CO., LTD.	
Engineer : NIPPON KOEI CO., LTD.	Dwg No. : UB -1- 0031
UPPER BALUCHAUNG HYDROPOWER PROJECT	
Title : INTAKE WEIR CROSS SECTIONS (1)	
PREPARED	CHECKED	APPROVED and DATE



SECTION AT J5

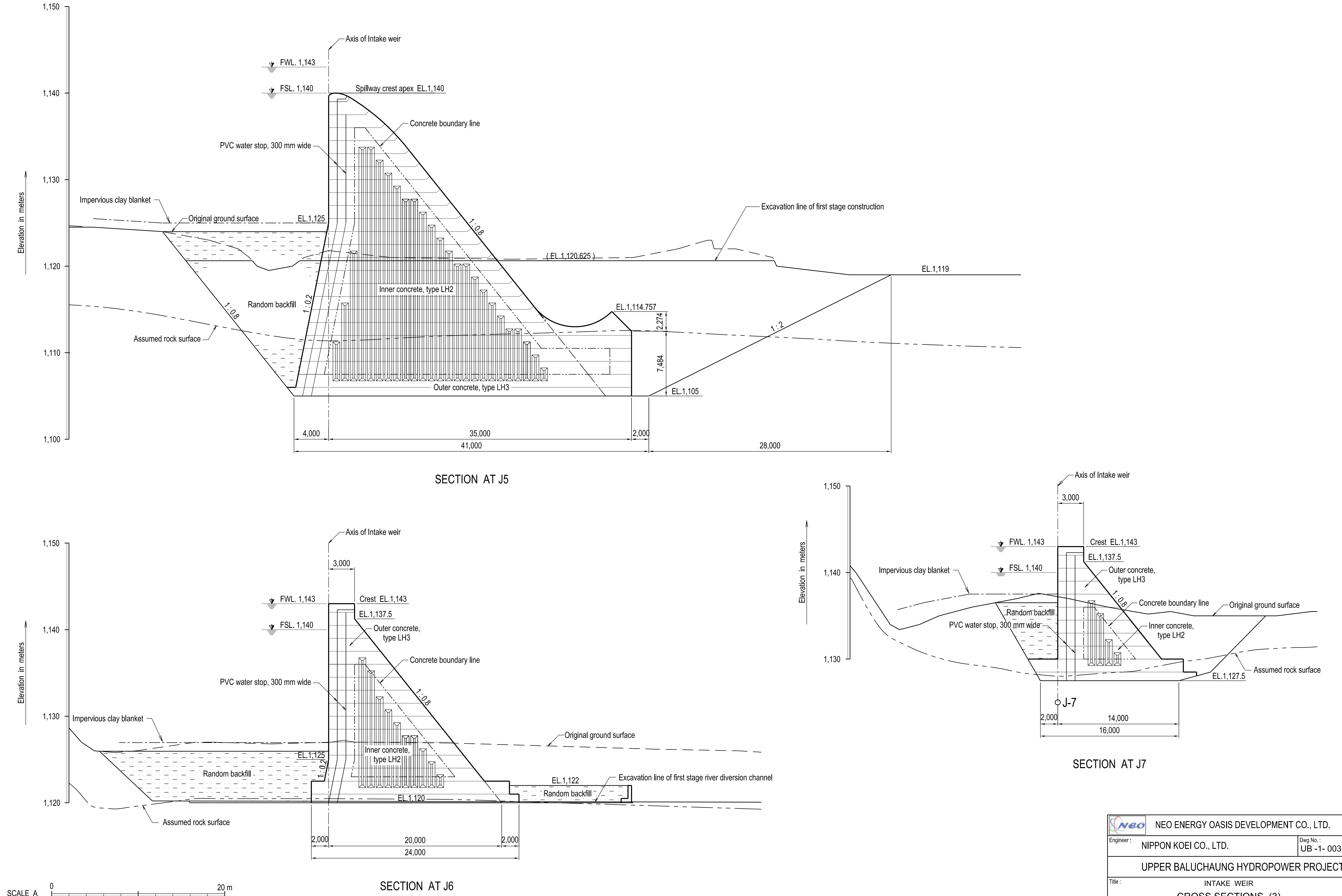


SECTION AT J4

CROSS SECTION (2)

SCALE A

NEO ENERGY OASIS DEVELOPMENT CO., LTD.	
Engineer : NIPPON KOEI CO., LTD.	Dwg No. : UB -1- 0032
UPPER BALUCHAUNG HYDROPOWER PROJECT	
Title : INTAKE WEIR CROSS SECTIONS (2)	
PREPARED	CHECKED	APPROVED and DATE



SCALE A 0 20 m

CROSS SECTION (3) SCALE A

NEO ENERGY OASIS DEVELOPMENT CO., LTD.

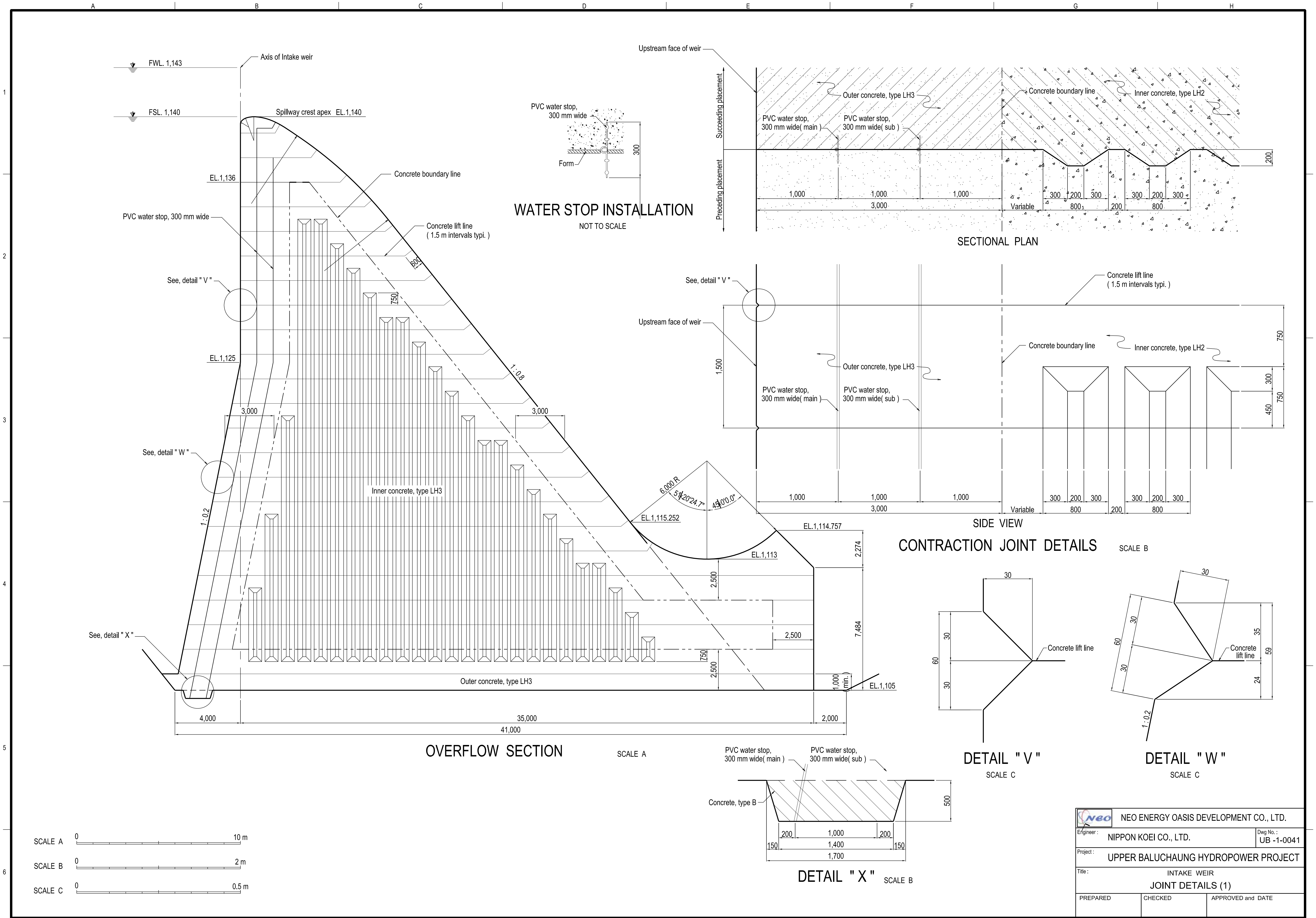
Engineer: NIPPON KOEI CO., LTD.

Dwg No.: UB -1- 0033

UPPER BALUCHAUNG HYDROPOWER PROJECT

Title: INTAKE WEIR
CROSS SECTIONS (3)

PREPARED	CHECKED	APPROVED and DATE


FWL. 1,143
FSL. 1,140
Axis of Intake weir
Spillway crest apex EL.1,140
EL.1,136
Concrete boundary line
PVC water stop, 300 mm wide
Concrete lift line
(1.5 m intervals typi.)
800
750
See, detail " V "
EL.1,125
1 : 0.8
3,000
3,000
See, detail " W "
Inner concrete, type LH3
6,000 R
51°20'24.7"
45°0'0.0"
EL.1,115.252
EL.1,114.757
EL.1,113
1 : 0.2
2,274
2,500
2,500
7,484
See, detail " X "
750
2,500
Outer concrete, type LH3
1,000 (min.)
EL.1,105
4,000
35,000
2,000
41,000
OVERFLOW SECTION
SCALE A
PVC water stop,
300 mm wide
300
Form
WATER STOP INSTALLATION
NOT TO SCALE
Upstream face of weir
Succeeding placement
Preceding placement
Outer concrete, type LH3
Concrete boundary line
Inner concrete, type LH2
PVC water stop,
300 mm wide(main)
PVC water stop,
300 mm wide(sub)
200
1,000
1,000
1,000
3,000
Variable
300 200 300
800
200
300 200 300
800
SECTIONAL PLAN
See, detail " V "
Upstream face of weir
Concrete lift line
(1.5 m intervals typi.)
1,500
Concrete boundary line
Inner concrete, type LH2
Outer concrete, type LH3
PVC water stop,
300 mm wide(main)
PVC water stop,
300 mm wide(sub)
750
300
750
450
1,000
1,000
1,000
3,000
Variable
300 200 300
800
200
300 200 300
800
SIDE VIEW
CONTRACTION JOINT DETAILS
SCALE B
30
30
60
30
Concrete lift line
DETAIL " V "
SCALE C
30
30
60
30
35
59
24
Concrete lift line
1 : 0.2
DETAIL " W "
SCALE C
PVC water stop,
300 mm wide(main)
PVC water stop,
300 mm wide(sub)
Concrete, type B
500
200
1,000
200
150
1,400
150
1,700
DETAIL " X "
SCALE B
SCALE A 0 10 m
SCALE B 0 2 m
SCALE C 0 0.5 m
NEO ENERGY OASIS DEVELOPMENT CO., LTD.
Engineer :
NIPPON KOEI CO., LTD.
Dwg No. :
UB -1-0041
Project :
UPPER BALUCHAUNG HYDROPOWER PROJECT
Title :
INTAKE WEIR
JOINT DETAILS (1)
PREPARED
CHECKED
APPROVED and DATE

Appendix 3

Public Grievance Sample Form

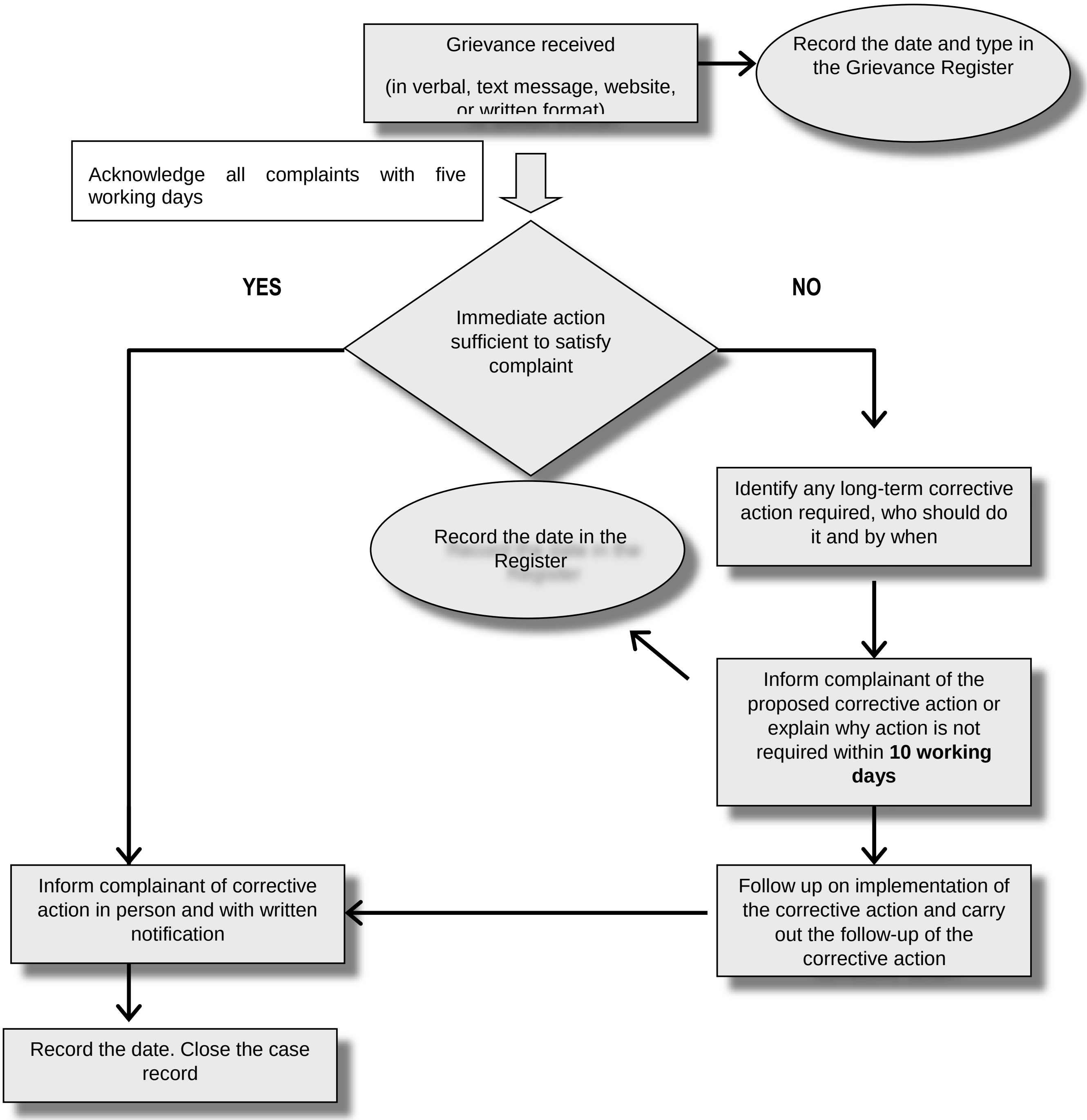
APPENDIX -3
PUBLIC GRIEVANCE SAMPLE FORM

Reference No:	
Full Name	
Contact Information **Please mark how you wish to be contacted (mail, telephone, e-mail).**	☐ **By Post: Please provide mailing address:** ______________________________ ______________________________ ______________ ☐ **By Telephone:** ______________________ ☐ **By E-mail** ______________________
Preferred Language for communication	☐ **Burmese** ☐ **English** ☐ **Other**
Description of Incident or Grievance:	What happened? Where did it happen? To whom did it happen? What is the result of the problem?
Date of Incident/Grievance	
	☐ **One time incident/grievance (date _______________)** ☐ **Happened more than once (how many times? _____)** ☐ **On-going (currently experiencing problem)**
What would you like to see happen to resolve the problem?	

Signature: ______________________________
Date: ______________________________

Please return this form to:
Name of Contact Person, Position and Title:____________________
Address:____
Tel.:____
E-mail: ____

Flowchart for Processing Grievances



Appendix 4

Meeting Minutes

အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းရပ်များကို သက်ဆိုင်သူများအား ရှင်းလင်းခြင်းနှင့် လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများမေးမြန်းခြင်း

မှတ်တမ်း

ရက်စွဲ	၃၁၊ ဩဂုတ်၊ ၂၀၁၆။
အချိန်	နံနက် ၁၁း၀၀ - ၁၂း၃၀။
နေရာ	ရာအိမ်မှူးနေအိမ်၊ ကျောက်တောရွာ၊ တုံးလည်ကျေးရွာအုပ်စု။
အစီအစဉ်များ	
အစီအစဉ် (၁) နံနက် ၁၁း၀၀	အစည်းအဝေးတက်ရောက်သူစာရင်းရယူခြင်း။
အစီအစဉ် (၂) နံနက် ၁၁း၁၅	Sustainable Environment Myanmar Co., Ltd (SEM) ၏ Senior Consultant (Social) ဒေါ်မြတ်သစ္စာနိုင်မှ ပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်း (ESIA) လုပ်ငန်းကို ရှင်းလင်းပြောကြားခြင်း။ ၁။ စီမံကိန်း ခြုံငုံသုံးသပ်ချက် - စွမ်းအားသစ်အိုအေစစ်ဖြိုးတိုးတက်မှု ကုမ္ပဏီလီမိတက် (Neo Energy Oasis Development Company Ltd.) ရှမ်းပြည်နယ် ညောင်ရွှေမြို့နယ် အင်းတိန်ကျေးရွာ၏ ချောင်းအထက် ၅ကီလိုမီတာ ခန့်အကွာရှိ မင်းလုံးကျေးရွာ အနီးတွင် ၃၀.၄ မဂ္ဂါဝပ် ရေအားလျှပ်စစ် စက်ရုံ တည်ဆောက်ရန် စီစဉ်ထားပါသည်။ - Resource and Environment Myanmar Co, Ltd., (REM) နှင့် Sustainable Environment Myanmar (SEM) Co, Ltd., တို့သည် အဆိုပါ စီမံကိန်းအတွက် သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင် အကျိုးသက်ရောက်မှု ဆန်းစစ်ခြင်း (ESIA) ကို လုပ်ဆောင်မည် ဖြစ်ပါသည်။ - ESIA သည် ဖြစ်နိုင်ခြေရှိသော သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင်

	အကျိုးသက်ရောက်မှုများ၊ အခွင့်အလမ်းများကို နိုင်ငံတကာစံချိန်စံညွှန်းများနှင့် အညီ လေ့လာခြင်းဖြစ်ပါသည်။ - ယခု အစည်းအဝေးသည် စီမံကိန်းအကြောင်း ခြုံငုံရှင်းပြရန်နှင့် စီမံကိန်းအပေါ် ဒေသခံတို့၏ သဘောထားအမြင်ကို နားလည်သိရှိရန်ဖြစ်ပါသည်။ ၂။ အထက်ဘီးလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်း၏ ယေဘုယျ ဖွဲ့စည်းပုံ အစီအစဉ်။ ၃။ စီမံကိန်းအကြောင်းအရာ။ ၄။ အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းအတွက် ပတ်ဝန်းကျင်နှင့် လူမှုအကျိုး သက်ရောက်မှု လေ့လာခြင်း။
အစီအစဉ် (၃) နံနက် ၁၁း၂၀	NEO Co., Ltd ၏ လက်ထောက် အထွေထွေမန်နေဂျာ ဦးဟန်မင်းထွန်းမှ စီမံကိန်းအကြောင်းအရာ အကျဉ်းချုပ်ကို ရှင်းလင်းပြောကြားခြင်း။
	မေးမြန်းဆွေးနွေးသူများ မရှိပါ။
အစီအစဉ် (၄) နံနက် ၁၁း၃၀	လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများ မေးမြန်းခြင်း။
နံနက် ၁၂း၂၅	အစီအစဉ်များ ပြီးဆုံးသည်။

အစည်းအဝေးတက်ရောက်သူများ

အစည်းအဝေးတက်ရောက်သူစုစုပေါင်းမှာ (၂၄) ဦးဖြစ်ပါသည်။ ကုမ္ပဏီများမှ (၉) ဦးဖြစ်ပြီး ဒေသခံရပ်မိရပ်ဖ (၁၅) ဦးဖြစ်ပါသည်။ တက်ရောက်သူစာရင်းမှာ အောက်ပါအတိုင်းဖြစ်ပါသည်။

SEM Co., Ltd မှတက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဒေါ်မြတ်သစ္စာနိုင်	Senior Consultant (Social)
၂။	ဒေါ်ဝါဝါဆန်း	Social Consultant and Data Analyst
၃။	ဒေါ်ပိုးမွန်မွန်ကျော်	Environmental Health and Safety Consultant
၄။	ဒေါ်အိမုံခင်	Consultant (Social)

NEO Co., Ltd မှ တက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးဟန်မင်းထွန်း	လက်ထောက်အထွေထွေ မန်နေဂျာ။
၂။	ဦးစိန်ကျော်	Staff
၃။	ဦးမောင်ငယ်	Staff
၄။	မနီနီဝင်း	Staff
၅။	မချိုချိုခိုင်	Staff

ရပ်မိရပ်ဖ၊ ဒေသခံပြည်သူများ

ကျောက်တောရွာ ★ 3

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ [illegible] လ၊([illegible])ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဦးသိန်းထွန်း	လယ်	ကျောက်တော	09-265857767	သိန်းထွန်း
၂။	ဦးသိန်းဆွေ	လယ်	"	09-32468777	သိန်းဆွေ
၃။	ဦးတင်	လယ်	"	"	[illegible]
၄။	ဦးသန်း	တောင်ယာ	"	-	ဦးသန်း
၅။	ဦးကောင်း	[illegible] (ဆယ်အိမ်မှူး)	"	09-36088505	ဦးကောင်း
၆။	ဦးမိုလ်	[illegible]	"	-	
၇။	ဦးမောင်လေး	[illegible]	"	-	[illegible]
၈။	ဦးကျော်ထွန်း	တောင်ယာ	"	-	ကျော်ထွန်း

မောင်လေး

၇

ကျောက်တော ၊ ဂျက်မ်မှူး ဇရပ်

၁၁:၀၀ - ၁၂:၃၀ am

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ၊(၃၁)ရက်

ရပ်ရွာမှ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဒေါ်သိန်းကြည်	လယ်	ကျောက်တောရွာ	-	
၂။	မောင်မျိုး	လယ်	ကျောက်တောရွာ	-	
၃။	ဦးအောင်မြေ	စက်အင်ဂျင်မှူး	ကျောက်တောရွာ	09-4539629954	မြေ
၄။	ကိုချမ်းသာ	တောင်ယာ	ကျောက်တောရွာ	09-254536827	သာ

၈

ကျောက်တောရွာ

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ၊(၃၁)ရက်

ရပ်ရွာမှ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	မနှင်း	ခြံယာ ၊ လယ်	ကျောက်တောရွာ	-	
၂။	ဝင်းကျော်	ခြံယာ ၊ ဆယ်အင်ဂျင်မှူး	ကျောက်တောရွာ	-	ဝင်းကျော်
၃။	မဖွား	ဈေးမြို့ရေး	ကျောက်တောရွာ	-	

ဓာတ်ပုံမှတ်တမ်းများ











အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းရပ်များကို သက်ဆိုင်သူများအား ရှင်းလင်းခြင်းနှင့် လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများမေးမြန်းခြင်း

မှတ်တမ်း

ရက်စွဲ	၂၊ စက်တင်ဘာလ၊ ၂၀၁၆။
အချိန်	နံနက် ၈း၃၀ - ၁၂း၃၀
နေရာ	ဘုန်းကြီးကျောင်း၊ မင်းလုံးရွာ၊ တုံးလည်ကျေးရွာအုပ်စု။
အစီအစဉ်များ	
အစီအစဉ် (၁) နံနက် ၈း၃၀	အစည်းအဝေးတက်ရောက်သူစာရင်းရယူခြင်း။
အစီအစဉ် (၂) နံနက် ၁၀း၀၅	Sustainable Environment Myanmar Co., Ltd (SEM) ၏ Senior Consultant (Social) ဒေါ်နယည်မှ ပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်း (ESIA) လုပ်ငန်းကို ရှင်းလင်းပြောကြားခြင်း။ ၁။ စီမံကိန်း ခြုံငုံသုံးသပ်ချက် - စွမ်းအားသစ်အိုအေစစ်ဖြိုးတိုးတက်မှု ကုမ္ပဏီလီမိတက် (Neo Energy Oasis Development Company Ltd.) ရှမ်းပြည်နယ် ညောင်ရွှေမြို့နယ် အင်းတိန်ကျေးရွာ၏ ချောင်းအထက် ၅ကီလိုမီတာ ခန့်အကွာရှိ မင်းလုံးကျေးရွာ အနီးတွင် ၃၀.၄ မဂ္ဂါဝပ် ရေအားလျှပ်စစ် စက်ရုံ တည်ဆောက်ရန် စီစဉ်ထားပါသည်။ - Resource and Environment Myanmar Co, Ltd., (REM) နှင့် Sustainable Environment Myanmar (SEM) Co, Ltd., တို့သည် အဆိုပါ စီမံကိန်းအတွက် သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင် အကျိုးသက်ရောက်မှု ဆန်းစစ်ခြင်း (ESIA) ကို လုပ်ဆောင်မည် ဖြစ်ပါသည်။ - ESIA သည် ဖြစ်နိုင်ခြေရှိသော သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင်

	အကျိုးသက်ရောက်မှုများ၊ အခွင့်အလမ်းများကို နိုင်ငံတကာစံချိန်စံညွှန်းများနှင့် အညီ လေ့လာခြင်းဖြစ်ပါသည်။ - ယခု အစည်းအဝေးသည် စီမံကိန်းအကြောင်း ခြုံငုံရှင်းပြရန်နှင့် စီမံကိန်းအပေါ် ဒေသခံတို့၏ သဘောထားအမြင်ကို နားလည်သိရှိရန် ဖြစ်ပါသည်။ ၂။ အထက်ဘီးလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်း၏ ယေဘုယျ ဖွဲ့စည်းပုံ အစီအစဉ်။ ၃။ စီမံကိန်းအကြောင်းအရာ။ ၄။ အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းအတွက် ပတ်ဝန်းကျင်နှင့် လူမှုအကျိုး သက်ရောက်မှု လေ့လာခြင်း။
အစီအစဉ် (၄) နံနက် ၁၀း၁၀ **မေး၁။**	တက်ရောက်လာသူများမှ မေးမြန်းဆွေးနွေးခြင်းနှင့် ပြည်လည်ဖြေကြားပေးခြင်း။ ကိုဝင်းနိုင်၊ တောင်ယာလုပ်ငန်း။ ကျွန်တော့်နာမည်ကတော့ ကိုဝင်းနိုင်လို့ခေါ်ပါတယ်။ ညောင်ရွှေမြို့နယ်၊ တုံးလည်ကျေးရွာအုပ်စု၊ မင်းလုံးကျေးရွာမှာ နေပါတယ်။ သဘာဝပတ်ဝန်းကျင်နဲ့ပတ်သက်ပြီး ဆန်းစစ်ထားပြီးပြီဆိုတော့ ဒီလိုမြေထု၊ ရေထု၊ လေထုကို ဆန်းစစ်ထားပြီဆိုတော့ လေထု၊ ရေထုရဲ့သက်ရောက်မှုက ကောင်းကျိုးနဲ့ ဆိုးကျိုး ဘယ်ဟာများလဲ ဆိုတာသိချင်ပါတယ်။
ဖြေ	ဒေါ်နယဉ်၊ SEM Co., Ltd ဟုတ်ကဲ့ရှင့်၊ အခုဟာကတော့ လေ့လာပြီးတဲ့ အဆင့်ပဲရှိသေးတယ်။ သုံးသပ်တဲ့ အဆင့်ကတော့ မလုပ်ရသေးဘူး။ ပြီးတော့မှ ထွက်လာမှာပါရှင့်။ ခုနက ပြောသလိုပဲ သုံးသပ်လို့ရတဲ့အခါ အစီရင်ခံစာထုတ်မယ်။ အစီရင်ခံစာထုတ်ပြီးတော့ ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးဝန်ကြီးဌာနကိုတင် တင်မှာမဟုတ်ဘူး။ အနည်းဆုံးတော့ မြို့နယ်မှာဖြစ်စေ၊ ရွာမှာဖြစ်စေ ရလာတဲ့ရလဒ် ကောင်းကျိုး ဆိုးကျိုးတွေ အကုန်လုံးကို ရွာတွေကို ပေးထားမယ့်။ အဲ့ဒီ အကျဉ်းချုပ်

	အစီရင်ခံစာကို ဖတ်လို့ရတယ်။ ရေထု၊ လေထုအခြေအနေ၊ လူမှုစီးပွားရေး အချက်အလက်တွေ ပါလိမ့်မယ်။ အကျဉ်းချုပ်လေး ရေးထားတာကို ဖတ်ပြီးတော့မှ မောင်လေးတို့အနေနဲ့ တကယ်လို့ လိုအပ်တာရှိတာ၊ အကြံဉာဏ် ပေးချင်တာရှိရင်လည်း စာရေးပြီးတော့ပေးလို့ရတယ်။ အခုဟာကတော့ လေ့လာတဲ့အဆင့်ပဲရှိနေသေးတယ်။ ရလဒ်တွေကို ရွာကရှိတဲ့လူတွေကိုလည်း ပြန်ပြီးတော့ တင်ပြပေးမှာပါ။ ရွာကလူတွေ အကြံပေးတဲ့အချက်တွေကို ယူပြီးတော့မှ ပြည့်စုံတဲ့ အစီရင်ခံစာတစ်ခုကို ပြန်ပြီးတော့တင်ပြပေးမှာပါ။ အခုလောလောဆယ်တော့ ကောင်းလား၊ ဆိုးလားဆိုတဲ့ဟာကို အဖြေမပေးနိုင်သေးပါဘူး။
မေး၂။	ကိုအောင်ကျော်၊ ခြံလုပ်ငန်း။ ESIA ဆိုတဲ့ အရှည်လေးသိချင်ပါတယ်ခင်ဗျ။
ဖြေ	ဒေါ်နယည်၊ SEM Co., Ltd Environmental and Social Impact Assessment ပါရှင့်။ သဘာဝ ပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်းပါရှင့်။
ဖြည့်စွက်ဆွေးနွေး။	ဦးထွန်းတင်၊ တုံးလည်ကျေးရွာအုပ်စု အုပ်ချုပ်ရေးမှူး။ ကောင်းကျိုးရော၊ ဆိုးကျိုးရောရှိမှာပါ။ ဆိုးတဲ့ဘက်ကကြည့်ရင် အဆိုးပဲမြင်မှာပါ။ အကောင်းအဆိုး နှစ်ဖက်လုံးက ကြည့်ရင် အကောင်းရော မြင်မှာပါ။ ဒေသခံတွေ အားလုံး အဆိုးဘက်ကကြည့်ရင်တော့ ကျေးလက်ဒေသဖွံ့ဖြိုးရေးဆိုတာ ဖြစ်လာမှာ မဟုတ်ပါဘူး။ ကုမ္ပဏီလာတဲ့ အတွက်ကြောင့် ကျေးလက်ဒေသ ဖွံ့ဖြိုးရေးအနေနဲ့ လမ်းတွေကောင်းလာပါတယ်။ ဒါပေမယ့် အခုပြောရမယ့်ကိစ္စက မြေပြဿနာပေါ့နော်။ တောင်သူတွေကို ဖြေရှင်းပေးရမှာ မြေပဲမလား။
ဖြေ	အရေးကြီးတာကတော့ မြေကိစ္စပေါ့။ မြန်မြန်ဆန်ဆန် ပြီးချင်ပါတယ်။ ပြဿနာတက်ရင် ဖြေရှင်းရခက်တယ်။ တောင်သူနဲ့ ကျွန်တော်ရအောင် ညှိပါမယ်။ ကျွန်တော်အုပ်ချုပ်ရေးမှူးလုပ်တဲ့ သက်တမ်း ၅ လအတွင်းမှာ

	မြေယာ အမှုတွဲ ၃၂ ခုရှိပါတယ်။ ဖြေရှင်းပြီးတာ ၂၀ ကျော်လောက်ရှိပါပြီ။ မြေယာကိစ္စနဲ့ ရောင်းတဲ့အခါ ကျေးရွာအုပ်ချုပ်ရေးမှူးလည်း သိရမယ်၊ ကိုယ့်သဘောနဲ့ကိုယ် ရောင်းတဲ့အခါ ဖြစ်လာတဲ့ပြဿနာကို ဖြေရှင်းလို့မရဘူး ဆိုတာ သိထားဖို့လိုတယ်။ တစ်ချို့နားလည်မှုနဲ့ ရောင်းလိုက်တဲ့အခါ ပြဿနာ ဖြစ်လာမှ သိရရင်ဖြေရှင်းတဲ့အခါ ခက်ခဲပါတယ်။ တောင်သူဘက်ကတော့ နာတာတော့ နာတာပေါ့။ ဒါပေမယ့် ကုမ္ပဏီဘက်ကလည်း ကောင်းအောင် လုပ်ပေးစေချင်ပါတယ်။ တောင်သူတွေဘက်ကလည်း ဥက္ကဋ္ဌက မပြောပေးဘူး လားဆိုပြီး ဖုန်းအမြဲဆက်ပါတယ်။ ညှိပေးတယ်လို့ ပြန်ပြောပါတယ်။ ကောင်းကျိုးနဲ့ ဆိုးကျိုးတွဲနေပေမယ့် ရင်းနှီးမြှုပ်နှံမှုက အများကြီးပြုလုပ်ထားပြီး ဖြစ်လို့ စီမံကိန်းပြီးစေချင်ပါတယ်။ ဦးအောင်မျိုးဝင်း၊ AE, NEO Co., Ltd။ မြေကိစ္စအတွက်က ကော်မရှင်ဖွဲ့စည်းထားပါတယ်။ အဲ့ဒီကော်မရှင်က ညှိနှိုင်းပြီး ဖြေရှင်းမှာပါ။ ဆုံးဖြတ်ချက်ချမှာပါ။ မီးကတော့ ၅၀ ကီလိုဝပ် Transformer တစ်လုံးတပ်ဆင်ပေးဖို့ရှိပါတယ်။
အစီအစဉ် (၅) နံနက် ၁၀း၂၀	လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများ မေးမြန်းခြင်း။
နံနက် ၁၂း၁၅	အစီအစဉ်များ ပြီးဆုံးသည်။

အစည်းအဝေးတက်ရောက်သူများ

အစည်းအဝေးတက်ရောက်သူစုစုပေါင်းမှာ (၃၁) ဦးဖြစ်ပါသည်။ ကုမ္ပဏီများမှ (၈) ဦးဖြစ်ပြီး ဒေသခံ ရပ်မိရပ်ဖ (၂၃) ဦးဖြစ်ပါသည်။ တက်ရောက်သူစာရင်းမှာ အောက်ပါအတိုင်းဖြစ်ပါသည်။

SEM Co., Ltd မှတက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးဉာဏ်လင်းမောင်	Senior Consultant (Ecology)
၂။	ဒေါ်နယည်	Senior Consultant (Social)
၃။	ဒေါ်မြတ်သစ္စာနိုင်	Senior Consultant (Social)
၄။	ဒေါ်ဝါဝါဆန်း	Social Consultant and Data Analyst
၅။	ဒေါ်ပိုးမွန်မွန်ကျော်	Environmental Health and Safety Consultant
၆။	ဒေါ်အိမုံခင်	Consultant (Social)

NEO Co., Ltd မှ တက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးအောင်မျိုးဝင်း	AE
၂။	ဦးသိန်းဝင်း	Staff

ရပ်မိရပ်ဖ၊ ဒေသခံပြည်သူများ

၉:၃၀ - 12:30
မင်းလုံးရွာ ၊ ဘုန်းကြီးကျောင်း

အထက်ဘဲလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဦးမောင်ငယ်	ရုံထမ်း၊ ဆယ်အိမ်မှူး	မင်းလုံးရွာ	09- -	ငယ်
၂။	ဦးမြ	မဲဆင်း၊	"	-	ဦးမြ
၃။	ဦးသိန်းမောင်	တောင်သူ (သူ့ပိုင်ဖက်)	"	-	ဦးသိန်းမောင်
၄။	ကိုသိန်းဝင်း	" (ရပ်ရွာအကောင်အထည်ဖော်ကော်မတီဝင်)	"	09-786775657 09-263307345	
၅။	ကိုမင်းဇော်	ကျေးရွာရုံထမ်း	"	09-361198578	
၆။	ကိုဇင်းကျော်	တောင်သူ	"	09-253370776	
၇။	ကိုဝင်းနိုင်	တောင်သူ	"	09-784962258	
၈။	ကိုအောင်ကွင်း	"	"	09-25796-	
၉။	ဦးကျော်စိုး	"	"	-	ဦးကျော်စိုး
၁၀။	ဦးအောင်	"	"	09-786090259	ဦးအောင်

8:30 - 12:30

မင်းလုံးရွာ ၊ ဘုန်းကြီးကျောင်း

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၉ခုနှစ်၊စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁	ဦးအောင်ကြိုး	၁၀အိမ်မှူး	တုံးလည်ရွာ	09454656545	[illegible]
၂.	ဦးထွန်းတင်	အုပ်စုအုပ်ချုပ်ရေးမှူး	တုံးလည်ရွာ	09 258302332	[illegible]
၃.	ဦးအောင်ဖြူ	ခြံလုပ်	မင်းလုံးရွာ	-	[illegible]
၄.	ဦးရွှေ	ရာအိမ်မှူး (ပုဂ္ဂလိက)	မင်းလုံးရွာ	0949353732	ရွှေ
၅။	ကိုကျော်ဇေကျော်	ခြံ	။	09-792545873	[illegible]
၆။	ကိုလှမောင်	ခြံလုပ်	ထီးလှိုင်ရွာ	09-258749220	လှမောင်
၇။	ဦးခဲ	ခြံလုပ်	။	09--	ဦးခဲ
၈။	ဦးဂဲထွန်း	ခြံလုပ်	။	09-[illegible]3480	[illegible]
၉။	ဦးကာ	ရာအိမ်မှူး (၁၀/၁၀)	။	-	[illegible]

8:30 - 12:30

မင်းလုံးရွာ ၊ ဘုန်းကြီးကျောင်း

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၉ခုနှစ်၊ စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးကျော်စိုးဇော	တောင်သူ	မင်းတုံ	09-784962154	ကျော်ဇော
၂.	ကိုအောင်ဦး	။	။	09-454656494	အောင်ဦး
၃.	ဦးခင်မောင်	။	။	ဖုန်း မရှိပါ	ခင်မောင်
၄.	ကိုချစ်ကို	။	။	09-36168129	ချစ်ကို

ဓာတ်ပုံမှတ်တမ်းများ











အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်း ဆောင်ရွက်ရာ မြေယာကိစ္စနှင့်ပတ်သက်သောလူများကို တွေ့ဆုံမေးမြန်းဆွေးနွေးခြင်း

မှတ်တမ်း

ရက်စွဲ	၂၊ စက်တင်ဘာလ၊ ၂၀၁၆။
အချိန်	နေ့လည်၊ ၃း၂၀ - ၄း၂၅။
နေရာ	ဘုန်းကြီးကျောင်း၊ နောက်ပိုးရွာ၊ နောင်တရားမြို့နယ်။
အစီအစဉ်များ	
အစီအစဉ် (၁)	အစည်းအဝေးတက်ရောက်သူစာရင်းရယူခြင်း။
အစီအစဉ် (၂)	Sustainable Environment Myanmar Co., Ltd (SEM) ၏ Senior Consultant (Social) ဒေါ်နယဉ်မှ ပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်း (ESIA) လုပ်ငန်း အကျဉ်းချုပ်ကို ရှင်းလင်းပြောကြားခြင်း။
အစီအစဉ် (၃)	ကျေးရွာအုပ်ချုပ်ရေးမှူးနှင့်တကွ သက်ဆိုင်သူများကို ဆွေးနွေးမေးမြန်းခြင်း။

အစည်းအဝေးတက်ရောက်သူများ

အစည်းအဝေးတက်ရောက်သူစုစုပေါင်းမှာ (၄၁) ဦးဖြစ်ပါသည်။ ကုမ္ပဏီများမှ (၈) ဦးဖြစ်ပြီး ဒေသခံရပ်မိရပ်ဖ (၃၃) ဦးဖြစ်ပါသည်။ တက်ရောက်သူစာရင်းမှာ အောက်ပါအတိုင်းဖြစ်ပါသည်။

SEM Co., Ltd မှတက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးဉာဏ်လင်းမောင်	Senior Consultant (Ecology)
၂။	ဒေါ်နယည်	Senior Consultant (Social)
၃။	ဒေါ်မြတ်သစ္စာနိုင်	Senior Consultant (Social)
၄။	ဒေါ်ဝါဝါဆန်း	Social Consultant and Data Analyst
၅။	ဒေါ်ပိုးမွန်မွန်ကျော်	Environmental Health and Safety Consultant
၆။	ဒေါ်အိမုံခင်	Consultant (Social)

NEO Co., Ltd မှ တက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးအောင်မျိုးဝင်း	AE
၂။	ဦးသိန်းဝင်း	Staff

ရပ်မိရပ်ဖ၊ ဒေသခံပြည်သူများ

နောက်ရိုးရွာ 3:20 - 4:25 pm

ဘုန်းကြီးကျောင်း,

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ကိုအောင်ကျော်	ဖြူ(တောင်ယာ)	ရာဇဗိုလ်ရွာ	09-254078890	[illegible]
၂.	ကိုခံကျော်	"	"	-	[illegible]
၃.	ဦးဘိုဇော်	"	"	"	ဇော်
၄.	ဦးမျိုးဝင်း	"	"	09-49851840	MYO
၅.	ဦးမောင်သို	"	"	09-37501832	[illegible]
၆.	ဦးချိုင်း	"	"	-	[illegible]
၇.	ဦးလှကြည်	"	"	-	ဦးလှကြိုင်
၈.	ဦးထွန်းအောင်	"	"	"	ဦးအောင်
၉.	ဦးမိုးရောင်	"	"	-	ဦးမိုးရောင်
၁၀.	ဦးမိုး	"	"	-	ဦးမိုး

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးဖေ	တောင်ယာ	ရာဇဗိုလ်	-	ဦးဖေ
၂.	ဦးပြေး	"	"	"	ဦးပြေး
၃.	ဦးရှော	"	"	"	ရှော
၄.	ဦးဖြူ	"	"	"	-
၅.	ဒေါ်ပြုံးဆေး	"	"	"	
၆.	မတင်ရီ	"	"	"	တင်
၇.	ဒေါ်ကြင်တင်	"	"	"	တင်
၈.	ဦးထွန်းတင်	" (ရပ်ရွာအထွေထွေဖွံ့ဖြိုးရေးကော်မတီ)	"	"	ဦးထွန်းတင်
၉.	ဦးထွန်းဝင်း	" (")		09-453728881	ဦးထွန်းဝင်း
၁၀.	ဦးချစ်စံ	ကုန်ချပ်ရေးမှူး	"	09-265822682	[illegible]

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးကျော်	ခြံယာ၊ သနပ်ဖက်	ချောင်ဝိုး	-	ဦးကျော်
၂.	ဦးဒုရှ	ခြံယာ၊ သနပ်ဖက်	ချောင်ဝိုး	-	ဒုရှ
၃.	ဦးဒုရှဖေ	ခြံယာ၊	ချောင်ဝိုး	-	ဖေ
၄.	ဦးလတ်	ခြံယာ၊ သနပ်ဖက်	ချောင်ဝိုး	-	လတ်
၅.	ဦးထွန်းဝင်း	ခြံယာ၊ ~~[illegible]~~	ချောင်ဝိုး	09 453728881	ဝင်း
၆	ဦးမောင်ခရီ	ခြံယာ၊ သနပ်ဖက်	ချောင်ဝိုး	-	
၇	ဦးလှ	ခြံယာ၊ ရှူမ်း	ချောင်ဝိုး	09 -	လှ
၈.	ဦးချစ်မောင်	ခြံယာ၊ သနပ်ဖက်	ချောင်ဝိုး	-	
၉.	ဦးသော်	ခြံယာ၊ မြေပဲ	ချောင်ဝိုး	09 265822840	[illegible]
၁၀.	ဦးရ	ခြံယာ၊ သနပ်ဖက်	ချောင်ဝိုး	-	[illegible]

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၂)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁၁	ဦးကျော်	သနပ်ဖက်၊ ရှူင်း	ချောင်ဝိုး	-	-
၁၂.	ဒေါ်နုရွှေအောင်	သနပ်ဖက်၊ ရှူင်း	ချောင်ဝိုး	-	-
၁၃.	ဒေါ်စိုင်း	သနပ်ဖက်၊ မြေပဲ	ချောင်ဝိုး	-	စိုင်း

ဓာတ်ပုံမှတ်တမ်းများ

အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းရပ်များကို သက်ဆိုင်သူများအား ရှင်းလင်းခြင်းနှင့် လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများမေးမြန်းခြင်း

မှတ်တမ်း

ရက်စွဲ	၃၁၊ ဩဂုတ်၊ ၂၀၁၆။
အချိန်	ညနေ ၃း၀၀ - ၅း၃၀။
နေရာ	ဖမ္ဘရုံ၊ တောင်ခမောက်ရွာ၊ တုံးလည်ကျေးရွာအုပ်စု။
အစီအစဉ်များ	
အစီအစဉ် (၁) ညနေ ၃း၁၀	အစည်းအဝေးတက်ရောက်သူစာရင်းရယူခြင်း။
အစီအစဉ် (၂) ညနေ ၃း၁၅	Sustainable Environment Myanmar Co., Ltd (SEM) ၏ Senior Consultant (Social) ဒေါ်မြတ်သစ္စာနိုင်မှ ပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် ထိခိုက်မှုဆန်းစစ်ခြင်း (ESIA) လုပ်ငန်းကို ရှင်းလင်းပြောကြားခြင်း။ ၁။ စီမံကိန်း ခြုံငုံသုံးသပ်ချက် - စွမ်းအားသစ်အိုအေစစ်ဖြိုးတိုးတက်မှု ကုမ္ပဏီလီမိတက် (Neo Energy Oasis Development Company Ltd.) ရှမ်းပြည်နယ် ညောင်ရွှေမြို့နယ် အင်းတိန်ကျေးရွာ၏ ချောင်းအထက် ၅ကီလိုမီတာ ခန့်အကွာရှိ မင်းလုံးကျေးရွာ အနီးတွင် ၃၀.၄ မဂ္ဂါဝပ် ရေအားလျှပ်စစ် စက်ရုံ တည်ဆောက်ရန် စီစဉ်ထားပါသည်။ - Resource and Environment Myanmar Co, Ltd., (REM) နှင့် Sustainable Environment Myanmar (SEM) Co, Ltd., တို့သည် အဆိုပါ စီမံကိန်းအတွက် သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင် အကျိုးသက်ရောက်မှု ဆန်းစစ်ခြင်း (ESIA) ကို လုပ်ဆောင်မည် ဖြစ်ပါသည်။ - ESIA သည် ဖြစ်နိုင်ခြေရှိသော သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင်

	အကျိုးသက်ရောက်မှုများ၊ အခွင့်အလမ်းများကို နိုင်ငံတကာစံချိန်စံညွှန်းများနှင့် အညီ လေ့လာခြင်းဖြစ်ပါသည်။ - ယခု အစည်းအဝေးသည် စီမံကိန်းအကြောင်း ခြုံငုံရှင်းပြရန်နှင့် စီမံကိန်းအပေါ် ဒေသခံတို့၏ သဘောထားအမြင်ကို နားလည်သိရှိရန် ဖြစ်ပါသည်။ ၂။ အထက်ဘီးလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်း၏ ယေဘုယျ ဖွဲ့စည်းပုံ အစီအစဉ်။ ၃။ စီမံကိန်းအကြောင်းအရာ။ ၄။ အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းအတွက် ပတ်ဝန်းကျင်နှင့် လူမှုအကျိုး သက်ရောက်မှု လေ့လာခြင်း။
အစီအစဉ် (၃) ညနေ ၃း၂၅	NEO Co., Ltd ၏ လက်ထောက် အထွေထွေမန်နေဂျာ ဦးဟန်မင်းထွန်းမှ စီမံကိန်းအကြောင်းအရာ အကျဉ်းချုပ်ကို ရှင်းလင်းပြောကြားခြင်း။
အစီအစဉ် (၅) ညနေ ၃း၃၈	ဖြည့်စွက်ဆွေးနွေးပေးခြင်း။ ဦးထွန်းတင်၊ တုံးလည်ကျေးရွာအုပ်စု အုပ်ချုပ်ရေးမှူး။ တောင်ခမောက်မှာ ရေအားလျှပ်စစ် ကိုယ်ထူကိုယ်ထ မလုပ်ဖြစ်တော့တဲ့ အတွက်ကြောင့် လိုအပ်တဲ့အရာကို ကုမ္ပဏီကို အကူအညီတောင်းချင်ရင်လည်း ဥက္ကဋ္ဌမှတစ်ဆင့် ပြောပြလို့ရပါကြောင်း ပြောကြားပါသည်။
အစီအစဉ် (၆) ညနေ ၃း၃၅	လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများ မေးမြန်းခြင်း။
ညနေ ၅း၃၀	အစီအစဉ်များ ပြီးဆုံးသည်။

အစည်းအဝေးတက်ရောက်သူများ

အစည်းအဝေးတက်ရောက်သူစုစုပေါင်းမှာ (၃၇) ဦးဖြစ်ပါသည်။ ကုမ္ပဏီများမှ (၁၁) ဦးဖြစ်ပြီး ဒေသခံ ရပ်မိရပ်ဖ (၂၆) ဦးဖြစ်ပါသည်။ တက်ရောက်သူစာရင်းမှာ အောက်ပါအတိုင်းဖြစ်ပါသည်။

SEM Co., Ltd မှတက်ရောက်သူများ

စဉ်	**အမည်**	**ရာထူး**
၁။	ဦးဉာဏ်လင်းမောင်	Senior Consultant (Ecology)
၂။	ဒေါ်နယဉ်	Senior Consultant (Social)
၃။	ဒေါ်မြတ်သစ္စာနိုင်	Senior Consultant (Social)
၄။	ဒေါ်ဝါဝါဆန်း	Social Consultant and Data Analyst
၅။	ဒေါ်ပိုးမွန်မွန်ကျော်	Environmental Health and Safety Consultant
၆။	ဒေါ်အိမုံခင်	Consultant (Social)

NEO Co., Ltd မှ တက်ရောက်သူများ

စဉ်	**အမည်**	**ရာထူး**
၁။	ဦးဟန်မင်းထွန်း	လက်ထောက်အထွေထွေ မန်နေဂျာ။
၂။	ဦးစိန်ကျော်	Staff
၃။	ဦးမောင်ငယ်	Staff
၄။	မနီနီဝင်း	Staff
၅။	မချိုချိုခိုင်	Staff

ရပ်မိရပ်ဖ၊ ဒေသခံပြည်သူများ

တောင်ခဲမောက်ရွာ ၊ ဓမ္မာရုံ
8:00 - 5:30 pm

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ် ဩဂုတ် လ(၃၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးထွန်းတင်	ကျေးရွာအုပ်ချုပ်ရေးမှူး	[illegible]	09-4258302332	[illegible]
၂.	ဦးမြ	ခြံ၊ လယ်	တောင်ခဲမောက်ရွာ		ဦးမြ
၃.	ဦးထော်ဇ	ခြံ၊ လယ်	တောင်ခဲမောက်ရွာ		[illegible]
၄.	ဦးထွား	ဆယ်အိမ်မှူး	တောင်ခဲမောက်ရွာ		[illegible]
၅.	ကိုဝင်း	ခြံ၊ လယ်	တောင်ခဲမောက်ရွာ		ကိုဝင်း
၆.	ဦးရာယား	ခြံ၊ လယ်	တောင်ခဲမောက်ရွာ		[illegible]
၇.	ဦးမြိုင်	တောင်ယာ	တောင်ခဲမောက်ရွာ		ဦးမြိုင်

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဇူလိုင် လ၊(၃၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဦးအောင်ကို	လယ်ခြံ	တောင်ခမောက် ကုန်းလည်ရွာ	၀၉၄၅၅၄၆၅၆၅၄၅	[illegible]
၂။	ဦးမိုး	ခြံ၊ ရာအိမ်မှူး	တောင်ခမောက်	၀၉၇၆၆၁၀၈၇၃၃	မိုးမိုး
၃။	ဦးအောင်ကျော်	ခြံယာ	တောင်ခမောက်	-	-
၄။	ဦးစု	တောင်ယာ	တောင်ခမောက်	၀၉၇၈၆၃၅၄၄၄၇၁	စုန်
၅။	ထွန်းလင်း	ခြံယာ	တောင်ခမောက်	-	ထွန်း
၆။	ဦးကျော်	တောင်ယာ	တောင်ခမောက်	-	ဦးကျော်
၇။	ဦးထွန်းခ	တောင်ယာ	တောင်ခမောက်	-	ထွန်း
၈။	ဦးရ	တောင်ယာ	တောင်ခမောက်	-	-

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဇူလိုင် လ၊(၃၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ယော်နိုး	ယာ (ပြောင်း)	တောင်ခမောက်	-	
၂။	ဖော်မကေ	"	"	-	
၃။	ဒေါ်ရှုလေး	"	"	.	ရွှေလ
၄။	ဒေါ်စိုးထွေး	ယာ (ပဲ၊ ပြောင်း)	"	-	ထွေး
၅။	ကိုကျော်စိုး	တောင်ယာ	"	-	စိုး
၆။	ဦးသိန်းအောင်	"	"	-	အောင်
၇။	ဦးမြ	"	"	-	မြ
၈။	ဦးထွန်းသူဝင်	"	"	-	ထွန်းသူဝင်
၉။	ဦးဖိုးထုံးလော်	ခြံ	"	-	ဖိုးလော်
၁၀။	ဦးထွန်းကျိုင်	အုပ်စုကိစ္စမှူး	"	၀၉-၃၆၁၆၈၇၈၆	[illegible]

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဇူလိုင် လ၊(၃၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
	ဦးအင်းကျော်	တောင်ယာ	တောင်ခမောက်	-	[illegible]

ဓာတ်ပုံမှတ်တမ်းများ











အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းရပ်များကို သက်ဆိုင်သူများအား ရှင်းလင်းခြင်းနှင့် လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများမေးမြန်းခြင်း

မှတ်တမ်း

ရက်စွဲ	၁၊ စက်တင်ဘာ၊ ၂၀၁၆။
အချိန်	နံနက် ၉း၀၀ - မွန်းလွဲ ၂း၂၅။
နေရာ	အခြေခံပညာမူလတန်းကျောင်း၊ တုံးလည်ရွာ၊ တုံးလည်ကျေးရွာအုပ်စု။
အစီအစဉ်များ	
အစီအစဉ် (၁) နံနက် ၉း၀၀	အစည်းအဝေးတက်ရောက်သူစာရင်းရယူခြင်း။
အစီအစဉ် (၂) နံနက် ၉း၅၀	NEO Co., Ltd ၏ လက်ထောက် အထွေထွေမန်နေဂျာ ဦးဟန်မင်းထွန်းမှ စီမံကိန်းအကြောင်းအရာ အကျဉ်းချုပ်ကို ရှင်းလင်းပြောကြားခြင်း။
အစီအစဉ် (၃) နံနက် ၁၀း၀၃	Sustainable Environment Myanmar Co., Ltd (SEM) ၏ Senior Consultant (Social) ဒေါ်နယည်မှ ပတ်ဝန်းကျင်နှင့် လူမှုဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်း (ESIA) လုပ်ငန်းကို ရှင်းလင်းပြောကြားခြင်း။ ၁။ စီမံကိန်း ခြုံငုံသုံးသပ်ချက် - စွမ်းအားသစ်အိုအေစစ်ဖြိုးတိုးတက်မှု ကုမ္ပဏီလီမိတက် (Neo Energy Oasis Development Company Ltd.) ရှမ်းပြည်နယ် ညောင်ရွှေမြို့နယ် အင်းတိန်ကျေးရွာ၏ ချောင်းအထက် ၅ကီလိုမီတာ ခန့်အကွာရှိ မင်းလုံးကျေးရွာ အနီးတွင် ၃၀.၄ မဂ္ဂါဝပ် ရေအားလျှပ်စစ် စက်ရုံ တည်ဆောက်ရန် စီစဉ်ထားပါသည်။ - Resource and Environment Myanmar Co, Ltd., (REM) နှင့် Sustainable Environment Myanmar (SEM) Co, Ltd., တို့သည် အဆိုပါ စီမံကိန်းအတွက် သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင် အကျိုးသက်ရောက်မှု ဆန်းစစ်ခြင်း (ESIA) ကို လုပ်ဆောင်မည်

	ဖြစ်ပါသည်။ - ESIA သည် ဖြစ်နိုင်ခြေရှိသော သဘာဝဝန်းကျင်နှင့် လူမှုဝန်းကျင် အကျိုးသက်ရောက်မှုများ၊ အခွင့်အလမ်းများကို နိုင်ငံတကာစံချိန်စံညွှန်းများနှင့် အညီ လေ့လာခြင်းဖြစ်ပါသည်။ - ယခု အစည်းအဝေးသည် စီမံကိန်းအကြောင်း ခြုံငုံရှင်းပြရန်နှင့် စီမံကိန်းအပေါ် ဒေသခံတို့၏ သဘောထားအမြင်ကို နားလည်သိရှိရန် ဖြစ်ပါသည်။ ၂။ အထက်ဘီးလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်း၏ ယေဘုယျ ဖွဲ့စည်းပုံ အစီအစဉ်။ ၃။ စီမံကိန်းအကြောင်းအရာ။ ၄။ အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းအတွက် ပတ်ဝန်းကျင်နှင့် လူမှုအကျိုး သက်ရောက်မှု လေ့လာခြင်း။
	မေးမြန်းဆွေးနွေးသူများ မရှိပါ။
အစီအစဉ် (၄) နံနက် ၁၀း၁၀	တက်ရောက်သူများနှင့် ကျေးရွာထဲရှိ အိမ်ထောင်စုများသို့ သွားရောက်၍ လူမှုစီးပွားရေးဆိုင်ရာ အိမ်ထောင်စုမေးခွန်းလွှာများ မေးမြန်းခြင်း။
မွန်းလွဲ ၂း၂၅	အစီအစဉ်များ ပြီးဆုံးသည်။

အစည်းအဝေးတက်ရောက်သူများ

အစည်းအဝေးတက်ရောက်သူစုစုပေါင်းမှာ (၅၉) ဦးဖြစ်ပါသည်။ ကုမ္ပဏီများမှ (၁၀) ဦးဖြစ်ပြီး ဒေသခံရပ်မိရပ်ဖ (၄၉) ဦးဖြစ်ပါသည်။ တက်ရောက်သူစာရင်းမှာ အောက်ပါအတိုင်းဖြစ်ပါသည်။

SEM Co., Ltd မှတက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးဉာဏ်လင်းမောင်	Senior Consultant (Ecology)
၂။	ဒေါ်နယဉ်	Senior Consultant (Social)
၃။	ဒေါ်မြတ်သစ္စာနိုင်	Senior Consultant (Social)
၄။	ဒေါ်ဝါဝါဆန်း	Social Consultant and Data Analyst
၅။	ဒေါ်ပိုးမွန်မွန်ကျော်	Environmental Health and Safety Consultant
၆။	ဒေါ်အိမ့်ခင်	Consultant (Social)

NEO Co., Ltd မှ တက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးဟန်မင်းထွန်း	လက်ထောက်အထွေထွေ မန်နေဂျာ။
၂။	ဦးစိန်ကျော်	Staff
၃။	မနီနီဝင်း	Staff
၄။	မချိုချိုခိုင်	Staff

ရပ်မိရပ်ဖ၊ ဒေသခံပြည်သူများ

ကုံးလည်ရွာ၊
ဝဝ ဖြေခံပညာမူလတန်းကျောင်း
9:00 - 10:00 am

အထက်ဘိလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ အောက်တိုဘာ လ၊(၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဦးအောင်မျိုးသန့်	တောင်သူ	ကုံးလည်	09-264318975	MS
၂။	ဦးခင်ရွှေ	"	"	မရှိ	ခင်ရွှေ
၃။	ဦးအောင်မြတ်စိုး	"	"	09-32455606	Soe
၄။	ကျော်ဦးဦး	"	"	09-776818462	ကျော်ဦးဦး
၅။	အောင်မျိုး	"	"	09-454581820	အောင်မျိုး
၆။	ဒေါ်တင်ကြည် ဒေါ်သီတာ	ဈေးဆိုင်	"	မရှိ	သီတာ
၇။	ဦးကြည်စိုး	ခြံ	"	-	ကြည်စိုး
၈။	ဒေါ်ဝင်းကြွယ်	ယာခြံ	"	-	ဝင်းကြွယ်
၉။	ကိုချစ်ထွေး	လယ်ခြံ	"	-	ကိုချစ်ထွေး

တိုးလည်ရွာ
အခြေခံပညာမူလတန်းကျောင်း

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးအောင်ငွေစိုး	ရေခြံ	တိုးလည်ရွာ	-	ငွေစိုး
၂.	မသန်းအေး	ရေခြံ	တိုးလည်ရွာ	09-261740725	[signature]
၃	ဦးဝင်းကျော်မိုး	ရေခြံ	တိုးလည်ရွာ	09-258758057	[signature]
၄.	ဒေါ်ခမ်းနုရွှေ	ရေခြံ	တိုးလည်ရွာ	0949597396	K.N.L
၅.	ဒေါ်ဘီတာအေး	ရေခြံ	တိုးလည်ရွာ	-	တာအေး
၆.	ဦးမျိုးသူ	ရေခြံ	တိုးလည်ရွာ	09-263783757	[signature]
၇.	ကိုအောင်သူလေး	ရေခြံ	တိုးလည်ရွာ	09-32057653	[signature]
၈.	ကိုနေကအေး	ရေခြံ	တိုးလည်ရွာ	-	[signature]
၉.	ကိုကျော်ဝင်းအောင်	ရေခြံ	တိုးလည်ရွာ	09-253377977	[signature]
၁၀.	ဒေါ်နန်းမြွန့်	ရေခြံ	တိုးလည်ရွာ	-	နန်းမြွန့်

တိုးလည်ရွာ

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ လ၊( )ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁၁.	ဒေါ်ရေထွန်းဦး	ရေခြံ	တိုးလည်ရွာ	-	ОО
၁၂.	ဒေါ်မြင့်အေး	ရေခြံ	တိုးလည်ရွာ	09428363757	မမြင့်အေး
၁၃.	ဒေါ်ခင်အေးဝင်း ဒေါ်ခင်အေးဝင်း	ရေခြံ	တိုးလည်ရွာ	-	ခင်အေးဝင်း
၁၄.	ဦးစိုးမောင်	ရေခြံ(ရပ်ကွက်လူကြီး)	တိုးလည်ရွာ	09455096759	စိုးမောင်
၁၅.	ဒေါ်သန်းညွန့်	ရေခြံ	တိုးလည်ရွာ	0936168698	သန်းညွန့်
၁၆.	ဦးသန်းထွန်း	ရေခြံ	တိုးလည်ရွာ	0936768697	[signature]
၁၇.	ဦးထွန်းအောင်	ရေခြံ	တိုးလည်ရွာ	-	[signature]
၁၈.	ဒေါ်သူဇာဝေ	ရေခြံ	တိုးလည်ရွာ	-	သူဇာဝေ
၁၉.	ကိုကျော်သူဝေ	ရေခြံ	တိုးလည်ရွာ	09259669162	ကျော်သူဝေ
၂၀.	ကိုစိုးလှိုင်	ရေခြံ	တိုးလည်ရွာ	09259384118	စိုး၊လှိုင်

တုံးလည်ရွာ
အခြေခံပညာမူလတန်းကျောင်း

အသက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ရိုင်းဝေဖြိုး	ခြံယာ၊ လယ်	တုံးလည်	၀၉၄၅၅၀၄၅၃၄၉၅	ရို
၂.	ကျော်ဆုရိုလင်း	ခြံယာ	တုံးလည်	၀၉၄၅၅၄၆၅၃၆၅၄	-
၃.	ပက်ရိုးထူးဆောင်	ခြံယာ၊ လယ်	တုံးလည်	၀၉၇၇၁၆၉၆၀၉၄	ပီ
၄.	မမြင့်မြင့်ထွေး	ခြံယာ၊ လယ်	တုံးလည်	-	မြင့်ထွေး
၅.	ကိုထွန်းလင်း	ခြံ၊ လယ်	တုံးလည်	၀၉ ၂၆၀၁၅၉၅၈၀	ကိုထွန်းလင်း
၆.	သောင်းမြင့်	ခြံ၊ လယ်	တုံးလည်	-	သောင်းမြင့်
၇.	ဦးမျိုးဝင်းသိုက်	ရာခြံ	တုံးလည်	၀၉ ၃၆၂၀၂၅၉၃	M
၈.	ဦးကျော်ငြိမ်း	ရာခြံ	တုံးလည်	၀၉ ၃၂၅၁၃၅၂၀	ဦးကျော်ငြိမ်း
၉.	ဦးမြတ်ဆွေ	ရာခြံ	တုံးလည်	-	ဦးမြတ်ဆွေ
၁၀.	ဦးကျော်မြင့်ဝင်း	ရာခြံ	တုံးလည်	-	ဦးကျော်ဝင်း

တုံးလည်ရွာ၊
အခြေခံပညာမူလတန်းကျောင်း
၅:၀၀ -

အသက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးကျော်သူလေး	ခြံယာ (ကျောင်းဥက္ကဋ္ဌ)	09 - 250843240 / တုံးလည် →		[illegible]
၂.	ဦးစိုးဝင်း	ရာခြံ	တုံးလည်		စိုးဝင်း
၃.	ဦးဂေးမင်း	ရာခြံ	〃	09-787866837	မင်း
၄.	ဦးချစ်ဘောင်း	〃	〃	09-440293459	ချစ်ဘောင်း
၅.	ကိုသားပု	〃	〃	-	သားပု
၆.	ဦးအောင်မျိုးကောင်	〃	〃	09-440491396	2MA
၇.	ဦးဘောင်းနိုင်	ခြံ	〃	09-263803971	နိုင်
၈.					
၉.					
၁၀.					

တုံးလည်ရွာ

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဦးကောင်ရီ	ရာ ဒြ (ရပ်ရွာအတောက်ကဏ္ဍပြုအဖွဲ့ဝင်)	တုံးလည်	09-454656545	[illegible]

တုံးလည်ရွာ

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ စက်တင်ဘာလ၊(၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁၁။	ကိုဘုန်းမြင့်ကျော်	ရာဒြ	တုံးလည်	[illegible]	ဘုန်းမြင့်ကျော်

တုံးလည်

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ၊(၃၁)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၂၁.	ကိုခိုင်လင်း	ရာဒြ	တုံးလည်ရွာ	09 262897284	[illegible]

ဓာတ်ပုံမှတ်တမ်းများ






အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းရပ်များကို သက်ဆိုင်သူများအား ရှင်းလင်းခြင်း အခမ်းအနား

အစည်းအဝေးမှတ်တမ်း

ရက်စွဲ	၂၉၊ ဩဂုတ်၊ ၂၀၁၆
အချိန်	နံနက်။ ၈း၀၀ - ၁၂း၄၀
နေရာ	မြို့နယ်ခန်းမ၊ အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာန၊ ညောင်ရွှေမြို့။
အခမ်းအနားအစီအစဉ်	
အစီအစဉ် (၁)	ရှမ်းပြည်နယ် လျှပ်စစ်၊ စွမ်းအင်နှင့် စက်မှုလက်မှု ဝန်ကြီး ဦးဆွေသိန်းမှ အဖွင့်အမှာစကားပြောကြားခြင်း။
အစီအစဉ် (၂)	အင်းတိုင်းရင်းသားဝန်ကြီး ဒေါက်တာဦးထွန်းလှိုင်မှ အမှာစကား ပြောကြားခြင်း။
အစီအစဉ် (၃)	စွမ်းအားသစ်ဖွံ့ဖြိုးတိုးတက်မှု ကုမ္ပဏီလီမိတက်၏ လက်ထောက် အထွေထွေ မန်နေဂျာ ဦးဟန်မင်းထွန်းမှ စီမံကိန်းအကြောင်းရှင်းလင်းပြော ကြားခြင်း။
အစီအစဉ် (၄)	မြန်မာ့သယံဇာတနှင့် ပတ်ဝန်းကျင် ကုမ္ပဏီ (Resource and Environment Myanmar Co.,Ltd) ၏ အကြီးတန်းအကြံပေး ဒေါ်နယည် မှ ESIA လုပ်ငန်းရပ်ဆိုင်ရာများကို ရှင်းလင်းပြောကြားခြင်း။
အစီအစဉ် (၅)	တက်ရောက်သူများမှ သိရှိလိုသည်များကို မေးမြန်းခြင်း၊ ဆွေးနွေးခြင်းနှင့် ပြန်လည်ဖြေကြားပေးခြင်း။

<table>
<tr><td>အစီအစဉ် (၆)</td><td>အင်းတိုင်းရင်းသားဝန်ကြီး ဒေါက်တာဦးထွန်းလှိုင်မှ ထပ်မံဖြည့်စွက်ပြောကြားပေးခြင်း။</td></tr>
<tr><td>အစီအစဉ် (၇)</td><td>အခမ်းအနားပြီးဆုံးကြောင်းကြေညာခြင်း။</td></tr>
<tr><td>နံနက် ၈း၀၀</td><td>အခမ်းအနား တက်ရောက်သူများစာရင်းရယူခြင်းနှင့် လက်ကမ်းစာစောင်များ ဝေပေးခြင်း။</td></tr>
<tr><td>နံနက် ၁၀း၃၀</td><td>အခမ်းအနားအစီအစဉ်ဖွင့်လှစ်ကြောင်း ကြေညာခြင်း။</td></tr>
<tr><td>အစီအစဉ် (၁)

နံနက် ၁၀း၃၀ - ၁၀း၄၅</td><td>ရှမ်းပြည်နယ် လျှပ်စစ်၊ စွမ်းအင်နှင့် စက်မှုလက်မှု ဝန်ကြီး ဦးဆွေသိန်းမှ အဖွင့်အမှာစကားပြောကြားခြင်း။</td></tr>
<tr><td colspan="2">လျှပ်စစ်ဝန်ကြီးမှ ၄င်းတာဝန်ထမ်းဆောင်နေစဉ် အချိန်တွင်း ဆောင်ရွက်သော လုပ်ငန်းများကို ပြန်လည်ပြောပြ ခဲ့ပါသည်။ ၄င်းတို့မှာ ရှမ်းပြည်နယ်အတွင်း Hydro ခေါ် ရေအားလျှပ်စစ်စီမံကိန်း များသည် ရှမ်းအရှေ့၊ ရှမ်းအနောက်၊ ရှမ်းမြောက် စုစုပေါင်းအားလုံး ၁၆၊၁၇ ခုခန့် ရှိကြောင်း၊ အရင့် အရင် အစိုးရလက်ထက်ကလုပ်ခဲ့တဲ့ မပြီးသေးတဲ့လုပ်ငန်းတွေဖြစ်ကြောင်း၊ ယင်းလုပ်ငန်းများထဲမှ အောက်ကျိုင်းတောင်း ရေအားလျှပ်စစ်တစ်ခုသာ မီးရရှိသေးကြောင်း၊ အောက်ကျိုင်းတောင်းသည် မီဂါဝပ် 54 ထွက်၍ ရရှိသောမီဂါဝပ်ကို နမ့်စမ်ဘက်ကိုသယ်ကြောင်း၊ ထိုသို့ရောက်ရှိလာသော လျှပ်စစ်ကို ကလောသို့ပို့ကြောင်း၊ ထို့ပြင် ရှမ်းပြည်မြို့တော် တောင်ကြီး၊ ကလော၊ အောင်ပန်း၊ ဟဲဟိုးတစ်ဝိုက်တွင် ရရှိလျက်ရှိသော လျှပ်စစ်မီးများသည် အောက်ကျိုင်းတောင်းမှ ရရှိသောမီးများသာ ဖြစ်ကြောင်း၊ ရေအားလျှပ်စစ်တွေအများကြီးလုပ်နေပေမယ့် ပြီးစီးမှုမရှိသေးကြောင်း ပြောကြားခဲ့ပါသည်။ ၄င်းအပြင် အထက်ကျိုင်းတောင်းတွင်လည်း 51 မီဂါဝပ်ခန့် ထွက်ရှိမှာ ဖြစ်သော်လည်း လုပ်ဆောင်ချိန်တွင် နိုင်ငံတော်မှ budget မထောက်ပံ့နိုင်သော အခြေအနေတစ်ခု၌ရှိနေသည့်အပြင် ပြည်တောင်စုကရွေးချယ်ပေးထားသော ကုမ္ပဏီမှ ဆောင်ရွက်ခြင်းမရှိသောကြောင့် အရင်အစိုးရလက်ထက်ကတည်းက ပြီးစီးရမည့် ကိစ္စရပ်များသည် ယနေ့အချိန်တိုင်အောင် မပြီးစီးခဲ့ကြောင်း၊ ရှမ်းပြည်နယ်တစ်နယ်လုံး မီးရရှိမှုမှာ ရှမ်းပြည်နယ်ရော၊ တစ်နိုင်ငံလုံးရောအားလုံးရရှိမှုသည် ၃၀%လောက်သာ ရှိကြောင်း၊ တစ်နိုင်ငံလုံးမီးရရှိမှု ၇၀%</td></tr>
</table>

လောက်ရရှိမည့် အနေအထားကို သုံးသပ်ရာတွင် ရှမ်းပြည်အနေဖြင့် ရှမ်းပြည်ကိုသုံးပိုင်း ပိုင်းပြီးခွဲခြားပြီးလေ့လာသုံးသပ်ရာ၌ ရှမ်းအရှေ့သည် National Grid Line လုံးဝမရောက်ရှိသေးတဲ့ အပိုင်းတစ်ပိုင်းအနေဖြင့် ရှိကြောင်း၊ ရှမ်းမြောက်သည် National Grid Line ရောက်ရှိနေသည့် အနေအထားဖြစ်ကြောင်းနှင့် ရှမ်းတောင်တွင်လည်း National Grid Line ရောက်ပြီးတော့မှ မီးရရှိမှုအနေအထား ကောင်းမွန်လာကြောင်း ပြောကြားခဲ့ပါသည်။ ရှမ်းအရှေ့အနေဖြင့် အစိုးရသစ် တက်ပြီးသည့်နောက် National Grid Line ဆွဲရန် ပြည်ထောင်စုကိုတောင်းပြီးဖြစ်၍ National Grid Line ကိုကျိုင်းတုံရောက်အောင် ဆွဲမည်ဖြစ်ကြောင်းနှင့် စီမံကိန်းကာလမှာ ၂ နှစ်ဖြစ်ကြောင်း၊ ကျိုင်းတုံတွင် ဓာတ်ခွဲရုံတည်ရန် မြေယာမရရှိခြင်းကြောင့် ၎င်းကိုယ်တိုင် မြေရရှိအောင် သွားရောက် ဆောင်ရွက်ရကြောင်း၊ ထိုကဲ့သို့ အခြေအနေများတွင် ရှမ်းပြည်အတွက်မီးရရှိမှု ပြန်လည် သုံးသပ်ရာ၌ အင်းလေးဒေသတွင် မီးမရရှိသေးသောကျေးရွာပေါင်း ၁၀၀ ကျော်ခန့်ရှိကြောင်း၊ အစိုးရအနေဖြင့် budget ကို ရှမ်းအရှေ့၊ ရှမ်းတောင်၊ ရှမ်းမြောက် ခွဲပေးရသောကြောင့် ကျေးရွာ၁၀၀ အားလုံးမီးရရှိရန် အချိန်အားဖြင့် ကြာမြင့်မည်ဖြစ်ကြောင်း၊ Solar စနစ်ကို သုံးသပ်ကြည့်ရာ၌လည်း Station ဆောက်ရန် မြေအခက်အခဲများကြောင့် အဆင်မပြေခဲ့ကြောင်း ပြောကြားခဲ့ပါသည်။ ယခု အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းတွင်လည်း NGO အဖွဲ့အစည်းများနှင့် သွားရောက်လေ့လာခဲ့ကြောင်း၊ NEO ရှင်းလင်းဆောင်တွင် သိလိုသည်များကို မေးမြန်းစေလိုကြောင်း၊ NEO သည်လည်း ၂၅% ခန့် ပြီးစီးလျက်ရှိကြောင်း၊ အင်းလေးဒေသ ထိခိုက်မှုရှိမရှိကိုလည်း သွားရောက်လေ့လာသင့်ကြောင်း၊ ကုမ္ပဏီအနေဖြင့် ဒေသခံတွေများ အမြင်မကြည်မလင် ဖြစ်နေသည် ရှိပါကလည်း Site ထဲသို့ ခေါ်သွား၍ ရှင်းပြရမည် ဖြစ်ကြောင်း၊ ယခုမံကိန်းမှ ထွက်ရှိမည်ဖြစ်သော မီဂါဝပ် ၃၀ မှ အင်းလေးဒေသတွင် မီးမရရှိသေးသော ကျေးရွာ ၁၀၀ မကကို အရင်မီးလင်းအောင်လုပ်ပေးရမည်ဖြစ်ကြောင်း၊ ပိုလျှံသော မီဂါဝပ်ကို ကလောသို့ ထည့်ရောင်းမှာဖြစ်ပြီး လိုအပ်နေသော ရှမ်းပြည်တောင်ပိုင်း သို့ပြန်ပို့မည် ဖြစ်ကြောင်း၊ စီမံကိန်းကြောင့် ပြည်သူလူထု၏ အိုးအိမ်မြေယာများကို ထိခိုက်ခဲ့ပါက နစ်နာကြေးကို ကျေနပ်တဲ့အထိ ကုမ္ပဏီမှ လုပ်ဆောင်ပေးရမည် ဖြစ်ကြောင်း၊ အထက်ဘီလူးချောင်းစီမံကိန်းမှ ကျောက်ထုတ်ချိန်တွင်လည်း မသက်ာဖွယ်ရာခံစားမိပါက ရွာထဲတွင်ပင် တားထား၍ သက်ဆိုင်ရာအဖွဲ့အစည်းများဖြစ်သော အုပ်ချုပ်ရေးမှူးများကို အကြောင်းကြားရမည် ဖြစ်ကြောင်း၊ ထို့နောက် ၎င်းတို့ကိုယ်တိုင် စစ်ဆေးမည် ဖြစ်ကြောင်း ပြောကြားခဲ့ပါသည်။ ထို့ပြင် စီမံကိန်းတစ်ခု

လုပ်ဆောင်မည်ဆိုပါက အကျိုးအမြတ် အကောင်းနဲ့အဆိုးကို ဝေဖန်သုံးသပ်ရမည် ဖြစ်ကြောင်း၊ စီမံကိန်းသည်လည်း ၂၀၁၈ တွင် ပြီးတော့မည်ဖြစ်ကြောင်း၊ ရွာများ အားလုံးကိုလည်း နစ်နာမှုမရှိအောင် ကုမ္ပဏီဘက်မှ လုပ်ပေးရမည်ဖြစ်ကြောင်း၊ ဒေသခံများ အနေဖြင့်လည်း နစ်ဦးနှစ်ဖက် နားလည်ပြီး အကျိုးရှိရှိ လုပ်ကိုင်စေချင်ကြောင်း ပြောကြားခဲ့ပါသည်။ ယခုကဲ့သို့ EIA, SIA နဲ့ပတ်သက်တဲ့လုပ်ငန်းများ လုပ်ဆောင်ချိန်တွင်လည်း နိုင်ငံတော်အစိုးရမှ သတ်မှတ်ထားသော ကုမ္ပဏီတွေကို ရွေးချယ်ပြီးငှားရကြောင်း၊ ယင်းကဲ့သို့ EIA, SIA ဖော်ထုတ်ပေးတဲ့ ကုမ္ပဏီမှလည်း ပြည်သူများနှင့် တွေ့ဆုံ၍ ၎င်းတို့လုပ်ဆောင်မည်များကို ရှင်းလင်းပြောပြမည်ဖြစ်ကြောင်း၊ အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်နှင့် ဆက်စပ်လျက်ရှိသော ရွာများကို ကွင်းဆင်းလေ့လာမှုများ ပြုလုပ်၍ ပွင့်လင်းမြင်သာသော ဆွေးနွေးမှုများ လုပ်ဆောင်သွားမည်ဖြစ်ကြောင်း၊ ဒေသခံများအနေနှင့်လည်း ပွင့်လင်း မြင်သာစွာမေးမြန်းခွင့်ရမည် ဖြစ်ကြောင်း၊ ထိုမှရရှိလာသော သုံးသပ်ချက်များမှတဆင့် ၎င်းတို့က ဆက်ပြီးလုပ်ရကြောင်း၊ ယခုအချိန်တွင် ယင်းကုမ္ပဏီမှ စတင်၍ ကွင်းဆင်းလေ့လာမည် ဖြစ်ကြောင်း၊ ရေအားလျှပ်စစ်စီမံကိန်းနဲ့ ပတ်သက်၍ ရှင်းလင်းပြောကြားရာတွင် ကျေးရွာများမှ ကျေနပ်ခြင်း မရှိဘူးပါက ၎င်းတို့ အစိုးရအဖွဲ့၊ ဝန်ကြီးများနှင့် တက်ရောက်ဆွေးနွေးနိုင်ကြောင်း၊ ကိုယ်တိုင်ကိုယ်ကျ သိချင်ပါကလည်း ကုမ္ပဏီနှင့် ဆက်သွယ်၍ ကုမ္ပဏီမှ လိုက်လံရှင်းပြရမည် ဖြစ်ကြောင်း၊ ၎င်းလက်ထက်တွင် ယခု အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်မှ လျှပ်စစ်မီး ရချင်ကြောင်း၊ အင်းဒေသသည်လည်း အဆင်ပြေသွားမည် ဖြစ်ကြောင်း၊ ဒေသခံများ အနေနှင့်လည်း ကိုယ်တိုင်ကိုယ်ကျ တွေ့ရှိချက်များနှင့် ညှိနှိုင်း၍ ပြေလည်အောင် ဆောင်ရွက်သွားစေချင်ကြောင်း ပြောကြားခဲ့ပါသည်။

အစီအစဉ် (၂) **နံနက် ၁၀း၄၅ - ၁၁း၀၀**	အင်းတိုင်းရင်းသားဝန်ကြီး ဒေါက်တာဦးထွန်းလှိုင်မှ အမှာစကား ပြောကြားခြင်း။

အင်းတိုင်းရင်းသားရေးရာ ဝန်ကြီးမှ အင်းထဲ၊ ရွာမ၊ ဖောင်တော်ဦးဘုရား ၂၄ နာရီ လျှပ်စစ်မီးနဲ့ပတ်သက်၍ ဝင်ရောက်လုပ်ကိုင်ခဲ့တဲ့ လူတစ်ယောက်အနေဖြင့် လျှပ်စစ်မီး တန်ဖိုးရှိကြောင်း၊ ခက်ခဲကြောင်း၊ ဘယ်လောက်ထိလိုအပ်ကြောင်း စသည်တို့ကို နားလည်ကြောင်း၊ နိုင်ငံအနေဖြင့် Lighting အတွက် အလွန်ခက်ခဲသော အနေအထားမျိုးတွင် ရှိနေကြောင်း၊ လက်ရှိ အသုံးပြုနေသော လျှပ်စစ်မီးသည်လည်း

ကျေနပ်ဖွယ်ရာ Supply မရှိသေးကြောင်း၊ လျှပ်စစ်မီးထုတ်လုပ်ခြင်းသည်လည်း အထူးလိုအပ်ချက်တစ်ရပ်အဖြစ် ရှိနေကြောင်း၊ လျှပ်စစ်မီးသည် ပြည်သူလူထု၏ အခြေခံလိုအပ်ချက် Basic Needs Infrastructure လည်းဖြစ်ကြောင်း၊ ဖွံ့ဖြိုးတိုးတက်မှုတစ်ရပ် ဖြစ်နေသောကြောင့် လျှပ်စစ်မီးထုတ်လုပ်မှုသည် လိုလားသည့်ကိစ္စရပ်တစ်ခုဖြစ်နေကြောင်း ပြောကြားခဲ့ပါသည်။ သို့ရာတွင်လည်း အင်းလေးဒေသသည် အာဆီယံနိုင်ငံများ၏ Cultural Heritage Park အဖြစ် ယဉ်ကျေးမှုနှင့် အမွေအနှစ်ဆိုင်ရာ ဥယျာဉ်ကြီးအဖြစ် သတ်မှတ်ထားသည့်အပြင် World Biosphere Network, UNESCO မှလည်း Men and Biosphere Reserve အဖြစ် သတ်မှတ်ထားသောကြောင့် ၎င်းတို့အနေဖြင့် သဘာဝအခြေအနေ ကိုလည်း ပျက်စီးခံလို့မရနိုင်သော အနေအထားမျိုးရှိနေကြောင်း ပြောကြားခဲ့ပါသည်။ တစ်ဖက်က လျှပ်စစ်ထုတ်လုပ်ရန် လိုအပ်နေသည့်အခြေအနေတွင် တစ်ဖက်က အင်းလေးကန်ဒေသကို သဘာဝအတိုင်းတည်ရှိဖို့ ကိစ္စရပ် ကလည်းရှိနေသောကြောင့် ညှိနှိုင်းဆောင်ရွက်သင့်ကြောင်း၊ ESIA နဲ့ပတ်သက်ပြီး ပြောဆိုရလျှင်လည်း အင်းတိုင်းရင်းသားများ၏ ကိုယ်စားလှယ်အနေဖြင့် ဒေသခံများ၏ အကျိုးစီးပွားကို မထိခိုက်စေချင်ကြောင်း၊ အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်နဲ့ ဆက်စပ်နေသော ဒေသခံတွေရဲ့ လုပ်ကိုင်ခွင့် မြေယာများသည် ဆုံးရှုံးခဲ့ရလျှင် တစ်သက်လုံး ပေးအပ်လိုက်ရမည့် အနေအထားတွင် ရှိနေသောကြောင့် ကုမ္ပဏီဘက်မှလည်း နားလည်ပေးစေလိုကြောင်း၊ နိုင်ငံတော်အဆင့် ဆောင်ရွက်သော စီမံကိန်းအနေဖြင့် ဌာနဆိုင်ရာစုံစုံညီညီနဲ့ ကျကျနနဆောင်ရွက်မည် အနေအထားမျိုးရှိကြောင်း၊ နိုင်ငံတော်အတိုင်ပင်ခံပုဂ္ဂိုလ်နဲ့ နိုင်ငံတော်သမ္မတကြီး ဦးထင်ကျော်တို့ရဲ့ ညွှန်ကြားချက်အရလည်း စီမံကိန်းကို ပြည်သူလူထုနဲ့ ပွင့်လင်းမြင်သာမှုရှိရှိဆောင်ရွက်ရမည့် အနေအထားမျိုးရှိကြောင်း၊ နိုင်ငံတော်ဘဏ္ဍာကို အတတ်နိုင်ဆုံးချွေတာရမယ့် အနေအထားတွင် ရှိနေကြောင်း၊ ဒေသခံတိုင်းရင်းသားများနဲ့ အင်းလေးကန်ရေရှည်တည်တံ့ရေးအတွက် မထိခိုက်စေသော ကိစ္စမျိုးဖြစ်ပါက ကန့်ကွက်စရာ မရှိကြောင်း၊ မြေယာကိစ္စရပ်များ ရှိခဲ့ပါကလည်း ရှိနေသော ဥပဒေနဲ့အညီ ဒေသခံတိုင်းရင်းသားများနှင့် ညှိနှိုင်းရမည် ဖြစ်ကြောင်း၊ သီးနှံလျော်ကြေးများမှအစ နှစ်ဦးနှစ်ဖက် အကျိုးကျေးဇူးရှိအောင် ဆောင်ရွက်စေချင်ကြောင်း၊ ပြည်သူလူထု နစ်နာရမယ့် ကိစ္စမျိုးကို ရှောင်ပေးစေချင်ကြောင်း၊ ပြည်သူလူထုအနေနဲ့ကလည်း နိုင်ငံတော်အတွက် ထည့်သွင်းစဉ်းစားပြီး အားလုံးညီညီညာညာနဲ့ ဆောင်ရွက်စေချင်ကြောင်း ပြောကြားခဲ့ပါသည်။

အစီအစဉ် (၃) **နံနက် ၁၁း၀၀ - ၁၁း၁၅**	စွမ်းအားသစ်ဖွံ့ဖြိုးတိုးတက်မှု ကုမ္ပဏီလီမိတက်၏ လက်ထောက်အထွေထွေမန်နေဂျာ ဦးဟန်မင်းထွန်းမှ စီမံကိန်းအကြောင်းရှင်းလင်းပြောကြားခြင်း။

ရှင်လင်းပြောကြားသည့်အကြောင်းအရာများမှာ အောက်ပါအတိုင်းဖြစ်သည်။

- စီမံကိန်းရည်ရွယ်ချက်
- တင်ပြချက်
- အဓိကတည်ဆောက်မည့် လုပ်ငန်းများ
- စီမံကိန်းဆိုင်ရာအချက်အလက်များ
- ဖောက်လုပ်ပေးထားသော လမ်းများ
- ရေလှောင်ဆည်တည်ဆောက်မည့် မြေနေရာပုံ
- ရေလှောင်ဆည် မြေကြီး၊ ကျောက်သားတူးဖော်ခြင်းလုပ်ငန်းဆောင်ရွက် ပြီးစီးမှု အခြေအနေ
- ရေလှောင်ဆည် အထက်တွင် အချိန် (၁၉) နှစ်ကြာသည့်အခါ ထိန်းသိမ်းနိုင်မည့် သဲ၊ နုန်း ပမာဏ အခြေအနေ
- Neo Energy Oasis Development Co., Ltd Social Impact Assessment (SIA) လုပ်ငန်းများ ဆောင်ရွက်မှု အခြေအနေ
- Social Impact Assessment လုပ်ငန်းများဆောင်ရွက်မှု လူမှုဝန်းကျင် အထောက်အကူပြု ဒေသဖွံ့ဖြိုးရေး လုပ်ငန်းများ ဆောင်ရွက်ပေးခြင်း
- စီမံကိန်း အခြေစိုက်စခန်း ဧရိယာအတွင်း ကျရောက်ခဲ့သည့် ယာများအတွက် တောင်သူများသို့ ထောက်ပံ့ကြေး ပေးအပ်ခြင်း။
- အထက်ဘီလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်း စွမ်းအားသစ် အိုအေစစ် ဖွံ့ဖြိုးတိုးတက်မှု ကုမ္ပဏီ လီမိတက်၏ ညောင်ရွှေမြို့နယ်၊ တုံးလည်ကျေးရွာအုပ်စု၊ အင်းတိန်ကျေးရွာတွင် စက်ရေတွင်း လှူဒါန်းခြင်း မှတ်တမ်းဓာတ်ပုံများအားရှင်းပြခြင်း
- အထက်ဘီလူးချောင်းရေအားလျှပ်စစ် စီမံကိန်း စွမ်းအားသစ် အိုအေစစ် ဖွံ့ဖြိုးတိုးတက်မှု ကုမ္ပဏီ လီမိတက်၏ ညောင်ရွှေမြို့နယ်၊ တုံးလည်ကျေးရွာအုပ်စု၊ မင်းလုံးကျေးရွာတွင် စာရေးကိရိယာနှင့် စာသင်ခုံများ လှူဒါန်းခြင်း မှတ်တမ်းဓာတ်ပုံများအားရှင်းပြခြင်း

<table>
<tr><td colspan="2">

- မင်းလုံးကျေးရွာသို့ စီမံကိန်းမှ ဆောင်ရွက်ပေးနေသော အစီအစဉ်များ
- စီမံကိန်းလုပ်ငန်းများ ဆောင်ရွက်ထားမှု နှင့် စီမံကိန်းတစ်ခုလုံး ပြီးစီးမှု ရာခိုင်နှုန်း အခြေအနေ တင်ပြချက်

</td></tr>
<tr><td>အစီအစဉ် (၄)

နံနက် ၁၁း၁၅ - ၁၁း၃၀</td><td>မြန်မာ့သယံဇာတနှင့် ပတ်ဝန်းကျင် ကုမ္ပဏီ (Resource and Environment Myanmar Co.,Ltd) ၏ အကြီးတန်းအကြံပေး ဒေါ်နယဉ် မှ ESIA လုပ်ငန်းရပ်ဆိုင်ရာများကို ရှင်းလင်းပြောကြားခြင်း။</td></tr>
<tr><td colspan="2">

ရှင်းလင်းပြောကြားသည့်အကြောင်းအရာများမှာ အောက်ပါအတိုင်းဖြစ်သည်။

- စီမံကိန်း ခြုံငုံသုံးသပ်ချက်
- ပတ်ဝန်းကျင်ထိခိုက်မှုဆိုင်ရာ လေ့လာဆန်းစစ်ခြင်း (EIA) နောက်ခံအချက်အလက်
- Preliminary EIA
- အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်း၏ ယေဘုယျဖွဲ့စည်းပုံ အစီအစဉ်
- EIA လုပ်ငန်းလုပ်ဆောင်ခြင်း ရည်ရွယ်ချက်
- အကျိုးသက်ရောက်မှု လေ့လာခြင်းနှင့် စီမံခန့်ခွဲမှု
- ဆောင်ရွက်ခဲ့သော လုပ်ငန်းစဉ်များ
- လူထုအကြံဉာဏ်ရယူမှု လုပ်ငန်းစဉ်ကို ခြုံငုံဖော်ပြခြင်း
- စီမံကိန်းအကြောင်းအရာ
- EIA အတွက် လိုအပ်သော အခြေခံအချက်အလက်များလေ့လာခြင်း
- လူမှုဝန်းကျင်ဆိုင်ရာ အချက်အလက်ကောက်ယူခြင်း နည်းလမ်းများ
- မြို့နယ်နှင့် ကျေးရွာများသို့ ကွင်းဆင်းမည့် အစီအစဉ်
- ဆက်သွယ်ရန်လိပ်စာများ

</td></tr>
<tr><td>အစီအစဉ် (၅)

နံနက် ၁၁း၃၀ - ၁၂း၃၀</td><td>တက်ရောက်သူများမှ သိရှိလိုသည်များကို မေးမြန်းခြင်း၊ ဆွေးနွေးခြင်းနှင့် ပြန်လည်ဖြေကြားပေးခြင်း။</td></tr>
</table>

မေးမြန်းဆွေးနွေးသူ နှင့် ပြန်လည်ဖြေကြားပေးသူ	အကြောင်းအရာ
မေး ၁။ ဦးသန်းထွန်းအောင် CDC ဥက္ကဋ္ဌ၊ ညောင်ရွှေ။	EIA နဲ့ပတ်သက်၍ မူများ၊ Procedureများ လွဲနေသည်ဟုထင်မိကြောင်း၊ လုပ်ငန်းသည် ရာခိုင်နှုန်းအားဖြင့် ၄၀% နီးပါးပြီးနေသည့်ချိန်မှ EIA လုပ်သည့်အတွက် Procedure လွဲနေသည်ဟု ထင်မိသောကြောင့် ဆွေးနွေးချင်ကြောင်း၊ တက်ရောက်လာသော ဝန်ကြီးများအား နောက်နောင် အင်းလေးကန်နဲ့ပတ်သက်သော စီမံကိန်းများ ဆောင်ရွက်မည်ဆိုပါက မဆောင်ရွက်ခင် EIA အတွက် သေချာကွင်းဆင်းပြီးမှ စီမံကိန်းတွေကို လုပ်စေချင်ကြောင်း၊ EIA ကို အကျယ်တဝင့် လေး ဒေသခံတွေ သိရှိအောင် နောက်ထပ် ကျယ်ကျယ်ဝင့်ဝင့်လေး ဆွေးနွေး စေချင်ကြောင်း၊လုပ်ငန်း တည်ဆောက်ပြီးမှ EIA ဆိုးကျိုးတွေဖြစ်လာပါက မနစ်နာစေကြောင်း၊ ယခုခေတ်စနစ်သစ်တွင်လည်း အင်းလေးကန် အုပ်ချုပ်ရေးအဖွဲ့ တရားဝင် ပေါ်ပေါက်ပြီ ဖြစ်သောကြောင့် နောက်နောင် စီမံကိန်းများရှိလာပါကလည်း Lake Authority (အင်းလေးကန် အုပ်ချုပ်ရေးအဖွဲ့) ရဲ့ သဘောထား မှတ်ချက်လေးကိုလည်း ယူသင့်ပါကြောင်း အကြံပြုဆွေးနွေးခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	EIA နဲ့ ပတ်သက်ပြီး လုပ်ဆောင်မှုတွေက Procedure လွဲနေသည်ဟု ပြောသွားချက်အရ ရှင်းလင်းရမည်ဆိုပါက ယခင်အချိန်က စီမံကိန်းများ လုပ်ဆောင်ပါက သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ လူမှုဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှု ဆန်းစစ်တာ မရှိခဲ့ကြောင်း၊ နိုင်ငံတကာတွင် ရှိလာခဲ့ကြောင်း၊ နောက်ပိုင်း၌ လက်ရှိ နိုင်ငံတွင် သဘာဝပတ်ဝန်းကျင်ဆိုက်ရာနဲ့ ပတ်သက်သော ဥပဒေ တွေ လုပ်ထုံးလုပ်နည်းတွေ မရှိခဲ့ဘူးသောကြောင့် World Bank၊ အာရှဖွံ့ဖြိုးရေးဘဏ်၊ နိုင်ငံတကာ ငွေကြေးရန်ပုံငွေ အဖွဲ့အစည်းများ စသည်တို့၏ စံနှုန်း၊ စံထားတွေကို စု၊ တု၊ ပြု၍ လုပ်ခဲ့ရကြောင်း၊ နိုင်ငံတော်အစိုးရရဲ့ ပြောင်းလဲလာခဲ့တဲ့ အချက်တွေနဲ့ ပတ်သက်၍ သဘာဝ ပတ်ဝန်းကျင်ဆိုင်ရာ လုပ်ထုံးလုပ်နည်းကို ၂၀၁၅ ခုနှစ်၊ ဒီဇင်ဘာလမှာ စတင်

	ပြဌာန်းခဲ့ကြောင်း၊ တတိယ အဖွဲ့အစည်းအနေဖြင့် သက်ဆိုင်ရာ ခွင့်ပြုချက်နှင့်အတူ မေလ ၂၀၁၅ ကတည်းက လုပ်ဆောင်ခဲ့ကြောင်း၊ လုပ်ပြီးခဲ့သော Preliminary Report ကိုလည်းသက်ဆိုင်ရာ ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးဌာနကိုလည်း တင်ပြခဲ့ကြောင်း၊ စီမံကိန်း ပေါ်မူတည်၍ ESIA, Environmental, Social Impact Assessment များကို နှစ်ရှည် လုပ်ရကြောင်း၊ ယခုမှ တင်ပြရခြင်းမှာလည်း အရင်ဆုံး Data ကောက်ရကြောင်း၊ ပြီးမှ Screening, Scoping လုပ်ရကြောင်း၊ စီမံကိန်းသည် ဘယ်လောက်ထိ ထိခိုက်နိုင်မလဲဆိုတာ တွက်သည့်ချိန်တွင် Desk Study ကို ရှုံး၍သာ လုပ်ဆောင်ကြောင်း၊ ထို့နောက် အချက်အလက်တွေ ကောက်ယူ၍ ယင်းတို့ပေါ်မူတည်၍ ဖြစ်နိုင်ချေကို တွက်ချက်ရကြောင်း၊ တွက်ချက်သောအခါ၌လည်း မဆောက်မီကာလ၊ ဆောက်လုပ်ဆဲကာလ၊ လည်ပတ်ဆဲကာလ၊ တည်ဆောက်ပြီးဖျက်သိမ်းကာလ အချိန်အထိမှန်းဆပြီး တွက်ချက်ရကြောင်း၊ ထို့နောက် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး ဦးစီးဌာနကို တင်ပြရကြောင်း ပြောကြားခဲ့ပါသည်။ အလားတူစွာပင် ထိုသို့ဆောင်ရွက်မှုများကို သက်ဆိုင်သူများဖြင့် ဆွေးနွေးခြင်းအဆင့် အနေဖြင့် ယခုလိုလာရောက်ချပြရခြင်းဖြစ်ကြောင်း၊ ယခုလိုတင်ပြရာ၌လည်း တက်ရောက်လာသော လူကြီးမင်းများဆီမှ တစ်ဆင့် အကြံဉာဏ်များ၊ သဘောထားအမြင်များ၊ စိုးရိမ်ပူပန်မှုများလည်း လိုအပ်ကြောင်း၊ Procedure လွဲချော်နေတယ် ဆိုသည်မှာလည်း ရှင်းပြသည့်အကြောင်းအရာ နည်းနည်းပါးပါး လိုအပ်သွားခြင်းဖြစ်ကြောင်း ပြန်လည်ဖြေကြားခဲ့ပါသည်၊ EIA လုပ်ဆောင်နေသော စီမံကိန်းအမျိုးအစားသည် Water Run of Type ဖြစ်ပြီး တကယ်တမ်းလက်ရှိ လုပ်ဆောင်နေ ရေအားလျှပ်စစ် စီမံကိန်းနဲ့ နှိုင်းစာရင် ယခု စီမံကိန်းသည် Eco-friendly အဖြစ် သတ်မှတ်ထားပြီး သဘာဝပတ်ဝန်းကျင်နဲ့ သဟဇာတဖြစ်တယ်လို့ ယူဆရပါကြောင်း၊ အကြောင်းရင်းမှာ ရေဝပ်ဧရိယာ Catchment Area အကြီးကြီးမလိုအပ်ခြင်း၊

	ရေကာသူဟာသူစီးနေမယ် စီးနေမည်ဖြစ်သောကြောင့် ရေလမ်းမှာ ရှိနေသော Biodiversity ရေနေ သတ္တဝါတွေကို ထိခိုက်မှုမရှိခြင်းတို့ကြောင့် ဖြစ်ကြောင်း၊ ထိခိုက်မှုရှိခဲ့ပါကလည်း လျှော့ချမည့် Environmental Management Plan သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအစီအစဉ်ကို ရေးဆွဲရကြောင်း၊ ရေးဆွဲပြီးတော့ သက်ဆိုင်ရာ Project Proponent တင်ပြရကြောင်း၊ Monitoring Plan (MP) ကိုလည်း ရေးဆွဲရကြောင်း၊ လုပ်ဆောင်မှုရှိ၊ မရှိကို စောင့်ကြည့်ရတာတွေရှိကြောင်း၊ ယခုအဆင့်မှာ ဒေသနဲ့ သက်ဆိုင်ရာလူထုနဲ့ ချပြသည့်အခြေအနေ၌သာ ရှိကြောင်း၊ နောက်ပိုင်း ထွက်ရှိလာမည့် အစီရင်ခံစာသည်လည်း Environmental Conservation Department ရှိ သက်ဆိုင်ရာ ကျွမ်းကျင်ပညာရှင်များဖြင့် ဖွဲ့စည်းထားသော Review Team မှ သုံးသပ်ပြီး လိုအပ်ချက်တွေကို ဖြည့်စွက်ပြုပြင်ပြီးမှ ခွင့်ပြုချက်ရမည် ဖြစ်ကြောင်း၊ ယခု အခြေအနေသည် Ongoing Process အနေဖြင့်သာရှိသေးကြောင်း ရှင်းလင်းပြော ကြားခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း Director, NEO Co.,Ltd	ဖြည့်စွက်ဖြေကြားရလျှင် ရေအားလျှပ်စစ်စီမံကိန်း လုပ်ဆောင်လျှင် Feasible Study လုပ်ရကြောင်း၊ ၂၀၁၀ ခုနှစ်ကတည်းက ဂျပန်ကုမ္ပဏီ Nippon Koei နှင့် Feasible Study အပ်ခဲ့ကြောင်း၊ Feasible Study အဆင့်တွင်လည်း ESIA လုပ်ရကြောင်း၊ ၂၀၁၅ ဒီဇင်ဘာလမှာ ထွက်ရှိလာသော ဥပဒေသစ်ရ ESIA ကို Full Report အဖြစ် အပြည့်အစုံ တစ်ခုဖြစ်အောင် ဆက်လုပ်ရကြောင်း၊ ထို့ကြောင့် စီမံကိန်းစတင်ချိန်ကတည်းက ESIA ကို လုပ်ဆောင်ခဲ့ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ၂။ ဦးထွန်းနအောင်	အစိုးရနှင့် လုပ်ဆောင်ခဲ့သော MOU တွင် ပါရှိသော သဘောတူညီချက်များကို အကြမ်းဖျင်း ပြောပြစေချင်ကြောင်း၊ EIA, SIA လုပ်ဆောင်ရာတွင် ၂၀၁၅ ခုနှစ် မေလတွင် ECD ကို တင်ပို့ခဲ့သော Report နှင့် ယခုလက်ရှိလုပ်ဆောင်နေသော လုပ်ငန်းစဉ် ကွာခြားမှုကို သိချင်ကြောင်း၊

NLD အဖွဲ့ဝင်၊ ညောင်ရွှေ	ဒေသခံပြည်သူများနှင့် ရှေ့ဆက် မည်ကဲ့သို့ ပူးပေါင်းဆောင်ရွက်သွားမည်ကို သိချင်ကြောင်း မေးမြန်းခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း Director, NEO Co.,Ltd	အိုအေစစ် ဖွံ့ဖြိုးတိုးတက်မှု ကုမ္ပဏီ လီမိတက်အနေဖြင့် လျှပ်စစ် စွမ်းအား ဝန်ကြီးဌာနနှင့် ၂၀၀၉ ခုနှစ်တွင် MOU ရေးထိုးခဲ့ကြောင်း၊ ထို့နောက် Feasible Study ကို လုပ်ဆောင်ခဲ့ကြောင်း၊ ၂၀၁၁ ဇန်နဝါရီလတွင် လျှပ်စစ် စွမ်းအင် ဝန်ကြီး ဌာန၊ ရေအားလျှပ်စစ် အကောင်အထည်ဖော်ရေး ဦးစီးဌာနအနေဖြင့် ပဋိဉာဏ် စာချုပ် MOUကို ရေးထိုးခဲ့ကြောင်း၊ ပဋိဉာဏ်ရဲ့သဘောတရားမှာ (Build, Operate, Transfer) အနေဖြင့် စီမံကိန်းကို တည်ဆောက်မယ်၊ မောင်းနှင် မယ်၊ ထို့နောက် နိုင်ငံတော်ကို ပြန်လွှဲပြောင်းပေးရတဲ့ စနစ်တစ်ခုဖြစ် ဆောင်ရွက်ခြင်းဖြစ်ကြောင်း ဖြေကြားပေးခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	NEO Energry မှ Nippon Koei ဂျပန်ကုမ္ပဏီနှင့် ပူးပေါင်းပြီး Feasible Study လုပ်ခဲ့ကြောင်း၊ REM ကုမ္ပဏီကို နောက်ပိုင်းမှ Assign လုပ်ခဲ့သည့်အပြင် လုပ်ထုံးလုပ်နည်းအသစ် ထွက်ရှိလာသောကြောင့် ပြန်လည် လုပ်ဆောင်ရသောကြောင့် ရှိနေသော ကွာဟချက်များကို နားလည်ပေးစေချင်ကြောင်း ပြောကြားခဲ့ပါသည်။
မေး ဦးထွန်းနအောင် NLD အဖွဲ့ဝင်၊ ညောင်ရွှေ	ပြည်သူနဲ့ ပူးပေါင်းဆောင်ရွက်သွားမည့် အခန်းကဏ္ဍကို ဖြေပေးစေကြောင်း ပြောကြားခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း	စီမံကိန်းလုပ်ဆောင်ရသော ရည်ရွယ်ချက်မှာ Win, Win, Win ဖြစ်ကြောင်း၊ နိုင်ငံတော်၊ ကုမ္ပဏီ၊ ပြည်သူ သုံးခုလုံး အကျိုးရှိရမည် ဖြစ်ကြောင်း၊ ဝန်ကြီးဌာန၊ ပြည်နယ်အစိုးရမှ သက်ဆိုင်သော တာဝန်ရှိပုဂ္ဂိုလ်များ၏

Director, NEO Co.,Ltd	လမ်းညွှန်ချက်ဖြင့် ပြည်သူတွေ အကျိုးထိခိုက်ခြင်း မရှိအောင်၊ ထိခိုက်မှုအနည်းဆုံး ဖြစ်အောင် ကြိုးစားပြီးဆောင်ရွက်သွားမည် ဖြစ်ကြောင်း ဖြေကြားခဲ့ပါသည်။
မေး ၃။ ဦးအောင်ခင် ICDO, ဥက္ကဋ္ဌ (Integrated Inle Lake Conservation and Development Organization)	ဘီလူးချောင်းနေရာတွင် အပြာရောင်သဘောမျိုး ရှိပြီး အပင်မပေါက်သော တောင်မျိုးရှိနေကြောင်း၊ တောင်ထဲတွင် ဓာတ်သတ္တုတစ်ခုခု ရှိနိုင်သည်ဟု ယူဆမိကြောင်း၊ ထို့ကြောင့် သက်ဆိုင်ရာ ဝန်ကြီးများ အနေဖြင့် ကျွမ်းကျင်တဲ့ပုဂ္ဂိုလ်များနှင့်အတူ ဆန်းစစ်ပေးစေချင်ကြောင်း၊ ကုမ္ပဏီမှ လမ်းဖောက်စဉ်တွင် Road Side Erosion ကိုထည့်ပေးစေချင်ကြောင်း၊ Gully Erosion ရှိလာသောအချိန်တွင် မည်ကဲ့သို့ Maintain လုပ်ဆောင်ပါမည်လဲ၊ မဖြစ်လာအောင် မည်ကဲ့သို့လုပ်ဆောင်ပါမည်လဲ စသည်တို့ကို ထည့်သွင်းပြီးတော့မှ စဉ်းစားပေးစေချင်ကြောင်း၊ Ecosystem တွေ ပျက်စီးမှာ စိုးရိမ်မိကြောင်း၊ ပြုန်းသွားသော သစ်တောများကို အစားထိုးပြန်လည်ပြီး Cover ဖြစ်အောင် လုပ်ဆောင်ရမည့် အစီအစဉ်များကိုလည်း ထည့်ပေးစေချင်ကြောင်း ဆွေးနွေးခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	Environmental နှင့်ပတ်သက်၍ ပြောရလျှင် Water Run of ဆိုသည်မှာ Eco-friendly ဖြစ်ကြောင်း၊ Catchment Area တွင် ရေအမြဲစီးနေမည် ဖြစ်ကြောင်း၊ လုပ်ဆောင်သော အဆင့်တိုင်းတွင် EMP ပါရှိကြောင်း၊ ECD က ချမှတ်ထားသော သဘာဝ ပတ်ဝန်းကျင်ဆိုင်ရာ ဥပဒေအရ ဒီအစီရင်ခံစာကို ECD ရှိ Review Team ကိုတင်ပြီးတာနှင့် တစ်ပြိုင်နက်တည်း အစီရင်ခံစာကို ပြည်သူ လူထုကို ချပြမည်ဖြစ်ကြောင်း၊ အသေးစိတ် လေ့လာကြည့်ရှု၍ လိုအပ်ပါက ဆက်လက်အကြံပြုနိုင်ကြောင်း ပြန်လည်ဆွေးနွေးခဲ့ပါသည်၊
မေး ဦးအောင်ခင်	EIA, SIA လုပ်ဆောင်ချိန်တွင် Monitoring အစီအစဉ်၌ ဤအရပ်ရှိလူများပါဝင်ခွင့် ရမရ သိချင်ကြောင်း၊ Monitoring

ICDO, ဥက္ကဋ္ဌ	ရေးထားပေမယ့် မလုပ်လို့ရှိရင် ပြဿနာဖြစ်နိုင်သောကြောင့် မည်သည့် System ဖြင့် လုပ်ဆောင်သွားမည်ကို သိချင်ကြောင်း မေးမြန်းခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	Monitoring Plan ကို ကုမ္ပဏီမှနေပြီး သက်ဆိုင်ရာ ကျွမ်းကျင်သူပညာရှင်ကို ငှားရမ်းပြီး စောင့်ကြည့်လုပ်ဆောင်ရမှာ ဖြစ်ကြောင်း၊ Monitoring လုပ်တဲ့ Plan များကို ၄င်း၏ဥပဒေအတိုင်း သက်ဆိုင်ရာကို တင်ပြရမှာ ဖြစ်ကြောင်း၊ ဥပဒေအရဆိုရလျှင် လွတ်လပ်သော အဖွဲ့အစည်းတစ်ခုကို ခန့်အပ်ပြီး Monitoring လုပ်ဆောင်ရမည် ဖြစ်ကြောင်း၊ ယခု REM အနေဖြင့် လောလောဆယ်အချိန်အထိ အစီရင်ခံစာရေးဆွဲ၍ ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများကို အတတ်နိုင်ဆုံး လျှော့ချ၍ အကျိုးဖြစ်နိုင်မည့် အရာများကို လေ့လာပြီးတော့ လုပ်ဆောင်မည် ဖြစ်ကြောင်း၊ Monitoring Plan ကတော့ သက်ဆိုင်ရာ ကုမ္ပဏီမှ လွတ်လပ်သော တတိယ အဖွဲ့အစည်းတစ်ခုကို ငှားရမ်းလုပ်ဆောင်မည် ဖြစ်ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ၄။ ဦးကျော်ကျော်ဦး၊ AE ၊ ဦးစီးအရာရှိ၊ ဆည်မြောင်းဦးစီးဌာန။	အထက်ဘီလူးချောင်း စီမံကိန်းတွင် Weir သာမက၊ အပေါ်တွင် ရေလှောင်ဆည်ဆိုသော Dam ရှိကြောင်း၊ အင်းလေးဒေသတွင် ရေသွင်းစိုက်ပျိုးသောကြောင့် ရေလိုအပ်သောအချိန်တွင် ရေထုတ်ပေးနိုင်ရန် စီမံချက်ထဲမှာ ထည့်သွင်းရေးဆွဲပေးစေချင်ကြောင်း၊ ထိုအကြံပြုချက်ကို Environmetal Impact, Social Impact ထဲတွင် ထည့်သွင်းစဉ်းစား၍ Management Plan ထဲထည့်ပေးစေချင်ကြောင်း အကြံပြုဆွေးနွေး ခဲ့ပါသည်။
ဖြေ ဦးဟန်မင်းထွန်း၊ AGM, NEO Co., Ltd	Storage Dam တွင် ရေကို လှောင်ထားမည် မဟုတ်ကြောင်း၊ မြေပြင်ရဲ့အထက်ကို ပေ ၆၀ ရှိသော Weir မှ ရေကို ရေသွယ်မြောင်းအတိုင်း လွှဲယူမည် ဖြစ်ကြောင်း၊ အောက်တွင်လည်း Outlet များမှ ရေထုတ်ပေးမည်ဖြစ်ကြောင်း၊ Second Storage Diversion Channel များလည်း ပါဝင်မည်ဖြစ်ကြောင်း၊ Weir အသေးစား ဖြစ်သောကြောင့် ရေကိုလွှဲယူတဲ့စနစ်နဲ့ ယူ၍ ပိုသောရေကို Over Flow, Spill Way မှတစ်ဆင့်

	စီးဆင်းစေမှာ ဖြစ်ကြောင်း၊ Outlet မှ ရေကိုလည်း လိုသလို ထုတ်ပေး သွားမည်ဖြစ်ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ဦးကျော်ကျော်ဦး၊ AE ၊ ဦးစီးအရာရှိ၊ ဆည်မြောင်းဦးစီးဌာန။	ရှမ်းပြည်ရှိ အကြီးဆုံးရေလှောင်ဆည်မှာ ၁၂ ပေသာမြင့်ကြောင်း၊ ၎င်းတို့ဌာန သတ်မှတ်ချက်အရ ရှမ်းပြည်နယ် အင်းလေးဒေသအရ Small Dam အမျိုးအစားတွင် ပါဝင်ကြောင်း၊ Rainfall Intensity ၏ Trend မှာ တဖြည်းဖြည်းကျဆင်းလာကြောင်း၊ Iso Height သည်လည်း 30 to 40 ကြားဖြစ်လာ၍ အင်းလေးထဲသို့ ရေဝင်ရန် စုဆောင်းနေရချိန် ဖြစ်နေကြောင်း၊ အင်းလေးကန် ရေနည်းနေသောအချိန်တွင် အပေါ်မှ စုထားသောရေထဲမှ စပါး စိုက်ပျိုးရေးအတွက်လည်း ခွဲပေးစေချင်ကြောင်း ပြောကြားခဲ့ပါသည်။
<u>ဖြေ</u> ဦးတိုးလှိုင်၊ ညွှန်ကြားရေးမှူး၊ ရေအားလျှပ်စစ် အကောင်အထည် ဖော်ရေး ဦးစီးဌာန။	စီမံကိန်းသည် ရေအားလျှပ်စစ် အကောင်အထည်ဖော်ရေး ဦးစီးဌာန၏ ဦးဆောင်မှုဖြင့် လုပ်ဆောင်နေကြောင်း၊ Construction နောက်ပိုင်း Weir နှင့်ပထမ Stage မရောက်ခင် ရေမပြတ်အောင် Ecologiacl Water ဆိုပြီးမှ 3o m^3/s ထုတ်ပေးနိုင်သော Outlet တစ်ခု ထားခဲ့ကြောင်း၊ အဲ့တစ်ချက်မှ တောက်လျှောက်လိုရင် လိုသလိုထုတ်ပေးလို့ရကြောင်း၊ Weir လေးက Elevated တစ်ခုပဲလုပပြီး Full Type (Maximum) Level မှာမှ ၅၀၀၀ လောက်သာ ရှိသည့်အတွက် မိုးတွင်းတစ်ခုတည်းဖြင့် Elevated ရောက်သွားနိုင်ကြောင်း၊ စက်က တစ်နှစ်လုံး ပုံမှန်လည်နေမှာ ဖြစ်သောကြောင့် ရေပြတ်သွားမည် မဟုတ်ကြောင်း၊ အနိမ့်ဆုံး Dry Season မှာ တောင်မှ $5m^3/s$ ရှိကြောင်း၊ စိုးရိမ်စရာ မလိုအပ်ကြောင်း ပြောကြားခဲ့ပါသည်။
<u>မေး ၅။</u> ဦးကျော်သက်ခိုင်၊	အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ် စီမံကိန်းမှ သဘာဝ ပတ်ဝန်းကျင်အပေါ်မှာ ရှိသော Impact, Social Impact တစ်ချို့ကို ကြားမိကြောင်း၊ ယခုလုပ်ဆောင်မည့် Assessment တွင် ၎င်းတို့ CSO ဖက် ပူးပေါင်းပါဝင်ခွင့် ရှိ/မရှိ၊ စီမံကိန်းနဲ့ပတ်သက်၍ ရှင်းလင်းပြောကြားချိန်တွင်

SMT၊ နလုံးလှအင်း မောင်မယ်။	ပါဝင်ပတ်သက်သော ဒေသခံနည်းနေကြောင်း၊ ဒီ့ထက်ပို၍ ပြည်သူတွေကို ပွင့်လင်းမြင်သာမှုရှိစွာနဲ့ ချပြသင့်ကြောင်း အကြံပြုဆွေးနွေးခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	Assessment လုပ်ဆောင်ချိန်တွင် ပါဝင်ချင်ပါက ပါဝင်ဆောင်ရွက်နိုင်ပါကြောင်း၊ Physical Study နှင့် Ecology Study များမှာ ပြီးခဲ့သော တစ်ပတ်ကျော်ကပဲ ပြီးသွားပြီဖြစ်ကြောင်း၊ ယခု Social Assessment ကိုလုပ်ဆောင်နေကြောင်း၊ တင်ပြသွားသော ရွာတွေကို ဆက်တိုက်သွားမည်ဖြစ်ကြောင်းနှင့် ဆန္ဒရှိပါက ကုမ္ပဏီမှ တာဝန်ရှိသူနှင့် ညှိနှိုင်းပြီး ပူးပေါင်းပါဝင်ဆောင်ရွက်နိုင်ကြောင်း ပြန်လည်ဆွေးနွေးခဲ့ပါသည်။
မေး၆။ ဦးမြတ်မင်းစိုး၊ ICDO အဖွဲ့ အတွင်းရေးမှူး။	စီမံကိန်း ၂ က ဘယ်တော့ပြီးမယ်ဆိုတာ မပါသေးကြောင်း၊ သတ်မှတ်ကာလတွင်း ပြီးအောင်မဆောင်ရွက်နိုင်ပါက ဘယ်လိုတာဝန်ခံပြီး လုပ်မလဲဆိုတာ သိချင်ကြောင်း၊ ထို့ပြင် ပြင်ပကို ကျောက်တွေထုတ်ယူသွားခြင်း ရှိ/မရှိ ဖြေပေးစေလိုကြောင်း၊ ယူသွားပါက မည်သည့် ရည်ရွယ်ချက်ဖြင့် သုံးမလဲဆိုတာ သိချင်ကြောင်း၊ ဝန်ကြီး ပြောသွားသလို ကျောက်ကားတွေ တွေ့ရင် ရွာသားများမှ တားဆီး၍ သက်ဆိုင်ရာကို အကြောင်းကြားစေခြင်းကို ကုမ္ပဏီမှ ခွင့်ပြုရန် ရှိ/မရှိ၊ မြေယာကိစ္စတွင်လည်း ကုမ္ပဏီမှ တကယ်လိုအပ်သော မြေအတိုင်းအတာထက် ပိုပြီးတော့ သိမ်းဆည်းတာမျိုး ရှိ/မရှိ၊ လက်ရှိ သိမ်းဆည်းပြီးခဲ့တဲ့ ကိစ္စ များတွင် မြေယာပိုင်းဆိုင်ရာမှ ကျွမ်းကျင် ပညာရှင်များနှင့် လွတ်လပ်သော ပညာရှင်များ အပါအဝင် ရွာသားများ၏ ကျနပ်မှု တစ်ခုတည်းတင် မဟုတ်ဘဲ သက်ဆိုင်ရာ ကျွမ်းကျင်ပုဂ္ဂိုလ်များ ပါဝင်သောသဘောတူညီမှုမျိုး လုပ်ဆောင်ပေးရန် တောင်းဆိုချင်ကြောင်း၊ ယခု ပြသွားသော EIA, SIA Power Point မှန်နေသောကြောင် နောက်ပွဲများတွင် ရှင်းရှင်းလင်းလင်းပြစေချင်ကြောင်း ဆွေးနွေးခဲ့ပါသည်။

ဖြေ ဦးမင်းထွန်း Director, NEO Co.,Ltd	ရေအားလျှပ်စစ်စက်ရုံ အမှတ် ၂ သည် ၂၀၁၈၊ ဒီဇင်ဘာလမတိုင်ခင်မှာ ပြီးမည်ဖြစ်ကြောင်း၊ ကျောက်ကိစ္စနဲ့ ပတ်သက်ပြီးပြောရလျှင် ကျောက်ထွက်လာတဲ့ဟာကို ကျောက်ခွဲစက်မှာပဲ အသုံးပြုတာ ဖြစ်ကြောင်း၊ ပြင်ပကို ထုတ်တယ်ဆိုတာ မဟုတ်ဘူးဆိုတာကို ၁၀၀% အာမခံနိုင်ကြောင်း၊ ကျောက်ကိစ္စနှင့် ပတ်သက်၍ ပြည်နယ်အစိုးရဆီမှ ခွင့်ပြုချက်ယူ၍ အချိန်မရွေးလေ့လာနိုင်ကြောင်း၊ အကယ်၍များ ကျောက်နမူနာစမ်းသပ်ခြင်း၊ သက်ဆိုင်တဲ့ လေ့လာမှုမျိုး လုပ်မည်ဆိုပါကလည်း ကြိုဆိုလျက်ရှိကြောင်း၊ မြေယာကိစ္စနှင့် ပတ်သက်၍ ရှမ်း လျှပ်စစ်ဝန်ကြီးမှ ကော်မတီတစ်ခုဖွဲ့ထားပေးကြောင်း၊ ၄င်းကော်မတီမှ မြေယာကိစ္စကို ညှိနှိုင်း၍ ကုမ္ပဏီမှ အမြန်ဆုံး ဖြေရှင်းပေးသွားမည် ဖြစ်ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	လိပ်စာမှာ တိုက်ဘီ၊ ၇၀၂၊ ဒဲလ်တာပလာဇာ၊ ရွှေဂုံတိုင်လမ်းမှာ တည်ရှိကြောင်း၊ တခြားရွာများတွင် ဆောင်ရွက်မည့် Power Point များတွင် ရှင်းလင်းအောင် လုပ်ဆောင်သွားမည်ဖြစ်ကြောင်း၊ မီးမရနိုင်သောနေရာများတွင် လက်ကမ်းစာစောင်များ၊ Venyl Sheet များ စီစဉ်ထားကြောင်း၊ အဆင်မပြေမှု ကို ထောက်ပြပေးတဲ့အတွက် ကျေးဇူးတင်မိပါကြောင်း ပြန်လည်ပြောကြားခဲ့ပါသည်။
ဖြေ ဦးတိုးလှိုင်၊ ညွှန်ကြားရေးမှူး၊ ရေအားလျှပ်စစ် အကောင်အထည် ဖော်ရေး ဦးစီးဌာန။	စီမံကိန်းပြီးစီးမှုကို ၂၀၁၈ ၊ ဒီဇင်ဘာတွင် လျာထားကြောင်း၊ အကြမ်းဖျင်း ၂ နှစ်လောက်လျာထားသော်လည်း Power House ဓာတ်အားပေးစက်ရုံနေရာတွင် မြေယာကိစ္စနဲ့ပတ်သက်၍ မပြတ်သေးတာလေးတွေ ရှိနေကြောင်း၊ ဒေသအဖွဲ့အစည်းအားလုံးနဲ့ အတည်ပြုထားသော စာရင်းအရ ပထမအဆင့် ဧက ၆၀ လောက်နစ်နာကြေးပေးရန် ရှိနေသောကြောင့် ဒေသခံများမှ အကူအညီပေးစေလိုကြောင်း၊ ထိုမှသာလျှင် စီမံကိန်းသည် မြန်မြန်ဆန်ဆန်

	ပြီးမည် ဖြစ်ကြောင်း၊ ဝိုင်းပြီးတော့ ကူညီဆောင်ရွက်ပေးစေလိုကြောင်း ဖြည့်စွက်ပြောကြားခဲ့ပါသည်။
မေး ၇။ ဦးကျော်သက်ခိုင်၊ SMT၊ နလုံးလှအင်း မောင်မယ်။	ယခု လက်ရှိမှာ သဘာဝ ပတ်ဝန်းကျင်အပေါ်တွင် မည်ကဲ့သို့ ကုစားမှုမျိုး လုပ်ထားပြီးပြီလဲ သိချင်ကြောင်း၊ ဒီဘီလူးချောင်းတစ်လျှောက်ရှိ အင်းတိန်လယ်ပြင်တို့၊ မင်းလုံးတို့၊ တုံးလည်တို့ရွာတွေမှာ ပေါင်းပြီးလုပ်ထားတဲ့ တာဘိုင်လေးတစ်ခုစီကို ဘယ်လို စုံစမ်းထားသလဲသိချင်ကြောင်း မေးမြန်းခဲ့ပါသည်။
ဖြေ ဦးဟာန်မင်းထွန်း၊ AGM, NEO Co., Ltd	ဒီဘီလူးချောင်းရှိ အင်းတိန်လယ်ပြင်ကို လျော်ကြေးငွေ ပေးပြီးဖြစ်ကြောင်း၊ တုံးလည်ကိုဝယ်ရန် စုံစမ်းခဲ့ပေမယ့် ဆက်လည်းမလုပ်တော့သည့်အပြင် ရောင်းခြင်းလည်းမရှိဘဲ ဒီအတိုင်း အစိုးရမီးကိုပဲ ဆက်ယူကြောင်း၊ တုံးလည် ရေအားလျှပ်စစ်က မပြီးသေးသည့်အပြင် ဒီအတိုင်းပဲ ထားလိုက်ကြောင်း၊ အင်းတိန်ရေအားလျှပ်စစ် ၃၀ ကီလိုဝပ်က ဖျက်လိုက်ပြီဖြစ်ကြောင်း၊ အစိုးရမီးလည်း လက်ရှိယူနေကြောင်း၊ ယခုအချိန်တွင် ဘီလူးချောင်းတစ်လျှောက်တွင် မရှိတော့ကြောင်း၊ Mini Hydro Power ယူရန် တုံးလည်ကို ညှိနှိုင်းခဲတဲ့ အနေအထားမှာ ညှိနှိုင်းမှု မပြေလည်ခဲ့ကြောင်း၊ အစိုးရမီးပဲ ဆက်ယူမယ်ဆိုပြီး ဝယ်၍လည်းမရခဲ့ကြောင်း၊ ဆက်လည်းမလုပ်တော့ဘူးလို့ ပြောခဲ့ကြောင်း၊ တကယ်လို့ လည်မယ်ဆိုပါက အောက်မှာ ရေထွက်တွေရှိကြောင်း၊ တုံးလည်နားတွင် ချောင်းတောက်လျှောက်မှာ ရေထွက်များသာမက Weir နှင့် Outlet ကနေ ထွက်လာသော ရေနဲ့ဆက်ပြီး Run မယ်ဆိုရင် Run လို့ရနိုင်ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ၈။ ဦးစောသူရဖြိုး၊ CDC Member	Win- Win-Win ဆိုသည်မှာ Win-Win Process လောက်သာ ရှိကြောင်း၊ Win- Win-Win Process ရဲ့ နောက်တွင် နိုင်ငံတော်အတွက်လည်း အကျိုးရှိမယ်၊ ပြည်သူအတွက်လည်း အကျိုးရှိတယ်၊ အဲ့ထက်ပိုပြီးတော့

	အကျိုးရှိသွားအောင် Information တစ်ခု အနေနဲ့ Right Information ကို အချိန်နှင့် တစ်ပြေးညီ အနီးစပ်ဆုံးချပြဖို့ အစီအစဉ်တွေရှိသလားနှင့် အစီအစဉ်တွေရှိရင် မည်သို့ချပြမည်လဲကို သိချင်မိကြောင်း၊ Community Level ကို Assessment လုပ်ချိန်တွင် CSO များ၏ အခန်းကဏ္ဍ မည်မျှထိ ပါလို့ရသလဲ သိချင်ကြောင်း၊ ဒီ့ထက်ကောင်းတဲ့ Information တွေ ဘာများပေးနိုင်သလဲသိချင်မိကြောင်း ပြောကြားခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း Director, NEO Co.,Ltd	ဆိုလိုသော Win-Win-Win ဆိုသည်မှာ ပထမ Win မှာ နိုင်ငံတော်တွင် လျှပ်စစ်ဓာတ်လိုအပ်နေသည့်အတွက် နိုင်ငံတော်အတွက် လျှပ်စစ်ဓာတ်အား ရမည်ဖြစ်ကြောင်း၊ စီမံကိန်းမှ ထွက်ရှိသော လျှပ်စစ်မီးကို ဝန်ကြီး လမ်းညွှန်ထားတဲ့အတိုင်း အင်းလေးကန်မှာရှိသော ကျေးရွာများကို မီးပေးမည်ဖြစ်ကြောင်း၊ ကျေးရွာတွေက မီးရရှိပြီးတော့ Win တစ်ခုဖြစ်ပါတယ်။ ကုမ္ပဏီကတော့ ရင်းနှီး မြှုပ်နှံထားပြီးတော့ ထိုက်သင့်တဲ့ အကျိုးတစ်ခု၊ နိုင်ငံတော်အတွက် ဖြည့်ဆည်း ပေးနိုင်တယ်ဆိုတဲ့ Win တစ်ခုကိုရမှာပါ။ ခုနက ESIA ကိစ္စ Participation ကတော့ ကျွန်တော်တို့ ကုမ္ပဏီအနေနဲ့ကတော့ ဒါကတော့ အချိန်နဲ့တပြေးညီ တွေ့ဆုံးပွဲတွေလုပ်မယ့်ဟာ အကုန်လုံးကို စနစ်တကျ ဒီမြို့နယ်အုပ်ချုပ်ရေးမှူးနဲ့ တိုင်ပင်ပြီးတော့ အဆင့်ဆင့် လျှပ်စစ်ဝန်ကြီးဌာနရော အဆင့်ဆင့်တင်ပြပြီးတော့ Right Information ပေးပြီးတော့ လုပ်ခြင်းဖြစ်ပါတယ်။ ဒီ့ထက်ပိုပြီးတော့လည်း Participation လုပ်နိုင်အောင် ပိုပြီးကျယ်ကျယ်ပြန့်ပြန့် ပါဝင်နိုင်အောင် ကျွန်တော်တို့ နောက်ဆက်လုပ်မယ့် ပွဲတွေကိုလည်း အသေးစိတ် အသိပေးပြီး လုပ်သွားမှာ ဖြစ်ပါတယ်။ ကျေးဇူးတင်ပါတယ်။
မေး ၉။ ဦးအောင်သက်နိုင်၊	ဒေသခံများကို မည်ကဲ့သို့ အလုပ်အကိုင် ခန့်အပ်ပေးပါမည်လဲ၊ ပတ်ဝန်းကျင်ကို မည်ကဲ့သို့ ပြန်လည်ကုစား ပေးပါမည်လဲ၊ စီမံကိန်းလုပ်သည့် နေရာမှ စိုက်ပျိုးမြေ လျော်ကြေးကို မည်ကဲ့သို့

SMT Member	ပေးလျော်ပါမည်လဲ၊ နစ်နာကြေးအမျိုးအစား (သို့) လျော်ကြေးအမျိုးအစားလား သိချင်ပါကြောင်း ဆွေးနွေးမေးမြန်းခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း Director, NEO Co.,Ltd	မြေယာလျော်ကြေးနဲ့ ပတ်သက်၍ ၄င်းတို့ကုမ္ပဏီတစ်ခုတည်းအနေဖြင့် ဆုံးဖြတ် ဆောင်ရွက်လို့မရကြောင်း၊ ဝန်ကြီးမှ ဦးဆောင်၍ ကော်မတီဖွဲ့ထားကြောင်း၊ ကော်မတီတွင် သက်ဆိုင်ရာ ဌာနဆိုင်ရာများ၊ မြို့နယ်ရပ်မိရပ်ဖများ၊ ကုမ္ပဏီမှလူများပါဝင်မည် ဖြစ်ကြောင်း၊ ကော်မတီမှ ညှိုင်း၍ တောင်သူများကျေနပ်တဲ့ တစ်ခုကိုပေးလျော်ရမည် ဖြစ်ကြောင်း၊ ၄င်းတို့ ကုမ္ပဏီအနေဖြင့် ကိုယ်ပိုင် ဆုံးဖြတ်ချက်ဖြင့် ဆောင်ရွက်၍ မရကြောင်း၊ ကော်မတီဖွဲ့၍ အဖက်ဖက်မှ သဘောတူညီထားသော နှုန်းတစ်ခုဖြင့် ပေးလျော်သွားမှာဖြစ်ကြောင်း၊ ကုမ္ပဏီတွင် အတတ် ပညာရှင်၊ အသိပညာရှင်၊ ကျွမ်းကျင်ပညာရှင် လုပ်သားများပါဝင် ဆောင်ရွက်ရကြောင်း၊ ယခုဆောင်ရွက်လျက်ရှိသော မြေကြီး၊ ကျောက်သားလုပ်ငန်း၊ ကွန်ကရစ်လုပ်ငန်းမှာ ၊ ရုံးပိုင်းဆိုင်ရာ Administration လုပ်ငန်းများတွင် ဒေသခံများကို အလုပ်အကိုင် အခွင့်အလမ်းများ ဆောင်ရွက်ပေးနေကြောင်း၊ ယင်းတို့မှလည်း တက်တက်ကြွကြွဖြင့် ကုမ္ပဏီကို ပူးပေါင်းဆောင်ရွက်ပေးနေကြောင်း၊ ၄င်းတို့သည် စီမံကိန်းတွင် လုပ်ဆောင်နေသော ကုမ္ပဏီဝန်ထမ်းစုစုပေါင်း၏ ၃၀% လောက်ရှိကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
ဖြေ ဦးဝင်းထက်၊ Environmental Expert, REM Co., Ltd	REM အနေဖြင့် Impact တွေတွက်ပြီးမှ သက်ဆိုင်ရာ ကုမ္ပဏီကို အကြံဉာဏ်ပေးရကြောင်း၊ Environmental Management Plan ရှိကြောင်း နှင့် ထွက်လာပါက သက်ဆိုင်ရာ ကုမ္ပဏီမှ လုပ်ဆောင်ထားခြင်းရှိ၊ မရှိ၊ ကုမ္ပဏီသည် Implementation တကယ်လိုက်နာဆောင်ရွက်ခြင်းရှိ၊ မရှိ စသည်တို့ကို လွတ်လပ်စွာ သုံးသပ်၍ ဖြေရှင်းနိုင်ပါကြောင်း၊ REM သည် အသေးစိတ် ထိခိုက်ဆန်းစစ်မှုများကို တွက်ချက်ပေးကြောင်း၊ ရှင်းလင်း အကြံပြုထားကြောင်း၊ ပြည်သူများကို ပြန်လည် ချပြချိန်တွင် သေချာလေ့လာစေချင်ကြောင်း၊ လွဲနေပါကလည်း အကြံပြုပေးစေလိုကြောင်း၊

	အခုအစီရင်ခံစာသည် ၂၀၁၁ ကတည်းက လုပ်ဆောင်ခဲ့သော်လည်း မူဝါဒအသစ်များ ပေါ်ထွက်လာသောကြောင့် ဆက်လက် လုပ်ဆောင်နေရကြောင်း၊ ဆက်လက်လေ့လာ၍ လိုအပ်တာများရှိပါက REM ကိုလည်းကောင်း၊ NEO Energy ကိုလည်းကောင်း အကြံဉာဏ်များကို ပေးစေလိုပါကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ၁၀။ ဦးထွန်းတင်၊ ကျေးရွာ အုပ်ချုပ်ရေးမှူး တုံးလည်းအုပ်စု။	မြေယာကိစ္စနဲ့ ပတ်သက်၍ တောင်သူ လယ်သမားတွေအနေဖြင့် အမြန်ဆုံး ဖြစ်စေချင်ကြောင်းနှင့် အမြန်ဆုံး ဆောင်ရွက်ပေးစေလိုကြောင်း ဆွေးနွေး တင်ပြခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း Director, NEO Co.,Ltd	အမြန်ဆုံး ဖြေရှင်းပေးသွားမှာပါလို့ ကတိပေးပါကြောင်း ပြန်လည် ပြောကြားခဲ့ပါသည်။
မေး ၁၁။ ဦးချော၊ ရာအိမ်မှူး၊ အင်းတိန်ကုန်းကျေးရွာ။	ကိုဟန်မင်းထွန်းပြောခဲ့သလို အင်းတိန်ကုန်းရှိ ရေအားလျှပ်စစ်သည် မဖျက်သိမ်းသေးကြောင်း၊ ယခုလက်ရှိ ရှိနေသောမီးမှာ ၄၈ အိမ်ပဲရှိကြောင်း၊ နောက်ထပ် ၉၁ အိမ်က မရသေးကြောင်း၊ အကြောင်းရင်းမှာ ရေအားလျှပ်စစ်လုပ်ရမလား၊ အစိုးရလျှပ်စစ် မီးနဲ့ပဲဝယ်ရမလားဆိုတာ ကြိုးစားနေဆဲဖြစ်ကြောင်း၊ ရေအားလျှပ်စစ်သည် မဖျက်သိမ်းသေးကြောင်း ပြောကြားခဲ့ပါသည်။

ဖြေ ဦးဟန်မင်းထွန်း၊ AGM, NEO Co., Ltd	အင်းတိန်ရွာအနေဖြင့်လည်း ၃၀ ကီလိုဝပ် လာရောင်းနေသည့်အပြင် ဖျက်ပြီလို့ ပြောထား၍ ၄င်းတို့က ဖျက်ပြီလို့ ပြောလိုက်ရကြောင်း ပြန်လည်ဖြေရှင်ခဲ့ပါသည်။
မေး ၁၂။ ဦးတက်ထွန်း၊ ဥက္ကဌ၊ အင်း/စာ ယဉ်ကျေး ဖွံ့ဖြိုးမှုအသင်း	EIA, SIA သည် စီမံကိန်း မစခင်ကလုပ်ရခြင်း (သို့) စီမံကိန်းစပြီးမှ လုပ်ရခြင်းလား ဆိုသည်ကို သေသေချာချာ ဖြေပေးစေလိုကြောင်း ပြောကြားခဲ့ပါသည်။
ဖြေ ဦးတိုးလှိုင်၊ ညွှန်ကြားရေးမှူး၊ ရေအားလျှပ်စစ် အကောင်အထည် ဖော်ရေး ဦးစီးဌာန။	အရင်ထဲက MOU လတ်မှတ်ထိုး ရကြောင်း၊ ကုမ္ပဏီမှ လုပ်ချင်သော စီမံကိန်းကို ကွင်းဆင်းပြီးလေ့လာရကြောင်း၊ ပုံမှန် အားဖြင့် ၁နှစ်၊ ၂နှစ် ခန့် ကြာကြောင်း၊ FS ဆိုသည့် ဖြစ်မြောက်နိုင်စွမ်း အစီရင်ခံစာကို ရေးတင်ရကြောင်း၊ ၄င်းတွင် စီမံကိန်းမှ အကျိုးရှိ၊မရှိ၊ EIA, SIA အချက်အလက်များ၊ စသည့်အချက်များအားလုံး FS ထဲမှာ အပြည့်အစုံပါမှ သာလျှင် သက်ဆိုင်ရာ လုပ်ချင်သော ကုမ္ပဏီနှင့် ဝန်ကြီးဌာနက နားလည်တဲ့ပညာရှင်တွေနဲ့မှ ဆုံးဖြတ်၍ အားသာသော အချက်များမှသာ၊ အကျိုးရှိမှသာ ဆောင်ရွက်ခြင်းဖြစ်ကြောင်း၊ မူလကတည်းက EIA, SIAကို ထည့်သွင်းစဉ်းစားခဲ့ကြောင်း၊ နိုင်ငံတော်မှ လုပ်ဆောင်သော စီမံကိန်းမှန်သမျှ နိုင်ငံတော် အစိုးရကို တင်ပြပြီး ခွင့်ပြုပြီးလုပ်ထားသော စီမံကိန်းများ ဖြစ်ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ဦးတက်ထွန်း၊	စီမံကိန်းတစ်ခုဆောင်ရွက်လျှင်၊ ပြည်သူတွေနှင့် အနီးပတ်ဝန်းကျင်မှ လူများ မည်သို့အကျိုးခံစားခွင့်ရှိပါမည်လဲ၊ အင်းတိန်လို ပတ်ဝန်းကျင်မှာရှိတဲ့

ဥက္ကဌ၊ အင်း/စာ ယဉ်ကျေး ဖွံ့ဖြိုးမှုအသင်း	လူတွေကို ချပြခဲ့ခြင်း ရှိ၊မရှိ၊ ၄င်းတို့၏ စိတ်သဘောထား ဆန္ဒကိုရောသိရှိခဲ့ခြင်း ရှိ၊မရှိကို မေးမြန်းခဲ့ပါသည်။
ဖြေ ဦးဆွေသိန်း၊ ရှမ်းပြည်နယ် လျှပ်စစ်၊ စွမ်းအင်နှင့် စက်မှု ဝန်ကြီး။	အစရင်အစိုးရလက်ထက်တွင် ပွင့်လင်းမြင်သာမှု မရှိခဲ့၍ လုပ်ဆောင်ခဲ့ခြင်းမရှိခဲ့ကြောင်း နှင့် ယခု ဒီအစိုးရလက်ထက်မှသာ ယခုလို လုပ်ကြခြင်း ဖြစ်ကြောင်း ရှင်းလင်းပြောကြားခဲ့ပါသည်။
မေး ဦးတက်ထွန်း၊ ဥက္ကဌ၊ အင်း/စာ ယဉ်ကျေး ဖွံ့ဖြိုးမှုအသင်း	ဆိုလိုခြင်းမှာ ပွင့်လင်းမြင်သာမှု ကောင်းမွန်သော အုပ်ချုပ်မှုများကို ၄င်းတို့ ဒေသတွေများတွင် ပြည့်ပြည့်ဝဝ မခံစားရသေးကြောင်း၊ လုပ်ပေးသော ကုမ္ပဏီကိုလည်း ကျေးဇူးတင်ကြောင်း၊ ပူးပေါင်းဆောင်ရွက်ရန် အသင့်ရှိကြောင်း၊ အကြံပြုချင်သည်မှာ မျှတ၍ ရှေ့ရေး နောက်ရေး ကြည့်ပြီး စေတနာထားကာ လုပ်ပေးကြစေချင်ကြောင်း၊ ဘာပဲလုပ်လုပ် ရေရှည်တည်တံ့ ခိုင်မြဲအောင် လုပ်စေချင်ကြောင်း၊ ၄င်းတို့ CSOများ၏ လက်တွေမှာ အဖြူရောင်လက်များ ဖြစ်သော်လည်း တရားဥပဒေကျော်၍ မတရားမှုတွေ ဖြစ်လာပါက CSO ရဲ့ လက်ထဲမှ ဆူးများထွက်လာမည် ဖြစ်ကြောင်း၊ အားလုံးပေးဆပ်ဖို့ ကူညီဖို့ အသင့်ရှိကြောင်းနှင့် ရွာသားတစ်ဦးချင်းစီရဲ့ ဆန္ဒ သဘောထားကို စဉ်းစားပေးစေလိုကြောင်း၊ ကူညီဖို့အဆင်သင့်ရှိကြောင်း၊ အင်းသားများမှာ သီလ၊ သမာဓိ ပြည့်စုံတဲ့သူတွေရှိကြောင်း၊ တန်ခိုးကြီးဘုရားတွေ ရှိကြောင်းနှင့် စေတနာ ထားပြီး လုပ်ပေးစေလိုကြောင်း ပြောကြားခဲ့ပါသည်။
ဖြေ ဦးမင်းထွန်း	စီမံကိန်း ၁၀၀% အောင်မြင်ဖို့ဆိုသည်မှာ ပြည်သူလူထု၏ ပါဝင်မှု တကယ်ကို အရေးကြီးပါကြောင်း၊ ယခုလို ပြည်သူတစ်ယောက်အနေနဲ့

<table>
<tr><td>Director,

NEO Co.,Ltd</td><td>ကူညီဆောင်ရွက်ပေးတဲ့အတွက် ကုမ္ပဏီရဲ့ကိုယ်စား အထူးကို အလေးအနက် ကျေးဇူးတင်ရှိပါကြောင်း ပြောကြားခဲ့ပါသည်။</td></tr>
<tr><td>အစီအစဉ် (၆)

နံနက် ၁၂း၃၀ - ၁၂း၄၀</td><td>အင်းတိုင်းရင်းသားဝန်ကြီး ဒေါက်တာဦးထွန်းလှိုင်မှ ထပ်မံဖြည့်စွက်ပြောကြားပေးခြင်း။</td></tr>
<tr><td colspan="2">ယနေ့ အစည်းအဝေးသည် အင်မတန်ကောင်းမွန်ကြောင်း၊ ပွင့်လင်းမြင်သာမှု ရှိ၍ အပြန်အလှန် ဆွေးနွေးညှိနှိုင်းခြင်းဖြင့် အဖြေရှာသော ကိစ္စရပ်ဖြစ်၍ နိုင်ငံတော် အတိုင်ပင်ခံပုဂ္ဂိုလ် ဒေါ်အောင်ဆန်းစုကြည်တို့ ချမှတ်ခဲ့သော လမ်းစဉ်အတိုင်း သဟဇာတဖြစ်ရေး၊ ဆွေးနွေးညှိနှိုင်း အဖြေရှာတဲ့ ကိစ္စရပ်ကို အကောင်အထည်ဖော်တာ ဖြစ်ကြောင်း၊ အင်းတိန်ချောင်းသည် စိုက်ပျိုးရေးသာမက ခရီးသွားလာရေးအတွက်လည်း ဥဒဟိုသွားလာလျှက်ရှိကြောင်း၊ အကယ်၍များ ဒီရေအားလျှပ်စစ်က စီမံခန့်ခွဲသလို ရေကပြည့်စုံအောင် အင်းတိန်ချောင်းတွင် သွားလို့မရတော့ခြင်း၊ လယ်ကလည်း ရေသွင်းလို့ မရတော့ခြင်း ထိုအချိန်မျိုးတွင် ရေအားလျှပ်စစ်ကို တစ်လတန်သည် ၁၄၊ ၁၅ ရက်တန်သည် ဦးစားမပေးဘဲ စိုက်ပျိုးရေးနှင့် Tourism ခရီးသွားလာရေးကို ဦးစားပေးစေချင်ကြောင်း၊ လွန်ခဲ့တဲ့နှစ်များတွင် အင်းခေါင်း အတွေ့အကြုံရှိခဲ့၍ ပြဿနာတွေရှိလာခဲ့ရင် ရေအားလျှပ်စစ်ကို နားထားပေးစေလိုကြောင်း၊ အမြဲတမ်းစိုက်ပေးနေတဲ့ တောင်သူ လယ်သမားနဲ့ အမြဲသွားလာနေတဲ့ Tourismအတွက် ဦးစားပေးစေချင်ကြောင်း၊ ဘာပဲဆိုဆို ယနေ့ဆွေးနွေးပွဲသည် ပွင့်ပွင့်လင်းလင်းဖြင့် ဆွေးနွေးပြီးတော့မှ အဆင်ပြေချောမွေ့စွာ ဆောင်ရွက်ကြရမည် ဖြစ်ကြောင်း၊ အားလုံးမှာ နိုင်ငံတော်နှင့် နိုင်ငံသားတို့၏ အကျိုးကျေးဇူးအတွက် ဆောင်ရွက်နေကြခြင်းဖြစ်ကြောင်း၊ အရင်တုန်းက လုပ်ခဲ့သော ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းမှာ အရင်အစိုးရလက်ထက်က စခဲ့ပေ မယ့် လုပ်လက်စကြီးအနေဖြင့် 63 Billions မှာ 15 Billions သုံးပြီးတဲ့အခါ ဆက်လုပ်စေလိုသော ဆန္ဒရှိကြောင်း ပြောကြား၍ နိဂုံးချုပ်ခဲ့ပါသည်။</td></tr>
<tr><td>အစီအစဉ် (၇)</td><td>အခမ်းအနားပြီးဆုံးကြောင်းကြေညာခြင်း။</td></tr>
</table>

အစည်းအဝေးမှတ်တမ်း ဓာတ်ပုံများ

(၁) အစည်းအဝေးတက်ရောက်သူစာရင်းရယူခြင်း

(၂) အမှာစကားပြောကြားခြင်း

	
အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက်
ပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ငန်းရပ်များ ကို
ညောင်ရွှေမြို့နယ်	

(၃) စီမံကိန်းအကြောင်းရှင်းလင်းပြောကြားခြင်းနှင့် ESIA လုပ်ငန်းရပ်များကိုရှင်းလင်းပြောကြားခြင်း

(၃) တက်ရောက်လာသူများမှ ဆွေးနွေးမေးမြန်းခြင်း



(၄) ဆွေးနွေးမေးမြန်းသည်များကို သက်ဆိုင်ရာတာဝန်ရှိသူများမှ ပြန်လည် ဖြေကြားဆွေးနွေးခြင်း။

အစည်းအဝေးတက်ရောက်သူများစာရင်း

ဆွေးနွေးပွဲသို့ တက်ရောက်သူစုစုပေါင်း (၈၄) ဦး ရှိပါသည်။ အစိုးရအဖွဲ့ဝင်နှင့် ဌာနဆိုင်ရာများမှ တက်ရောက်သူ (၃၅) ဦး၊NEO Co., Ltdနှင့် REM Co., Ltd စသည့် ကုမ္ပဏီနှင့် NGO, CSO များမှ တက်ရောက်သူ (၂၇) ဦး၊ ကျေးရွာအုပ်ချုပ်ရေးမှူးနှင့် ဒေသခံရပ်ဖိရပ်ဖ (၂၂) ဦးတို့ တက်ရောက်ကြပါသည်။ တက်ရောက်သူစာရင်းမှာ အောက်ပါအတိုင်း ဖြစ်ပါသည်။

မြန်မာ့သယံဇာတနှင့် ပတ်ဝန်းကျင်ကုမ္ပဏီမှ (REM Co., Ltd) မှ တက်ရောက်သူများ

စဉ်	အမည်	ရာထူး
၁။	ဦးဝင်းထက်	Environmental Expert
၂။	ဒေါ်ညိုမီရာဇတ်	Cultural Expert
၃။	ဒေါ်နယဉ်	Senior Consultant (Social)
၄။	ဒေါ်မြတ်စွာနိုင်	Senior Consultant (Social)

၅။	ဒေါ်နိုင်နိုင်ဝင်း	Senior Consultant (Ecology)
၆။	ဦးဉာဏ်လင်းမောင်	Senior Consultant (Ecology)
၇။	ဒေါ်ပိုးမွန်မွန်ကျော်	Environmental Health and Safety Consultant
၈။	ဒေါ်မြတ်သက်ခိုင်	Consultant (Ecology)
၉။	ဒေါ်ဝါဝါဆန်း	Social Consultant and Data Analyst
၁၀။	ဒေါ်အိမုံခင်	Consultant (Social)

အစိုးရအဖွဲ့ဝင်နှင့်ဌာနဆိုင်ရာတာဝန်ရှိသူများ

အချိန်- ၁၀း၃၀ - ၁၂း၃၀

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ(၂၄)ရက်

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေး ဦးစီးဌာန ခန်းမ၊ ညောင်ဦး။

အစိုးရအဖွဲ့ဝင်နှင့် ဌာနဆိုင်ရာတာဝန်ရှိသူများ

စဉ်	အမည်	ရာထူး	ဌာန	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	[illegible]	[illegible]			
၂.	ဦး[illegible]	မြို့နယ်[illegible]	[illegible] (၁)	09449561904	
၃.	ဦး[illegible]	မြို့နယ်[illegible]	[illegible] (၂)		
၄.	[illegible]			09428358529	
၅.	ဦး[illegible]	[illegible] - ၂	[illegible]		
၆.	ဦးစွေ့သိန်း				

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ(၂၄)ရက်

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေး ဦးစီးဌာန ခန်းမ၊ ညောင်ဦး

အစိုးရအဖွဲ့ဝင်နှင့် ဌာနဆိုင်ရာတာဝန်ရှိသူများ

စဉ်	အမည်	ရာထူး	ဌာန	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
	ဒေါ်ခင်ဌေးကျော်	ဦးစီးအရာရှိ	ပြတိုက်		
	ဦး[illegible]	ဥက္ကဋ္ဌ	ICDO	09428325932	
	Dr. [illegible]	[illegible]	[illegible]	09248341676	
	ဦး[illegible]	[illegible]	[illegible]	09.777186210	
	[illegible]	[illegible]	[illegible]	0943141741	
	ဦး[illegible]	[illegible]	[illegible]	09-5280860	
	ဦးရွှေဂျယ်	ဦးစီးအရာရှိ	ကျေးလက်ဦးစီး	09-458042591	
	ဦး[illegible]	[illegible]	NLD	09.249808942	
	[illegible]	CDC - [illegible]	CDC	09.428360650	
	[illegible]	" member	CDC	09.778337553	

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ [illegible] လ(၂၉)ရက်

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာနခန်းမ၊ ဒီမော့ဆိုမြို့

အစိုးရအဖွဲ့ဝင်နှင့် ဌာနဆိုင်ရာတာဝန်ရှိသူများ

စဉ်	အမည်	ရာထူး	ဌာန	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
	[illegible]	CDC member	CDC	09458040450	

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ [illegible] လ(၂၉)ရက်

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာနခန်းမ၊ ဒီမော့ဆိုမြို့

အစိုးရအဖွဲ့ဝင်နှင့် ဌာနဆိုင်ရာတာဝန်ရှိသူများ

စဉ်	အမည်	ရာထူး	ဌာန	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁	[illegible]	[illegible]	[illegible]	၀၉-၅၂၁၄၃၆၇	
၂	[illegible]	ဒု-[illegible]	[illegible]		
၃	[illegible]	[illegible]	[illegible]		
၄	[illegible]	ဒု-[illegible]	[illegible]	095214352	
၅.	[illegible]	[illegible]	NOM	0949384932	
၆.	[illegible]	[illegible]	[illegible]	09 428148700	
၇.	ဦးနေမျိုးသူရိန်	ဦးစီးမှူး	[illegible]	09 428316398	
၈	[illegible]	〃	[illegible]	081 209480	
၉	[illegible]	[illegible]	[illegible]	09.402570847	
၁၀၊	[illegible]	[illegible]	[illegible]	09.254835050	

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ ခုနှစ်၊ [illegible] လ(၂၉)ရက်

မြို့နယ်ဂေဟာ[illegible]

အစိုးရအဖွဲ့ဝင်နှင့် ဌာနဆိုင်ရာတာဝန်ရှိသူများ

စဉ်	အမည်	ရာထူး	ဌာန	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဒေါ်ခြိမ်းခြိမ်းခိုင်	[illegible] ညွှန်ကြားရေးမှူး	[illegible]	081-206812	
၂။	ဒေါ်အိမွန်	ဒု-ဦး-စီး မှူး	"	"	
၃။	ဒေါ်နှင်း[illegible]	T-E-O	ပညာရေး	09.36201308	
၄	မောင်ကျော်[illegible]	[illegible]	[illegible]	09778522385	
၅	[illegible]	[illegible]	[illegible]		
၆	[illegible]	[illegible]	မြို့နယ်[illegible]	09419360990	
၇	ဦး[illegible]	ဒု-ဦး-စီး	[illegible]	[illegible]	
၈၊	[illegible]	AE	[illegible]	09.5415293	

ကုမ္ပဏီနှင့် NGO များ

အချိန် - ၁၀:၃၀ - ၁၂:၃၀

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ ခုနှစ်၊ [illegible] လ၊(၂၉)ရက်

မြို့နယ်ဂေဟာ[illegible]

Company နှင့် NGO များ

စဉ်	အမည်	ရာထူး	အဖွဲ့အစည်း/ဌာန အမည်	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁။	ဦးမြတ်[illegible]	ညွှန်ကြားရေးမှူး	ICDC	09.428354349	
၂။	ဦး[illegible]	[illegible] ညွှန်ကြားရေးမှူး	SAVE THE INLE LAKE	09.428358348	

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ၊(၂၉)ရက်

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာနရုံး၊ [illegible]

ရပ်မိရပ်ဖ/ဒေသခံပြည်သူများ Company / NGOs များ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁	ဦးမင်းထွန်း	Director	NEO. Co. Ltd.	09.5562288	
၂	ဦးဝင်းရွှေ	A.D	〃	09.5301802	
၃	ဦးသော်ဇင်ထွန်း	AGM	〃	09-252274349	
၄	ဒေါ်သက်သက်ထွန်း	Director	〃	09-5507788	29/8/16
၅	ဒေါ်ခင်ခင်ဦး	G.M	〃	09.256122787	Khin 29/8
၆	ဒေါ်ခင်လေးသွင်	C.A	〃	09-5027973	

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ၊(၂၉)ရက်

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာနရုံး၊ [illegible]

Company နှင့် NGO များ

စဉ်	အမည်	ရာထူး	အဖွဲ့အစည်း/ဌာန အမည်	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁	ဒေါ်တင်တင်နု	[illegible]	[illegible]	09-428344975	
၂	ဦးထွန်းဝေ	[illegible]	〃	09 788910478	
၃	ဦးဖြိုး	ကျောင်းဝန်	〃	09 782648479	
၄	မလေးနွယ်	ကျောင်းသူ	〃	09-774363800	
၅	ဦးအောင်မြင့်	[illegible]	[illegible]	08-[illegible]	
၆	ဦးသာရ	[illegible]	[illegible]	09.254656134	
၇	ကျော်သက်နိုင်	SMT	[illegible]	09-428341740	
၈	[illegible]	Member	[illegible]	09-36168805	
	အောင်သက်နိုင်	〃	[illegible]	09-252167060	

ရပ်မိရပ်ဖ ဒေသခံပြည်သူများ

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

သက်ဆိုင်သူများနှင့် ဆွေးနွေးညှိနှိုင်းခြင်းအခမ်းအနားသို့ တက်ရောက်သူစာရင်း

၂၀၁၆ခုနှစ်၊ [illegible] လ၊(၂၉)ရက်

မြို့နယ်ကထွေထွေအုပ်ချုပ်ရေး ဦးစီးမှူး၊ ရုံးဝင်း[illegible]၊ သောင်ချောင်း။

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးထွန်းဝင်း	ကျေးရွာအုပ်ချုပ်ရေးမှူး	[illegible] - ကျေးရွာ[illegible]	09.258302332	[illegible]
၂။	ဦးဖိုးခွန်	ရာအိမ်မှူး	မင်းလုံး	09-49353732	ခွန်
၃။	ဦးဝင်း	"	ကျောက်တော်	09-253640882	ဝင်း
၄.	ဦးအောင်မွေး	ဆယ်အိမ်မှူး	"	-	မွေး
၅.	ဦးလှ[illegible]	[illegible]	မင်းလုံး	09-360[illegible]	[illegible]
၆.	ကိုငှန်း	"	တောင်ခဲတောက်	09-49230884	[illegible]
၇။	ကိုဝင်းနိုင်	"	မင်းလုံး	09-784962158	နိုင်
၈.	ဒေါ်ထွန်းမြေ	"	[illegible]	ဖုန်း မရှိ	မြေ
၉။	မောင်အောင်ဆို	"	[illegible]	09-254244956	[illegible]

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

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၂၀၁၆ခုနှစ်၊ [illegible] လ၊(၂၉)ရက်

မြို့နယ်ကထွေထွေအုပ်ချုပ်ရေး ဦးစီးမှူး၊ ခန်းမ၊ သောင်ချောင်း။

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁	ဦးဦး	ရာအိမ်မှူး - တောင်ခဲတောက်		09.786188733	ဦး ဦး
၂	" သက်အောင်	တောင်သူ	[illegible]	09.786090259	ဦး[illegible]
၃။	" [illegible]အောင်	ဆယ်အိမ်မှူး	[illegible]	09. —	ဦး[illegible]
၄။	" [illegible]	တောင်သူ	"	09.253310776	[illegible]
၅။	ဦး[illegible]	ဆယ်အိမ်မှူး	တောင်ခဲတောက်	09-786354471	[illegible]
၆။	ဦး[illegible]	[illegible] / ရာအိမ်မှူး	[illegible]	09.252975768	[illegible]
၇။	ဦးသိန်းအေး	ဈေးရောင်း	[illegible]	09.428354181	[illegible]

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၂၀၁၆ခုနှစ်၊ ဩဂုတ် လ(၂၉)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

မြို့နယ်အထွေထွေအုပ်ချုပ်ရေးဦးစီးဌာန ခန်းမ၊ [illegible]။

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
	ဦးဂုဏ်	[illegible] / ဥက္ကဌ	ထိန်းကျိုင်		[illegible]
	ဦး[illegible]ကာ	[illegible]	။		[illegible]
	ဦးလှအောင်	တောင်သူ	။		[illegible]
	ဦးကျော်	တောင်သူ	။		ကျော်
	ဦးသန်းကျော်	တောင်သူ	မင်းလုံး	09-79254587	[illegible]
	ဦးချစ်ကျိုင်	ဥက္ကဌ	သပြေပင်	09-5215512	[illegible]

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းအတွက် ပတ်ဝန်းကျင်ထိခိုက်မှုဆန်းစစ်ခြင်း ဆောင်ရွက်ရန်

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စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁.	ဦးထွန်းဝင်	ကျေးရွာအုပ်ချုပ်ရေးမှူး	[illegible] - ကျေးရွာအုပ်စု	09-258302332	[illegible]
၂.	ဦးမိုးသွင်	[illegible]	မင်းလုံး	09-49353732	[illegible]
၃.	ဦးဝင်း	။	ကျောက်တော်	09-253640882	[illegible]
၄.	ဦးအောင်မွေး	[illegible]	။	-	မွေး
၅.	ဦးလှန်း	တောင်သူ	မင်းလုံး	09-360[illegible]	[illegible]
၆.	ကိုငနီ	။	တောင်ခမောက်	09-49230884	[illegible]
၇.	ကိုဝင်းနိုင်	။	မင်းလုံး	09-784962158	[illegible]
၈.	ကိုထွန်းမြင့်	။	ထိန်းကျိုင်	[illegible]	[illegible]
၉.	မောင်အောင်ဆိုး	။	ထိန်းကျိုင်	09-253424956	[illegible]

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၂၀၁၆ခုနှစ်၊ [illegible] လ၊(၂၉)ရက်

ရပ်မိရပ်ဖ/ ဒေသခံပြည်သူများ

[illegible]

စဉ်	အမည်	အလုပ်အကိုင်	နေရပ်လိပ်စာ	ဆက်သွယ်ရန်ဖုန်း	လက်မှတ်
၁	ဦးဦး	ရာအိမ်မှူး - [illegible]		09.786188733	ဦးဦး
၂	〃 [illegible]	တောင်သူ	[illegible]	09.7860 90259	[illegible]
၃။	〃 [illegible]	ဆယ်အိမ်မှူး	[illegible]	09. —	[illegible]
၄။	〃 [illegible]	တောင်သူ	〃	09. 253310776	
၅။	[illegible]	ဆယ်အိမ်မှူး	[illegible]	09.786354471	[illegible]
၆။	ဦးချော	[illegible] / [illegible]	[illegible]	09. 252975768	
၇။	ဦးသိန်းအေး	ဈေးရောင်း	[illegible]	09. 428354181	

Appendix 5

EMERGENCY RESPONSE PLAN

Present Status of Environment, Health and Safety Upper Baluchaung Hydropower Project

1. Working Condition

There are eleven departments, one hundred and ninety-four workers in Upper Baluchaung Hydropower Project. The name list of departments is descripted as follows:

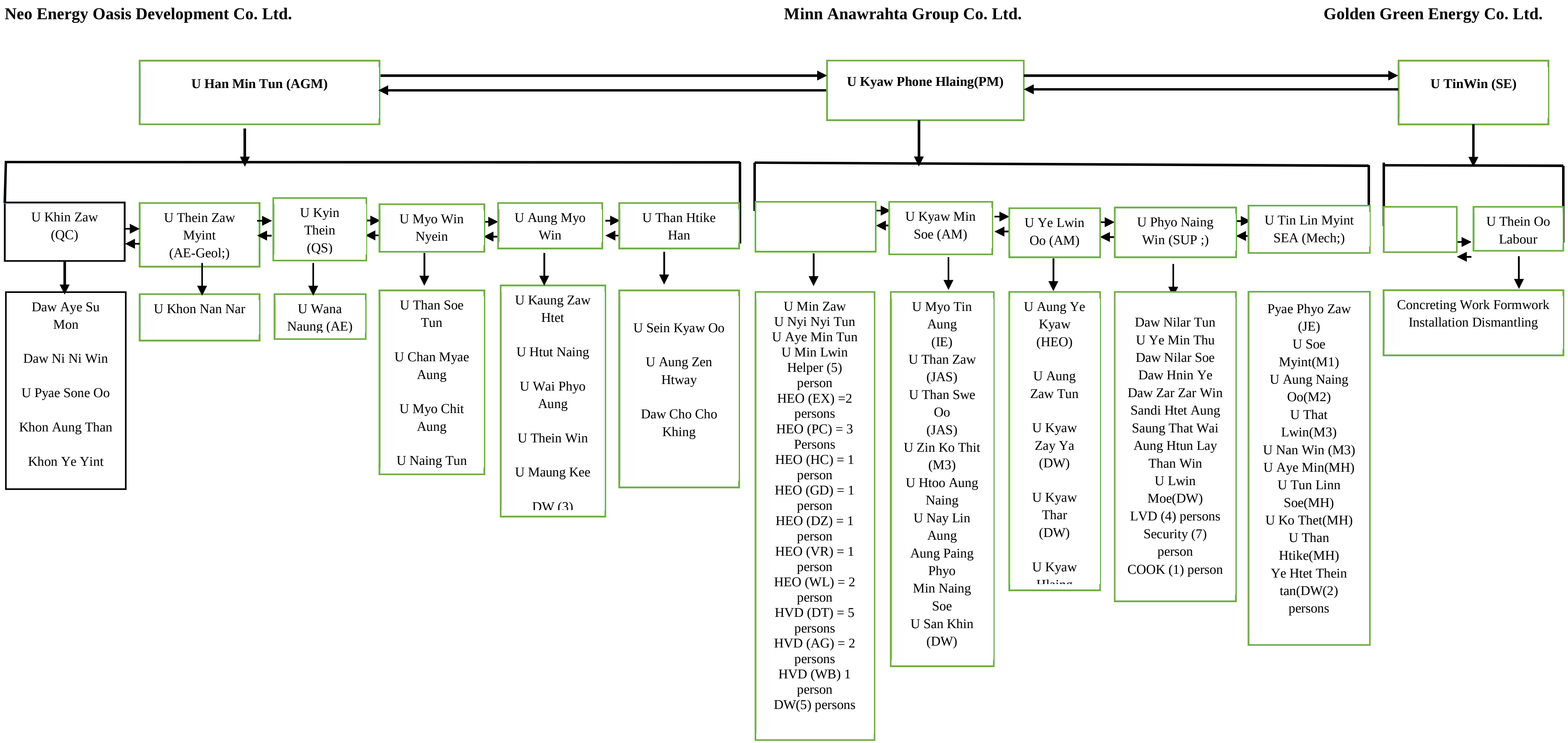
1) Engineering Department
2) Geological Department
3) QC & QS Department
4) Admin Department
5) Finance & Progress Department
6) PCD
7) Crushing Plant
8) Batching Plant
9) Operation
10) Survey
11) Service

1.1 Provision

Umbrella, Shoe, Hat, Rain Coat, food (breakfast, lunch, dinner) and Office Uniforms are provided for employees. Although there are warning signs near the working area, Personal Protective Equipment are not provided sufficiently. For the Employees' Health, doctors and nurse come monthly to be checked. If the diseases may be serious, they transfer to HeYar Ywar Ma Hospital. The fire equipment is provided in working area and employee's camp. Therefore, there is no training for fire drill and Occupational Health and Safety Training.

	
Fig-1.1 Canteen for Employees	**Fig-1.2 Accommodation for Employees**
	
Fig-1.3 Fire Extinguishers are kept in Employees' Accommodation	**Fig-1.4 Latrine for Employees**
 **Fig-1.5 Solid waste Disposal**	 **Fig-1.6 Water Usage**

1.2 Organization Chart of Neo Energy Oasis Development Co., Ltd



2. Health and Safety

2.1 Legislations

According to current legal framework in Myanmar, there should be organized Health and Safety Committee. There must be sufficient First Aid Boxes. If the workers in a factory or project exceed 250, doctors or nurses in clinic are to be appointed. If the workers of a factory exceed 100, recreation centers and canteens are to be kept for food.

If the project will be implemented, emergency response plan and emergency contact list should be available.

2.1.1 Working hours

Shall not exceed 8 working hours per day or 44 hours per week. Shall not exceed 48 hours per week for the work which has to be done continuously. There must be a minimum 30 minutes interval after each 5 working hours. The combined working hours and interval time shall not exceed 10 hours per day. The working days shall not exceed 6 days per week. There must be one day holiday each week (Sunday). If Sunday service is required, there must be a substitution of another day.

2.1.2 Overtime

Shall not exceed more than 16 hours per week or, for continuous work, 12 hours per week. The overtime wage shall be calculated as double the basic wage. Permission of Factories and the General Labour Law Inspection Department must be obtained for an approval of a constant overtime policy.

If working on days-off

Comply in accordance with the overtime and general working hour provisions. There must be substituted an alternative day-off.

Occupational Health and Safety

According to workers be healthy, worker accommodation should be neat and tidy. Housekeeping should be priority first. A clean and fresh environment should be kept for the improvement of their working ability and health. And then Good Sanitation System should be arranged for their health.

For solid wastes disposal, it should be considered as a specific area and it should be far with their resident. Thus, the following ways should be done for healthy.

- Recycle bins should be separated with colors for different types of waste.
- Recycle bins should be kept along the project area.
- Waste must be collected daily by dump truck.

- Brick tank is better for waste tank and it should be covered.
- The collected wastes should be done burning or land filling.

How to set up HSE Committee

There is no correct number of committee members because the circumstances will vary from business to business. How many management and employee representatives you have on your committee will depend on the size and spread of your business and the types of work done.

Generally, committee members can include:

- Management representatives
- Employee representatives
- Co-opted workers and others
- Frequency of Meeting

These health and safety committee should meet regularly. The frequency will depend on the:

volume of business;

- size and spread of the workforce;
- type of work done in the workplace and their associated risks; and
- Issues to be discussed and other relevant factors.

How this committee will work

To ensure you cover all relevant issues, the committee should agree some standing items for the agenda and allow for other items to be added as necessary. Consider standing items such as:

- statistics on accident records, ill health, sickness absence;
- accident investigations and subsequent action;
- inspections of the workplace by enforcing authorities, management or employee health and safety representatives;
- risk assessments;
- health and safety training;
- emergency procedures; and
- Changes in the workplace affecting the health, safety and welfare of employees.

If the health and safety committee is discussing accidents, the aim is to stop them happening again, not to give blame. Committees should:

- look at the facts in an impartial way
- consider what precautions might be taken
- recommend appropriate actions
- Monitor progress with implementing the health and safety interventions.

Emergency Response Plan for Project Operation

For any emergency case, master point should be considered. An emergency condition classification system is one method to describe and prioritize emergency events according to their varying levels of severity and urgency. Safety design should include an emergency flood warning system and action plan that would effectively notify all concerned in time for appropriate action.

Table-4.1: Table of Emergency Actions

No	Emergency Case	Actions to be taken
1.	Fire	Rescue - Rescue any person in immediate danger if safe to do so Alarm - Raise the alarm by shouting to raise attention to others. - If confident and safe to do so, commence fighting the fire. Evaluate - If not practical to fight the fire, move to safe area ensuring all other personnel are warned along the way Report - Advice the Emergency coordinator of the reasons for the alarm and location of fire.
2.	Serious Accident	Assess the patient by checking for Airway, Breathing, pulse and obvious. Report directly to First Aid or Security Centers Make the injured person comfortable before the first aid provider arrive Treat the obvious injuries as able Reassure the injured person
3	Earthquake	After the earthquake, the visual inspection of dam body & galleries etc. will be carried out and instrumentation readings will also be taken and the same shall be intimated to the design department. If instrumentation readings indicate earthquake of magnitude more than specification, the information shall be immediately passed to Power House, Civil Authorities & Defence Department. If there appears to be any possibility any substantial damage or failure of dam due to earthquake, immediate information shall be passed on to Civil Authorities. All of the employees near hazardous places should be ready for evacuation necessary action to shift safer places shall be taken by the project authorities.

Table-4.2: Table of Emergency Condition Specification

No	Emergency Classification	Causes
	Condition – C Advisory/ Non-Failure condition	Instrumentation readings reach pre-determined numerical limits. Any sign of slumping. Any sinkhole. Any newly detected crack. Any seismic event regardless of how slight. Any significant obstruction in the spillway. Evidence of damage due to vandalism at any structure. A civil disorder near the reservoir structure.
	Condition – B Warning Condition (A potential failure situation is developing, but is still considered controllable)	Water level of the lake is at an unsafe level. Water is eroding the auxiliary or emergency spillway. Any developing erosion, settlement, or upheaval occurring on the downstream slope or at the toe of dam that is considered to be controllable. Any undocumented leakage through any dam structure considered to be controllable.
	Condition – A Emergency Condition (Failure is imminent or has occurred)	Water has overtopped or will overtop any dam or dike. Any uncontrollable erosion, settlement or upheaval occurring on the downstream slope or at the toe of the dam. Any uncontrollable leakage through any dam structure. A dislocation or failure of any structure which allows for an expanding, uncontrollable discharge of water through the spillway, dam, or dikes indicating a breach is occurring. Dam is failing, about to fail or has failed.

Table-4.3: Table of Emergency Contact List

Main Contact Numbers from Project Site		
Name	Position	Phone No:
U Kyaw Phone Hlaing	Project Manager	09-8580904
	Health and Safety Supervisor	09-252274349
U Han Min Htun	Assistant General Manager	
U Tin Win	SE	09-261742041
	First-aider	
	Emergency Controller	

Main Contact Numbers from Local Area		
Name	Position	Phone No:
Nyaung Shwe Township Fire Department	For emergency	081-209832
Nyaung Shwe Township Police Station	For security	081-209001
Nyaung Shwe Township Hospital	For injury	081-209004

Vehicle List

Table-5.1: Table of Vehicle List

No	Machine & Vehicle	Unit	Quantity	Remark
1	Excavator	Nos	5	
2	Excavator (Breaker)	Nos	1	
3	Grader	Nos	1	
4	Wheel Loader	Nos	1h	
5	Vibration Roller	Nos	1	
6	Dozzer	Nos	1	
7	Hydraulic Crawler Drill	Nos	2	
8	Pneumatic Crawler Drill	Nos	6	
9	Dump Truck	Nos	8	
10	Water Bowser	Nos	1	
11	AG	Nos	2	
12	Canter	Nos	2	
13	Concrete Pump	Nos	1	
14	Generator	Nos	1	
15	Motor Cycle	Nos	17	

Fig-5.1 Vehicle Parking

5.1 Vehicular Safety

The majority of vehicular accidents occur due to drive error (unsafe act), followed by vehicular mechanical failure and then road conditions (unsafe conditions). Danger zone should be defined as the area around operating machines or working personnel, in which there is potential for being struck by moving equipment or objects. The danger zone may vary according to the machine or work being performed. Maintain proper ergonomic principles when setting up seat for operating position. Adequate ventilation must be provided. Work safely procedures are described as following.

- Familiarize yourself with warning devices, gauges, and controls.
- Check for obstacles or soft soil conditions in the work area.
- Check for overhead powerlines.
- Adjust speed to suit working conditions and terrain. Avoid sudden stops, starts or turns.
- Never place any part of body or limb under raised loader arms. That’s why it is so important to keep the safety screens in place.
- If it is necessary to carry out repairs with the loader arms raised, be sure to lock the arms in place.

Fuel Storage

There are 1 no of storage tank (Capacity- 2400 Gallons) and 4 nos. of storage tank (Capacity- 3200 Gallons).

	
Fig-6.1 Fuel Storage Tank	**Fig-6.2 Generator**

6.1 Fuel storage Safety

Fuel leaking or evaporating from a tank, whether above ground or below, can do major environmental damage. Or course, diesel is flammable, and so extra caution is required when storing it in large quantities.

Hazards encountered in petroleum and petrochemical storage tanks include, fire or explosion, asphyxiation, toxicity, entrapment, falls, and physical and chemical hazards including steam, heat, noise, cold and electrical shock.

To ensure maximum safety, follow these guidelines when storing fuel:

- Use a proper fuel container to store fuel in.
- Keep fuel dry.
- For safety reasons store fuel in an isolated area. Do not store fuel near your residents or near appliances such as water tanks.
- Do not store fuel near ammunition.
- Store fuel downwind from any homes or buildings.
- Store fuel in a cool, dark area away from any sunlight or high temperature fluctuations.
- Rotate your fuel supply regularly.
- Have a fire extinguisher on hand in the area where the fuel is stored.
- Check the storage containers or tanks regularly to ensure that the fuel is safely stored away and that there are not any signs of leaking.

Appendix 6

Social Impact Assessment

Neo

Neo Energy Oasis Development Co., Ltd.

စွမ်းအားသစ်အိုအေစစ်ဖွံ့ဖြိုးတိုးတက်မှုကုမ္ပဏီလီမိတက်

အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်း

Social Impact Assessment (SIA) လုပ်ငန်းများဆောင်ရွက်မှု

လူမှုပတ်ဝန်းကျင် အထောက်အကူပြုဒေသဖွံ့ဖြိုးရေး

လုပ်ငန်းများဆောင်ရွက်ပေးခြင်း

Neo Energy Oasis Development Co., Ltd.
Social Impact Assessment (SIA) လုပ်ငန်းများဆောင်ရွက်မှု အခြေအနေ

(၁) အခြေစိုက်စခန်းဧရိယာတွင် ပါဝင်သော မြေဧရိယာ(၂၅.၅၁)ကေအတွက် နစ်နာကြေးပေးအပ်ခြင်း	-	၂၅,၅၁၀,၀၀၀ ကျပ်
(၂) လူမှုပတ်ဝန်းကျင် အထောက်အကူပြု ဒေသဖွံ့ဖြိုးရေးလုပ်ငန်းများ ဆောင်ရွက်ပေးခြင်း	-	၇၈၅,၁၃၉,၁၀၀ ကျပ်
(၃) အင်းတိန်ကုန်းအခြေခံပညာအလယ်တန်းကျောင်းအတွက်စက်ရေတွင်း တူးဖော်ခြင်းလုပ်ငန်း (၆ ″ ɸ x ၄၀၀′)	-	၃,၈၈၅,၅၃၀ ကျပ်
(၄) နောင်ဝိုးရွာ မီးလင်းရေး ကော်မတီသို့ 20 KVA ရေအားလျှပ်စစ်လုပ်ငန်း ဆောင်ရွက်ခြင်း	-	၄,၄၂၈,၇၉၈ ကျပ်
(၅) ပင်မှို၊ ချောကုန်း၊ လက်ပံပင်၊ ငုတ် ကျေးရွာအုပ်စုဒေသအတွက်လမ်း ဖောက်လုပ်ပြုပြင်ပေးခြင်း	-	၆,၂၄၀,၀၀၀ ကျပ်
စုစုပေါင်းကုန်ကျစရိတ်		**၈၂၅,၂၀၃,၄၂၈ ကျပ်**

စီမံကိန်းအခြေစိုက်စခန်းဧရိယာအတွင်း ကျရောက်ခဲ့သည့် ယာမြေများအတွက် တောင်သူများသို့ ထောက်ပံ့ကြေး ပေးအပ်ခြင်း

၂။ အထက်ဘီလူးချောင်း ရေအားလျှပ်စစ်စီမံကိန်း အခြေစိုက်စခန်းဧရိယာအတွင်းသို့ မြေဧရိယာစုစုပေါင်း (၂၅.၅၁)ဧက ပါဝင်ခဲ့သဖြင့် သက်ဆိုင်ရာတောင်သူ (၁၃)ဦးသို့ နစ်နာမှုအတွက် ထောက်ပံ့ကြေးအဖြစ် ဒေသအာဏာပိုင်များ၊ ဌာနဆိုင်ရာများနှင့် သက်ဆိုင်ရာတောင်သူများ ညှိနှိုင်းချက်အရ တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၂.၆.၂၀၁၃) ရက်နေ့တွင် စီမံကိန်းရှင်းလင်းဆောင်၌ အခမ်းအနားဖြင့် တစ်ဦးချင်းသို့ ပေးချေခဲ့ပါသည်။

- စုစုပေါင်းပေးချေခဲ့မှုမှာ ၂၅,၅၁၀,၀၀၀ကျပ် (နှစ်ရာငါးဆယ့်ငါးသိန်း တစ်သောင်းကျပ်တိတိ) ဖြစ်ပါသည်။

အခြေစိုက်စခန်းဧရိယာတွင် ပါဝင်သောမြေယာရှင်များ၏ အမည်စာရင်းနှင့် နစ်နာမှုထောက်ပံ့ကြေး ပေးချေခြင်း ကုန်ကျစရိတ် ဇယားချုပ်

စဉ်	အကြောင်းအရာ	ကုန်ကျစရိတ် (ကျပ်)
(၁)	ဦးသိန်းဆွေအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၂၅) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၂၅၀,၀၀၀
(၂)	ဦးဝင်းအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၀၄) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၄၀,၀၀၀
(၃)	ဦးအောင်သော်အား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၇၄) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၇၄၀,၀၀၀
(၄)	ဦးအောင်ထွန်းအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၇၆) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၇၆၀,၀၀၀
(၅)	ဦးအောင်အား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၉၇) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၉၇၀,၀၀၀
(၆)	ဦးအောင်ကောင်းအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၈၅) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၈၅၀,၀၀၀
(၇)	ဦးစံဖေအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၄.၄၇) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၄,၄၇၀,၀၀၀
(၈)	ဦးဝင်းအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၅၉) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၅၉၀,၀၀၀
(၉)	ဦးတင်အား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၆.၆၅) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၆,၆၅၀,၀၀၀
(၁၀)	ဦးသိန်းအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၂.၇၄) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၂,၇၄၀,၀၀၀
(၁၁)	ဦးဖြူအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၄.၀၄) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၄,၀၄၀,၀၀၀
(၁၂)	ဦးဖူးအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၃) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၃,၀၀၀,၀၀၀
(၁၃)	ဦးမောင်ငွေအား တစ်ဧကလျှင် ကျပ်(၁၀)သိန်းနှုန်းဖြင့် (၀.၄၁) ဧကအတွက် လျော်ကြေးငွေပေးအပ်ခြင်း	၄၁၀,၀၀၀
	စုစုပေါင်း ကုန်ကျစရိတ်	**၂၅,၅၁၀,၀၀၀**

စီမံကိန်းအခြေစိုက်စခန်းဧရိယာအတွင်း ကျရောက်ခဲ့သည့် ယာမြေများအတွက်

တောင်သူများသို့ ထောက်ပံ့ကြေး ပေးအပ်ခြင်း မှတ်တမ်းဓာတ်ပုံများ

သိမ်းဆည်းမြေအတွက် သီးနှံစိုက်ကေများအပေါ်

နစ်နာကြေးပေးအပ်ပွဲ

ကော်မတီဝင်များ၊ တောင်သူများနှင့် ကုမ္ပဏီမှ တာဝန်ရှိသူများ မှတ်တမ်းဓာတ်ပုံ

Social Impact Assessment လုပ်ငန်းများဆောင်ရွက်မှု လူမှုပတ်ဝန်းကျင် အထောက်အကူပြု ဒေသဖွံ့ဖြိုးရေးလုပ်ငန်းများ ဆောင်ရွက်ပေးခြင်း ကုန်ကျစရိတ် ဇယားအချုပ်

စဉ်	ဆောင်ရွက်ပေးသည့် အကြောင်းအရာ	ကုန်ကျစရိတ် (ကျပ်)
(၁)	အောင်ပန်း-တောင်ခမောက်-အင်းတိန် လမ်းပိုင်းဆောက်လုပ်မှု	၄၁၆,၅၂၄,၉၀၀
(၂)	ခေါင်တိုင်-သန်းတောင်-အင်းတိန် လမ်းပိုင်း ဆောက်လုပ်မှု	၃၅၅,၇၆၀,၂၀၀
(၃)	မင်းလုံးကျေးရွာနှင့် ကျေးရွာဘုန်းတော်ကြီးကျောင်းသို့ လျှပ်စစ်မီးလိုင်းသွယ်တန်း တပ်ဆင်လှူဒါန်းခြင်း	၁,၀၀၀,၀၀၀
(၄)	အင်းတိန်ရွာထိပ်ရှိရှေးဟောင်းတောင်ပေါ်စေတီ(၅)ဆူအား ညဘက်ကြည့်ညိုနိုင်ရန် Solar မီးလုံးတပ်ဆင် လှူဒါန်းခြင်း	၁၄၀,၀၀၀
(၅)	မင်းလုံး(အထက်)ရွာ မူလတန်းကျောင်း အုပ်ရေကန်သွပ်မိုး ဆောက်လုပ်လှူဒါန်းခြင်း	၇၂၀,၀၀၀
(၆)	ရွှေအင်းတိန် ဘုရားကြီးမှ ဟောင်းနွမ်းပျက်စီးနေသော စေတီရံ(၄)ဆူပြင်ဆင်ခြင်းနှင့် အခြားမွမ်းမံပြင်ဆင်မှုများ	၄,၄၀၀,၀၀၀
(၇)	မင်းလုံး(အောက်)ရွာအနီးရှိ ရှေးဟောင်းစေတီများ ပြန်လည်ပြုပြင်ပေးခြင်းနှင့် ထီးတော်များတင်ခြင်း	၂,၅၉၇,၀၀၀
(၈)	မင်းလုံး(အောက်)ရွာအနီးရှိ ရှေးဟောင်းစေတီများ၏ အာရုံခံဇရပ်အဟောင်းအား ဖျက်၍ အသစ်တည်ဆောက် ပေးခြင်း	၃,၁၇၇,၀၀၀
(၉)	အင်းတိန်ကျေးရွာ ဘီလူးချောင်းသစ်သားတံတားကြီးခိုင်ခန့်စေရန် ပြန်လည် ပြုပြင်တည်ဆောက်ခြင်းသို့ အလှူငွေ ထည့်ဝင်လှူဒါန်းခြင်း	၅၀၀,၀၀၀
(၁၀)	မင်းလုံး(အထက်)ရွာ မူလတန်းကျောင်း အိမ်သာဆောက်လုပ်လှူဒါန်းခြင်း	၃၂၀,၀၀၀
	စုစုပေါင်း ကုန်ကျစရိတ်	**၇၈၅,၁၃၉,၁၀၀**

ကျေးရွာဆက်သွယ်ရေးလမ်းများအဆင့်မြှင့်ပြုပြင်ပေးခြင်း

၁။ စီမံကိန်းတည်ဆောက်ရေးလုပ်ငန်းများဆောင်ရွက်နေစဉ် လိုအပ်ချက်အရ စီမံကိန်းချဉ်းကပ်လမ်းအဖြစ် အောင်ပန်း-အင်းတိန်-ခေါင်တိုင် ဆက်သွယ်ရေးလမ်းကို ရွေးချယ်ခဲ့ပါသည်။ အောင်ပန်းမှ အင်းတိန်လမ်းအရှည် (၂၀.၄)မိုင်နှင့် အင်းတိန် မှ ခေါင်တိုင်ထိ လမ်းအရှည် (၁၁.၂) မိုင် မူလရှိပြီး ကျေးရွာဆက်သွယ်ရေးလမ်းများမှာ မူလက လမ်းသားအကျယ် (၁၂)ပေခန့်သာရှိပြီး လမ်းဘေးဝဲ/ယာ အချို့နေရာများတွင် ချုံနွယ်များထူထပ်၍ ယာဉ်ငယ်များဖြစ်သည့် မော်တော်ဆိုင်ကယ်များ၊ ထော်လာဂျီများသာ သွားလာနိုင်သည့် အခြေအနေရှိခဲ့ရာမှ မော်တော်ယာဉ်ကြီး/ငယ်များ ရာသီမရွေး သွားလာနိုင်သည်အထိ လမ်းအဆင့်မြှင့်တည်ဆောက်ခြင်း လုပ်ငန်းများဖြစ်သည့် လမ်းအကျယ် (၂၄)ပေအထိ လမ်းသားချဲ့ခြင်း၊ လမ်းဖြတ်အဆောက်အအုံများ အသစ်တည်ဆောက်ခြင်း၊ (၁)ပေထုရှိ ဖြုန်းကျောက်ခင်းပေးခြင်းတို့ကို ဆောက်ရွက်ပေးခဲ့၍ ယခုအခါ အောင်ပန်း-အင်းတိန်-ခေါင်တိုင် လမ်းမကြီးတလျှောက် ကျေးရွာများ အားလုံး ရာသီမရွေး လမ်းပန်းဆက်သွယ်ရေး အဆင်ပြေချောမွေ့စွာ ကူးသန်းသွားလာနိုင်ကြပြီ ဖြစ်ပါသည်။

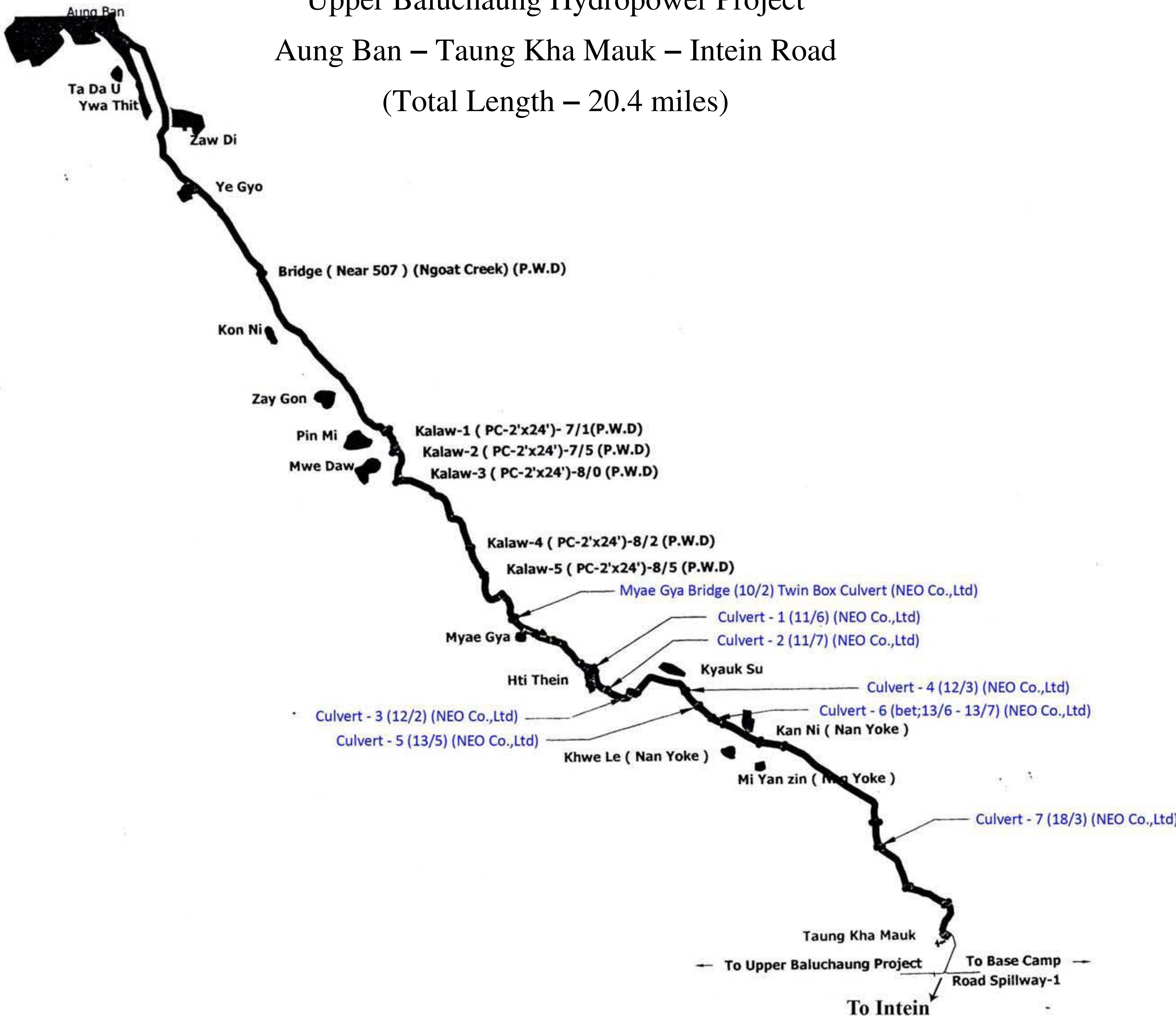
ဆောင်ရွက်ခဲ့သည့် လုပ်ငန်းများ

- လမ်းသားအကျယ် (၂၄)ပေ အထိချဲ့ခြင်း - ၃၁.၆ မိုင်
- လမ်းသားအကျယ် ဖြုန်းကျောက်ခင်းခြင်း - ၂၅ မိုင်
- လမ်းဖြတ်အဆောက်အအုံ အသစ်တည်ဆောက်ခြင်း - ၈ လုံး

Upper Baluchaung Hydropower Project

Aung Ban – Taung Kha Mauk – Intein Road

(Total Length – 20.4 miles)



အောင်ပန်း-တောင်ခမောက်-အင်းတိန် လမ်းပိုင်းဆောက်လုပ်မှု ကုန်ကျစရိတ်ဇယား

စဉ်	ဖြူန်းမြေသားခင်းခြင်း နှင့် လမ်းဖြတ်အဆောက်အအုံ အမှတ် (Box Culvert)	အရွယ်အစား (Size)	ကုန်ကျစရိတ် (ကျပ်)
၁	ဖြူန်းမြေသားခင်းခြင်းလုပ်ငန်း		၃၅၉,၃၂၆,၉၀၀
၂	မြေခြားတံတား (Twin Box Culvert Bridge) ဆောက်လုပ်ခြင်း	၃၀′ x ၁၃′ x ၆′	၁၇,၀၄၀,၀၀၀
၃	Box Culvert No-1 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၅၁၄,၀၀၀
၄	Box Culvert No-2 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၆၆၆,၀၀၀
၅	Box Culvert No-3 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၈၂၀,၀၀၀
၆	Box Culvert No-4 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၇၁၀,၀၀၀
၇	Box Culvert No-5 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၅၈၈,၀၀၀
၈	Box Culvert No-6 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၉၀၅,၀၀၀
၉	Box Culvert No-7 ဆောက်လုပ်ခြင်း	၂၄′ x ၅′ x ၅′	၅,၉၅၅,၀၀၀
	စုစုပေါင်းကုန်ကျစရိတ်		၄၁၆,၅၂၄,၉၀၀

အောင်ပန်း-တောင်ခမောက်-အင်းတိန် လမ်းပိုင်း
ဖောက်လုပ်နေပုံ

အောင်ပန်း-တောင်ခမောက်-အင်းတိန် လမ်းပိုင်း
ဖောက်လုပ်ပြီးစီးပုံ

အောင်ပန်း-တောင်ခမောက်-အင်းတိန် ဖြုန်းကျောက်ရောမြေအမျိုးအစားလမ်း ဖောက်လုပ်ထားပုံ

အရှည် - ၂၀.၄ မိုင်
အကျယ် - ၂၄ ပေ
ကုန်ကျစရိတ်- ၃၅၉,၃၂၆,၉၀၀ ကျပ်

မြေခြားတံတား

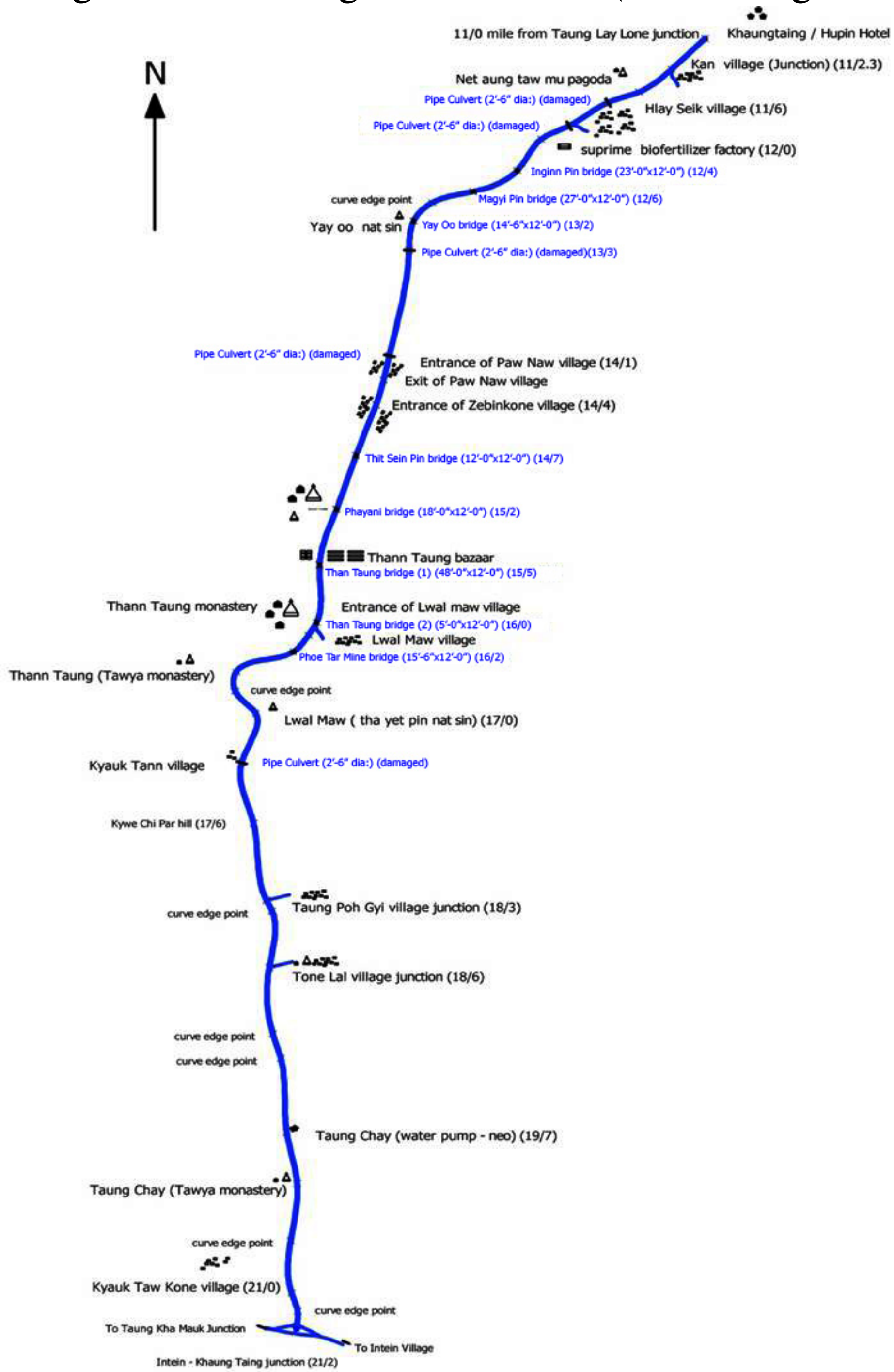
မြေခြားတံတားသည် အောင်ပန်း-တောင်ခမောက်-အင်းတိန်လမ်းတွင် တည်ရှိပြီး အောင်ပန်းမြို့မှ ၁၀မိုင် ၂ဖာလုံ အကွာတွင် တည်ရှိ၍ စီမံကိန်းချဉ်းကပ်လမ်း၏ အဓိကကျသော တံတား (Twin Box Culvert Bridge) တစ်ခုဖြစ်ပါသည်။ ယင်းတံတား မတည်ဆောက်နိုင်မီကာလများ၏ မိုးရာသီတွင် ချောင်းရေစီးဆင်းမှုများသောကြောင့် စီမံကိန်းချဉ်းကပ်လမ်းမှာ ယာဉ်များသွားလာမှု ပြတ်တောက်ခဲ့ရသည့် အခြေအနေအထိ ဖြစ်ခဲ့ပါသည်။

ယင်းတံတား တည်ဆောက်ပြီးစီးခဲ့သည့် ၂၀၁၂ ခုနှစ် မေလမှစ၍ စီမံကိန်းချဉ်းကပ်လမ်းမှာ ရာသီမရွေး အသုံးပြုနိုင်သည့်လမ်းဖြစ်ခဲ့ပါသည်။

အောင်ပန်း-တောင်ခမောက်-အင်းတိန် လမ်းပိုင်းရှိ လမ်းဖြတ်မြေခြားတံတား

တည်နေရာ - မိုင်တိုင် ၁၀/၂
အရွယ်အစား - ၃၀′x ၁၃′x ၆′
ကုန်ကျစရိတ်- ၁၇,၀၄၀,၀၀၀ ကျပ်

Khaung Taing - Thann Taung - Intein Road (Total Length – 11.2 miles)



ခေါင်တိုင်-သန်းတောင် - အင်းတိန် လမ်းပိုင်းဆောက်လုပ်မှု ကုန်ကျစရိတ်

စဉ်	အမည်	အရွယ်အစား (Size)	အမျိုးအစား	မှတ်ချက်
၁	မြုန်းမြေသားခင်းခြင်းလုပ်ငန်း			
၂	အင်ကြင်းပင်	၂၃'- ၀" x ၁၂'- ၀"	သစ်သားတံတား	အသစ်ဆောက်လုပ်ခြင်း
၃	မန်ကျည်းပင်	၂၇'- ၀" x ၁၂' - ၀"	သစ်သားတံတား	အဟောင်းအားပြုပြင်မွမ်းမံ
၄	ရေဦး	၁၄'- ၆" x ၁၂' - ၀"	သစ်သားတံတား	အဟောင်းအားပြုပြင်မွမ်းမံ
၅	သစ်စိမ်းပင်	၁၂' - ၀" x ၁၂' - ၀"	သစ်သားတံတား	အဟောင်းအားပြုပြင်မွမ်းမံ
၆	ဘုရားနီ	၁၈' - ၀" x ၁၂' - ၀"	သစ်သားတံတား	အသစ်ဆောက်လုပ်ခြင်း
၇	သန်းတောင်(၁)	၄၈' - ၀" x ၁၂' - ၀"	သစ်သားတံတား	အဟောင်းအားပြုပြင်မွမ်းမံ
၈	သန်းတောင်(၂)	၅' - ၀" x ၁၂' - ၀"	သစ်သားတံတား	အဟောင်းအားပြုပြင်မွမ်းမံ
၉	ဖိုးတာမိုင်း	၁၅'- ၆" x ၁၂' - ၀"	သစ်သားတံတား	အသစ်ဆောက်လုပ်ခြင်း
၁၀	လှေဆိပ်ရွာနှင့်စူပရင်းဓာတ်မြေဩဇာ စက်ရုံကြား	၂'-၆" ø	Pipe Culvert	2 Nos
၁၁	ရေဦးနတ်စင်နှင့် ပေါါနော်ရွာကြား	၂'-၆" ø	Pipe Culvert	2 Nos
၁၂	လွှယ်မောရွာနှင့် ကျောက်တန်းရွာကြား	၂'-၆" ø	Pipe Culvert	1 No
	စုစုပေါင်းကုန်ကျစရိတ်			**၃၅၅,၇၆၀,၂၀၀ ကျပ်**

ခေါင်တိုင်-သန်းတောင်-အင်းတိန် လမ်းပိုင်း
မဖောက်လုပ်မီပုံ

ခေါင်တိုင်-သန်းတောင်-အင်းတိန် လမ်းပိုင်း
ဖောက်လုပ်ပြီးစီးပုံ

ခေါင်တိုင်-သန်းတောင်-အင်းတိန် ဖြုန်းကျောက်ရောမြေအမျိုးအစားလမ်း ဖောက်လုပ်ထားပုံ

လမ်းဖောက်လုပ်ပြီးစီးမှုများ

အောင်ပန်း-တောင်ခမောက်-အင်းတိန် စီမံကိန်းချဉ်းကပ်လမ်းနှင့် ခေါင်တိုင်-သန်းတောင်-အင်းတိန် စီမံကိန်းချဉ်းကပ်လမ်းများမှာ Neo Energy Oasis Development Co.,Ltd. အနေဖြင့် ဖြန်းကျောက်ရောမြေအမျိုးအစားလမ်းအဖြစ်သာ ဆောင်ရွက်ပေးခဲ့ခြင်း ဖြစ်ပါသည်။ ယင်းလမ်း နှစ်လမ်းအား ၂၀၁၂ ခုနှစ် ဖေဖော်ဝါရီလတွင် ဖြန်းကျောက်ရောမြေ အမျိုးအစားလမ်း အဖြစ် အပြီးဆောင်ရွက်ပေးခဲ့ပြီး ယနေ့အထိ လိုအပ်သော ထိန်းသိမ်းပြုပြင်ခြင်းလုပ်ငန်းများ ဆောင်ရွက်လျှက် ရှိပါသည်။

ခေါင်တိုင်-အင်းတိန်လမ်းပိုင်းအား ယခုအချိန်တွင် ခေါင်တိုင်မှ ကျောက်တောကုန်း ကျေးရွာအစပ်ထိ (၁၀) မိုင်ခန့်အား (၁၂)ပေ လမ်းအကျယ်ဖြင့် ကတ္တရာလမ်းကို ရှမ်းပြည်နယ်အစိုးရအဖွဲ့၏ ဦးဆောင်လမ်းညွှန်မှုဖြင့် ဖြူစင်ကုမ္ပဏီမှ ဆောင်ရွက်ထားရှိ၍ လမ်းပန်းဆက်သွယ်ရေးကောင်းမွန်လျှက်ရှိပါသည်။

အောင်ပန်း-အင်းတိန်၊ ခေါင်တိုင်-အင်းတိန် လမ်းဖွင့်ပွဲအခမ်းအနား မြင်ကွင်းပုံ
(၁၁.၂.၂၀၁၂)

စီမံကိန်းရှင်းလင်းဆောင်အတွင်း စီမံကိန်းဆိုင်ရာများ ရှင်းလင်းတင်ပြပုံ
(၁၁.၂.၂၀၁၂)

ကျေးရွာလျှပ်စစ်မီးရရှိရေးလုပ်ငန်း

၃။ အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်း ရေလွှဲတမံအနီး၊ မင်းလုံး ကျေးရွာရှိ အိမ်ခြေ (၆၀)ခန့်နှင့် ကျေးရွာဘုန်းတော်ကြီးကျောင်းသို့ 25 H.P မီးစက်ဖြင့် စီမံကိန်းစတင်ချိန်မှစ၍ လျှပ်စစ်မီးပေးဝေခဲ့ပါသည်။ ထို့ပြင် အင်းတိန်ရွာထိပ်ရှိ ရှေးဟောင်း တောင်ပေါ်ဘုရားစေတီများ ညဘက်ကြည်ညိုနိုင်ရန် Solar မီးလုံးများဖြင့် တပ်ဆင်လှူဒါန်း ခဲ့ပါသည်။

- မင်းလုံးကျေးရွာရှိအိမ်ခြေ(၆၀)ခန့်နှင့် ကျေးရွာဘုန်းတော်ကြီးကျောင်းသို့ လျှပ်စစ်မီးလိုင်းသွယ်တန်းခြင်းကုန်ကျစရိတ် (Generator အပါအဝင်) - **၁,၀၀၀,၀၀၀ ကျပ်**
- လစဉ်လျှပ်စစ်မီးအတွက် ကုန်ကျစရိတ် (ညနေ-၆:၀၀ နာရီမှ ည-၁၁:၀၀ နာရီထိ နေ့စဉ်ပေးဝေခြင်း) - **၂၄၀,၀၀၀ ကျပ်**
- အင်းတိန်ရွာထိပ်ရှိ ရှေးဟောင်း တောင်ပေါ်ဘုရားစေတီများ ညဘက်ကြည်ညိုနိုင်ရန် Solar မီးလုံးများဖြင့် တပ်ဆင်လှူဒါန်းခြင်း

Solar Plate	(100W)	-	1 Plate
Inverter	(200W)	-	1 No
Battery	(70 Ah- 12 V)	-	1 No
Bulb	(3W)	-	5 Nos
PVC Wire		-	100 yds

စုစုပေါင်းလှူဒါန်းမှု ကုန်ကျစရိတ် - **၁၄၀,၀၀၀ ကျပ်**

(၃) အင်းတိန်ကုန်း အခြေခံပညာအလယ်တန်းကျောင်းအတွက် စက်ရေတွင်း တူးဖော်ခြင်းလုပ်ငန်း

Rotary Table တွင်းတူးစနစ်ဖြင့် (၆ ″ ф x ၄၀၀′) စက်ရေတွင်းတူးဖော်ခြင်း လုပ်ငန်း (အင်းတိန်ကုန်းအခြေခံပညာအလယ်တန်းကျောင်း) - ၃,၈၈၅,၅၃၀ ကျပ်

Donation of Drilling 6"Ø Tube-well at Indeingone Village sponsored by MOAI and NEO

Drilling 6"ø Tube-well by Mobile heavy drilling machine at Indein Kone Village
Sponsored by Neo Energy Oasis Development Co., Ltd.

Opening Ceremony of donation for drilling 6"ø Tube-well at Indein Kone Village

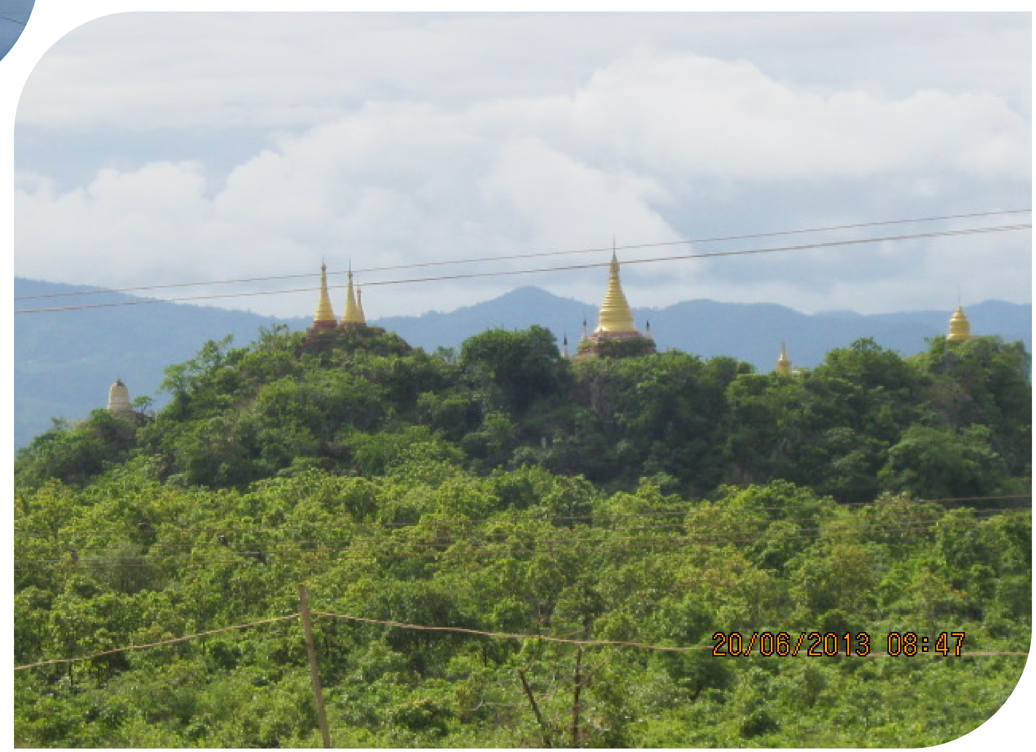
(၄) နောင်ပိုးရွာ မီးလင်းရေးကော်မတီသို့ 20 KVA ရေအားလျှပ်စစ်လုပ်ငန်း ဆောင်ရွက်ခြင်း

နောင်ပိုးရွာ မီးလင်းရေး ကော်မတီသို့ 20 KVA အသေးစားရေအားလျှပ်စစ်လုပ်ငန်း

ဆောင်ရွက်ပေးခြင်း	-	၄,၄၂၈,၇၉၈ ကျပ်

မင်းလုံး(အထက်/အောက်)ရွာများသို့ ညပိုင်းမီးပေးနိုင်ရန်
မီးလိုင်းသွယ်တန်း လှူဒါန်းခြင်း

ရှေးဟောင်းတောင်ပေါ်စေတီများ ညဘက်ကြည်ညိုနိုင်ရန်
Solar မီးလုံးများ တပ်ဆင်ထားပုံ



အင်းတိန်ကျေးရွာ ဆုတောင်းပြည့်ဘုရားများ ညမီးပူဇော်ရန်
Battery နှင့် Inverter တပ်ဆင်လှူဒါန်းခြင်း

အင်းတိန်ကျေးရွာ ဆုတောင်းပြည့်ဘုရားများ ညမီးပူဇော်ရန်
Solar Plate တပ်ဆင်လှူဒါန်းခြင်း

(၅) ပင်မှီ၊ ချောကုန်း၊ လက်ပံပင်၊ ငုတ် ကျေးရွာအုပ်စုဒေသအတွက်လမ်း ဖောက်လုပ်ပြုပြင်ပေးခြင်း

ပင်မှီ၊ ချောကုန်း၊ လက်ပံပင်၊ ငုတ် ကျေးရွာအုပ်စုဒေသအတွက်လမ်း - ၆,၂၄၀,၀၀၀ ကျပ်

ဖောက်လုပ်ပြုပြင်ပေးခြင်း(၁၅′ ပေအကျယ်၊ (၇)မိုင် ကျောက်ချောလမ်း)

ကျေးရွာရေရရှိရေးလုပ်ငန်း

၄။ စီမံကိန်းအနီးရှိ မင်းလုံးကျေးရွာရေရရှိရေးအတွက် အထက်ဘီလူးချောင်းမှ ရေစုပ်စက်ဖြင့် ရေပိုက်များသွယ်တန်းပြီးရေပေးဝေခြင်း၊တခါတရံ ရေစက်ပျက်ပါက ရေကားများ (Water Bowsers) ဖြင့် ကျေးရွာရှိ ရေလှောင်ကန်အရောက် ရေဖြည့်ပေးခြင်းတို့ဖြင့် ဆောင်ရွက်ပေးလျှက်ရှိပါသည်။

❑ မင်းလုံး(အထက်)ရွာ မူလတန်းကျောင်းအုပ်ရေကန်သွပ်မိုး ဆောက်လုပ်လှူဒါန်းခြင်း	-	၇၂၁,၁၁၁ ကျပ်
❑ မင်းလုံးကျေးရွာရေရရှိရေးအတွက် လစဉ်ကုန်ကျစရိတ်	-	၃၁၁,၁၁၁ ကျပ်
❑ လစဉ် မင်းလုံးကျေးရွာသို့ လျှပ်စစ်မီးပေးဝေလှူဒါန်းခြင်း	-	၅၄၀,၀၀၀ ကျပ်
❑ နှစ်စဉ် ဘာသာရေးနှင့် လူမှုရေးပွဲများတွင် ပါဝင်ကူညီဆောင်ရွက်ပေးခြင်း	-	၈၄၁,၁၁၁ ကျပ်

မင်းလုံး (အထက်ရွာ) မူလတန်းကျောင်း အုတ်ရေကန်သွပ်မိုး ဆောက်လုပ်လှူဒါန်းခြင်း

မင်းလုံး (အထက်ရွာ) မူလတန်းကျောင်း အုတ်ရေကန် ရေဖြည့်လှူဒါန်းခြင်း

မင်းလုံး (အထက်ရွာ) UNDP အုတ်ရေကန် ရေဖြည့်လှူဒါန်းခြင်း

မင်းလုံး (အထက်ရွာ) ဘုန်းကြီးကျောင်း အုတ်ရေကန် ရေဖြည့်လှူဒါန်းခြင်း

လူမှုဖွံ့ဖြိုးရေး အထောက်အကူပြုလုပ်ငန်းများ

၅။ စီမံကိန်းနယ်မြေအနီးရှိ ပတ်ဝန်းကျင်ကျေးရွာများမှ လူငယ်များသည် စီမံကိန်းလုပ်ငန်းများတွင် ဝင်ရောက်တာဝန်ထမ်းဆောင်နိုင်သည့် အခွင့်အရေးများရရှိခဲ့ပြီး အတွေ့အကြုံ ဗဟုသုတများတိုးပွားခြင်း၊ တစ်ဖက်တစ်လမ်းမှ အထိုက်အလျောက်လုပ်အားခဝင်ငွေရရှိခြင်း၊ မိမိတို့ဒေသဖွံ့ဖြိုးရေးလုပ်ငန်းတွင် ကိုယ်တိုင်ပါဝင်ဆောင်ရွက်နိုင်ခြင်း စသော လူမှုဖွံ့ဖြိုးရေးအကျိုးသက်ရောက်မှုများကို ရရှိခံစားနိုင်ကြပါသည်။ စီမံကိန်းတွင် ဒေသတွင်းလူငယ် အမျိုးသား (၁၈) ဦးနှင့် အမျိုးသမီး (၆) ဦးတို့ဝင်ရောက်တာဝန်ထမ်းဆောင်နေကြပါသည်။ ထို့ပြင် နေ့စားအလုပ်သမား (၅၀) ဦးခန့်ကိုလည်း နေ့စဉ်လုပ်ငန်းလိုအပ်ချက်အလိုက်ဝင်ရောက်လုပ်ကိုင်နေကြပါသည်။

- စီမံကိန်းလုပ်ငန်းခွင်အနီး ကျေးရွာများတွင်ကျင်းပသည့် အားကစားပွဲများ ဖြစ်မြောက်ရေးအတွက် (နှစ်စဉ်) စက်ယာဉ်/ယန္တရားအကူအညီပေးခြင်း - ၃၄၀,၀၀၀ကျပ်

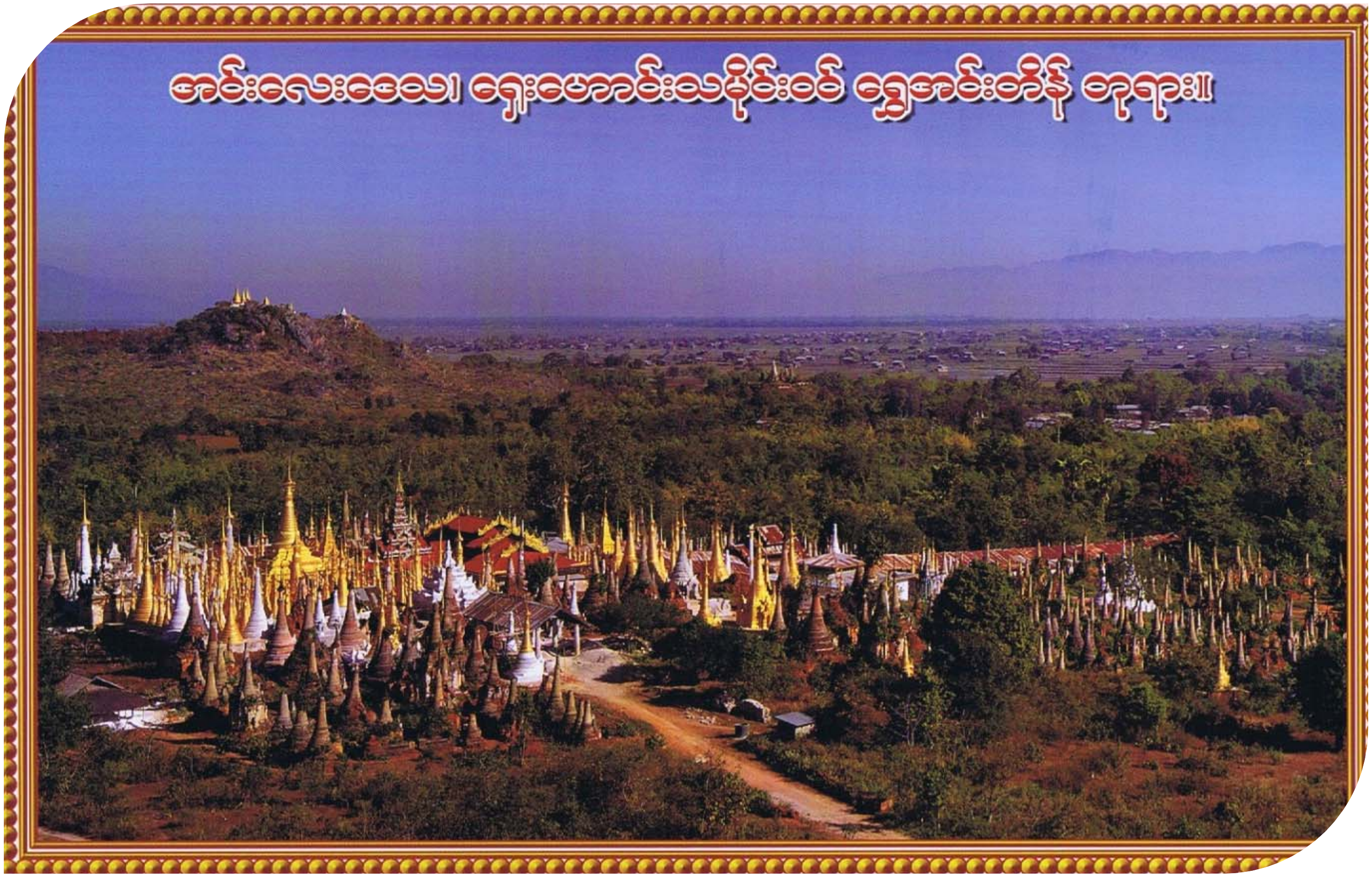
- ကုမ္ပဏီဝန်ထမ်းများမှ ကျေးရွာများ၏ အကူအညီတောင်းမှုအပေါ် ပါဝင်ကူညီဆောင်ရွက်ပေးခြင်း။

ဘာသာရေးလုပ်ငန်းများ

၆။ စွမ်းအားသစ်အိုအေစစ်ဖွံ့ဖြိုးတိုးတက်မှုကုမ္ပဏီအနေဖြင့် စီမံကိန်းဧရိယာ အနီးရှိ ရှေးဟောင်း ရွှေအင်းတိန် ဘုရားကြီးမှဟောင်းနွမ်းပျက်စီးနေသော စေတီရံ (၄) ဆူ ပြန်လည်ပြုပြင်ခြင်း အလှူငွေပေးအပ်ပွဲနှင့် ရေစက်ချအခမ်းအနားကို (၁၁.၂.၂၀၁၂) နေ့တွင် ပြုလုပ်လှူဒါန်းခဲ့ပါသည်။ မင်းလုံးရွာအနီးရှိ ရှေးဟောင်းစေတီများ ပြန်လည်ပြုပြင်ပေးခြင်းနှင့် အာရုံခံဇရပ်တစ်ခု တည်ဆောက်ပေးခြင်းတို့ကိုလည်း ဆောင်ရွက်ခဲ့ပါသည်။

(က) ရွှေအင်းတိန်ဘုရားကြီးမှ ဟောင်းနွမ်းပျက်စီးနေသော စေတီရံ(၄)ဆူပြင်ဆင်ခြင်းနှင့် အခြားမွမ်းမံပြင်ဆင်မှုများကုန်ကျစရိတ်	-	၄,၄၀၀,၀၀၀ ကျပ်
(ခ) မင်းလုံး(အောက်)ရွာ အနီးရှိ ရှေးဟောင်းစေတီများ ပြန်လည်ပြုပြင်ပေးခြင်းနှင့် ထီးတော်များတင်ခြင်းအတွက် ကုန်ကျစရိတ်	-	၂,၅၉၇,၀၀၀ ကျပ်
(ဂ) မင်းလုံး(အောက်)ရွာ အနီးရှိ ရှေးဟောင်းစေတီများ၏ အာရုံခံဇရပ်အဟောင်းအား ဖျက်၍ အသစ်တည်ဆောက်ပေးခြင်း	-	၃,၁၇၇,၀၀၀ ကျပ်
(ဃ) အင်းတိန်ကျေးရွာ ၊ မင်းလုံးကျေးရွာ နှင့် စီမံကိန်းလုပ်ငန်းခွင် အနီးရှိ အခြားကျေးရွာများ၏ ဘာသာရေးပွဲများ (ဝါဆိုသင်္ကန်း ကပ်ခြင်း ၊ ကထိန်ခင်းခြင်း၊ ပဋ္ဌာန်းပွဲ ကျင်းပခြင်း၊ စာပြန်ပွဲကျင်းပခြင်း)တွင် (နှစ်စဉ်) ပါဝင်၍ လှူဒါန်းခြင်း၊ ကူညီဆောင်ရွက် ပေးခြင်း	-	၅၀၀,၀၀၀ ကျပ်

အင်းလေးဒေသ ရှေးဟောင်းသမိုင်းဝင် ရွှေအင်းတိန်ဘုရားများ



အင်းတိန်ကျေးရွာ ရွှေအင်းတိန်ဘုရားများ ပြုပြင်မွမ်းမံလှူဒါန်းခြင်း

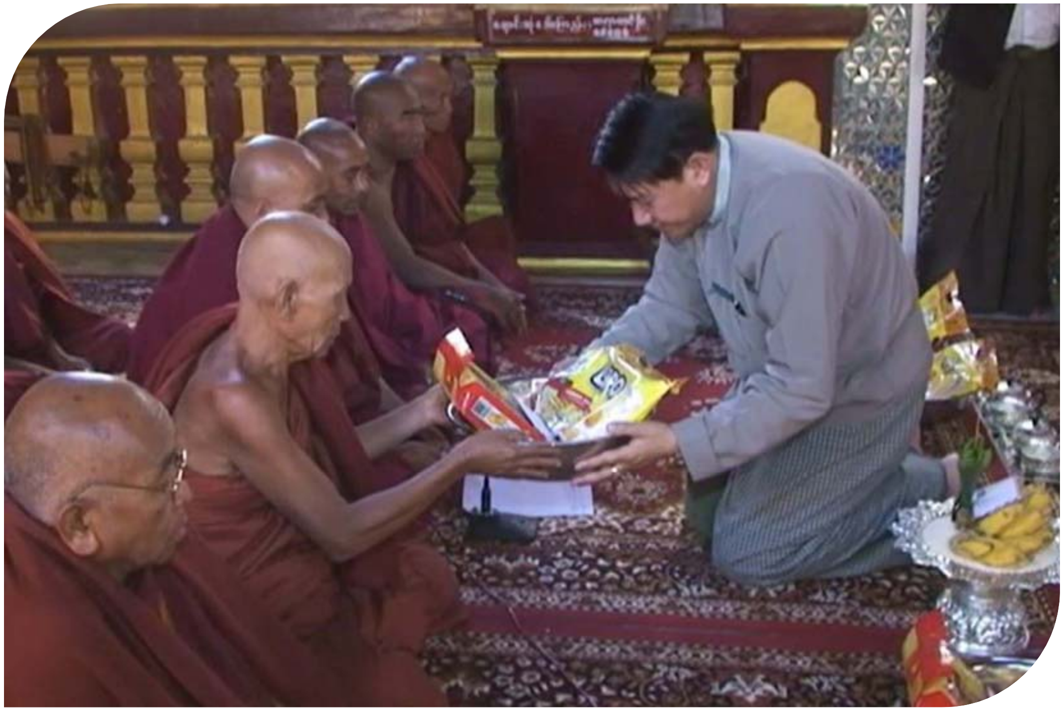
အင်းတိန်ကျေးရွာ ရွှေအင်းတိန်ဘုရားများ ပြုပြင်မွမ်းမံလှူဒါန်းခြင်း

မင်းလုံး (အောက်ရွာ) ဘုရားများ ပြုပြင်မွမ်းမံလှူဒါန်းခြင်း

မင်းလုံး(အောက်ရွာ)ရှိ ရှေးဟောင်းစေတီများ
ပြုပြင်မွမ်းမံခြင်း နှင့် အာရုံခံဇရပ်တစ်ခု
တည်ဆောက်ပေးခြင်း

မင်းလုံး (အထက်ရွာ) လူပျို၊ အပျိုဘုရား ပြုပြင်မွမ်းမံလှူဒါန်းခြင်း

စေတီရံ(၄)ဆူ ပြန်လည်ပြုပြင်ခြင်း
အလှူငွေပေးအပ်ပွဲနှင့် ရေစက်ချအခမ်းအနား



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နှင့် အာရုံခံဇရပ်တစ်ခု တည်ဆောက်ပေးခြင်း
ရေစကြချအခမ်းအနား

ရွှေအင်းတိန်ဘုရားရှေ့ရှိ ဘီလူးချောင်းတံတား ပြုပြင်ရာတွင် အလှူငွေထည့်ဝင်ခြင်း

၇။ ရှေးဟောင်းရွှေအင်းတိန်ဘုရားကြီးသို့ သွားရာလာလမ်းပေါ်ရှိ ဘီလူးချောင်းကူး သစ်သားတံတားကြီး ခိုင်ခန့်စေရန် ညောင်ရွှေမြို့နယ်မှ ကြီးကြပ်၍ ပြန်လည်ပြုပြင်တည်ဆောက်ရာတွင်လည်း အလှူငွေကျပ် (၅၀၀,၀၀၀) ထည့်ဝင်လှူဒါန်းခဲ့ပါသည်။

ရွှေအင်းတိန်ဘုရားရှေ့ရှိ ဘီလူးချောင်းတံတား ပြုပြင်ပြီး မှတ်တမ်းဓာတ်ပုံ

ရွှေအင်းတိန်ဘုရားရှေ့ရှိ ဘီလူးချောင်းတံတား

ပြုပြင်ပြီး မှတ်တမ်းဓာတ်ပုံများ

ကျန်းမာရေးနှင့်ပညာရေးအထောက်အကူပြုလုပ်ငန်းများ

၈။ မိမိကုမ္ပဏီအနေဖြင့် ဒေသအတွင်းရှိ ကျန်းမာရေးနှင့် ပညာရေး အထောက်အကူလုပ်ငန်းများကို တစ်ဖက်တစ်လမ်းမှ အထောက်အကူပြု၍ ပါဝင်ကူညီဆောင်ရွက် ပေးလိုပါကြောင်း (၂၆.၁၂.၂၀၁၁) ရက်နေ့စွဲပါ စာအမှတ် ၄၃၁/ ၁၂ - ၁၁ / NEO ဖြင့် ရှမ်းပြည်နယ်အစိုးရအဖွဲ့သို့ တင်ပြအကြောင်းကြားခဲ့ပါသည်။

ဆောင်ရွက်ပေးမည့်လုပ်ငန်းများမှာ-

(က) အင်းတိန်ကျေးရွာရှိ မူလတန်းလွန်ကျောင်းအား အလယ်တန်းကျောင်းသို့ တိုးမြှင့်တည်ဆောက်ပေးရန်

(ခ) မြို့နယ်မှသတ်မှတ်ပေးသည့် သင့်လျော်မည့် မြေနေရာတွင် ကျေးရွာတိုက်နယ် ဆေးရုံတစ်ခု တည်ဆောက်ပေးရန် တို့ဖြစ်ပါသည်။

- မင်းလုံး(အထက်)ရွာ မူလတန်းကျောင်းအိမ်သာဆောက်လုပ်လှူဒါန်းခြင်း - **၃၂၀,၀၀၀ ကျပ်**

မင်းလုံး (အထက်ရွာ) မူလတန်းကျောင်းအိမ်သာ ဆောက်လုပ်လှူဒါန်းခြင်း

၉။ အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်းသည် ရေလှောင်တမံစနစ် (Storage Dam) ဖြင့် ရေယူခြင်း မဟုတ်ဘဲ ရေလွှဲစနစ် (Run-of-River) အမျိုးအစားဖြစ်သဖြင့် အနီးပတ်ဝန်းကျင်ကျေးရွာများ ရေလွှမ်းမိုးခြင်းမရှိပါ။

ရေလွှမ်းမိုး၍ ကျေးရွာများ ပြောင်းရွှေ့ပေးရခြင်း၊ နစ်နာကြေးများပေးရခြင်းတို့ မရှိပါကြောင်း တင်ပြအပ်ပါသည်။

အင်းတိန် - လယ်ပြင်ကျေးရွာ၏ အသေးစား

ရေအားလျှပ်စစ်စက်ရုံအတွက်

နစ်နာကြေးနှင့်ဒေသဖွံ့ဖြိုးတိုးတက်ရေးအတွက် အလှူငွေပေးအပ်ပွဲ

(13. 10. 2013)

အင်းတိန်လယ်ပြင်ကျေးရွာ၏ အသေးစား ရေအားလျှပ်စစ်စက်ရုံနစ်နာကြေးနှင့်အလှူ ငွေပေးအပ်ပွဲတွင် ရှမ်းပြည်နယ်လျှပ်စစ်နှင့် စက်မှုဝန်ကြီးဦးစိုင်းထွန်းရင်မှ အဖွင့်အမှာ စကားပြောကြားပုံ

အင်းတိန်လယ်ပြင်ကျေးရွာ၏ အသေးစား ရေအားလျှပ်စစ်စက်ရုံနစ်နာကြေးနှင့်အလှူ ငွေပေးအပ်ပွဲတွင် တက်ရောက်သူများ

ညောင်ရွှေမြို့နယ် အုပ်ချုပ်ရေးမှူး ဦးကျော်ဇောလှမှ အမှာစကားပြော ကြားပုံ

အင်းတိန်လယ်ပြင်ကျေးရွာမီးလင်းရေး အဖွဲ့မှနစ်နာကြေးငွေလက်ခံရယူနေပုံ

အင်းတိန်လယ်ပြင်ကျေးရွာ၏ အသေးစား ရေအားလျှပ်စစ်စက်ရုံနှစ်နာကြေးနှင့်အလှူ ငွေပေးအပ်ပွဲ မှတ်တမ်းတင်ဓာတ်ပုံ

အင်းတိန်လယ်ပြင်ကျေးရွာ၏ အသေးစား ရေအားလျှပ်စစ်စက်ရုံနှစ်နာကြေးနှင့်အလှူ ငွေပေးအပ်ပွဲ မှတ်တမ်းတင်ဓာတ်ပုံ

Appendix 7

Volume-III Supporting Report (1/2)

Hydrology and Geology

UB/FS-3

NEO ENERGY OASIS DEVELOMENT CO., LTD.

FEASIBILITY STUDY AND BASIC DESIGN

UPPER BALUCHAUNG HYDROPOWER PROJECT

FINAL REPORT

VOLUME-III : SUPPORTING REPORT (1/2)

HYDROLOGY & GEOLOGY

June 2010

NIPPON KOEI

FEASIBILITY STUDY AND BASIC DESIGN

UPPER BALUCHAUNG HYDROPOWER PROJECT

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HYDROLOGY & GEOLOGY

Report No	Issue No.	Issue Date	Prepared By	Reviewed by	Approved by	Reason for Change
UB/FS-3	1	30/06/10	NK Team	HK	HK	First Issue for Comment

TABLE OF OVERALL CONTENTS

Supporting Report

Hydrological Investigation

FEASIBILITY AND BASIC DESIGN
UPPER BALUCHAUNG HYDROPOWER PROJECT
FINAL REPORT

VOLUME-III : SUPPORTING REPORT (1/2)
HYDROLOGY & GEOLOGY

TABLE OF CONTENTS

TABLES

FIGURES

CHAPTER-A HYDROLOGY

A.1 Objectives

The objectives of the hydrological studies for the Upper Baluchaung Hydroelectric Power Project are to:

review and update the basic relevant hydrological data,

review and estimate the long-tern sequence of daily discharge,

estimate flood levels for various probabilities of occurrence,

estimate the probable maximum flood (PMF) into the proposed sites,

estimate net evaporation losses from the proposed regulating reservoir, and

review and estimate sediment inflow into the reservoir or intake.

A.2 Study Area

(1) River Basin Topography

Flow of Upper Baluchaung through the Gorge

As shown on the location map of Figure 3.4.1, the Upper Baluchaung, originated from the peak of hill at EL.1,625 m about 2 km west of Pinlaung Town, flows from south to north though the forest mountainous area. After joining the Thande-chaung at about 6 km north of Tigyit Town, which flows though the cultivated or glass-land flat plateau area, the Upper Baluchaung enters into the gorge at around EL. 1,212 m near the Saung wun village, and eventually flows into the Inle Lake via Indein village at around EL. 900 m.

The maximum altitude of the Upper Baluchaung is at EL. 1,625 m, located in the south of the river basin. Its total river length is about 95 km to the Inle Lake with the total head of 700 m approximately at the UB-2 Powerhouse. At the Indein village near the Inle Lake, the Upper Baluchung has a total catchment area of 836 km^2.

The proposed locations of the main components are summarized as follows:

Component	Latitude	Longitude	Catchment
Regulating Dam	20^{o}30'57"N	96^{o}43'40"E	767 km^2
UB-1 Intake	20^{o}29'03"N	96^{o}47'03"E	802 km^2
UB-2 Intake	20^{o}28'19"N	96^{o}48'43"E	822 km^2

The Inle Lake, the second largest lake in Myanmar, flows south into the Nam Pawn River, and then reach the Mobye Dam reservoir, which was constructed to utilize the abundant hydro potential for the power generation through a series of the historical Baluchaung Hydropower Projects.

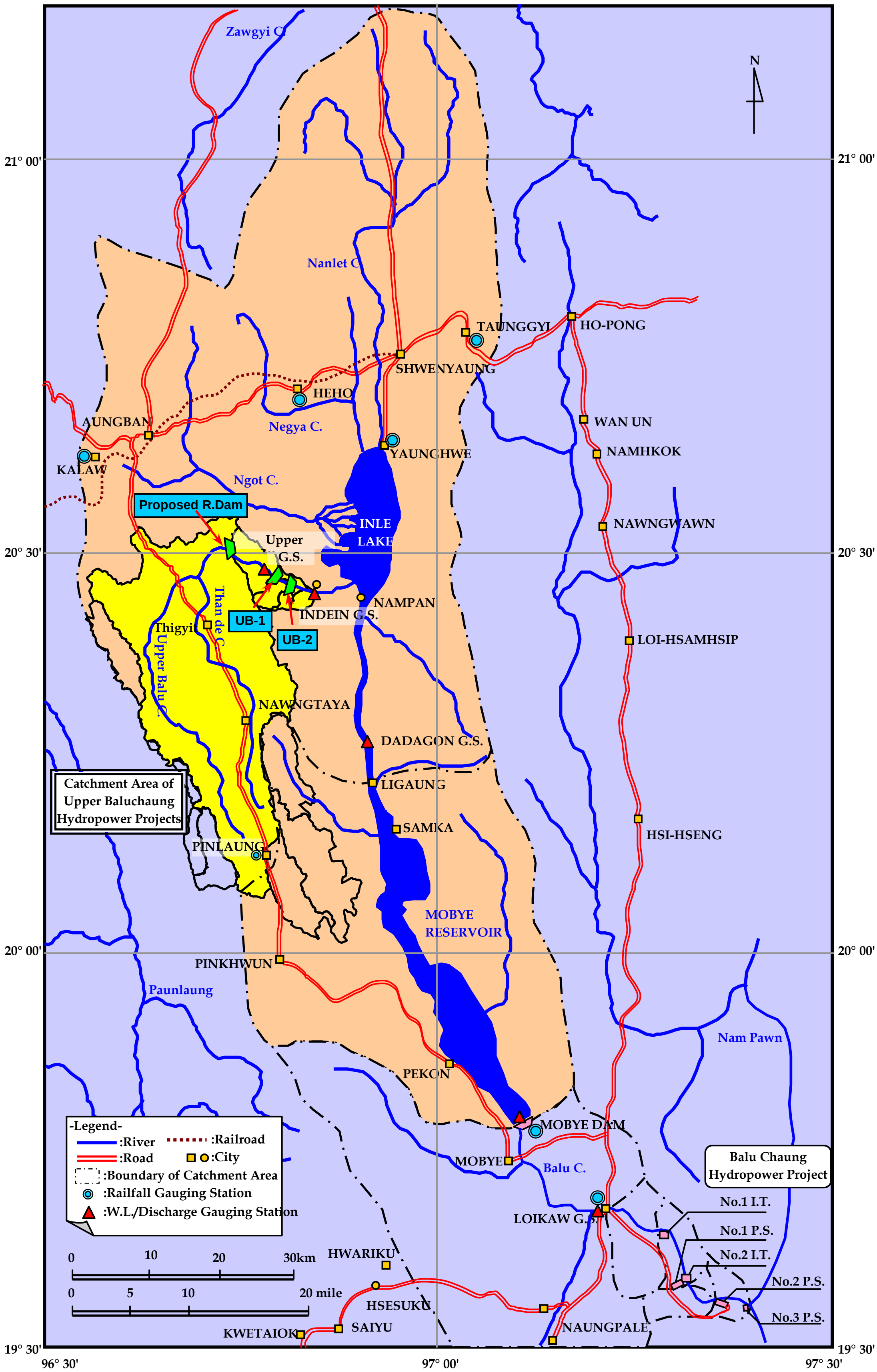


Figure A.1 Location Map of the Upper Baluchaung River Basin

(2) Climate Conditions

The project site is located in a monsoon climate area where the climate is characterized by a well-defined dry season in the winter and a rainy southwestern monsoon in the summer months. The meteorology of the project area is influenced by the northeast monsoon, with the wet season from May to October and dry season from November to April as shown in Figure A.2. Mean annual rainfall at each gauging station is largely different from area to area. It is generally indicated that there is more rainfall at higher altitudes in the catchment.

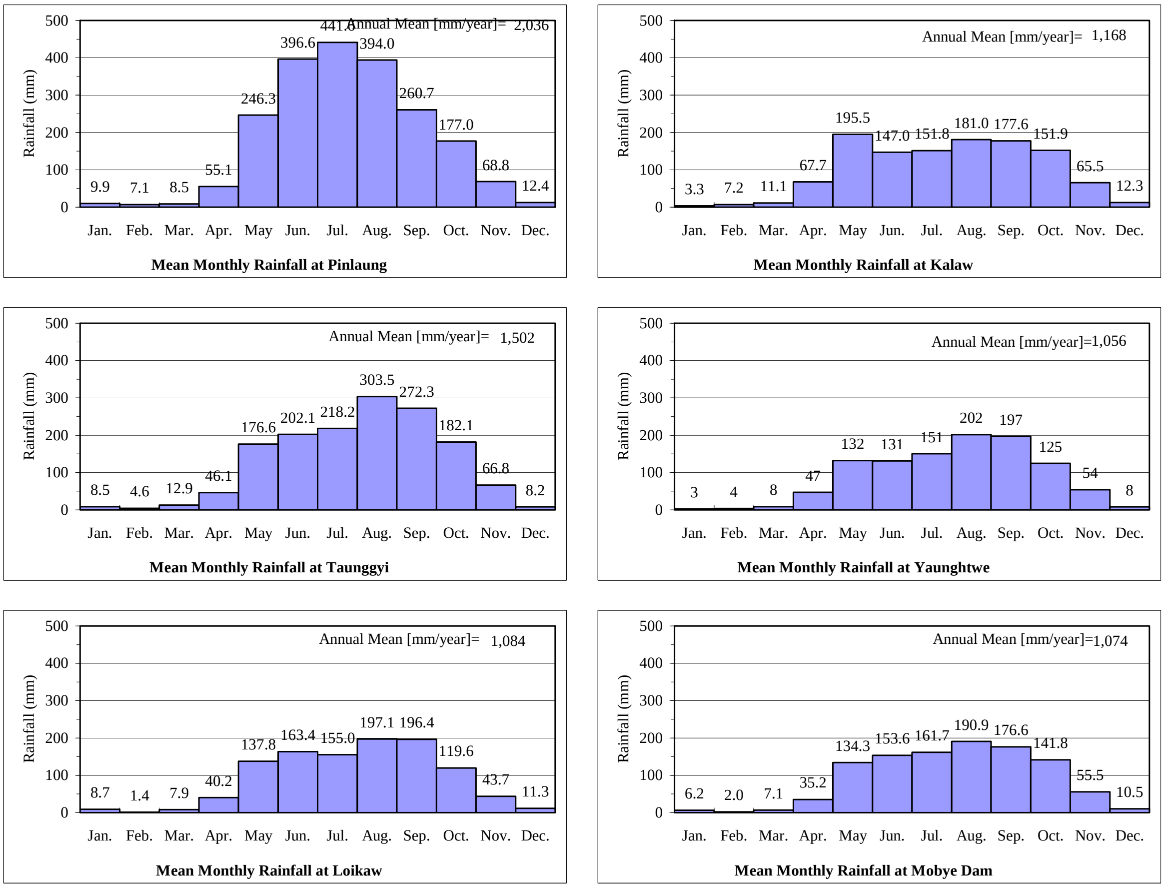


Figure A.2 Mean Monthly Rainfall in the Baluchaung River Basin

Temperatures reach their maximum towards the end of the dry season, in April. Table A.1 shows monthly pan-evaporation records at Mobye dam. Mean annual pan-evaporation ratio at Mobye Dam is 1,773 mm/year.

Table A.1 Monthly Pan-Evaporation Records at Mobye Dam

Station: Mobye Dam (unit:mm)

year	MONTH												Annual
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1971	94	135	163	172	172	160	126	81	126	72	95	77	1473
1972	87	141	221	192	201	154	117	87	106	119	127	106	1658
1973	107	150	217	248	266	135	123	136	93	82	53	67	1677
1974	93	121	190	156	147	120	92	122	70	117	88	77	1393
1975	80	106	137	104	171	132	80	114	49	96	75	110	1254
1976	78	126	230	257	205	162	184	117	155	153	100	124	1891
1977	87	142	203	235	233	170	203	129	85	139	100	132	1858
1978	87	120	169	254	209	*135*	161	*115*	184	*123*	61	174	1792
1979	101	129	194	258	232	*135*	*136*	74	177	127	101	62	1726
1980	147	89	119	157	85	123	125	96	88	126	85	90	1330
1981	105	138	214	197	178	81	166	101	102	81	*117*	75	1555
1982	150	184	294	189	202	156	60	110	117	127	239	219	2047
1983	185	202	318	332	280	176	187	137	62	130	220	117	2346
1984	134	185	250	134	204	89	114	156	162	128	182	209	1947
1985	141	161	208	271	188	113	114	105	109	208	48	193	1859
1986	253	181	228	307	176	135	180	166	124	147	179	135	2211
1987	94	163	270	412	308	125	149	104	136	112	122	125	2120
1988	120	159	258	228	203	120	NA	NA	NA	NA	NA	NA	NA
Average	119	146	216	228	203	135	136	115	114	123	117	123	1,773

Source: Baluchaung Hydroelectric Project No.1 Power Station, O&M Manual Vol.II, NEWJEC, 1993
Note: *Italic* figures were replaced with the mean monthly value.

A.3 Review of Previous Hydrological Studies

The previous hydrological studies related to the Upper Baluchaung Hydropower Project are as follows.

(i) "*Pre-Feasibility Study of Hydropower Projects in the Union of Myanmar*", Kansai Electric Power Co., Inc. Japan (KEPCO) in corporation with Myanmar Electric Power Enterprise (MEPE), May 2002.

(ii) "*Review of Pre-Feasibility Study on Upper Baluchaung Hydropower Project*", Minn Anawrahta Group Co., Ltd. (MGC), November 2009.

(iii) "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

Results of previous studies are summarized in Table A.2 below:

Table A.2 Summary of Previous Hydrological Study for Upper Baluchaung

No.	Source (Study by)	Study Year	C.A. [km^2]	Note	Mean Annual Rainfall [mm/year]	Mean Annual Runoff [m^3/s]	Period (Year) of Discharge	Runoff Coeff.	PMF/ Design Flood [m^3/s]	Specific Sediment Yield [$t/km^2/year$]	Annual Sediment Inflow Vol. [MCM/Yr]
1	KEPCO Pre-F/S	2002	820	at UB-1 Intake	1,925	8.1	1990-1999	0.16	-	-	-
2	MGC Review of Pre-F/S	2009	820	at UB-1 Intake	1,925	9.3	1990-2008	0.19	-	-	-
3	T.Furuichi Lake Inle Study	2008	813	Indein G.S	1,832	15.2	2005	0.32	-	121	-

Source:
(1) "Pre-Feasibility Study of Hydropower Projects in the Union of Myanmar", Kansai Electric Power Co., Inc. Japan (KEPCO) in corporation with Myanmar Electric Power Enterprise (MEPE), May 2002.
(2) "Review of Pre-Feasibility Study on Upper Baluchaung Hydropower Project", Minn Anawrahta Group Co., Ltd. (MGC), November 2009.
(3) "Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

(1) Pre-F/S by KEPCO / MEPE (2002)

The Pre-F/S for the Upper Baluchaung hydropower was carried out by Kansai Electric Power Co., Inc. Japan (KEPCO) in corporation with Myanmar Electric Power Enterprise (MEPE), May 2002. The Pre-F/S had carried out the following hydrological analyses:

1) Measurement of catchment area at proposed Upper Baluchaung dam site (C.A.=340 km2) and run-of-river intake site (C.A.=820 km2).

2) Estimation of mean annual basin rainfall at project site by using Pinlaung rainfall gauging station from 1970-1996.

   - Mean Annual Precipitation (MAP) = 1,925 mm/year

3) Estimation of mean monthly runoff at Upper Baluchaung dam site and intake site was carried out by using monthly runoff data at Mobye dam site and taking into account dispersion of rainfall upstream Mobye dam as shown below:

Basin	River	CA (km^2)	Rainfall (mm)
A	Upper Balu Chaung	835	1,925 at Pinlaung
B	Ngot Chaung	819	1,290 at Karaw
C	Inle Lake and others	4,636	1,345 (in average) 1,509 at Taunggyi/1,181 at Yaunghwe
Total	Mobye Dam/Baluchaung	6,290	

$$Q_{in(Dam)} = Q_{in(Mobye)} \times \frac{CA_a \times R_a}{CA_a \times R_a + CA_b \times R_b + CA_c \times R_c} = 16.2\% \times Q_{in(Mobye)}$$

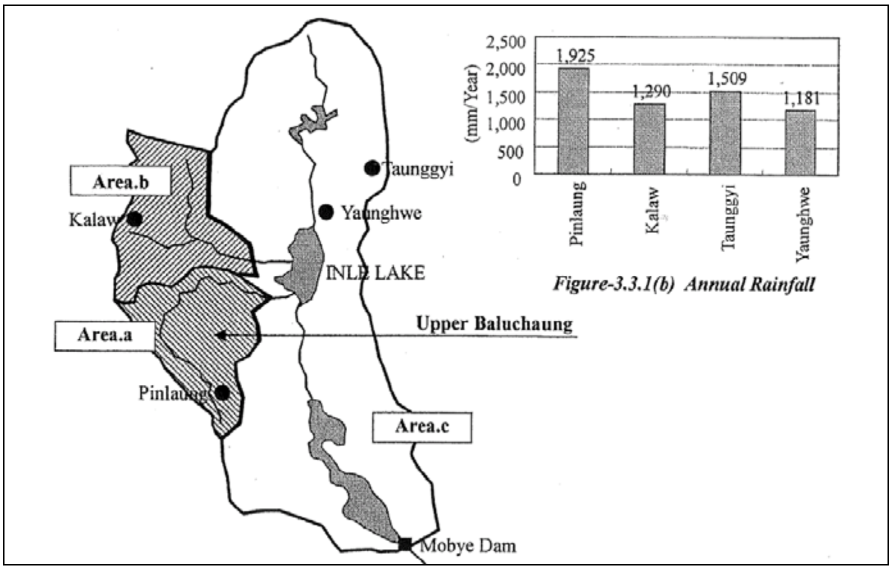


Figure A.3 Catchment Division of the River Basin by KEPCO Method

The period of the data is 10 years from 1990 to 1999 and average annual runoff of Upper Baluchaung is below:

- Mean Annual Runoff (MAR) = 3.4 m^3/s at dam site (C.A.=340 km^2)

- Mean Annual Runoff (MAR) = 8.1 m^3/s at intake site (C.A.=820 km^2).

4) Discharge measurements were carried out in cooperation with at 5 sites in April 2000, December 2000 and May 2001.

5) Water level gauging station (C.A,=830 km^2) near the proposed UB-1 intake site was installed by MEPE on August 2000. Daily water level was measured from August 2000 to May 2002.

(2) Review of Pre-F/S by MGC (2009)

Estimation of monthly runoff at proposed site was conducted by using same method of Pre-F/S. The period of additional data of 2000 to 2008 was adopted. Average annual runoff of Upper Baluchaung River becomes as follows;

- Mean Annual Runoff (MAR) = 9.3 m^3/s at intake site (C.A.=820 km^2).

It is important to note that Investigation Report for the Baluchaung No.1 HPP (January 1985) pointed out that the data conversion from the water level to the discharge at the Mobye Dam had included over-estimate, because the gauge reading was along the arc length of the radial gate, but the overflow discharge should be estimated using the perpendicular length from the bottom edge of the gate to the overflow weir. Therefore modification had been recommended to obtain correct values of the discharge over the Mobye Dam. Compared with those data, the monthly discharge data at the Mobye Dam is not equal to the calibrated one shown in the Investigation Report (1985), meaning that the monthly discharge data may not have been calibrated. Dispersion of the discharge data shown in Figure A.4 indicates the error among the discharge data.

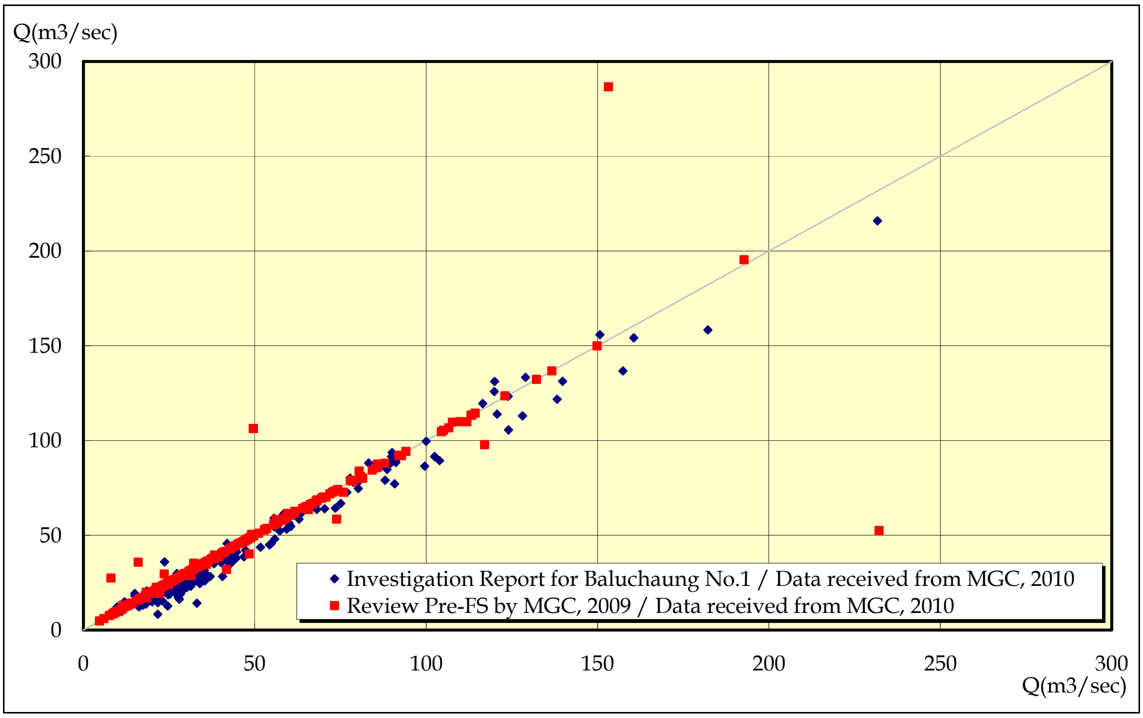


Figure A.4 Dispersion of Discharge Data at Mobye Dam

(3) Sedimentation Study in Lake Inle by Dr. T. Furuichi (2008)

Dr. T. Furuichi, of the Tokyo University of Agriculture and Technology, was carried out the study of sedimentation in Lake Inle for his doctor thesis in the Australian National University in 2008. The study includes discharge measurement, hourly water level measurement by pressure sensor and suspended sediment yield by water sampling and automatic turbidity sensor at Indein gauging station in the Upper Baluchaung River.

A.4 Review of the Catchment Area

The catchment areas at the UB-1 intake site and the Indein water level gauging station estimated in the previous studies are shown in the Table below:

Table A.3 Catchments Area by Previous Study

Source	C.A. [km^2] at UB-1 Intake site	C.A. [km^2] at Indein gauging station
Pre-F/S by KEPCO	820	-
Dr. T. Furuichi	-	813

In this study, the catchment area was reviewed and re-measured by using 1/50,000 maps covering the whole area. The results of the estimate after review were shown below:

Table A.4 Catchments Area at Upper Baluchaung HEPP Proposed Site

Location	Remaining (km^2)	Catchment (km^2)
Storage Dam site	767	767
No.1 Intake	36	802
No.1 P/S	14	816
No.1 Intake	6	822
No.1 P/S	5	828
Indein G/S	8	836

A.5 Hydrological Data Collected

The available hydrological data collected to date are summarized as follows. The collected data were attached in ***Appendix-A***.

Table A.5 Collected Meteorological and Hydrological Data

[Water Level / Discharge Observation Data]

No.	Data	Location	Period	Source
1	Monthly discharge	Mobye dam (CA=6,300 km^2)	Jan.1971 - Nov. 2009	hard copy
2	Monthly discharge	Mobye dam (CA=6,300 km^2)	Jan.1990 - Dec. 2008	Pre FS (MGC)
3	Discharge Measurement	Upper Baluchaung 5 sites	26-28 Apr.2000, 2-5 Dec.2000, 15 May 2001	KEPCO/ MEPE
4	Daily water level	Upper Baluchaung G/S (UB-1)	Aug.2000 - May.2002	MEPE
5	Discharge Measurement	Upper Baluchaung G/S (UB-1)	Aug.2000 - May.2002	MEPE (once/month)
6	Hourly water level	Indein	Oct.2004 - May.2006	Dr. T. Furuichi
7	Hourly discharge (by H-Q rating curve)	Indein	Oct.2004 - May.2006	Dr. T. Furuichi
8	Daily water level	Indein	from Jan.2010	measured by MGC
9	Discharge Measurement	Indein	from Jan.2010	measured by MGC

[Pan Evaporation Data]

No.	Data	Location	Period	Source
1	Monthly Pan Evaporation	Mobye dam	Jan.1971 - Jun. 1988	Baluchaung HEPP No.1 P/S, NEWJEC, 1993

Table A.6 Collected Rainfall Data

Year / Station	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Pinlaung																														
Kalaw								△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Heho																														
Taunggi																														
Yaunghtwe				○	○	×	×	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Loikaw																														
Mobye																														

Year / Station	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Pinlaung																														
Kalaw	○	○	○	○	○	○	○	○	×	○	×	×	×	×	×	×	×	×	×	×	×	×	△	○	○	○	○	×	×	×
Heho																														
Taunggi																					○	○	○	●	●	●	●	●	●	●
Yaunghtwe	○	○	○	○	○	○	○	○	×	○	×	×	×	×	×	×	×	△	△	△	△	×	×	×	○	○	○	○	×	×
Loikaw																						○	○	○	○	○	○	○	×	×
Mobye																														

Year / Station	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Pinlaung	△	○	○	△	△	×	○	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Kalaw	×	×	×	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●	●	●	●	●	●	●	●	●	●
Heho										×	×	×	×	×	×	×	×	×	×	×	○	○	○	○	○	○	○	○	○	○
Taunggi	●	○	○	●	●	○	●	●	●	●	●	●	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Yaunghtwe	×	×	×	×	×	×	×	×	×	×	×	○	○	○	○	○	○	○	○	●	●	●	●	●	●	●	●	●	●	●
Loikaw	×	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△		
Mobye								○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△		

Year / Station	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Pinlaung	●	●	●	●	●	△	△	●	●	●	●	●	●	●	●	●	●	●	●	
Kalaw	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Heho	○	○	○	○	○	○	○	○	●	●	○									
Taunggi	●	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○		
Yaunghtwe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Loikaw																				
Mobye																				

Notes:
●: Daily rainfall data is available (completely).
○: Monthly rainfall data is available (completely).
△: Monthly rainfall data is available, but incompletely. (there is some missing month)
×: Rainfall data is not available. (missing data year)

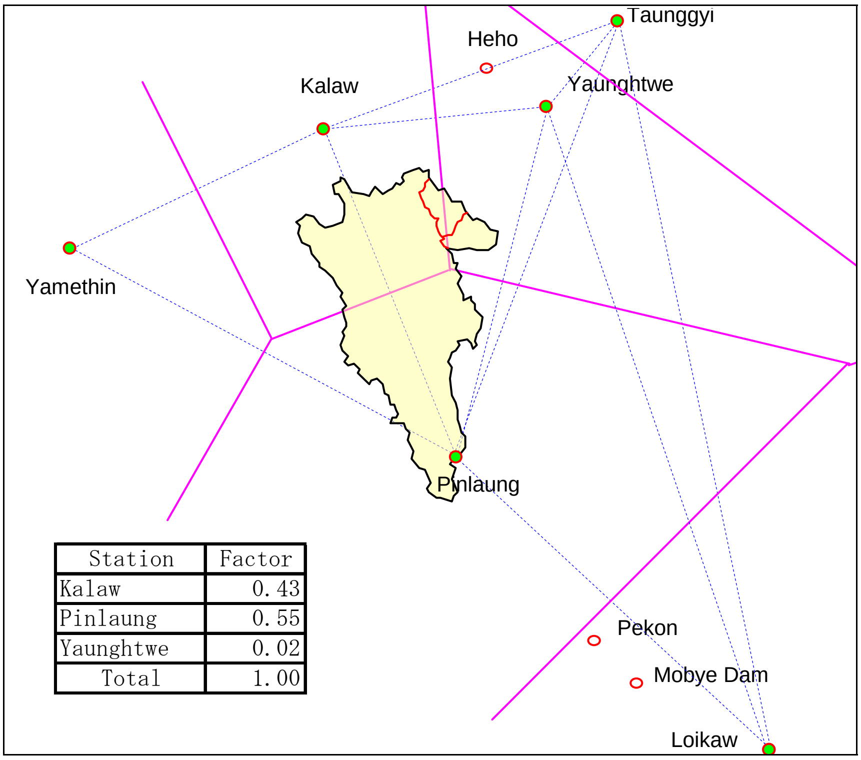
A.6 Rainfalls

(1) Rainfall Gauging Stations

The locations of rainfall gauging stations in and around the Upper Baluchaung River basin are shown in Figure A.1. The monthly and daily rainfall data collected to date is attached in the ***Appendix-A***. The *Thiessen*'s polygon with the factor for each rainfall gauging station is shown in Figure A.5.

(2) Accuracy of Rainfall Data

The relationship of 6 rainfall stations for the double mass curve of annual rainfall among all stations is shown in Figure A.8. As seen in these figures, there is no significant deviation in the 6 rainfall data.



Station	Factor
Kalaw	0.43
Pinlaung	0.55
Yaunghtwe	0.02
Total	1.00

Figure A.5 Thiessen Polygon of Rainfall for Upper Baluchaung Basin

(3) Lon-Term Annual Rainfall Records

The long-term annual rainfall records are shown in Figure A.9. According to this figures, the trend of annual rainfall in recent 40 years seems being smaller than early 1900's. In this study, the hydrological data for the period from 1970 to 2009 (40 years) was adopted for the low-flow analysis and the Tank model simulation by the taking into account the following conditions;

(i) The number of missing records of rainfall data at representative gauging stations in the Upper Baluchaung River basin is small for the period from 1970 to 2009.

(ii) A series of long-term annual rainfall records on 10-year moving average shows that the annual rainfall fluctuates around the long-term average and includes both wet and dry years.

(4) Interpolation of Missing Rainfall Data

The correlation of monthly rainfall records between stations are shown in Figure A.6. For the low-flow analysis periods from 1970 to 2009, the daily rainfall data of missing period at Pinlaung, Kalaw and Yaunghtwe were supplemented by means of the above correlation analysis of monthly rainfall records between stations. For estimating the missing data, the linear regression equation is as given in the following equation.

$$R_{target} = a * R_{base}$$

where : R_{target} : estimated rainfall data at target station

R_{base} : observed rainfall data at base station

a : correlation coefficient of regression equation

The correlation coefficients for the interpolation of missing rainfall data of each station are shown in table below.

Table A.7 Equation for Interpolation of Missing Rainfall Data

Target Rainfall Station	No.	Coefficient a	Base Rainfall Station
Pinlaung	(1)	1.2458	x (Taungyyi)
	(2)	1.6426	x (Kalaw)
Kalaw	(1)	0.6362	x (Taungyyi)
	(2)	0.4422	x (Pinlaung)
Yaunghtwe	(1)	0.5795	x (Taungyyi)
	(2)	0.4031	x (Pinlaung)

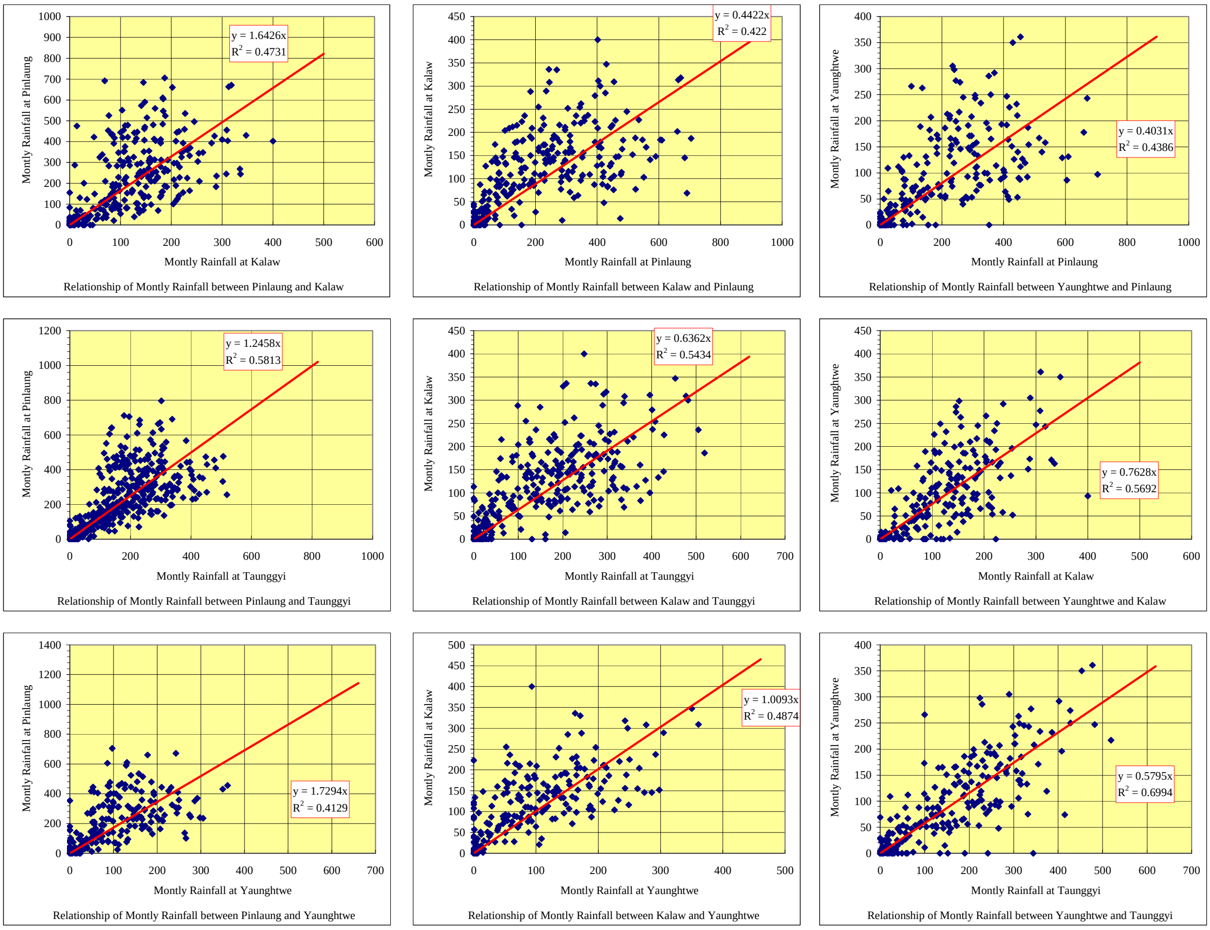


Figure A.6 Correlation of Monthly Rainfalls in/around Project Site

(5) Basin Mean Rainfall

The *Thiessen*'s coefficient is used for estimate of the mean rainfall at the Project area. The annual mean rainfall is estimated at 1,575mm at the UB-1 site as shown in Table A.8 and Figure A.7.

Table A.8 Estimated Annual Basin Mean Rainfall at UB-1

Year	Annual Rainfall (mm)	Max.Daily Rainfall	Year	Annual Rainfall	Max.Daily Rainfall (mm/day)
1970	1,777	53	1990	1,619	44
1971	1,850	57	1991	1,863	58
1972	1,562	55	1992	1,798	88
1973	1,605	48	1993	1,554	46
1974	1,515	40	1994	1,358	92
1975	1,594	61	1995	1,490	64
1976	1,562	42	1996	1,510	58
1977	1,436	44	1997	1,165	90
1978	1,315	43	1998	1,062	32
1979	1,193	46	1999	1,831	56
1980	1,489	72	2000	1,476	56
1981	1,517	45	2001	1,644	50
1982	1,614	66	2002	1,828	193
1983	1,657	42	2003	1,383	41
1984	1,714	44	2004	1,897	131
1985	1,817	50	2005	1,862	46
1986	1,319	65	2006	1,817	57
1987	1,510	56	2007	1,746	66
1988	1,395	54	2008	1,837	70
1989	1,350	54	2009	1,478	46
			Max.	1,897	193
			Average	1,575	

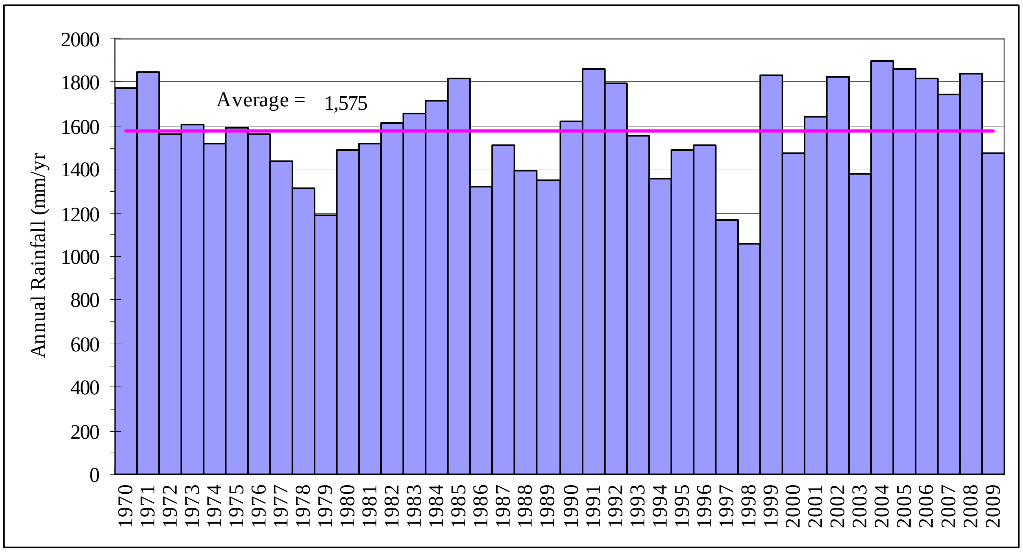


Figure A.7 Estimated Annual Basin Mean Rainfall at UB-1

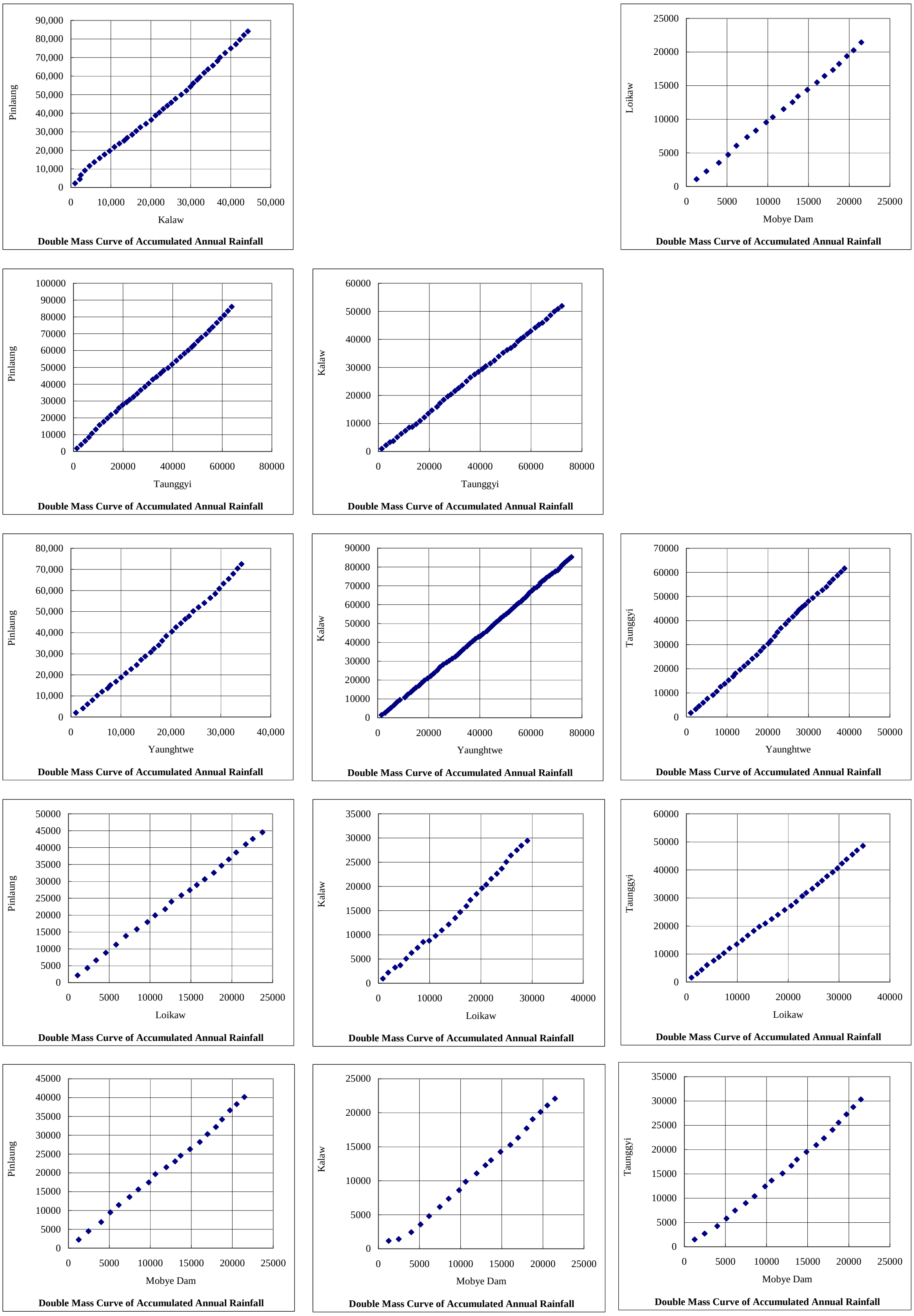
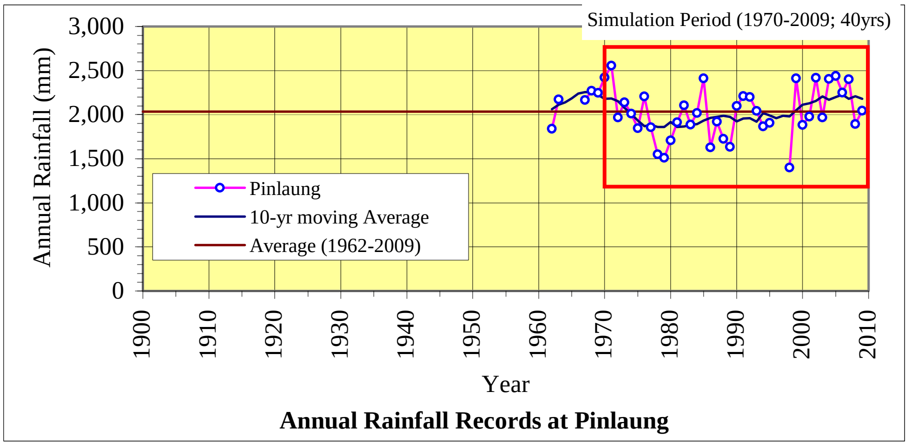
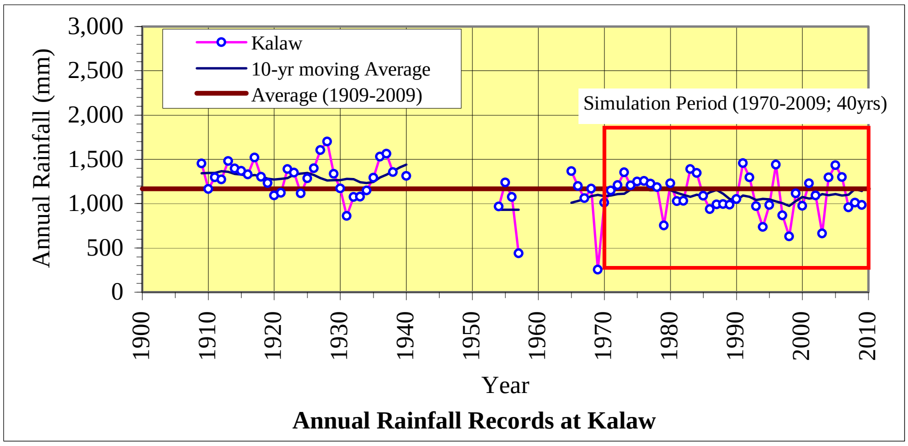
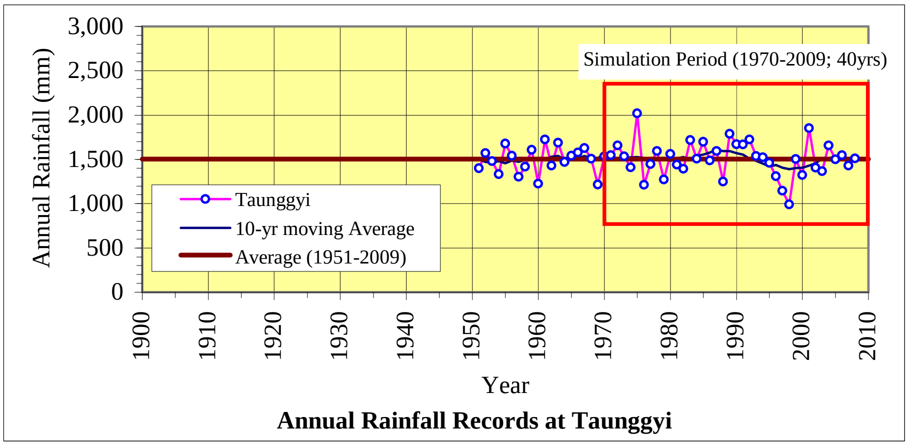


Figure A.8 Double Mass Curve of Annual Rainfall among all Stations







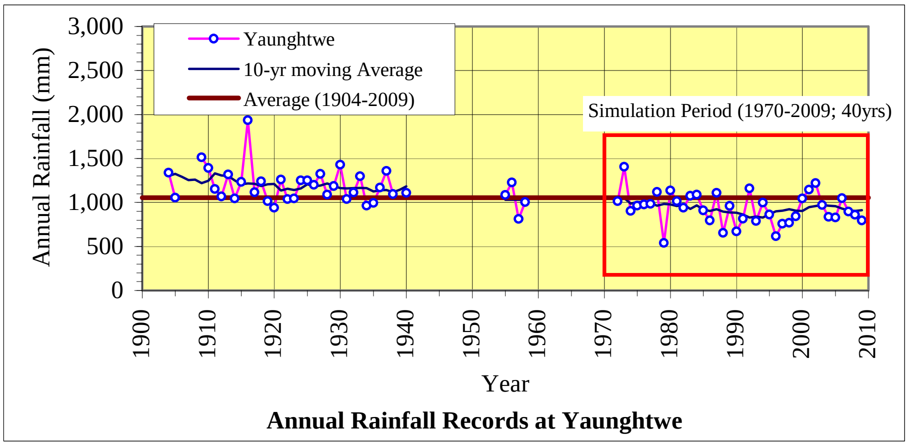


Figure A.9 Long-Term Annual Rainfall Records in/around Project Site

A.7 Runoff Data

(1) Water Level Records

The water level and the discharge measurement have been undertaken to date at the following gauging stations, of which locations are shown in Figure A.1.

1) WL Gauging Station near the UB-1 Intake (MEPE)

A water level gauge was installed near the UB-1 intake site (C.A.=802 km^2) by MEPE in August 2000. The daily water level was measured by the village people three times a day from 26 August 2000 to 31 May 2002. The observed water level gauge height record is shown Figure A.10 and the data attached in the ***Appendix-A***.

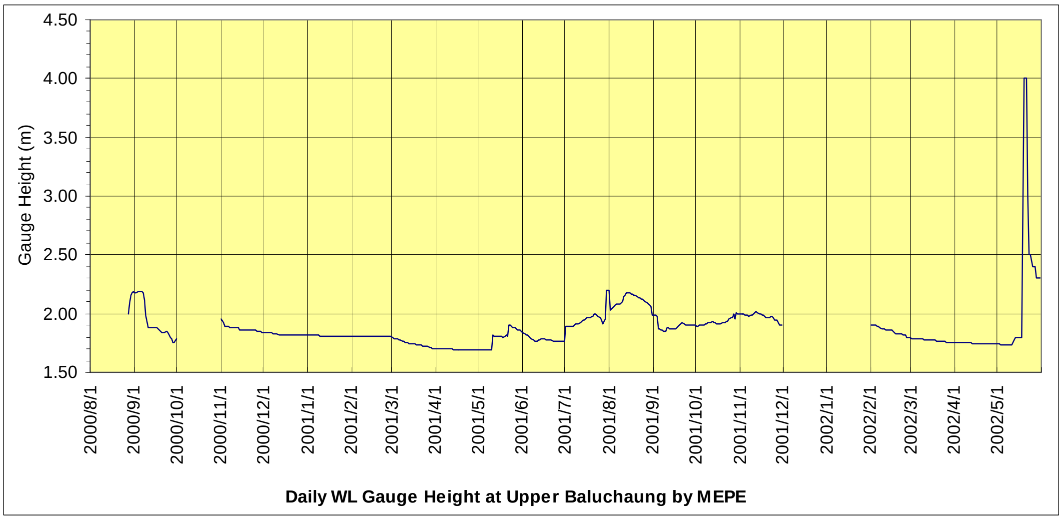


Figure A.10 Observed Water Level Record at Upper Baluchaung G.S.

2) WL Gauging Station at Indein Village (Dr. Furuichi/ Forest Department)

A water level gauge with an automatic pressure sensor was installed at the Indein irrigation weir by Dr. Furuichi in cooperation with the Forest Department in October 2004. The station was equipped with an automatic pressure sensor, a turbidity sensor and a rain gauge. The hourly water level was observed from 16 October 2004 to 2nd June 2006.

WL Gauging Station at Indein (Dr. Furuichi)

3) WL Gauging Station at Indein Village (NEO)

A water level gauge was installed upstream the existing irrigation intake of Indein (C.A.=836 km^2) by NEO. The daily water level is being measured three times a day since 05 January 2010.

Installation of Staff Gauge at Indein by MGC

WL Gauging Station at Indein (NEO)

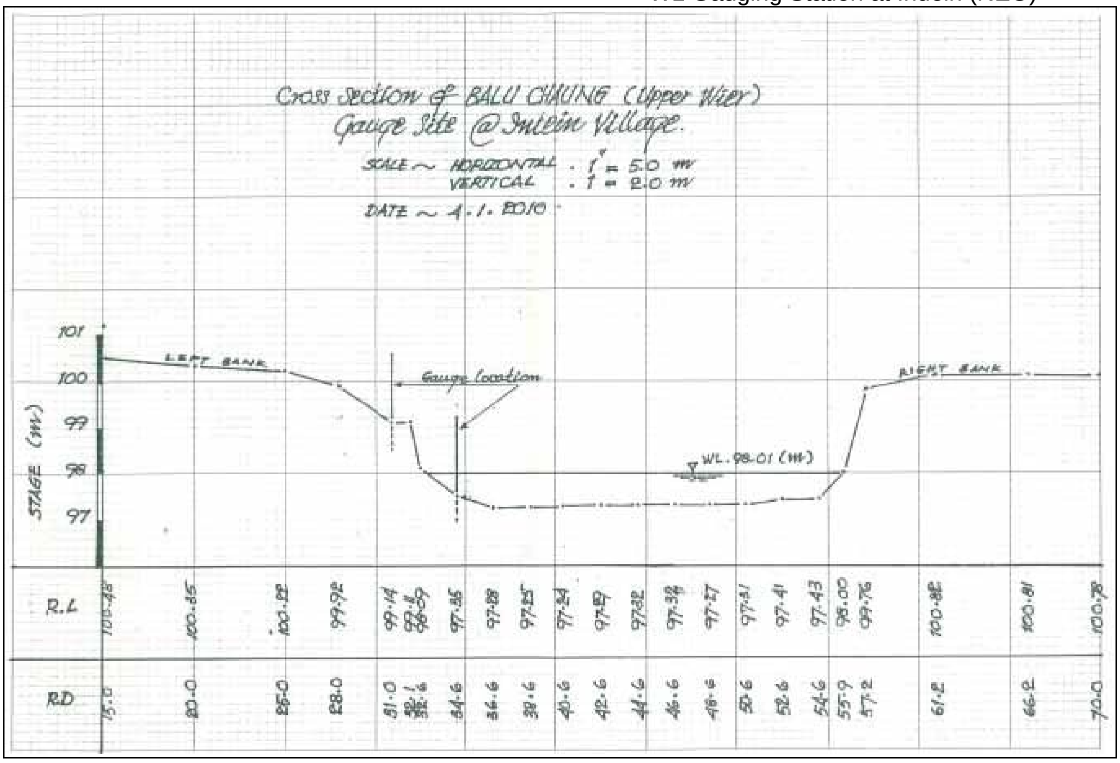


Figure A.11 Cross Section of Indein New Water Level G.S.

(2) Discharge Measurement

1) WL Gauging Station near the UB-1 Intake (MEPE)

The discharge was measured near the UB-1 Intake site by MEPE as shown below:

Table A.9 Discharge Measured near the UB-1 Intake Site (MEPE)

No.	Date	Gauge Height (m)	Measured Discharge (m^3/s)	No.	Date	Gauge Height (m)	Measred Discharge (m^3/s)
1	27-Aug-2000	2.00	14.9	10	30-Jun-2001	1.76	10.6
2	29-Aug-2000	1.75	10.3	11	30-Jul-2001	2.20	23.5
3	29-Nov-2000	1.84	13.7	12	30-Aug-2001	2.06	15.1
4	30-Dec-2000	1.82	11.0	13	30-Sep-2001	1.90	11.5
5	30-Jan-2001	1.81	9.52	14	29-Oct-2001	*2.01*	19.1
6	28-Feb-2001	1.81	9.24	15	28-Nov-2001	1.90	8.49
7	31-Mar-2001	1.70	3.35	16	28-Feb-2002	1.80	9.00
8	30-Apr-2001	1.69	7.84	17	31-Mar-2002	1.75	8.24
9	31-May-2001	1.85	14.2	18	30-Apr-2002	1.74	6.86

Source: MEPE (rounded data)

2) WL Gauging Station at Indein Village (Dr. Furuichi/ Forest Department)

The discharge was measured at the Indein W.L. gauge station by Dr. Furuichi / Forest Department as shown below:

Table A.10 Discharge Measured at Indein (Dr. Furuichi)

Date	Time	Stage (m)	Discharge (m^3/sec)
10.08.2005	14:30-16:00	1.230	26.7
19.05.2006	13:00-14:00	0.593	6.05
21.05.2006	15:00-16:00	0.587	6.05
03.06.2006	15:00-15:30	0.655	6.49

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

3) WL Gauging Station at Indein Village (NEO)

The discharge is being measured at the new water level gauge station in Indein by NEO starting from January 2010 as shown below:

Table A.11 Discharge Measured at Indein (NEO)

Date	Time	W.L. Gauge Height (cm)	Measured Discharge (m^3/s)
2010/1/5	15:30-15:50	84	5.91
2010/1/6	11:00-11:30	84	5.92
2010/2/21	15:30-16:00	80	5.20
2010/3/16	13:30-14:05	85	6.39

(3) Discharge Rating Curve

1) WL Gauging Station near the UB-1 Intake (MEPE)

The equation showing the relation between discharge and gauge height at the water level gauging station site (MEPE) is given below:

$$Q = 18.905 \times (H - 1.0914)^2$$

Where, Q : discharge (m^3/s) H : gauge height (m)

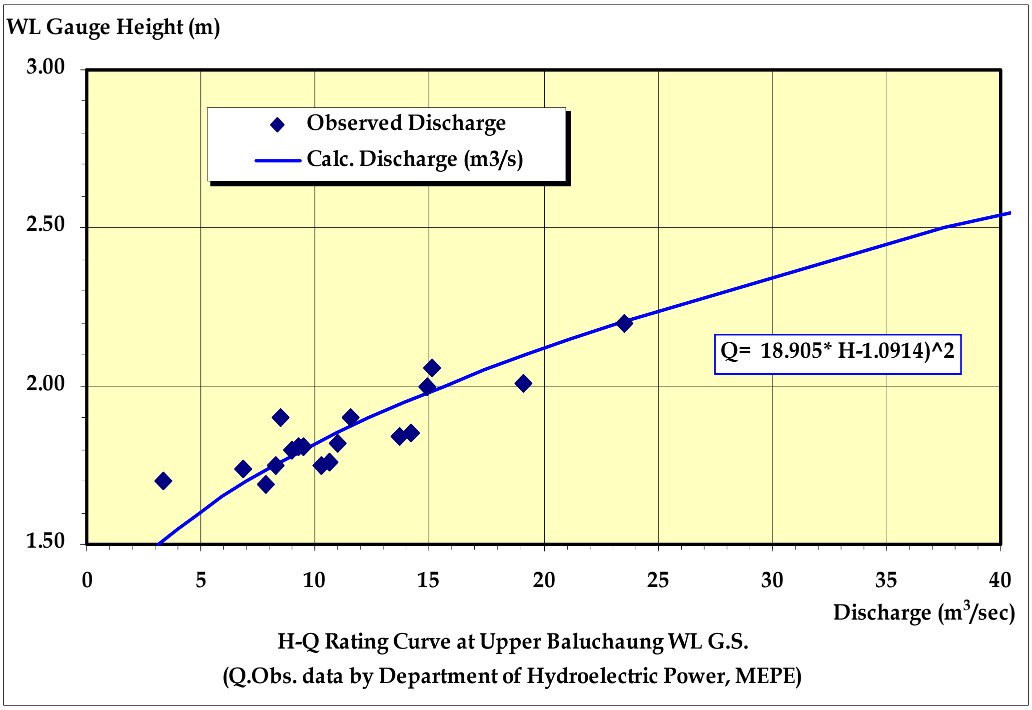


Figure A.12 Rating Curve near UB-1 Intake Site (MEPE)

2) WL Gauging Station at Indein Village (Dr. Furuichi/ Forest Department)

The equation showing the relation between discharge and gauge height at the water level gauging station site is given by Dr. Furuichi as below:

$$Q = 17.156 \times H^{2.0572}$$

Where, Q : discharge (m^3/s) H : gauge height (m)

According to Dr. *Furuichi* report, the minimum and maximum discharges directly measured were 6.05 m^3/s and 26.65 m^3/s, respectively. The reliable range for extrapolation is 2.42 m^3/s to 53.30 m^3/s. Discharge lower than 2.42 m^3/s did not occur throughout the period; however, discharge higher than 53.30 m^3/s is seen during the middle of August to early October 2005.

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

3) WL Gauging Station at Indein Village (NEO)

The equation showing the relation between discharge and gauge height at the water level gauging station site (NEO) is given below:

$$Q = 0.002 \times (H\text{-}29.126)^2$$

Where, Q : discharge (m^3/s) H : gauge height (m)

It is noted that the available data are limited to establish the rating curve, accordingly the above H-Q equation at the Indein new gauging station (NEO) needs to be updated by incorporating further data.

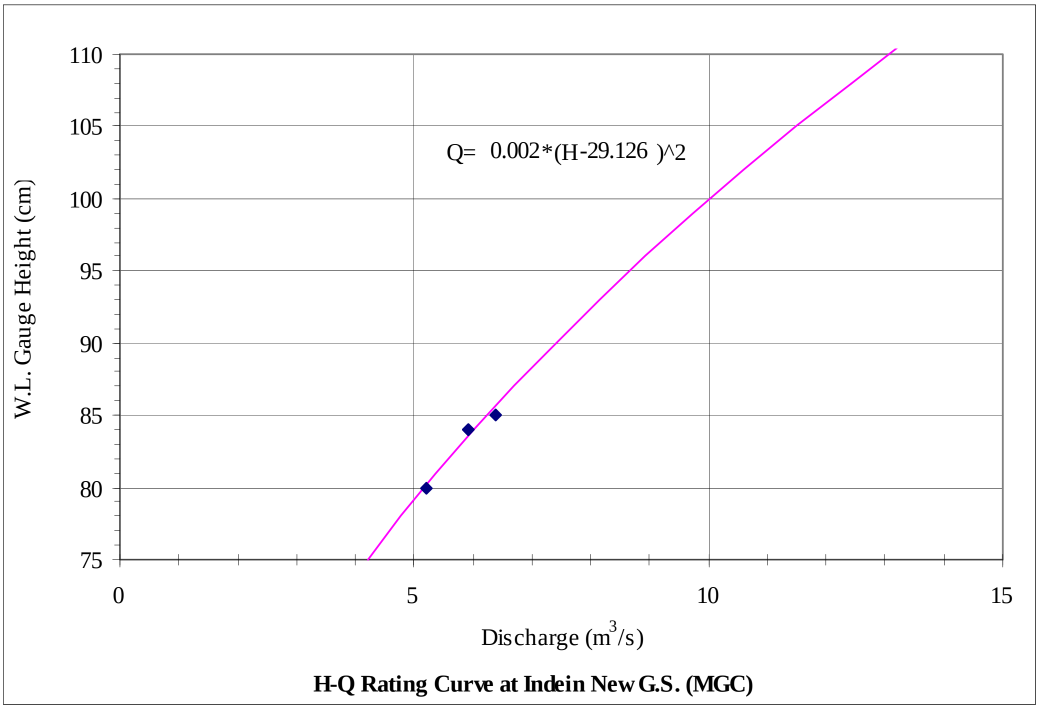


Figure A.13 Stage-Discharge Rating Curve at Indein New W.L. Gauge Station

(4) Daily Discharge

1) WL Gauging Station near the UB-1 Intake (MEPE)

Discharges can be obtained from water levels and the discharge rating curve. The daily discharges at the UB-1 Intake site (MEPE) was calculated as shown Figure A.14 and the whole data are attached in the ***Appendix-A***.

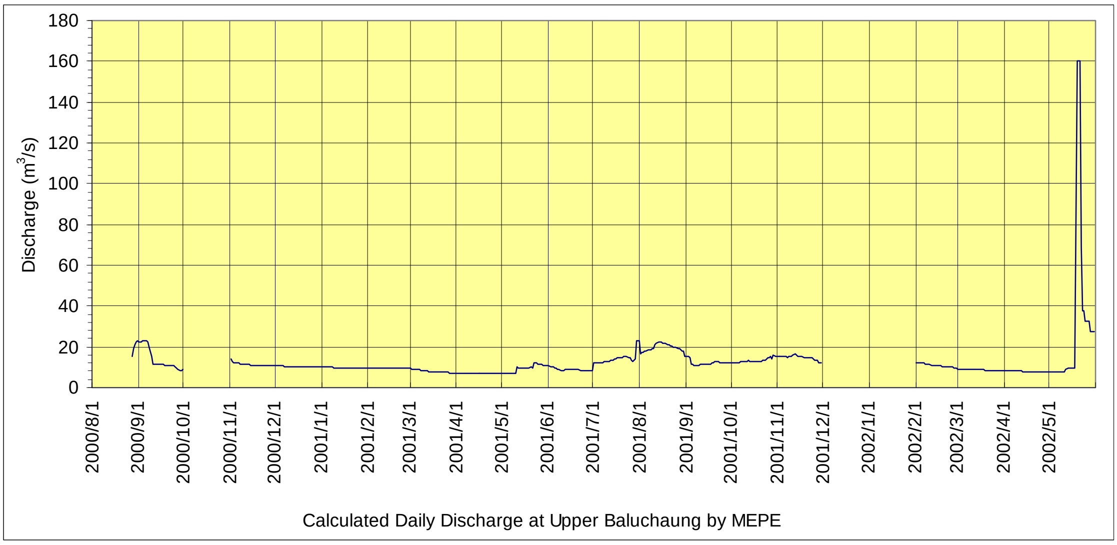


Figure A.14 Daily Discharges near UB-1 Intake Site (MEPE)

The average monthly mean discharge is summarized in the table below:

Table A.12 Observed Monthly Discharges at Upper Baluchaung W.L. G.S.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
2000								20.17	13.89		11.51	10.18	
2001	9.83	9.76	8.01	6.86	9.40	8.91	14.18	19.54	12.22	13.33	14.82		11.53
2002	9.83	9.76	8.01	6.86	9.40	8.91	14.18	19.54	12.22	13.33	14.82		

2) WL Gauging Station at Indein Village (Dr. Furuichi/ Forest Department)

The hourly discharge at Indein gauge station by Dr. Furuichi is shown in Figure A.15.

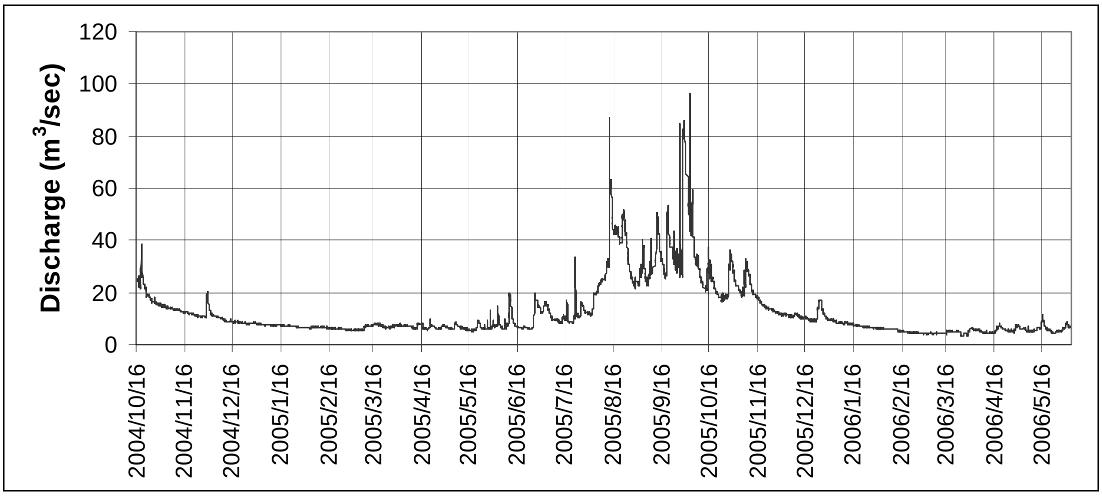


Figure A.15 Observed Hourly Discharge at Indein W.L. G.S.

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

Also, calculated daily discharge at Indein gauge station is shown in Figure A.16.

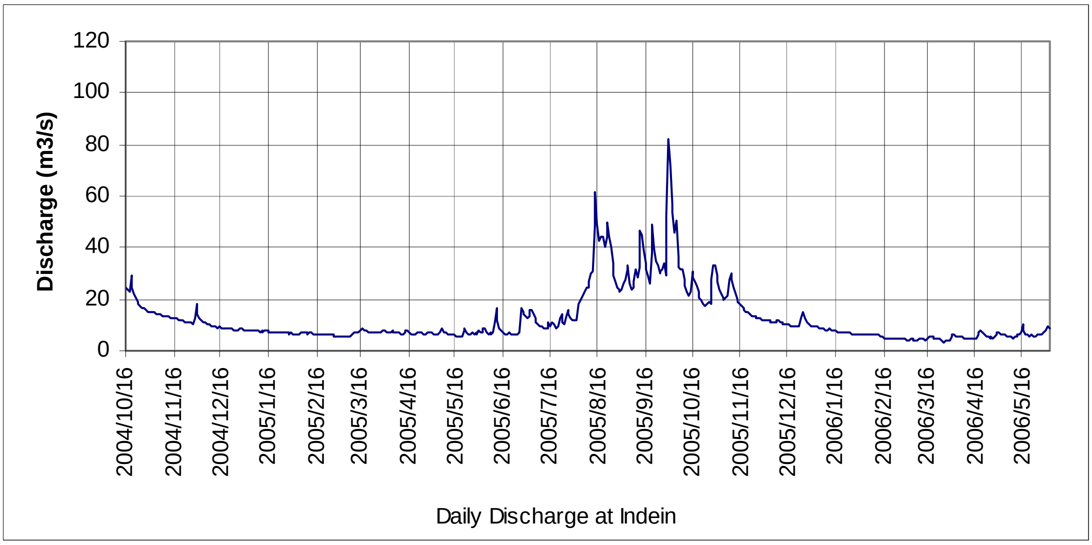


Figure A.16 Observed Daily Mean Discharge at Indein W.L. G.S.

The monthly runoff at Indein from November 2004 to May 2006 is shown in Table below:

Table A.13 Monthly Discharge Measured at Indein (Dr. Furuichi)

Month	Mean Discharge (m^3/s)	Monthly Runoff ($10^6 m^3$/mon)	Annual Runoff ($10^6 m^3$/yr)	Monthly Runoff (mm)	Monthly contribution for the annual discharge in 2005(%)
2004.11	12.9	33.5		40.1	
2004.12	9.4	25.3		30.3	
2005.01	7.4	19.7		23.6	4.1%
2005.02	6.5	15.7		18.8	3.3%
2005.03	6.9	18.4		22.0	3.8%
2005.04	7.0	18.2		21.8	3.8%
2005.05	6.7	18.0		21.5	3.8%
2005.06	8.8	22.7		27.2	4.7%
2005.07	11.5	30.9		37.0	6.4%
2005.08	32.3	86.5		103.5	18.0%
2005.09	35.2	91.2		109.1	19.0%
2005.1	30.2	81.0		96.9	16.9%
2005.11	18.4	47.8		57.2	10.0%
2005.12	11.0	29.5		35.3	6.2%
Annual 2005	15.2		479.6	573.7	
2006.01	7.7	20.7		24.8	
2006.02	5.4	13.0		15.6	
2006.03	4.5	12.1		14.5	
2006.04	5.6	14.6		17.5	
2006.05	6.0	16.2		19.4	

C.A.at Indein [km^2]= 836

Runoff Coefficient in 2005 = 0.32

Specific Discharge of 2005 = 1.81 m^3/sec/100 km^2

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

A.8 Low-Flow Analysis

(1) General Approach

In the Pre-FS Report, the available monthly discharges of the Project area was converted from those measured at the Mobye Dam, on the assumption that the river discharge could be estimated based on the proportion of the catchment to the whole area at the Mobye Dam, taking into account the weight of typical rainfall at the respective area.

However as pointed out in the Inception Report, the discharge converted from the water level at the Mobye Dam includes some errors (over-estimate) because the gauge reading along the arc length of the radial gate had been used for the conversion. In addition, monthly discharge will result in over-estimate for the power simulation of a run-of-river scheme planning, as peak discharge exceeding the maximum plant discharge can't be utilized for power generation, but such consideration is not available when the monthly discharge is applied.

On the other hand, the daily runoff data at the UB-1 Intake site for 1.5 years from August 2000 to May 2002, and the hourly runoff data at Indein for 1.5 years from October 2004 to May 2006 were obtained. These discharge data are insufficient for the hydropower planning as raw data, but are useful to estimate the daily discharge simulated from the daily rainfall through the low-flow analysis by means of the Tank Model Method (*Sugawara*, 1956). The daily rainfall data for 40 years from 1970 to 2009 are available at Pinlaung, Kalaw, Nyaunshwe and Taunggyi.

(2) Concept of the Tank Model

The basic concept of the Tank model (*Sugawara*, 1956) is a simple tank with holes to let out water. The outflow from each hole is proportionate to the height between the hole and water surface. Provided that a tank is accommodated with one bottom-hole and two side holes, the rule for outflow computation is as follows;

$$y_n = 0 \qquad (X_n \leqq h_1)$$

$$y_n = \alpha_1(X_n - h_1) \qquad (h_1 < X_n \leqq h_2)$$

$$y_n = \alpha_2(X_n - h_2) + \alpha_1(X_n - h_1) \qquad (h_2 < X_n),$$

$$z_n = \beta X_n,$$

$$X_{n'} = X_n - y_n - z_n,$$

$$Z_n+1 = X_{n'} + x_n + 1 \qquad \text{-----------------} \; (1)$$

where, X_n : water depth of stage n,

y_n : outflow from side holes of stage n,

z_n : outflow from bottom hole of stage n,

x_n : inflow of stage n,

α_1, α_2 : coefficient of side holes, and

β : coefficient of bottom hole.

Normally, a tank model combining several tanks in a series makes a better simulation result. In Japan, the tank model consisting of four tanks in a series successfully analyzes a number of river basins. In such models, each tank interacts in the manner described in the above equation (1). The top tank receives the rainfall as inflow to the tank, while the tanks below get the supply from the bottom holes of the tank directory above. The last or the bottom tank only has a side hole. The aggregated outflow from all the side holes of the tanks constitutes the inflow into the river course. Trial-and-error is needed to determine the tank parameters that minimize the difference between the observed and estimated runoff.

(3) Calibration Results

The tank model parameters for the UB-1 Intake site are shown in the Figure A.17, which were calibrated from the discharge measured at the UB-1 Intake site and Indein on a daily time-step base. It is noted that the daily discharge measured at Indein was used as a reference after adjustment of catchment ratio between the UB-1 and Indein.

$$Q_{UB\text{-}1} = Q_{Indein} * 802\ km^2 / 836\ km^2$$
$$= Q_{Indein} * 0.9593$$

The comparison between the measured and simulated discharges is shown in Figure 3.4.9. It should be noted that the water levels at the UB-1 Intake site were measured three times a day, but peak discharges during floods were not obtained, and thus could not be traced by the simulation (refer to upper part of Figure A.18). On the other hand, the water levels at Indein were measured hourly, and accordingly the simulation followed the peak discharge (refer to lower part of Figure A.18).

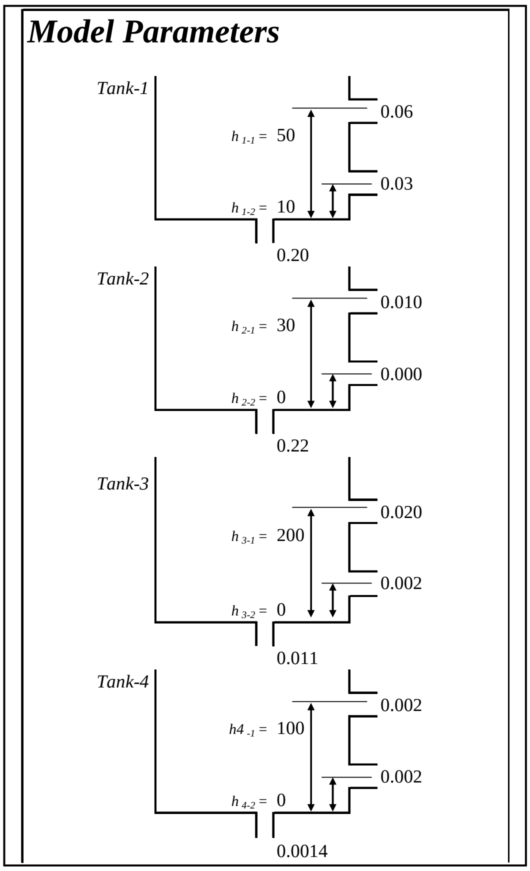


Figure A.17 Calibrated Tank Model Parameters for UB-1 Intake Site

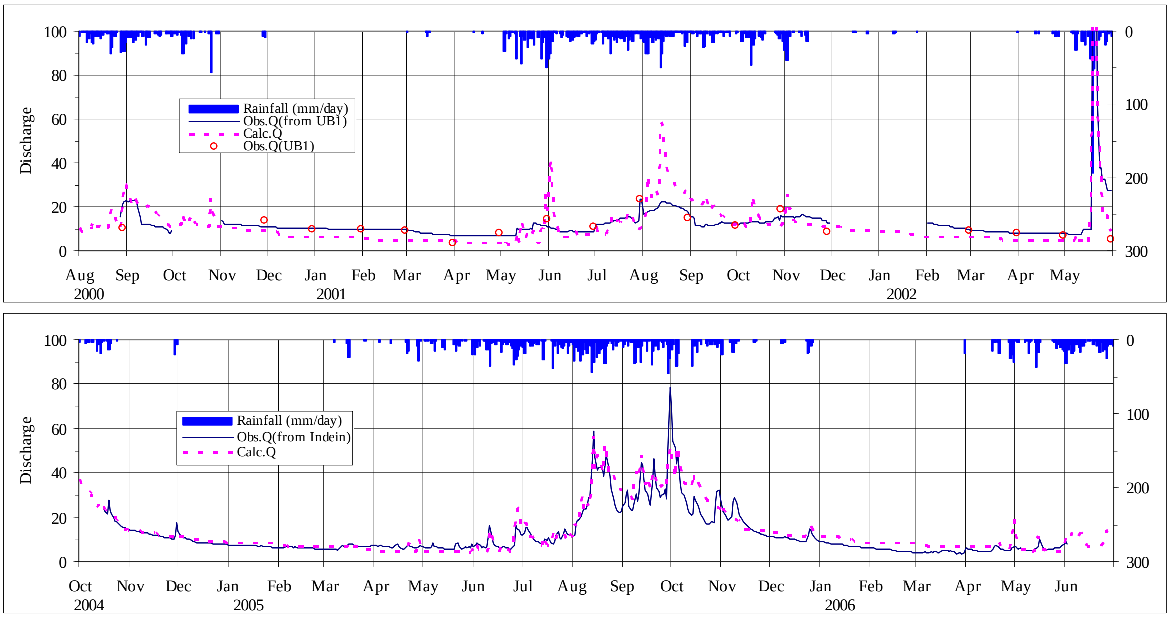


Figure A.18 Comparison of Measured and Simulated Discharges at UB-1

As seen in Figure A.18, the simulation results show relatively good correspondence with the measured discharges, particularly for the hourly ones at Indein. It is therefore judged that the daily discharges simulated from the rainfall will be reliable for the hydropower planning of the Project.

The relationship between observed and computed daily discharge by Tank model are plotted in the Figure A.19. The correlation coefficient (R^2) with the reliable observation periods between August 2000 and May 2002 was 0.76, and between October 2004 and June 2005 was 0.88.

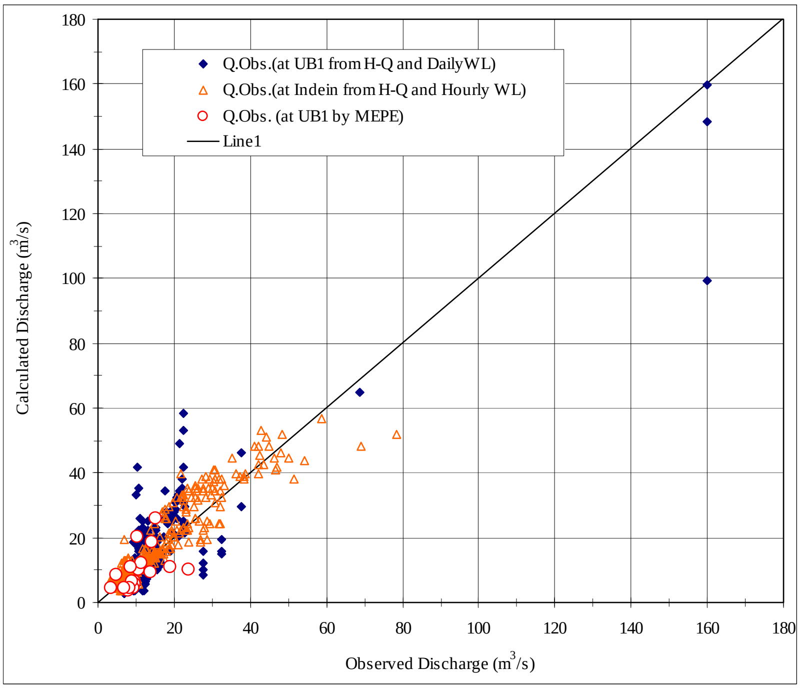


Figure A.19 Relationship between Measured and Simulated Discharges

(4) Estimate of Long-Term Runoff at UB-1 Intake Site

Using the simulation model for the UB-1 established as above, the daily mean discharge at the UB-1 Intake site are estimated for 40 years from 1970 to 2009. The daily discharge simulated at the proposed UB-1 intake site is shown in Figure A.22 and ***Appendix-A***. Simulated mean monthly discharge for 40 years (1970-2009) at the proposed UB-1 intake site is shown in Table A.14 and Figure A.20.

Table A.14 Simulated Monthly Discharge at UB-1 Intake Site by Tank Model

Month / Year	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual Mean
1970	6.62	6.17	4.64	4.58	6.62	7.43	27.75	37.04	37.37	19.34	12.07	10.12	15.05
1971	8.20	6.50	6.02	4.64	5.57	13.80	25.09	48.69	40.10	22.79	13.34	10.63	17.19
1972	8.59	7.36	6.50	5.04	5.12	6.19	11.65	21.62	19.06	16.52	11.78	9.91	10.80
1973	8.35	6.50	5.93	4.67	8.14	13.55	11.29	19.85	30.04	17.96	11.45	8.89	12.24
1974	7.28	6.50	5.24	4.67	4.52	7.39	8.08	17.54	27.48	14.61	10.86	8.44	10.22
1975	7.88	6.00	4.64	4.33	4.79	9.44	10.23	15.09	20.98	15.63	12.00	9.22	10.03
1976	7.43	6.50	5.15	4.64	5.48	8.14	13.44	21.41	21.38	17.30	10.58	8.86	10.88
1977	6.83	6.37	4.73	5.04	3.98	5.44	8.56	11.10	16.27	12.37	10.33	7.07	8.18
1978	6.35	4.71	4.58	3.68	3.38	7.76	8.62	14.25	18.72	12.01	8.64	6.50	8.28
1979	5.39	4.64	4.07	3.18	2.99	7.21	10.17	12.30	10.43	9.67	7.15	5.57	6.92
1980	4.64	4.09	3.20	2.78	4.64	7.06	7.21	9.70	18.94	17.28	11.26	8.89	8.31
1981	6.50	5.77	4.64	4.36	5.18	7.58	13.20	16.08	12.41	10.72	11.46	7.79	8.83
1982	6.50	5.14	4.64	3.96	3.98	9.22	9.91	24.22	35.37	22.45	11.97	9.01	12.22
1983	7.49	6.50	5.33	4.70	4.52	14.79	8.29	9.82	12.84	18.20	20.79	13.41	10.56
1984	10.78	8.83	7.01	7.80	5.60	17.26	21.95	30.93	27.66	23.30	13.21	10.09	15.39
1985	8.35	6.86	6.41	5.07	5.90	19.21	19.46	22.16	25.03	18.32	17.42	12.37	13.91
1986	9.91	8.35	6.74	6.41	4.64	8.14	8.69	8.98	12.16	11.08	8.42	6.77	8.35
1987	5.54	4.64	4.10	5.38	2.78	5.35	9.13	14.94	20.70	13.84	11.35	7.94	8.82
1988	6.50	5.19	4.64	4.05	5.84	9.68	9.25	13.65	10.18	8.84	9.04	6.71	7.81
1989	4.76	4.64	3.71	3.06	3.95	5.01	8.83	13.47	10.46	11.17	8.48	6.65	7.04
1990	4.85	4.67	3.80	3.43	11.88	9.92	21.98	19.49	15.71	11.61	10.02	8.05	10.51
1991	6.50	5.80	4.64	5.69	5.36	22.18	20.75	23.66	15.96	15.66	17.20	13.89	13.14
1992	9.97	8.19	6.50	5.85	5.84	10.18	21.89	48.72	35.67	23.87	14.88	11.83	17.00
1993	9.19	8.19	6.50	6.16	7.13	13.15	10.09	14.64	25.15	15.81	11.85	8.74	11.38
1994	7.31	6.50	5.09	4.64	4.07	12.96	10.03	19.70	18.72	11.28	8.01	6.50	9.58
1995	5.39	4.64	4.07	3.18	5.06	4.48	7.24	10.80	13.34	13.06	12.50	9.67	7.81
1996	6.71	7.62	5.66	5.57	4.49	7.42	9.88	12.96	11.57	10.45	8.36	6.56	8.11
1997	5.39	4.64	4.88	4.36	3.32	2.81	19.50	10.95	9.43	8.59	5.26	4.64	7.02
1998	3.86	2.98	2.78	2.14	2.82	2.39	6.41	6.41	9.09	6.17	4.30	3.11	4.38
1999	2.78	2.25	1.86	3.13	3.18	9.91	5.98	29.85	26.83	18.05	23.05	10.51	11.48
2000	8.59	6.66	6.80	4.86	5.48	9.59	10.18	12.87	18.14	13.17	9.99	7.13	9.46
2001	6.44	4.77	4.64	3.74	7.12	11.04	11.52	30.40	18.01	13.77	13.30	9.64	11.25
2002	7.84	6.50	5.63	4.64	24.19	8.57	19.94	30.90	35.73	16.80	13.40	11.62	15.55
2003	9.85	8.62	6.50	5.91	5.81	12.56	11.13	11.08	11.73	11.23	8.67	6.50	9.13
2004	5.39	4.64	4.04	5.04	13.74	16.43	19.80	35.33	37.96	24.16	12.72	9.94	15.80
2005	8.35	6.67	6.44	5.17	4.58	8.63	11.10	33.63	36.36	34.25	16.92	12.34	15.43
2006	10.12	8.35	6.80	7.21	5.93	9.87	21.44	28.06	27.13	34.34	15.72	11.23	15.58
2007	8.77	7.76	6.50	5.41	7.43	11.17	14.22	23.84	29.64	25.99	15.04	11.17	13.95
2008	9.13	7.62	6.50	7.12	5.36	11.60	10.41	15.60	21.44	21.94	33.75	12.31	13.54
2009	9.58	8.19	6.53	6.50	5.15	7.40	12.82	26.02	22.31	12.81	9.77	7.78	11.26
Mean	7.25	6.16	5.20	4.79	5.89	9.80	13.18	20.69	21.69	16.41	12.41	8.95	11.06

The annual mean discharge at the UB-1 Intake site (catchment area of 802 km^2) is estimated at 11.1 m^3/s (435 mm/annum = specific yield of 1.38 $m^3/sec/100\ km^2$), with the runoff coefficient of 0.27 (= MAR/MAP = 435/1,575 = 0.27) as shown in Table A.15.

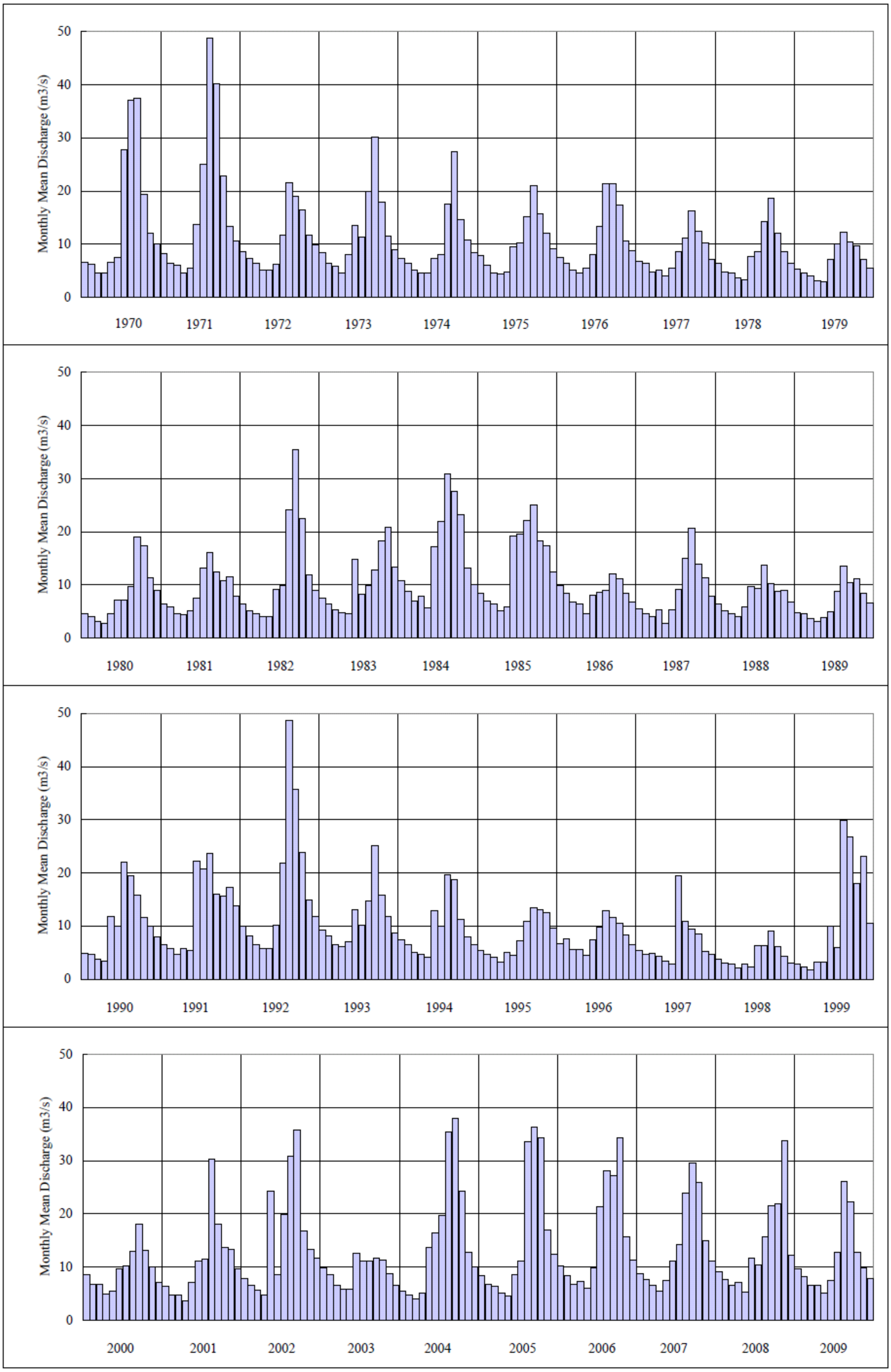


Figure A.20 Monthly Mean Discharge at UB-1 Simulated by Tank Model

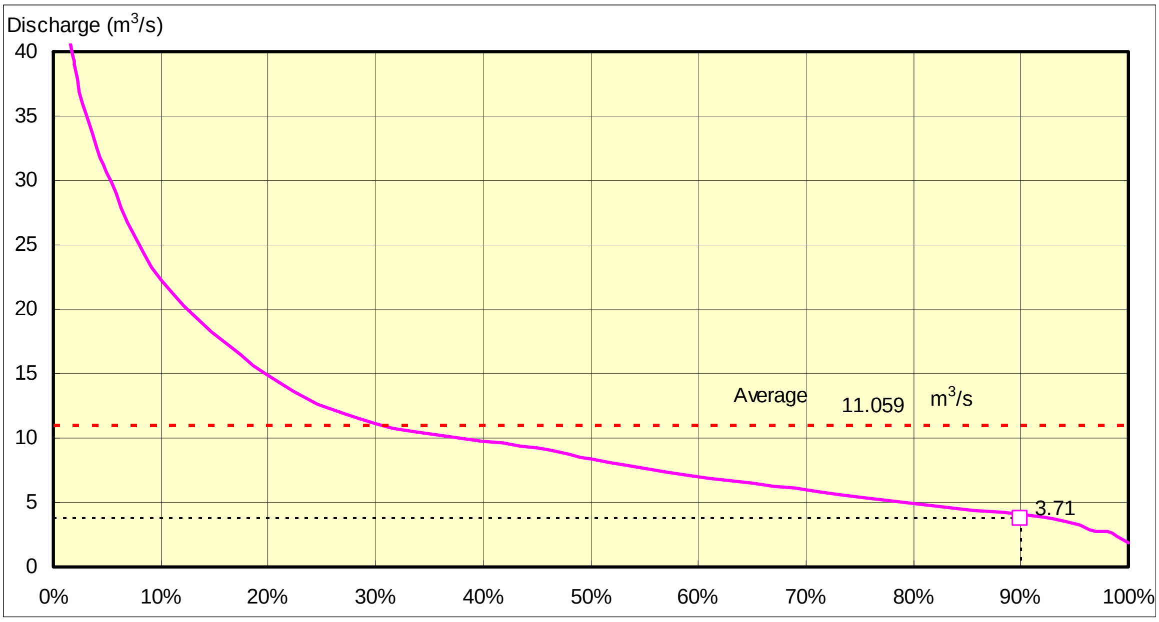
Table A.15 Discharge at UB-1 Simulated by Tank Model

Year	Q Max. (m^3/s)	Q Min (m^3/s)	Q Ave. (m^3/s)	Q.Ave. (mm)	Rainfall (mm)	Runoff Coefficient
1970	73.3	3.71	15.0	592	1,777	0.33
1971	75.2	3.71	17.2	676	1,850	0.37
1972	35.3	4.64	10.8	426	1,562	0.27
1973	57.6	4.64	12.2	481	1,605	0.30
1974	37.1	3.71	10.2	402	1,515	0.27
1975	30.6	2.78	10.0	395	1,594	0.25
1976	43.6	3.71	10.9	429	1,562	0.27
1977	33.4	2.78	8.2	322	1,436	0.22
1978	42.7	2.78	8.3	326	1,315	0.25
1979	35.3	2.78	6.9	272	1,193	0.23
1980	26.9	1.86	8.3	328	1,489	0.22
1981	27.8	3.71	8.8	347	1,517	0.23
1982	62.2	2.78	12.2	481	1,614	0.30
1983	46.4	3.71	10.6	415	1,657	0.25
1984	57.6	4.64	15.4	607	1,714	0.35
1985	51.1	4.64	13.9	547	1,817	0.30
1986	32.5	4.64	8.4	328	1,319	0.25
1987	49.2	2.78	8.8	347	1,510	0.23
1988	38.1	2.78	7.8	308	1,395	0.22
1989	72.4	2.78	7.0	277	1,350	0.21
1990	43.6	2.78	10.5	413	1,619	0.26
1991	50.1	3.71	13.1	517	1,863	0.28
1992	107.7	4.64	17.0	670	1,798	0.37
1993	40.8	4.64	11.4	447	1,554	0.29
1994	49.2	3.71	9.6	377	1,358	0.28
1995	37.1	2.78	7.8	307	1,490	0.21
1996	38.1	3.71	8.1	320	1,510	0.21
1997	118.8	1.86	7.0	276	1,165	0.24
1998	25.1	1.86	4.4	172	1,062	0.16
1999	74.3	1.86	11.5	451	1,831	0.25
2000	30.6	3.71	9.5	373	1,476	0.25
2001	58.5	2.78	11.2	442	1,644	0.27
2002	159.7	3.71	15.6	612	1,828	0.33
2003	40.9	4.64	9.1	359	1,383	0.26
2004	79.8	2.78	15.8	623	1,897	0.33
2005	56.6	3.71	15.4	607	1,862	0.33
2006	75.2	4.64	15.6	613	1,817	0.34
2007	44.6	4.64	13.9	548	1,746	0.31
2008	87.3	4.64	13.5	534	1,837	0.29
2009	50.1	4.64	11.3	443	1,478	0.30
Max.	**159.7**	**4.64**	**17.2**	**676**	**1,897**	**0.37**
Min.	**25.1**	**1.86**	**4.4**	**172**	**1,062**	**0.16**
Ave.	**54.9**	**3.53**	**11.1**	**435**	**1,575**	**0.27**

Runoff coefficient in this basin seems relatively small, but runoff coefficient by observed discharge at Indein gauging station in 2005 is also small at 0.318 as shown in Table A.13.

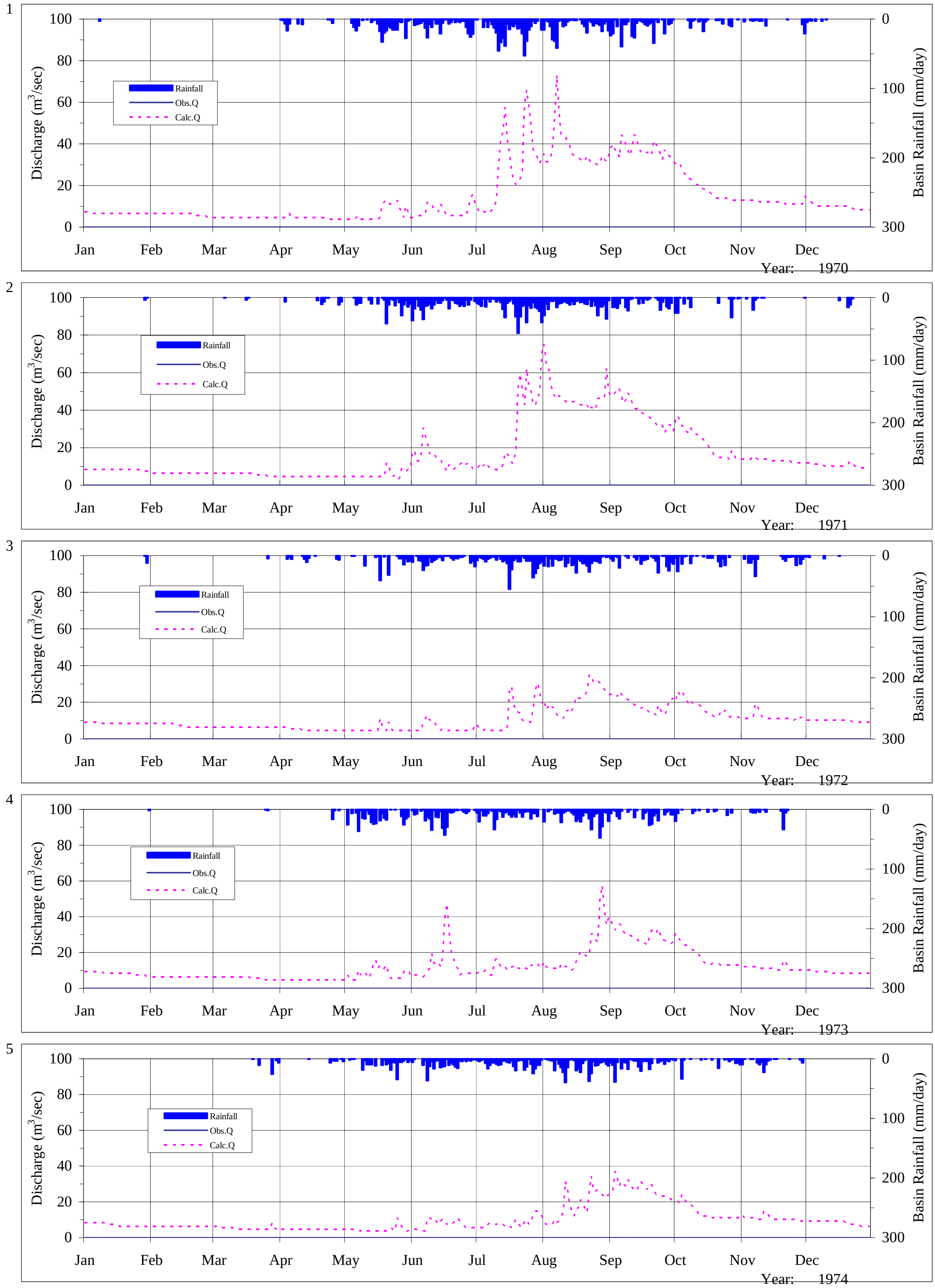
(5) Flow Duration Curve at UB-1 Intake Site

The flow duration curve of the simulated runoff at the UB-1 intake site is shown in Figure A.21. Several levels of excess probability of simulated runoff are summarized below.



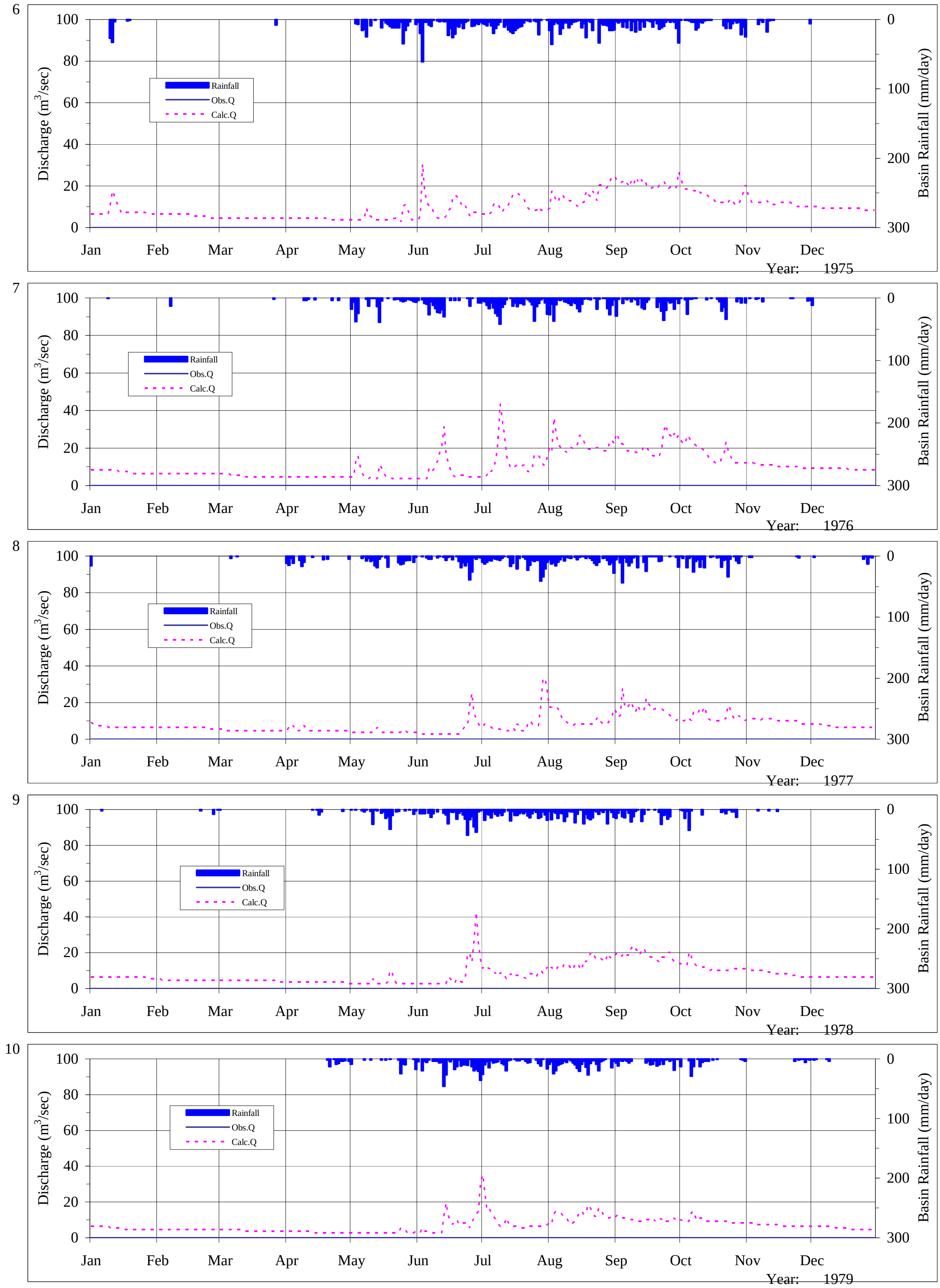
Location		Excess Probability	Discharge
Maximum	(m^3/s)	0%	160
Discharge 95-day	(m^3/s)	25%	13.0
Discharge 185-day	(m^3/s)	50%	8.35
Discharge 275-day	(m^3/s)	75%	4.65
Discharge 328-day	(m^3/s)	90%	3.71
Discharge 355-day	(m^3/s)	97%	2.78
Minimum	(m^3/s)	100%	1.86
Average	(m^3/s)		11.1

Figure A.21 Flow Duration Curve at UB-1 Intake Site by Tank Model



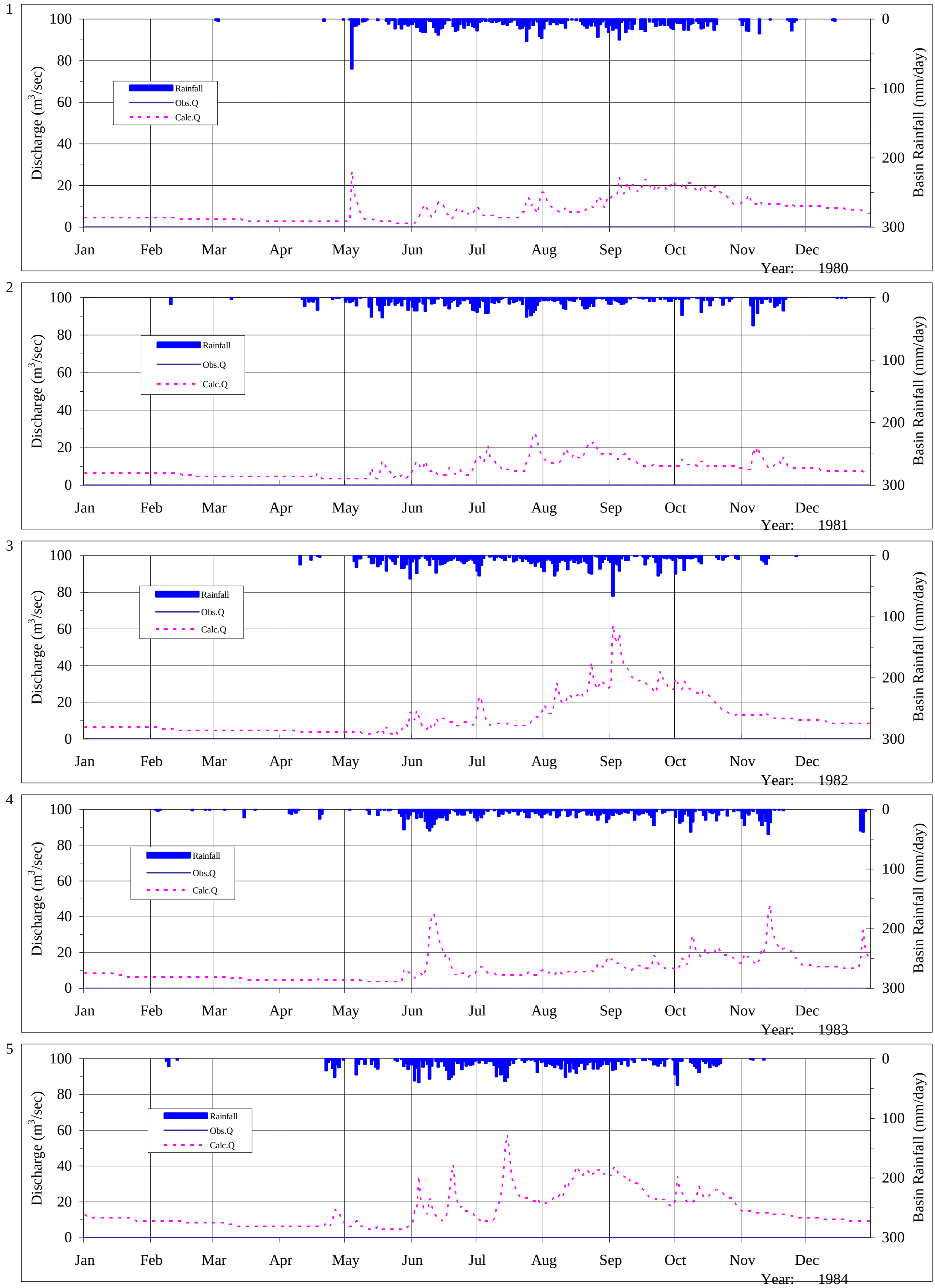
Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (1/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (1/8) [1970-1974]



Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (2/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (2/8) [1975-1979]



Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (3/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (3/8) [1980-1984]

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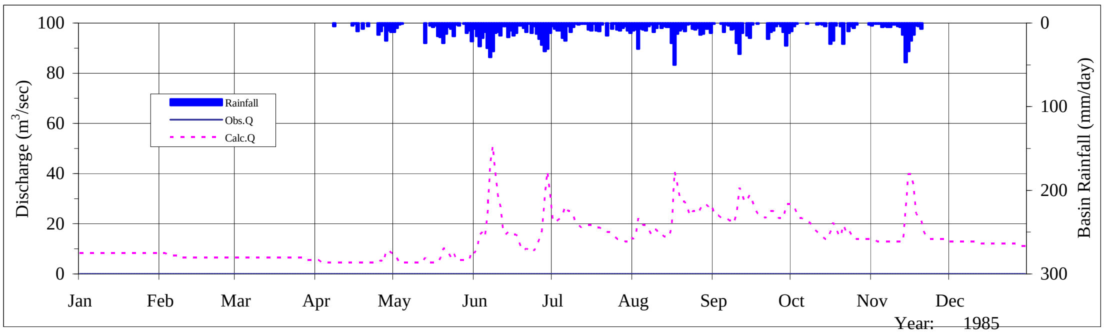

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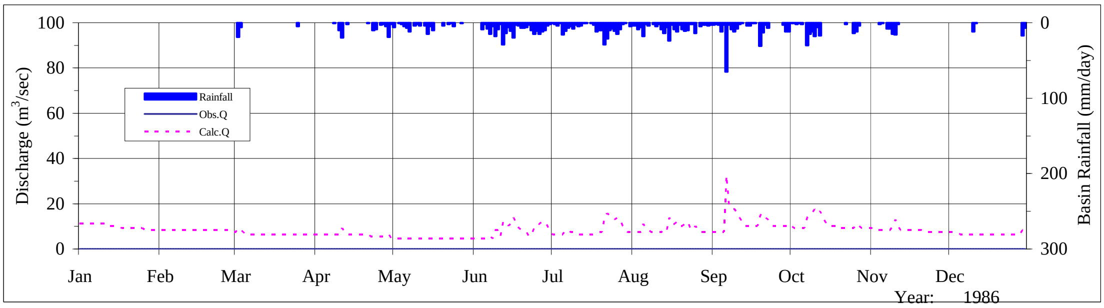

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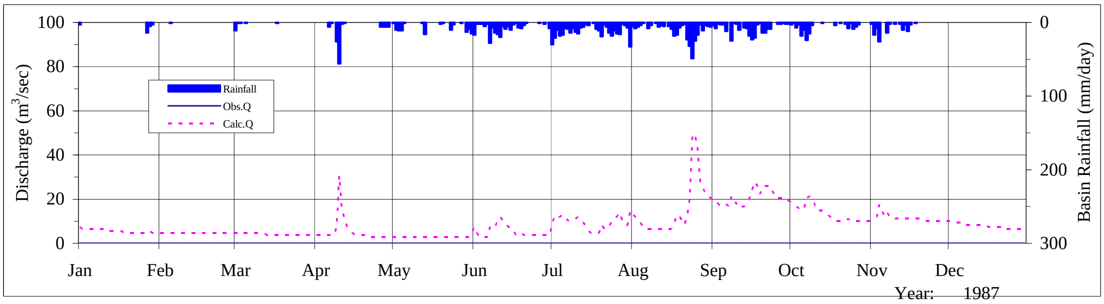

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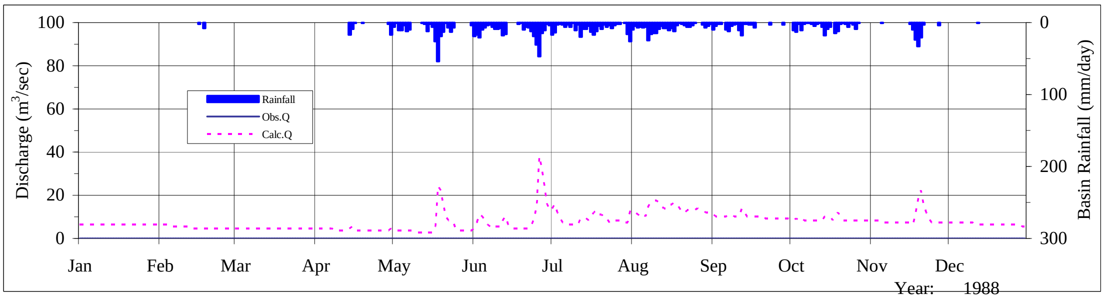

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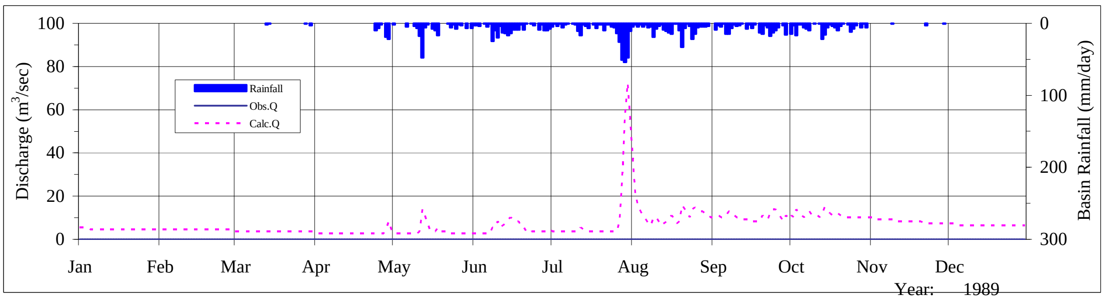
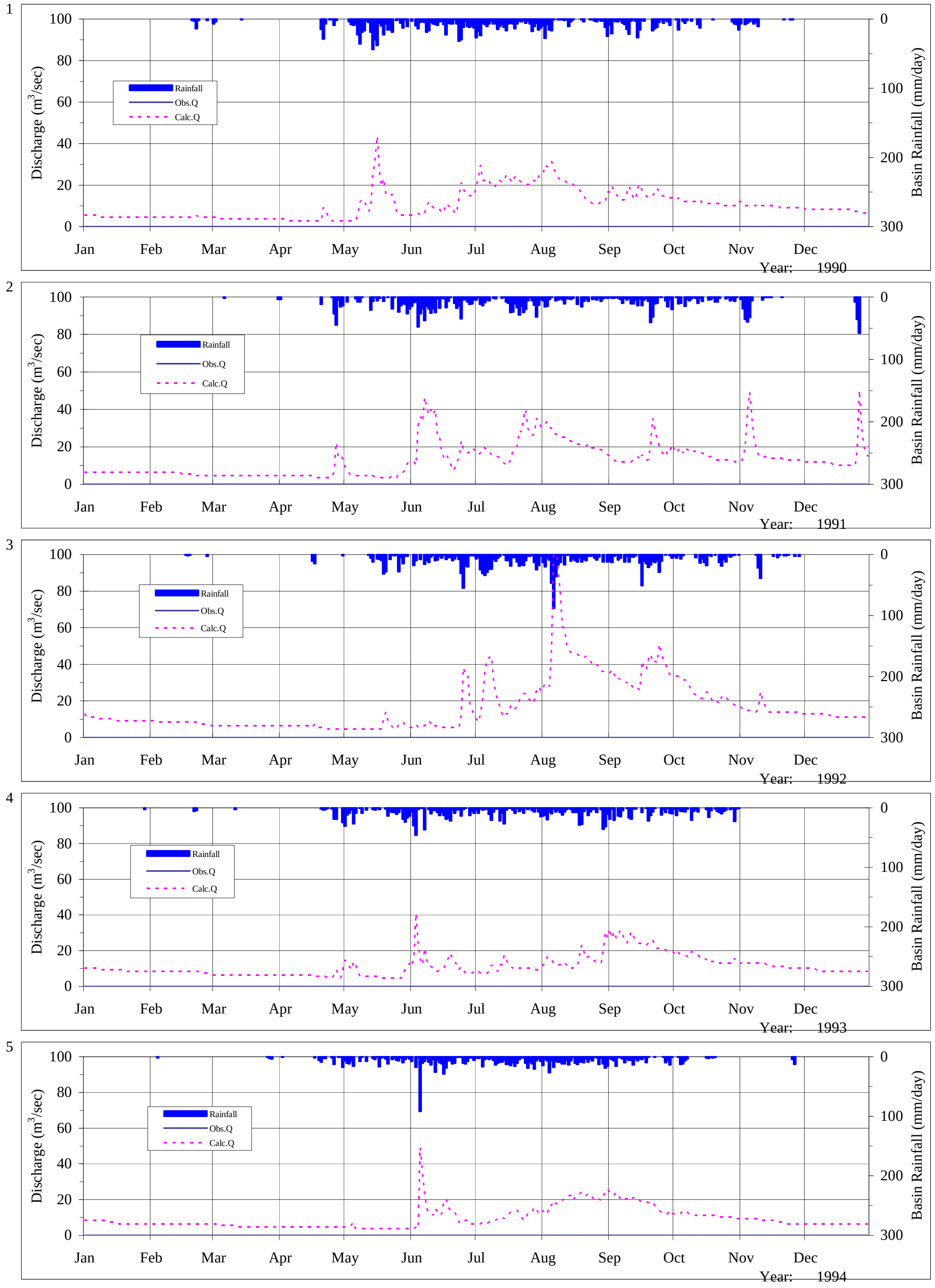


Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (4/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (4/8) [1985-1989]



Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (5/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (5/8) [1990-1994]

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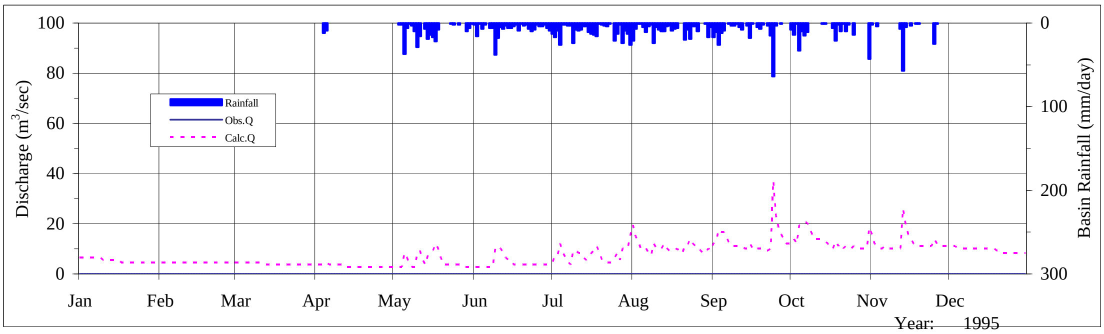

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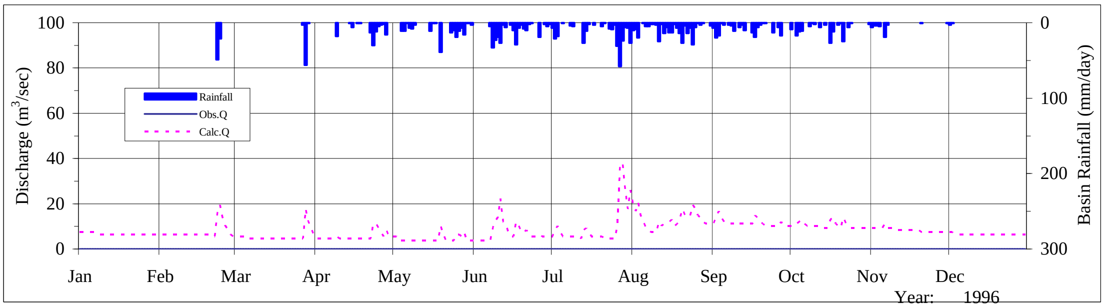

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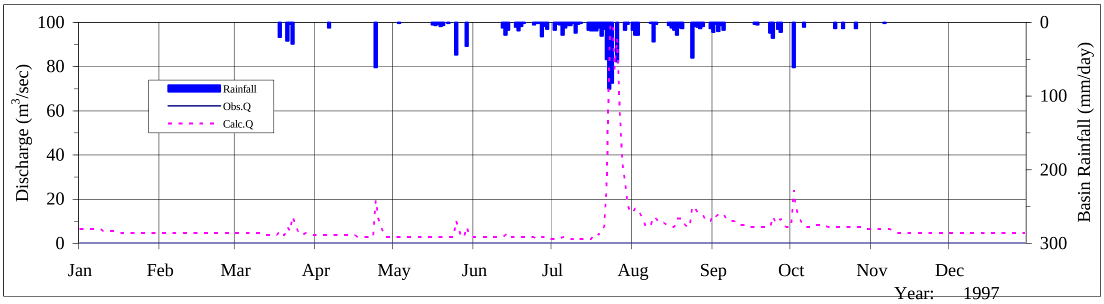

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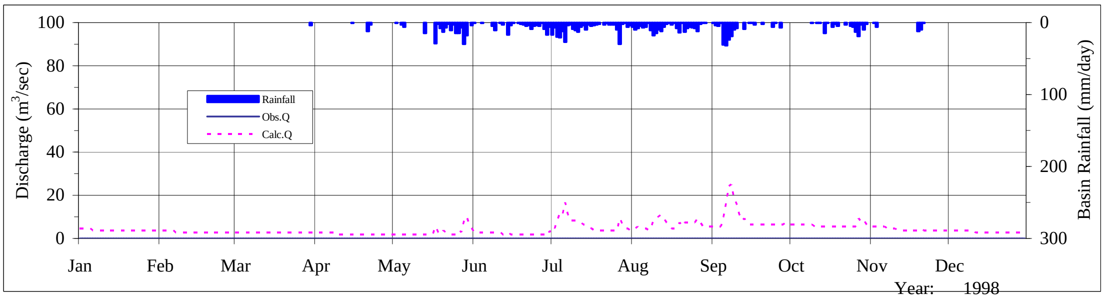

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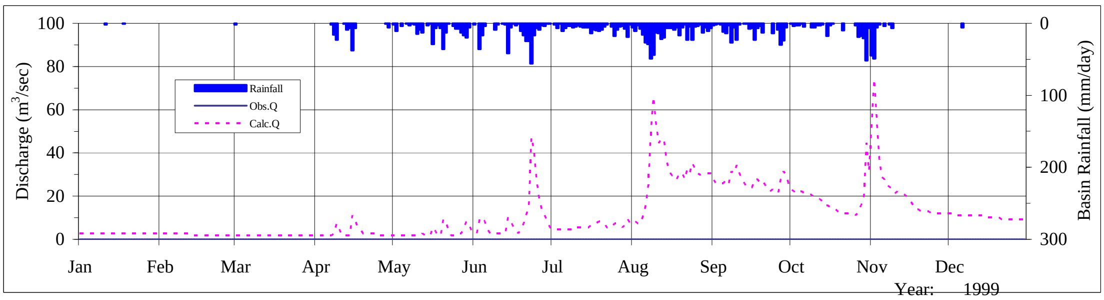
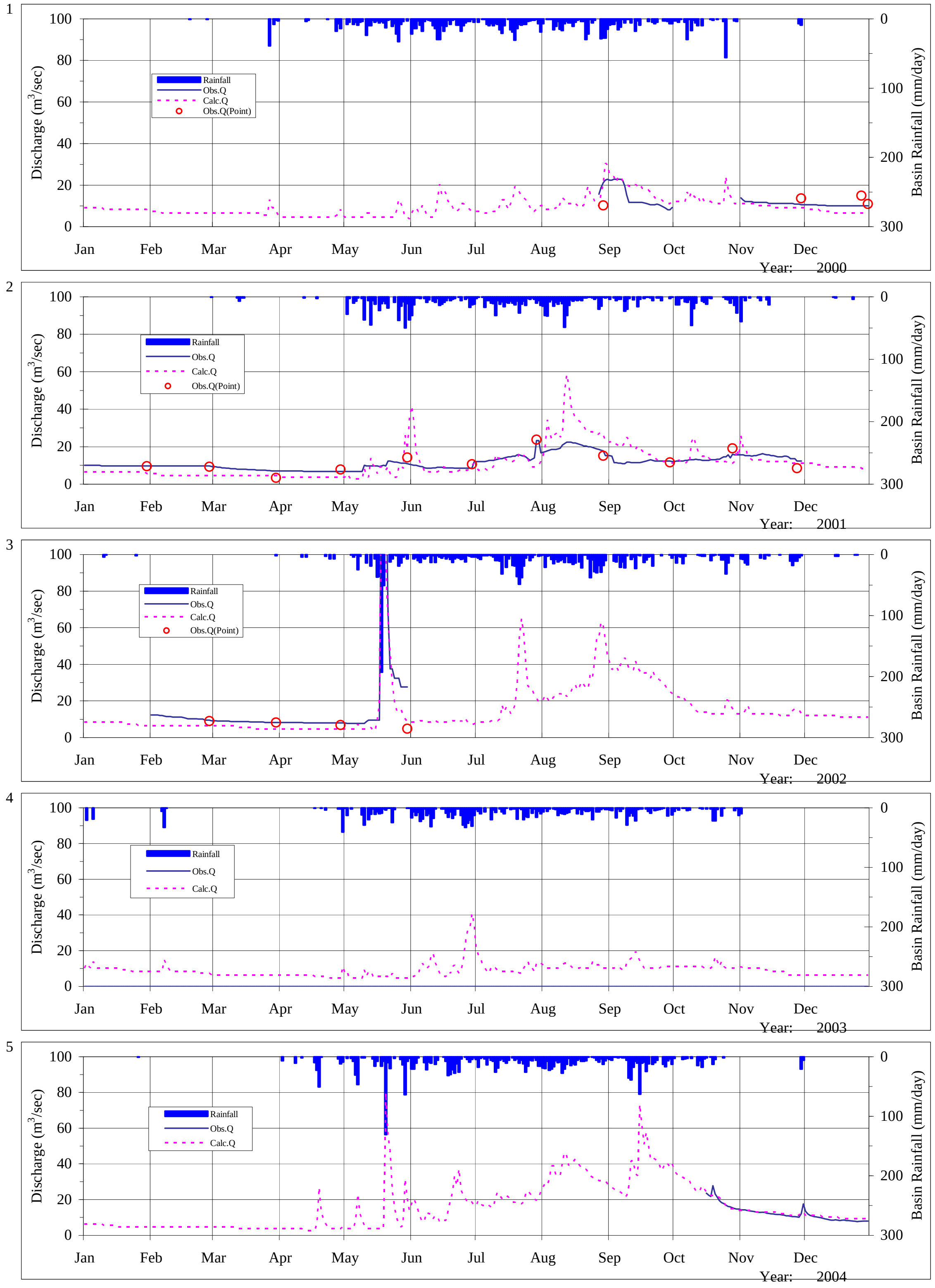


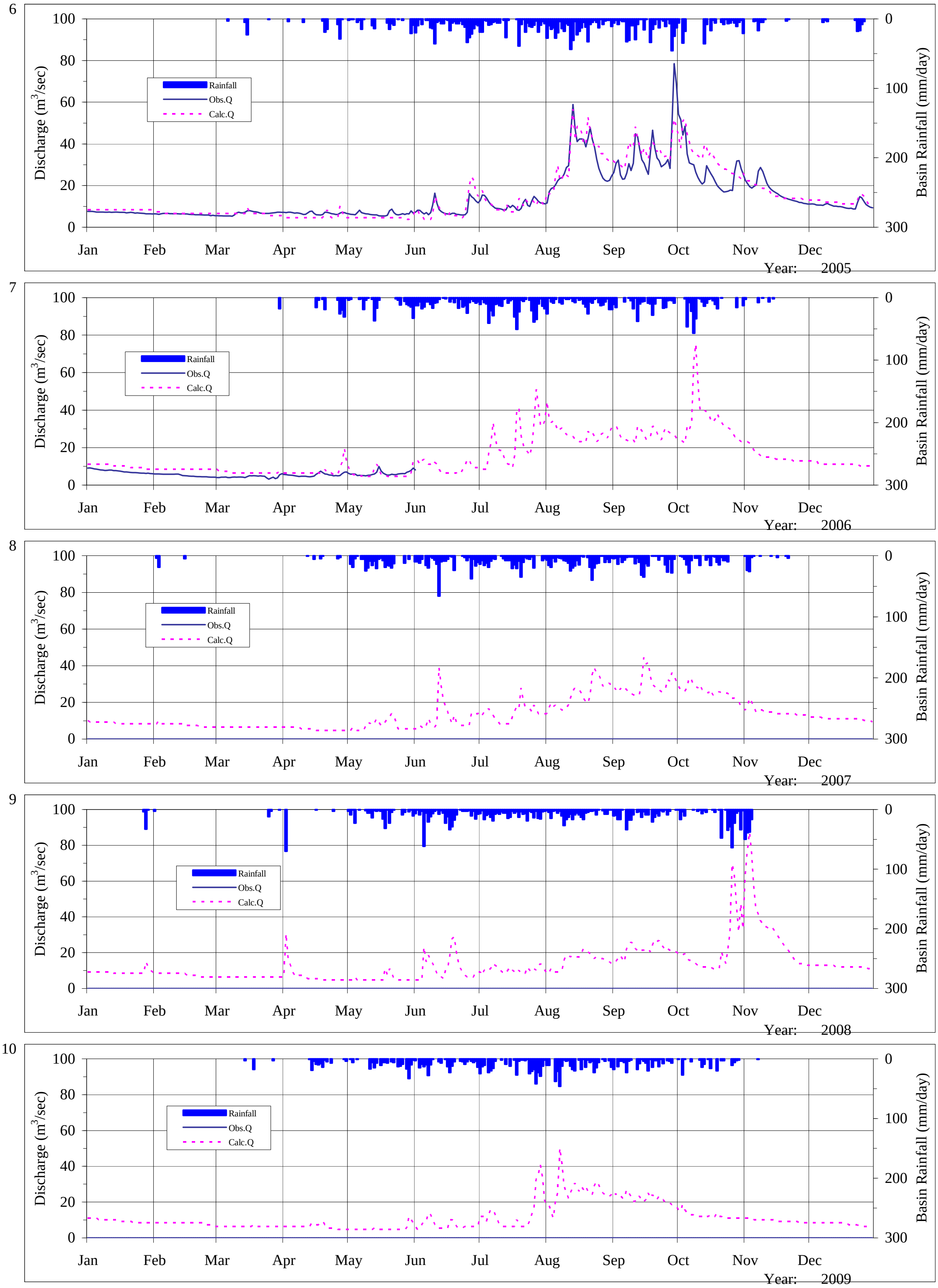
Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (6/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (6/8) [1995-1999]



Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (7/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (7/8) [2000-2004]



Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	**Figure** Estimated Discharge by Tank Model at Upper Baluchaung W.L. Station (After Simulation) (8/8)
Nippon Koei Co., Ltd.	

Figure A.22 Daily Discharge at UB-1 Simulated by Tank Model (8/8) [2005-2009]

(6) Reliability of Simulated Flow at UB-1 Intake Site by Tank Model

The relationship between observed and simulated daily discharge at UB-1 are plotted as shown in the Supporting Report. The correlation coefficient (R^2) of observation periods from August 2000 to May 2002 was 0.76, and from October 2004 to June 2005 was 0.88.

For the reliability check of simulated flow by Tank Model, mean annual runoff height and runoff coefficient at UB1 and other near rivers is plotted as shown in Figure A.23.

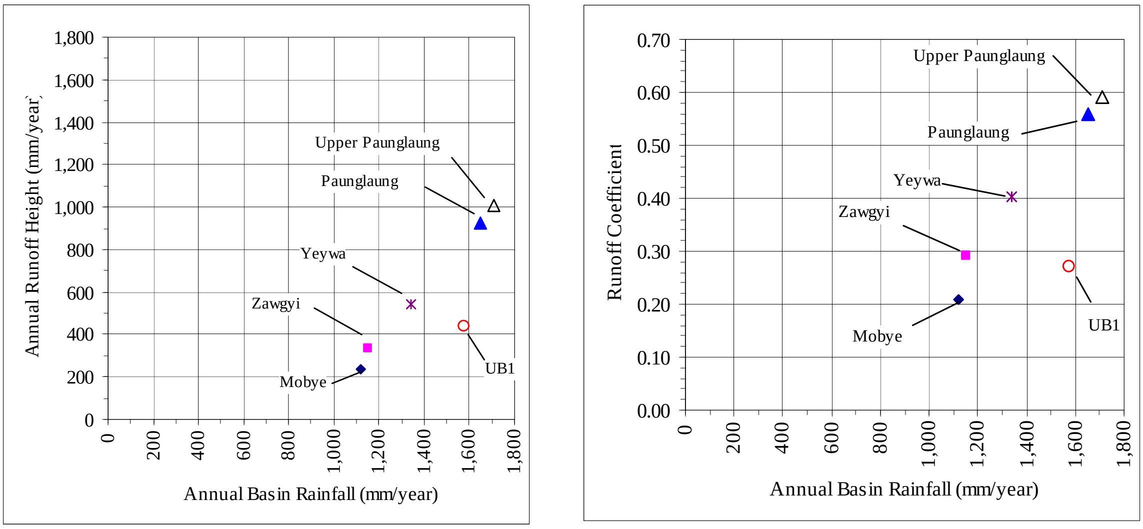


Figure A.23 Runoff Height and Runoff Coefficient at UB-1 and Other Rivers

As shown in Figure A.23, mean annual runoff height and runoff coefficient at UB1 by Tank Model is relatively smaller than nearby other river sites, considering its mean annual basin rainfall.

As a one of possibility of this reason, estimated mean annual basin rainfall at UB1 might be larger than actual basin rainfall. The basin rainfall at UB1 was estimated by the *Thiessen*'s method using mainly Pinlaung and Kalaw rainfall gauging stations. However, the Pinlaung rainfall station is located at mountainous area. According to the topographic map, a mountain ridge at elevation of around 1,800m is lies at north-east of Pinlaung. In the south-west monsoon period, heavy rain will be occurred in this mountainous area. This is to say, there is possibility that rainfall data of the Pinlaung station is not always represent as a southern part of UB1 basin rainfall. For more reliable estimation of basin rainfall, it is required to install additional newly rainfall gauging stations in the basin.

There is other possibility of groundwater leakage loss from UB1 basin to adjacent river basin through the limestone layers, particularly from the cavities. In case of this assumption, the runoff coefficient of UB1 will be lower than other rivers. Incidentally, in the Paunglaung River basin, located at west contact with UB1 basin, the annual basin rainfall and runoff coefficient are relatively high due to mountainous topography and limestone geological features.

Figure A.24 shows the dimensionless flow duration curves (FDC) of simulated discharge at UB1 by Tank Model and other rivers in Myanmar. Compared with inflow records at the Mobye Dam of reliable period from 1971 to 1988, the simulated discharge at UB1 by the Tank Model is well correspondence with low-flow part of FDC. It is therefore judged that simulated discharge at UB1 by the Tank Model will be reliable.

It is important to note that Investigation Report for the Baluchaung No.1 HPP (January 1985, NEWJEC) pointed out that the data conversion from the water level to the discharge at the Mobye Dam had included over-estimate, because the gauge reading was along the arc length of the radial gate, but the overflow discharge should be estimated using the perpendicular length from the bottom edge of the gate to the overflow weir. Therefore modification had been conducted for the data of 1971-1988 in the Study.

Furthermore, in the low-flow part of the FDC of simulated discharge at UB1 by Tank Model is higher than the flow of the Myitnge River of Yeywa HEPP project basin. Conversely, in the high-flow part, UB1 is less than the Yeywa. This reason why, the direct runoff of the Yeywa basin in the rainy season is might be relatively larger than UB1, due to the mountainous topographic condition compared with UB1 basin. As a result, it is conceivable that low-flow part of FDC at Yeywa is less than UB1.

Notes; In general, the limestone layers spread in the Shan plateau. Therefore, infiltration ratio of rainfall is high and many springs exist in the river basin in this area. Especially the Myitnge River runs in the deep gorges and a lot of groundwater from many springs flows into the river between upstream to the Yeywa HEPP project site. This condition has an effect for rise of low-flow part of FDC at Yeywa. This effect shows relatively good flow duration of the Yeywa compared to the Bilin River or the Paunglaung River. However, the effect of the groundwater at Yeywa is not even leached to the levels of good FDC, especially on the low-flow part, at Mobye, Zawgi or UB1 such as relatively flat basin. This is shows that the low-flow part of FDC at Yeywa lies slightly lower than above 3 basins.

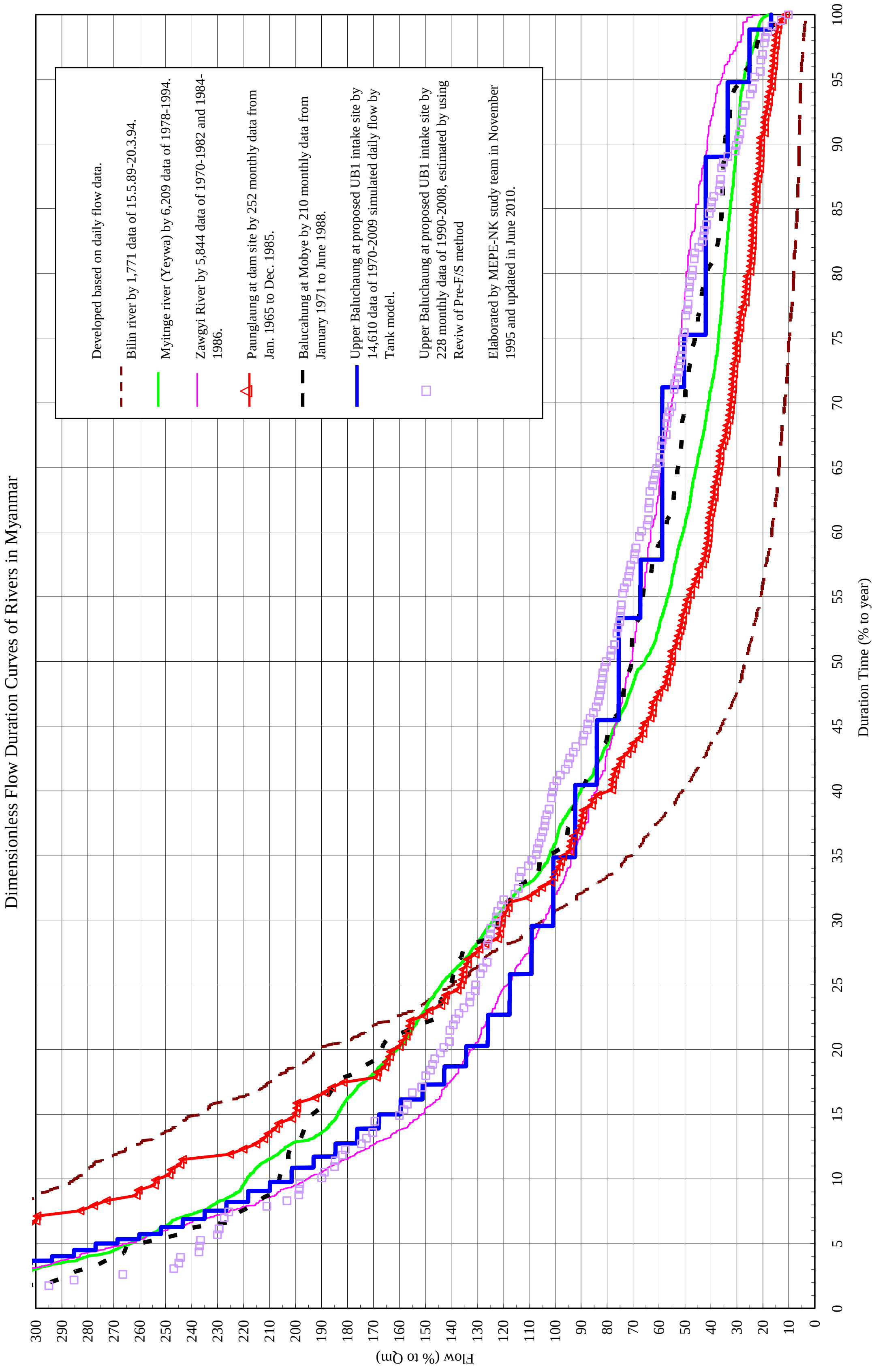
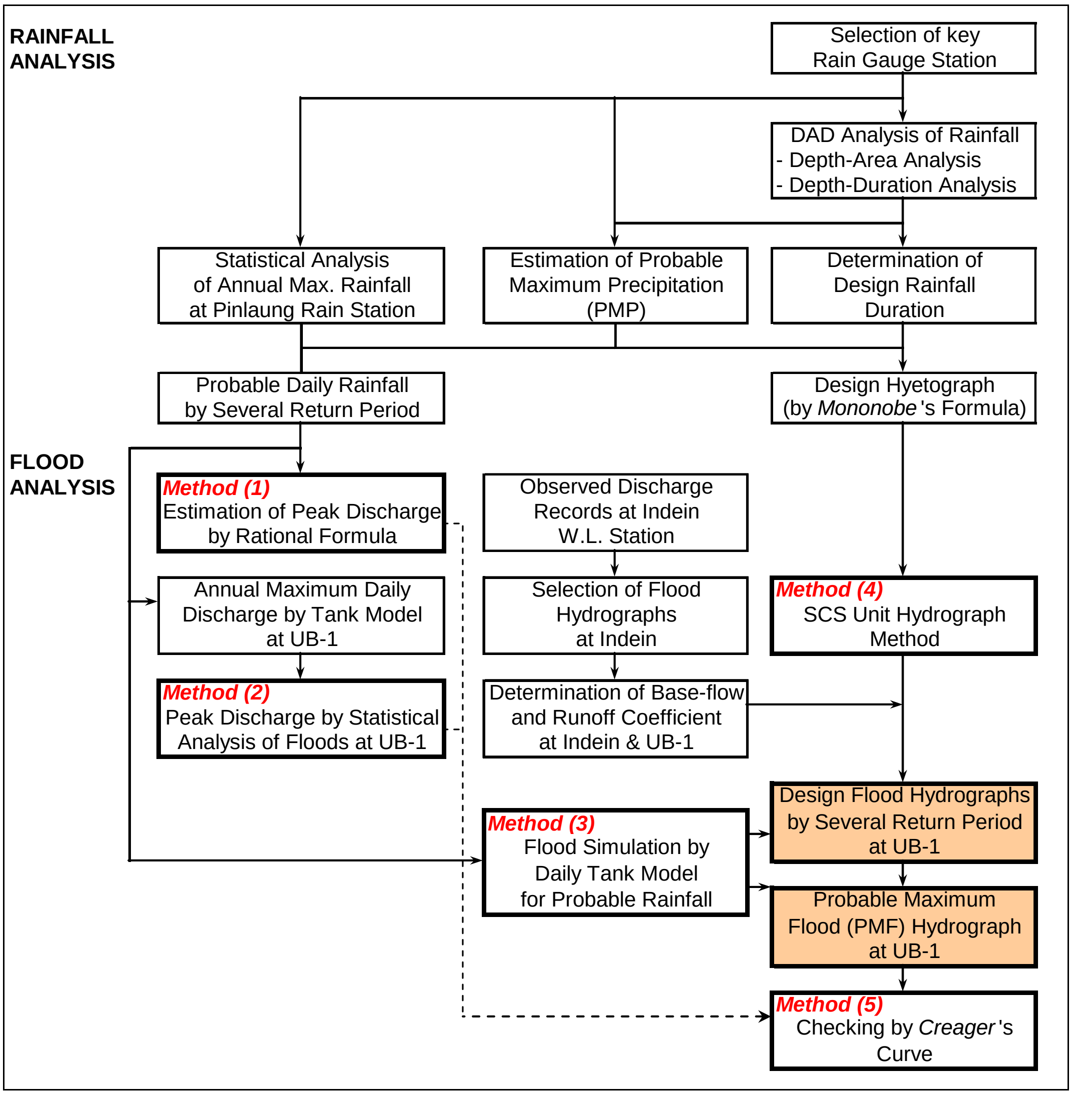


Figure A.24 Dimensionless Flow Duration Curves of Rivers in Myanmar

A.9 Flood Analysis

(1) General Approach

Flood analysis was carried out to estimate floods of different occurrence probability, as well as the probable maximum flood (PMF), at the proposed UB-1 intake, UB-2 intake and regulating dam sites. These flood estimates are required for the design of intake weir, spillways and diversion facilities, and for determination of the dam height, etc. The outline of flood analysis is described in the chart below.



Data relating to the floods through the Upper Baluchaung is extremely limited and hourly rainfall records are not available for the Project area. However luckily Dr. Furuichi measured the continuous discharge at Indein with an automatic recorder from Nov. 2004 to May 2006, in which the peak discharge at 80 - 100 m^3/s were recorded several times in the wet season of 2005.

By utilizing these peak flood discharge and the daily rainfall data, the following methods were applied to obtain comprehensive solution for the flood discharges through the comparison:

- *Rational Formula* method to estimate peak flood discharge,
- Statistical analysis by using annual maximum discharge from 1970-2009 by daily Tank Model,
- Flood simulation by daily *Tank Mode*l,
- *U.S. Soil Conservation Service* (SCS) Synthetic *Unit Hydrograph* method*,*
- Checking by the *Creager*'s curve

(2) Depth-Area (DA) Analysis

Heavy rainfall occurs intensively for a short duration and in a limited area in the Upper Baluchaung River basin. Therefore the average depth of rainstorm (basin mean rainfall) is likely to be smaller than the depth of point rainstorm. Depth-Area analysis aims at obtaining the area reduction factor to estimate the basin mean rainfall.

***Horton*'s Method**

In general, the relationship between point rainfall depth and average rainfall area is expressed by an exponential equation, known as *Horton*'s equation as presented below.

$$P_b = P_o * exp\ [-kA^n]$$

Where, P_b : Average rainfall depth over an area A [mm]

P_o : Maximum point rainfall depth at the storm center [mm]

A : Area in question [km^2]

k, n : Constant for a given area

To estimate the basin mean rainfall from point rainfall, the area reduction factor showing the ratio of basin mean rainfall is introduced as expressed below.

$$P_b = f_a * P_o$$

Where, P_b : Basin mean rainfall depth [mm]

P_o : Point rainfall depth [mm]

f_a : Area reduction factor

If *Horton*'s equation is applied, the area reduction factor under the given rainfall duration is given by the following equation.

$$\begin{aligned} f_a &= exp\ [-kA^n] \\ &= exp\ [-0.1*802^{0.25}] = 0.588 \end{aligned}$$

Firstly, the area reduction factor is estimated at **0.588** for the catchment area of 802 km^2 for the proposed UB-1 intake site by applying *Horton*'s equation assuming that constant *k* and *n* are 0.1 and 0.25 (for 24 hr rainfall, *Horton*, 1924), respectively. These constants have been widely and empirically applied for 24 hours rainfall in tropical forest rain areas.

***Thiessen*'s Polygon Method**

Secondly, the relationship between point rainfall and basin mean rainfall at the proposed UB-1 intake site is analyzed to estimate the area reduction factor for the Upper Baluchaung River basin. The selected rainfall station for this analysis was Pinlaung station in the project basin. The basin mean rainfall is determined by averaging the mean monthly point rainfall at a Pinlaung rain gauge station and the corresponding basin mean rainfall on the same month by *Thiessen*'s polygon method. The point rainfall is plotted against the area reduction factor as shown in Figure A.25. The results of area reduction factors for Pinlaung rainfall station is **0.7575**.

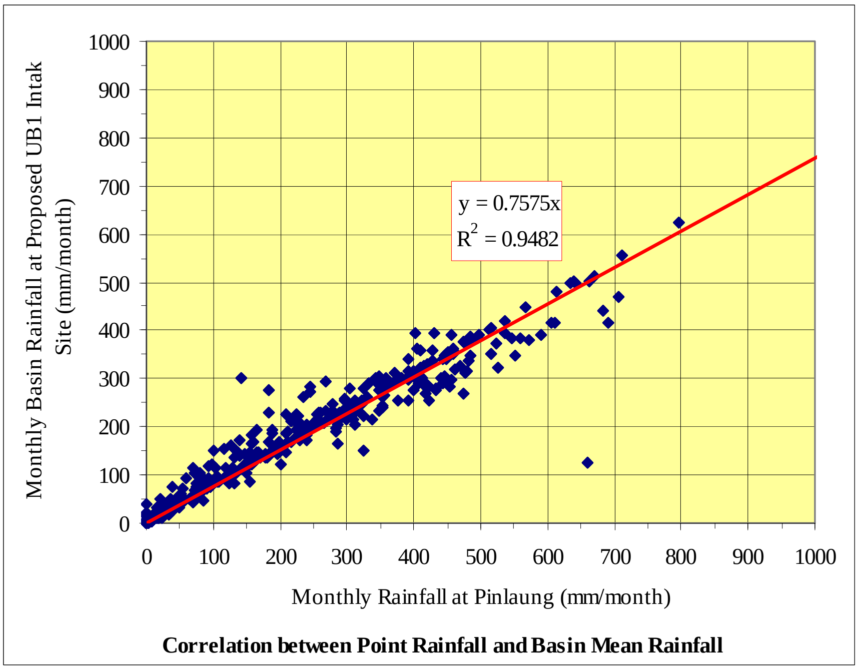


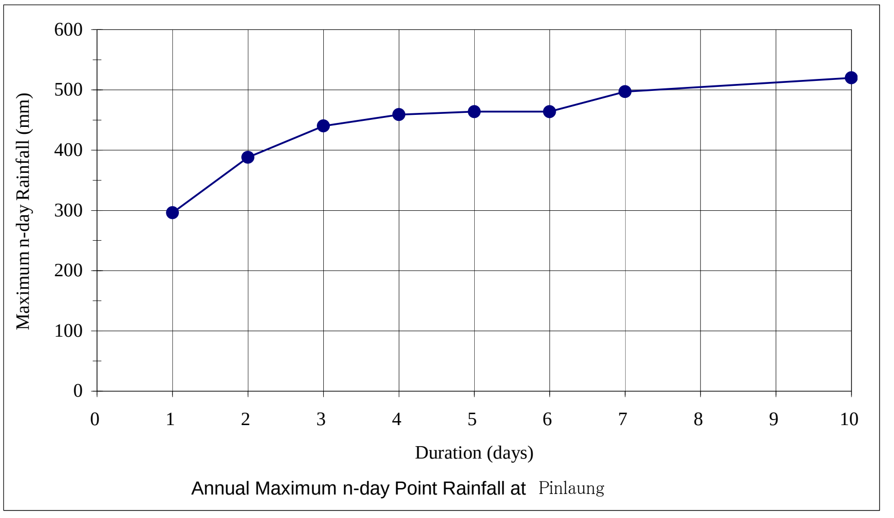
Figure A.25 Relationship between Point Rainfall and Basin Rainfall

In due consideration of the above, the area reduction factor was conservatively determined to be **0.7575**.

(3) Depth-Duration (DD) Analysis

Due to limited rainfall data, hourly rainfall record is not available in/around basin up to date; hourly rainfall distribution hyetograph is not able to estimate. In this study, annual n-day maximum rainfall at Pinlaung is analyzed as shown in below:

Duration (Days)	Rainfall Depth (mm)
1-day	296.0
2-days	388.0
3-days	440.0
4-days	459.0
5-days	464.0
6-days	464.0
7-days	497.0
10-days	520.0
15-days	565.0
20-days	658.0
30-days	841.0
40-days	941.0
50-days	1,133.0



Based on the above, after 3-days rainfall seems to be almost flat in the graph, therefore, the flood duration of 1-day (24 hours), 2-days (48 hours) and 3-days (72 hours) were adopted as the design rainfall hyetograph for estimating the probable maximum precipitation (PMP).

Table A.16 Annual *n*-days Maximum Point Rainfall at Pinlaung

Unit: mm

Year	Duration												
	1-day	2-days	3-days	4-days	5-days	6-days	7-days	10-days	15-days	20-days	30-days	40-days	50-days
1970	88	141	190	254	288	309	323	356	546	631	841	931	1,027
1971	101	151	194	214	238	281	302	373	562	658	818	941	1,133
1972	90	117	149	164	181	195	208	240	397	456	556	721	820
1973	64	103	141	147	165	184	205	271	331	387	489	649	774
1974	64	92	119	132	142	166	179	209	297	370	514	618	750
1975	59	78	91	108	126	143	165	204	246	298	366	445	557
1976	72	124	167	196	223	240	266	315	362	438	623	744	899
1977	69	129	164	180	192	210	226	275	354	386	463	679	811
1978	76	107	136	158	209	238	254	271	326	365	446	555	697
1979	77	113	148	180	198	215	230	265	320	414	511	593	671
1980	47	90	116	119	121	137	139	225	251	314	391	490	595
1981	58	84	118	149	181	201	212	230	278	349	484	587	690
1982	94	117	144	189	198	213	219	269	365	434	581	799	921
1983	69	95	134	161	182	203	223	285	367	431	505	616	668
1984	73	115	157	196	224	263	283	310	346	475	660	775	1,008
1985	86	125	154	187	208	239	264	321	403	482	705	886	1,005
1986	104	109	122	127	129	149	166	198	252	334	417	482	649
1987	86	131	173	208	238	243	262	309	358	394	509	611	715
1988	75	127	153	177	197	210	217	257	292	330	440	543	721
1989	86	166	238	286	309	324	335	354	383	428	570	639	709
1990	54	106	128	137	152	173	192	281	378	453	591	717	873
1991	104	122	160	174	184	219	243	320	421	530	704	833	914
1992	101	156	186	209	215	240	246	282	464	516	639	807	1,045
1993	84	139	151	176	206	240	260	315	368	435	585	675	793
1994	101	106	121	126	142	169	181	246	362	392	546	690	813
1995	101	127	128	129	133	146	164	203	238	319	445	574	658
1996	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	54	82	108	145	158	174	183	225	288	330	404	497	608
1999	97	150	191	239	261	283	318	390	450	501	610	709	853
2000	83	106	130	148	165	183	190	226	303	353	479	590	731
2001	71	89	108	141	163	187	220	248	285	342	497	638	735
2002	296	388	440	459	464	464	497	520	565	602	675	755	918
2003	68	111	159	202	254	276	298	334	415	470	661	716	818
2004	192	206	237	249	268	268	282	363	450	484	614	836	966
2005	70	106	139	161	182	197	215	277	405	544	679	821	920
2006	92	147	183	189	199	214	234	289	454	518	719	838	930
2007	117	142	160	176	192	205	220	262	298	366	556	724	863
2008	96	147	183	212	233	263	276	429	552	553	554	693	831
2009	78	117	169	201	236	257	261	279	452	473	571	771	866
Max.	296	388	440	459	464	464	497	520	565	658	841	941	1,133

(4) Probable Rainfall

Annual maximum daily rainfall at Pinlaung is shown Table A.17. The frequency curve of maximum daily rainfall at Pinlaung is given in Figure A.26, and the probable maximum daily rainfalls at Pinlaung were estimated for each return period as shown in Table A.18 The Log Peason Type-III giving a conservative value, was adopted finally.

Table A.17 Annual Maximum Daily Rainfall at Pinlaung

No.	Year	Annual Max. Daily Rainfall		Rank	Excess Proba-bility	Return Period (Year)
		Date	Daily Rainfall (mm)			
1	1970	24-Jul	88.0	15	63.75%	2.76
2	1971	21-Jul	101.0	6	86.25%	7.27
3	1972	16-Jul	90.0	14	66.25%	2.96
4	1973	28-Aug	64.0	32	21.25%	1.27
5	1974	26-May	64.0	32	21.25%	1.27
6	1975	25-Aug	59.0	34	16.25%	1.19
7	1976	9-Jul	72.0	26	36.25%	1.57
8	1977	26-Jun	69.0	29	28.75%	1.40
9	1978	25-Jun	76.0	23	43.75%	1.78
10	1979	14-Jun	77.0	22	46.25%	1.86
11	1980	31-Jul	47.0	38	6.25%	1.07
12	1981	7-Nov	58.0	35	13.75%	1.16
13	1982	3-Sep	94.0	12	71.25%	3.48
14	1983	28-Dec	69.0	29	28.75%	1.40
15	1984	4-Jun	73.0	25	38.75%	1.63
16	1985	18-Aug	86.0	16	61.25%	2.58
17	1986	7-Sep	104.0	4	91.25%	11.43
18	1987	25-Aug	86.0	16	61.25%	2.58
19	1988	26-Jun	75.0	24	41.25%	1.70
20	1989	31-Jul	86.0	16	61.25%	2.58
21	1990	25-Jun	54.0	36	11.25%	1.13
22	1991	27-Dec	104.0	4	91.25%	11.43
23	1992	6-Aug	101.0	6	86.25%	7.27
24	1993	4-Jun	84.0	19	53.75%	2.16
25	1994	6-Jun	101.0	6	86.25%	7.27
26	1995	25-Sep	101.0	6	86.25%	7.27
27	1996					
28	1997					
29	1998	29-May	54.0	36	11.25%	1.13
30	1999	24-Jun	97.0	10	76.25%	4.21
31	2000	25-Oct	83.0	20	51.25%	2.05
32	2001	2-Nov	71.0	27	33.75%	1.51
33	2002	19-May	296.0	1	98.75%	80.00
34	2003	1-May	68.0	31	23.75%	1.31
35	2004	20-May	192.0	2	96.25%	26.67
36	2005	29-Sep	70.0	28	31.25%	1.45
37	2006	19-Jul	92.0	13	68.75%	3.20
38	2007	13-Jun	117.0	3	93.75%	16.00
39	2008	26-Oct	96.0	11	73.75%	3.81
40	2009	8-Aug	78.0	21	48.75%	1.95
	Max.		296.0			

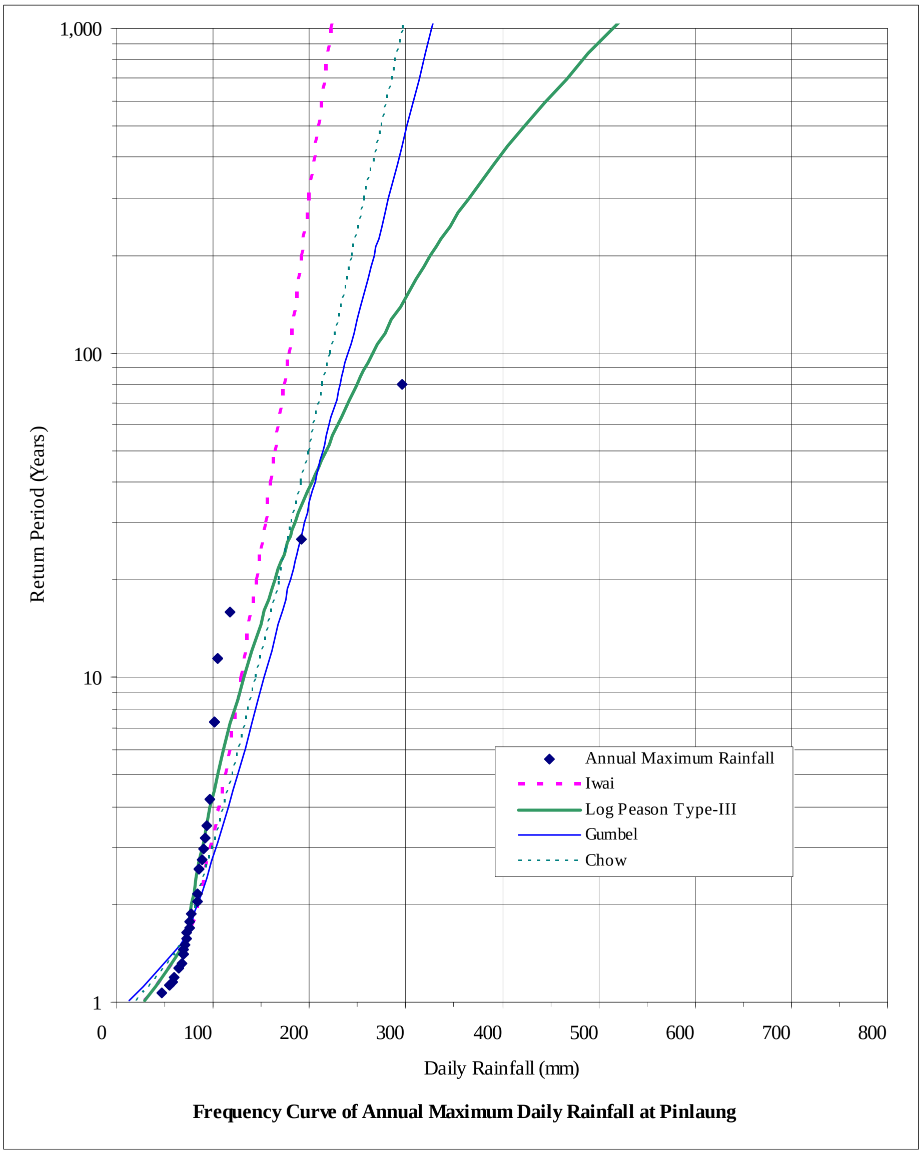


Figure A.26 Frequency Curve of Maximum Daily Rainfall at Pinlaung

Table A.18 Probable Maximum Daily Rainfall at Pinlaung

(mm/day)

Return Period (Year)	Excess Proba-bility	Computation Method			
		Iwai	**Log Peason Type-III**	**Gumbel**	**Chow**
1.01	0.9901	**29**	**29**	**13**	**20**
1.50	0.6667	**71**	**69**	**66**	**68**
2	0.5000	**84**	**77**	**83**	**83**
5	0.2000	**112**	**105**	**125**	**120**
10	0.1000	**130**	**132**	**153**	**145**
20	0.0500	**145**	**164**	**180**	**168**
25	0.0400	**150**	**176**	**189**	**176**
30	0.0333	**154**	**186**	**195**	**182**
40	0.0250	**160**	**203**	**206**	**192**
50	0.0200	**164**	**217**	**215**	**199**
80	0.0125	**174**	**249**	**232**	**215**
100	0.0100	**178**	**266**	**241**	**222**
200	0.0050	**192**	**326**	**266**	**245**
300	0.0033	**200**	**366**	**282**	**258**
500	0.0020	**209**	**423**	**301**	**275**
1,000	0.0010	**222**	**515**	**326**	**298**

(5) Probable Maximum Rainfall (PMP)

Probable Maximum Rainfall (PMP) was estimated by the simple statistical *Hershfield* [1961] method using a series of the annual maximum daily rainfall records. This method is widely applied in the basin where rainfall records are available but other basic meteorological records are hardly obtainable. The *Hershfield*'s equation is expressed by the following equation.

Source: "*Manual for estimation of probable maximum precipitation, operational hydrology report No.1*", World Meteorological Organization (WMO) -No.332

$$X_m = X_n + K_m * S_n$$

Where, X_m : Extreme value of 24-hour rainfall (PMP) (mm)

X_n : Adjusted mean annual maximum rainfall (mm)

K_m : Statistical coefficient

S_n : Adjust standard deviation of a series of annual maximum rainfall

As seen in the above equation, PMP in question is assumed to be given as the adjusted mean annual maximum rainfall in question plus the K_m times the standard deviation of a series of annual maximum rainfall in question.

The PMP at the Pinlaung rainfall gauging station is estimated by applying a series of annual maximum rainfall in the catchment of proposed UB-1 intake site, due to length of the observation period and the values of recorded maximum 1-day rainfall.

The computation of the point PMP is shown in Table A.20. Result of estimated PMP by the *Hershfield* (WMO, 332) method is shown in Table A.19.

Table A.19 Estimated PMP for UB-1 by *Hershfield*'s Method

	24 hr PMP	48 hr PMP	72 hr PMP
PMP of Point Rainfall at Pinlaung	554 mm	554 mm	662 mm
PMP of Basin Rainfall for UB-1 (802 km^2)	420 mm	420 mm	510 mm

Table A.20 Computation of PMP by *Hershfield*'s Method

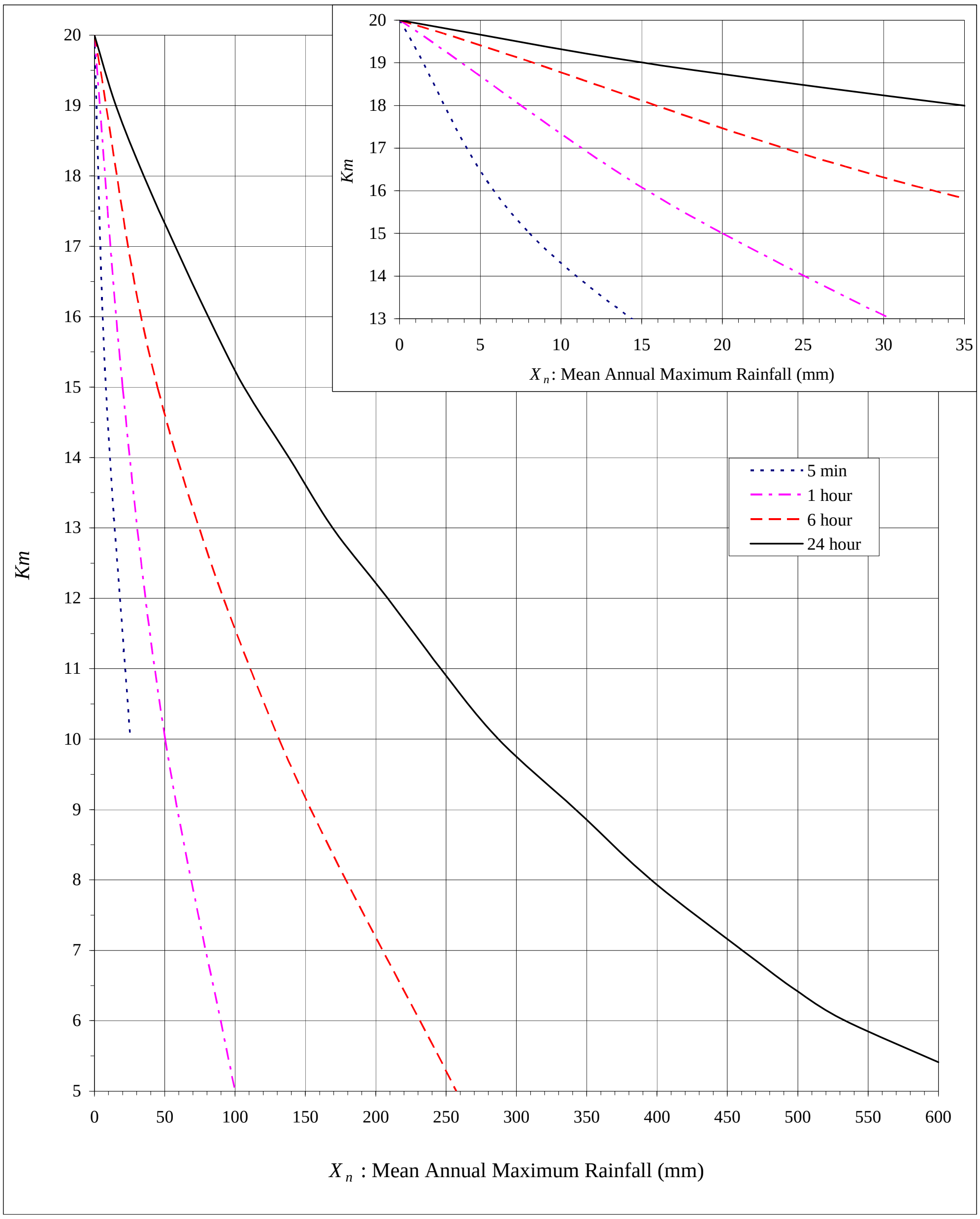
Station: Pinlaung

Catchment Area (km^2) = 802

No.	Year	Annual Maximum Precipitation (mm)					
		Duration (hour)					
			24 hr (1 day)		48 hr (2 days)		72 hr (3 days)
1	1970		88.0		141.0		190.0
2	1971		101.0		151.0		194.0
3	1972		90.0		117.0		149.0
4	1973		64.0		103.0		141.0
5	1974		64.0		92.0		119.0
6	1975		59.0		78.0		91.0
7	1976		72.0		124.0		167.0
8	1977		69.0		129.0		164.0
9	1978		76.0		107.0		136.0
10	1979		77.0		113.0		148.0
11	1980		47.0		90.0		116.0
12	1981		58.0		84.0		118.0
13	1982		94.0		117.0		144.0
14	1983		69.0		95.0		134.0
15	1984		73.0		115.0		157.0
16	1985		86.0		125.0		154.0
17	1986		104.0		109.0		122.0
18	1987		86.0		131.0		173.0
19	1988		75.0		127.0		153.0
20	1989		86.0		166.0		238.0
21	1990		54.0		106.0		128.0
22	1991		104.0		122.0		160.0
23	1992		101.0		156.0		186.0
24	1993		84.0		139.0		151.0
25	1994		101.0		106.0		121.0
26	1995		101.0		127.0		128.0
27	1998		54.0		82.0		108.0
28	1999		97.0		150.0		191.0
29	2000		83.0		106.0		130.0
30	2001		71.0		89.0		108.0
31	2002	M	296.0	M	388.0	M	440.0
32	2003		68.0		111.0		159.0
33	2004		192.0		206.0		237.0
34	2005		70.0		106.0		139.0
35	2006		92.0		147.0		183.0
36	2007		117.0		142.0		160.0
37	2008		96.0		147.0		183.0

			Duration (hour)		
			24 hr (Case-1)	48 hr (Case-2)	72 hr (Case-3)
n	Number of Data (Length of Record)	(years)	37	37	37
m	Maximum	(mm)	296.0	388.0	440.0
X_n	Mean Annual Maximum Rainfall	(mm)	89.7	128.2	160.0
X_{n-m}	Mean (excluding maximum)	(mm)	84.0	121.0	152.2
S_n	Standard Deviation	(mm)	42.7	51.2	57.6
S_{n-m}	Standard Dev.(w/o.max)	(mm)	25.1	26.7	33.4
X_{n-m} / X_n			0.94	0.94	0.95
S_{n-m} / S_n			0.59	0.52	0.58
Adjustment of menas (X_n) for maximum observed amount and record length:					
F_{x1}	Adjustment Factor (X_n) for maximum observed amount (from **Figure 2.4.25**)	(%)	96%	96%	97%
F_{x2}	Adjustment Factor (X_n) for record length (from **Figure 2.4.27**)	(%)	100%	100%	100%
ADX_n	Adjusted X_n $(ADX_n = Xn * F_{x1} * F_{x2})$	(mm)	**86.5**	**123.6**	**155.9**
Adjustment of standard deviation for maximum observed amount and record length:					
F_{s1}	Adjustment Factor (S_n) for maximum observed amount (from **Figure 2.4.26**)	(%)	66%	58%	65%
F_{s2}	Adjustment Factor (S_n) for record length (from **Figure 2.4.27**)	(%)	103%	103%	103%
ADS_n	Adjusted S_n $(ADS_n = Sn * F_{s1} * Fs_2)$		**28.9**	**30.4**	**38.4**
K_m	Function of rainfall duration and mean of annual series (from **Figure 2.4.24**)		16	14	13
Unadjustment point values of PMP:					
$X_{m(ua)}$	Unadjustment point values of PMP: $(X_{m(ua)} = ADX_n + K_m * ADS_n)$	(mm)	**549**	**549**	**655**
Adjustment of PMP based on hourly data to true maximum values:					
T	Number of observation unit (fixed tim interval of rainfall observation)	(hour)	24	24	24
F_o	Adjustment Factor (T) for observation unit (from **Figure 2.4.28**)	(%)	101%	101%	101%
$X_{m(t)}$	Adjustment of PMP based on hourly data to true maximum values: $(X_{m(t)} = X_{m(ua)} * F_o)$	(mm)	**554**	**554**	**662**
(Note: If annual series data had been compiled from fixed observational time interval instead of hourly data, the adjustment factor for all duration would have been 1.13)					
Adjustment of point PMP to study area (catchment area):					
CA_b	Covered Area of Rainfall Data (if point rainfall : 25 km^2)	(km^2)	25	25	25
CA	Study Area (Catchment Area)	(km^2)	802	802	802
F_{CA}	Area Reduction Factor for point rainfall to area (from Depth - Area Analysis)	(%)	**75.75%**	**75.75%**	**75.75%**
PMP	**PMP for study area** $(PMP = X_{m(t)} * F_{CA})$	(mm)	**420**	**420**	**501**
	(rounded PMP)	(mm)	**420**	**420**	**510**

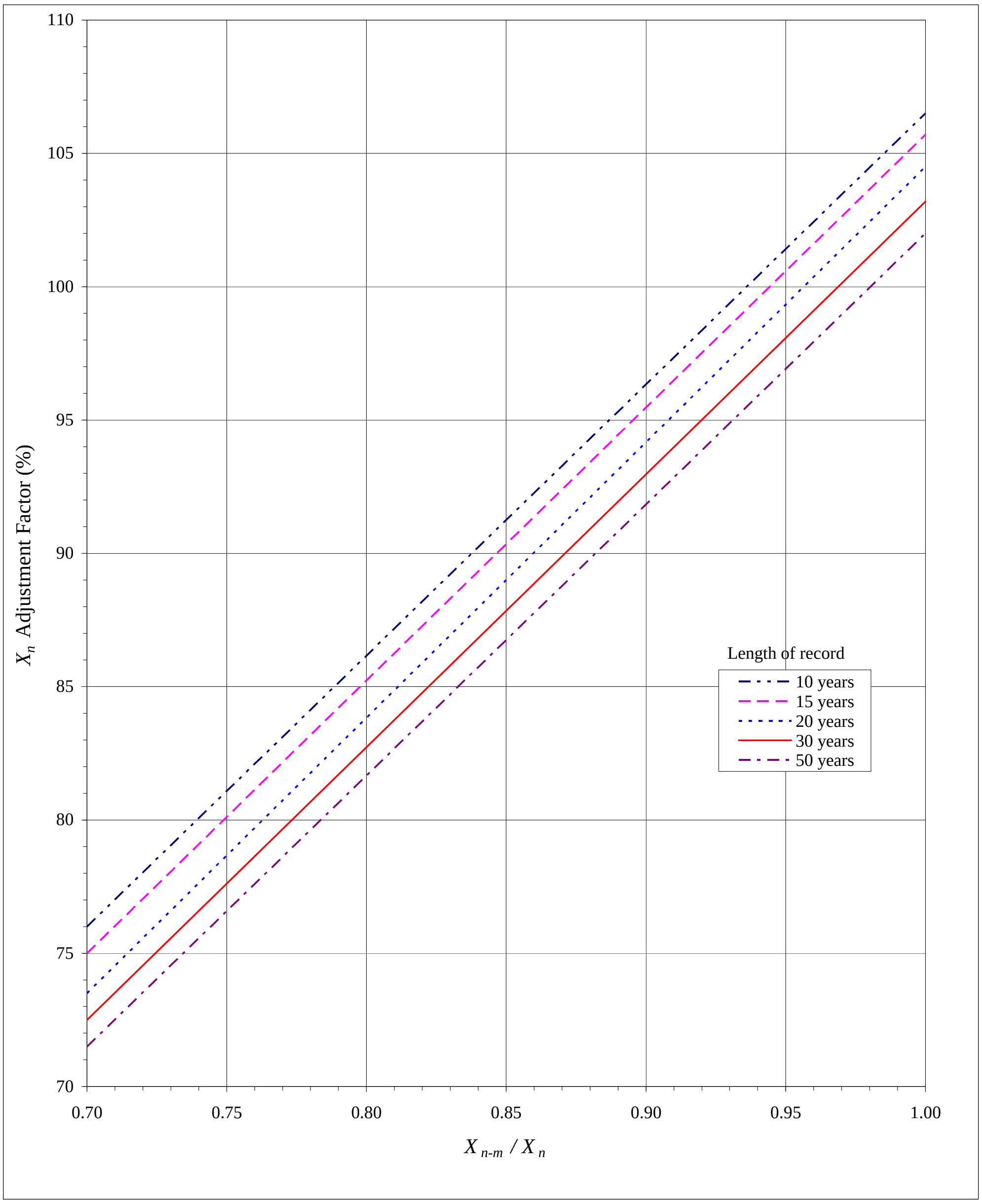
Source: Operational Hydrology Report No.1, WMO No. 332,
Manual for Estimation of Probable Maximum Precipitation, Second Edition,
pp. 96 - 108, Word Meteorological Organization (WMO), 1986.



Source: Operational Hydrology Report No.1, WMO No. 332,
"Manual for Estimation of Probable Maximum Precipitation", Second Edition,
Page 97, Figure 4.1, Word Meteorological Organization (WMO), 1986.

Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	Figure *Km* as a Function of Rainfall Duration and Mean of Annual Series [Hershfield, 1965]
Nippon Koei Co., Ltd.	

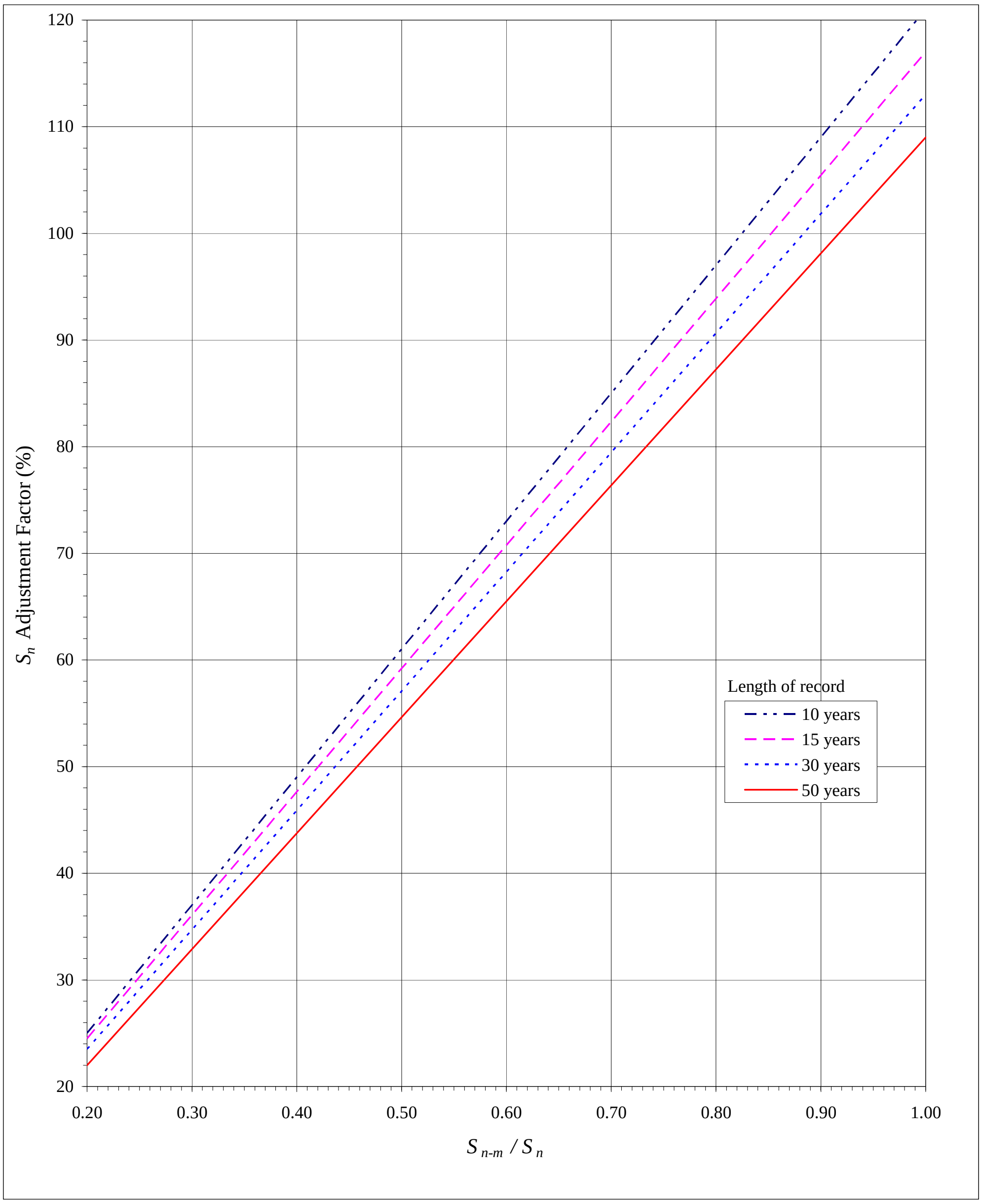
Figure A.27 K_m as a Function of Rainfall Duration and Mean of Annual Series



Source: Operational Hydrology Report No.1, WMO No. 332,
"Manual for Estimation of Probable Maximum Precipitation", Second Edition,
Page 98, Figure 4.2, Word Meteorological Organization (WMO), 1986.

Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	Figure Adjustment of Mean of Annual Series for Maximum Rainfall [Hershfield, 1961]
Nippon Koei Co., Ltd.	

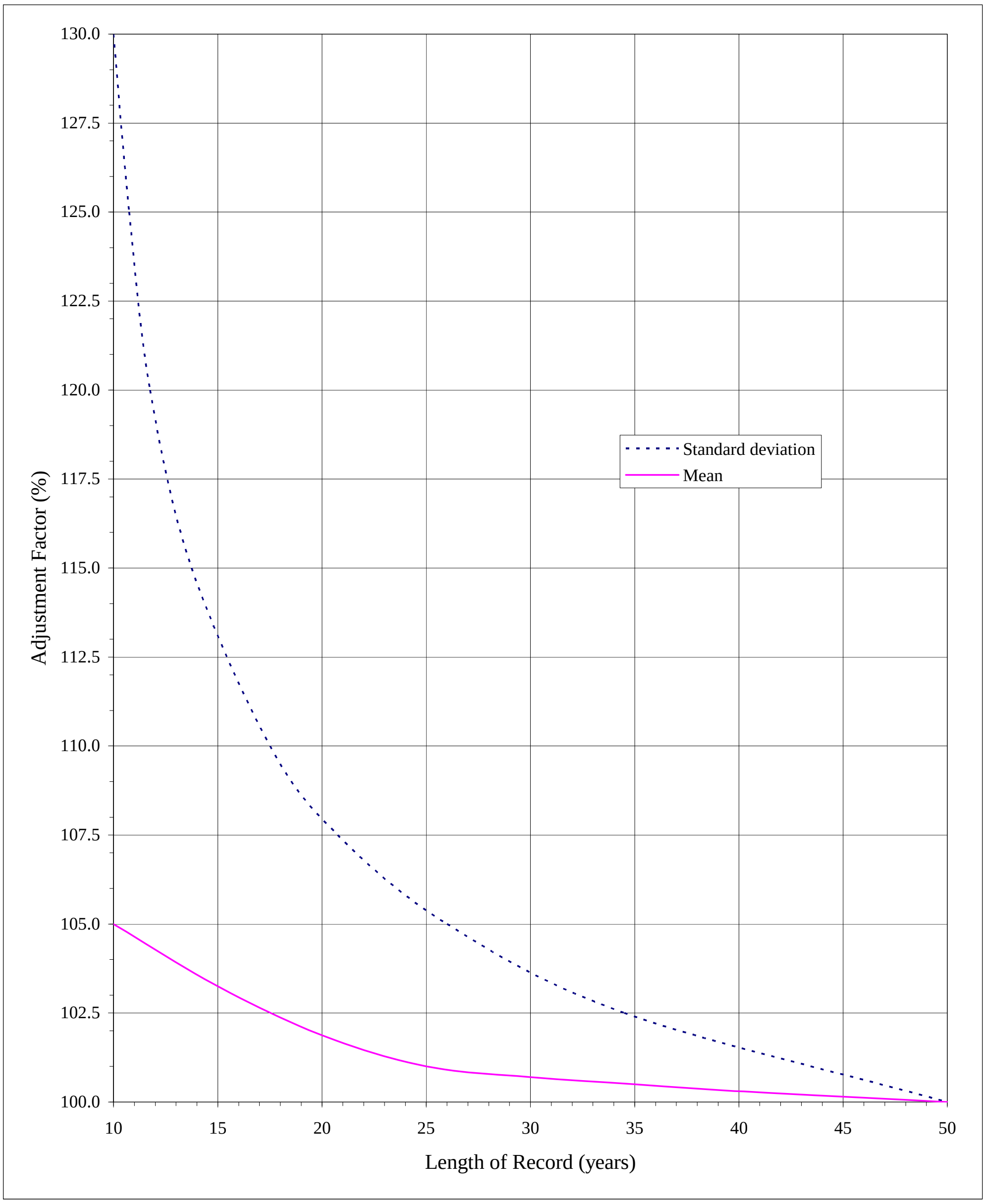
Figure A.28 Adjustment of Mean of Annual Series for Maximum Rainfall



Source: Operational Hydrology Report No.1, WMO No. 332, "Manual for Estimation of Probable Maximum Precipitation", Second Edition, Page 99, Figure 4.3, Word Meteorological Organization (WMO), 1986.

Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	Figure Adjustment of Standerd Deviation of Annual Series for Maximum Rainfall [Hershfield, 1961]
Nippon Koei Co., Ltd.	

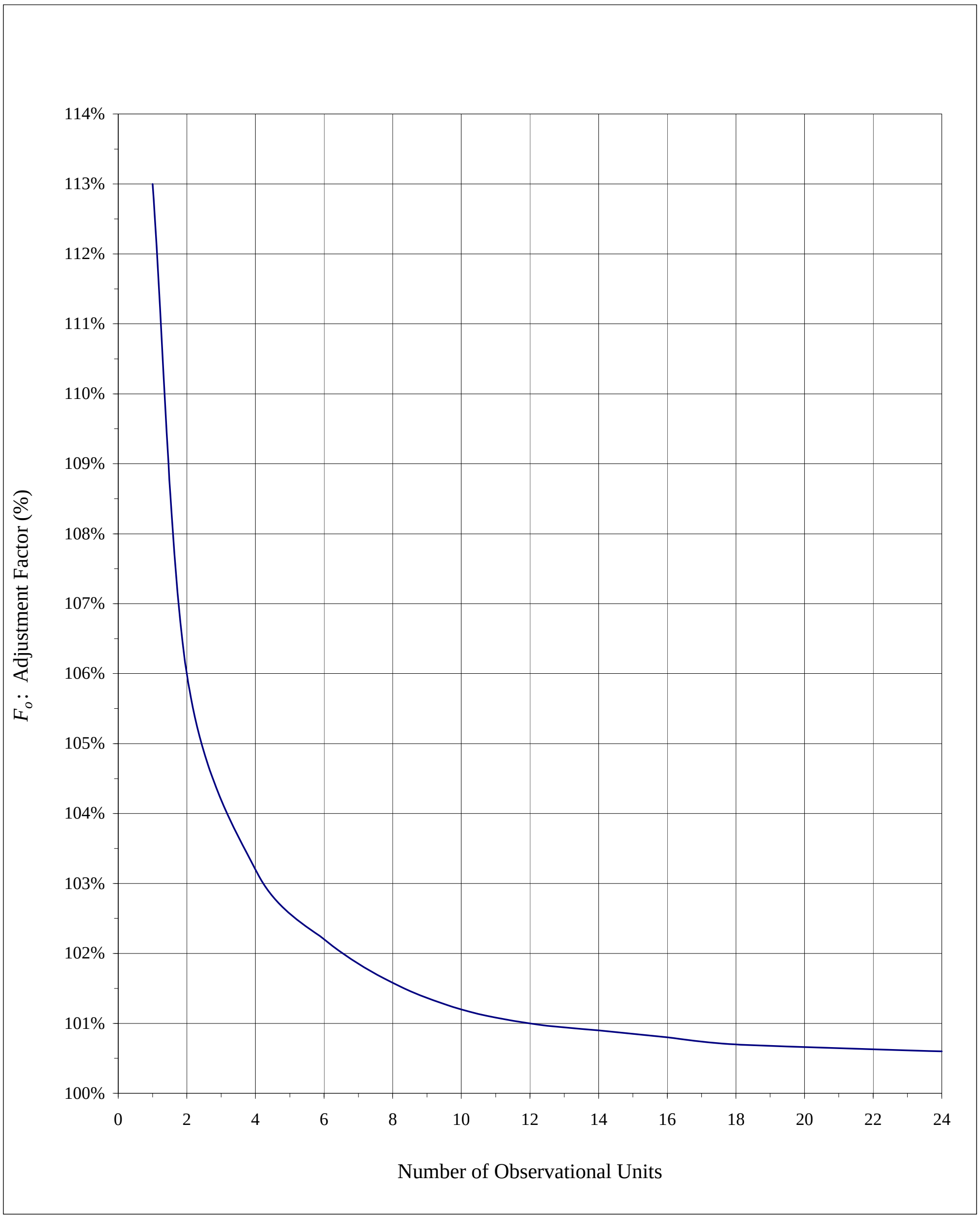
Figure A.29 Adjustment of Standard Deviation of Annual Series for Maximum Rainfall



Source: Operational Hydrology Report No.1, WMO No. 332,
"Manual for Estimation of Probable Maximum Precipitation", Second Edition,
Page 100, Figure 4.4, Word Meteorological Organization (WMO), 1986.

Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	Figure Adjustment of Mean and Standard Deviation of Annual Series for Length of Record [Hershfield, 1961]
Nippon Koei Co., Ltd.	

Figure A.30 Adjustment of Mean and Standard Deviation of Annual Series



Source: Operational Hydrology Report No.1, WMO No. 332,
"Manual for Estimation of Probable Maximum Precipitation", Second Edition,
Page 101, Figure 4.5, Word Meteorological Organization (WMO), 1986.

Feasibility Study and Basic Design Upper Baluchaung Hydropower Project in Myanmar	Figure Adjustment of Fixed Interval Precipitation Amounts for Number of Observation Units within the Interval [Weiss, 1964]
Nippon Koei Co., Ltd.	

Figure A.31 Adjustment of Fixed Interval Precipitation Amounts for Number of Observation Units within the Interval

(6) Design Flood

1) Method 1 : Rational Formula

Flood peak discharges by several return periods were estimated by using the *Rational Formula*. The *Rational Formula* is shown below:

[*Rational Formula*] (*Lloyd Davies*, 1906)

$$Q_p = \frac{1}{3.6} f \times r_t \times A \quad [\mathrm{m^3/s}]$$

where, Q_p : peak discharge [m³/s]

f : runoff coefficient (0.5~0.75; large river in flat land; Mononobe, 1933)

r_t : average rainfall intensity in flood duration [mm/hr]

A : catchment area [km²]

[*Ito Formula*]

$$r_t = \frac{R_{24}}{24}\left(\frac{34.7}{t^{1.35}+1.5}\right) \quad [\mathrm{mm/hr}]$$

where, R_{24} : probable daily rainfall [mm/day]

t : time of concentration of runoff [hour]

[*Rziha Formula*]

$$t = \frac{L}{W} \quad [\mathrm{min}]$$

$$W = 20 \times \left(\frac{h}{L}\right)^{0.6} \quad [\mathrm{m/s}]$$

where, t : time of concentration of runoff [min]

W : flood velocity [m/s]

L : length of river channel (from top of basin to discharge point) [m]

h : height difference (from top of basin to discharge point) [m]

[Runoff Coefficient; f]

Topography.	Runoff Coefficient *f*
steep mountains	0.75～0.90
Tertiary mountains or hills	0.70～0.80
gently undulating lands and forest	0.50～0.75
flat cultivated fields	0.45～0.60
paddy field under irrigation	0.70～0.80
mountainous river	0.75～0.85
mountainous river	0.75～0.85
small river in flat land	0.45～0.75
large river in flat land	0.50～0.75

Source: Mononobe (1933)

Estimated peak flood discharges at proposed regulating dam site (C.A.=767 km^2) by the Rational Formula and using assumed runoff coefficient of 0.5 and 0.75 were shown in the Table below.

Table A.21 Estimated Peak Flood Discharge at Regulating Dam by Rational Formula

Return Period (Year)	Excess Probability (%)	Daily Rainfall at Pinlaung (Point Rainfall) R_{24} (mm)	Area Reduction Factor of Point Rainfall to Basin Rainfall	Daily Basin Rainfall R_{24} (mm)	Length of River (main stream) L (km)	Height Difference of Basin H (m)	Flood Velocity by Rziha Formula W (m/s)	Time of Concentration $t = L / W$ t (hour)
10	10.0%	132	0.7575	100	81.22	312	0.71	31.8
20	5.0%	164	0.7575	124	81.22	312	0.71	31.8
100	1.0%	266	0.7575	202	81.22	312	0.71	31.8
200	0.5%	326	0.7575	247	81.22	312	0.71	31.8
1000	0.1%	515	0.7575	390	81.22	312	0.71	31.8
PMP		554	0.7575	420	81.22	312	0.71	31.8
Max. Rainfall	(1970-2007)	296	0.7575	224	81.22	312	0.71	31.8

W=20(h/L)^0.6*

Return Period (Year)	Excess Probability (%)	Rainfall Intensity of Time Duration [Ito Formula] r_t (mm/hr)	Catchment Area (at R.Dam) A (km^2)	Runoff Coefficient f [*1]	Peak Discharge [Ito] Q_p (m^3/s)	Runoff Coefficient f [*1]	Peak Discharge [Ito] Q_p (m^3/s)
10	10.0%	1.3	767	0.50	**138**	0.75	**208**
20	5.0%	1.7	767	0.50	**181**	0.75	**272**
100	1.0%	2.7	767	0.50	**288**	0.75	**431**
200	0.5%	3.3	767	0.50	**352**	0.75	**527**
1000	0.1%	5.2	767	0.50	**554**	0.75	**831**
PMP		5.6	767	0.50	**597**	0.75	**895**
Max. Rainfall	(1970-2007)	3.0	767	0.50	320	0.75	479

*1: Mononobe (1933) *1: Mononobe (1933)

$r_t = R_{24}/24*(34.7 / ((t/60)^{1.35} + 1.5)$ [Ito formula] $Q_p = 1/3.6*f*r_t*A$ $Q_p = 1/3.6*f*r_t*A$

2) Method 2 : Statistical Analysis of Annual Maximum Daily Discharge by Tank Model

Using results of the daily Tank Model from 1970 to 2009, the statistical analysis of annual maximum daily discharge by the Tank Model was carried out as shown below. The frequency curve of *Log-Peason Type-III* was applied.

Table A.22 Estimated Probable Flood Discharge at UB1

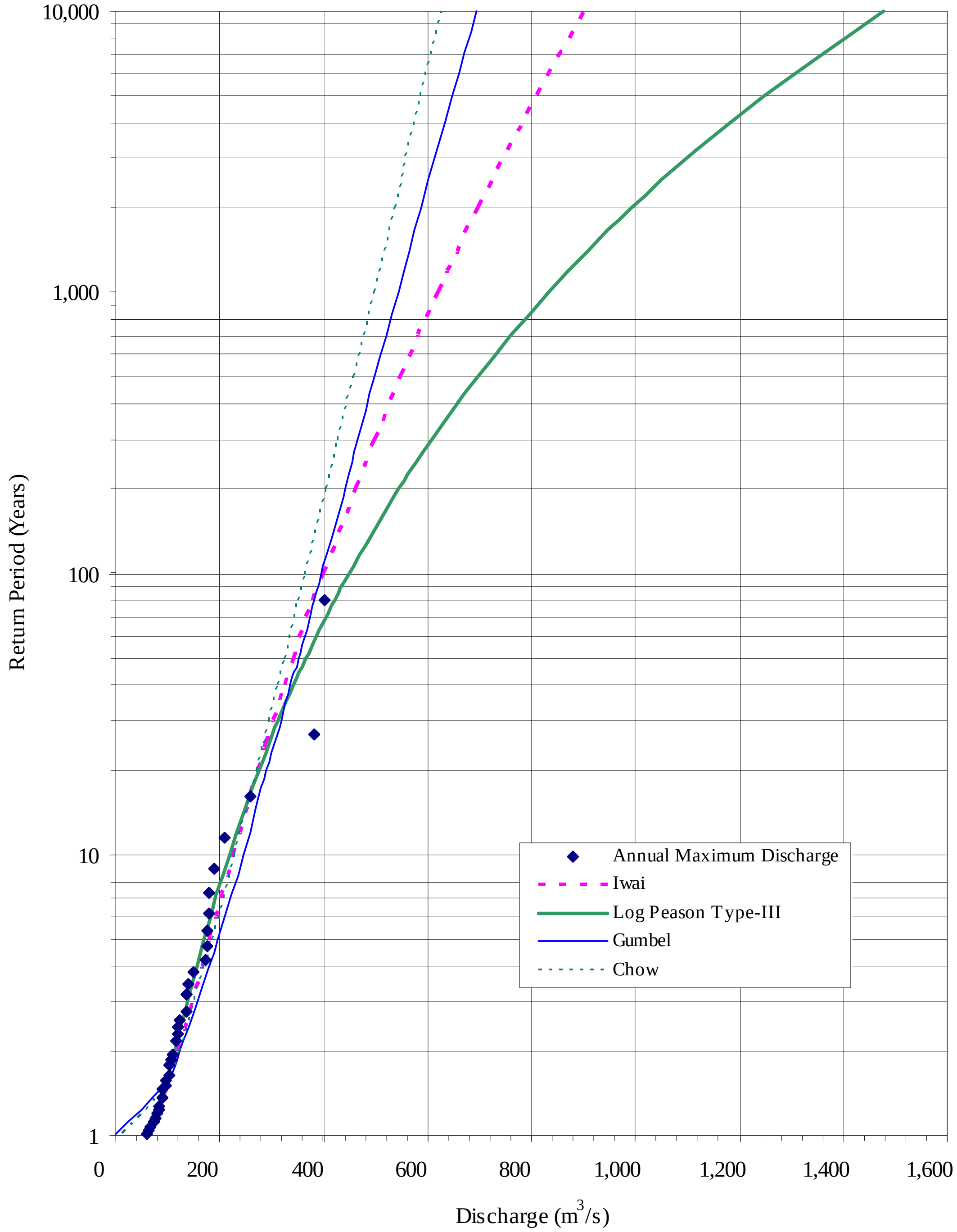
(C.A.=802 km^2) (m^3/s)

Return Period (Year)	Excess Proba-bility	Daily Discharge **Log Peason Type-III**	Assumed Peak Ratio for Daily Q	Estimated Peak Discharge
10	0.1000	**219**	2.39	524
20	0.0500	**276**	2.39	660
50	0.0200	**366**	2.39	875
100	0.0100	**448**	2.39	1,070
200	0.0050	**544**	2.39	1,299
1,000	0.0010	**833**	2.39	1,991
10,000	0.0001	**1,477**	2.39	3,530

Table A.23 Estimated Probable Flood Discharge at Regulating Dam

(C.A.=767 km^2) (m^3/s)

Return Period (Year)	Excess Proba-bility	Daily Discharge **Log Peason Type-III**	Assumed Peak Ratio for Daily Q	Estimated Peak Discharge
10	0.1000	**210**	2.39	501
20	0.0500	**264**	2.39	631
50	0.0200	**350**	2.39	837
100	0.0100	**428**	2.39	1,024
200	0.0050	**520**	2.39	1,242
1,000	0.0010	**797**	2.39	1,904
10,000	0.0001	**1,413**	2.39	3,376



Frequency Curve of Annual Maximum Flood Estimated by Tank Model (at UB-1)

Figure A.32 Frequency Curve of Annual Maximum Flood by Tank Model at UB-1

Table A.24 Annual Maximum Discharge at UB1 (by Tank Model Simulation)

No.	Year	Annual Max. Daily Discharge by Tank Model (m^3/s)	Peak Factor for Daily Discharge (assumed)	Estimated Annual Max. Peak Discharge (m^3/s)	Rank	Excess Proba-bility	Return Period (Year)
1	1970	73.33	2.39	175.3	9	78.75%	4.71
2	1971	75.18	2.39	179.7	7	83.75%	6.15
3	1972	35.28	2.39	84.3	32	21.25%	1.27
4	1973	57.55	2.39	137.5	13	68.75%	3.20
5	1974	37.13	2.39	88.7	30	26.25%	1.36
6	1975	30.63	2.39	73.2	36	11.25%	1.13
7	1976	43.63	2.39	104.3	23	43.75%	1.78
8	1977	33.42	2.39	79.9	34	16.25%	1.19
9	1978	42.70	2.39	102.1	25	38.75%	1.63
10	1979	35.27	2.39	84.3	33	18.75%	1.23
11	1980	26.91	2.39	64.3	39	3.75%	1.04
12	1981	27.84	2.39	66.5	38	6.25%	1.07
13	1982	62.19	2.39	148.6	11	73.75%	3.81
14	1983	46.41	2.39	110.9	21	48.75%	1.95
15	1984	57.55	2.39	137.5	13	68.75%	3.20
16	1985	51.06	2.39	122.0	16	61.25%	2.58
17	1986	32.48	2.39	77.6	35	13.75%	1.16
18	1987	49.19	2.39	117.6	19	53.75%	2.16
19	1988	38.06	2.39	91.0	28	31.25%	1.45
20	1989	72.40	2.39	173.0	10	76.25%	4.21
21	1990	43.63	2.39	104.3	23	43.75%	1.78
22	1991	50.12	2.39	119.8	18	56.25%	2.29
23	1992	107.67	2.39	257.3	3	93.75%	16.00
24	1993	40.84	2.39	97.6	27	33.75%	1.51
25	1994	49.19	2.39	117.6	19	53.75%	2.16
26	1995	37.13	2.39	88.7	30	26.25%	1.36
27	1996	38.06	2.39	91.0	28	31.25%	1.45
28	1997	118.82	3.39	402.8	1	98.75%	80.00
29	1998	25.05	2.39	59.9	40	1.25%	1.01
30	1999	74.25	2.39	177.5	8	81.25%	5.33
31	2000	30.63	2.39	73.2	36	11.25%	1.13
32	2001	58.48	2.39	139.8	12	71.25%	3.48
33	2002	159.65	2.39	381.6	2	96.25%	26.67
34	2003	40.85	2.39	97.6	26	36.25%	1.57
35	2004	79.83	2.39	190.8	5	88.75%	8.89
36	2005	56.62	2.39	135.3	15	63.75%	2.76
37	2006	75.19	2.39	179.7	6	86.25%	7.27
38	2007	44.55	2.39	106.5	22	46.25%	1.86
39	2008	87.25	2.39	208.5	4	91.25%	11.43
40	2009	50.13	2.39	119.8	17	58.75%	2.42
	Max.	159.65		402.8			

For estimation of peak flood discharge from daily mean maximum discharge by the Tank Model, assumed ratio of 2.39 times was applied which was derived from relationship between hourly peak flood discharge record and the daily mean discharge at Indein observed by Dr. Furuichi as shown below.

Table A.25 Peak Ratio to Mean Daily Discharge

Flood Occurred Date/ Hour	Hourly Peak Discharge (m^3/s)	Daily Mean Discharge (m^3/s)	Peak/ Daily Mean Ratio (Times)
2005/8/13 17:30	87.03	50.09	1.74
2005/9/27 19:30	84.69	35.47	2.39
2005/9/29 20:30	82.62	54.81	1.51
2005/10/3 18:30	96.21	54.74	1.76
		Average=	**1.85**
		Maximum=	**2.39**

Source: Furuichi, T. 2008. *Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*. A final report submitted to Forest Department, Myanmar. 8 March 2008

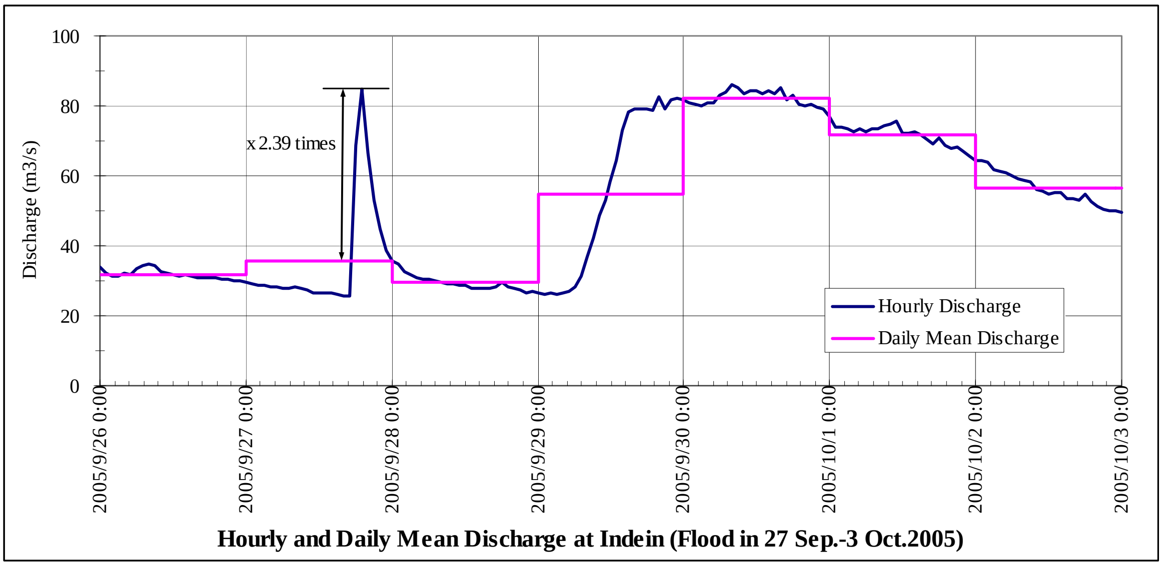


Figure A.33 Hourly and Daily Mean Discharge at Indein (27 Sep.~3 Oct. 2005 Flood)

3) Method 3 : Flood Simulation by Daily Tank Model

Using the calibrated daily Tank Model for UB-1 as shown in **Section A.8** the flood simulation was carried out by each return period. The maximum daily rainfall during 1970-2009 at Pinlaung was occurred in 19 May 2005 at 296 mm/day. For the flood simulation, several design daily basin rainfalls at each return period were inputted in the Tank Model. The results of flood simulation by the Tank Model were shown below. Base flow was assumed at 20 m^3/s based on an average base flow discharge during rainy season. For estimation of peak flood discharge from daily mean maximum discharge by the Tank Model, assumed ratio of 2.39 times was also applied.

Table A.26 Estimated of Peak Flood Discharge at Regulating Dam by Tank Model

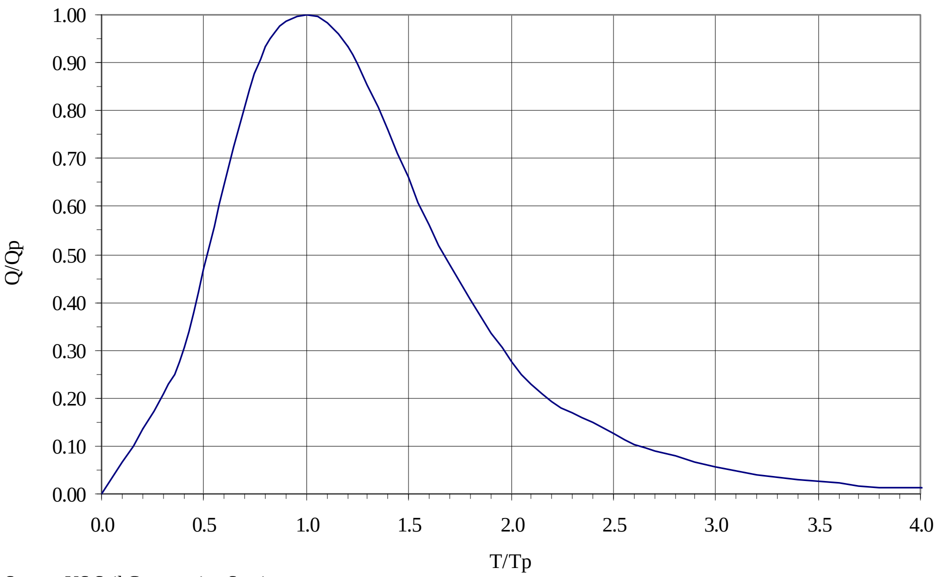
CA [km^2]= 767

Return Period (Year)	Excess Probability (%)	Daily Maximum Rainfall at Pinlaung R_{24} (mm)	Area Reduction Factor of Point Rainfall to Basin Rainfall	Daily Maximum Basin Mean Rainfall R_{24} (mm)	Daily Max. Discharge by Tank (UB-Dam) Q_p (m^3/s)	Hourly Peak/ Daily Man Ratio (assumed)	Assumed Base Flow Q_{Base} (m^3/s)	Estimated Peak Discharge (UB-Dam) Q_p (m^3/s)
10	10.0%	132	0.7575	100	61.26	2.39	20.00	167
20	5.0%	164	0.7575	124	83.45	2.39	20.00	220
100	1.0%	266	0.7575	**202**	**155.35**	2.39	20.00	**391**
200	0.5%	326	0.7575	247	196.19	2.39	20.00	489
1,000	0.1%	515	0.7575	390	324.91	2.39	20.00	796
PMF		554	0.7575	**420**	**352.43**	2.39	20.00	**862**
Max. Rainfall (1970-2008)	(2002/May/19)	296	0.7575	224	171.33	2.39	20.00	430

4) Method 4 : SCS Unit Hydrograph

To estimate the flood hydrographs of different occurrence probability and the probable maximum flood (PMF), the Unit hydrograph analysis was applied. The hydrograph method synthesizes the design flood and probable maximum flood (PMF) runoff hydrographs from probable rainfalls and the probable maximum precipitation (PMP) from the unit hydrograph, which shows the relationship between a single unit of the basin mean rainfall and runoff.

In this study, the unit hydrograph method established by the *U.S. Soil Conservation Service* (SCS), which has been employed for various water resource development projects to date, was applied to estimate the flood hydrograph simply from the probable rainfalls. The standard dimensionless unit hydrograph given by the SCS synthetic method is shown in Figure A.34.



Source: US Soil Consevation Service

Standerd Dimensionless Hydrograph (by SCS Method)

Figure A.34 Standard Dimensionless Hydrograph by *SCS*

The SCS method was developed by analyzing a large number of basins from various geographic locations. Unit hydrographs were evaluated for a large number of actual watersheds and then made dimensionless by dividing all discharge ordinates by the peak discharge and the time ordinates by the time to peak. The average of these dimensionless unit hydrographs was computed.

SCS Unit Hydrograph

The SCS unit hydrograph is derived from the flood concentration time and unit basin mean rainfall. The unit hydrograph is constructed for a unit rainfall of 1.0 mm. The peak discharge of the unit hydrograph is calculated as follows.

$$Q_p = 0.208 \times A \times \frac{Q}{t_p}$$

where, Q_p : Peak Discharge [m^3/sec]
A : Catchment Area [km^2]
Q : Total volume of the unit graph (= 1 mm)
t_p : Time to peak [hours]

The SCS has determined that the time to peak (t_p) and rainfall duration (D) are related to time to concentration (t_c) as follows.

$$t_p = 2 \times \left(\frac{t_c}{3} \right)$$

$$D = 0.133 \times t_c$$

The calculation process of the SCS unit hydrograph is expressed below.

SCS Unit Hydrograph	at Upper Baluchaung Proposed Regulating Dam Site		
Q_p = 0.208 * A * Q / t_p	***(US Soil Conservation Service Unit Hydrograph)***	Dam site	
Q_p : Peak Discharge [m^3/sec]		**14.5**	[m^3/sec/mm]
A : Catchment Area [km^2]		767	[km^2]
Q : Total volume of the unit graph (= 1 mm)		1	[mm]
t_p : Time to peak [hours]		11.00	[hours]
Time to Peak			
t_p = 2 * t_c / 3		**11.0**	[hours]
		10.933	
Rainfall Duration			
D = 0.133 * t_c		**3.0**	[hours]
		2.18	[hours]
Flood Concentration Time			
(*Kirpich*'s formula)			
t_c = 3.97 * $L^{0.77}$ * $S^{-0.385}$	**(*Kirpich*'s formula)**	**16.4**	[hours]
t_c : Flood concentration time [min]		983	[min]
L : Maximum length of travel of water [km]		81.2	[km]
S : Average slope (= H/L)		0.004	
H : Difference in elevation between the remote point in the basin and the outlet		312	[m]

Flood Concentration Time

Flood concentration time is defined as the time of travel from the most remote point in the catchment to the forecast point. The flood concentration time can be estimated by the formula of *Kirpich* as follows.

$$t_c = 3.97 \times L^{0.77} \times S^{-0.385} \qquad \text{(Kirpich's formula)}$$

where, t_c : Flood concentration time [min]

L : Maximum length of travel of water [km]

S : Average slope (= H/L)

H : Difference in elevation between the remote point in the basin and the outlet

With a maximum length of travel (L) of 81.2 km and difference in elevation (H) of 312 m, the concentration time (t_c) was found to be 983 minutes or about 16.4 hours. With a catchment area (A) of 767 km^2, the peak flow (Q_p) is found to be 14.5 m^3/sec/mm. The time to peak (t_p) is found to be 11.0 hours and the duration of the hydrograph (D) is 3.0 hours. The time to peak (t_p) was checked by using hourly flood hydrograph records at Indein gauging station as shown in the Figure A.35. According to the Figure A.35, the time to peak (t_p) of observed floods at Indein is to be at around 10 hours, except local floods caused by only downstream rainfall near Yaunghste station.

Design Hyetograph

Because of no hourly rainfall data available in/around project site during observed flood record period at Indein or UB-1, the design rainfall pattern hyetograph was assumed by using following *Mononobe*'s Formula.

[*Mononobe*'s Formula]

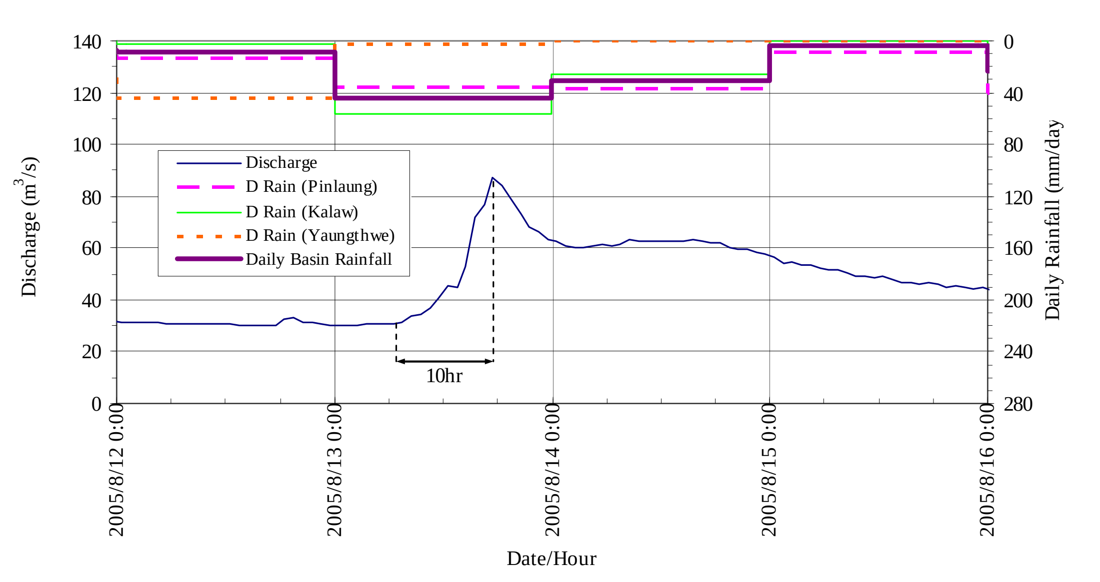
$$r_t = \frac{R_{24}}{24} \times \left(\frac{24}{t} \right)^{2/3} \quad \text{[mm/hr]} \qquad \text{(for 24hr)}$$

where, r_t : average rainfall intensity in flood duration [mm/hr]

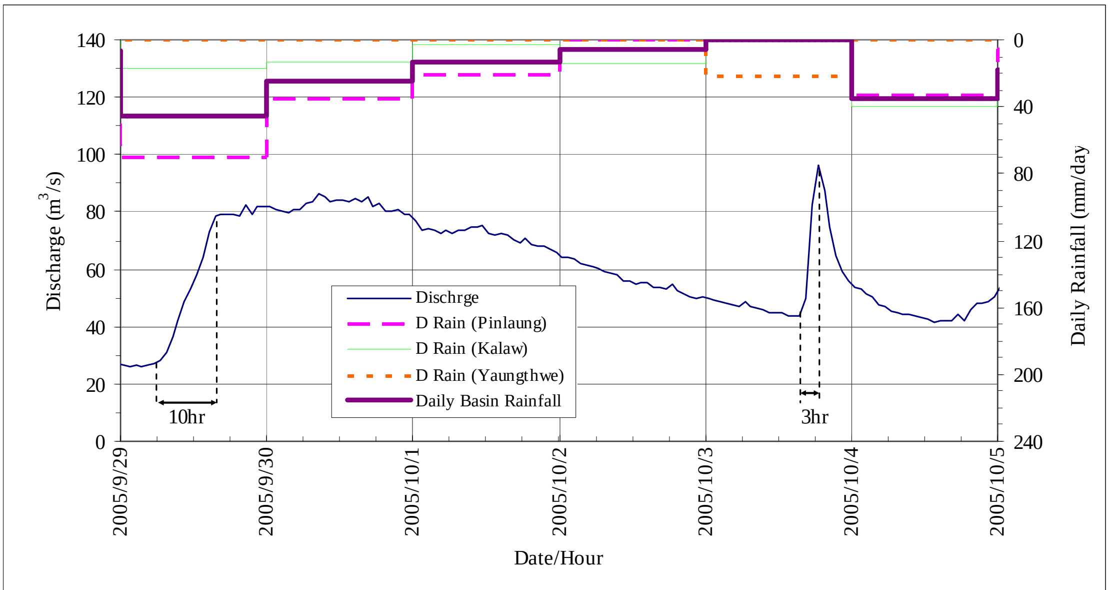
R_{24} : probable daily rainfall [mm/day]

t : time of concentration of runoff [hour]

Distribution of hourly rainfall intensity was assumed 3-types such as central concentration, forward concentration and backward concentration patterns in 24 hours.



Hourly Flood Hydrograph at Indein Gauging Station (12-16 Aug, 2005)



Hourly Flood Hydrograph at Indein Gauging Station (Sep.29-Oct.5 2005)

Figure A.35 Hourly Observed Flood Hydrograph at Indein

Base Flow

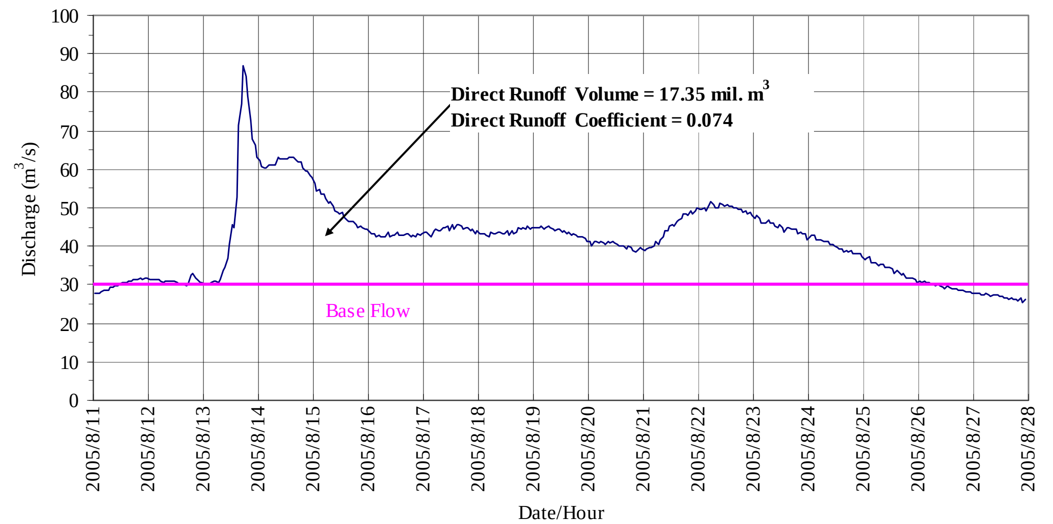
In order to estimate direct flood runoff, the base flow should be separated from the hydrograph. Through the Tank Model analysis for 40 years from 1970 to 2009, the base flow during the wet season was estimated at 20 m^3/s in the river basin.

Direct Runoff Coefficient (Rainfall Excess)

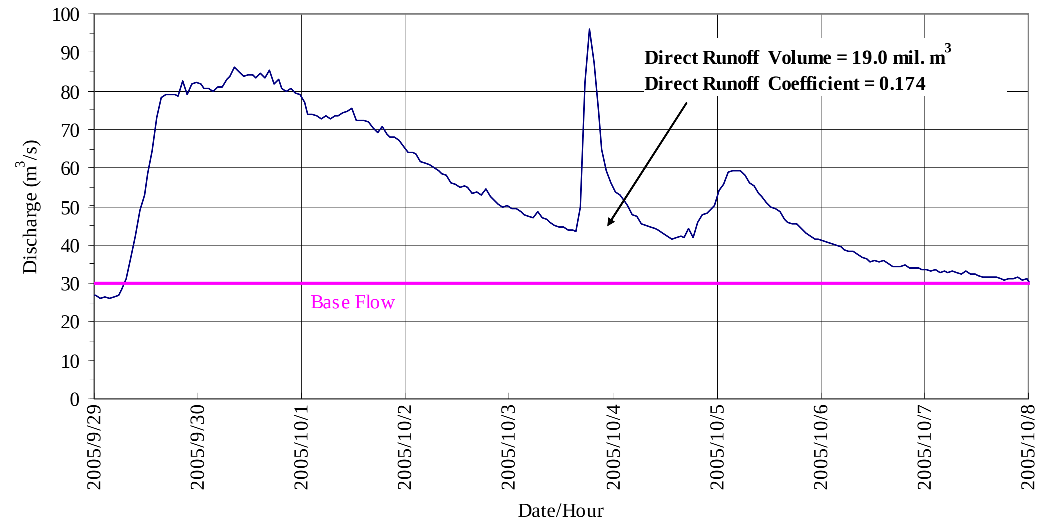
In order to estimate a flood hydrograph by mean of unit-graph, it is required to compute rainfall excess by separating effective rainfall from storm rainfall, which generally includes losses for interception, depression, soil moisture charge, evaporation and transpiration. However such data are not available, and therefore the direct runoff coefficients ranging from 0.074 to 0.174, which were obtained from the floods measured at Indein in 2005 as shown in Figure A.36, were applied as rainfall excess for estimate of each probable flood:

1/10-year flood	0.174
1/20-year flood	0.174
1/100-year flood	0.174
1/200-year flood	0.200
1/1,000-year flood	0.300
PMF	0.400

A drain rate grows in the same way big to give it bigger rainfall than an existing flood with PMF calculation. To estimate PMF, it was set at 40 % of direct runoff coefficient for the safety side.



Hourly Flood Hydrograph at Indein Gauging Station (11-28 Aug, 2005)



Hourly Flood Hydrograph at Indein Gauging Station (Sep.29-Oct.8 2005)

Figure A.36 Direct Runoff Coefficient of Flood Records at Indein

PMF and Design Flood Hydrographs

The Probable Maximum Flood (PMF) and design flood hydrographs and estimated peak discharge calculated using the SCS unit hydrograph and PMP calculated by *Hershfield*'s method, are shown in Figures A.37 to A.43. Summary of estimated PMF and design flood by SCS Unit Hydrograph method is presented in the Table below.

Table A.27 Peak Flood Discharge at RD and UB1 by SCS Method

PMF at Proposed Regulating Dam Site C.A.[km^2] = **767**

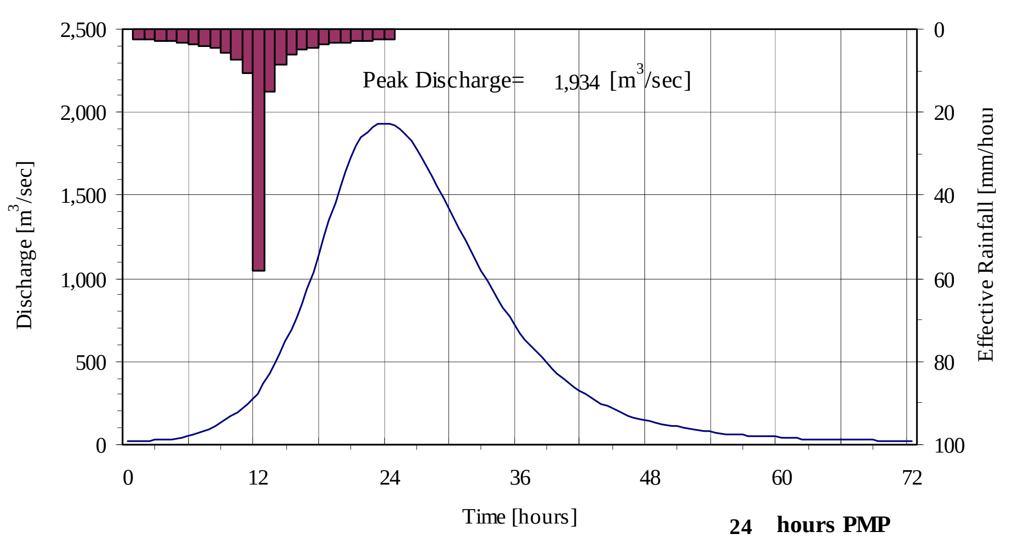
Duration of PMP [hours]	PMP Basin Rainfall [mm]	Direct Runoff Coefficient (assumed)	Base flow (assumed) [m^3/sec]	PMF Peak Discharge [m^3/sec]	PMF Specific yield [m^3/sec/100km^2]
24 hr	**420**	**0.40**	**20.0**	**1,940**	**252.9**

Design Flood at Proposed Regulating Dam Site

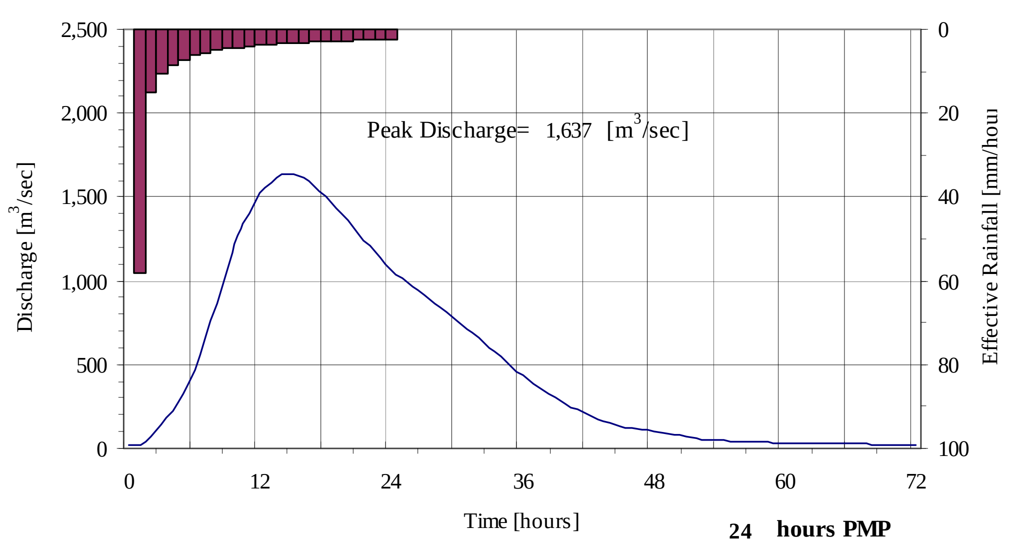
Return Period (Year)	Max. Basin Rainfall R_{24} (mm)	Direct Runoff Coefficient (assumed)	Base flow (assumed) [m^3/sec]	Flood Peak Discharge [m^3/sec]	Flood Specific yield [m^3/sec/100km^2]
2	58	0.174	20.0	135	17.6
5	80	0.174	20.0	178	23.2
10	100	0.174	20.0	218	28.4
20	124	0.174	20.0	266	34.7
100	202	0.174	20.0	**420**	54.8
200	247	0.200	20.0	**580**	75.6
1000	390	0.300	20.0	**1,350**	176.0

Design Flood at Proposed UB1 Intake Site C.A.[km^2] = **802**

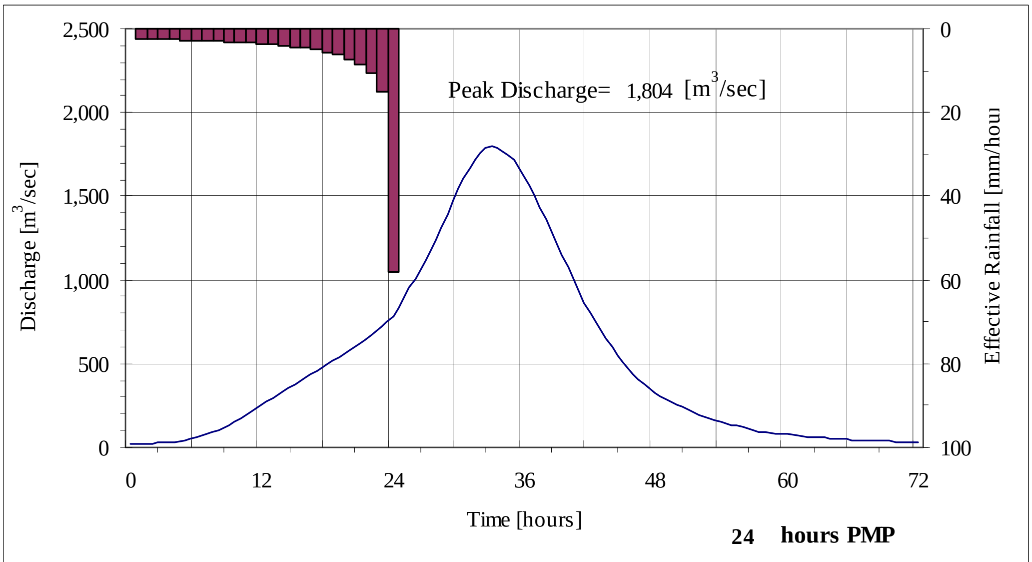
Return Period (Year)	Max. Basin Rainfall R_{24} (mm)	Direct Runoff Coefficient (assumed)	Base flow (assumed) [m^3/sec]	Flood Peak Discharge [m^3/sec]	Flood Specific yield [m^3/sec/100km^2]
2	58	0.174	20.0	141	18.4
5	80	0.174	20.0	186	24.3
10	100	0.174	20.0	228	29.7
20	124	0.174	20.0	278	36.2
100	202	0.174	20.0	**440**	57.4
200	247	0.200	20.0	**610**	79.5
1000	390	0.300	20.0	**1,410**	183.8



PMF Hydrograph at Upper Baluchaung Proposed Regulation Dam Site



PMF Hydrograph at Upper Baluchaung Proposed Regulation Dam Site



PMF Hydrograph at Upper Baluchaung Proposed Regulation Dam Site

Figure A.37 24hr-PMF Hydrograph at Proposed Regulation Dam Site

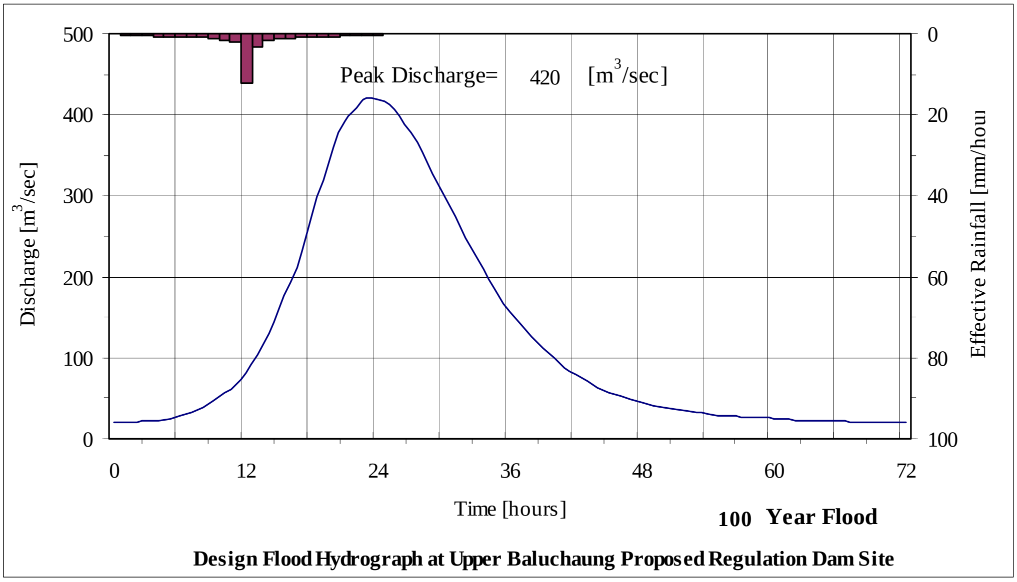


Figure A.38 1/100yr Flood Hydrograph at Proposed Regulation Dam Site

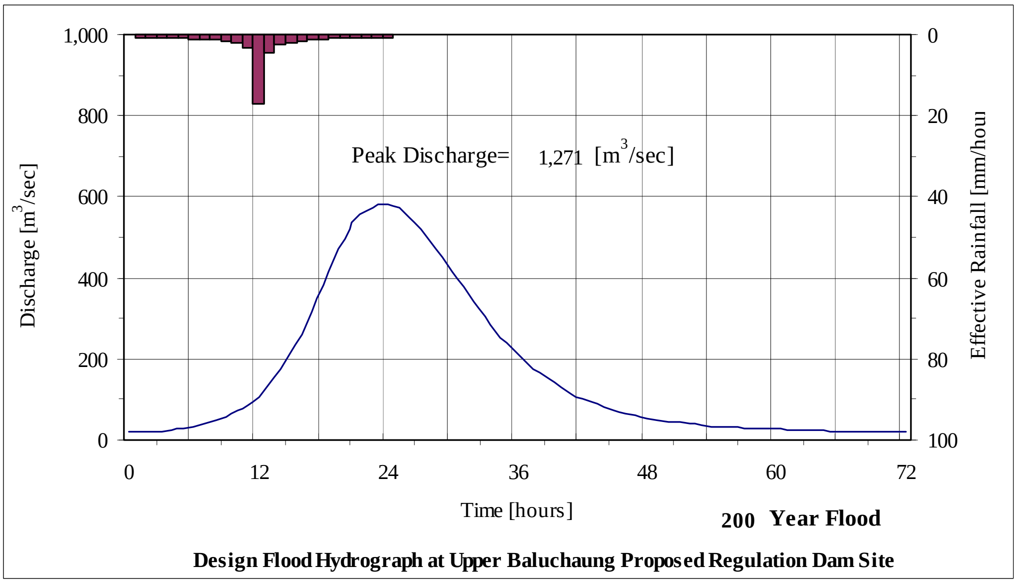


Figure A.39 1/200yr Flood Hydrograph at Proposed Regulation Dam Site

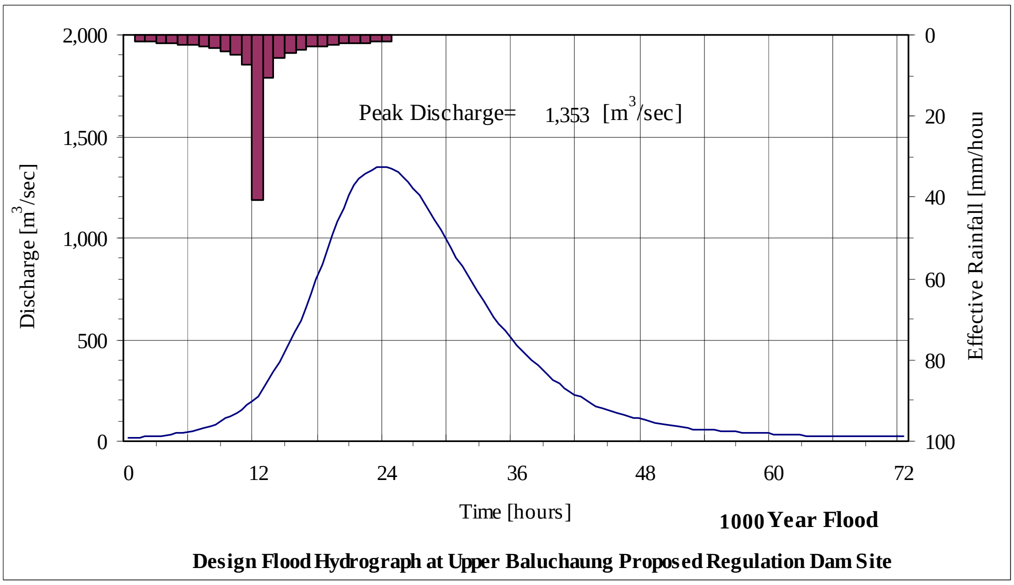


Figure A.40 1/1000yr Flood Hydrograph at Proposed Regulation Dam Site

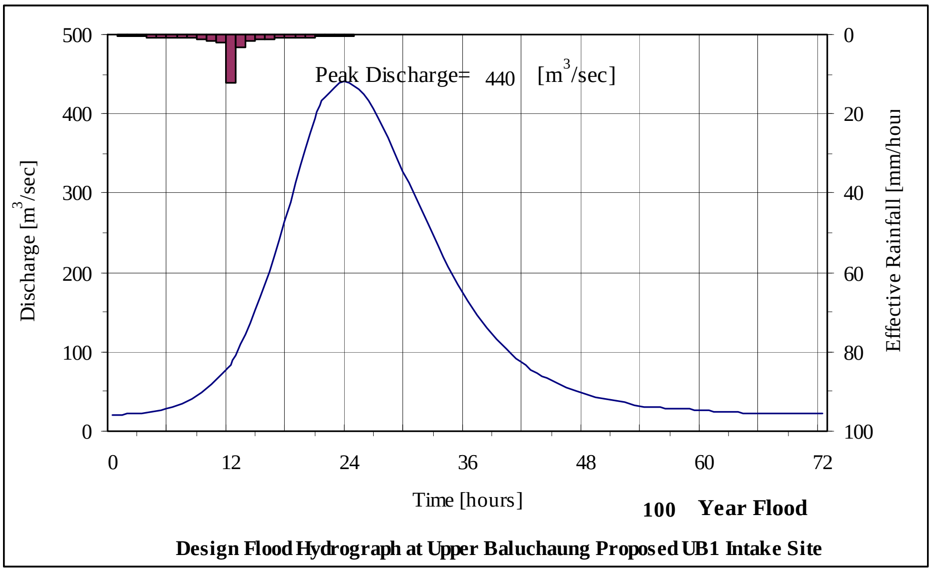


Figure A.41 1/100yr Flood Hydrograph at UB1 Intake Site

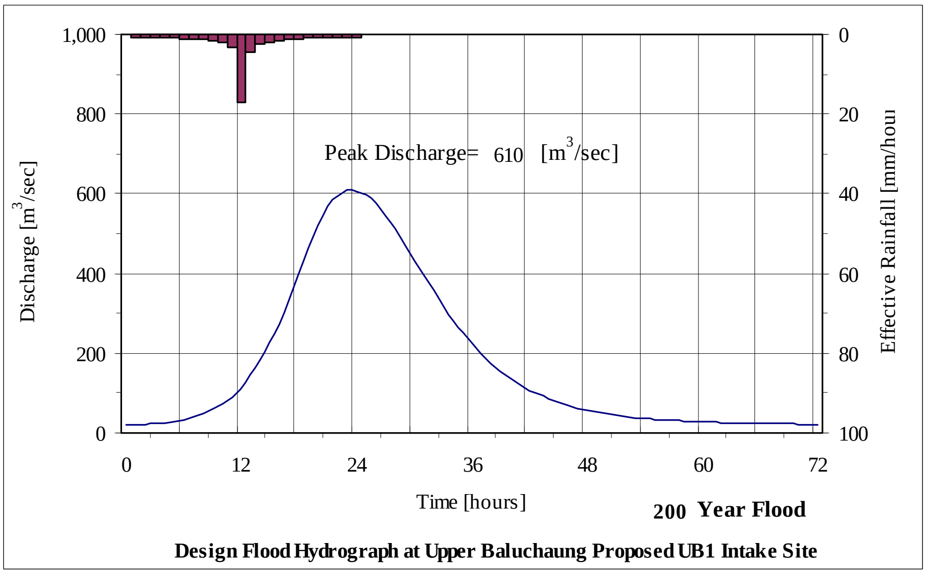


Figure A.42 1/200yr Flood Hydrograph at UB1 Intake Site

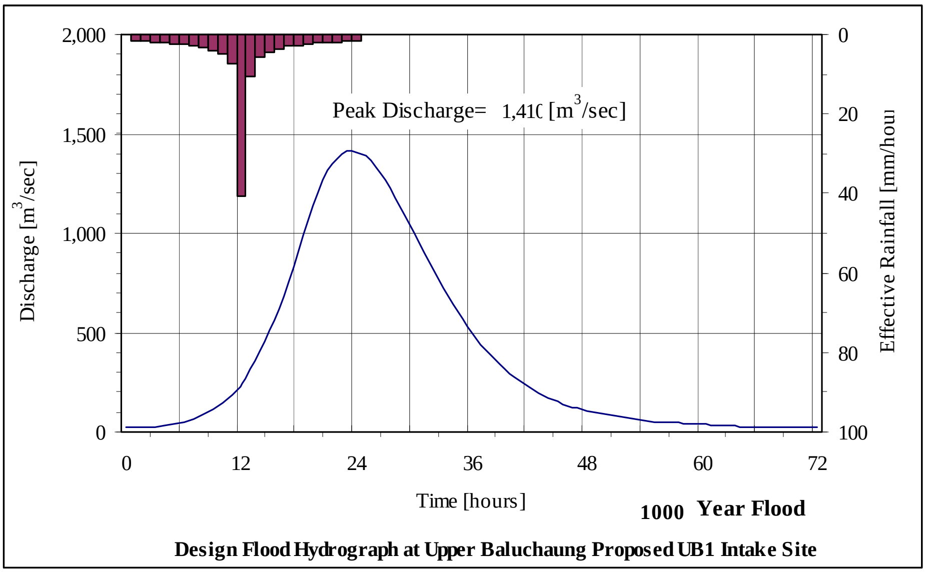


Figure A.43 1/1000yr Flood Hydrograph at UB1 Intake Site

5) Comparison of Design Flood by Several Methods

The peak flood discharges estimated by various methods are shown in Table A.28 for comparison. There are no definite reasons to justify the design flood because of the limited availability of the flood records and hourly rainfall, but it is understood that the SCS Method gives reasonable value as compare with other methods. It is therefore judged that the SCS Method be applied for the Study.

Table A.28 Comparison of Peak Floods

No.	Method	Note	Runoff Coefficient	Flood Peak Discharge (m^3/s) at Upper Baluchaung Proposed Regulating Dam Site [CA=767km^2]					
			f	1/10yr	1/20yr	**1/100yr**	1/200yr	1/1,000yr	PMF
1	Rational Formula (Velocity by Rziha Formula)	[Ito Formula]	0.5	138	181	288	352	554	597
2	Rational Formula (Velocity by Rziha Formula)	[Ito Formula]	0.75	208	272	431	527	831	895
3	Tank Model	(Daily Mean Peak)		61	83	155	196	325	352
		(x2.39times+Baseflow 20m^3/s)		166	219	391	489	797	862
4	Unit Hydrograph (SCS Unit Hydrograph)	Base flow = 20m^3/s	0.174～0.4	218	266	**420**	583	1,353	**1,940**
5	Flood Frequency by using Annual Max. Q (Annual Max. Daily Q by Tank Model x 2.39times)			210	264	428	520	797	

	1/10yr	1/20yr	1/100yr	1/200yr	1/1,000yr	PMF
Daily Rainfall at Pinlaung (mm/day)	132	164	266	326	515	554
Daily Basin Mean Rainfall (mm/day)	100	124	202	247	390	420

Table A.29 Peak Flood Discharge by SCS Method

	Site	C. A. (km^2)	Return Period Year/ Design Flood Peak Discharge (m^3/sec)					
			1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
1	Regulating dam	767	218	266	420	583	1,353	1,940
2	UB-1 Intake	802	228	278	440	609	1,415	2,029
3	UB-1 Powerhouse	816	232	283	447	620	1,439	2,064
4	UB-2 Intake	822	234	285	451	625	1,450	2,079
5	UB-2 Powerhouse	828	236	287	454	629	1,460	2,094
6	Indein	836	238	290	458	635	1,474	2,115

(7) *Creager*'s Coefficient of Design Floods

The peak flood discharges estimated above are plotted to see the distribution on the *Creager's Curve* which gives a comprehensive range of the regional characteristics of floods. A *Creager*'s coefficient is given by the following equations:

$$Q_p = 0.503 \times C \times \left(\frac{A}{2.59} \right)^a$$

$$a = 0.894 \times \left(\frac{A}{2.59} \right)^{-0.048} -1$$

Where, Q_p : Peak discharge [m^3/sec]
C : *Creager*'s coefficient
A : Catchment area [km^2]

The *Creager*'s coefficient corresponding to each design flood is summarized as follows:

Table A.30 Peak Flood Discharge and *Creager*'s Coefficient

Return Period	Design Flood (m^3/s)	Catchment Area (km^2)	Specific Flood ($m^3/s/km^2$)	Creager's C
1/100yr	420	767	0.55	6.7
1/200yr	583	767	0.76	9.3
1/1000yr	1,353	767	1.76	21.6
PMF	1,940	767	2.53	31.0

Figure A.44 shows the relationship between peak flood discharge and catchment area estimated for the Project, together with those of other projects in Myanmar. It is understood that the estimated floods at the proposed Regulating Dam site are within a reasonable range as compared with other projects in the region.

Table A.31 Largest Floods and Design Floods in Myanmar

Station			Available Data	Latitude	Longitude	Catchment Area	Elevation	Max. Flood Q (m^3/s)	Specific Q ($m^3/s/km^2$)	Creager's C	Flood Occurrence Date
Code	(Name of River)		Year			(km^2)	(m)	Data of Flood Occurrence			
2010	HKAMTI	(CHINDWINN)	72 - 94	N 26:00	E 95:42	27,420	142.0	23,000	0.839	87.3	13.7.91
2020	HTAMATHI	(CHINDWINN)	67 - 94	N 25:19	E 95:17	39,440	145.6	20,940	0.531	71.0	18.7.91
2040	HOMALIN	(CHINDWINN)	68 - 93	N 24:52	E 94:54	43,124	131.0	20,940	0.486	69.1	12.7.68
2060	MAWLAIK	(CHINDWINN)	72 - 94	N 23:38	E 94:25	69,339	112.6	27,040	0.390	77.7	20.7.76
2070	KALEWA	(CHINDWINN)	66 - 94	N 23:12	E 94:18	72,848	110.6	28,130	0.386	79.7	7.10.66
2110	MONYWA	(CHINDWINN)	66 - 94	N 22:06	E 95:18	110,350	73.3	27,550	0.250	69.9	9.10.80
3010	MACHANBAW	(MALIKHA)	83 - 94	N 26:30	E 97:14	2,792	1,219.0	4,350	1.558	38.4	27.9.87
3060	KATHA	(AYEYARWADY)	66 - 93	N 24:10	E 96:20	77,942	94.0	21,900	0.281	61.0	12.10.79
3100	SAGAING	(AYEYARWADY)	66 - 94	N 21:52	E 95:59	117,900	70.2	30,664	0.260	76.4	13.8.74
3710	HSIPAW	(MYITNGE)	66 - 94	N 22:36	E 97:18	11,798	436.0	1,170	0.099	5.9	21.8.73
3720	SHWESAYAN	(MYITNGE)	67 - 94	N 21:41	E 96:23	27,904	-	3,926	0.141	14.8	15.10.86
4020	CHAUK	(AYEYARWADY)	72 - 91	N 20:54	E 94:50	323,630	53.5	36,800	0.114	72.1	15.8.74
4080	PROME	(AYEYARWADY)	66 - 94	N 18:48	E 95:13	340,390	31.3	51,500	0.151	99.3	15.8.74
5020	ZALUN	(AYEYARWADY)	85 - 94	N 14:06	E 95:13		13.7	30,540			
5510	NGATHAING GYAU	(NGAWUM)	85 - 94	N 17:24	E 95:05		13.4	3,340			
6220	ZAUNGTU	(BAGO)	86 - 94	N 17:38	E 96:14	1,927	9.8	1,382	0.717	14.3	15.8.86
6240	BAGO	(BAGO)	66 - 94	N 17:20	E 96:30	2,580	11.3	1,430	0.554	13.1	26.8.70
7040	TAUNGOO	(SITTAUNG)	67 - 94	N 18:55	E 96:28	14,660	44.3	1,623	0.111	7.6	27.8.73
7060	MADAUK	(SITTAUNG)	67 - 94	N 17:55	E 96:51	26,758	10.8	4,520	0.169	17.3	14.8.91
7570	SHWEGYIN	(SHWEGYIN)	65 - 94	N 17:55	E 96:32	1,747	12.0	3,100	1.774	33.6	5.8.94
8080	HPA-AN	(THAN-LWIN)	66 - 94	N 16:50	E 97:40	295,270	12.8	20,940	0.071	41.8	17.8.91

Source : Department of Meteorology and Hydrology

State/ Division	Project Name/ Site Name	Catchment Area (km^2)	Design Flood/ Measured (m^3/s)		Specific Flood ($m^3/s/km^2$)	Creager's C	Remarks
Shan	Kyaington-2	67	180	*1	2.69	11.5	
Shan	Kyaukme	181	200	*1	1.10	6.9	
Shan	Nanlet Chaung	710	248	*1	0.35	4.1	Design Flood (100ys)
Shan	Nyaunggyat Dam	2,445	2,200	*1	0.90	20.6	Design Flood (100ys)
Shan	Hu-mon	23	183	*1	7.96	24.2	Design Flood (100ys)
Shan	Zawgyi	4,087	1,982	*1	0.48	14.8	Measured Flood (24/09/1949)
Shan	Yenwe	912	2,180	*1	2.39	32.0	Measured Flood (1937)
Mandalay	Samon	2,580	1,526	*1	0.59	13.9	Design Flood (100ys)
Mandalay	Thitson	376	510	*1	1.36	11.8	Measured Flood (1917)
Mandalay	Panlaung	2,577	1,699	*1	0.66	15.5	Measured Flood (10/1926)
Mandalay	Thinbon Chaung	290	1,334	*1	4.60	35.5	Measured Flood
Shan	Mobye	1,780	800		0.45	8.6	Estimate inflow from max spillway Capacity
Shan	Heho	249	660		2.65	19.1	One of estimate of flood discharge
Shan	Yeywa	28,206	7,410		0.26	27.6	Design Flood (10,000 ys)
Shan	Yeywa	28,206	12,470		0.44	46.7	PMF
Shan	Paunglaung	4,381	5,000		1.14	36.6	Design Flood (1,000 ys)
Shan	Paunglaung	4,381	10,000		2.28	73.2	PMF
Shan	Upper Paunglaung	2,572	3,500		1.36	32.0	Design Flood (1,000 ys)
Shan	Upper Paunglaung	2,572	7,000		2.72	64.0	PMF
					Average	**26.2**	

Source *1: Study on Introduction of Renewable Energies in Rural Areas in Myanmar, Vol.5 Development Plan, Appendix B, Heho Small Hydro, JICA/Nippon Koei, Sep.2003

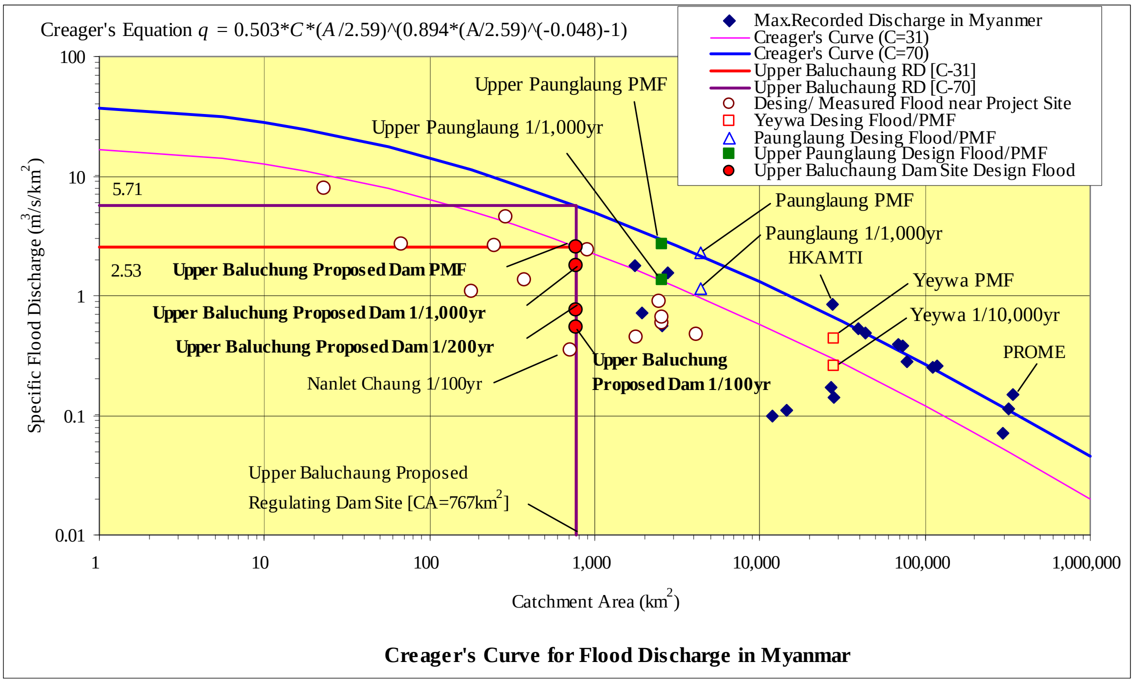


Figure A.44 ***Creager*'s Curve for Flood Discharges in Myanmar**

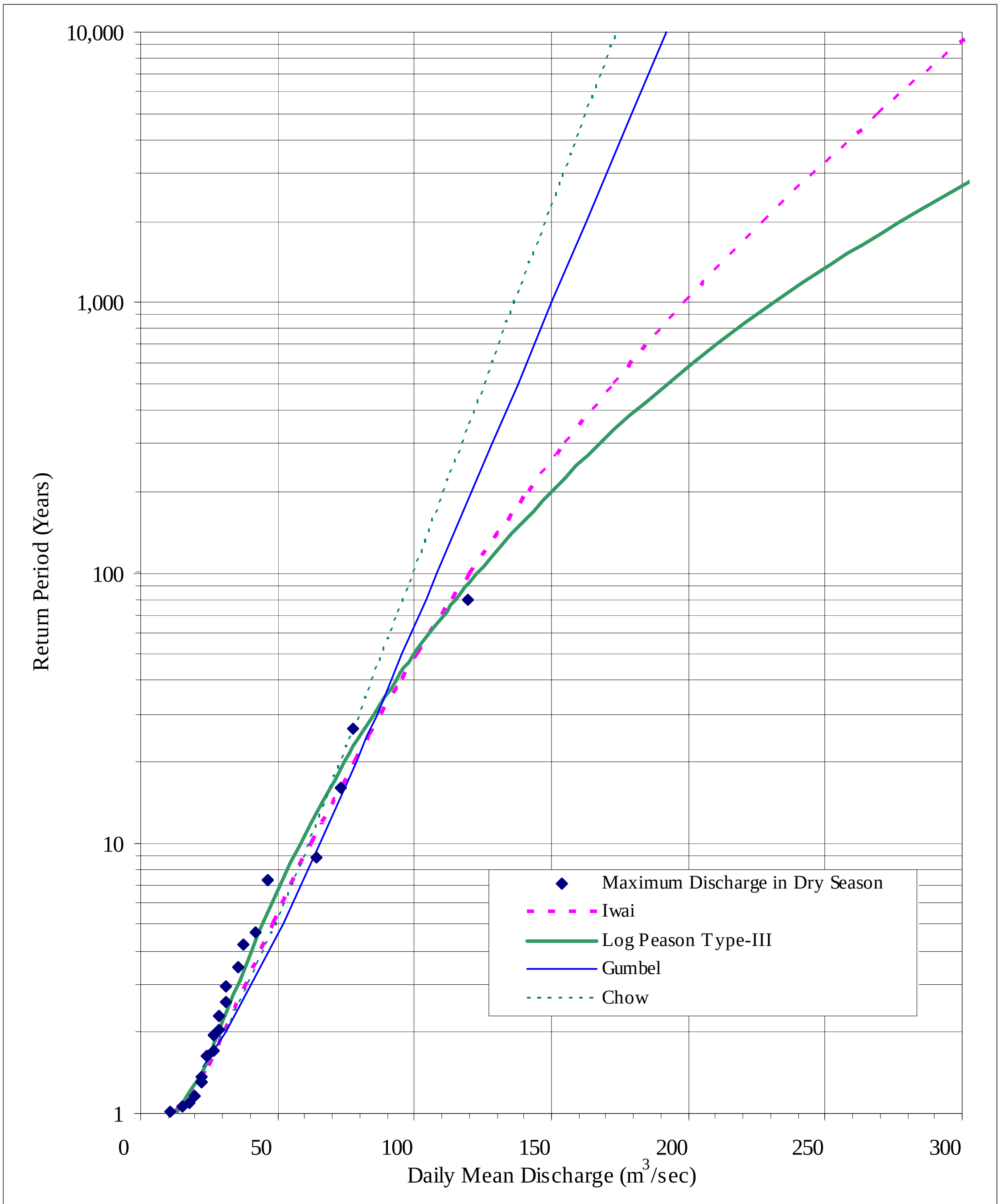
(8) Probable Floods during Dry Season

Probable floods (peak discharge) during the dry season from November/December to April were estimated for the construction planning. The data used for the analysis are i) the daily discharge in the dry season at UB-1 from 1970 to 2009 simulated by the Tank Model, and ii) peak ratio of 2.39 (peak daily discharge/mean daily discharge). The frequency curve of the "Log Peason Type-III" is applied for the probability analysis. The probable peak flood discharges in the dry season estimated at the UB-1 site are summarized in the Table below.

Table A.32 Peak Flood Discharge during Dry Season at UB-1

Return Period (Year)	Excess Probability	November-April	December-April
		Peak Discharge (m^3/s)	Peak Discharge (m^3/s)
2	0.5000	41.6	28.6
5	0.2000	70.1	44.6
10	0.1000	**96.0**	**58.5**
20	0.0500	127	74.5
25	0.0400	138	80.2
30	0.0333	148	85.1
40	0.0250	165	93.2
50	0.0200	**178**	**99.8**
80	0.0125	210	115
100	0.0100	227	123

Note: Log Peason Type-III was applied.



Flood Frequency Curve for Dry Season Period (December - April)
at Upper Baluchaung Proposed No.1 Intake Site [C.A. = 802 km^2]

Figure A.45 Flood Frequency Curve for Dry Season Period at UB-1

Table A.33 Annual Maximum Flood Discharge in Dry Season (Nov.-Apr.) at UB-1

No.	Year	Dry Season Maximum Discharge				Rank	Excess Proba-bility	Return Period (Year)
		Date	Daily Mean Max. Discharge (m^3/sec)	Peak Factor to Daily Q	Estimated Peak Discharge (m^3/sec)			
1	1970	1-Jan	14.9	2.39	35.5	25	38.75%	1.63
2	1971	2-Jan	15.8	2.39	37.7	21	48.75%	1.95
3	1972	3-Jan	19.5	2.39	46.6	19	53.75%	2.16
4	1973	4-Jan	15.8	2.39	37.7	21	48.75%	1.95
5	1974	5-Jan	14.9	2.39	35.5	25	38.75%	1.63
6	1975	6-Jan	20.4	2.39	48.8	16	61.25%	2.58
7	1976	7-Jan	12.1	2.39	28.8	33	18.75%	1.23
8	1977	8-Jan	11.1	2.39	26.6	34	16.25%	1.19
9	1978	9-Jan	11.1	2.39	26.6	36	11.25%	1.13
10	1979	10-Jan	8.4	2.39	20.0	39	3.75%	1.04
11	1980	11-Jan	15.8	2.39	37.7	24	41.25%	1.70
12	1981	12-Jan	20.4	2.39	48.8	15	63.75%	2.76
13	1982	13-Jan	13.9	2.39	33.3	28	31.25%	1.45
14	1983	14-Jan	46.4	2.39	110.9	4	91.25%	11.43
15	1984	15-Jan	15.8	2.39	37.7	21	48.75%	1.95
16	1985	16-Jan	39.9	2.39	95.4	5	88.75%	8.89
17	1986	17-Jan	13.0	2.39	31.1	30	26.25%	1.36
18	1987	18-Jan	30.6	2.39	73.2	6	86.25%	7.27
19	1988	19-Jan	22.3	2.39	53.2	13	68.75%	3.20
20	1989	20-Jan	10.2	2.39	24.4	37	8.75%	1.10
21	1990	21-Jan	12.1	2.39	28.8	32	21.25%	1.27
22	1991	22-Jan	50.1	2.39	119.8	3	93.75%	16.00
23	1992	23-Jan	25.1	2.39	59.9	11	73.75%	3.81
24	1993	24-Jan	13.9	2.39	33.3	29	28.75%	1.40
25	1994	25-Jan	9.3	2.39	22.2	38	6.25%	1.07
26	1995	26-Jan	26.0	2.39	62.1	8	81.25%	5.33
27	1996	27-Jan	19.5	2.39	46.6	17	58.75%	2.42
28	1997	28-Jan	19.5	2.39	46.6	17	58.75%	2.42
29	1998	29-Jan	5.6	2.39	13.3	40	1.25%	1.01
30	1999	30-Jan	74.3	2.39	177.5	2	96.25%	26.67
31	2000	31-Jan	13.0	2.39	31.1	30	26.25%	1.36
32	2001	1-Feb	26.0	2.39	62.1	10	76.25%	4.21
33	2002	2-Feb	17.6	2.39	42.1	20	51.25%	2.05
34	2003	3-Feb	14.9	2.39	35.5	25	38.75%	1.63
35	2004	4-Feb	26.9	2.39	64.3	7	83.75%	6.15
36	2005	5-Feb	26.0	2.39	62.1	8	81.25%	5.33
37	2006	6-Feb	23.2	2.39	55.5	12	71.25%	3.48
38	2007	7-Feb	22.3	2.39	53.2	13	68.75%	3.20
39	2008	8-Feb	**87.3**	2.39	208.5	1	98.75%	80.00
40	2009	9-Feb	11.1	2.39	26.6	34	16.25%	1.19

A.10 Reservoir Evaporation

The evaporation rate from the reservoir surface water (lake evaporation losses) was estimated, based on the monthly pan-evaporation measured at the Mobye Dam meteorological station. Actual evaporation loss from a reservoir surface is generally known to be less than that from a pan because of relatively large thermal inertia of lake and susceptibility of the pan to heat gains from radiation.

Pan coefficients generally lie in a range from 0.7 to 0.8, whilst 0.85 is applicable for humid regions. In this study, a pan coefficient of 0.8 was applied to estimate the monthly evaporation from the reservoir as follows:

Table A.34 Estimated Reservoir Evaporation

Station: Mobye Dam (unit:mm/day)

year	MONTH												Annual mean
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Average Daily Pan Evaporation	3.84	5.22	6.96	7.60	6.56	4.48	4.40	3.70	3.81	3.96	3.91	3.97	4.86
Pan Coefficient	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
Average Daily Reservoir	3.07	4.18	5.57	6.08	5.25	3.58	3.52	2.96	3.05	3.17	3.13	3.18	3.89

Source: Baluchaung Hydroelectric Project No.1 Power Station, O&M Manual Vol.II, NEWJEC, 1993

A.11 Reservoir Sedimentation

According to the research by Dr. Furuichi on sedimentation in Inle Lake, the annual suspended sediment yield at Indein in 2005 is estimated at 121 ton/km^2/year as shown in Table A.35.

Table A.35 Monthly Sediment Yields at Indein

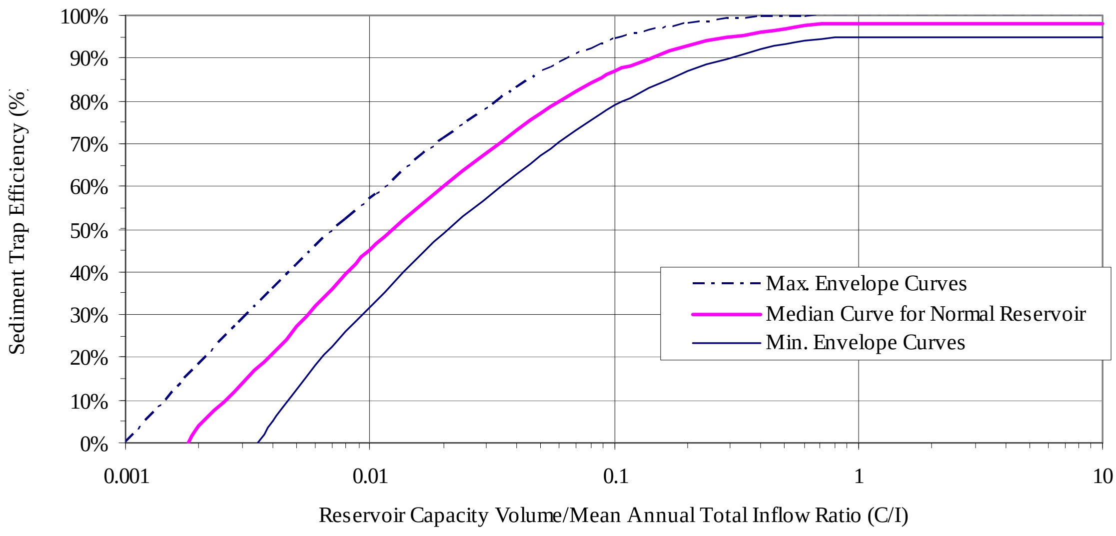
Month	Sediment yield (t/mon)	Sediment yield (t/yr)	Monthly contribution to the annual yield in 2005 (%)
2004.11	2,421		
2004.12	1,163		
2005.01	604		0.6
2005.02	399		0.4
2005.03	523		0.5
2005.04	524		0.5
2005.05	499		0.5
2005.06	1,175		1.2
2005.07	2,025		2.1
2005.08	37,253		37.9
2005.09	31,814		32.4
2005.10	16,683		17.0
2005.11	5,100		5.2
2005.12	1,694		1.7
Total 2005		98,293	
2006.01	703		
2006.02	260		
2006.03	186		
2006.04	312		
2006.05	395		
	C.A. at Indein =	813 km^2	
	Annual Sediment Yield (2005) =	121 t/km^2/yr	

Source: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", A final report submitted to Forest Department, Myanmar, Takahisa Furuichi, Centre for Resource and Environmental Studies, The Australian National University, 8 March 2008.

Assuming bed-load yield of 20% and average bulk density of the sediment at 1.20 t/m^3, the annual sediment yield from the Upper Baluchaung is estimated at 121 m^3/km^2/year. Using the catchment area of 767 km^2 at the Regulating Dam site, and assuming a trap efficiency of 91.3% given by *Brune*'s curve, the 100-year sediment volume at the proposed Regulating Dam site is estimated at 8,480,000 m^3 as shown below.

Annual Suspended Sediment Load Yield from Upper Baluchaung	121	t/km^2/yr	*1
Assumed Bed Road Yield	20%		
Assumed Bed Road Yield (assumed 20% of suspended load)	24.2	t/km^2/yr	
Total Annual Sediment Yield from Upper Baluchaung	145.2	t/km^2/yr	
Average Bulk Density of Sediment Load	1.20	t/m^3	
Total Annual Sediment Yield (Volume) from Upper Baluchaung	121	m^3/km^2/yr	
Catchment Area of Proposed Regulating Dam	767	km^2	
Annual Sediment Yield (Volume) at Proposed Regulating Dam	92,807	m^3/yr	
(*C*) Reservoir Gross Storage Capacity Volume by H-A-V curve	62	x10^6 m^3	
Mean Annual Discharge at Proposed Dam Site	10.58	m^3/s	
(*I*) Mean Annual Inflow Volume in Reservoir	333.57	x10^6 m^3	
Reservoir Capacity Volume/Mean Annual Total Inflow Ratio (C/I)	0.19		
Assumed Sediment Trap Efficiency by *Brune*'s Curve	91.3%		
Annual Sediment Trap at Proposed Regulating Dam	84,800	m^3/yr	
Total Reservoir Sedimentation after 100 year	**8,480,000**	**m^3**	

Source *1: "*Catchment Processes and Sedimentation in Lake Inle, Southern Shan State, Myanmar*", Takahisa Furuichi, Center for Resource and Environmental Studies, The Australian National University, A final report submitted to Forest Department, Myanmar, 08 March, 2008



Source: Reservoir Sedimentation, Impact, Extent, and Mitigation, K. Mahmood, World Bank Technical Paper Number 71

Brune's Curve for Reservoir Trap Efficiency

Figure A.46 *Brune*'s Curve for Reservoir Trap Efficiency

Appendix-A

Hydrology

Annual Rainfall

Annual Rainfall in Baluchaung River Basin (1/2)

Unit=mm

Year	Pinlaung	Kalaw	Taunggyi	Yaunghtwe	Loikaw	Mobye Dam
latitude	N 20°07'	N 20°37'	N 20°47'	N 20°39'	N 19°40'	N 19°46'
longitude	E 96°47'	E 96°34'	E 97°03'	E 96°56'	E 97°18'	E 97°05'
1900						
1901						
1902						
1903						
1904				1,337		
1905				1,056		
1906						
1907						
1908						
1909		1,453		1,513		
1910		1,165		1,391		
1911		1,296		1,152		
1912		1,271		1,070		
1913		1,480		1,317		
1914		1,397		1,045		
1915		1,370		1,235		
1916		1,330		1,934		
1917		1,520		1,117		
1918		1,302		1,241		
1919		1,232		1,014		
1920		1,091		940		
1921		1,120		1,262		
1922		1,390		1,038		
1923		1,348		1,045		
1924		1,116		1,251		
1925		1,285		1,250		
1926		1,398		1,200		
1927		1,603		1,324		
1928		1,700		1,089		
1929		1,337		1,186		
1930		1,173		1,428		
1931		860		1,037		
1932		1,075		1,114		
1933		1,077		1,299		
1934		1,150		964		
1935		1,291		995		
1936		1,530		1,170		
1937		1,563		1,357		
1938		1,356		1,097		
1939						
1940		1,314		1,110		
1941						
1942						
1943						
1944						
1945						
1946						
1947						
1948						
1949						
1950						
1951			1,398			
1952			1,570		1,006	
1953			1,480		1,111	
1954		968	1,334		882	
1955		1,240	1,676	1,087	1,040	
1956		1,075	1,539	1,226	1,333	
1957		438	1,303	812	1,026	
1958			1,416	1,004	954	
1959			1,606			

Annual Rainfall in Baluchaung River Basin (2/2)

Unit=mm

Year	Pinlaung	Kalaw	Taunggyi	Yaunghtwe	Loikaw	Mobye Dam
latitude	N 20°07'	N 20°37'	N 20°47'	N 20°39'	N 19°40'	N 19°46'
longitude	E 96°47'	E 96°34'	E 97°03'	E 96°56'	E 97°18'	E 97°05'
1960			1,227			
1961			1,723			
1962	1,841		1,429			
1963	2,173		1,687		1,129	
1964			1,470		1,396	
1965		1,365	1,541		1,146	
1966		1,197	1,577		1,039	
1967	2,166	1,063	1,626		1,187	
1968	2,270	1,169	1,507		1,081	1,255
1969	2,248	256	1,214		1,186	1,213
1970	2,423	1,012	1,535		1,266	1,531
1971	2,557	1,149	1,548		1,197	1,128
1972	1,968	1,210	1,658	1,016	1,329	1,030
1973	2,138	1,353	1,532	1,407	1,297	1,301
1974	2,010	1,205	1,409	904	958	1,089
1975	1,845	1,250	2,020	964	1,216	1,262
1976	2,205	1,255	1,213	976	783	814
1977	1,855	1,227	1,446	983	1,196	1,329
1978	1,552	1,186	1,594	1,118	1,038	1,080
1979	1,509	753	1,272	539	866	665
1980	1,709	1,229	1,560	1,137	969	1,149
1981	1,915	1,029	1,439	1,016	1,115	1,199
1982	2,104	1,032	1,392	942	941	932
1983	1,886	1,390	1,718	1,074	886	1,036
1984	2,018	1,344	1,507	1,087	911	745
1985	2,410	1,088	1,696	910	1,150	961
1986	1,628	938	1,487	796	874	832
1987	1,921	991	1,593	1,110	1,181	937
1988	1,724	995	1,250	653		
1989	1,633	987	1,789	960		
1990	2,097	1,050	1,671	670		
1991	2,211	1,456	1,667	817		
1992	2,200	1,296	1,725	1,161		
1993	2,041	970	1,536	789		
1994	1,868	736	1,525	997		
1995	1,907	983	1,460	863		
1996		1,440	1,308	619		
1997		868	1,145	759		
1998	1,399	630	992	770		
1999	2,413	1,116	1,504	844		
2000	1,882	975	1,322	1,045		
2001	1,979	1,230	1,852	1,148		
2002	2,419	1,090	1,407	1,220		
2003	1,969	662	1,366	969		
2004	2,406	1,294	1,658	835		
2005	2,437	1,433	1,500	830		
2006	2,251	1,298	1,548	1,047		
2007	2,401	957	1,430	897		
2008	1,895	1,013	1,509	859		
2009	2,046	985		797		
2010						

Monthly Rainfall Data

Monyhly Rainfall data

Station: Pinlaung latitude: N 20°07' longitude: E 96°47' (unit:mm)

year	MONTH												Annual
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1961	NA	NA	NA	NA	NA	NA	796	476	281	117	78	0	Rack
1962	0	46	0	17	259	414	449	282	176	198	0	0	1841
1963	0	0	0	64	166	458	513	474	163	292	18	25	2173
1964	0	0	0	39	329	407	363	371	NA	288	46	0	NA
1965	0	0	8	0	269	551	525	296	255	404	NA	NA	Rack
1966	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1967	19	0	7	54	279	199	421	559	393	210	22	3	2166
1968	123	0	3	92	158	347	496	547	161	320	23	0	2270
1969	1	0	0	37	287	422	434	691	201	155	19	1	2248
1970	5	0	0	69	348	325	684	393	407	105	39	48	2423
1971	7	0	11	51	272	484	663	572	258	148	44	47	2557
1972	22	0	0	59	210	229	515	370	229	164	155	15	1968
1973	2	0	4	27	427	376	352	455	296	101	98	0	2138
1974	0	0	45	44	245	312	417	444	296	131	76	0	2010
1975	82	0	0	0	305	256	326	344	231	216	77	8	1845
1976	1	12	3	30	244	355	605	393	307	211	25	19	2205
1977	19	0	4	98	210	283	455	248	260	245	0	33	1855
1978	3	18	3	12	168	410	269	359	235	71	4	0	1552
1979	0	0	0	82	70	400	286	353	180	94	31	13	1509
1980	0	0	6	0	165	358	352	253	326	134	105	10	1709
1981	0	0	0	81	312	321	481	285	130	119	184	2	1915
1982	0	0	0	34	184	405	347	524	419	164	27	0	2104
1983	0	3	18	21	79	449	283	291	226	225	217	74	1886
1984	0	24	0	76	154	610	415	410	136	188	5	0	2018
1985	0	0	0	96	232	705	312	446	310	153	156	0	2410
1986	0	0	27	74	82	391	300	240	239	189	49	37	1628
1987	39	1	2	104	108	183	470	479	259	148	128	0	1921
1988	0	15	0	33	228	402	313	338	149	138	106	2	1724
1989	0	0	6	51	115	310	442	308	233	160	8	0	1633
1990	0	18	5	76	402	453	477	195	317	83	71	0	2097
1991	0	0	3	69	189	660	461	141	225	146	195	122	2211
1992	0	10	0	26	140	413	535	430	332	183	131	0	2200
1993	5	10	6	46	298	535	242	460	230	209	0	0	2041
1994	0	3	16	31	126	459	475	444	197	84	33	0	1868
1995	0	0	0	25	266	268	445	289	299	179	136	0	1907
1996	0	86	35	103	278	297	NA	NA	NA	NA	NA	NA	Rack
1997	0	NA	NA	NA	NA	NA	671	590	434	120	83	14	Rack
1998	0	0	4	27	272	156	394	277	188	80	1	0	1399
1999	3	0	4	130	288	479	285	613	280	210	111	10	2413
2000	0	1	42	17	253	452	377	354	192	194	0	0	1882
2001	0	0	22	4	351	323	382	367	134	270	118	8	1979
2002	9	0	4	31	633	264	515	498	163	159	129	14	2419
2003	67	41	0	4	297	640	294	239	224	121	42	0	1969
2004	2	0	0	154	567	421	366	362	410	89	35	0	2406
2005	0	0	43	96	130	481	358	641	400	177	46	65	2437
2006	0	0	20	140	171	412	711	301	273	198	25	0	2251
2007	0	31	0	10	349	419	477	484	382	196	53	0	2401
2008	57	6	22	95	212	495	428	298	308	380	212	0	2513
2009	0	0	20	106	203	256	576	332	249	151	2	0	1895
Average	9.9	7.1	8.5	55.1	246.3	396.6	441.6	394.0	260.7	177.0	68.8	12.4	2,046

Monyhly Rainfall data

Station: Kalaw latitude: N 20°37' longitude: E 96°34' (unit:mm)

year	MONTH												Annual Total
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1908	NA	NA	NA	NA	NA	NA	117	287	103	144	240	0	Rack
1909	0	0	0	108	322	175	192	201	151	204	100	0	1,453
1910	0	0	77	98	182	126	101	134	188	193	66	0	1,165
1911	0	0	34	148	201	112	242	165	179	212	1	2	1,296
1912	20	0	3	48	207	226	88	195	127	269	80	8	1,271
1913	5	4	20	6	177	220	210	180	285	186	173	14	1,480
1914	0	0	0	76	227	222	159	320	149	90	120	34	1,397
1915	0	6	0	108	286	144	186	186	135	118	78	123	1,370
1916	0	2	0	61	134	309	228	184	240	87	50	35	1,330
1917	0	4	42	35	254	114	194	240	295	217	117	8	1,520
1918	0	0	4	52	198	158	182	199	230	137	120	22	1,302
1919	0	3	0	9	179	172	136	253	285	113	55	27	1,232
1920	7	4	31	23	223	100	245	151	109	167	31	0	1,091
1921	17	1	3	77	123	58	143	137	236	140	185	0	1,120
1922	2	0	0	138	147	155	138	168	195	304	95	48	1,390
1923	0	1	8	162	130	267	92	232	267	129	12	48	1,348
1924	1	0	0	9	214	165	148	199	176	118	85	1	1,116
1925	0	0	0	134	131	276	244	121	183	188	6	2	1,285
1926	2	25	18	53	90	197	90	301	143	391	85	3	1,398
1927	0	40	0	114	406	122	181	115	170	301	154	0	1,603
1928	0	26	0	133	226	195	348	323	202	209	38	0	1,700
1929	0	0	49	200	255	179	212	127	146	114	51	4	1,337
1930	2	8	21	22	387	152	140	86	169	102	84	0	1,173
1931	4	0	14	55	148	110	128	139	165	69	1	27	860
1932	0	26	6	114	86	173	205	106	178	172	9	0	1,075
1933	0	0	7	13	179	155	205	242	170	79	26	1	1,077
1934	1	4	0	54	126	135	256	242	169	135	28	0	1,150
1935	0	0	0	76	94	141	200	183	157	256	182	2	1,291
1936	0	35	0	110	271	283	157	226	153	225	40	30	1,530
1937	0	65	0	59	231	174	181	282	301	146	22	102	1,563
1938	0	5	8	78	283	222	92	229	212	178	49	0	1,356
1939	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1940	2	9	13	76	213	176	174	194	190	170	80	17	1,314
1941	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1942	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1943	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1944	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1945	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1946	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1947	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1948	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1949	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1950	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1951	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1952	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1953	NA	NA	NA	NA	NA	NA	152	256	275	183	7	1	Rack
1954	0	0	23	70	232	120	81	150	165	116	0	11	968
1955	0	0	38	94	334	124	57	172	150	159	112	0	1,240
1956	3	4	0	56	174	102	102	104	363	145	20	2	1,075
1957	0	0	0	0	0	0	66	22	278	72	0	0	438
1958	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1959	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1961	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1962	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1963	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1964	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1965	2	29	27	40	335	103	77	140	170	311	82	49	1,365
1966	16	0	0	0	336	140	141	61	294	83	84	42	1,197
1967	1	3	0	100	179	135	114	168	279	70	12	2	1,063
1968	34	0	0	98	181	220	245	184	86	115	6	0	1,169
1969	17	0	0	0	10	48	84	69	28	0	0	0	256

Monyhly Rainfall data

Station: Kalaw latitude: N 20°37' longitude: E 96°34' (unit:mm)

year	MONTH Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1970	0	0	0	13	262	59	145	179	147	65	127	15	1,012
1971	4	0	5	72	155	183	313	141	139	81	26	30	1,149
1972	0	0	0	137	255	111	152	237	96	98	122	2	1,210
1973	0	0	6	9	285	109	146	309	211	204	73	1	1,353
1974	0	0	41	41	143	193	88	211	205	146	137	0	1,205
1975	89	0	0	0	252	186	126	254	173	107	60	3	1,250
1976	0	11	0	27	336	156	184	223	116	167	35	0	1,255
1977	0	0	0	160	160	93	106	136	193	308	45	26	1,227
1978	0	2	0	28	123	179	188	232	289	145	0	0	1,186
1979	0	7	0	113	21	128	118	108	88	147	18	5	753
1980	0	0	6	10	237	225	106	162	218	178	88	0	1,229
1981	1	26	8	44	180	155	164	101	86	107	150	6	1,029
1982	0	0	0	17	287	167	95	187	105	123	51	0	1,032
1983	0	17	13	87	133	213	77	135	173	253	205	83	1,390
1984	0	14	0	133	139	183	133	301	153	284	4	0	1,344
1985	0	0	0	71	140	185	70	133	159	112	218	0	1,088
1986	0	0	35	96	109	87	108	151	161	98	55	38	938
1987	8	0	31	131	64	192	149	112	147	85	74	0	991
1988	0	4	0	65	215	210	150	64	50	147	90	0	995
1989	0	0	6	71	210	98	127	156	133	186	0	0	987
1990	0	29	19	50	400	75	108	85	158	59	66	0	1,050
1991	0	0	0	175	209	201	147	181	232	142	91	78	1,456
1992	0	0	0	28	214	136	231	346	237	84	20	0	1,296
1993	0	13	0	54	217	46	145	155	201	136	3	0	970
1994	0	0	0	54	230	227	14	100	112	0	0	0	736
1995	0	0	0	16	157	94	98	195	121	135	168	0	983
1996	0	85	72	133	215	154	330	203	132	116	0	0	1,440
1997	0	0	57	51	71	71	319	147	82	69	0	0	868
1998	0	0	3	3	79	53	69	111	136	108	67	0	630
1999	2	0	0	83	175	79	107	172	211	146	141	0	1,116
2000	0	0	63	85	171	82	115	198	94	131	37	0	975
2001	0	0	2	8	379	96	163	290	102	166	20	5	1,230
2002	5	0	0	18	248	71	110	243	180	111	105	0	1,090
2003	6	36	0	12	94	78	101	104	131	98	0	0	662
2004	0	0	0	102	207	177	170	266	267	86	18	0	1,294
2005	0	0	17	73	93	101	410	118	267	222	76	55	1,433
2006	0	0	17	105	158	113	115	171	233	338	47	0	1,298
2007	0	24	0	37	182	160	55	137	141	137	84	0	957
2008	13	0	8	48	149	106	70	152	186	218	62	0	1,013
2009	0	0	29	48	179	123	95	263	151	98	1	0	985
Average	3.3	7.2	11.1	67.7	195.5	147.0	151.8	181.0	177.6	151.9	65.5	12.3	1,168

Monyhly Rainfall data

Station: Taunggyi latitude: N 20^{o}47' longitude: E 97^{o}03' (unit:mm)

year	MONTH												Annual
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1951	100	0	7	17	118	258	165	267	247	205	14	0	1398
1952	0	9	101	15	193	209	213	400	321	93	16	0	1570
1953	6	1	0	82	176	205	135	346	224	203	68	34	1480
1954	0	0	55	62	180	204	95	232	224	226	42	14	1334
1955	0	0	30	45	154	336	144	443	167	157	199	1	1676
1956	0	9	101	6	159	220	225	313	397	55	54	0	1539
1957	0	0	3	13	120	362	154	323	181	147	0	0	1303
1958	22	0	8	40	131	83	203	380	307	182	50	10	1416
1959	115	5	0	45	223	198	318	275	230	197	0	0	1606
1960	27	1	0	2	282	225	192	151	183	67	72	25	1227
1961	0	2	0	60	170	242	302	507	231	134	75	0	1723
1962	1	11	0	69	272	163	216	355	177	164	1	0	1429
1963	0	1	16	114	108	247	230	449	185	302	15	20	1687
1964	0	0	5	42	279	95	235	242	314	129	129	0	1470
1965	8	25	0	23	274	120	183	216	212	396	84	0	1541
1966	5	0	0	18	208	196	175	194	337	375	41	28	1577
1967	7	0	8	54	133	142	366	318	401	174	22	1	1626
1968	26	0	8	66	96	183	281	275	286	265	21	0	1507
1969	0	0	3	40	161	169	270	338	64	161	8	0	1214
1970	0	0	0	67	226	261	231	274	293	86	56	41	1535
1971	1	0	3	78	197	259	292	266	242	153	22	35	1548
1972	0	0	17	62	117	245	218	402	262	140	190	5	1658
1973	0	0	5	40	149	99	229	477	346	100	87	0	1532
1974	0	0	58	10	210	188	127	303	270	51	192	0	1409
1975	70	0	28	0	205	519	238	408	284	207	57	4	2020
1976	2	25	0	17	263	106	131	240	313	87	22	7	1213
1977	20	0	13	121	189	89	189	188	243	339	26	29	1446
1978	0	0	0	42	153	256	323	286	290	228	15	1	1594
1979	0	0	0	0	106	311	174	344	152	166	5	14	1272
1980	0	0	3	17	140	428	204	317	359	87	0	5	1560
1981	3	12	6	57	219	161	199	248	211	144	179	0	1439
1982	0	0	0	39	99	184	139	311	303	268	49	0	1392
1983	0	11	11	0	116	295	258	242	302	246	235	2	1718
1984	0	9	0	65	117	222	131	482	311	167	0	3	1507
1985	0	0	0	40	129	196	282	314	266	227	242	0	1696
1986	0	0	24	35	118	199	319	224	374	135	28	31	1487
1987	9	9	20	119	38	230	144	260	427	169	168	0	1593
1988	0	0	0	20	170	261	224	222	104	145	104	0	1250
1989	0	0	11	38	125	187	386	334	415	292	1	0	1789
1990	0	22	4	57	248	233	211	332	330	142	92	0	1671
1991	0	0	0	60	127	230	123	270	316	266	196	79	1667
1992	0	2	0	23	62	152	306	453	505	181	33	8	1725
1993	0	7	5	44	254	168	144	258	405	243	8	0	1536
1994	0	0	22	45	174	180	206	396	337	131	33	1	1525
1995	0	1	3	8	159	155	172	355	273	209	125	0	1460
1996	0	49	44	74	125	222	201	236	155	134	61	7	1308
1997	0	0	11	100	139	140	298	189	195	19	45	9	1145
1998	0	0	9	31	143	131	132	198	166	120	62	0	992
1999	3	0	3	61	114	173	234	274	411	119	111	1	1504
2000	1	1	42	79	243	157	203	229	219	148	0	0	1322
2001	0	0	13	1	439	171	253	356	106	452	31	30	1852
2002	13	0	0	42	302	111	306	171	232	122	108	0	1407
2003	34	51	0	8	196	137	196	216	302	226	0	0	1366
2004	0	0	0	78	384	143	254	346	303	119	31	0	1658
2005	0	0	30	81	122	214	363	138	227	149	148	28	1500
2006	0	1	13	76	125	149	179	399	336	249	21	0	1548
2007	0	1	7	18	206	187	155	301	309	176	70	0	1430
2008	18	0	1	110	156	113	180	318	211	289	113	0	1509
Average	8.5	4.6	12.9	46.1	176.6	202.1	218.2	303.5	272.3	182.1	66.8	8.2	1,502

Monyhly Rainfall data

Station: Yaunghtwe latitude: N 20^{o}39' longitude: E 96^{o}56' (unit:mm)

year	MONTH Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
1904	0	5	0	110	247	197	194	213	188	126	37	20	1,337
1905	0	5	11	0	110	141	131	83	298	259	18	0	1,056
1906	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1907	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1908	NA	NA	NA	NA	NA	NA	NA	NA	NA	245	169	0	Rack
1909	0	0	0	142	249	153	287	104	232	167	179	0	1,513
1910	0	6	82	61	152	258	140	233	211	243	5	0	1,391
1911	0	0	3	91	92	169	234	214	124	220	5	0	1,152
1912	13	0	0	49	167	179	148	267	124	63	60	0	1,070
1913	3	0	15	0	134	257	211	129	216	135	208	9	1,317
1914	0	0	0	37	119	201	159	255	106	93	63	12	1,045
1915	0	5	4	142	196	189	99	124	189	108	59	120	1,235
1916	0	0	0	50	201	416	404	406	335	80	33	9	1,934
1917	0	3	81	5	107	66	115	319	268	77	74	2	1,117
1918	0	0	2	34	193	66	199	256	321	87	72	11	1,241
1919	0	8	0	10	186	156	138	242	152	53	47	22	1,014
1920	5	0	27	8	103	92	138	264	93	184	26	0	940
1921	25	0	3	50	98	59	256	224	218	127	202	0	1,262
1922	1	0	0	101	75	30	215	15	335	144	104	18	1,038
1923	0	2	20	107	177	153	58	246	191	61	5	25	1,045
1924	0	2	1	66	176	89	124	317	191	168	114	3	1,251
1925	0	0	0	33	135	217	157	183	386	117	1	21	1,250
1926	1	5	15	10	130	125	86	247	161	350	65	5	1,200
1927	0	8	0	37	337	72	280	144	140	229	77	0	1,324
1928	0	9	0	109	189	154	178	201	179	49	21	0	1,089
1929	0	1	6	101	237	105	84	195	364	74	19	0	1,186
1930	6	21	3	18	450	156	211	97	322	107	37	0	1,428
1931	2	2	1	43	133	104	41	260	270	134	0	47	1,037
1932	0	10	12	54	50	58	353	131	189	239	18	0	1,114
1933	0	0	1	8	246	193	228	383	109	82	47	2	1,299
1934	0	1	0	54	32	105	198	274	243	34	23	0	964
1935	0	0	1	23	72	52	156	148	254	85	194	10	995
1936	0	26	4	82	138	141	190	292	179	113	1	4	1,170
1937	0	38	0	120	149	171	211	234	230	93	24	87	1,357
1938	0	3	0	56	253	146	115	209	165	66	84	0	1,097
1939	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1940	2	5	11	54	172	147	178	226	109	132	61	13	1,110
1941	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1942	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1943	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1944	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1945	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1946	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1947	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1948	NA	NA	NA	NA	113	77	103	305	328	149	43	NA	Rack
1949	NA	NA	NA	113	167	41	NA	NA	NA	93	97	NA	Rack
1950	NA	NA	NA	35	57	303	NA	NA	231	157	37	NA	Rack
1951	NA	NA	NA	6	51	NA	NA	NA	NA	NA	NA	10	Rack
1952	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1953	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1954	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1955	0	0	9	106	197	152	124	258	123	53	65	0	1,087
1956	0	0	0	31	150	151	154	234	369	120	17	0	1,226
1957	0	0	34	22	105	148	79	146	182	96	0	0	812
1958	24	0	39	2	98	39	195	199	263	145	0	0	1,004
1959	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Monyhly Rainfall data

Station: Yaunghtwe latitude: N 20°39' longitude: E 96°56' (unit:mm)

year	MONTH												Annual
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1961	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1962	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1963	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1964	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1965	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1966	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1967	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1968	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1969	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1970	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1971	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1972	0	0	0	112	52	83	167	292	145	165	0	0	1,016
1973	0	0	0	0	151	114	286	361	208	266	21	0	1,407
1974	0	0	0	25	199	66	49	210	171	54	130	0	904
1975	47	0	0	0	137	217	76	196	153	99	39	0	964
1976	0	0	0	34	163	86	86	193	249	56	109	0	976
1977	0	0	3	38	186	51	112	158	146	277	12	0	983
1978	0	0	0	50	59	192	245	165	305	102	0	0	1,118
1979	0	0	0	29	105	106	148	0	0	133	12	6	539
1980	0	0	1	15	65	296	184	185	233	87	69	1	1,137
1981	2	24	3	26	98	77	155	192	188	115	136	0	1,016
1982	0	0	0	15	174	62	98	139	225	208	22	0	942
1983	0	3	7	27	76	92	93	147	211	204	214	0	1,074
1984	0	4	0	33	73	131	164	244	263	166	4	7	1,087
1985	0	0	4	47	88	96	158	140	89	118	169	0	910
1986	0	0	6	8	88	88	72	298	118	79	38	0	796
1987	12	5	17	72	72	150	124	191	279	148	41	0	1,110
1988	0	0	0	40	167	101	112	100	52	16	66	0	653
1989	0	0	12	25	74	110	232	242	76	182	6	0	960
1990	0	4	6	88	78	88	92	75	132	48	60	0	670
1991	0	0	0	50	72	178	127	99	132	48	56	54	817
1992	0	0	0	65	67	55	158	350	344	104	17	0	1,161
1993	0	0	5	78	84	169	145	47	170	92	0	0	789
1994	0	0	8	58	125	128	227	213	157	59	21	3	997
1995	0	0	22	1	48	40	53	161	274	140	125	0	863
1996	0	0	22	1	48	40	53	171	166	117	0	0	619
1997	0	0	1	11	106	74	244	129	124	25	41	4	759
1998	0	0	10	23	87	163	24	222	166	29	45	0	770
1999	0	0	0	72	163	72	35	194	211	76	15	5	844
2000	0	32	18	67	151	239	77	114	169	178	0	0	1,045
2001	0	0	36	0	127	70	166	345	80	250	49	24	1,148
2002	0	0	0	20	13	226	150	292	216	132	165	6	1,220
2003	0	33	10	73	139	157	187	149	144	55	0	22	969
2004	0	0	0	69	129	170	158	143	104	44	2	15	835
2005	0	0	12	44	59	61	131	82	266	115	59	0	830
2006	0	0	21	58	103	82	87	299	207	164	27	0	1,047
2007	0	15	0	32	140	167	95	124	163	99	62	0	897
2008	47	0	0	17	132	114	39	153	166	162	31	0	859
2009	0	0	7	71	98	103	59	239	114	106	0	0	797
Average	3	4	8	47	132	131	151	202	197	125	54	8	1,056

Monyhly Rainfall data

Station: Loikaw latitude: N 19°40' longitude: E 97°18' (unit:mm)

year	MONTH												Annual
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1952	0	0	45	3	124	106	118	254	210	69	77	0	1006
1953	19	1	0	53	149	220	149	201	166	102	36	15	1111
1954	0	0	52	43	188	57	139	118	124	133	26	2	882
1955	0	0	0	64	195	191	103	234	185	41	27	0	1040
1956	0	5	0	18	149	106	216	262	464	113	0	0	1333
1957	0	0	0	9	149	268	113	233	183	65	6	0	1026
1958	13	0	57	30	120	90	210	177	132	121	3	1	954
1959	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1961	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1962	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1963	0	0	0	74	81	205	91	186	178	253	48	13	1129
1964	0	0	0	30	238	154	275	162	234	194	105	4	1396
1965	0	21	1	52	147	167	103	149	176	240	33	57	1146
1966	0	0	0	27	102	202	223	132	176	129	48	0	1039
1967	4	0	3	17	202	158	136	187	344	73	52	11	1187
1968	34	0	0	16	114	127	177	209	127	248	29	0	1081
1969	11	0	17	13	227	221	204	263	104	100	26	0	1186
1970	0	0	0	86	256	222	125	252	155	54	23	93	1266
1971	0	0	6	39	176	132	287	236	155	127	14	25	1197
1972	4	0	0	103	71	239	83	344	194	109	166	16	1329
1973	0	0	4	7	155	209	88	497	257	55	25	0	1297
1974	0	0	10	19	112	165	114	195	188	93	62	0	958
1975	77	0	0	0	86	384	127	210	168	128	36	0	1216
1976	0	0	0	0	106	113	139	133	139	138	14	1	783
1977	30	3	29	104	86	79	148	91	210	318	61	37	1196
1978	18	6	1	103	91	167	251	174	166	50	3	8	1038
1979	0	1	0	27	89	196	161	99	141	152	0	0	866
1980	0	0	5	0	111	116	200	112	347	42	34	2	969
1981	0	4	8	15	193	93	274	221	161	39	107	0	1115
1982	0	0	0	44	200	157	113	107	224	93	3	0	941
1983	0	0	0	31	58	167	116	160	111	113	118	12	886
1984	0	3	0	58	53	133	114	155	209	138	7	41	911
1985	0	2	0	70	116	137	207	166	270	74	108	0	1150
1986	0	0	8	37	200	136	121	119	129	90	9	25	874
1987	78	0	15	65	99	94	77	270	259	132	92	0	1181
1988	0	0	0	70	103	181	113	NA	NA	NA	NA	NA	NA
Average	8.7	1.4	7.9	40.2	137.8	163.4	155.0	197.1	196.4	119.6	43.7	11.3	1,084

Monyhly Rainfall data

Station: Mobye Dam latitude: N 19°46' longitude: E 97°05' (unit:mm)

year	MONTH												Annual Total
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1968	0	0	0	0	0	228	176	238	222	371	20	0	1255
1969	0	0	0	12	253	120	201	258	113	210	46	0	1213
1970	0	0	25	86	283	152	138	333	262	121	83	48	1531
1971	0	0	29	43	185	147	243	195	108	131	6	41	1128
1972	0	0	0	66	18	110	112	250	127	117	223	7	1030
1973	0	0	7	0	196	158	169	375	242	54	100	0	1301
1974	0	0	27	30	145	229	68	245	186	159	0	0	1089
1975	69	2	0	2	86	278	206	291	212	81	35	0	1262
1976	0	0	6	30	128	86	120	155	167	122	0	0	814
1977	0	0	16	103	198	58	178	127	232	336	19	62	1329
1978	5	16	0	31	135	84	237	199	292	72	1	8	1080
1979	0	4	0	40	80	196	156	6	16	165	1	1	665
1980	0	0	2	4	152	151	225	125	318	96	62	14	1149
1981	0	11	11	21	200	95	306	150	146	73	181	5	1199
1982	0	0	0	53	151	189	130	126	172	107	4	0	932
1983	0	0	2	16	91	152	153	175	147	131	148	21	1036
1984	0	4	0	62	79	145	111	168	109	65	0	2	745
1985	0	0	0	42	132	134	130	103	133	190	97	0	961
1986	0	0	12	26	96	141	105	137	188	121	6	0	832
1987	57	0	13	51	119	136	69	162	139	113	78	0	937
1988	0	6	0	22	93	237	NA	NA	NA	NA	NA	NA	NA
Average	6.2	2.0	7.1	35.2	134.3	153.6	161.7	190.9	176.6	141.8	55.5	10.5	1,074

Source: Baluchaung Hydroelectric Project No.1 Power Station, O&M Manual Vol.II, NEWJEC, 1993

Daily Rainfall Data

(Pinlaung)

Daily Rainfall Record at Pinlaung

Year: 1970 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	2	2	25	19	1	0	23	
2	0	0	0	0	0	0	1	16	33	0	0	6	
3	0	0	0	0	0	17	0	3	38	0	0	2	
4	0	0	0	8	0	15	0	3	1	0	0	5	
5	0	0	0	30	8	7	10	13	11	0	0	0	
6	0	0	0	13	9	10	2	46	0	0	1	5	
7	0	0	0	0	20	6	19	48	48	0	6	0	
8	5	0	0	0	16	13	3	54	8	0	0	0	
9	0	0	0	0	0	48	14	5	12	16	2	6	
10	0	0	0	0	3	15	21	3	5	0	1	0	
11	0	0	0	0	0	12	34	16	0	2	1	1	
12	0	0	0	14	1	2	84	5	27	0	0	0	
13	0	0	0	0	0	5	57	7	40	0	15	0	
14	0	0	0	0	0	13	49	3	8	0	0	0	
15	0	0	0	0	3	24	64	1	4	31	0	0	
16	0	0	0	0	0	9	11	3	4	7	0	0	
17	0	0	0	0	NA	2	2	4	8	0	0	0	
18	0	0	0	0	32	2	1	0	14	0	0	0	
19	0	0	0	0	43	13	13	2	2	0	0	0	
20	0	0	0	0	29	7	13	4	12	0	0	0	
21	0	0	0	0	21	2	25	16	3	4	0	0	
22	0	0	0	0	15	3	22	18	49	3	0	0	
23	0	0	0	0	12	0	36	3	1	1	0	0	
24	0	0	0	2	21	1	88	7	4	11	0	0	
25	0	0	0	2	27	1	47	7	0	0	0	0	
26	0	0	0	0	27	3	28	5	1	0	0	0	
27	0	0	0	0	8	17	17	11	30	8	0	0	
28	0	0	0	0	8	27	5	16	0	19	0	0	
29	0		0	0	0	10	11	28	15	0	0	0	
30	0		0	0	43	39	5	13	10	0	13	0	
31	0		0		2		0	8		2		0	Annual
Total	5	0	0	69	348	325	684	393	407	105	39	48	2,423
Max.	5	0	0	30	43	48	88	54	49	31	15	23	88

Year: 1971 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	17	10	63	2	0	2	1	
2	0	0	0	0	0	37	14	49	0	41	0	0	
3	0	0	0	0	0	31	19	17	4	41	0	0	
4	0	0	0	12	0	3	18	34	17	1	0	0	
5	0	0	0	0	0	23	2	11	23	0	0	0	
6	0	0	0	0	1	36	6	11	14	0	0	0	
7	0	0	1	0	15	61	3	8	1	0	37	0	
8	0	0	0	0	14	23	11	20	0	2	1	0	
9	0	0	0	0	15	23	3	17	25	25	0	0	
10	0	0	0	0	0	15	4	15	23	0	0	0	
11	0	0	0	0	0	32	5	12	4	0	2	0	
12	0	0	0	0	0	18	7	12	3	0	2	0	
13	0	0	0	0	8	4	15	13	0	0	0	0	
14	0	0	0	0	19	17	22	20	1	0	0	0	
15	0	0	0	0	0	17	48	8	0	0	0	0	
16	0	0	0	0	0	3	14	13	0	0	0	0	
17	0	0	8	0	18	0	9	11	11	0	0	4	
18	0	0	2	0	0	1	5	7	2	0	0	0	
19	0	0	0	0	1	3	15	14	4	0	0	0	
20	0	0	0	0	4	7	43	10	4	0	0	0	
21	0	0	0	16	45	4	101	12	0	0	0	23	
22	0	0	0	11	21	9	50	18	0	0	0	19	
23	0	0	0	0	3	7	20	4	2	0	0	0	
24	0	0	0	0	6	25	8	25	0	0	0	0	
25	0	0	0	0	16	18	59	9	36	0	0	0	
26	0	0	0	0	3	16	21	10	8	0	0	0	
27	0	0	0	0	9	5	29	38	0	0	0	0	
28	0	0	0	0	30	21	14	24	27	32	0	0	
29	6		0	0	17	8	28	17	32	3	0	0	
30	1		0	12	8	0	24	20	15	0	0	0	
31	0		0		19		36	30		3		0	Annual
Total	7	0	11	51	272	484	663	572	258	148	44	47	2,557
Max.	6	0	8	16	45	61	101	63	36	41	37	23	101

Daily Rainfall Record at Pinlaung

Year: 1972 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	4	1	16	1	0	0	3	
2	0	0	0	0	0	0	1	1	14	48	10	3	
3	0	0	0	0	0	1	7	15	0	0	0	0	
4	0	0	0	8	1	13	11	9	0	20	10	0	
5	0	0	0	5	0	15	14	29	9	3	4	0	
6	0	0	0	10	0	42	11	9	0	2	10	0	
7	0	0	0	0	0	10	8	10	0	0	36	0	
8	0	0	0	0	0	26	4	4	2	2	9	0	
9	0	0	0	0	0	3	5	11	7	0	0	9	
10	0	0	0	0	20	13	1	1	0	0	0	0	
11	0	0	0	0	0	14	2	9	0	2	0	0	
12	0	0	0	8	0	8	10	8	3	0	0	0	
13	0	0	0	12	0	2	12	2	9	0	0	0	
14	0	0	0	8	0	3	10	14	1	2	0	0	
15	0	0	0	0	6	14	23	19	21	0	0	0	
16	0	0	0	0	1	2	90	36	12	0	0	0	
17	0	0	0	1	75	1	27	11	9	6	0	0	
18	0	0	0	0	0	1	11	13	10	7	0	0	
19	0	0	0	0	3	7	8	8	0	0	2	0	
20	0	0	0	0	0	12	17	16	3	0	6	0	
21	0	0	0	0	46	7	19	14	8	19	11	0	
22	0	0	0	0	0	9	2	27	14	33	4	0	
23	0	0	0	0	0	5	6	21	41	2	6	0	
24	0	0	0	0	0	2	13	15	0	18	3	0	
25	0	0	0	0	1	1	17	13	0	0	3	0	
26	0	0	0	0	0	0	15	12	0	0	23	0	
27	0	0	0	1	8	0	63	17	25	0	1	0	
28	0	0	0	6	24	7	47	2	30	0	13	0	
29	1	0	0	0	0	2	39	2	3	0	2	0	
30	21		0	0	17	5	14	6	7	0	2	0	
31	0		0		8		7	0		0		0	Annual
Total	22	0	0	59	210	229	515	370	229	164	155	15	1,968
Max.	21	0	0	12	75	42	90	36	41	48	36	9	90

Year: 1973 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	2	0	27	12	0	0	
2	0	0	0	0	0	2	8	28	10	27	0	0	
3	0	0	0	0	35	12	28	0	1	9	0	0	
4	0	0	0	0	0	11	3	5	4	0	0	0	
5	0	0	0	0	9	0	15	1	16	1	0	0	
6	0	0	0	0	0	4	15	0	21	0	7	0	
7	0	0	0	0	8	1	10	11	4	0	8	0	
8	0	0	0	0	50	25	1	8	0	0	8	0	
9	0	0	0	0	2	18	4	8	0	0	2	0	
10	0	0	0	0	20	21	46	29	7	10	6	0	
11	0	0	0	0	22	47	23	8	1	4	0	0	
12	0	0	0	0	3	3	2	5	0	0	1	0	
13	0	0	0	0	11	17	5	2	19	2	6	0	
14	0	0	0	0	30	19	17	4	2	0	0	0	
15	0	0	0	0	34	5	8	8	0	0	0	0	
16	0	0	0	0	32	43	5	12	0	0	0	0	
17	0	0	0	0	0	58	12	27	21	6	0	0	
18	0	0	0	0	26	40	17	22	8	0	0	0	
19	0	0	0	0	9	6	12	28	4	0	0	0	
20	0	0	0	0	20	8	17	15	36	5	4	0	
21	0	0	0	0	24	7	3	6	34	3	46	0	
22	0	0	0	0	0	3	8	8	15	0	8	0	
23	0	0	0	0	1	3	18	21	9	0	2	0	
24	0	0	0	0	0	0	7	46	25	0	0	0	
25	0	0	0	0	1	3	5	16	0	0	0	0	
26	0	0	1	23	0	6	5	11	0	14	0	0	
27	0	0	3	2	0	9	21	8	12	0	0	0	
28	0	0	0	0	16	5	10	64	6	8	0	0	
29	0		0	2	35	0	9	39	2	0	0	0	
30	0		0	0	22	0	16	7	12	0	0	0	
31	2		0		17		0	8		0		0	Annual
Total	2	0	4	27	427	376	352	455	296	101	98	0	2,138
Max.	2	0	3	23	50	58	46	64	36	27	46	0	64

Daily Rainfall Record at Pinlaung

Year: 1974 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	10	6	4	2	1	19	1	5	0	
2	0	0	0	0	0	10	4	0	12	5	13	0	
3	0	0	NA	0	0	1	9	1	15	0	1	0	
4	0	0	0	0	4	0	5	4	25	0	0	0	
5	0	0	0	0	2	0	2	4	10	60	0	0	
6	0	0	0	0	0	0	15	1	0	3	1	0	
7	0	0	0	NA	0	0	30	37	27	0	1	0	
8	0	0	0	0	0	5	20	0	8	0	0	0	
9	0	0	0	0	0	55	13	10	13	1	7	0	
10	0	0	0	0	15	17	12	27	30	0	12	0	
11	0	0	0	0	0	8	16	33	1	0	9	0	
12	0	0	0	0	2	25	20	59	3	0	1	0	
13	0	0	0	0	18	3	17	13	5	0	5	0	
14	0	0	0	0	19	1	8	3	6	0	6	0	
15	0	0	0	0	0	21	5	0	11	0	0	0	
16	0	0	0	0	22	13	11	4	20	1	0	0	
17	0	0	0	0	0	22	13	20	9	0	1	0	
18	0	0	0	0	0	1	5	13	7	0	1	0	
19	0	0	0	0	0	20	22	37	1	3	0	0	
20	0	0	0	0	4	12	35	7	29	0	0	0	
21	0	0	0	0	18	17	7	2	14	0	0	0	
22	0	0	0	0	7	24	3	1	0	27	0	0	
23	0	0	13	0	8	23	2	42	0	0	0	0	
24	0	0	0	0	8	5	15	36	0	0	0	0	
25	0	0	0	12	9	8	25	9	1	3	0	0	
26	0	0	0	6	64	0	1	17	2	1	0	0	
27	0	0	0	7	9	3	15	20	13	9	0	0	
28	0	0	NA	7	9	3	41	10	5	2	0	0	
29	0		27	0	8	7	24	10	8	0	4	0	
30	0		0	2	2	4	9	8	2	11	9	0	
31	0		5		11		11	15		4		0	Annual
Total	0	0	45	44	245	312	417	444	296	131	76	0	2,010
Max.	0	0	27	12	64	55	41	59	30	60	13	0	64

Year: 1975 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	7	1	20	31	26	8	
2	0	0	0	0	0	5	6	5	4	2	0	0	
3	0	0	0	0	0	18	13	40	5	0	0	0	
4	0	0	0	0	0	43	4	12	0	1	0	0	
5	0	0	0	0	12	3	8	5	0	1	0	0	
6	0	0	0	0	0	3	5	10	2	1	0	0	
7	0	0	0	0	10	9	35	16	18	5	12	0	
8	0	0	0	0	22	16	11	18	2	0	2	0	
9	0	0	0	0	29	1	15	8	20	18	6	0	
10	34	0	0	0	0	0	5	5	1	15	0	0	
11	44	0	0	0	0	3	0	6	24	7	27	0	
12	2	0	0	0	0	5	16	13	1	9	3	0	
13	0	0	0	0	0	3	8	3	14	0	1	0	
14	0	0	0	0	0	1	17	5	1	2	0	0	
15	0	0	0	0	0	2	30	3	2	2	0	0	
16	0	0	0	0	19	20	30	1	0	2	0	0	
17	0	0	0	0	0	1	24	8	3	0	0	0	
18	0	0	0	0	7	22	24	11	5	0	0	0	
19	2	0	0	0	12	11	18	20	17	0	0	0	
20	0	0	0	0	14	7	5	2	0	0	0	0	
21	0	0	0	0	22	11	7	0	10	0	0	0	
22	0	0	0	0	20	2	1	15	16	15	0	0	
23	0	0	0	0	21	10	0	0	7	23	0	0	
24	0	0	0	0	18	5	3	0	18	1	0	0	
25	0	0	0	0	6	0	0	59	8	24	0	0	
26	0	0	0	0	55	0	3	9	2	11	0	0	
27	0	0	0	0	23	17	5	11	0	1	0	0	
28	0	0	0	0	13	16	24	8	2	0	0	0	
29	0		0	0	2	10	2	16	6	0	0	0	
30	0		0	0	0	12	0	13	23	36	0	0	
31	0		0		0		0	21		9		0	Annual
Total	82	0	0	0	305	256	326	344	231	216	77	8	1,845
Max.	44	0	0	0	55	43	35	59	24	36	27	8	59

Daily Rainfall Record at Pinlaung

Year: 1976 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	31	4	9	10	34	2	0	19	
2	0	0	0	0	9	0	11	9	3	0	1	0	
3	0	0	0	0	55	4	21	65	0	5	0	0	
4	0	0	0	0	24	0	30	17	13	33	0	0	
5	0	0	0	0	0	16	13	5	0	4	0	0	
6	0	0	0	0	0	43	29	0	0	1	1	0	
7	0	12	0	0	0	7	43	2	0	0	0	0	
8	0	0	0	0	3	21	52	4	11	1	11	0	
9	1	0	0	6	0	28	72	10	2	0	0	0	
10	0	0	0	6	1	40	27	16	5	0	0	0	
11	0	0	0	4	1	44	17	20	16	0	0	0	
12	0	0	0	0	2	30	5	13	2	0	0	0	
13	0	0	0	0	15	48	0	15	27	6	0	0	
14	0	0	0	6	53	0	1	30	13	0	0	0	
15	0	0	0	0	0	0	12	33	3	0	0	0	
16	0	0	0	0	0	8	15	13	1	0	0	0	
17	0	0	0	0	0	0	25	3	0	0	0	0	
18	0	0	0	0	0	7	12	0	0	3	0	0	
19	0	0	0	0	0	0	16	1	0	4	0	0	
20	0	0	0	0	0	1	20	5	1	22	0	0	
21	0	0	0	0	6	0	2	0	11	28	2	0	
22	0	0	0	0	4	0	3	1	38	61	1	0	
23	0	0	0	0	3	0	9	31	35	0	0	0	
24	0	0	0	0	8	2	11	4	7	0	0	0	
25	0	0	0	8	8	22	67	0	9	0	0	0	
26	0	0	3	0	3	2	22	1	13	0	0	0	
27	0	0	0	0	3	0	15	1	12	10	0	0	
28	0	0	0	0	4	0	5	23	31	2	0	0	
29	0	0	0	0	2	14	1	39	3	15	6	0	
30	0		0	0	0	14	9	20	17	0	3	0	
31	0		0		9		32	2		14		0	Annual
Total	1	12	3	30	244	355	606	393	307	211	25	19	2,206
Max.	1	12	3	8	55	48	72	65	38	61	11	19	72

Year: 1977 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	19	0	0	0	0	4	5	16	40	25	0	0	
2	0	0	0	13	0	0	12	10	5	1	0	0	
3	0	0	0	22	0	0	21	20	0	5	0	3	
4	0	0	0	4	0	0	18	16	0	0	0	0	
5	0	0	0	12	0	0	13	20	68	28	0	0	
6	0	0	0	0	0	5	14	17	2	8	0	0	
7	0	0	2	0	7	0	8	4	16	0	0	0	
8	0	0	0	8	1	7	9	1	23	42	0	0	
9	0	0	0	16	0	0	8	12	19	11	0	0	
10	0	0	2	14	6	0	10	3	4	6	0	0	
11	0	0	0	0	16	3	7	2	2	9	0	0	
12	0	0	0	0	12	0	2	4	24	3	0	0	
13	0	0	0	0	20	0	0	0	0	11	0	0	
14	0	0	0	3	25	0	1	3	0	0	0	0	
15	0	0	0	0	9	6	21	9	10	0	0	0	
16	0	0	0	0	2	4	19	4	31	4	0	0	
17	0	0	0	0	0	2	0	1	1	0	0	0	
18	0	0	0	0	0	11	22	0	0	0	0	0	
19	0	0	0	4	26	0	2	3	0	5	0	0	
20	0	0	0	0	0	1	0	0	1	4	0	0	
21	0	0	0	2	0	16	0	4	1	18	0	0	
22	0	0	0	0	0	33	8	13	1	0	0	0	
23	0	0	0	0	0	20	28	3	9	0	0	0	
24	0	0	0	0	17	20	11	14	0	38	0	0	
25	0	0	0	0	16	19	12	14	0	5	0	0	
26	0	0	0	0	12	69	16	0	0	0	0	9	
27	0	0	0	0	14	46	12	7	0	0	0	1	
28	0	0	0	0	3	5	12	6	0	11	0	20	
29	0		0	0	5	8	69	12	0	10	0	0	
30	0		0	0	0	4	60	16	3	1	0	0	
31	0		0		19		35	14		0		0	Annual
Total	19	0	4	98	210	283	455	248	260	245	0	33	1,855
Max.	19	0	2	22	26	69	69	20	68	42	0	20	69

Daily Rainfall Record at Pinlaung

Year: 1978 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	2	0	0	3	4	15	9	0	0	0	
2	0	0	1	0	0	0	1	6	23	1	0	0	
3	0	0	0	0	0	7	18	31	8	3	0	0	
4	0	0	0	0	0	10	9	6	1	15	0	0	
5	0	0	0	0	0	13	7	10	17	5	0	0	
6	3	0	0	0	0	0	7	25	20	26	0	0	
7	0	0	0	0	3	4	4	11	1	1	4	0	
8	0	0	0	0	4	15	13	11	2	0	0	0	
9	0	0	0	0	2	10	4	27	27	0	0	0	
10	0	0	0	0	0	0	10	21	2	0	0	0	
11	0	0	0	0	5	6	15	3	0	0	0	0	
12	0	0	0	0	23	0	8	2	2	16	0	0	
13	0	0	0	0	0	0	0	4	0	0	0	0	
14	0	0	0	0	0	10	2	32	4	0	0	0	
15	0	0	0	0	0	9	21	12	10	0	0	0	
16	0	0	0	0	2	30	5	1	0	0	0	0	
17	0	0	0	12	8	6	10	1	0	0	0	0	
18	0	0	0	0	18	9	7	30	0	0	0	0	
19	0	0	0	0	11	1	13	14	0	0	0	0	
20	0	0	0	0	60	6	9	2	1	0	0	0	
21	0	3	0	0	14	6	9	16	0	2	0	0	
22	0	0	0	0	0	5	5	25	0	2	0	0	
23	0	0	0	0	4	16	15	3	39	0	0	0	
24	0	0	0	0	5	29	25	8	15	0	0	0	
25	0	0	0	0	0	76	11	0	14	0	0	0	
26	0	0	0	0	0	31	3	1	22	0	0	0	
27	0	15	0	0	3	15	8	3	18	0	0	0	
28	0	0	0	0	0	36	17	0	0	0	0	0	
29	0		0	0	0	51	2	31	0	0	0	0	
30	0		0	0	0	6	0	0	0	0	0	0	
31	0		0		6		7	8		0		0	Annual
Total	3	18	3	12	168	410	269	359	235	71	4	0	1,552
Max.	3	15	2	12	60	76	25	32	39	26	4	0	76

Year: 1979 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	5	33	65	12	0	0	7	1	
2	0	0	0	0	13	0	46	15	2	1	0	1	
3	0	0	0	0	0	0	17	1	3	0	0	2	
4	0	0	0	0	0	36	5	14	5	0	0	1	
5	0	0	0	0	0	5	28	26	8	0	0	0	
6	0	0	0	0	0	4	5	6	4	1	0	0	
7	0	0	0	0	0	0	12	12	8	34	0	0	
8	0	0	0	0	0	0	4	1	3	23	0	0	
9	0	0	0	0	0	3	9	1	7	0	0	0	
10	0	0	0	0	0	7	2	10	0	2	0	8	
11	0	0	0	0	0	8	4	0	0	11	0	0	
12	0	0	0	0	0	10	5	0	0	0	0	0	
13	0	0	0	0	0	8	23	10	0	2	0	0	
14	0	0	0	0	0	77	6	15	0	7	0	0	
15	0	0	0	0	0	36	4	26	0	7	0	0	
16	0	0	0	0	0	3	0	35	12	0	0	0	
17	0	0	0	0	0	8	0	15	6	4	0	0	
18	0	0	0	0	0	1	5	5	17	0	0	0	
19	0	0	0	0	0	5	6	23	9	0	0	0	
20	0	0	0	0	2	1	1	46	0	0	0	0	
21	0	0	0	4	0	1	0	15	16	0	0	0	
22	0	0	0	23	0	18	0	5	13	0	0	0	
23	0	0	0	0	0	4	7	3	5	0	0	0	
24	0	0	0	2	4	17	10	13	16	0	7	0	
25	0	0	0	17	45	15	0	28	0	0	1	0	
26	0	0	0	15	0	1	0	9	2	0	3	0	
27	0	0	0	8	0	12	0	5	7	0	0	0	
28	0	0	0	8	0	18	14	1	2	0	2	0	
29	0		0	5	0	32	7	0	35	0	11	0	
30	0		0	0	0	37	1	0	0	2	0	0	
31	0		0		1		0	1		0		0	Annual
Total	0	0	0	82	70	400	286	353	180	94	31	13	1,509
Max.	0	0	0	23	45	77	65	46	35	34	11	8	77

Daily Rainfall Record at Pinlaung

Year: 1980 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	8	30	26	12	8	5	0	
2	0	0	0	0	0	3	8	2	29	9	0	0	
3	0	0	6	0	0	9	2	0	21	11	31	0	
4	0	0	0	0	39	18	2	14	16	3	33	0	
5	0	0	0	0	6	21	5	1	23	11	0	0	
6	0	0	0	0	3	33	0	7	9	0	0	0	
7	0	0	0	0	4	26	5	15	0	0	0	0	
8	0	0	0	0	0	1	9	6	14	2	0	0	
9	0	0	0	0	0	6	2	10	5	11	17	0	
10	0	0	0	0	3	4	4	10	3	0	0	0	
11	0	0	0	0	1	9	5	24	26	0	0	0	
12	0	0	0	0	0	27	4	3	12	0	0	0	
13	0	0	0	0	0	20	14	0	0	25	0	4	
14	0	0	0	0	0	10	9	2	0	6	2	6	
15	0	0	0	0	0	15	15	0	0	2	0	0	
16	0	0	0	0	0	11	9	2	20	4	0	0	
17	0	0	0	0	0	4	7	0	32	0	0	0	
18	0	0	0	0	0	4	1	0	0	0	0	0	
19	0	0	0	0	0	0	2	8	8	27	0	0	
20	0	0	0	0	0	1	10	9	0	15	0	0	
21	0	0	0	0	12	21	3	6	0	0	0	0	
22	0	0	0	0	0	18	7	12	0	0	0	0	
23	0	0	0	0	3	12	15	11	2	0	5	0	
24	0	0	0	0	5	2	46	8	16	0	0	0	
25	0	0	0	0	0	16	26	8	4	0	9	0	
26	0	0	0	0	13	5	1	46	16	0	3	0	
27	0	0	0	0	18	17	17	13	0	0	0	0	
28	0	0	0	0	13	8	1	8	14	0	0	0	
29	0	0	0	0	12	8	3	0	24	0	0	0	
30	0		0	0	18	21	43	0	20	0	0	0	
31	0		0		15		47	2		0		0	Annual
Total	0	0	6	0	165	358	352	253	326	134	105	10	1,709
Max.	0	0	6	0	39	33	47	46	32	27	33	6	47

Year: 1981 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	36	4	2	1	0	0	
2	0	0	0	0	0	12	37	7	20	6	0	0	
3	0	0	0	0	0	24	26	7	2	1	0	0	
4	0	0	0	0	11	36	8	7	9	4	0	0	
5	0	0	0	0	6	12	5	6	10	43	0	0	
6	0	0	0	0	5	0	19	5	6	3	1	0	
7	0	0	0	0	24	0	45	10	13	0	58	0	
8	0	0	0	0	0	39	0	8	18	0	0	0	
9	0	0	0	0	2	2	15	6	14	0	39	0	
10	0	0	0	0	0	0	16	5	0	0	0	0	
11	0	0	0	0	0	12	9	13	0	0	13	0	
12	0	0	0	0	0	6	10	32	0	2	0	0	
13	0	0	0	22	27	4	5	5	0	1	0	0	
14	0	0	0	2	57	0	2	4	0	15	0	0	
15	0	0	0	12	0	0	0	7	0	8	12	0	
16	0	0	0	3	0	1	0	10	0	0	0	0	
17	0	0	0	13	0	0	18	3	4	0	13	0	
18	0	0	0	6	16	14	0	0	0	0	10	0	
19	0	0	0	20	30	32	4	3	1	7	13	0	
20	0	0	0	0	19	13	2	1	9	0	1	2	
21	0	0	0	0	0	8	4	31	4	0	22	0	
22	0	0	0	0	14	4	8	31	9	0	2	0	
23	0	0	0	0	13	21	0	24	0	0	0	0	
24	0	0	0	0	0	18	0	15	0	21	0	0	
25	0	0	0	0	8	2	55	24	1	2	0	0	
26	0	0	0	0	16	9	12	4	0	1	0	0	
27	0	0	0	0	7	3	51	0	0	0	0	0	
28	0	0	0	1	16	2	31	1	3	4	0	0	
29	0		0	2	5	13	32	3	3	0	0	0	
30	0		0	0	0	34	20	2	2	0	0	0	
31	0		0		36		11	7		0		0	Annual
Total	0	0	0	81	312	321	481	285	130	119	184	2	1,915
Max.	0	0	0	22	57	39	55	32	20	43	58	2	58

Daily Rainfall Record at Pinlaung

Year: 1982 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	29	15	20	15	0	0	0	
2	0	0	0	0	0	10	29	47	9	50	0	0	
3	0	0	0	0	0	1	60	13	94	3	0	0	
4	0	0	0	0	0	48	17	9	23	3	0	0	
5	0	0	0	0	0	8	7	8	27	4	0	0	
6	0	0	0	0	3	1	0	17	45	30	0	0	
7	0	0	0	0	0	0	0	43	6	7	0	0	
8	0	0	0	0	0	5	4	45	1	8	0	0	
9	0	0	0	0	1	13	1	4	5	0	0	0	
10	0	0	0	0	0	28	12	5	15	6	0	0	
11	0	0	0	28	0	4	2	6	0	0	0	0	
12	0	0	0	0	0	7	1	3	0	1	19	0	
13	0	0	0	0	0	30	3	41	0	2	0	0	
14	0	0	0	0	0	5	1	13	2	17	8	0	
15	0	0	0	0	21	20	11	7	0	0	0	0	
16	0	0	0	0	3	23	0	12	0	0	0	0	
17	0	0	0	0	15	22	0	10	2	0	0	0	
18	0	0	0	0	16	13	0	20	16	0	0	0	
19	0	0	0	1	4	14	14	20	6	0	0	0	
20	0	0	0	5	0	8	15	3	2	0	0	0	
21	0	0	0	0	14	9	1	16	0	5	0	0	
22	0	0	0	0	0	1	6	10	1	9	0	0	
23	0	0	0	0	5	15	16	40	14	0	0	0	
24	0	0	0	0	0	12	7	55	58	8	0	0	
25	0	0	0	0	20	15	11	0	49	4	0	0	
26	0	0	0	0	4	20	13	1	5	0	0	0	
27	0	0	0	0	0	15	20	0	7	0	0	0	
28	0	0	0	0	21	13	19	25	4	0	0	0	
29	0		0	0	31	3	29	19	4	0	0	0	
30	0		0	0	26	13	18	11	9	7	0	0	
31	0		0		0		15	1		0		0	Annual
Total	0	0	0	34	184	405	347	524	419	164	27	0	2,104
Max.	0	0	0	28	31	48	60	55	94	50	19	0	94

Year: 1983 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	16	19	24	25	1	0	0	
2	0	0	0	0	0	4	32	15	12	0	0	0	
3	0	0	0	0	0	7	8	10	3	0	40	0	
4	0	0	0	0	0	25	16	7	7	0	2	0	
5	0	2	0	0	0	8	14	11	10	36	10	0	
6	0	0	0	0	0	25	1	3	15	13	0	0	
7	0	0	2	4	0	0	0	3	5	1	0	0	
8	0	0	0	0	0	27	0	15	3	0	0	0	
9	0	0	0	1	0	52	0	17	3	66	0	0	
10	0	0	0	1	0	43	3	3	9	18	10	0	
11	0	0	0	0	0	39	0	0	1	0	45	0	
12	0	0	0	0	0	21	21	3	1	0	4	0	
13	0	0	0	0	0	21	13	0	12	0	27	0	
14	0	0	0	0	0	20	11	8	11	2	37	0	
15	0	0	0	0	0	25	3	1	15	0	36	0	
16	0	0	16	0	0	20	1	1	12	32	0	0	
17	0	0	0	0	0	17	0	25	10	2	2	0	
18	0	0	0	0	1	24	4	7	3	0	0	0	
19	0	0	0	0	0	13	7	6	1	6	0	0	
20	0	0	0	0	0	0	4	0	14	9	0	0	
21	0	0	0	15	0	0	16	0	8	9	4	0	
22	0	0	0	0	0	0	3	17	25	15	0	0	
23	0	0	0	0	0	1	2	11	8	0	0	0	
24	0	0	0	0	0	6	8	16	0	1	0	0	
25	0	0	0	0	0	5	21	6	0	0	0	0	
26	0	0	0	0	0	16	22	13	10	10	0	0	
27	0	0	0	0	8	3	7	30	0	0	0	0	
28	0	1	0	0	9	3	7	16	0	0	0	69	
29	0		0	0	60	4	13	9	3	0	0	5	
30	0		0	0	1	4	11	9	0	0	0	0	
31	0		0		0		16	5		4		0	Annual
Total	0	3	18	21	79	449	283	291	226	225	217	74	1,886
Max.	0	2	16	15	60	52	32	30	25	66	45	69	69

Daily Rainfall Record at Pinlaung

Year: 1984 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	17	1	8	4	9	0	0	
2	0	0	0	0	0	62	12	16	9	31	0	0	
3	0	0	0	0	0	5	6	9	31	2	0	0	
4	0	0	0	0	0	73	6	17	5	7	0	0	
5	0	0	0	0	0	6	14	2	7	0	2	0	
6	0	0	0	0	0	19	6	19	16	0	3	0	
7	0	0	0	0	15	0	5	9	0	0	0	0	
8	0	0	0	0	1	15	0	8	0	0	0	0	
9	0	24	0	0	1	39	14	27	6	0	0	0	
10	0	0	0	0	16	6	51	3	0	0	0	0	
11	0	0	0	0	0	0	16	42	0	6	0	0	
12	0	0	0	0	0	5	42	6	10	42	0	0	
13	0	0	0	0	13	25	47	26	0	0	0	0	
14	0	0	0	0	6	4	68	7	0	4	0	0	
15	0	0	0	0	20	6	39	22	0	0	0	0	
16	0	0	0	0	24	15	20	25	1	5	0	0	
17	0	0	0	0	0	24	0	23	1	26	0	0	
18	0	0	0	0	0	54	13	1	0	0	0	0	
19	0	0	0	0	0	52	1	0	1	12	0	0	
20	0	0	0	0	0	48	0	31	3	11	0	0	
21	0	0	0	0	0	8	0	1	0	18	0	0	
22	0	0	0	0	0	13	4	8	7	15	0	0	
23	0	0	0	10	0	5	10	8	5	0	0	0	
24	0	0	0	3	1	30	4	18	1	0	0	0	
25	0	0	0	0	8	7	0	10	4	0	0	0	
26	0	0	0	56	0	22	4	21	21	0	0	0	
27	0	0	0	0	1	12	1	18	1	0	0	0	
28	0	0	0	4	5	12	2	18	0	0	0	0	
29	0	0	0	0	5	18	16	4	0	0	0	0	
30	0		0	3	25	8	2	3	3	0	0	0	
31	0		0		13		11	0		0		0	Annual
Total	0	24	0	76	154	610	415	410	136	188	5	0	2,018
Max.	0	24	0	56	25	73	68	42	31	42	3	0	73

Year: 1985 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	28	21	18	20	18	0	0	
2	0	0	0	0	14	9	5	12	1	17	5	0	
3	0	0	0	0	10	25	10	10	0	0	1	0	
4	0	0	0	0	0	38	14	31	0	1	0	0	
5	0	0	0	0	0	32	15	13	1	0	0	0	
6	0	0	0	0	0	19	32	12	20	0	6	0	
7	0	0	0	0	0	39	38	17	3	0	0	0	
8	0	0	0	0	0	73	8	5	5	1	0	0	
9	0	0	0	7	0	38	19	2	14	0	0	0	
10	0	0	0	0	0	20	9	17	12	0	0	0	
11	0	0	0	0	0	14	1	3	27	0	0	0	
12	0	0	0	0	0	23	1	0	67	0	0	0	
13	0	0	0	0	0	7	0	10	5	2	4	0	
14	0	0	0	0	43	3	0	6	0	1	4	0	
15	0	0	0	0	0	22	1	7	26	7	36	0	
16	0	0	0	0	2	15	14	7	32	0	37	0	
17	0	0	0	2	6	18	12	39	3	4	35	0	
18	0	0	0	18	0	21	0	86	0	38	4	0	
19	0	0	0	0	2	4	0	24	2	5	4	0	
20	0	0	0	7	17	3	17	13	0	0	8	0	
21	0	0	0	0	37	3	3	13	0	0	12	0	
22	0	0	0	2	17	19	0	11	0	46	0	0	
23	0	0	0	0	2	0	27	1	0	0	0	0	
24	0	0	0	0	11	20	0	1	12	0	0	0	
25	0	0	0	0	26	4	12	9	5	6	0	0	
26	0	0	0	0	1	21	1	15	6	4	0	0	
27	0	0	0	6	5	33	13	9	2	3	0	0	
28	0	0	0	0	0	37	9	13	6	0	0	0	
29	0		0	38	1	60	11	23	16	0	0	0	
30	0		0	16	22	57	4	7	25	0	0	0	
31	0		0		16		15	12		0		0	Annual
Total	0	0	0	96	232	705	312	446	310	153	156	0	2,410
Max.	0	0	0	38	43	73	38	86	67	46	37	0	86

Daily Rainfall Record at Pinlaung

Year: 1986 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	4	0	3	7	5	6	0	0	
2	0	0	0	0	11	0	2	3	5	1	0	0	
3	0	0	20	0	0	0	2	6	4	0	0	0	
4	0	0	7	0	0	0	5	12	1	0	0	0	
5	0	0	0	0	0	17	1	5	17	1	0	0	
6	0	0	0	0	0	3	15	9	1	0	1	0	
7	0	0	0	0	7	0	18	3	104	0	0	0	
8	0	0	0	0	20	27	11	7	5	51	0	0	
9	0	0	0	1	0	2	4	0	1	21	9	0	
10	0	0	0	0	8	28	7	2	11	19	8	0	
11	0	0	0	0	0	16	4	0	8	9	28	22	
12	0	0	0	0	7	0	9	0	1	1	3	2	
13	0	0	0	0	0	41	8	16	1	24	0	0	
14	0	0	0	4	4	25	2	19	0	0	0	0	
15	0	0	0	0	7	7	1	6	0	0	0	0	
16	0	0	0	0	3	18	0	39	7	0	0	0	
17	0	0	0	0	0	34	1	5	2	0	0	0	
18	0	0	0	0	0	5	4	16	1	0	0	0	
19	0	0	0	0	0	7	7	21	0	0	0	0	
20	0	0	0	0	0	12	11	2	23	0	0	0	
21	0	0	0	0	0	10	14	15	19	0	0	0	
22	0	0	0	0	0	10	51	18	6	0	0	0	
23	0	0	0	0	0	3	24	10	11	0	0	0	
24	0	0	0	18	2	16	16	3	0	0	0	0	
25	0	0	0	17	9	25	13	0	0	0	0	0	
26	0	0	0	0	0	16	19	2	0	26	0	0	
27	0	0	0	0	0	23	26	0	0	22	0	0	
28	0	0	0	0	0	20	17	0	0	8	0	0	
29	0		0	0	0	18	3	5	1	0	0	0	
30	0		0	34	0	8	2	4	5	0	0	1	
31	0		0		0		0	5		0		12	Annual
Total	0	0	27	74	82	391	300	240	239	189	49	37	1,628
Max.	0	0	20	34	20	41	51	39	104	51	28	22	104

Year: 1987 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	6	0	0	0	0	5	5	58	10	2	0	0	
2	0	0	0	0	1	15	51	6	5	6	0	0	
3	0	0	0	0	0	3	37	15	14	1	15	0	
4	0	0	1	0	9	3	16	7	4	4	13	0	
5	0	1	0	0	20	1	30	5	6	1	47	0	
6	0	0	1	0	1	8	31	1	0	30	0	0	
7	0	0	0	0	0	0	10	0	1	4	0	0	
8	0	0	0	2	0	13	15	4	0	29	11	0	
9	0	0	0	0	0	0	23	1	32	25	1	0	
10	0	0	0	0	0	2	13	0	2	0	0	0	
11	0	0	0	75	0	27	22	2	4	0	0	0	
12	0	0	0	3	0	33	27	11	16	0	0	0	
13	0	0	0	1	0	8	13	1	0	0	2	0	
14	0	0	0	0	29	14	10	7	11	1	15	0	
15	0	0	0	0	0	3	5	0	11	0	1	0	
16	0	0	0	0	0	16	6	6	24	0	16	0	
17	0	0	0	0	0	4	0	7	39	0	6	0	
18	0	0	0	0	0	1	1	18	0	0	0	0	
19	0	0	0	0	0	4	15	31	1	7	1	0	
20	0	0	0	0	3	15	12	12	0	0	0	0	
21	0	0	0	0	1	4	18	7	22	1	0	0	
22	0	0	0	0	0	1	6	3	20	0	0	0	
23	0	0	0	0	0	0	1	35	15	3	0	0	
24	0	0	0	0	0	0	15	42	13	12	0	0	
25	0	0	0	0	5	0	6	86	0	1	0	0	
26	0	0	0	0	0	0	9	45	0	9	0	0	
27	23	0	0	0	0	0	24	30	3	7	0	0	
28	4	0	0	10	2	0	27	5	3	5	0	0	
29	6		0	3	0	3	3	19	0	0	0	0	
30	0		0	10	22	0	7	6	3	0	0	0	
31	0		0		15		12	9		0		0	Annual
Total	39	1	2	104	108	183	470	479	259	148	128	0	1,921
Max.	23	1	1	75	29	33	51	86	39	30	47	0	86

Daily Rainfall Record at Pinlaung

Year: 1988 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	6	10	20	16	11	0	0	0	
2	0	0	0	0	1	10	23	8	9	0	0	0	
3	0	0	0	0	20	25	6	12	4	23	0	0	
4	0	0	0	0	16	10	3	6	4	1	0	0	
5	0	0	0	0	0	6	5	11	0	0	1	0	
6	0	0	0	0	17	5	10	8	18	3	0	0	
7	0	0	0	0	19	4	5	43	16	1	0	0	
8	0	0	0	0	0	3	10	23	8	0	0	0	
9	0	0	0	0	0	14	2	25	6	1	0	0	
10	0	0	0	0	0	8	8	26	0	2	0	0	
11	0	0	0	0	0	14	0	16	14	3	0	0	
12	0	0	0	0	0	33	24	9	31	1	0	2	
13	0	0	0	0	0	15	12	12	4	2	0	0	
14	0	0	0	0	13	0	15	8	0	25	0	0	
15	0	0	0	15	0	0	8	10	5	3	0	0	
16	0	0	0	2	2	0	0	10	6	9	0	0	
17	0	0	0	0	12	0	20	19	13	0	0	0	
18	0	15	0	0	27	3	21	7	0	13	28	0	
19	0	0	0	1	22	2	8	1	0	14	38	0	
20	0	0	0	0	23	9	0	3	0	2	33	0	
21	0	0	0	0	2	10	5	7	0	0	6	0	
22	0	0	0	0	13	7	11	11	0	3	0	0	
23	0	0	0	0	23	20	7	10	0	10	0	0	
24	0	0	0	0	12	26	15	7	0	2	0	0	
25	0	0	0	0	0	52	8	0	0	1	0	0	
26	0	0	0	0	0	75	4	0	0	17	0	0	
27	0	0	0	0	0	24	4	0	0	2	0	0	
28	0	0	0	0	0	13	0	5	0	0	0	0	
29	0	0	0	1	0	3	1	13	0	0	0	0	
30	0		0	14	0	1	15	9	0	0	0	0	
31	0		0		0		43	3		0		0	Annual
Total	0	15	0	33	228	402	313	338	149	138	106	2	1,724
Max.	0	15	0	15	27	75	43	43	31	25	38	2	75

Year: 1989 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	12	14	15	0	0	0	0	
2	0	0	0	0	0	0	9	9	0	4	0	0	
3	0	0	0	0	0	5	2	4	3	0	0	0	
4	0	0	0	0	0	7	8	2	6	26	0	0	
5	0	0	0	0	0	0	1	1	9	3	0	0	
6	0	0	0	0	0	2	1	6	1	1	0	0	
7	0	0	0	0	0	9	3	3	13	8	0	0	
8	0	0	0	0	0	1	1	11	21	12	0	0	
9	0	0	0	0	0	23	0	0	11	18	0	0	
10	0	0	0	0	0	13	0	23	3	0	2	0	
11	0	0	0	0	4	33	1	9	1	0	0	0	
12	0	0	0	0	1	8	13	5	5	0	0	0	
13	0	0	0	0	51	20	28	4	1	0	0	0	
14	0	0	0	0	2	25	3	7	0	0	0	0	
15	0	0	1	0	2	20	4	20	12	24	0	0	
16	0	0	0	0	0	26	12	23	1	10	0	0	
17	0	0	0	0	0	14	0	27	9	3	0	0	
18	0	0	0	0	2	15	1	1	2	0	0	0	
19	0	0	0	0	24	16	1	1	0	9	0	0	
20	0	0	0	0	0	4	2	0	22	3	0	0	
21	0	0	0	0	0	16	1	36	19	8	0	0	
22	0	0	0	0	0	2	6	12	3	1	0	0	
23	0	0	0	0	0	0	2	0	7	0	5	0	
24	0	0	0	0	10	1	3	5	20	0	0	0	
25	0	0	0	0	0	1	6	37	23	6	0	0	
26	0	0	0	12	0	0	11	15	9	3	0	0	
27	0	0	0	0	0	2	23	9	10	5	0	0	
28	0	0	0	0	6	3	48	4	0	0	0	0	
29	0		0	0	0	14	72	3	6	10	0	0	
30	0		0	39	13	18	80	9	16	1	1	0	
31	0		5		0		86	7		5		0	Annual
Total	0	0	6	51	115	310	442	308	233	160	8	0	1,633
Max.	0	0	5	39	51	33	86	37	23	26	5	0	86

Daily Rainfall Record at Pinlaung

Year: 1990 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	15	22	44	0	15	0	
2	0	0	0	0	0	4	45	19	11	0	13	0	
3	0	0	5	0	0	0	29	27	38	2	0	0	
4	0	0	0	0	0	9	41	4	6	23	6	0	
5	0	0	0	0	14	26	10	23	8	0	10	0	
6	0	0	0	0	0	7	14	22	7	5	7	0	
7	0	0	0	0	7	5	20	2	4	11	3	0	
8	0	0	0	0	42	8	12	0	8	3	2	0	
9	0	0	0	0	0	29	5	1	4	0	0	0	
10	0	0	0	0	11	17	4	1	14	1	11	0	
11	0	0	0	0	31	4	8	1	12	0	0	0	
12	0	0	0	0	4	12	26	2	6	0	0	0	
13	0	0	0	0	3	14	18	1	1	12	0	0	
14	0	0	0	0	0	16	13	18	1	0	0	0	
15	0	0	0	0	44	8	9	4	31	0	0	0	
16	0	0	0	0	43	5	30	1	28	0	0	0	
17	0	0	0	0	35	10	13	0	4	0	0	0	
18	0	0	0	0	1	42	11	0	5	0	0	0	
19	0	0	0	0	10	10	10	0	0	0	0	0	
20	0	0	0	0	37	12	26	1	0	2	0	0	
21	0	5	0	0	2	13	12	8	0	0	0	0	
22	0	7	0	53	17	1	3	0	27	0	0	0	
23	0	3	0	2	13	9	2	0	20	0	0	0	
24	0	0	0	0	34	52	3	1	21	0	0	0	
25	0	0	0	0	0	54	10	2	2	0	2	0	
26	0	0	0	0	1	22	5	2	0	0	2	0	
27	0	3	0	17	1	6	11	5	11	0	0	0	
28	0	0	0	4	10	18	33	1	0	0	0	0	
29	0		0	0	23	21	16	2	2	0	0	0	
30	0		0	0	1	19	3	5	2	9	0	0	
31	0		0		18		20	20		15		0	Annual
Total	0	18	5	76	402	453	477	195	317	83	71	0	2,097
Max.	0	7	5	53	44	54	45	27	44	23	15	0	54

Year: 1991 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	26	32	9	0	3	37	0	0	
2	0	0	0	1	0	25	9	8	1	0	8	0	
3	0	0	0	0	0	15	1	9	0	0	14	0	
4	0	0	0	0	0	0	20	7	3	0	56	0	
5	0	0	0	0	0	29	25	3	2	18	55	0	
6	0	0	0	0	0	42	14	1	4	0	49	0	
7	0	0	3	0	0	24	6	0	8	9	10	0	
8	0	0	0	0	0	50	10	3	17	0	0	0	
9	0	0	0	0	5	26	0	5	1	10	0	0	
10	0	0	0	0	2	29	4	4	3	6	0	0	
11	0	0	0	0	0	39	5	5	0	0	0	0	
12	0	0	0	0	0	31	0	16	18	1	0	0	
13	0	0	0	0	0	44	0	5	0	16	1	0	
14	0	0	0	0	0	5	3	4	0	3	0	0	
15	0	0	0	0	12	30	1	3	7	12	1	0	
16	0	0	0	0	1	3	14	4	0	0	1	0	
17	0	0	0	0	0	3	15	0	24	0	0	0	
18	0	0	0	0	0	30	41	16	6	1	0	0	
19	0	0	0	0	0	12	23	0	2	8	0	0	
20	0	0	0	0	0	1	16	18	10	1	0	0	
21	0	0	0	21	0	0	11	9	30	10	0	0	
22	0	0	0	0	1	12	46	3	53	10	0	0	
23	0	0	0	0	0	30	16	12	2	0	0	0	
24	0	0	0	0	31	20	37	0	16	0	0	0	
25	0	0	0	0	2	63	15	0	1	0	0	0	
26	0	0	0	1	0	8	11	5	0	0	0	18	
27	0	0	0	1	43	6	2	0	0	1	0	104	
28	0	0	0	30	24	15	10	1	0	3	0	0	
29	0		0	4	8	19	20	0	8	0	0	0	
30	0		0	11	21	17	53	0	6	0	0	0	
31	0		0		13		24	0		0		0	Annual
Total	0	0	3	69	189	660	461	141	225	146	195	122	2,211
Max.	0	0	3	30	43	63	53	18	53	37	56	104	104

Daily Rainfall Record at Pinlaung

Year: 1992 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	13	19	4	0	0	0	
2	0	0	0	0	0	33	8	19	23	8	0	0	
3	0	0	0	0	0	19	17	9	6	2	0	0	
4	0	0	0	0	0	0	44	0	0	12	0	0	
5	0	0	0	0	0	14	54	6	3	4	0	0	
6	0	0	0	0	0	0	39	101	8	0	0	0	
7	0	0	0	0	0	0	38	55	0	0	0	0	
8	0	0	0	0	0	0	39	30	12	0	0	0	
9	0	0	0	0	0	23	10	23	5	0	40	0	
10	0	0	0	0	0	8	20	1	20	0	70	0	
11	0	0	0	0	0	1	11	30	8	3	0	0	
12	0	0	0	0	1	18	6	1	8	0	0	0	
13	0	0	0	0	11	17	0	0	3	26	0	0	
14	0	0	0	0	21	0	2	8	0	3	0	0	
15	0	0	0	0	0	11	7	5	0	23	0	0	
16	0	0	0	0	0	0	14	4	86	31	0	0	
17	0	1	0	26	15	13	23	13	18	1	0	0	
18	0	3	0	0	0	2	9	9	15	6	0	0	
19	0	1	0	0	1	6	4	22	20	0	0	0	
20	0	0	0	0	50	14	10	15	0	1	0	0	
21	0	0	0	0	0	13	34	18	17	0	4	0	
22	0	0	0	0	15	4	6	5	12	19	4	0	
23	0	0	0	0	2	5	19	0	14	26	1	0	
24	0	0	0	0	3	42	16	0	29	3	0	0	
25	0	0	0	0	1	92	6	6	15	12	0	0	
26	0	0	0	0	1	29	5	12	0	0	6	0	
27	0	5	0	0	6	37	1	2	0	2	0	0	
28	0	0	0	0	1	4	24	0	0	0	6	0	
29	0	0	0	0	6	4	22	0	3	0	0	0	
30	0		0	0	6	4	31	0	3	0	0	0	
31	0		0		0		3	17		1		0	Annual
Total	0	10	0	26	140	413	535	430	332	183	131	0	2,200
Max.	0	5	0	26	50	92	54	101	86	31	70	0	101

Year: 1993 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	16	25	15	24	10	18	0	0	
2	0	0	0	0	45	12	2	23	7	2	0	0	
3	0	0	0	0	17	55	5	18	0	22	0	0	
4	0	0	0	0	17	84	4	31	39	0	0	0	
5	0	0	0	0	0	6	7	11	0	3	0	0	
6	0	0	0	0	21	1	6	18	23	10	0	0	
7	0	0	0	0	17	1	3	4	5	12	0	0	
8	0	0	0	0	0	67	20	9	2	0	0	0	
9	0	0	0	0	0	0	34	5	0	0	0	0	
10	0	0	0	0	16	5	10	15	0	22	0	0	
11	0	0	0	0	0	19	3	21	18	10	0	0	
12	0	0	6	0	7	9	2	12	20	6	0	0	
13	0	0	0	0	0	7	5	5	3	5	0	0	
14	0	0	0	0	0	8	4	1	4	0	0	0	
15	0	0	0	0	0	1	49	5	0	0	0	0	
16	0	0	0	0	1	14	4	15	0	0	0	0	
17	0	0	0	0	1	19	1	13	15	1	0	0	
18	0	0	0	0	0	35	1	12	0	8	0	0	
19	0	0	0	0	0	32	8	43	0	0	0	0	
20	0	0	0	0	0	35	15	51	30	0	0	0	
21	0	4	0	0	0	7	2	9	6	4	0	0	
22	0	6	0	0	20	16	10	3	8	0	0	0	
23	0	0	0	0	10	7	6	24	2	13	0	0	
24	0	0	0	1	5	5	2	12	0	18	0	0	
25	0	0	0	0	10	25	2	3	0	8	0	0	
26	0	0	0	0	9	5	5	6	21	3	0	0	
27	0	0	0	11	1	1	1	14	1	0	0	0	
28	0	0	0	34	1	0	5	0	0	0	0	0	
29	5		0	0	20	24	0	1	0	1	0	0	
30	0		0	0	34	10	2	49	16	40	0	0	
31	0		0		30		9	3		3		0	Annual
Total	5	10	6	46	298	535	242	460	230	209	0	0	2,041
Max.	5	6	6	34	45	84	49	51	39	40	0	0	84

Daily Rainfall Record at Pinlaung

Year: 1994 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	3	2	10	10	24	2	0	0	
2	0	0	0	0	0	4	4	19	4	0	0	0	
3	0	0	0	1	6	0	5	9	0	0	0	0	
4	0	3	0	0	21	0	4	12	1	1	0	0	
5	0	0	0	0	6	2	31	47	22	23	0	0	
6	0	0	0	0	0	101	9	10	0	22	0	0	
7	0	0	0	0	0	5	4	23	4	12	0	0	
8	0	0	0	0	0	15	4	12	7	8	0	0	
9	0	0	0	0	15	5	6	16	19	0	0	0	
10	0	0	0	0	1	16	10	6	3	0	0	0	
11	0	0	0	0	0	23	24	20	7	0	0	0	
12	0	0	0	0	15	6	20	11	2	0	0	0	
13	0	0	0	0	0	46	16	7	23	0	0	0	
14	0	0	0	0	0	11	16	26	0	0	0	0	
15	0	0	0	0	0	18	10	12	8	0	0	0	
16	0	0	0	0	2	16	24	2	4	0	0	0	
17	0	0	0	0	1	43	24	20	3	4	0	0	
18	0	0	0	3	26	35	26	23	3	5	0	0	
19	0	0	0	0	4	12	18	17	3	1	0	0	
20	0	0	0	10	2	10	29	16	2	4	0	0	
21	0	0	0	14	4	6	20	18	0	2	0	0	
22	0	0	0	0	16	19	9	8	0	0	0	0	
23	0	0	0	0	0	1	4	17	1	0	0	0	
24	0	0	0	0	0	2	4	7	0	0	0	0	
25	0	0	0	0	0	2	20	12	0	0	0	0	
26	0	0	0	0	0	20	34	2	0	0	9	0	
27	0	0	2	0	0	19	16	4	1	0	24	0	
28	0	0	6	0	0	15	19	24	19	0	0	0	
29	0		8	1	3	2	38	6	12	0	0	0	
30	0		0	2	0	3	12	4	25	0	0	0	
31	0		0		1		5	24		0		0	Annual
Total	0	3	16	31	126	459	475	444	197	84	33	0	1,868
Max.	0	3	8	14	26	101	38	47	25	23	24	0	101

Year: 1995 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	1	15	39	9	0	18	0	
2	0	0	0	0	0	2	24	25	28	4	1	0	
3	0	0	0	0	0	0	31	13	19	26	0	0	
4	0	0	0	0	0	1	15	1	32	2	0	0	
5	0	0	0	21	0	13	42	1	11	53	0	0	
6	0	0	0	4	49	2	4	7	4	3	0	0	
7	0	0	0	0	0	0	4	9	0	11	0	0	
8	0	0	0	0	1	8	5	7	2	3	0	0	
9	0	0	0	0	6	6	5	3	5	0	0	0	
10	0	0	0	0	18	61	9	1	6	0	0	0	
11	0	0	0	0	3	21	15	2	1	0	0	0	
12	0	0	0	0	24	8	12	13	7	0	0	0	
13	0	0	0	0	0	6	15	19	0	0	13	0	
14	0	0	0	0	9	3	7	16	0	1	59	0	
15	0	0	0	0	27	11	7	3	0	1	9	0	
16	0	0	0	0	19	11	20	3	30	0	0	0	
17	0	0	0	0	27	8	23	14	1	0	0	0	
18	0	0	0	0	37	4	18	13	0	11	0	0	
19	0	0	0	0	14	17	29	10	8	23	1	0	
20	0	0	0	0	0	1	2	0	3	0	1	0	
21	0	0	0	0	0	4	4	0	3	18	0	0	
22	0	0	0	0	0	4	6	2	0	1	0	0	
23	0	0	0	0	0	11	7	7	1	19	0	0	
24	0	0	0	0	2	19	1	19	26	3	0	0	
25	0	0	0	0	3	15	0	5	101	0	0	0	
26	0	0	0	0	0	3	32	7	1	0	33	0	
27	0	0	0	0	1	8	21	19	0	0	1	0	
28	0	0	0	0	0	6	3	0	1	0	0	0	
29	0		0	0	0	4	40	0	0	0	0	0	
30	0		0	0	18	10	15	1	0	0	0	0	
31	0		0		8		14	30		0		0	Annual
Total	0	0	0	25	266	268	445	289	299	179	136	0	1,907
Max.	0	0	0	21	49	61	42	39	101	53	59	0	101

Daily Rainfall Record at Pinlaung

Year: 1996 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
30	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
31	NA		NA		NA		NA	NA		NA		NA	Annual
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Max.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Year: 1997 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
30	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
31	NA		NA		NA		NA	NA		NA		NA	Annual
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Max.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Daily Rainfall Record at Pinlaung

Year: 1998 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	4	9	0	0	0	0	0	
2	0	0	0	0	0	0	16	10	0	0	0	0	
3	0	0	0	0	0	0	13	18	1	0	1	0	
4	0	0	0	0	0	0	37	15	9	0	0	0	
5	0	0	0	0	2	0	39	9	2	0	0	0	
6	0	0	0	0	2	0	21	9	12	0	0	0	
7	0	0	0	0	0	0	48	4	53	0	0	0	
8	0	0	0	0	0	0	8	2	29	0	0	0	
9	0	0	0	0	0	0	5	20	25	0	0	0	
10	0	0	0	0	0	20	16	11	13	1	0	0	
11	0	0	0	0	0	NA	15	25	8	0	0	0	
12	0	0	0	0	0	2	23	18	0	1	0	0	
13	0	0	0	0	0	6	10	22	0	1	0	0	
14	0	0	0	0	27	0	7	10	16	0	0	0	
15	0	0	0	0	0	30	18	0	NA	7	0	0	
16	0	0	0	1	0	1	5	NA	1	0	0	0	
17	0	0	0	NA	0	1	8	2	2	0	0	0	
18	0	0	0	0	30	0	5	1	5	6	0	0	
19	0	0	0	0	1	1	6	6	0	3	0	0	
20	0	0	0	0	11	4	2	23	0	9	0	0	
21	0	0	0	0	24	5	0	2	2	0	0	0	
22	0	0	0	21	10	9	5	11	0	0	NA	0	
23	0	0	0	5	3	7	1	1	0	0	NA	0	
24	0	0	0	0	20	16	6	10	0	0	0	0	
25	0	0	0	0	5	9	5	11	10	8	0	0	
26	0	0	0	0	24	8	3	15	0	4	0	0	
27	0	0	0	0	21	7	11	17	0	0	NA	0	
28	0	0	0	0	13	NA	36	2	0	18	0	0	
29	0		0	0	54	5	3	1	0	0	0	0	
30	0		0	0	25	21	2	2	0	18	0	0	
31	0		4		0		11	NA		4		0	Annual
Total	0	0	4	27	272	156	394	277	188	80	1	0	1,399
Max.	0	0	4	21	54	30	48	25	53	18	1	0	54

Year: 1999 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	NA	0	0	0	1	3	4	0	10	0	
2	0	0	4	0	NA	2	0	8	3	0	16	0	
3	0	0	0	0	1	0	4	20	3	7	60	0	
4	0	0	0	0	0	42	6	4	NA	4	10	0	
5	0	0	0	0	6	18	2	14	0	0	4	0	
6	0	0	0	0	NA	2	19	22	22	1	0	0	
7	0	0	0	0	0	0	12	48	17	4	5	10	
8	0	0	0	3	4	0	7	41	5	0	0	NA	
9	0	0	0	0	0	0	8	80	2	0	0	0	
10	0	0	0	41	1	16	10	70	8	0	6	0	
11	2	0	0	0	20	2	7	22	37	0	0	0	
12	0	0	0	0	1	0	6	17	4	5	0	0	
13	0	0	0	2	24	2	9	40	0	6	0	0	
14	0	0	0	NA	0	2	10	36	1	0	0	0	
15	0	0	0	9	5	75	10	12	0	0	0	0	
16	0	0	0	61	1	3	11	13	11	33	0	0	
17	0	0	0	13	2	1	6	11	4	3	0	0	
18	1	0	0	0	5	4	8	13	26	1	0	0	
19	0	0	0	0	NA	2	19	7	7	0	0	0	
20	0	0	0	0	NA	20	20	5	5	0	0	0	
21	0	0	0	0	60	30	17	3	16	0	0	0	
22	0	0	0	0	24	46	9	0	0	17	0	0	
23	0	0	0	0	1	46	3	35	0	0	0	0	
24	0	0	0	0	0	97	NA	NA	0	0	0	0	
25	0	0	0	0	7	27	7	20	23	0	0	0	
26	0	0	0	0	14	12	20	8	0	NA	0	0	
27	0	0	0	0	14	16	17	7	3	4	0	0	
28	0	0	0	NA	23	6	9	4	55	13	0	0	
29	0		0	0	29	7	6	23	20	3	0	0	
30	0		0	1	35	1	2	11	4	27	0	0	
31	0		0		11		20	16		82		0	Annual
Total	3	0	4	130	288	479	285	613	280	210	111	10	2,413
Max.	2	0	4	61	60	97	20	80	55	82	60	10	97

Daily Rainfall Record at Pinlaung

Year: 2000 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	40	0	13	17	4	0	0	
2	0	0	0	0	8	22	4	NA	13	6	0	0	
3	0	0	0	0	9	24	0	1	6	9	0	0	
4	0	0	0	0	0	4	0	2	6	0	0	0	
5	0	0	0	0	13	7	1	1	29	0	0	0	
6	0	0	0	0	3	28	2	1	15	NA	0	0	
7	NA	0	0	0	13	5	7	6	2	33	0	0	
8	0	0	0	0	5	2	12	1	11	1	0	0	
9	0	0	0	0	4	4	17	10	1	30	0	0	
10	0	0	0	0	0	5	12	30	1	4	0	0	
11	0	0	0	0	16	18	14	10	NA	0	0	0	
12	0	0	0	0	11	24	24	5	0	8	0	0	
13	0	0	0	6	8	54	31	9	24	0	0	0	
14	0	0	0	3	2	52	19	11	5	0	0	0	
15	0	0	0	0	6	14	0	17	5	0	0	0	
16	0	0	0	0	6	21	1	9	0	0	0	0	
17	0	0	0	0	10	7	22	4	0	0	0	0	
18	0	NA	0	0	2	3	33	1	0	0	0	0	
19	0	1	0	0	10	12	54	7	4	3	0	0	
20	0	0	0	0	11	1	26	1	0	0	0	0	
21	0	0	0	0	3	2	15	28	7	2	0	0	
22	0	0	0	0	NA	16	16	40	NA	0	0	0	
23	0	0	0	0	6	16	14	NA	9	0	0	0	
24	0	0	0	0	9	32	15	7	NA	3	0	0	
25	0	0	0	0	34	18	8	0	NA	83	0	0	
26	0	0	0	0	45	10	6	0	5	0	0	0	
27	0	0	24	2	13	2	4	NA	0	0	0	0	
28	0	NA	0	6	6	3	3	26	8	0	0	0	
29	0	0	13	0	0	0	NA	39	12	6	NA	0	
30	NA		2	0	0	6	1	49	12	2	0	0	
31	0		3		0		16	26		0		0	Annual
Total	0	1	42	17	253	452	377	354	192	194	0	0	1,882
Max.	0	1	24	6	45	54	54	49	29	83	0	0	83

Year: 2001 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	1	0	0	36	12	18	1	0	0	0	
2	0	0	0	0	0	33	5	21	7	0	71	0	
3	0	0	0	0	6	22	2	50	0	18	0	0	
4	0	0	0	0	3	4	0	35	1	23	0	0	
5	0	0	0	0	0	2	0	14	3	3	0	0	
6	0	0	0	0	15	5	10	0	3	4	3	0	
7	0	0	0	0	10	NA	10	20	8	8	0	0	
8	0	0	0	0	3	6	4	4	NA	10	0	0	
9	0	0	0	0	NA	9	13	NA	NA	7	0	0	
10	0	0	0	0	4	5	14	8	31	56	4	0	
11	0	0	NA	0	48	NA	31	2	3	33	10	0	
12	0	0	0	0	0	6	8	35	NA	10	0	0	
13	0	0	3	4	8	14	16	43	2	0	0	0	
14	0	0	12	0	53	4	12	24	NA	0	9	0	
15	0	0	4	0	9	26	28	8	29	12	21	1	
16	0	0	2	0	8	22	13	13	7	11	0	0	
17	0	0	0	0	0	16	18	4	NA	12	0	0	
18	0	0	0	0	15	10	13	11	6	NA	0	0	
19	0	0	0	0	NA	3	19	8	2	0	0	0	
20	0	0	0	0	0	11	22	8	2	0	0	0	
21	0	0	0	0	4	8	9	2	3	0	0	0	
22	0	0	0	0	14	5	29	3	8	0	0	0	
23	0	0	0	0	0	NA	13	1	0	0	0	0	
24	0	0	0	0	0	1	7	1	2	0	0	7	
25	0	0	0	0	0	11	20	3	3	1	0	0	
26	0	0	0	0	0	NA	6	7	8	5	0	NA	
27	0	0	0	0	56	7	8	NA	0	7	0	0	
28	0	0	0	0	18	3	4	14	0	9	0	0	
29	0		0	0	5	31	7	10	0	3	0	0	
30	0		0	0	55	23	18	NA	5	19	0	0	
31	0		0		17		11	0		19		0	Annual
Total	0	0	22	4	351	323	382	367	134	270	118	8	1,979
Max.	0	0	12	4	56	36	31	50	31	56	71	7	71

Daily Rainfall Record at Pinlaung

Year: 2002 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	7	3	0	10	0	0	
2	0	0	0	0	0	0	6	1	0	0	1	0	
3	0	0	0	0	0	13	10	24	0	25	9	0	
4	0	0	0	0	0	9	15	5	11	5	13	0	
5	0	0	0	0	0	17	4	3	21	0	20	0	
6	0	0	0	0	8	12	4	13	2	12	0	0	
7	0	0	0	0	1	8	3	7	2	6	0	0	
8	0	0	0	0	36	13	2	13	13	0	0	0	
9	0	0	0	0	0	0	4	20	6	0	0	0	
10	5	0	0	0	0	2	7	19	0	0	0	0	
11	1	0	0	0	0	4	16	14	0	0	3	0	
12	0	0	0	0	23	3	19	23	5	0	0	0	
13	0	0	0	0	0	23	17	6	0	2	12	0	
14	0	0	0	5	33	3	27	24	18	1	1	0	
15	0	0	0	0	0	6	NA	22	2	2	3	0	
16	0	0	0	0	5	3	13	28	3	5	0	5	
17	0	0	0	0	19	4	5	25	0	0	0	6	
18	0	0	0	0	52	12	3	0	23	0	0	0	
19	0	0	0	0	296	7	33	5	17	18	0	0	
20	0	0	0	0	92	15	35	16	6	3	1	0	
21	0	0	0	0	NA	23	62	1	6	0	0	0	
22	0	0	0	0	0	13	86	2	24	0	0	0	
23	0	0	0	1	20	7	63	4	0	1	0	0	
24	0	0	0	0	8	10	32	36	0	8	0	0	
25	3	0	0	13	1	13	11	5	0	0	12	1	
26	0	0	0	0	3	12	2	44	4	51	21	2	
27	0	0	0	12	14	19	13	31	0	0	11	0	
28	0	0	0	0	4	3	9	20	0	4	12	0	
29	0		0	0	5	6	1	51	0	6	6	0	
30	0		0	0	1	4	0	14	0	0	4	0	
31	0		4		12		6	19		0		0	Annual
Total	9	0	4	31	633	264	515	498	163	159	129	14	2,419
Max.	5	0	4	13	296	23	86	51	24	51	21	6	296

Year: 2003 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	68	1	22	18	5	22	23	0	
2	38	0	0	0	0	10	4	12	7	9	19	0	
3	0	0	0	0	24	11	4	2	8	2	0	0	
4	0	0	0	0	0	23	6	10	0	7	0	0	
5	29	0	0	0	0	14	0	3	26	0	0	0	
6	0	10	0	0	0	38	13	0	4	2	0	0	
7	0	31	0	0	0	34	0	3	9	1	0	0	
8	0	0	0	0	0	2	0	5	4	9	0	0	
9	0	0	0	0	0	22	5	23	NA	4	0	0	
10	0	0	0	0	21	15	8	14	42	0	0	0	
11	0	0	0	0	28	50	14	18	19	0	0	0	
12	0	0	0	0	0	23	0	14	11	0	0	0	
13	0	0	0	0	24	4	4	13	4	0	0	0	
14	0	0	0	0	17	0	5	5	24	2	0	0	
15	0	0	0	0	0	0	17	3	5	1	0	0	
16	0	0	0	0	16	0	2	2	2	0	0	0	
17	0	0	0	0	13	4	0	0	3	0	0	0	
18	0	0	0	0	16	14	5	6	0	0	0	0	
19	0	0	0	0	9	29	4	3	0	2	0	0	
20	0	0	0	0	3	12	3	5	2	19	0	0	
21	0	0	0	1	7	32	35	3	7	40	0	0	
22	0	0	0	0	1	21	2	10	1	0	0	0	
23	0	0	0	0	0	3	4	11	1	0	0	0	
24	0	0	0	0	46	2	30	3	5	1	0	0	
25	0	0	0	0	2	22	24	15	5	0	0	0	
26	0	0	0	0	NA	52	29	NA	3	0	0	0	
27	0	0	0	0	0	59	2	13	2	0	0	0	
28	0	0	0	0	0	48	9	12	0	0	0	0	
29	0		0	0	0	39	4	5	25	0	0	0	
30	0		0	3	0	56	28	2	0	0	0	0	
31	0		0		2		11	6		0		0	Annual
Total	67	41	0	4	297	640	294	239	224	121	42	0	1,969
Max.	38	31	0	3	68	59	35	23	42	40	23	0	68

Daily Rainfall Record at Pinlaung

Year: 2004 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	38	3	6	6	0	0	0	
2	0	0	0	1	2	4	3	20	8	0	0	0	
3	0	0	0	0	0	7	5	11	2	0	0	0	
4	0	0	0	0	0	4	1	36	2	0	0	0	
5	0	0	0	0	14	0	6	29	3	2	0	0	
6	0	0	0	0	40	0	11	31	2	7	0	0	
7	0	0	0	0	72	14	1	12	4	6	0	0	
8	0	0	0	10	0	34	11	6	4	0	0	0	
9	0	0	0	0	0	12	15	14	10	0	0	0	
10	0	0	0	0	4	0	45	2	13	0	0	0	
11	0	0	0	3	0	NA	29	13	52	0	0	0	
12	0	0	0	NA	0	23	10	18	27	28	0	0	
13	0	0	0	0	0	10	3	5	12	NA	0	0	
14	0	0	0	0	0	0	13	18	17	20	0	0	
15	0	0	0	0	9	0	19	13	83	5	0	0	
16	0	0	0	0	14	2	10	17	7	4	0	0	
17	0	0	0	19	0	12	0	3	6	0	0	0	
18	0	0	0	30	19	43	4	6	35	2	0	0	
19	0	0	0	47	12	53	11	9	5	3	0	0	
20	0	0	0	1	192	37	8	9	0	9	0	0	
21	0	0	0	0	14	43	20	12	20	0	0	0	
22	0	0	0	0	31	21	6	1	8	0	0	0	
23	0	0	0	0	0	44	22	0	8	0	0	0	
24	0	0	0	NA	5	7	40	2	0	3	0	0	
25	0	0	0	0	0	0	6	3	0	0	0	0	
26	2	0	0	0	0	0	11	5	4	0	0	0	
27	0	0	0	0	4	0	3	16	30	0	0	0	
28	0	0	0	6	10	2	2	5	12	0	0	0	
29	0	0	0	20	107	9	5	22	7	0	28	0	
30	0		0	17	13	2	14	13	23	0	7	0	
31	0		0		5		29	5		0		0	Annual
Total	2	0	0	154	567	421	366	362	410	89	35	0	2,406
Max.	2	0	0	47	192	53	45	36	83	28	28	0	192

Year: 2005 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	11	14	12	14	21	5	0	
2	0	0	0	0	3	23	26	44	10	0	0	0	
3	0	0	0	0	1	17	25	18	NA	0	0	0	
4	0	0	0	7	2	1	3	23	8	33	0	0	
5	0	0	0	NA	0	15	4	23	0	6	0	0	
6	0	0	0	0	2	0	12	50	7	0	0	0	
7	0	0	5	0	3	0	11	36	0	0	4	0	
8	0	0	0	0	0	4	7	7	56	0	23	4	
9	0	0	0	0	2	21	6	25	36	0	4	2	
10	0	0	0	0	0	22	8	33	12	0	3	4	
11	0	0	0	8	0	43	8	12	11	0	0	0	
12	0	0	0	0	0	8	0	13	36	0	0	0	
13	0	0	0	0	15	6	3	35	15	0	0	0	
14	0	0	0	0	20	13	37	37	NA	16	0	0	
15	0	0	5	0	0	12	3	8	1	15	0	0	
16	0	0	32	0	0	2	0	41	22	0	0	0	
17	0	0	0	0	0	3	0	32	1	30	0	0	
18	0	0	0	0	0	31	0	20	0	4	0	0	
19	NA	0	0	0	0	11	2	8	16	0	0	0	
20	0	0	0	5	6	8	53	21	21	0	0	0	
21	0	0	0	30	18	7	11	58	10	0	6	0	
22	0	0	0	8	13	6	2	15	0	0	1	0	
23	0	0	0	0	17	5	26	8	0	0	0	3	
24	0	0	0	0	0	15	8	4	0	0	0	12	
25	0	0	0	0	1	22	15	9	5	8	0	19	
26	0	0	1	0	0	60	16	24	2	0	0	13	
27	0	0	0	0	3	46	12	1	0	1	0	8	
28	0	0	0	38	0	33	4	15	12	11	0	0	
29	0		0	0	0	21	25	5	70	20	0	0	
30	0		0	0	0	15	12	4	35	9	0	0	
31	0		0		24		5	NA		3		0	Annual
Total	0	0	43	96	130	481	358	641	400	177	46	65	2,437
Max.	0	0	32	38	24	60	53	58	70	33	23	19	70

Daily Rainfall Record at Pinlaung

Year: 2006 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	2	60	13	32	24	0	0	0	
2	0	0	0	0	0	21	15	10	16	0	0	0	
3	0	0	0	0	6	13	6	2	27	0	0	0	
4	0	0	0	0	0	12	15	8	0	0	0	0	
5	0	0	0	0	0	32	15	15	0	0	0	0	
6	0	0	0	0	0	25	60	6	0	33	0	0	
7	0	0	0	0	0	12	35	0	0	12	0	0	
8	0	0	0	0	2	11	53	14	0	39	14	0	
9	0	0	0	0	35	20	20	6	0	33	0	0	
10	0	0	0	0	0	30	18	2	0	12	2	0	
11	0	0	0	0	2	16	23	4	8	0	0	0	
12	0	0	0	0	0	14	25	5	2	1	0	0	
13	0	0	0	0	1	0	5	0	35	10	9	0	
14	0	0	0	0	22	0	1	3	15	0	0	0	
15	0	0	0	0	11	1	17	15	0	14	0	0	
16	0	0	0	0	7	3	9	2	2	5	0	0	
17	0	0	0	19	0	0	5	6	0	0	0	0	
18	0	0	0	0	0	13	55	6	17	3	0	0	
19	0	0	0	0	0	4	92	16	13	4	0	0	
20	0	0	0	4	0	11	36	15	31	3	0	0	
21	0	0	0	2	0	1	6	38	16	0	0	0	
22	0	0	0	0	0	23	10	10	2	0	0	0	
23	0	0	0	0	0	5	4	17	1	0	0	0	
24	0	0	0	0	0	7	0	3	0	0	0	0	
25	0	0	0	0	1	8	2	1	25	0	0	0	
26	0	0	0	0	20	43	24	3	0	0	0	0	
27	0	0	0	8	0	2	60	13	7	0	0	0	
28	0	0	0	35	7	5	54	12	7	0	0	0	
29	0		0	19	11	4	18	9	8	29	0	0	
30	0		0	53	21	16	3	1	17	0	0	0	
31	0		20		23		12	27		0		0	Annual
Total	0	0	20	140	171	412	711	301	273	198	25	0	2,251
Max.	0	0	20	53	35	60	92	38	35	39	14	0	92

Year: 2007 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	20	3	2	0	0	0	
2	0	7	0	0	0	1	26	9	3	0	0	0	
3	0	18	0	0	22	11	14	29	7	2	10	0	
4	0	0	0	0	10	2	28	32	22	4	33	0	
5	0	0	0	0	3	5	19	7	4	11	2	0	
6	0	0	0	0	1	0	35	16	20	25	NA	0	
7	0	0	0	0	NA	2	16	6	13	33	0	0	
8	0	0	0	0	8	37	8	5	6	8	0	0	
9	0	0	0	0	5	3	10	6	3	0	0	0	
10	0	0	0	0	33	7	0	15	2	0	0	0	
11	0	0	0	0	35	13	0	13	3	7	0	0	
12	0	0	0	NA	15	25	2	22	23	8	0	0	
13	0	0	0	0	20	117	8	40	5	0	0	0	
14	0	0	0	0	9	18	11	35	0	0	0	0	
15	0	6	0	0	23	16	13	22	54	12	0	0	
16	0	0	0	NA	6	16	15	14	23	3	0	0	
17	0	0	0	0	6	10	36	26	16	22	5	0	
18	0	0	0	0	11	2	22	2	30	1	0	0	
19	0	0	0	0	28	2	39	0	0	0	0	0	
20	0	0	0	2	22	30	16	NA	1	13	0	0	
21	0	0	0	0	30	0	48	5	2	20	0	0	
22	0	0	0	0	30	0	19	17	1	5	3	0	
23	0	0	0	0	22	0	6	50	0	14	0	0	
24	0	0	0	0	0	0	8	30	1	8	0	0	
25	0	0	0	0	0	0	10	12	2	0	0	0	
26	0	0	0	0	0	14	4	21	28	0	0	0	
27	0	0	0	2	0	0	32	2	40	0	0	0	
28	0	0	0	6	NA	51	0	0	10	0	0	0	
29	0		0	0	0	9	0	15	50	0	0	0	
30	0		0	NA	10	28	0	10	11	0	0	0	
31	0		0		0		12	20		0		0	Annual
Total	0	31	0	10	349	419	477	484	382	196	53	0	2,401
Max.	0	18	0	6	35	117	48	50	54	33	33	0	117

Daily Rainfall Record at Pinlaung

Year: 2008 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	6	0	0	4	10	8	4	13	NA	64	0	
2	0	0	0	95	11	0	4	3	17	14	61	0	
3	0	0	0	0	2	5	30	19	2	8	57	0	
4	0	0	0	0	40	0	18	3	8	16	30	0	
5	0	0	0	0	0	80	14	3	2	NA	0	0	
6	0	0	0	0	1	10	22	9	0	NA	0	0	
7	0	0	0	0	0	35	29	5	44	0	0	0	
8	0	0	0	0	0	21	14	2	31	1	0	0	
9	0	0	0	0	0	11	10	30	31	0	0	0	
10	0	0	0	0	9	4	9	31	13	0	0	0	
11	0	0	0	0	5	2	7	23	0	0	0	0	
12	0	0	0	0	24	15	11	11	2	0	0	0	
13	0	0	0	0	2	4	10	5	8	0	0	0	
14	0	0	0	0	5	0	27	11	22	0	0	0	
15	0	0	0	0	3	42	22	10	3	0	0	0	
16	0	0	0	0	5	21	5	16	14	0	NA	0	
17	0	0	0	0	23	58	10	24	2	1	0	NA	
18	0	0	0	0	52	50	5	30	0	0	0	0	
19	0	0	0	0	0	32	23	9	35	0	0	0	
20	0	0	0	0	20	14	8	4	16	0	0	0	
21	0	0	0	0	0	0	14	4	8	74	0	0	
22	0	0	0	0	2	2	13	2	4	0	0	0	
23	0	0	0	0	0	4	33	0	2	1	0	NA	
24	0	0	0	0	0	5	5	13	7	18	0	0	
25	0	0	20	0	0	4	0	2	2	51	0	0	
26	0	0	0	0	0	4	24	0	16	96	0	0	
27	6	0	0	0	0	18	5	3	5	36	0	0	
28	49	0	0	0	0	5	27	5	0	10	0	0	
29	2	0	0	0	2	25	10	13	0	3	0	0	
30	0		2	0	1	14	8	2	1	51	0	0	
31	0		0		1		3	2		NA		0	Annual
Total	57	6	22	95	212	495	428	298	308	380	212	0	2,513
Max.	49	6	20	95	52	80	33	31	44	96	64	0	96

Year: 2009 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	25	3	24	0	0	0	
2	0	0	0	0	0	0	39	0	17	2	0	0	
3	0	0	0	0	0	0	23	15	0	0	0	0	
4	0	0	0	0	10	0	20	0	20	43	0	0	
5	0	0	0	0	0	16	0	0	3	2	0	0	
6	0	0	0	0	0	20	42	65	4	0	0	0	
7	0	0	0	0	0	16	35	17	10	0	0	0	
8	0	0	0	0	0	48	29	78	23	2	2	0	
9	0	0	0	0	0	16	0	17	5	0	0	0	
10	0	0	0	0	0	1	0	0	2	0	0	0	
11	0	0	0	0	0	0	0	5	0	0	0	0	
12	0	0	0	0	25	0	3	1	0	0	0	0	
13	0	0	0	0	10	8	0	1	16	0	0	0	
14	0	0	0	0	20	10	14	14	6	15	0	0	
15	0	0	5	27	0	0	0	29	2	0	0	0	
16	0	0	0	8	0	0	21	0	4	0	0	0	
17	0	0	0	16	15	6	0	4	13	23	0	0	
18	0	0	0	18	10	20	3	33	13	0	0	0	
19	0	0	10	3	0	22	49	0	2	0	0	0	
20	0	0	0	18	13	9	6	6	26	17	0	0	
21	0	0	0	0	0	0	4	4	6	0	0	0	
22	0	0	0	3	9	0	0	9	3	2	0	0	
23	0	0	0	0	0	8	0	6	24	6	0	0	
24	0	0	0	12	0	9	2	0	0	0	0	0	
25	0	0	0	0	18	14	4	19	13	0	0	0	
26	0	0	0	0	18	5	35	1	0	0	0	0	
27	0	0	0	0	13	2	32	0	6	20	0	0	
28	0	0	5	0	0	8	75	1	7	11	0	0	
29	0		0	0	17	10	42	4	0	6	0	0	
30	0		0	1	12	8	52			2	0	0	
31	0		0		13		21					0	Annual
Total	0	0	20	106	203	256	576	332	249	151	2	0	1,895
Max.	0	0	10	27	25	48	75	78	26	43	2	0	78

Source: Department of Meteorology and Hydrology, Myanmar

Daily Rainfall Data

(Kalaw)

Unit in inches

Daily Rainfall Record at Kalaw

Year: 1980 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.30		0.01	0.21	0.06	0.53		
2			0.22			0.24	0.09	0.20	0.04	0.10	0.30		
3					0.05	0.58	0.15	0.07	0.15				
4					4.60	0.20			0.36	0.42			
5					0.72	0.58		0.42	1.55	0.94			
6					0.75	0.07		0.06	0.02	0.05			
7					0.49	0.42		0.01	0.15	1.36			
8								0.01	1.03	0.57			
9					0.36			0.06	1.01	0.01	1.02		
10					0.12		0.23						
11						0.62	0.04			0.32			
12						0.30				0.53			
13						1.10				0.04			
14						0.78	0.13		0.02	0.84			
15						0.41	0.08	0.02	1.33	0.19			
16				0.04	0.21	0.05	0.02		0.37	0.70			
17										0.34			
18								0.30	0.02	0.32			
19								0.25		0.11			
20					0.30	0.95	0.21	0.43					
21				0.29		0.55	1.13	0.89	0.35				
22					0.16	0.50	0.82	0.05	0.98		0.08		
23						0.10	0.13	0.32					
24					1.05	0.05	0.58	0.02	0.05		1.54		
25						0.39		0.48	0.46				
26					0.08	0.02	0.02	0.07	0.04				
27					0.36			0.04					
28					0.07	0.05			0.11				
29						0.59	0.17	0.05					
30				0.07			0.13	1.05	0.32				
31							0.23	1.56		0.12			Annual
Total	0.00	0.00	0.22	0.40	9.32	8.85	4.16	6.37	8.57	7.02	3.47	0.00	48.38
Max.	0.00	0.00	0.22	0.29	4.60	1.10	1.13	1.56	1.55	1.36	1.54	0.00	4.60

Year: 1981 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.38	0.12		0.78				
2					0.66	0.72	0.25	0.04					
3					0.30	0.68	0.14						
4					0.13	0.11		0.10		0.03			
5					0.20	0.05	0.26		0.03	0.30			
6					0.04		1.31	0.22	0.39		1.10		
7						0.93		0.06	0.32	0.12	1.15		
8						0.02				0.19	0.12		
9								0.04			0.28		
10		1.03	0.27			0.15		0.66			0.25		
11						0.32		0.78	0.19		0.19	0.04	
12				0.23		0.55	0.27	0.08					
13				0.14							0.27		
14						0.15		0.26	0.04	1.35	0.08		
15								0.15	0.11	0.06			
16				0.30		0.02		0.03				0.08	
17				0.02	1.11	1.21	0.02			0.36	0.67		
18					1.06	0.08	0.25		0.11	1.14	0.62	0.12	
19				0.83	1.42	0.03	0.45				0.13		
20	0.02				0.14		0.42	1.13	0.07		0.10		
21					0.13			0.12			0.80		
22			0.04		0.41	0.04	0.02		0.09		0.16		
23						0.18	1.03	0.09	0.03	0.12			
24					0.12			0.04					
25					0.64	0.06	0.08	0.03	0.19				
26			0.02	0.23			1.01	0.02					
27					0.30		0.10	0.04	0.20	0.54			
28					0.37	0.17	0.50	0.08	0.03				
29						0.14	0.18		0.41				
30					0.02	0.12	0.04		0.40				
31					0.05								Annual
Total	0.02	1.03	0.33	1.75	7.10	6.11	6.45	3.97	3.39	4.21	5.92	0.24	40.52
Max.	0.02	1.03	0.27	0.83	1.42	1.21	1.31	1.13	0.78	1.35	1.15	0.12	1.42

Daily Rainfall Record at Kalaw

Year: 1982 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1						2.00	0.32	0.76		0.58			
2						0.37	0.85		0.50	0.19			
3						0.43	0.04		1.28	0.03			
4						0.25	0.65			0.18			
5						0.08		0.23		0.13			
6					0.67			0.28		0.72			
7					1.74		0.02	0.82	0.13				
8					0.46	0.09		0.02	0.04				
9					0.38		0.03	0.84	0.48	0.49			
10						0.02		0.39		0.06			
11							0.13	0.34		0.16	0.60		
12						0.22		0.61		0.18			
13					0.28	1.03	0.15	0.07	0.13	0.77	1.29		
14					1.16	0.32	0.22			0.32			
15						0.40	0.13						
16				0.67		0.15		0.35					
17					0.81		0.24	0.21	0.03				
18					0.50	0.14	0.03	0.18	0.45				
19					0.54		0.21	0.03	0.12				
20					0.04	0.27		0.04	0.03				
21					1.60			0.04					
22					0.16	0.14	0.07	0.59	0.27	0.14			
23					0.20		0.04	0.58	0.30	0.02			
24					0.86				0.02	0.24			
25					0.31	0.16			0.09	0.04			
26					0.03	0.14	0.14	0.04		0.03			
27						0.03	0.16	0.16			0.11		
28					0.80		0.08	0.72	0.27				
29					0.24	0.31	0.06	0.07					
30					0.08	0.03	0.11						
31					0.42		0.06			0.55			
Total	0.00	0.00	0.00	0.67	11.28	6.58	3.74	7.37	4.14	4.83	2.00	0.00	40.61
Max.	0.00	0.00	0.00	0.67	1.74	2.00	0.85	0.84	1.28	0.77	1.29	0.00	2.00

Year: 1983 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1						0.05	0.35	0.08	0.19		0.06		
2						0.13	0.15		0.11	1.12	1.37		
3		0.11					0.45		0.77		0.47		
4		0.24			0.11	0.07	0.45	0.03	0.12	2.00	0.39		
5						0.18		0.26	0.02	0.02	0.28		
6				0.60		0.05				0.05	0.12		
7				0.51		0.31	0.25		0.36	0.14	0.31		
8				0.29	0.03	0.48		0.50	0.22	0.98			
9				0.50		0.26		0.09	0.35	0.08	0.64		
10				0.12		1.12			0.12	0.96	1.18		
11						0.75				0.37	0.17		
12					0.06	1.25	0.05		0.05		0.40		
13					0.70	0.38		1.07	1.04	0.05	0.40		
14						0.15	0.14	0.40	0.06		1.98		
15						0.04		0.02	0.09	0.95	0.18		
16			0.46			0.31	0.20	0.03					
17					0.94		0.46	0.02	0.17				
18						0.44		0.13	0.08	0.46			
19									0.38	0.37	0.11		
20		0.21		1.42	0.12		0.02	0.13	0.15	0.04			
21			0.06			0.11	0.06	0.12	0.76	1.30			
22		0.02			0.20	0.40	0.10		1.19	0.09			
23					0.07	0.80		0.08		0.11			
24						0.20	0.06	0.09					
25						0.53	0.10	0.08					
26		0.05					0.20	0.11		0.48			
27		0.02			0.24	0.02		0.17	0.47			3.28	
28					0.63			0.04	0.08				
29					0.13	0.36				0.41			
30					0.55			0.10	0.05				
31					1.47			1.75					
Total	0.00	0.65	0.52	3.44	5.25	8.39	3.04	5.30	6.83	9.98	8.06	3.28	54.74
Max.	0.00	0.24	0.46	1.42	1.47	1.25	0.46	1.75	1.19	2.00	1.98	3.28	3.28

Daily Rainfall Record at Kalaw

Year: 1984 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1							0.27	0.05	0.13	1.97			
2						0.27	0.02	0.43	1.22	2.50			
3						1.17		0.30	0.08	0.26			
4						0.03			0.11				
5								0.85					
6					2.44	0.27	0.03	0.38					
7					0.02	0.30	0.07	0.34	0.02				
8		0.37					0.36	0.55	0.28	0.53			
9				0.03		1.15	0.23	0.20	0.75	0.70			
10						0.75	0.22			1.15			
11							0.54	0.70	0.22	1.14	0.16		
12					0.03	0.09	0.35	0.42		0.03			
13		0.20			0.17		0.03	0.74		0.10			
14						0.24	0.02	0.24		0.16			
15					0.22	0.12	1.00	0.45		0.73			
16					0.35	0.35		0.88	0.22	0.23			
17						0.51	0.12		0.18				
18						0.52	0.08	0.68		0.69			
19						0.20		0.65		0.35			
20						0.04				0.65			
21								0.87	0.87				
22				1.80		0.05	0.10	0.11	0.37				
23						0.38		0.03	0.79				
24					0.16	0.11		0.64	0.70				
25				1.40			0.08		0.06				
26								0.50					
27				0.80		0.22		0.20					
28				1.20	0.97	0.42	0.32	0.05					
29					0.51		1.30	0.08					
30					0.36		0.10	0.64	0.03				
31					0.25			0.86					Annual
Total	0.00	0.57	0.00	5.23	5.48	7.19	5.24	11.84	6.03	11.19	0.16	0.00	52.93
Max.	0.00	0.37	0.00	1.80	2.44	1.17	1.30	0.88	1.22	2.50	0.16	0.00	2.50

Year: 1985 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.97	0.59	0.02	0.15	0.11	0.13	0.14		
2					0.34	0.18	0.14	0.17		0.10			
3						0.17	0.17	0.20		0.34			
4					0.14	0.61	0.11	1.20	0.01		0.05		
5					0.11	0.03	0.09		0.04		0.05		
6						0.09	0.05	0.15	0.03		0.15		
7						0.75			0.04		0.35		
8						0.06		0.10	0.03		0.45		
9						1.17	0.07	0.12			0.50		
10						0.13	0.02	0.13	0.05		0.15		
11						0.31		0.37	0.86		0.15		
12						0.18	0.09	0.11		0.16	0.35		
13					0.02		0.05	0.04	0.82		0.25		
14						0.26		0.04	0.04	0.05	1.00		
15						0.42		0.08	0.05		2.50		
16				0.24	0.15	0.05	0.05	0.12	0.02		1.18		
17				0.02	0.13	0.46	0.23	0.21		2.06	0.15		
18					0.23	0.07	0.05	0.24			1.11		
19					1.40	0.08	0.78				0.05		
20				0.25	0.62	0.07	0.02	0.21					
21				0.02	0.34	0.39				0.35			
22				0.25	0.34	0.05		0.34					
23					0.33	0.06		0.13	1.78				
24					0.05	0.03			0.40	0.87			
25					0.13	0.19	0.04	0.14	0.55	0.02			
26				1.20	0.12	0.13	0.05		0.02	0.33			
27				0.60	0.05	0.09	0.12	0.10					
28				0.23		0.55	0.34	0.60					
29						0.13			0.18				
30							0.17	0.25	1.22				
31					0.03		0.10	0.02					Annual
Total	0.00	0.00	0.00	2.81	5.50	7.30	2.76	5.22	6.25	4.41	8.58	0.00	42.83
Max.	0.00	0.00	0.00	1.20	1.40	1.17	0.78	1.20	1.78	2.06	2.50	0.00	2.50

Daily Rainfall Record at Kalaw

Year: 1986 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.04		0.80			
2						0.01		0.16					
3			0.72				0.06			0.07			
4			0.19		0.10		0.09	0.24	0.21	0.13			
5					0.15		0.02	0.31	0.20		0.18		
6					0.45		0.73	1.18	0.18	0.14			
7					0.30	0.76	0.10		0.70				
8						0.05	0.09	0.04		0.19	0.73		
9						0.32	0.22		0.80	0.26	0.30		
10						0.23	0.38		0.54	0.13	0.90		
11				0.90	0.19		0.06	0.32	0.34	1.12	0.05		
12				1.80		0.12		0.20	0.09	0.51			
13						0.58				0.33			
14					0.20			0.30					
15					1.00	0.18		0.23	0.33				
16					0.30	0.11		0.12	0.01				
17					0.95	0.15							
18							0.03						
19						0.04	0.77						
20							0.40	0.19	1.65				
21					0.35	0.11	0.18	0.08	0.25				
22				0.09		0.05	0.05	0.11					
23					0.20	0.06	0.71	0.39		0.16			
24						0.08	0.12						
25						0.08	0.04	0.15					
26			0.48			0.18	0.09	1.18					
27				0.30		0.17	0.10						
28				0.20	0.10	0.09		0.47					
29				0.50		0.05			0.21				
30								0.08	0.84			1.49	
31								0.16					Annual
Total	0.00	0.00	1.39	3.79	4.29	3.42	4.24	5.95	6.35	3.84	2.16	1.49	36.92
Max.	0.00	0.00	0.72	1.80	1.00	0.76	0.77	1.18	1.65	1.12	0.90	1.49	1.80

Year: 1987 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						1.14	0.47	0.14	0.03				
2			0.96			0.77	0.19	0.17	0.07		0.22		
3			0.13		0.86	0.05	0.07				0.83		
4					0.49	0.03	0.08	0.16		0.40	0.11		
5						0.12	0.15	0.07		0.21			
6						0.10		0.07	0.28	0.12			
7				0.54		0.14	0.18		1.01	0.75			
8						1.80	0.05	0.52	0.01	0.77	0.75		
9						0.60	0.06	0.22	0.66	0.07	0.15		
10				2.40		1.15	0.10		0.01	0.40	0.02		
11				1.27		0.10	0.05		0.01		0.22		
12						0.12			0.09				
13						0.08		0.32			0.05		
14						0.15	0.03	0.06	0.05		0.12		
15						0.24			0.19		0.16		
16						0.13	0.07	0.16	0.36		0.30		
17						0.09		0.50	0.06				
18			0.12			0.02		0.69	1.85				
19						0.43	0.08		0.24				
20							0.36		0.12				
21						0.19	0.84		0.18				
22									0.26				
23							0.47	0.28	0.06				
24					0.92		0.49	0.71	0.14	0.02			
25							1.35	0.15		0.04			
26					0.03		0.49	0.03		0.37			
27	0.09			0.56		0.10	0.13	0.05		0.20			
28	0.22						0.13						
29				0.36				0.04	0.06				
30				0.02	0.10		0.02	0.06	0.03				
31					0.10								Annual
Total	0.31	0.00	1.21	5.15	2.50	7.55	5.86	4.40	5.77	3.35	2.93	0.00	39.03
Max.	0.22	0.00	0.96	2.40	0.92	1.80	1.35	0.71	1.85	0.77	0.83	0.00	2.40

Daily Rainfall Record at Kalaw

Year: 1988 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1					0.25	1.24	0.52	0.07	0.37				
2						1.00	0.15	0.04	0.04	0.97			
3						0.60				0.03			
4					0.20	0.40		0.24		0.11			
5					0.35	0.37		0.12		0.94			
6					0.13	0.16		0.15					
7						0.05		0.12	0.33				
8						0.38		0.29		0.13			
9						0.12		0.09		0.11			
10						0.44	0.59	0.08	0.14	0.35			
11							0.32		0.25	0.05			
12					0.05		0.59		0.06				
13					0.15	0.72	0.17	0.12		0.45			
14				1.59	0.35		0.03	0.31	0.15	0.35			
15					0.14			0.50	0.06	0.70			
16		0.16			0.39		1.19	0.21		0.08	0.20		
17					1.75		0.53	0.12			0.90		
18					3.60					0.70	0.74		
19					0.59		0.09			0.38	1.10		
20					0.07	0.42	0.79	0.02		0.12	0.20		
21								0.04		0.07			
22					0.02	0.29							
23						0.10			0.25				
24				0.02		0.46							
25						0.20				0.23			
26						0.50							
27						0.16					0.39		
28						0.37			0.32				
29				0.11									
30				0.85	0.02	0.30	0.70						
31					0.39		0.25						
Total	0.00	0.16	0.00	2.57	8.45	8.28	5.92	2.52	1.97	5.77	3.53	0.00	39.17
Max.	0.00	0.16	0.00	1.59	3.60	1.24	1.19	0.50	0.37	0.97	1.10	0.00	3.60

Year: 1989 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1								0.22					
2					0.19	0.28		0.03		1.19			
3									0.71	0.23			
4					0.04			0.35		0.15			
5								0.10		0.06			
6							0.40	0.08	0.04	0.12			
7					0.47		0.03	0.02	0.69	0.15			
8									0.35	0.16			
9						1.10		0.42	0.12				
10					0.33	0.25	0.06	0.52	0.05				
11					0.34	0.15	0.15	0.23	0.28	0.08			
12					1.58		0.30	0.14					
13					1.80	0.15	0.13	0.02		0.05			
14			0.17		0.46			0.46	0.04	1.95			
15					0.09	0.57	0.11		0.10	0.25			
16								0.02	0.08				
17					0.69	0.09			0.18	0.03			
18					0.85	0.06	0.11		0.07	0.38			
19					0.35		0.51			0.09			
20							0.08	0.93	0.06	0.76			
21							0.13	1.16	0.40				
22							0.59		0.13				
23					0.06		0.11	0.10	0.15				
24								0.08	0.66	0.09			
25				0.92	0.16	0.22	0.19	0.12		0.75			
26					0.72			0.59	0.46	0.55			
27				0.15	0.14	0.74	0.09	0.08					
28						0.02		0.22	0.04				
29			0.06	1.73		0.20	1.07	0.26					
30						0.02	0.90		0.64	0.02			
31							0.02			0.27			
Total	0.00	0.00	0.23	2.80	8.27	3.85	4.98	6.15	5.25	7.33	0.00	0.00	38.86
Max.	0.00	0.00	0.17	1.73	1.80	1.10	1.07	1.16	0.71	1.95	0.00	0.00	1.95

Daily Rainfall Record at Kalaw

Year: 1990 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1						0.04	0.45		0.06		0.68		
2			0.60			0.02	0.23		0.24				
3			0.08				0.21	1.20					
4					0.40	0.46	0.12	0.50		0.28	0.35		
5								0.30		0.04	0.05		
6					0.80	0.14		0.42	0.03				
7					0.41	0.12		0.03		0.04			
8						0.10			0.15		0.56		
9					3.34	0.24			0.52		0.44		
10					1.22	0.69	0.48	0.05	0.67	0.24	0.42		
11						0.21	0.22		1.43				
12							0.04	0.11					
13					0.30	0.07	0.06			0.08			
14					1.76		0.09	0.09	0.21	1.18			
15			0.08		1.82		0.65	0.14	0.86				
16					0.59								
17					1.72	0.20							
18					0.45	0.03							
19					0.40		0.12						
20		0.16			0.25			0.04					
21		0.04		1.40	0.50								
22		0.95			0.58		0.12		0.18		0.10		
23				0.51	0.80	0.19	0.29		0.30				
24					0.06	0.30	0.06		0.04				
25						0.06			0.39				
26				0.05	0.11	0.03		0.13	0.03				
27					0.07		0.12	0.09					
28						0.07		0.02	0.15				
29					0.04		0.20	0.14	0.27	0.32			
30							0.35	0.04	0.70	0.16			
31					0.11		0.44	0.05					
Total	0.00	1.15	0.76	1.96	15.73	2.97	4.25	3.35	6.23	2.34	2.60	0.00	41.34
Max.	0.00	0.95	0.60	1.40	3.34	0.69	0.65	1.20	1.43	1.18	0.68	0.00	3.34

Year: 1991 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1				0.35		0.15		0.33					
2				0.35		0.10		0.15					
3					0.76	0.03		1.01	0.12	0.12	1.06		
4						0.69	0.05	1.00	0.07	0.98	0.43		
5						2.85	0.06	0.20			0.87		
6						0.30	0.10				0.51		
7					0.25	0.50	0.15			0.90	0.04		
8					0.69	1.00		0.37		0.40			
9					0.45	0.05		0.20	0.07				
10						0.27		0.08	0.31				
11						0.43		0.20	0.16	0.10			
12						0.15		0.23	0.12	0.17	0.47		
13						0.05			0.98	0.12			
14					1.90		0.01	0.08	0.45		0.08		
15						0.08	0.08	0.20	0.92				
16							0.03		0.30				
17					0.55	0.10	0.15		0.08				
18					0.22		0.18	0.28	0.13	0.42			
19							1.00		0.04				
20					0.64		0.20	0.55	0.11				
21							1.03	0.20	2.21	0.24	0.12		
22						0.30	0.27	0.11	0.27	0.26			
23						0.14	0.57		0.87	0.16			
24					0.18	0.28	0.39		0.12				
25							1.07	0.40	0.05	0.04		0.72	
26				0.05		0.10			0.02	0.24		2.35	
27				2.35	0.03	0.05		0.40	0.04				
28				2.60	0.10			0.15	0.52	0.40			
29				0.29	0.62	0.13	0.16	0.60	1.08	0.31			
30				0.88		0.18	0.30	0.30	0.09	0.66			
31					1.85			0.10		0.06			
Total	0.00	0.00	0.00	6.87	8.24	7.93	5.80	7.14	9.13	5.58	3.58	3.07	57.34
Max.	0.00	0.00	0.00	2.60	1.90	2.85	1.07	1.01	2.21	0.98	1.06	2.35	2.85

Daily Rainfall Record at Kalaw

Year: 1992 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.20	0.75	0.29			
2								0.80		0.10			
3							1.40						
4							0.58	0.85	0.07				
5							0.42	3.85	0.65				
6							0.65	2.95	0.05				
7						1.45	0.25	0.55					
8						0.92	0.20		0.50		0.05		
9							0.15						
10									0.06				
11										0.27			
12													
13													
14						0.30		0.60		0.45			
15							0.55	0.43	1.25				
16				0.95	0.65	0.05	0.15	0.70	0.24		0.27		
17						0.06	0.50	0.41	0.08				
18					0.90	0.33			0.60		0.42		
19					2.85	0.20	0.27		0.90		0.05		
20						0.19	0.63		1.50				
21						0.03			0.10				
22						0.02	1.23		0.60	0.20			
23						0.44	0.63	0.24	0.20	0.40			
24						0.70	0.15	0.15	1.10	0.60			
25						0.41		0.23	0.20	0.45			
26					2.50	0.27		0.14		0.10			
27					0.20			0.24	0.05	0.25			
28					1.33					0.14			
29							1.18	1.05		0.05			
30				0.15			0.07		0.42				
31							0.08	0.24					Annual
Total	0.00	0.00	0.00	1.10	8.43	5.37	9.09	13.63	9.32	3.30	0.79	0.00	51.03
Max.	0.00	0.00	0.00	0.95	2.85	1.45	1.40	3.85	1.50	0.60	0.42	0.00	3.85

Year: 1993 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					1.45		0.04	0.20	0.43		0.12		
2					0.60		0.28	0.16	1.34	0.08			
3					0.20		0.59	0.16	0.16	0.08			
4								0.28		0.20			
5					0.38		0.04	0.08		0.39			
6					1.42				0.08	0.08			
7									1.10				
8							0.04	0.20	0.35	0.16			
9							0.20	0.08					
10							0.12		0.12	0.83			
11								0.08	0.67				
12							0.08	0.04	0.75	0.04			
13							1.69		0.04	0.35			
14						0.30	0.59						
15					0.25	1.05							
16					0.32		0.16						
17						0.25		0.08		0.20			
18					0.24			0.12		1.06			
19								0.51	0.08	0.43			
20						0.23	0.08		0.51				
21		0.39		0.13	0.20			0.08	0.91				
22		0.12		0.31	0.25				0.24	0.51			
23				0.30						0.04			
24					0.50		0.71	0.04	0.04	0.04			
25					0.21			0.08		0.12			
26				0.20	0.52					0.20			
27				1.17	0.65		0.04	0.04	0.24				
28					0.15		0.24		0.75	0.28			
29					0.75		0.59	0.24	0.12	0.12			
30					0.45			0.82		0.12			
31							0.20	2.80		0.04			Annual
Total	0.00	0.51	0.00	2.11	8.54	1.83	5.69	6.09	7.93	5.37	0.12	0.00	38.19
Max.	0.00	0.39	0.00	1.17	1.45	1.05	1.69	2.80	1.34	1.06	0.12	0.00	2.80

Daily Rainfall Record at Kalaw

Year: 1994 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1					1.45	0.27		0.25	0.25				
2					0.60	0.50		0.40	0.10				
3					0.70				0.45				
4						1.62			0.55				
5					0.38			0.05	0.34				
6					1.42	3.25		0.08					
7						0.75		0.42					
8							0.28	0.10					
9													
10								0.50	0.35				
11						0.12	0.08	0.10	0.20				
12						0.20	0.04	0.50	0.40				
13						0.08		0.20	0.15				
14						0.04			0.25				
15					0.25	0.03			0.20				
16					0.32	0.27			0.15				
17						0.52			0.24				
18					0.24								
19						0.07			0.76				
20						0.15							
21				0.13	0.20	0.75							
22				0.31	0.25	0.05							
23				0.30									
24					0.50								
25					0.21								
26				0.20	0.52								
27				1.17	0.65	0.10							
28					0.15								
29					0.75	0.10							
30					0.45	0.05		0.85					
31							0.15	0.50					
Total	0.00	0.00	0.00	2.11	9.04	8.92	0.55	3.95	4.39	0.00	0.00	0.00	28.96
Max.	0.00	0.00	0.00	1.17	1.45	3.25	0.28	0.85	0.76	0.00	0.00	0.00	3.25

Year: 1995 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1							0.04	0.39		0.00	2.95		
2						0.08		0.63	0.15	0.50	0.15		
3					0.04	1.50				0.00			
4					0.20		0.04		0.75		0.40		
5					0.16		0.24		0.50	0.30			
6				0.63	0.94	0.04		0.08	0.60	0.70			
7					0.51			0.51		0.75			
8						0.12				0.85			
9						0.24	0.04						
10						0.39	1.77	2.09					
11					2.52	0.51		0.32					
12					0.28	0.08	0.20	0.12	0.10				
13						0.35			0.70				
14					0.16	0.16		0.12			2.15		
15					0.32			0.20	0.25				
16					0.28			0.08	0.10				
17					0.24			0.12			0.30		
18					0.16		0.35						
19							0.04			0.75			
20									0.50	0.20			
21						0.08							
22					0.04			1.77					
23						0.08		0.32	0.20				
24								0.79					
25								0.08	0.70				
26							0.24		0.20	1.25	0.65		
27					0.16		0.16						
28						0.08		0.04					
29							0.20						
30					0.04		0.04						
31					0.12		0.51						
Total	0.00	0.00	0.00	0.63	6.17	3.71	3.87	7.66	4.75	5.30	6.60	0.00	38.69
Max.	0.00	0.00	0.00	0.63	2.52	1.50	1.77	2.09	0.75	1.25	2.95	0.00	2.95

Daily Rainfall Record at Kalaw

Year: 1996 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1							0.59	0.15	0.60	0.83			
2							1.18	0.40					
3								0.80	1.30	1.60			
4					0.75					0.70			
5					0.70								
6					0.10			0.20					
7					0.20			0.20					
8					0.70	1.00	0.39	0.10	0.10				
9				1.65			0.39			0.10			
10						1.30		0.05					
11						0.45		2.00	0.15				
12									0.25				
13							0.20		0.95				
14							0.39	0.25		0.10			
15					1.00	0.30		0.70					
16						0.60		0.15		0.48			
17						0.65				0.20			
18						0.15		0.05					
19					2.25	0.15		0.20		0.10			
20								0.75					
21						0.65		0.15		0.20			
22								0.30					
23		2.70		2.65	0.45		0.39	0.10					
24		0.65		0.10	0.65		0.59	0.75	0.70	0.05			
25				0.30	0.80			0.20					
26				0.30	0.20		1.97		0.38				
27					0.40		3.94	0.05	0.76				
28			2.85	0.25		0.15	1.18	0.10					
29						0.50							
30						0.15							
31					0.25		1.77	0.35		0.20			Annual
Total	0.00	3.35	2.85	5.25	8.45	6.05	12.98	8.00	5.19	4.56	0.00	0.00	56.68
Max.	0.00	2.70	2.85	2.65	2.25	1.30	3.94	2.00	1.30	1.60	0.00	0.00	3.94

Year: 1997 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1									0.24				
2								0.29	0.38				
3							0.30	0.50	0.05	1.80			
4					0.04		0.05	0.50	0.35				
5							0.10		0.13				
6							0.50		0.30				
7				0.20			0.21			0.18			
8							0.12						
9							0.11						
10							0.03	0.77					
11							0.42	0.05					
12							0.07						
13						0.20							
14						0.50							
15						0.30							
16							0.30	0.10					
17					0.08		0.32	0.20					
18					0.12	0.18	0.32	0.30	0.05				
19			0.60		0.04	0.32	0.33	0.50	0.10	0.25			
20					0.16	0.16	0.20	0.20					
21					0.12	0.04	0.53	0.23					
22			0.75				0.24			0.25			
23			0.05				1.45						
24			0.85				2.64		0.40				
25				1.80		0.09	2.41	1.43	0.60				
26					1.30	0.03		0.14					
27						0.02	1.55	0.18	0.26	0.25			
28						0.55		0.24	0.38	0.00			
29						0.14		0.15					
30					0.94	0.28	0.30						
31							0.05						Annual
Total	0.00	0.00	2.25	2.00	2.80	2.81	12.55	5.78	3.24	2.73	0.00	0.00	34.16
Max.	0.00	0.00	0.85	1.80	1.30	0.55	2.64	1.43	0.60	1.80	0.00	0.00	2.64

Daily Rainfall Record at Kalaw

Year: 1998 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1						0.12	0.08	0.32					
2							0.71	0.08					
3					0.08				0.32				
4											0.51		
5					0.16								
6					0.43				2.17				
7							0.04	0.35	0.24				
8									0.71				
9						0.47			0.43				
10								1.06	0.24				
11							0.24	0.12	0.28				
12									0.04				
13													
14					0.04	0.04		0.04					
15								0.16	0.04	0.98			
16						0.32	0.04		0.08	0.08			
17							0.08	0.12					
18					1.10		0.12			0.28			
19					0.16			0.43					
20					0.16		0.04	0.08			1.14		
21									0.04		0.91		
22				0.08	0.16	0.04		0.63			0.08		
23				0.04		0.04		0.63		0.28			
24								0.04					
25								0.08		0.04			
26					0.12		0.08		0.08	0.32			
27					0.32		0.35	0.24		1.22			
28							0.94		0.67	0.79			
29					0.04	0.55				0.28			
30					0.35	0.51							
31			0.12										Annual
Total	0.00	0.00	0.12	0.12	3.12	2.09	2.72	4.38	5.34	4.27	2.64	0.00	24.80
Max.	0.00	0.00	0.12	0.08	1.10	0.55	0.94	1.06	2.17	1.22	1.14	0.00	2.17

Year: 1999 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1									0.39		0.08		
2					0.20	0.04		0.12	0.16	0.08	3.31		
3					0.98				0.04		1.50		
4						1.14	0.35	0.04		0.08			
5						0.63			0.12	0.24			
6						0.24	0.04	0.39					
7					0.08			0.04	0.39	0.24	0.16		
8					0.04			0.59	0.04	0.04			
9				1.42	0.08			0.44	2.28		0.16		
10					0.16	0.04		0.51	0.12	0.51	0.35		
11	0.08				0.36	0.08	0.12	0.04	0.28	0.55			
12					0.79	0.04		0.40					
13								0.04					
14				0.75	0.04	0.04	0.04			0.20			
15				0.20		0.04		0.08	0.08				
16				0.43		0.36			0.16				
17					2.52		1.02	0.08	0.43	0.08			
18					0.35		0.43	0.16	0.75				
19					0.24			0.16	0.32				
20					0.59			1.26	0.08				
21					0.28			0.39	0.32				
22							0.04	0.04		0.04			
23								0.32					
24					0.04	0.24		0.43	0.04				
25						0.16	0.12	1.06	0.16				
26							0.68	0.04					
27						0.04			0.63	0.08			
28										0.98			
29					0.08		0.04		1.18	1.46			
30				0.47	0.04		0.59		0.32	0.59			
31							0.75	0.16		0.59			Annual
Total	0.08	0.00	0.00	3.27	6.87	3.09	4.22	6.79	8.29	5.76	5.56	0.00	43.93
Max.	0.08	0.00	0.00	1.42	2.52	1.14	1.02	1.26	2.28	1.46	3.31	0.00	3.31

Daily Rainfall Record at Kalaw

Year: 2000 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1													
2					0.28	0.16	0.28		0.04				
3						0.04	0.04		0.39				
4						0.08	0.12						
5					0.04	0.51	0.04		0.04				
6					0.32	0.24	0.59	1.38	0.35	0.47			
7					0.16	0.08	0.59	0.67		1.10			
8					0.24		0.04	0.20					
9					0.16		0.08	0.87		0.08			
10							0.08	0.08					
11					1.38			0.12	0.59	0.51			
12					0.32	0.04	0.20	0.08		0.55			
13				0.04	0.47		0.35	0.12	0.39				
14					0.04	0.12		0.04	0.04	0.91			
15					0.12	0.24		0.12	0.55				
16						0.55							
17					0.04	0.63	0.32		0.04				
18					0.20		0.08	0.04					
19							0.12		0.12				
20					0.63	0.12		0.28	0.04	0.04			
21					0.04			1.30	0.12				
22					0.04				0.63				
23				0.08	0.63			0.08					
24				0.04	0.16			0.20		0.24			
25					0.28			0.16		0.98			
26					0.79			0.04					
27			2.32	1.54	0.08	0.04			0.28				
28				0.35	0.04	0.16		1.30			0.63		
29			0.04	1.30		0.08	0.08	0.59			0.83		
30			0.04		0.28	0.12	0.59	0.08	0.08	0.24			
31			0.08				0.91	0.04		0.04			
Total	0.00	0.00	2.48	3.35	6.74	3.21	4.51	7.79	3.70	5.16	1.46	0.00	38.40
Max.	0.00	0.00	2.32	1.54	1.38	0.63	0.91	1.38	0.63	1.10	0.83	0.00	2.32

Year: 2001 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1						1.57	0.51	0.28		0.08			
2						1.06		0.28			0.08		
3					2.24	0.12		0.24		0.28	0.04		
4					0.12			1.02	0.12	0.04	0.51		
5						0.04	0.08		0.43				
6					0.16		1.06	0.43	0.24				
7					0.12			0.32		0.35			
8							0.28	0.59		0.32			
9						0.35	0.20	1.06	2.09	0.12			
10					0.08	0.24	0.28	0.24	0.24	1.38			
11					0.94		1.18	0.87	0.08	0.08	0.04		
12						0.32	0.16	2.72		0.43			
13					0.16		0.24	0.55	0.28				
14					1.42	0.04	0.08	0.04	0.04				
15					0.08		0.04				0.12		
16			0.08		0.71		0.16			0.24		0.16	
17							0.04	0.24		0.39			
18					1.22					0.20			
19				0.32	1.02					0.24			
20					0.67		0.08	0.08					
21					0.79		0.16	0.04	0.04				
22					0.87		0.87		0.16	0.04			
23							0.43		0.04				
24							0.32		0.04			0.04	
25					0.79		0.24		0.04				
26					0.04				0.16	0.12			
27					0.63			0.20		0.04			
28					0.47			1.06		0.47			
29					0.51			0.91		0.08			
30					1.77	0.04		0.08		0.24			
31					0.12			0.16		1.38			
Total	0.00	0.00	0.08	0.32	14.93	3.78	6.41	11.41	4.00	6.52	0.79	0.20	48.44
Max.	0.00	0.00	0.08	0.32	2.24	1.57	1.18	2.72	2.09	1.38	0.51	0.16	2.72

Daily Rainfall Record at Kalaw

Year: 2002 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1													
2							0.04	0.04			0.55		
3								0.67			0.20		
4				0.04					0.39		0.63		
5					0.08	0.04				0.39	0.51		
6						0.59		0.04		0.75			
7								1.06	1.81				
8					0.51			0.04	0.43				
9	0.04				0.24	0.24		0.08	1.69				
10	0.12						0.04		0.16				
11						1.02	0.12				0.39		
12				0.32	0.08				0.47				
13							0.04		0.35				
14				0.12	0.12		1.54		1.10	0.12			
15							0.04	0.04		0.20			
16					0.39	0.39	1.22	0.04					
17					2.40		0.39						
18					0.67								
19					2.76			0.83					
20								1.18	0.08				
21							0.16			0.12			
22							0.12		0.55				
23				0.24	0.12	0.08	0.28	0.35					
24					0.20	0.04	0.12	1.65		0.35			
25	0.04					0.08		0.47		0.79	0.35		
26								0.28		0.39	0.59		
27					1.02	0.12	0.16	1.14		1.26	0.43		
28					1.06			0.59			0.35		
29					0.12			0.08			0.12		
30						0.20	0.04	0.98	0.04				
31													Annual
Total	0.20	0.00	0.00	0.72	9.77	2.80	4.31	9.56	7.07	4.37	4.12	0.00	42.92
Max.	0.12	0.00	0.00	0.32	2.76	1.02	1.54	1.65	1.81	1.26	0.63	0.00	2.76

Year: 2003 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.35	0.08	0.12	0.04					
2					0.04	1.05							
3						0.08	0.35						
4							0.63						
5	0.24				0.20				0.24				
6						0.16							
7		1.42							0.08				
8						0.12							
9						0.04	1.54		0.04	0.20			
10					0.08	0.20		0.08	0.55				
11					1.26	0.35			0.36				
12						0.51		0.32	0.28				
13					0.63			0.16	1.10				
14					0.16		0.35	0.43	0.75				
15					0.20					0.08			
16					0.20	0.16			0.12				
17										0.20			
18					0.04	0.08		0.59					
19					0.35			0.08	0.20	0.12			
20						0.08		0.75	0.47	1.10			
21				0.04				0.24	0.47	0.04			
22								0.04		0.24			
23				0.32	0.08		0.08		0.39				
24						0.08	0.32	0.28	0.08	1.26			
25					0.08		0.16	1.10		0.08			
26							0.04		0.04				
27					0.04	0.08							
28							0.39						
29				0.12									
30										0.43			
31										0.12			Annual
Total	0.24	1.42	0.00	0.48	3.71	3.07	3.98	4.11	5.17	3.87	0.00	0.00	26.05
Max.	0.24	1.42	0.00	0.32	1.26	1.05	1.54	1.10	1.10	1.26	0.00	0.00	1.54

Daily Rainfall Record at Kalaw

Year: 2004 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1							0.32	1.46	0.20	0.28			
2				0.55	0.16	1.69	1.46	0.79	0.12	0.04			
3						0.67		0.12					
4					0.24			0.32					
5							0.08	0.43		0.35			
6					0.79		0.71						
7					0.67	0.24	0.16						
8				0.51		0.20		0.59		0.04			
9					0.16	0.20		0.08	0.08	0.32			
10						0.98	0.08	2.40	2.60				
11							0.28	1.30	0.98				
12							0.04	0.28	0.24				
13							0.16		0.08	0.63			
14					0.35		0.04	0.47	0.16	0.63			
15					0.98		0.04	0.39	1.61	0.08			
16							0.04	0.39	0.63				
17						0.12		0.39	0.55				
18				0.55	0.47	0.75			0.51				
19				2.24	0.08	0.04		0.24	0.83	1.02			
20					2.28	0.16		0.28					
21					0.24	0.35	0.04	0.04	0.20				
22					0.24	0.04	0.16		0.55				
23						0.20		0.04	0.16				
24							0.32						
25							1.14	0.04					
26						0.08		0.32	0.98				
27					0.24	0.43	0.47						
28				0.04	0.75	0.71	0.08	0.08	0.04				
29				0.12	0.47	0.04	0.32	0.04			0.55		
30					0.04	0.08	0.75				0.16		
31													Annual
Total	0.00	0.00	0.00	4.01	8.16	6.98	6.69	10.49	10.52	3.39	0.71	0.00	50.95
Max.	0.00	0.00	0.00	2.24	2.28	1.69	1.46	2.40	2.60	1.02	0.55	0.00	2.60

Year: 2005 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.24			0.28	0.12	1.65		
2						0.71	0.04	0.35	0.08	0.55			
3								0.04	0.20				
4							0.12	0.20	0.32	1.57			
5							0.28		0.16	1.38			
6			0.04		0.40		0.39				0.28		
7						0.16	0.75		0.32		0.08		
8					1.41				0.20		0.35	0.28	
9						0.12		0.04	1.02		0.24	0.08	
10						0.15			0.24		0.31	0.12	
11				0.04		1.14			0.35		0.08		
12								0.08	0.94				
13					0.20		0.04	2.24					
14					0.24		0.51	1.02		2.52			
15			0.16			0.04	0.08		0.04				
16			0.47					0.08	0.35				
17													
18								0.20					
19							0.04	0.08	2.28	0.51			
20				0.04	0.23		0.16	0.04	0.35				
21				0.27	0.43	0.28	0.75	0.08	0.20				
22				0.99		0.31	0.28			0.43			
23							0.91	0.04	1.10	0.75		0.04	
24							1.81		0.04	0.08		1.02	
25							1.93			0.16		0.59	
26						0.08	0.04		0.87	0.55		0.04	
27				0.71		0.12	3.03			0.12			
28				0.74		0.36	2.68						
29				0.08		0.27	0.79		0.67				
30							1.18		0.51				
31					0.74		0.35	0.16					Annual
Total	0.00	0.00	0.67	2.87	3.65	3.98	16.16	4.65	10.52	8.74	2.99	2.17	56.40
Max.	0.00	0.00	0.47	0.99	1.41	1.14	3.03	2.24	2.28	2.52	1.65	1.02	3.03

Daily Rainfall Record at Kalaw

Year: 2006 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1									0.51		1.22		
2					0.39	0.12	0.24	1.85	0.20		0.31		
3						0.51			0.08				
4						0.04		0.20					
5							0.08			0.16			
6						0.12	0.71			2.60			
7					0.24		0.16		0.63				
8					0.12								
9								0.59	0.08	3.46			
10					0.39				0.43	2.48			
11								0.08	1.14	0.04			
12					0.04					0.08			
13					0.24	0.24		0.08	1.69	0.12	0.16		
14					2.24		0.04	0.43	0.16	1.26			
15					0.91				0.59	0.12	0.16		
16					0.04				0.43				
17				0.47		0.04		0.08		0.20			
18				0.32			0.04			0.31			
19							0.08	0.08	0.20	0.83			
20				0.08		0.12	0.32	0.63	0.91	1.50			
21				1.65			0.04	0.47	0.12				
22						0.39				0.12			
23						0.04			0.04				
24					0.16	0.98		0.08	0.08				
25					0.35	0.79	0.28		0.32				
26					0.12	0.08	0.71	0.59	1.46				
27						0.63	0.59	0.47	0.08				
28				0.55	0.20		0.47	0.43					
29				0.87	0.43	0.31	0.04	0.16	0.04				
30				0.20	0.16	0.04		0.12					
31			0.67		0.20		0.71	0.39		0.04			Annual
Total	0.00	0.00	0.67	4.14	6.23	4.45	4.51	6.73	9.19	13.32	1.85	0.00	51.09
Max.	0.00	0.00	0.67	1.65	2.24	0.98	0.71	1.85	1.69	3.46	1.22	0.00	3.46

Year: 2007 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.24	0.24				
2					0.04	0.75		0.16	0.27				
3		0.83			0.16	0.32	0.04	0.04			1.69		
4					1.18	0.98	0.04	0.12	0.16		0.75		
5					0.31	0.32	0.12			0.04	0.12		
6					0.08			0.08	0.04	0.12	0.12		
7						1.33				0.87	0.04		
8					0.12		0.04	0.12		0.31			
9					0.24		0.04	0.16			0.12		
10					0.59					0.35			
11					0.08			0.16					
12					0.08					1.10			
13				0.08	0.47	0.16		0.24	0.08				
14					0.35		0.19	0.08	0.98		0.12		
15		0.12			0.75		0.04	0.43	0.16				
16				0.59	0.24				2.01	0.12			
17					0.04		0.12	0.04	0.39	0.35			
18					0.20		0.24		0.08	0.08			
19				0.47	0.35	0.08		0.16		0.16			
20					0.39	0.68		0.04		0.31			
21					0.04		0.79	0.04		0.39	0.08		
22					0.31			0.87			0.24		
23					0.08			1.14	0.67		0.04		
24						0.08		0.28		0.31			
25						0.27	0.04	0.55		0.87			
26													
27				0.31		0.28	0.23		0.43				
28					1.06	0.87	0.04	0.08					
29						0.07	0.04	0.28					
30						0.12		0.04	0.04				
31							0.16	0.04					Annual
Total	0.00	0.95	0.00	1.45	7.16	6.31	2.17	5.39	5.55	5.38	3.32	0.00	37.68
Max.	0.00	0.83	0.00	0.59	1.18	1.33	0.79	1.14	2.01	1.10	1.69	0.00	2.01

Daily Rainfall Record at Kalaw

Year: 2008 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.04	0.12	0.28		0.32	0.04	1.38		
2				1.58	0.24	0.12		0.24	0.08	0.83	0.51		
3						0.55		0.43	1.42	0.00	0.56		
4					0.08	0.20		0.08	1.18	0.20			
5					0.04	1.61							
6							0.04	0.08					
7						0.16	0.24		0.91				
8								0.87	0.12	0.04			
9					0.20	0.12		0.98	0.04				
10					0.08	0.04	0.24		0.16	0.32			
11					0.28					0.08			
12					0.08			0.20	0.39	0.63			
13					0.04			1.26		0.16			
14						0.47		0.28	0.04	0.43			
15					0.04		0.04	0.04	0.20	0.04			
16				0.08					0.12				
17					0.28	0.20			0.75	0.08			
18					0.32	0.12	0.12			0.47			
19							0.04	0.08	0.12				
20					1.14	0.12		0.24	0.39	0.08			
21					0.47			0.04	0.24	0.63			
22								0.16	0.79				
23						0.08	0.12	0.20					
24				0.24			0.04	0.16		2.24			
25			0.08			0.04	0.47			0.08			
26			0.24		0.79					1.02			
27					0.47	0.08		0.04		0.32			
28	0.51							0.47		0.08			
29					0.28	0.16	0.98	0.12		0.12			
30									0.04	0.55			
31					0.98		0.16			0.16			Annual
Total	0.51	0.00	0.32	1.90	5.85	4.19	2.77	5.97	7.31	8.60	2.45	0.00	39.87
Max.	0.51	0.00	0.24	1.58	1.14	1.61	0.98	1.26	1.42	2.24	1.38	0.00	2.24

Year: 2009 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.35	0.20			0.04				
2						0.28	0.32	1.02	0.83				
3					0.08			0.24					
4						1.38			0.20	0.35			
5									0.20				
6					0.04	0.20		0.16	0.16				
7						0.08	0.04	0.95		0.04			
8						0.16	0.04	0.24	0.91	0.35			
9						0.12	0.39	0.24	0.08				
10								0.16	0.08				
11								0.12					
12					0.28			0.20		0.20			
13								0.95	0.87	1.26			
14					0.32	0.12	0.08	0.95	0.43	0.08			
15				0.39	0.67		0.04	0.39					
16						0.04		0.04	0.12	0.04			
17					0.24	0.83				0.32			
18				0.04		1.10			1.14				
19			1.14	0.55	0.51			0.12					
20				0.35				1.02		0.98			
21				0.20							0.04		
22				0.35			0.16	0.08	0.04	0.16			
23					0.59		0.24						
24								2.09	0.08				
25					0.28	0.12	2.09	0.43	0.04				
26					0.20	0.20	0.16	0.47	0.04				
27					0.20		0.04						
28							0.04						
29					0.63			0.20	0.67				
30					2.40		0.08			0.08			
31					0.24			0.28					Annual
Total	0.00	0.00	1.14	1.88	7.03	4.83	3.72	10.35	5.93	3.86	0.04	0.00	38.78
Max.	0.00	0.00	1.14	0.55	2.40	1.38	2.09	2.09	1.14	1.26	0.04	0.00	2.40

Source: Meteorological Department (Upper Myanmar), Mandalay

Daily Rainfall Data

(Yaunghtwe)

Unit in inches

Daily Rainfall Record at Yaunghtwe

Year: 1980 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1			0.04			0.04		0.12	0.19	0.08	1.53		
2						1.10			0.10	0.03			
3					0.67	0.48	0.08		0.37				
4					0.51	0.12			0.73	0.08			
5					0.08	0.24			0.31	0.18			
6					0.08								
7									0.26	1.41			
8							0.39		0.40	0.54	0.13		
9							0.91				0.10		
10						2.14			0.47				
11						1.21			1.01				
12						1.95				0.55			
13						0.81						0.02	
14						0.10	0.12		0.33	0.08			
15					0.12			0.28	0.29				
16								0.99					
17													
18					0.32		0.19	0.12					
19						0.35		1.89		0.05			
20						0.26	2.06	0.11	0.68	0.11			
21				0.08		0.20	0.79	0.46	1.60				
22				0.32		0.31	0.58	0.11					
23					0.32	0.80	0.18	0.20					
24						0.29	0.27	0.41			0.94		
25					0.04		0.15	0.17					
26						0.54	0.80		0.10				
27					0.35				0.28	0.33			
28					0.04	0.22			0.84				
29					0.04	0.51	0.50		0.52				
30				0.19			0.08	0.67	0.70				
31							0.14	1.77					Annual
Total	0.00	0.00	0.04	0.59	2.57	11.67	7.24	7.30	9.18	3.44	2.70	0.02	44.75
Max.	0.00	0.00	0.04	0.32	0.67	2.14	2.06	1.89	1.60	1.41	1.53	0.02	2.14

Year: 1981 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1							0.05		0.82				
2					0.31	0.48		0.56					
3					0.11				0.05				
4					0.24	0.59		0.81	0.13				
5					0.06		0.17		0.80	1.42			
6							1.11	0.03	0.85		0.92		
7						0.16			1.20		0.49		
8							0.23				0.38		
9							0.20	0.24		0.23	0.03		
10			0.02			0.77	0.02	0.10	0.31		0.13		
11		0.94				0.08		1.69	0.75		0.26		
12						0.14		0.15		0.48			
13				0.16				0.05		0.66	0.46		
14						0.21			0.08		0.52		
15				0.12									
16				0.06	0.08				1.02	0.27			
17					0.03	0.09			0.15	0.31	0.61		
18				0.26	0.65	0.04			0.11	0.75	0.69		
19					0.56		0.96	2.77	0.31	0.07	0.09		
20						0.29	0.47	0.33			0.40		
21	0.08				0.90		0.13		0.09		0.39		
22					0.55			0.34	0.17				
23						0.04	0.24		0.11				
24				0.11			0.55						
25			0.08		0.28			0.11	0.19				
26				0.33		0.11	0.40						
27							0.50	0.16		0.34			
28									0.06				
29						0.02	0.20						
30					0.09	0.03	0.62	0.21	0.19				
31							0.25						Annual
Total	0.08	0.94	0.10	1.04	3.86	3.05	6.10	7.55	7.39	4.53	5.37	0.00	40.01
Max.	0.08	0.94	0.08	0.33	0.90	0.77	1.11	2.77	1.20	1.42	0.92	0.00	2.77

Daily Rainfall Record at Yaunghtwe

Year: 1982 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.07	0.01	0.30		3.12			
2							0.05		0.61				
3						0.28			0.13	1.78			
4					0.32	0.46	0.01						
5													
6					0.58			0.03					
7													
8						0.54			0.35				
9				0.28		0.04	0.21	0.09	0.89				
10								0.57		0.36			
11								0.03	0.10		0.51		
12						0.31		0.96		1.89			
13					0.45	0.32	0.06				0.35		
14						0.03	2.19			0.43			
15						0.13	0.34	1.14	0.34				
16					0.11	0.06		1.13	0.81				
17					0.92		0.25		1.28				
18				0.31	0.08	0.08	0.18	0.42	1.55				
19					0.13		0.14		0.16				
20						0.11	0.15	0.26	0.06				
21									0.62				
22						0.02		0.20					
23					0.20			0.15	0.41				
24					0.15			0.15	1.10				
25					0.05	0.01	0.25						
26					1.76		0.03	0.03	0.43	0.59			
27					0.33								
28					1.36								
29					0.13								
30													
31					0.27								Annual
Total	0.00	0.00	0.00	0.59	6.84	2.46	3.87	5.46	8.84	8.17	0.86	0.00	37.09
Max.	0.00	0.00	0.00	0.31	1.76	0.54	2.19	1.14	1.55	3.12	0.51	0.00	3.12

Year: 1983 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.04	0.86		2.19		
2						0.05			0.74	0.86	0.23		
3							0.36				0.21		
4		0.02								2.15	0.38		
5										0.06			
6			0.05	0.56		0.08		0.98					
7					0.17	0.02		0.03		0.39			
8				0.42	0.12	0.59		0.03		1.12	0.21		
9						0.92		0.70		1.88	0.36		
10				0.02		0.25			0.09	0.32	0.51		
11						0.11		0.11	0.24	0.23	0.83		
12					1.20	0.23			2.14		1.34		
13						0.67	0.03	0.29			1.98		
14								0.20			0.17		
15					0.20		0.27			0.06			
16									0.43	0.13			
17			0.24		0.26		1.80	0.17					
18		0.04						0.06	2.53	0.25			
19								0.15	0.89				
20				0.08			0.45	0.23		0.08			
21								0.43		0.11			
22							0.10			0.21			
23		0.06					0.22						
24						0.68							
25							0.11						
26								0.98					
27					0.05	0.03		0.26	0.37				
28					0.15			0.02					
29					0.15			0.03					
30					0.20		0.32	0.96		0.19			
31					0.48			0.13					Annual
Total	0.00	0.12	0.29	1.08	2.98	3.63	3.66	5.80	8.29	8.04	8.41	0.00	42.30
Max.	0.00	0.06	0.24	0.56	1.20	0.92	1.80	0.98	2.53	2.15	2.19	0.00	2.53

Daily Rainfall Record at Yaunghtwe

Year: 1984 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.48			2.36	0.49		0.21	
2						0.86	0.23		1.64				
3						0.16			0.20	0.13			
4							0.07		0.18		0.14		
5						0.05		0.66	0.28				
6					0.99	0.40	0.02	1.49					
7					0.51	0.05	0.20		3.38				
8		0.01		0.02		0.92	0.23	0.42					
9							1.79	0.40	0.08	0.79			
10						0.24		0.06					
11						0.04	0.58	0.18		0.11			
12					0.01	0.19	0.45	0.22					
13		0.16			0.01		0.04						
14							0.08	0.31					
15					0.44		0.05	0.35	0.29	0.50			
16								1.61					
17						0.50	0.58			1.60			
18						0.08	0.12			1.62			
19						0.07		0.29	0.14	0.76			
20								0.95	0.05	0.52			
21						0.10	0.19	0.34					
22				0.15	0.02		0.02		1.46				
23									0.30				
24					0.08			0.02				0.01	
25				0.80	0.05	1.03						0.04	
26													
27								0.98					
28				0.03	0.23		1.21						
29				0.12			0.53						
30				0.18	0.44		0.04	1.13					
31					0.08		0.01	0.18					Annual
Total	0.00	0.17	0.00	1.30	2.86	5.17	6.44	9.59	10.36	6.52	0.14	0.26	42.81
Max.	0.00	0.16	0.00	0.80	0.99	1.03	1.79	1.61	3.38	1.62	0.14	0.21	3.38

Year: 1985 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.31	0.26				1.10			
2								0.91			0.62		
3													
4							0.10	0.75					
5											0.10		
6							0.39						
7						0.12			0.06	0.18			
8			0.17			0.19			0.10	0.20			
9					0.02	0.17			0.33				
10									0.28				
11													
12						0.12	0.41		0.50		0.19		
13					0.43	0.08		0.21			0.26		
14							1.40			1.22	1.67		
15								0.35			0.57		
16				0.28			0.19	0.20	0.12		2.35		
17				0.10	0.12	0.43		0.59		1.30	0.20		
18							0.40				0.09		
19						0.19				0.15	0.58		
20					1.17	0.50	1.06				0.03		
21					0.21	0.35				0.03			
22					0.54	0.53	0.51						
23					0.25				0.04				
24					0.26	0.52	0.61		0.09	0.27			
25						0.03		0.41	0.12				
26				0.80			0.20		0.21				
27				0.40	0.04	0.16				0.20			
28				0.17		0.12	0.14	0.61	1.29				
29				0.11			0.82	0.30					
30					0.12			0.45	0.35				
31								0.75					Annual
Total	0.00	0.00	0.17	1.86	3.47	3.77	6.23	5.53	3.49	4.65	6.66	0.00	35.83
Max.	0.00	0.00	0.17	0.80	1.17	0.53	1.40	0.91	1.29	1.30	2.35	0.00	2.35

Daily Rainfall Record at Yaunghtwe

Year: 1986 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.01		0.39	0.52					
2								0.68					
3			0.24					0.86					
4								0.33		0.48			
5					0.10		0.13		0.38		0.52		
6					0.38			1.27	1.20				
7					0.05								
8					1.92	0.11				0.41	0.20		
9						0.14				0.36			
10							0.26	1.25		0.35	0.79		
11							0.40	3.81	0.42	1.51			
12						1.45	0.97						
13						0.52			0.04				
14					0.15			0.36	0.02				
15								0.45					
16					0.17			1.55	0.09				
17													
18					0.17				0.20				
19					0.09								
20					0.26	0.32	0.13						
21							0.18						
22							0.20						
23				0.05		0.40	0.19		1.09				
24						0.20							
25						0.20		0.34					
26						0.13							
27													
28								0.32					
29				0.07					1.21				
30				0.21	0.15								
31													Annual
Total	0.00	0.00	0.24	0.33	3.45	3.47	2.85	11.74	4.65	3.11	1.51	0.00	31.35
Max.	0.00	0.00	0.24	0.21	1.92	1.45	0.97	3.81	1.21	1.51	0.79	0.00	3.81

Year: 1987 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.10				1.22			
2		0.07	0.56			0.15	0.35		1.23				
3		0.11			0.49			0.12					
4					0.40		0.04			1.05			
5										0.21	0.35		
6							0.55	0.07					
7				0.24		0.17	0.08	0.07	0.19	0.12	0.42		
8						2.01	0.08	1.07	0.42	0.10			
9						0.10	0.71	2.16					
10						0.22	0.32		0.27	0.05			
11				1.05		0.49	0.08						
12						0.28			0.59		0.30		
13					1.46	0.21	0.32	0.28	0.27				
14						0.30		0.04	0.40				
15						0.85			0.72		0.50		
16									1.18		0.04		
17								0.12	1.38	0.04			
18			0.10			0.11		0.27	1.27				
19						0.16	0.59	0.02					
20				0.02		0.10	0.32			0.08			
21						0.13			0.26	0.08			
22					0.20			0.14	0.53				
23					0.24			1.08	0.06	0.07			
24							0.47	1.66		2.19			
25							0.55	0.16					
26							0.43			0.38			
27	0.01			0.49				0.27		0.22			
28	0.46				0.04	0.14			1.35				
29						0.28			0.87				
30				1.02		0.10							
31													Annual
Total	0.47	0.18	0.66	2.82	2.83	5.90	4.89	7.53	10.99	5.81	1.61	0.00	43.69
Max.	0.46	0.11	0.56	1.05	1.46	2.01	0.71	2.16	1.38	2.19	0.50	0.00	2.19

Daily Rainfall Record at Yaunghtwe

Year: 1988 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1					0.11	0.43							
2					1.42	0.51							
3						0.58		0.01					
4						0.45		0.04					
5					0.22				0.14	0.49			
6					1.62			0.15	0.21				
7							0.31	0.10					
8								0.10	0.32				
9							0.43	0.12					
10									0.21				
11									0.62				
12									0.54				
13							0.34			0.01			
14				0.09	1.26		0.21						
15				0.54	0.10		0.30			0.02			
16					0.39		0.46			0.02			
17					0.62		0.31						
18					0.55	0.50	0.14				0.52		
19							0.12				1.11		
20											0.81		
21							0.20						
22						0.20	0.18			0.07			
23						0.08							
24							0.38						
25						0.19		2.75					
26													
27						0.26	0.28				0.16		
28				0.25	0.18		0.12	0.65					
29				0.38	0.11	0.37	0.22						
30				0.31		0.41	0.41						
31													Annual
Total	0.00	0.00	0.00	1.57	6.58	3.98	4.41	3.92	2.04	0.61	2.60	0.00	25.71
Max.	0.00	0.00	0.00	0.54	1.62	0.58	0.46	2.75	0.62	0.49	1.11	0.00	2.75

Year: 1989 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1						0.20							
2						0.28			0.19	0.30			
3						0.40				0.35			
4						0.37				1.48			
5													
6						0.39	1.25	0.70		0.31			
7						0.22	0.42			0.31			
8						0.12	0.42						
9						0.20		0.10					
10					0.16	0.10	0.60	1.20	0.17				
11					1.33	0.20	0.50	1.17					
12							0.80						
13										1.28			
14								0.39		1.29			
15						0.35	1.26		0.20				
16							1.26	0.46	0.30				
17					1.18				0.30				
18									0.05				
19						0.17	1.82	0.17	0.05	0.05			
20							0.27	0.40		0.27			
21								0.80	0.24				
22								0.30	0.41				
23								0.11	0.81				
24				0.07				1.14	0.06	1.05	0.25		
25						0.41				0.07			
26						0.41		0.40	0.21	0.40			
27					0.12	0.53		0.61					
28			0.37		0.12			0.10					
29								1.36					
30			0.11	0.90			0.53						
31								0.13					Annual
Total	0.00	0.00	0.48	0.97	2.91	4.35	9.13	9.54	2.99	7.16	0.25	0.00	37.78
Max.	0.00	0.00	0.37	0.90	1.33	0.53	1.82	1.36	0.81	1.48	0.25	0.00	1.82

Daily Rainfall Record at Yaunghtwe

Year: 1990 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1							0.23	0.95	1.11		0.05		
2			0.18			1.10	0.28		0.08		0.04		
3						0.63	0.41		0.42				
4								0.19			0.83		
5						0.29					0.54		
6													
7							0.18		0.11		0.15		
8							0.48		0.47		0.07		
9						0.12	0.36		0.74	0.75	0.04		
10						0.24					0.49		
11						0.02							
12					0.64		0.07		0.24				
13					0.98					0.69			
14			0.05		0.50		0.10	0.75	0.35				
15						0.05		0.08	0.31				
16								0.18	0.25				
17									0.06				
18					0.19								
19					0.12								
20				0.51				0.31					
21		0.15		0.40			0.28						
22						0.17							
23						0.47	0.29		0.05				
24				0.85		0.25			0.23				
25				1.69		0.12			0.17				
26									0.61		0.14		
27					0.30			0.45		0.17			
28									0.01				
29							0.03			0.23			
30							0.51			0.06			
31					0.34		0.39	0.03					Annual
Total	0.00	0.15	0.23	3.45	3.07	3.46	3.61	2.94	5.21	1.90	2.35	0.00	26.37
Max.	0.00	0.15	0.18	1.69	0.98	1.10	0.51	0.95	1.11	0.75	0.83	0.00	1.69

Year: 1991 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1				0.04				0.95	1.11		0.05		
2									0.08		0.04		
3					0.16	0.24			0.42				
4								0.19			0.83		
5						1.18					0.54		
6						1.18							
7									0.11				
8					0.32				0.47		0.07		
9					0.59				0.74	0.75	0.04		
10											0.49		
11							0.67	0.80					
12						0.79	0.98		0.24				
13										0.69			
14								0.75	0.35				
15						0.87		0.08	0.31				
16								0.28	0.25				
17					0.71				0.06				
18						1.18			0.05				
19													
20						0.43	0.83	0.31					
21					0.35								
22						0.79	0.94						
23													
24						0.35	0.71		0.23				
25				0.20	0.12		0.39		0.17				
26				0.71	0.51				0.61		0.14	0.75	
27				0.59			0.47	0.45		0.17		1.38	
28				0.43					0.01				
29					0.08					0.23			
30								0.10		0.06			
31													Annual
Total	0.00	0.00	0.00	1.97	2.84	7.01	4.99	3.91	5.21	1.90	2.20	2.13	32.16
Max.	0.00	0.00	0.00	0.71	0.71	1.18	0.98	0.95	1.11	0.75	0.83	1.38	1.38

Daily Rainfall Record at Yaunghtwe

Year: 1992 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1							0.04		0.60				
2								0.71	0.18	0.96			
3							0.20	1.18					
4							0.59						
5							0.04	2.32	1.20				
6							0.35		1.94				
7						0.12			0.78				
8									0.28				
9								0.51	0.41				
10									0.57		0.47		
11													
12					0.04	0.08							
13					0.04			1.18					
14					0.94				0.17				
15					0.08					0.47			
16				0.83		0.75	0.87	0.16	2.46	1.26			
17				1.73		0.20	1.10	0.20	0.65	0.10			
18						0.47		0.12	0.25	0.33			
19					1.34				0.05				
20									0.31				
21					0.20				0.30				
22									0.04	0.57	0.21		
23						0.39	1.18						
24						0.16		1.38	1.83				
25								1.18	0.75				
26								1.57	0.12	0.16			
27							1.10	0.43	0.18	0.26			
28								0.16	0.47				
29							0.75	1.30					
30								0.91					
31								0.47					Annual
Total	0.00	0.00	0.00	2.56	2.64	2.17	6.22	13.78	13.54	4.11	0.68	0.00	45.70
Max.	0.00	0.00	0.00	1.73	1.34	0.75	1.18	2.32	2.46	1.26	0.47	0.00	2.46

Year: 1993 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.08		0.04		1.05				
2							0.28	0.18	0.10				
3					0.08	0.04	0.59	0.20	0.14				
4					0.16			0.12		1.05			
5					0.24	0.08	0.04		0.11				
6					0.12				0.75				
7						0.04			0.05	0.52			
8						0.28	0.04	0.26	0.74	0.45			
9			0.08		1.02		0.20		0.20				
10							0.12		0.27				
11									0.05				
12			0.12			0.24	0.08			0.46			
13					0.08	0.08	1.69						
14						1.54	0.59						
15						2.05							
16						0.04	0.16	0.24	0.98				
17						0.16		0.07	0.35				
18						0.12		0.20					
19						0.28		0.47	0.21				
20					0.16	0.04	0.08	0.03	0.82				
21				1.57		0.75			0.10	0.20			
22				0.59	0.20	0.08			0.10	0.85			
23				0.20	0.39	0.08			0.33				
24					0.16	0.20	0.71			0.10			
25						0.16							
26					0.12	0.28			0.35				
27				0.24			0.04	0.07					
28				0.47	0.20		0.24						
29					0.28		0.59						
30						0.12							
31							0.20						Annual
Total	0.00	0.00	0.20	3.07	3.29	6.66	5.69	1.84	6.70	3.63	0.00	0.00	31.08
Max.	0.00	0.00	0.12	1.57	1.02	2.05	1.69	0.47	1.05	1.05	0.00	0.00	2.05

Daily Rainfall Record at Yaunghtwe

Year: 1994 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					1.18		0.64	0.49	0.07	0.59			
2					0.38		0.13	0.02	0.08	0.18			
3					0.78			0.12					
4								0.09	0.04	0.10			
5						0.70	0.42	0.61	1.08				
6						1.40		1.23	1.10	0.57			
7					0.12	0.46		0.71	0.06	0.07			
8							0.21	0.41		0.03			
9							0.12	0.06	0.03				
10						0.48	0.55						
11							0.06	0.01					
12							0.05		0.15				
13				0.33			0.05		0.37				
14							0.05	0.13					
15							0.40	0.08	0.48				
16				0.45			0.32	0.36	0.03	0.06			
17					1.51		0.30	0.47	0.56	0.41			
18							0.43	0.21		0.11	0.05		
19						0.22		0.09					
20				0.22			0.44	0.81	0.09			0.08	
21						0.10	0.15			0.20		0.03	
22							0.18		0.07				
23				0.26		1.27							
24						0.17		0.20	0.03				
25			0.17			0.14		0.37	0.05				
26			0.10		0.13		0.19	0.60	0.83		0.79		
27			0.04		0.07		0.14	0.03	0.06				
28				0.58		0.05	2.22	0.45	0.05				
29				0.43	0.22	0.05	0.99	0.03	0.86				
30							0.76	0.48	0.08				
31					0.52		0.12	0.31					Annual
Total	0.00	0.00	0.31	2.27	4.91	5.04	8.92	8.37	6.17	2.32	0.84	0.11	39.26
Max.	0.00	0.00	0.17	0.58	1.51	1.40	2.22	1.23	1.10	0.59	0.79	0.08	2.22

Year: 1995 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.16			0.79	0.87		1.06		
2								0.79	0.28	0.24	0.51		
3							0.08		0.35	0.24	0.47		
4							0.20		0.98				
5							0.08		0.28	1.14			
6									1.10	2.17			
7										0.87			
8									0.12				
9									0.87				
10				0.04		0.59		0.32	0.35				
11					0.04	0.98			0.28				
12					0.16		0.32		0.16		0.04		
13									0.12				
14					0.59						2.08		
15					0.35					0.04	0.08		
16					0.54			0.16	0.16				
17								0.16	0.24	0.28			
18								0.20		0.24			
19									0.28				
20									0.43	0.04	0.20		
21									0.47				
22					0.04				0.08				
23								1.77	0.16				
24								0.79	1.34				
25									1.54				
26			0.87				0.63			0.16	0.47		
27							0.39						
28							0.39						
29									0.32				
30								0.98		0.08			
31								0.39					Annual
Total	0.00	0.00	0.87	0.04	1.88	1.57	2.09	6.35	10.78	5.50	4.91	0.00	33.99
Max.	0.00	0.00	0.87	0.04	0.59	0.98	0.63	1.77	1.54	2.17	2.08	0.00	2.17

Daily Rainfall Record at Yaunghtwe

Year: 1996 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.79	0.39				
2					0.16			0.79	0.12	0.83			
3							0.08						
4							0.20		0.67	2.05			
5							0.08			1.73			
6													
7													
8									1.10				
9									0.12				
10				0.04		0.59		0.32					
11					0.04	0.98			1.30				
12					0.16		0.32						
13													
14					0.60								
15					0.35			0.39					
16					0.55			0.16					
17								0.16					
18								0.20	0.39				
19									0.94				
20													
21					0.04								
22													
23								1.77					
24								0.79	0.71				
25			0.87										
26							0.63		0.79				
27							0.39						
28							0.39						
29													
30								0.98					
31								0.39					Annual
Total	0.00	0.00	0.87	0.04	1.90	1.57	2.09	6.74	6.53	4.61	0.00	0.00	24.35
Max.	0.00	0.00	0.87	0.04	0.60	0.98	0.63	1.77	1.30	2.05	0.00	0.00	2.05

Year: 1997 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1													
2									0.08		0.56		
3								0.18	0.06				
4									0.09				
5						0.39	0.18	0.14	0.05				
6									0.11	0.45			
7						0.10			0.42	0.12	1.07		
8						0.07			0.18				
9							0.24	1.46					
10							0.28	0.18		0.18			
11							0.23	0.11	0.39				
12							0.27	0.33					
13							1.21						
14							0.52					0.12	
15							0.03		0.61			0.05	
16				0.15	0.74	0.69	0.23	0.64					
17					1.06			0.10					
18					0.10	0.18	0.21	0.14	0.30				
19				0.27	0.28			0.23					
20					0.06		0.06						
21			0.01				0.28						
22						0.10	2.61		0.78				
23			0.03		1.63		1.59						
24							1.03	0.15					
25					0.11	0.55			0.70				
26								0.16	0.59				
27						0.36	0.14	0.24	0.09				
28					0.18			0.08	0.23				
29						0.49	0.37	0.14	0.22				
30							0.03	0.78		0.22			
31							0.08	0.03	0.05				Annual
Total	0.00	0.00	0.04	0.42	4.16	2.93	9.59	5.09	4.95	0.97	1.63	0.17	29.95
Max.	0.00	0.00	0.03	0.27	1.63	0.69	2.61	1.46	0.78	0.45	1.07	0.12	2.61

Daily Rainfall Record at Yaunghtwe

Year: 1998 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1					0.91		0.32	0.08	0.51		0.16		
2					0.16	1.06		0.08	2.60				
3					0.08			0.12			1.42		
4						0.04		0.08					
5						1.42		0.04	0.08				
6								3.19	0.59				
7													
8								0.12	0.16				
9						0.08		0.24	0.28				
10							0.28	0.04	0.20				
11					0.08				0.75				
12													
13					0.51								
14													
15								0.12					
16				0.08			0.12	1.14	0.08	0.04			
17				0.08	0.16			0.20	0.32	0.04			
18				0.59									
19					0.24				0.35				
20						0.04		0.16		0.59			
21				0.16	0.16			0.12	0.59	0.28			
22								0.08					
23								0.24			0.20		
24								0.24					
25					0.71			1.02					
26							0.20	0.32					
27						1.46	0.04	0.04	0.04				
28						1.89		1.06					
29					0.28	0.04				0.08			
30			0.35			0.39							
31			0.04		0.12					0.12			
Total	0.00	0.00	0.39	0.91	3.41	6.42	0.96	8.73	6.55	1.15	1.78	0.00	30.30
Max.	0.00	0.00	0.35	0.59	0.91	1.89	0.32	3.19	2.60	0.59	1.42	0.00	3.19

Year: 1999 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1									0.08		0.39		
2									0.12		0.16		
3							0.12	0.20		0.12			
4						0.39		0.28	1.14				
5					2.09	0.20			0.63				
6					0.12							0.08	
7						0.08			0.20			0.12	
8				0.08		0.35		0.04					
9					1.18				1.22		0.04		
10					0.12				0.32				
11								0.59		0.20			
12					0.20			0.67					
13					0.12	0.16		0.04					
14				0.63									
15				0.12		0.43			0.98				
16									0.43				
17							0.08		0.12				
18						0.71	0.04	0.98	0.08				
19					0.55	0.16			0.28				
20					1.65	0.08		1.34	0.12				
21									1.54				
22					0.08			2.20	0.59				
23					0.32	0.24		0.08					
24							0.08	1.06					
25							0.16	0.08					
26													
27													
28						0.04	0.04			2.36			
29				2.01			0.47	0.04	0.47	0.08			
30							0.35	0.04		0.24			
31							0.04						
Total	0.00	0.00	0.00	2.84	6.43	2.84	1.38	7.64	8.32	3.00	0.59	0.20	33.24
Max.	0.00	0.00	0.00	2.01	2.09	0.71	0.47	2.20	1.54	2.36	0.39	0.12	2.36

Daily Rainfall Record at Yaunghtwe

Year: 2000 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1								0.28	0.20	0.71			
2					0.28		0.28		0.43	0.04			
3					0.55	0.12			0.16				
4					0.12		0.20			1.77			
5							0.47						
6						0.12				0.43			
7					0.04			0.28					
8								1.54					
9								0.55					
10					0.12	0.04		0.12	1.73				
11					0.83		0.59	0.55					
12				0.16			0.47		0.16				
13						0.04			1.38				
14						0.04			0.20				
15				0.04	0.24		0.20		0.16				
16				0.04	0.12	1.14	0.51						
17					0.71	0.43							
18				0.39	0.94	0.35	0.08	0.24	0.39	1.65			
19				0.04		2.01		0.24	0.16	0.55			
20							0.04						
21				0.04			0.08			0.59			
22					0.55		0.12						
23					0.83				0.59				
24					0.39				0.08	0.39			
25				0.79	0.04				0.39				
26		0.08		0.39	0.12				0.63				
27		1.10	0.04	0.08		4.21							
28		0.08		0.55	0.04	0.91		0.67					
29				0.12									
30			0.63		0.04					0.87			
31			0.04										
Total	0.00	1.26	0.71	2.64	5.96	9.41	3.04	4.47	6.66	7.00	0.00	0.00	41.15
Max.	0.00	1.10	0.63	0.79	0.94	4.21	0.59	1.54	1.73	1.77	0.00	0.00	4.21

Year: 2001 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1								1.61			0.16		
2								1.22			0.83		
3									0.12		0.43		
4								0.43	0.51				
5					0.71		0.43	0.98		2.17	0.20		
6						0.12	0.04	0.04					
7							0.87	0.83					
8						0.12	0.94						
9							0.71				0.32		
10					0.63		0.91		0.39	0.79			
11			0.32										
12			0.32					0.04	0.51	0.39			
13			0.28			1.89	0.20	0.79	0.75				
14			0.16		0.35		0.28	1.18					
15					0.20			0.91		0.08			
16					0.16			0.08				0.28	
17					0.51					2.01			
18					0.55			0.12		0.08			
19								0.75					
20							0.16	0.47					
21					0.04		0.28	1.57	0.28				
22					0.63		0.39					0.67	
23						0.43	0.87						
24													
25									0.04	0.35			
26			0.32				0.39		0.20				
27					0.32				0.35	1.38			
28								2.24		0.59			
29					0.16			0.04		0.83			
30					0.35	0.20	0.08	0.28		1.18			
31					0.39								
Total	0.00	0.00	1.40	0.00	5.00	2.76	6.55	13.58	3.15	9.85	1.94	0.95	45.18
Max.	0.00	0.00	0.32	0.00	0.71	1.89	0.94	2.24	0.75	2.17	0.83	0.67	2.24

Daily Rainfall Record at Yaunghtwe

Year: 2002 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1										0.60			
2								0.20		1.20	0.30		
3								0.10	0.40	0.70	1.70		
4							0.10		0.40	0.40	0.90		
5					0.20						0.20		
6								0.50					
7						0.30			0.90				
8						0.40		0.20	1.10				
9								0.10	0.50			0.25	
10									0.50				
11					0.10				0.30				
12				0.20		0.60		0.20	0.20				
13				0.40		0.80	1.60		0.20	0.20			
14							0.80		1.90	1.10	0.40		
15						0.90	0.30		0.60				
16						0.60	0.20		1.30				
17						0.60	0.10	0.80					
18						1.40							
19						0.80		0.90					
20													
21					0.10	0.70							
22				0.20		0.40	0.10	0.30					
23					0.10	0.20	0.10	1.00		0.10			
24										0.60	0.60		
25						0.80		2.60		0.30	0.90		
26						0.20	0.20	2.30			0.70		
27						0.20	1.70	1.40			0.40		
28							0.60	0.60			0.40		
29							0.10	0.30					
30									0.20				
31													Annual
Total	0.00	0.00	0.00	0.80	0.50	8.90	5.90	11.50	8.50	5.20	6.50	0.25	48.05
Max.	0.00	0.00	0.00	0.40	0.20	1.40	1.70	2.60	1.90	1.20	1.70	0.25	2.60

Year: 2003 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.12		0.08			
2					0.91		0.91			1.24			
3					0.35	0.35	0.43		0.47	0.12			
4						0.51	0.39	0.47					
5						0.79			0.08				
6						0.16			0.08				
7		0.12					0.39		0.67				
8		1.18				0.04		0.24	0.51				
9									0.08	0.04			
10								0.20	0.24				
11						0.35				0.08			
12						0.04		0.04	0.08	0.16			
13						0.28	0.20	0.12	0.24				
14						0.12	0.51	0.94	0.39				
15						0.12	1.22	0.04		0.35			
16					0.71		0.20						
17								1.54					
18				1.10	0.63	0.35		0.43	0.59				
19			0.16			0.20		1.06	0.04				
20												0.35	
21			0.12	0.20	1.02							0.47	
22				0.04	0.04		0.20	0.16	0.47			0.04	
23				0.20		0.71	0.20		0.87				
24						0.87	0.35	0.24	0.24	0.04			
25					1.10	1.30	0.47		0.51	0.04			
26					0.20		0.16						
27													
28				0.35				0.08	0.12				
29			0.12	0.98	0.51		0.47	0.16					
30							1.02						
31							0.24	0.04					Annual
Total	0.00	1.30	0.40	2.87	5.47	6.19	7.36	5.88	5.68	2.15	0.00	0.86	38.16
Max.	0.00	1.18	0.16	1.10	1.10	1.30	1.22	1.54	0.87	1.24	0.00	0.47	1.54

Daily Rainfall Record at Yaunghtwe

Year: 2004 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1				0.04		0.16	0.04			0.28			
2				0.08		0.12	0.55		0.20				
3						0.20		0.47	0.24				
4						0.12	0.16						
5					0.12			0.28					
6						0.98	1.34				0.04		
7					0.32	0.12							
8				0.24		1.24							
9				0.55		0.35	0.04	0.51	0.04				
10							0.28	0.55	0.35	0.20			
11							0.32		0.12	0.08		0.59	
12					0.20		0.04		0.43				
13				0.04		0.59	0.35	0.71	0.47	0.43			
14							0.08		0.10	0.32			
15					0.83		0.08	0.63	0.43				
16				0.08			0.04	0.08	0.12	0.32			
17					0.16	0.42		0.04		0.12			
18				0.04	0.57	0.16		0.63	0.59				
19				1.50	0.43	0.51	0.08	0.32	0.28				
20					0.79	0.08		0.67					
21					0.04	0.47		0.08					
22						0.08	1.18		0.04				
23							0.35		0.39				
24				0.04			0.39						
25							0.35	0.12					
26							0.16						
27					0.04	0.32					0.04		
28				0.04	0.06	0.79	0.16						
29				0.08	0.79		0.20	0.55	0.28				
30					0.32		0.04						
31					0.39								Annual
Total	0.00	0.00	0.00	2.73	5.06	6.71	6.23	5.64	4.08	1.75	0.08	0.59	32.87
Max.	0.00	0.00	0.00	1.50	0.83	1.24	1.34	0.71	0.59	0.43	0.04	0.59	1.50

Year: 2005 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1					0.20								
2													
3						0.79				0.87			
4					0.28								
5				0.24					0.12				
6											1.36		
7					0.31				0.24				
8											0.39		
9							0.28				0.20		
10						0.28			2.20				
11							1.65	0.79					
12						0.98	0.29	1.73					
13			0.12			0.04	0.05	0.12					
14									1.18				
15			0.35						0.20				
16										0.31			
17						0.12							
18								0.39	0.55		0.39		
19								0.08	0.12	0.20			
20							0.59						
21					0.98		1.88		0.16				
22					0.20	0.16	0.37		1.69	0.31			
23					0.04		0.05		0.98	0.24			
24								0.12	0.28	0.12			
25				0.63					0.04	1.69			
26				0.87	0.31								
27						0.04			2.66	0.79			
28									0.04				
29													
30													
31													Annual
Total	0.00	0.00	0.47	1.74	2.32	2.41	5.16	3.23	10.46	4.53	2.34	0.00	32.66
Max.	0.00	0.00	0.35	0.87	0.98	0.98	1.88	1.73	2.66	1.69	1.36	0.00	2.66

Daily Rainfall Record at Yaunghtwe

Year: 2006 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1								0.32	0.08				
2							0.20	0.28	0.67	0.04			
3									0.08				
4													
5					0.71		1.38	1.65					
6							0.12			0.51			
7					0.39				0.08	2.64			
8						1.34		0.39	0.83	0.22	1.02		
9										1.65			
10									0.79	0.16			
11									1.46	0.51			
12					0.04				0.16	0.24			
13						1.14		0.67		0.16			
14									0.04				
15					1.50	0.20			0.20		0.04		
16								0.28	1.18				
17							0.32	0.12					
18				1.06				0.19					
19				0.20	0.98			0.87	1.02				
20						0.35			1.15				
21									0.35				
22							0.08	2.64	0.04				
23						0.08	0.71	0.20					
24					0.20		0.63	0.51		0.08			
25								0.61					
26			0.79					0.79		0.20			
27			0.04	0.16		0.12		1.26					
28				0.59	0.24			0.98		0.04			
29				0.26									
30													
31													Annual
Total	0.00	0.00	0.83	2.27	4.06	3.23	3.44	11.76	8.13	6.45	1.06	0.00	41.23
Max.	0.00	0.00	0.79	1.06	1.50	1.34	1.38	2.64	1.46	2.64	1.02	0.00	2.64

Year: 2007 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1		0.10						0.87	0.68				
2		0.15			0.10	1.52	0.01	0.02		0.13	1.51		
3		0.31			0.10	0.12	0.01	0.10			0.47		
4					0.77	0.89	0.02			0.40			
5							0.04		0.01		0.22		
6					0.02					0.67			
7					0.01			0.17					
8													
9					0.50			0.37					
10					0.15	0.02	0.04		1.13	0.27			
11					0.17	0.46		0.08	0.01				
12					0.44	0.27		0.13	1.50	0.13			
13					0.18	0.57	0.63	0.22	0.76	0.31	0.20		
14		0.01			0.07		0.07	0.02	0.45	0.62			
15		0.03			0.01	0.04	0.16		0.25	0.27			
16					0.23		0.06		0.12				
17				0.02	0.16		0.14		0.35				
18				0.51	0.17		0.16	0.12		0.04			
19				0.42	0.47	0.93	0.02	0.18					
20					0.21		1.01				0.04		
21					0.17		0.07	0.43					
22					1.07		0.17	0.25					
23					0.01	0.36	0.12	0.16	0.18	1.04			
24						1.00	0.27		0.26				
25							0.73						
26				0.26		0.01		0.45	0.01				
27				0.04		0.18		0.43	0.53				
28					0.48	0.22		0.08					
29					0.03			0.14	0.17				
30								0.68					
31													Annual
Total	0.00	0.60	0.00	1.25	5.52	6.59	3.73	4.90	6.41	3.88	2.44	0.00	35.32
Max.	0.00	0.31	0.00	0.51	1.07	1.52	1.01	0.87	1.50	1.04	1.51	0.00	1.52

Daily Rainfall Record at Yaunghtwe

Year: 2008 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1				0.60	0.67	0.31			0.46	0.52	0.21		
2						0.07		1.51	0.13		0.52		
3					0.07	0.07		0.15	0.16	0.03	0.23		
4					0.05	0.89			0.30	0.12	0.11		
5						0.15		0.16	0.74	0.27			
6					0.02	0.22		0.08	0.32	0.60	0.14		
7								0.47	0.49				
8						0.10	0.01	0.08	0.12				
9							0.31	0.08	0.78				
10					0.26			0.21	0.14				
11					0.76					0.20			
12								0.02		0.10			
13					0.27			0.01	0.11	0.63			
14					0.04	1.13			0.13				
15					0.17	0.01		0.13					
16					0.21	0.30							
17						0.21			0.12				
18					0.08	0.11			0.85				
19					1.37			0.78	0.11	0.32			
20					0.02			0.08		0.79			
21								0.89	0.03				
22					0.20		0.18	0.39					
23							0.01		0.99	0.66			
24					0.11	0.07				0.36			
25							0.02			0.29			
26	0.08						0.80	0.13		0.21			
27	1.77				0.43			0.33		0.12			
28						0.49				0.20			
29				0.05	0.46	0.13	0.10		0.05	0.34			
30						0.21			0.51	0.09			
31							0.10	0.52		0.52			Annual
Total	1.85	0.00	0.00	0.65	5.19	4.47	1.53	6.02	6.54	6.37	1.21	0.00	33.83
Max.	1.77	0.00	0.00	0.60	1.37	1.13	0.80	1.51	0.99	0.79	0.52	0.00	1.77

Year: 2009 (unit: inches)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1						0.16	0.12	0.96					
2							0.13	0.08		0.18			
3						0.22			0.14				
4					0.04	0.67				0.05			
5						0.31			0.44				
6					0.39	0.02	0.07	0.28		0.09			
7					0.01	0.07		1.77	0.59				
8						0.03	0.02	1.18					
9								0.77	0.25				
10									0.11	0.21			
11					0.32			0.34		0.71			
12									0.27	0.53			
13					0.12	0.71	0.22	1.37	0.18	0.21			
14				1.33	0.39		0.15	0.03	0.23				
15				0.12		0.75				0.10			
16				0.09	0.21	0.32				0.29			
17				0.78		0.47		0.05	0.06				
18			0.26	0.17	0.42		0.15	0.10		0.25			
19				0.10									
20							0.56						
21							0.07			0.22			
22					0.48	0.06			1.04	0.83			
23							0.06	1.42	0.07				
24					0.02	0.08		0.39					
25					0.29		0.09		0.70				
26								0.17					
27						0.14	0.08	0.01					
28				0.22		0.03		0.21	0.11	0.51			
29					0.84		0.05		0.30				
30					0.08			0.22					
31					0.24		0.56	0.07					Annual
Total	0.00	0.00	0.26	2.81	3.85	4.04	2.33	9.42	4.49	4.18	0.00	0.00	31.38
Max.	0.00	0.00	0.26	1.33	0.84	0.75	0.56	1.77	1.04	0.83	0.00	0.00	1.77

Source: Meteorological Department (Upper Myanmar), Mandalay

Daily Rainfall Data

(Taunggyi)

Daily Rainfall Record at Taunggyi

Year: 1954 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	33	0	8	3	2	0	0	
2	0	0	0	0	0	3	0	0	5	1	0	0	
3	0	0	0	0	1	42	3	0	3	8	0	0	
4	0	0	0	0	12	6	3	0	27	12	0	3	
5	0	0	0	29	0	3	11	2	3	12	0	0	
6	0	0	0	6	0	42	6	5	70	22	1	0	
7	0	0	0	0	1	5	1	12	16	29	0	0	
8	0	0	0	0	1	3	0	39	2	0	5	0	
9	0	0	0	0	1	1	1	1	1	33	30	0	
10	0	0	0	0	0	3	20	4	7	21	0	0	
11	0	0	0	11	0	3	0	13	18	0	0	5	
12	0	0	0	0	0	11	1	2	24	20	0	1	
13	0	0	0	0	0	1	2	4	2	0	0	4	
14	0	0	0	0	0	1	3	7	0	0	0	1	
15	0	0	0	0	2	2	0	54	0	5	0	0	
16	0	0	0	0	0	1	23	1	7	9	0	0	
17	0	0	0	0	44	0	0	3	1	6	0	0	
18	0	0	0	0	37	0	0	1	6	2	0	0	
19	0	0	0	0	8	0	0	1	6	0	0	0	
20	0	0	0	0	3	0	0	14	2	4	6	0	
21	0	0	28	0	1	0	3	5	7	0	0	0	
22	0	0	8	13	9	0	2	3	4	0	0	0	
23	0	0	0	0	0	0	2	1	0	11	0	0	
24	0	0	0	0	0	0	0	0	1	7	0	0	
25	0	0	0	0	1	35	0	3	1	11	0	0	
26	0	0	0	0	0	5	13	5	0	3	0	0	
27	0	0	0	0	3	0	0	4	0	1	0	0	
28	0	0	0	0	37	0	0	19	0	2	0	0	
29	0		0	3	7	1	1	7	7	2	0	0	
30	0		0	0	1	3	0	1	1	3	0	0	
31	0		19		11		0	13		0		0	Annual
Total	0	0	55	62	180	204	95	232	224	226	42	14	1,334
Max.	0	0	28	29	44	42	23	54	70	33	30	5	70

Year: 1955 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	6	26	0	12	2	1	3	0	
2	0	0	0	0	0	18	1	11	4	8	25	0	
3	0	0	0	0	0	0	0	3	1	11	2	0	
4	0	0	0	0	0	10	2	6	1	11	0	0	
5	0	0	0	0	0	10	1	14	6	5	0	0	
6	0	0	0	14	2	18	1	11	5	0	21	0	
7	0	0	0	1	5	34	4	5	0	11	3	0	
8	0	0	0	0	19	40	0	18	0	0	14	0	
9	0	0	0	0	0	5	0	1	0	0	0	0	
10	0	0	0	0	0	2	2	7	18	0	2	0	
11	0	0	0	1	1	13	8	20	15	1	39	0	
12	0	0	0	0	1	1	1	26	9	12	74	0	
13	0	0	0	0	16	0	3	0	7	1	9	0	
14	0	0	0	0	2	0	1	9	12	8	5	0	
15	0	0	0	0	5	25	1	2	0	1	0	0	
16	0	0	0	0	17	2	3	16	9	4	0	0	
17	0	0	0	0	18	24	5	7	35	28	1	0	
18	0	0	0	0	3	6	11	23	6	9	0	0	
19	0	0	0	0	0	5	6	32	0	0	0	0	
20	0	0	0	0	5	0	20	39	0	0	0	0	
21	0	0	0	0	6	0	2	36	0	1	0	0	
22	0	0	0	0	8	0	0	1	2	0	0	0	
23	0	0	0	0	3	35	4	1	2	0	1	1	
24	0	0	0	0	3	10	1	1	3	0	0	0	
25	0	0	0	16	8	1	5	0	1	1	0	0	
26	0	0	0	5	3	8	1	21	8	3	0	0	
27	0	0	2	1	0	6	8	5	1	4	0	0	
28	0	0	11	0	12	17	11	31	14	1	0	0	
29	0		0	7	2	18	23	24	4	6	0	0	
30	0		17	0	2	2	10	24	2	0	0	0	
31	0		0		7		9	37		30		0	Annual
Total	0	0	30	45	154	336	144	443	167	157	199	1	1,676
Max.	0	0	17	16	19	40	23	39	35	30	74	1	74

Daily Rainfall Record at Taunggyi

Year: 1956 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	8	28	15	6	29	0	14	0	
2	0	0	0	0	0	4	4	6	47	0	24	0	
3	0	0	0	0	1	8	10	5	8	0	11	0	
4	0	0	0	0	1	0	2	5	3	9	0	0	
5	0	0	0	0	0	0	30	58	36	0	0	0	
6	0	0	19	0	0	89	8	15	4	0	0	0	
7	0	0	0	0	0	11	2	18	2	0	0	0	
8	0	0	0	0	0	18	1	2	8	0	0	0	
9	0	0	0	0	0	2	0	0	0	0	0	0	
10	0	0	0	0	0	16	3	3	5	0	2	0	
11	0	0	0	0	0	3	1	21	67	9	0	0	
12	0	0	0	0	0	2	3	2	16	0	0	0	
13	0	0	0	0	0	0	1	0	0	5	0	0	
14	0	0	0	0	9	3	12	0	0	0	0	0	
15	0	0	0	0	0	0	2	5	0	0	2	0	
16	0	0	0	0	0	2	0	23	0	7	1	0	
17	0	0	0	0	2	2	1	32	0	0	0	0	
18	0	0	0	0	0	2	1	0	0	3	0	0	
19	0	0	0	0	0	3	8	18	17	0	0	0	
20	0	0	0	0	0	0	1	0	0	0	0	0	
21	0	0	0	0	1	0	4	6	20	0	0	0	
22	0	0	0	0	7	8	29	30	15	14	0	0	
23	0	0	0	0	34	1	37	3	76	0	0	0	
24	0	0	0	6	34	0	17	0	10	0	0	0	
25	0	0	0	0	10	0	1	15	0	0	0	0	
26	0	0	25	0	12	6	11	2	0	5	0	0	
27	0	9	46	0	0	0	3	16	0	3	0	0	
28	0	0	11	0	1	0	1	8	34	0	0	0	
29	0	1	0	0	1	12	11	11	0	0	0	0	
30	0		0	0	27	0	1	2	0	0	0	0	
31	0		0		11		5	1		0		0	Annual
Total	0	10	101	6	159	220	225	313	397	55	54	0	1,540
Max.	0	9	46	6	34	89	37	58	76	14	24	0	89

Year: 1957 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	13	47	10	2	0	0	
2	0	0	0	0	13	10	11	32	51	39	0	0	
3	0	0	0	0	3	32	4	11	16	8	0	0	
4	0	0	0	1	12	26	0	2	21	3	0	0	
5	0	0	0	11	0	5	0	1	6	19	0	0	
6	0	0	0	0	0	20	0	1	14	5	0	0	
7	0	0	0	0	0	41	1	2	1	1	0	0	
8	0	0	0	0	0	1	0	7	5	6	0	0	
9	0	0	0	0	2	40	0	0	1	0	0	0	
10	0	0	0	0	0	31	0	2	0	1	0	0	
11	0	0	0	0	0	3	13	38	4	30	0	0	
12	0	0	0	0	0	26	4	2	0	16	0	0	
13	0	0	0	0	0	21	5	1	1	1	0	0	
14	0	0	0	0	0	11	0	20	6	0	0	0	
15	0	0	0	0	0	0	0	21	7	0	0	0	
16	0	0	0	0	0	0	12	0	1	0	0	0	
17	0	0	3	0	0	1	3	8	1	0	0	0	
18	0	0	0	0	0	0	1	0	0	0	0	0	
19	0	0	0	0	0	0	1	24	4	14	0	0	
20	0	0	0	0	0	0	4	4	0	1	0	0	
21	0	0	0	1	24	1	4	0	0	0	0	0	
22	0	0	0	0	0	20	5	5	8	0	0	0	
23	0	0	0	0	0	33	9	4	1	0	0	0	
24	0	0	0	0	2	2	4	6	2	0	0	0	
25	0	0	0	0	5	19	1	2	15	0	0	0	
26	0	0	0	0	2	4	1	5	0	0	0	0	
27	0	0	0	0	25	8	0	26	5	0	0	0	
28	0	0	0	0	1	2	6	3	0	0	0	0	
29	0		0	0	28	4	2	1	0	1	0	0	
30	0		0	0	3	1	43	45	1	0	0	0	
31	0		0		0		7	3		0		0	Annual
Total	0	0	3	13	120	362	154	323	181	147	0	0	1,303
Max.	0	0	3	11	28	41	43	47	51	39	0	0	51

Daily Rainfall Record at Taunggyi

Year: 1958 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	3	0	0	3	0	11	0	0	10	
2	0	0	0	20	0	0	2	3	4	0	0	0	
3	0	0	0	0	0	0	1	15	1	2	0	0	
4	0	0	0	0	0	0	1	0	18	1	0	0	
5	0	0	0	0	1	0	0	1	13	0	0	0	
6	0	0	0	0	22	9	0	17	64	0	0	0	
7	6	0	0	0	1	1	7	19	3	24	0	0	
8	1	0	0	0	0	0	26	27	4	0	0	0	
9	0	0	0	0	0	13	17	58	14	0	0	0	
10	0	0	0	0	15	8	8	9	2	0	12	0	
11	0	0	0	0	1	2	43	2	0	13	7	0	
12	0	0	0	0	1	2	8	0	0	21	0	0	
13	0	0	0	0	1	1	0	0	4	5	0	0	
14	0	0	0	0	0	3	0	53	4	0	0	0	
15	0	0	0	0	0	0	1	3	53	1	0	0	
16	0	0	0	0	0	3	1	2	0	0	0	0	
17	0	0	0	0	0	0	1	2	0	1	0	0	
18	0	0	0	0	0	5	1	1	0	5	1	0	
19	0	0	0	3	39	2	1	0	0	21	3	0	
20	0	0	0	0	24	0	1	84	0	1	11	0	
21	0	0	0	14	23	2	2	35	9	16	0	0	
22	0	0	0	0	0	1	2	0	59	0	0	0	
23	0	0	0	0	0	0	30	0	21	1	1	0	
24	0	0	0	0	0	3	4	21	8	0	0	0	
25	0	0	0	0	0	5	16	2	7	34	0	0	
26	0	0	0	0	2	17	7	0	0	15	13	0	
27	0	0	0	0	0	6	9	1	0	3	2	0	
28	0	0	0	0	0	0	7	0	4	0	0	0	
29	0		0	0	0	0	2	1	4	17	0	0	
30	14		0	0	1	0	0	2	0	1	0	0	
31	1		8		0		2	22		0		0	Annual
Total	22	0	8	40	131	83	203	380	307	182	50	10	1,416
Max.	14	0	8	20	39	17	43	84	64	34	13	10	84

Year: 1959 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	3	0	0	15	15	14	25	3	11	0	0	
2	0	2	0	0	0	10	5	5	4	5	0	0	
3	0	0	0	0	0	2	37	4	35	0	0	0	
4	0	0	0	0	1	1	19	3	7	39	0	0	
5	0	0	0	0	0	9	1	19	7	0	0	0	
6	0	0	0	0	3	24	5	4	3	0	0	0	
7	0	0	0	0	0	9	5	1	4	0	0	0	
8	0	0	0	0	12	10	2	3	2	18	0	0	
9	0	0	0	0	0	16	2	1	0	8	0	0	
10	0	0	0	0	0	4	15	0	4	0	0	0	
11	0	0	0	0	8	3	1	1	1	1	0	0	
12	0	0	0	0	0	2	25	3	5	9	0	0	
13	0	0	0	0	3	2	7	14	6	0	0	0	
14	0	0	0	0	4	0	4	4	4	14	0	0	
15	0	0	0	0	0	0	7	0	1	16	0	0	
16	0	0	0	0	0	0	27	0	0	0	0	0	
17	0	0	0	0	0	0	12	18	0	0	0	0	
18	0	0	0	0	0	0	4	1	0	0	0	0	
19	0	0	0	0	0	2	0	0	28	6	0	0	
20	0	0	0	0	0	0	4	9	18	22	0	0	
21	0	0	0	12	8	0	1	7	0	0	0	0	
22	5	0	0	17	3	0	2	9	1	0	0	0	
23	55	0	0	14	0	1	1	13	38	0	0	0	
24	55	0	0	0	13	0	4	9	11	0	0	0	
25	0	0	0	0	28	31	7	15	2	0	0	0	
26	0	0	0	0	38	20	21	26	31	0	0	0	
27	0	0	0	0	39	27	45	6	1	1	0	0	
28	0	0	0	0	8	6	27	37	7	1	0	0	
29	0		0	0	6	4	1	18	1	1	0	0	
30	0		0	2	14	0	2	5	6	6	0	0	
31	0		0		20		11	15		39		0	Annual
Total	115	5	0	45	223	198	318	275	230	197	0	0	1,606
Max.	55	3	0	17	39	31	45	37	38	39	0	0	55

Daily Rainfall Record at Taunggyi

Year: 1960 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	5	0	6	9	0	0	0	3	
2	0	0	0	0	0	0	41	1	3	0	0	22	
3	0	0	0	0	18	3	5	1	2	0	0	0	
4	0	0	0	0	0	29	3	1	3	0	0	0	
5	0	0	0	0	1	3	7	5	1	0	18	0	
6	0	0	0	0	0	13	32	1	13	0	0	0	
7	0	1	0	0	0	5	7	1	4	0	0	0	
8	0	0	0	0	0	15	2	9	3	4	0	0	
9	0	0	0	0	0	9	4	2	2	15	0	0	
10	0	0	0	0	0	20	1	6	8	0	0	0	
11	0	0	0	0	0	6	0	3	10	0	0	0	
12	0	0	0	0	0	9	6	1	3	1	0	0	
13	0	0	0	0	0	35	0	3	0	0	0	0	
14	0	0	0	0	16	7	0	11	4	0	0	0	
15	0	0	0	0	0	14	0	26	37	2	0	0	
16	0	0	0	0	4	17	2	20	0	7	0	0	
17	0	0	0	0	0	2	0	0	1	1	0	0	
18	0	0	0	0	0	0	0	1	0	9	0	0	
19	0	0	0	0	80	1	0	7	0	0	2	0	
20	0	0	0	0	10	0	0	4	0	0	2	0	
21	0	0	0	0	17	0	4	9	0	4	0	0	
22	0	0	0	0	3	5	23	4	1	12	0	0	
23	0	0	0	1	41	12	3	2	20	1	0	0	
24	0	0	0	0	11	2	18	15	3	5	0	0	
25	0	0	0	1	24	0	1	1	21	0	0	0	
26	1	0	0	0	2	0	12	1	10	2	0	0	
27	24	0	0	0	2	9	0	1	10	0	1	0	
28	2	0	0	0	39	3	11	3	7	0	2	0	
29	0	0	0	0	9	3	2	0	13	4	28	0	
30	0		0	0	0	3	1	0	4	0	19	0	
31	0		0		0		1	3		0		0	Annual
Total	27	1	0	2	282	225	192	151	183	67	72	25	1,227
Max.	24	1	0	1	80	35	41	26	37	15	28	22	80

Year: 1961 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	1	12	19	23	10	16	0	0	
2	0	0	0	0	0	0	1	9	15	8	0	0	
3	0	0	0	0	0	0	5	5	8	2	0	0	
4	0	0	0	0	13	3	1	15	5	1	0	0	
5	0	2	0	0	1	1	0	17	5	0	0	0	
6	0	0	0	0	0	39	1	16	6	0	0	0	
7	0	0	0	0	24	13	1	9	6	6	0	0	
8	0	0	0	0	38	14	8	13	8	4	1	0	
9	0	0	0	0	6	15	1	5	3	2	20	0	
10	0	0	0	0	8	3	3	7	13	0	9	0	
11	0	0	0	0	0	7	1	5	4	0	0	0	
12	0	0	0	0	0	6	5	3	1	9	0	0	
13	0	0	0	0	8	6	6	6	3	0	0	0	
14	0	0	0	0	5	7	19	50	0	1	13	0	
15	0	0	0	0	1	6	17	17	10	3	2	0	
16	0	0	0	0	0	0	15	36	15	6	0	0	
17	0	0	0	0	0	0	4	3	3	0	0	0	
18	0	0	0	35	0	15	1	19	13	3	0	0	
19	0	0	0	5	1	5	23	3	30	0	0	0	
20	0	0	0	0	0	1	10	12	15	31	0	0	
21	0	0	0	0	0	7	22	28	6	0	0	0	
22	0	0	0	0	0	9	9	18	10	0	0	0	
23	0	0	0	0	3	1	5	81	15	5	0	0	
24	0	0	0	0	5	50	15	6	0	6	0	0	
25	0	0	0	0	10	6	12	17	8	0	8	0	
26	0	0	0	0	6	2	66	0	6	0	22	0	
27	0	0	0	0	18	1	16	45	0	0	0	0	
28	0	0	0	18	1	2	7	9	0	0	0	0	
29	0		0	1	7	2	2	7	0	0	0	0	
30	0		0	1	11	9	6	3	13	0	0	0	
31	0		0		3		1	20		31		0	Annual
Total	0	2	0	60	170	242	302	507	231	134	75	0	1,723
Max.	0	2	0	35	38	50	66	81	30	31	22	0	81

Daily Rainfall Record at Taunggyi

Year: 1962 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
29	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
30	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
31	NA		NA		NA		NA	NA		NA		NA	Annual
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Max.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Year: 1963 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
29	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
30	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
31	NA		NA		NA		NA	NA		NA		NA	Annual
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Max.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Daily Rainfall Record at Taunggyi

Year: 1964 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	3	0	0	0	5	0	
2	0	0	0	0	0	0	9	0	8	0	5	0	
3	0	0	0	0	0	0	0	1	45	6	15	0	
4	0	0	0	0	9	0	12	23	5	21	6	0	
5	0	0	0	0	10	0	18	4	9	2	0	0	
6	0	0	0	0	1	0	2	37	0	0	0	0	
7	0	0	0	0	0	0	13	0	31	2	0	0	
8	0	0	0	0	45	19	22	37	62	25	1	0	
9	0	0	0	0	26	0	4	10	16	1	0	0	
10	0	0	0	0	12	0	2	3	3	0	0	0	
11	0	0	0	0	0	30	2	3	16	2	0	0	
12	0	0	0	0	0	0	0	1	7	11	0	0	
13	0	0	0	0	5	3	4	3	12	0	0	0	
14	0	0	0	6	21	5	1	19	4	8	0	0	
15	0	0	0	1	25	0	7	3	0	0	0	0	
16	0	0	5	0	29	4	0	0	0	28	0	0	
17	0	0	0	0	22	13	3	1	0	0	0	0	
18	0	0	0	0	0	8	2	2	2	9	0	0	
19	0	0	0	0	37	1	3	0	6	0	0	0	
20	0	0	0	0	0	0	1	2	15	0	1	0	
21	0	0	0	0	0	0	0	1	33	0	12	0	
22	0	0	0	4	0	12	15	14	25	1	8	0	
23	0	0	0	2	4	0	82	2	3	4	1	0	
24	0	0	0	0	4	0	10	1	5	6	0	0	
25	0	0	0	26	0	0	0	1	0	0	0	0	
26	0	0	0	0	0	0	0	19	3	0	55	0	
27	0	0	0	0	24	0	0	0	0	0	20	0	
28	0	0	0	0	0	0	6	19	4	0	0	0	
29	0	0	0	3	1	0	13	4	0	3	0	0	
30	0		0	0	2	0	1	3	0	0	0	0	
31	0		0		2		0	29		0		0	Annual
Total	0	0	5	42	279	95	235	242	314	129	129	0	1,470
Max.	0	0	5	26	45	30	82	37	62	28	55	0	82

Year: 1965 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	4	2	4	7	15	0	0	
2	0	0	0	0	0	0	2	6	0	2	7	0	
3	0	9	0	0	42	0	1	1	0	14	53	0	
4	0	2	0	0	1	0	4	2	13	6	3	0	
5	0	0	0	0	12	36	0	3	16	1	0	0	
6	0	0	0	0	1	0	0	0	1	3	0	0	
7	0	0	0	0	2	0	0	2	12	18	0	0	
8	0	1	0	0	2	0	7	7	4	36	0	0	
9	0	13	0	0	0	0	6	4	0	1	0	0	
10	0	0	0	0	0	12	1	5	4	19	0	0	
11	0	0	0	0	9	3	4	0	59	43	0	0	
12	0	0	0	0	3	5	60	8	13	27	0	0	
13	0	0	0	2	2	5	2	0	0	1	18	0	
14	0	0	0	0	0	8	0	6	6	12	3	0	
15	7	0	0	0	0	2	0	10	11	17	0	0	
16	1	0	0	0	0	1	0	18	23	7	0	0	
17	0	0	0	0	0	1	1	9	0	1	0	0	
18	0	0	0	0	0	3	1	16	0	0	0	0	
19	0	0	0	0	0	0	3	3	0	18	0	0	
20	0	0	0	8	11	0	3	23	0	0	0	0	
21	0	0	0	2	0	4	0	3	16	0	0	0	
22	0	0	0	11	0	2	0	13	0	0	0	0	
23	0	0	0	0	0	4	0	32	11	0	0	0	
24	0	0	0	0	21	2	0	14	4	29	0	0	
25	0	0	0	0	13	17	23	0	0	71	0	0	
26	0	0	0	0	13	1	27	2	2	49	0	0	
27	0	0	0	0	0	2	24	14	0	6	0	0	
28	0	0	0	0	84	1	5	8	0	0	0	0	
29	0		0	0	46	0	2	0	0	0	0	0	
30	0		0	0	12	7	5	2	10	0	0	0	
31	0		0		0		0	1		0		0	Annual
Total	8	25	0	23	274	120	183	216	212	396	84	0	1,541
Max.	7	13	0	11	84	36	60	32	59	71	53	0	84

Daily Rainfall Record at Taunggyi

Year: 1966 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
29	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
30	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
31	NA		NA		NA		NA	NA		NA		NA	
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Max.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Year: 1967 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1	0	0	0	0	0	0	14	9	19	0	0	0	
2	0	0	0	0	0	0	21	36	3	13	0	0	
3	0	0	0	0	0	2	16	1	5	12	0	0	
4	1	0	0	0	0	0	46	0	14	1	0	0	
5	0	0	0	0	0	31	2	20	0	0	0	0	
6	0	0	0	0	0	2	0	4	4	0	0	0	
7	0	0	0	0	0	0	1	5	15	0	0	0	
8	0	0	0	8	0	0	0	6	16	0	0	0	
9	0	0	1	0	0	1	1	12	23	0	0	0	
10	0	0	0	0	2	9	6	9	8	23	0	0	
11	0	0	1	0	14	17	9	1	2	0	0	0	
12	0	0	1	0	4	17	1	11	1	0	0	0	
13	4	0	0	0	0	11	0	1	4	13	0	1	
14	0	0	0	0	16	0	0	3	5	2	0	0	
15	0	0	0	0	0	2	0	4	2	17	0	0	
16	0	0	0	0	18	0	6	1	29	15	0	0	
17	2	0	0	0	14	0	15	5	37	0	18	0	
18	0	0	0	0	9	0	29	3	4	0	4	0	
19	0	0	0	22	19	2	0	0	1	0	0	0	
20	0	0	0	2	9	2	43	2	43	0	0	0	
21	0	0	0	0	6	2	21	20	13	0	0	0	
22	0	0	5	8	2	0	7	28	0	0	0	0	
23	0	0	0	2	0	0	28	28	6	3	0	0	
24	0	0	0	0	7	0	13	2	18	5	0	0	
25	0	0	0	5	0	6	1	1	59	13	0	0	
26	0	0	0	2	1	9	8	0	9	2	0	0	
27	0	0	0	2	9	0	14	15	50	18	0	0	
28	0	0	0	3	0	16	5	8	9	36	0	0	
29	0		0	0	0	9	1	3	2	0	0	0	
30	0		0	0	3	4	49	31	0	1	0	0	
31	0		0		0		9	49		0		0	
Total	7	0	8	54	133	142	366	318	401	174	22	1	1,626
Max.	4	0	5	22	19	31	49	49	59	36	18	1	59

Daily Rainfall Record at Taunggyi

Year: 1968 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	1	0	36	11	5	23	0	0	
2	0	0	0	0	16	0	8	4	2	61	1	0	
3	0	0	0	0	5	27	2	0	4	1	0	0	
4	0	0	0	0	0	6	0	14	0	8	0	0	
5	0	0	0	0	0	12	1	4	5	0	0	0	
6	0	0	0	0	0	22	1	6	81	0	0	0	
7	0	0	0	0	0	8	7	4	24	0	0	0	
8	0	0	0	0	0	5	5	6	6	13	0	0	
9	0	0	0	0	21	8	4	2	0	5	0	0	
10	0	0	0	0	2	3	7	5	3	25	0	0	
11	0	0	0	0	4	0	0	2	23	11	0	0	
12	0	0	0	0	3	0	3	1	8	4	0	0	
13	0	0	0	0	0	7	0	30	30	10	1	0	
14	0	0	0	1	13	6	0	47	10	20	0	0	
15	0	0	0	0	1	3	0	17	0	0	0	0	
16	0	0	0	0	0	1	51	25	0	5	0	0	
17	22	0	0	0	1	2	7	3	0	0	0	0	
18	4	0	0	0	0	1	0	13	0	1	0	0	
19	0	0	0	1	6	2	7	0	8	3	0	0	
20	0	0	8	0	0	8	0	1	28	22	1	0	
21	0	0	0	0	16	1	0	36	0	12	0	0	
22	0	0	0	0	4	6	15	18	1	0	0	0	
23	0	0	0	0	0	17	4	0	6	0	0	0	
24	0	0	0	2	0	13	13	2	0	10	0	0	
25	0	0	0	4	0	3	1	6	0	4	0	0	
26	0	0	0	0	0	19	15	5	2	18	0	0	
27	0	0	0	51	0	0	66	0	6	4	0	0	
28	0	0	0	0	0	0	6	5	7	5	10	0	
29	0	0	0	7	0	0	2	1	26	0	0	0	
30	0		0	0	3	3	6	0	1	0	8	0	
31	0		0		0		14	7		0		0	Annual
Total	26	0	8	66	96	183	281	275	286	265	21	0	1,507
Max.	22	0	8	51	21	27	66	47	81	61	10	0	81

Year: 1969 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	17	0	31	0	4	5	0	
2	0	0	0	0	0	21	2	25	0	31	0	0	
3	0	0	0	0	0	42	16	1	0	18	0	0	
4	0	0	0	0	0	0	3	4	4	0	0	0	
5	0	0	0	0	1	0	0	0	6	0	0	0	
6	0	0	0	0	0	1	0	42	3	0	0	0	
7	0	0	0	0	5	0	0	5	0	0	0	0	
8	0	0	0	0	18	0	0	12	0	2	3	0	
9	0	0	0	0	0	2	15	3	0	0	0	0	
10	0	0	0	0	0	0	2	2	0	0	0	0	
11	0	0	0	0	0	16	0	1	4	0	0	0	
12	0	0	0	0	8	0	6	11	10	18	0	0	
13	0	0	0	0	0	0	55	44	1	21	0	0	
14	0	0	2	0	0	0	37	26	11	3	0	0	
15	0	0	1	8	0	4	2	11	0	0	0	0	
16	0	0	0	14	1	0	2	7	0	3	0	0	
17	0	0	0	6	0	1	0	17	0	0	0	0	
18	0	0	0	11	3	1	0	6	3	4	0	0	
19	0	0	0	1	1	0	0	7	1	0	0	0	
20	0	0	0	0	1	9	13	20	2	0	0	0	
21	0	0	0	0	40	13	3	6	0	0	0	0	
22	0	0	0	0	0	4	15	0	2	0	0	0	
23	0	0	0	0	0	1	33	0	6	0	0	0	
24	0	0	0	0	35	0	8	27	7	11	0	0	
25	0	0	0	0	0	0	43	0	0	0	0	0	
26	0	0	0	0	1	3	1	3	4	0	0	0	
27	0	0	0	0	1	2	6	0	0	0	0	0	
28	0	0	0	0	2	12	4	11	0	42	0	0	
29	0		0	0	2	7	0	1	0	2	0	0	
30	0		0	0	22	13	2	8	0	0	0	0	
31	0		0		20		2	7		2		0	Annual
Total	0	0	3	40	161	169	270	338	64	161	8	0	1,214
Max.	0	0	2	14	40	42	55	44	11	42	5	0	55

Daily Rainfall Record at Taunggyi

Year: 1970 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	1	9	23	0	0	30	
2	0	0	0	5	0	0	0	25	19	0	0	6	
3	0	0	0	7	0	0	0	0	0	0	13	3	
4	0	0	0	8	0	0	1	7	2	0	1	2	
5	0	0	0	0	4	10	21	13	19	1	0	0	
6	0	0	0	0	24	0	8	18	1	0	4	0	
7	0	0	0	0	21	0	6	19	48	0	0	0	
8	0	0	0	0	4	19	3	44	13	6	7	0	
9	0	0	0	0	0	1	0	1	4	15	1	0	
10	0	0	0	26	0	0	6	0	4	11	7	0	
11	0	0	0	0	0	20	3	9	0	1	8	0	
12	0	0	0	0	0	0	1	22	36	0	0	0	
13	0	0	0	0	0	15	9	0	16	13	6	0	
14	0	0	0	0	18	1	5	0	4	6	0	0	
15	0	0	0	0	0	27	15	0	0	2	0	0	
16	0	0	0	0	2	3	2	0	2	1	0	0	
17	0	0	0	0	7	0	50	0	1	2	0	0	
18	0	0	0	0	1	0	30	1	0	1	0	0	
19	0	0	0	0	34	0	14	0	32	0	0	0	
20	0	0	0	0	14	5	0	18	1	0	0	0	
21	0	0	0	0	19	1	0	7	11	1	0	0	
22	0	0	0	0	10	12	4	35	28	0	0	0	
23	0	0	0	0	21	10	5	0	0	3	5	0	
24	0	0	0	0	14	14	16	4	10	4	0	0	
25	0	0	0	1	3	10	21	20	1	0	0	0	
26	0	0	0	20	4	4	3	12	1	0	0	0	
27	0	0	0	0	0	11	6	2	16	16	0	0	
28	0	0	0	0	3	23	0	0	0	3	0	0	
29	0		0	0	0	72	0	8	0	0	0	0	
30	0		0	0	17	3	1	0	1	0	4	0	
31	0		0		6		0	0		0		0	Annual
Total	0	0	0	67	226	261	231	274	293	86	56	41	1,535
Max.	0	0	0	26	34	72	50	44	48	16	13	30	72

Year: 1971 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	2	0	18	13	0	0	3	
2	0	0	0	0	0	57	5	6	0	7	0	0	
3	0	0	0	0	0	3	1	1	47	10	0	0	
4	0	0	0	3	0	3	13	1	21	0	6	0	
5	0	0	0	0	0	3	2	0	17	0	0	0	
6	0	0	0	0	0	0	42	0	8	34	0	0	
7	0	0	2	0	13	5	0	3	0	0	0	0	
8	0	0	0	0	5	6	4	19	3	3	13	0	
9	0	0	0	0	4	0	0	4	7	9	3	0	
10	0	0	0	0	0	5	2	4	30	0	0	0	
11	0	0	0	0	0	1	15	3	2	0	0	0	
12	0	0	0	0	0	7	1	1	0	0	0	0	
13	0	0	0	0	0	11	0	5	1	0	0	0	
14	0	0	0	0	0	0	25	5	0	0	0	0	
15	0	0	0	0	0	0	19	6	34	0	0	0	
16	0	0	0	0	0	11	3	15	6	0	0	0	
17	0	0	0	0	1	4	5	0	10	0	0	11	
18	0	0	0	0	0	11	2	4	2	0	0	0	
19	0	0	0	18	0	56	7	0	8	0	0	0	
20	0	0	0	0	7	1	26	6	0	0	0	0	
21	0	0	0	8	61	10	6	11	1	0	0	10	
22	0	0	0	2	2	13	14	5	0	31	0	5	
23	0	0	0	2	1	23	9	2	0	0	0	6	
24	0	0	0	2	2	1	28	1	15	0	0	0	
25	0	0	0	0	14	3	28	2	0	0	0	0	
26	0	0	0	0	2	17	5	28	9	0	0	0	
27	0	0	1	0	11	5	2	30	3	8	0	0	
28	0	0	0	0	44	0	1	5	1	49	0	0	
29	1		0	43	10	0	1	19	2	2	0	0	
30	0		0	0	3	1	17	2	2	0	0	0	
31	0		0		17		9	60		0		0	Annual
Total	1	0	3	78	197	259	292	266	242	153	22	35	1,548
Max.	1	0	2	43	61	57	42	60	47	49	13	11	61

Daily Rainfall Record at Taunggyi

Year: 1972 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	31	25	29	17	14	0	0	
2	0	0	0	0	0	0	10	1	6	0	0	3	
3	0	0	0	0	0	1	1	33	5	4	0	0	
4	0	0	0	5	3	3	1	1	9	10	21	0	
5	0	0	0	0	3	2	8	3	52	0	33	0	
6	0	0	0	1	1	3	1	1	0	0	1	0	
7	0	0	0	0	0	42	0	1	0	0	49	0	
8	0	0	0	0	0	7	0	19	0	41	3	0	
9	0	0	0	0	0	6	1	3	1	2	0	0	
10	0	0	0	0	22	14	23	0	1	0	0	0	
11	0	0	0	3	0	2	0	45	0	0	0	0	
12	0	0	0	7	0	6	1	25	3	0	0	0	
13	0	0	0	16	0	5	12	0	8	0	0	0	
14	0	0	0	0	0	5	10	28	0	4	0	0	
15	0	0	0	0	0	1	1	17	9	1	0	0	
16	0	0	0	0	0	0	20	27	6	15	0	2	
17	0	0	0	0	0	0	28	0	8	3	0	0	
18	0	0	0	0	0	0	6	6	0	0	0	0	
19	0	0	0	0	2	0	2	30	0	0	0	0	
20	0	0	0	0	0	0	4	13	1	1	11	0	
21	0	0	0	0	23	0	0	34	0	0	10	0	
22	0	0	0	0	0	0	0	42	3	1	3	0	
23	0	0	0	0	0	0	1	5	18	14	0	0	
24	0	0	0	0	0	6	8	2	0	21	0	0	
25	0	0	0	0	0	0	0	8	3	0	0	0	
26	0	0	17	0	19	0	1	11	2	9	11	0	
27	0	0	0	18	1	1	5	8	15	0	4	0	
28	0	0	0	12	6	27	10	2	29	0	23	0	
29	0	0	0	0	19	28	0	1	32	0	18	0	
30	0		0	0	1	55	17	0	34	0	3	0	
31	0		0		17		22	7		0		0	Annual
Total	0	0	17	62	117	245	218	402	262	140	190	5	1,658
Max.	0	0	17	18	23	55	28	45	52	41	49	3	55

Year: 1973 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
26	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
29	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
30	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
31	NA		NA		NA		NA	NA		NA		NA	Annual
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Max.	0	0	0	0	0	0	0	0	0	0	0	0	0

Daily Rainfall Record at Taunggyi

Year: 1974 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1	0	0	0	4	5	2	0	5	5	4	25	0	
2	0	0	0	0	0	2	2	0	0	0	10	0	
3	0	0	0	0	0	0	0	0	8	0	0	0	
4	0	0	0	0	0	0	1	0	89	0	0	0	
5	0	0	0	0	0	0	0	4	1	2	0	0	
6	0	0	0	0	2	0	0	11	0	0	1	0	
7	0	0	0	0	0	38	2	0	7	0	2	0	
8	0	0	0	0	0	0	1	6	6	0	0	0	
9	0	0	0	0	0	22	0	11	0	0	12	0	
10	0	0	0	0	37	14	0	0	6	0	12	0	
11	0	0	0	0	12	2	0	16	3	0	3	0	
12	0	0	0	0	31	11	0	28	0	0	80	0	
13	0	0	0	1	0	7	1	29	4	0	25	0	
14	0	0	0	0	0	9	0	1	1	7	4	0	
15	0	0	0	3	0	13	5	5	27	0	6	0	
16	0	0	0	0	0	23	0	2	34	0	0	0	
17	0	0	0	0	0	4	1	30	0	0	0	0	
18	0	0	0	0	0	1	1	35	0	0	2	0	
19	0	0	0	0	37	0	2	9	17	1	0	0	
20	0	0	3	0	0	0	1	13	6	1	0	0	
21	0	0	0	0	1	2	2	8	2	1	1	0	
22	0	0	0	0	14	4	0	2	0	5	0	0	
23	0	0	13	0	52	10	6	51	0	0	0	0	
24	0	0	0	0	4	3	39	20	24	1	2	0	
25	0	0	0	1	7	1	0	1	14	0	0	0	
26	0	0	0	0	1	7	0	9	5	0	0	0	
27	0	0	0	0	5	10	3	0	7	0	0	0	
28	0	0	0	1	2	2	8	5	2	4	0	0	
29	0		39	0	0	1	15	1	2	2	0	0	
30	0		1	0	0	0	20	0	0	7	7	0	
31	0		2		0		17	1		16		0	
Total	0	0	58	10	210	188	127	303	270	51	192	0	1,409
Max.	0	0	39	4	52	38	39	51	89	16	80	0	89

Year: 1975 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1	0	0	0	0	0	24	2	0	15	61	38	4	
2	0	0	0	0	0	3	8	47	2	0	0	0	
3	0	0	0	0	0	36	0	48	7	0	0	0	
4	0	0	0	0	21	131	25	3	9	3	0	0	
5	0	0	0	0	1	7	0	3	39	3	1	0	
6	0	0	0	0	0	8	21	2	6	6	0	0	
7	0	0	0	0	36	10	2	43	6	4	2	0	
8	0	0	0	0	6	4	25	12	0	13	0	0	
9	0	0	0	0	31	0	0	2	19	18	2	0	
10	28	0	0	0	0	0	4	8	8	13	0	0	
11	31	0	0	0	31	0	0	29	17	0	11	0	
12	5	0	0	0	0	0	8	1	0	1	0	0	
13	0	0	0	0	5	0	14	8	26	6	0	0	
14	0	0	0	0	0	10	21	1	8	1	2	0	
15	0	0	0	0	0	7	5	0	36	1	0	0	
16	0	0	0	0	6	43	12	2	2	0	0	0	
17	0	0	0	0	2	42	11	28	0	0	0	0	
18	6	0	0	0	3	50	1	1	0	0	0	0	
19	0	0	0	0	0	51	4	52	6	0	0	0	
20	0	0	0	0	9	20	24	4	4	0	0	0	
21	0	0	0	0	0	18	4	14	3	0	0	0	
22	0	0	0	0	3	14	0	27	18	2	0	0	
23	0	0	0	0	2	27	7	1	29	1	0	0	
24	0	0	0	0	6	4	6	0	2	7	0	0	
25	0	0	0	0	2	6	1	4	0	0	0	0	
26	0	0	0	0	16	0	0	4	0	1	0	0	
27	0	0	0	0	11	4	0	7	15	4	0	0	
28	0	0	28	0	6	0	31	11	3	16	0	0	
29	0		0	0	7	0	1	2	4	14	0	0	
30	0		0	0	0	0	1	30	0	9	1	0	
31	0		0		1		0	14		23		0	
Total	70	0	28	0	205	519	238	408	284	207	57	4	2,020
Max.	31	0	28	0	36	131	31	52	39	61	38	4	131

Daily Rainfall Record at Taunggyi

Year: 1976 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	3	5	0	76	35	0	0	7	
2	0	0	0	0	6	0	0	18	0	0	0	0	
3	0	0	0	0	27	4	1	5	0	2	0	0	
4	0	0	0	0	41	31	1	5	5	29	0	0	
5	0	0	0	0	0	4	2	1	5	1	7	0	
6	0	0	0	0	0	10	1	13	10	4	0	0	
7	0	24	0	0	0	8	3	3	2	2	0	0	
8	0	1	0	0	2	2	3	12	0	2	0	0	
9	0	0	0	2	47	4	10	6	1	0	1	0	
10	0	0	0	2	0	3	1	2	1	0	0	0	
11	0	0	0	0	1	1	1	2	6	0	0	0	
12	0	0	0	0	0	7	0	0	0	0	0	0	
13	0	0	0	0	19	12	0	2	5	0	0	0	
14	0	0	0	0	36	0	0	3	38	0	0	0	
15	0	0	0	0	19	0	22	13	19	2	0	0	
16	0	0	0	0	0	0	0	10	8	0	0	0	
17	0	0	0	0	0	0	1	2	0	0	0	0	
18	0	0	0	0	2	0	8	4	0	0	0	0	
19	0	0	0	0	0	0	0	4	0	13	0	0	
20	0	0	0	0	0	11	0	1	50	32	0	0	
21	0	0	0	0	0	0	0	1	4	0	0	0	
22	0	0	0	13	0	0	4	1	1	0	0	0	
23	0	0	0	0	0	0	4	5	60	0	0	0	
24	1	0	0	0	3	0	18	1	56	0	0	0	
25	1	0	0	0	5	4	1	0	0	0	0	0	
26	0	0	0	0	10	0	7	1	3	0	0	0	
27	0	0	0	0	0	0	1	1	2	0	0	0	
28	0	0	0	0	3	0	1	17	2	0	0	0	
29	0	0	0	0	11	0	2	20	0	0	6	0	
30	0		0	0	22	0	10	4	0	0	8	0	
31	0		0		6		29	7		0		0	Annual
Total	2	25	0	17	263	106	131	240	313	87	22	7	1,213
Max.	1	24	0	13	47	31	29	76	60	32	8	7	76

Year: 1977 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	20	0	0	1	16	0	0	3	20	16	0	0	
2	0	0	0	16	0	1	12	1	13	0	0	0	
3	0	0	0	10	0	0	4	6	2	4	6	1	
4	0	0	0	6	0	4	0	7	37	0	6	0	
5	0	0	1	18	0	0	1	16	24	14	0	0	
6	0	0	0	0	0	0	1	1	5	0	0	0	
7	0	0	11	0	0	19	0	13	5	4	0	0	
8	0	0	0	8	1	3	0	0	11	11	0	0	
9	0	0	0	27	29	1	5	5	2	12	0	0	
10	0	0	1	9	2	0	4	0	3	11	0	0	
11	0	0	0	0	0	3	0	5	0	44	0	0	
12	0	0	0	0	2	3	0	5	20	12	0	0	
13	0	0	0	0	18	1	0	0	0	45	0	0	
14	0	0	0	0	17	7	5	0	0	0	0	0	
15	0	0	0	0	0	12	18	2	15	0	0	0	
16	0	0	0	0	0	0	7	0	29	0	0	0	
17	0	0	0	0	0	0	0	0	3	4	0	0	
18	0	0	0	0	10	0	32	4	5	0	0	0	
19	0	0	0	13	14	0	9	9	3	0	0	0	
20	0	0	0	0	0	0	0	5	2	0	0	0	
21	0	0	0	13	0	2	7	5	1	30	0	0	
22	0	0	0	0	0	3	2	0	28	24	0	0	
23	0	0	0	0	0	0	26	35	10	22	0	0	
24	0	0	0	0	5	19	33	24	0	45	0	0	
25	0	0	0	0	19	0	0	7	0	7	2	0	
26	0	0	0	0	22	3	0	0	0	0	12	0	
27	0	0	0	0	0	4	0	2	4	2	0	2	
28	0	0	0	0	20	2	0	0	1	8	0	7	
29	0		0	0	14	2	12	2	0	24	0	7	
30	0		0	0	0	0	5	18	0	0	0	12	
31	0		0		0		6	13		0		0	Annual
Total	20	0	13	121	189	89	189	188	243	339	26	29	1,446
Max.	20	0	11	27	29	19	33	35	37	45	12	12	45

Daily Rainfall Record at Taunggyi

Year: 1978 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	1	0	0	34	27	1	0	0	
2	0	0	0	0	2	1	0	0	9	0	0	0	
3	0	0	0	0	0	11	27	0	7	0	0	0	
4	0	0	0	0	4	5	10	2	3	24	0	0	
5	0	0	0	0	0	0	17	0	10	1	0	0	
6	0	0	0	0	0	0	36	3	10	74	0	0	
7	0	0	0	0	0	14	7	1	1	5	0	0	
8	0	0	0	0	5	16	3	5	18	0	0	0	
9	0	0	0	0	0	6	30	17	22	0	0	0	
10	0	0	0	0	0	0	1	2	37	1	0	0	
11	0	0	0	0	0	4	5	3	11	1	0	0	
12	0	0	0	0	42	0	0	10	0	1	6	1	
13	0	0	0	0	2	0	0	6	0	0	0	0	
14	0	0	0	2	7	0	2	14	63	0	0	0	
15	0	0	0	1	0	14	27	6	10	0	0	0	
16	0	0	0	4	17	26	2	1	0	0	9	0	
17	0	0	0	9	0	1	15	0	2	0	0	0	
18	0	0	0	13	17	1	21	25	0	0	0	0	
19	0	0	0	0	20	12	0	0	0	0	0	0	
20	0	0	0	0	1	45	0	47	1	0	0	0	
21	0	0	0	0	8	11	7	27	0	12	0	0	
22	0	0	0	0	1	1	4	2	17	5	0	0	
23	0	0	0	0	6	0	10	0	11	24	0	0	
24	0	0	0	0	0	1	1	0	5	4	0	0	
25	0	0	0	0	0	4	2	28	5	3	0	0	
26	0	0	0	0	0	1	2	4	12	14	0	0	
27	0	0	0	0	0	12	3	13	9	14	0	0	
28	0	0	0	12	0	32	20	4	0	44	0	0	
29	0		0	1	4	34	41	26	0	0	0	0	
30	0		0	0	0	4	13	5	0	0	0	0	
31	0		0		16		17	1		0		0	Annual
Total	0	0	0	42	153	256	323	286	290	228	15	1	1,594
Max.	0	0	0	13	42	45	41	47	63	74	9	1	74

Year: 1979 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	4	0	2	35	15	5	0	6	
2	0	0	0	0	7	17	4	2	21	44	0	2	
3	0	0	0	0	0	0	2	17	35	0	0	2	
4	0	0	0	0	0	0	7	62	0	0	0	0	
5	0	0	0	0	0	6	0	19	0	0	0	0	
6	0	0	0	0	0	12	2	26	0	10	0	0	
7	0	0	0	0	0	7	1	10	0	36	0	0	
8	0	0	0	0	7	0	12	27	19	2	0	0	
9	0	0	0	0	0	9	1	12	0	0	0	4	
10	0	0	0	0	0	0	0	0	1	1	0	0	
11	0	0	0	0	7	0	22	2	0	24	0	0	
12	0	0	0	0	0	4	27	10	0	22	0	0	
13	0	0	0	0	0	7	27	6	0	9	0	0	
14	0	0	0	0	0	13	0	7	0	0	0	0	
15	0	0	0	0	0	25	0	6	0	2	0	0	
16	0	0	0	0	7	0	0	7	0	1	0	0	
17	0	0	0	0	0	1	2	4	1	0	0	0	
18	0	0	0	0	7	0	0	4	1	0	0	0	
19	0	0	0	0	0	53	0	3	14	3	0	0	
20	0	0	0	0	0	43	0	5	10	0	0	0	
21	0	0	0	0	0	4	5	0	10	0	0	0	
22	0	0	0	0	1	6	13	0	11	0	0	0	
23	0	0	0	0	0	29	10	3	0	0	0	0	
24	0	0	0	0	0	4	0	7	0	0	0	0	
25	0	0	0	0	0	8	0	17	8	0	0	0	
26	0	0	0	0	30	1	1	1	0	0	0	0	
27	0	0	0	0	36	22	8	0	2	0	2	0	
28	0	0	0	0	0	34	1	0	2	0	0	0	
29	0		0	0	0	2	27	0	0	0	1	0	
30	0		0	0	0	4	0	0	2	0	2	0	
31	0		0		0		0	52		7		0	Annual
Total	0	0	0	0	106	311	174	344	152	166	5	14	1,272
Max.	0	0	0	0	36	53	27	62	35	44	2	6	62

Daily Rainfall Record at Taunggyi

Year: 1980 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	1	64	3	5	4	3	0	0	
2	0	0	0	0	0	28	2	26	15	0	0	0	
3	0	0	3	0	18	14	0	3	25	3	0	0	
4	0	0	0	0	2	8	0	25	57	9	0	0	
5	0	0	0	0	58	3	1	0	9	0	0	0	
6	0	0	0	0	0	4	7	6	0	2	0	0	
7	0	0	0	0	6	1	3	0	30	0	0	0	
8	0	0	0	0	1	3	16	2	21	9	0	0	
9	0	0	0	0	0	0	6	31	12	2	0	0	
10	0	0	0	0	1	0	1	1	7	3	0	1	
11	0	0	0	0	0	51	0	0	62	2	0	2	
12	0	0	0	0	0	32	0	0	9	0	0	0	
13	0	0	0	0	0	48	0	0	0	39	0	2	
14	0	0	0	0	0	62	0	0	20	2	0	0	
15	0	0	0	0	0	24	2	0	13	7	0	0	
16	0	0	0	0	0	0	2	3	9	1	0	0	
17	0	0	0	1	0	1	3	11	0	0	0	0	
18	0	0	0	0	4	4	0	1	0	2	0	0	
19	0	0	0	0	3	2	0	12	0	0	0	0	
20	0	0	0	0	0	3	6	8	0	2	0	0	
21	0	0	0	0	0	1	87	1	15	1	0	0	
22	0	0	0	5	2	7	10	44	10	0	0	0	
23	0	0	0	11	3	2	4	1	15	0	0	0	
24	0	0	0	0	4	33	20	5	0	0	0	0	
25	0	0	0	0	25	31	6	13	14	0	0	0	
26	0	0	0	0	0	0	0	22	0	0	0	0	
27	0	0	0	0	0	2	11	0	5	0	0	0	
28	0	0	0	0	7	0	0	0	7	0	0	0	
29	0	0	0	0	0	0	4	9	0	0	0	0	
30	0		0	0	2	0	7	49	0	0	0	0	
31	0		0		3		3	39		0		0	Annual
Total	0	0	3	17	140	428	204	317	359	87	0	5	1,560
Max.	0	0	3	11	58	64	87	49	62	39	0	2	87

Year: 1981 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	8	5	0	2	0	0	
2	0	0	0	0	0	30	2	5	11	0	0	0	
3	0	0	0	0	9	7	1	58	2	0	0	0	
4	0	0	0	0	15	11	2	10	30	10	0	0	
5	0	0	0	0	0	7	1	8	7	0	0	0	
6	0	0	0	0	9	9	4	4	10	17	0	0	
7	0	0	0	0	4	0	36	4	31	0	13	0	
8	0	0	0	0	0	9	0	23	28	0	10	0	
9	0	0	0	0	0	0	0	2	1	1	39	0	
10	0	0	1	0	0	11	2	2	1	3	5	0	
11	0	0	0	0	0	12	0	16	4	0	8	0	
12	0	12	0	0	0	0	1	27	26	29	2	0	
13	0	0	0	5	3	5	1	9	0	2	0	0	
14	0	0	0	10	4	0	0	4	0	4	24	0	
15	0	0	0	0	0	2	0	0	0	0	15	0	
16	0	0	0	4	0	0	1	0	0	0	0	0	
17	0	0	0	0	5	0	0	0	2	0	0	0	
18	0	0	0	1	3	0	3	0	16	16	2	0	
19	0	0	0	1	13	3	0	0	0	17	35	0	
20	3	0	0	0	19	13	20	5	0	14	0	0	
21	0	0	0	0	2	0	9	6	2	0	18	0	
22	0	0	0	0	14	14	2	28	0	0	4	0	
23	0	0	0	0	34	1	0	8	0	0	0	0	
24	0	0	0	0	7	7	0	1	2	0	4	0	
25	0	0	4	0	13	2	50	5	0	0	0	0	
26	0	0	0	0	18	4	1	0	6	0	0	0	
27	0	0	1	32	1	4	5	0	0	0	0	0	
28	0	0	0	4	18	1	18	15	7	29	0	0	
29	0		0	0	8	7	0	0	21	0	0	0	
30	0		0	0	0	2	13	3	4	0	0	0	
31	0		0		20		19	0		0		0	Annual
Total	3	12	6	57	219	161	199	248	211	144	179	0	1,439
Max.	3	12	4	32	34	30	50	58	31	29	39	0	58

Daily Rainfall Record at Taunggyi

Year: 1982 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	5	13	22	0	0	21	0	
2	0	0	0	0	0	6	1	11	22	5	5	0	
3	0	0	0	0	0	0	4	0	18	12	0	0	
4	0	0	0	0	0	13	1	0	32	29	0	0	
5	0	0	0	0	2	2	9	1	14	0	0	0	
6	0	0	0	0	0	1	0	4	5	21	0	0	
7	0	0	0	0	0	0	0	15	28	5	0	0	
8	0	0	0	0	0	0	0	21	1	0	0	0	
9	0	0	0	0	0	6	2	0	8	0	0	0	
10	0	0	0	0	0	1	11	2	37	36	0	0	
11	0	0	0	0	0	1	1	27	0	16	0	0	
12	0	0	0	0	0	15	1	1	1	31	10	0	
13	0	0	0	0	0	84	0	25	1	39	0	0	
14	0	0	0	0	1	4	6	2	2	17	13	0	
15	0	0	0	0	1	3	12	11	0	38	0	0	
16	0	0	0	0	0	3	3	16	2	8	0	0	
17	0	0	0	0	0	0	0	28	10	0	0	0	
18	0	0	0	0	9	2	0	35	14	0	0	0	
19	0	0	0	39	1	1	0	9	10	0	0	0	
20	0	0	0	0	0	0	0	2	12	0	0	0	
21	0	0	0	0	0	0	25	48	0	0	0	0	
22	0	0	0	0	0	20	3	1	30	0	0	0	
23	0	0	0	0	0	4	1	5	0	2	0	0	
24	0	0	0	0	0	1	1	9	9	0	0	0	
25	0	0	0	0	2	0	0	5	12	0	0	0	
26	0	0	0	0	2	1	1	0	6	0	0	0	
27	0	0	0	0	18	2	6	0	18	1	0	0	
28	0	0	0	0	2	0	3	5	2	0	0	0	
29	0		0	0	40	7	0	4	9	0	0	0	
30	0		0	0	4	2	13	1	0	6	0	0	
31	0		0		17		22	1		2		0	Annual
Total	0	0	0	39	99	184	139	311	303	268	49	0	1,392
Max.	0	0	0	39	40	84	25	48	37	39	21	0	84

Year: 1983 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	2	0	1	11	0	0	0	
2	0	0	0	0	0	0	2	2	0	0	0	0	
3	0	0	0	0	0	2	3	0	51	0	41	0	
4	0	1	0	0	0	0	4	0	35	0	9	0	
5	0	7	0	0	0	0	3	1	7	28	12	0	
6	0	0	0	0	0	0	17	25	2	13	17	0	
7	0	0	0	0	0	44	0	2	0	1	0	0	
8	0	0	0	0	8	9	2	0	2	1	0	0	
9	0	0	0	0	4	28	0	7	2	62	1	0	
10	0	0	0	0	0	18	4	36	26	34	6	0	
11	0	0	0	0	0	35	0	0	9	0	39	0	
12	0	0	0	0	0	30	0	0	2	0	9	0	
13	0	0	0	0	21	10	71	14	14	0	7	0	
14	0	0	0	0	3	56	27	18	17	0	37	0	
15	0	0	0	0	0	1	0	10	14	0	55	0	
16	0	0	1	0	0	0	4	0	1	18	2	0	
17	0	0	7	0	1	0	6	0	0	11	0	0	
18	0	0	0	0	11	2	31	6	1	0	0	0	
19	0	0	0	0	0	0	6	17	0	5	0	0	
20	0	1	0	0	0	13	5	0	43	2	0	0	
21	0	0	0	0	0	0	8	6	54	13	0	0	
22	0	2	0	0	0	0	3	47	1	17	0	0	
23	0	0	3	0	0	21	42	0	0	27	0	0	
24	0	0	0	0	2	0	2	0	5	2	0	0	
25	0	0	0	0	0	22	0	3	0	11	0	0	
26	0	0	0	0	0	0	13	3	0	0	0	0	
27	0	0	0	0	0	0	1	0	0	1	0	0	
28	0	0	0	0	19	0	1	0	0	0	0	2	
29	0		0	0	40	0	0	2	3	0	0	0	
30	0		0	0	7	2	1	3	2	0	0	0	
31	0		0		0		2	39		0		0	Annual
Total	0	11	11	0	116	295	258	242	302	246	235	2	1,718
Max.	0	7	7	0	40	56	71	47	54	62	55	2	71

Daily Rainfall Record at Taunggyi

Year: 1984 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	6	16	0	25	12	6	0	0	
2	0	0	0	0	0	27	2	5	71	8	0	0	
3	0	0	0	0	0	15	2	6	17	0	0	0	
4	0	0	0	0	0	12	0	6	31	2	0	0	
5	0	0	0	0	0	1	2	3	14	30	0	0	
6	0	0	0	0	0	0	2	86	4	0	0	0	
7	0	0	0	0	49	14	6	20	0	3	0	0	
8	0	0	0	0	0	23	4	46	36	0	0	0	
9	0	2	0	17	0	8	1	29	3	0	0	0	
10	0	0	0	0	0	11	23	2	1	20	0	0	
11	0	0	0	0	0	0	7	50	18	1	0	0	
12	0	1	0	4	0	0	16	4	2	2	0	0	
13	0	0	0	0	3	2	12	1	5	0	0	0	
14	0	6	0	0	0	0	7	8	0	2	0	0	
15	0	0	0	4	3	0	9	11	0	0	0	0	
16	0	0	0	0	0	1	4	27	0	4	0	0	
17	0	0	0	0	0	0	2	22	5	23	0	0	
18	0	0	0	0	12	16	2	7	2	3	0	0	
19	0	0	0	0	0	4	0	3	1	22	0	0	
20	0	0	0	0	5	0	0	6	0	16	0	0	
21	0	0	0	0	0	4	0	12	35	25	0	0	
22	0	0	0	0	0	0	2	54	0	0	0	0	
23	0	0	0	3	0	0	5	0	15	0	0	0	
24	0	0	0	0	0	1	1	1	0	0	0	0	
25	0	0	0	6	0	0	0	12	6	0	0	2	
26	0	0	0	17	2	0	0	5	2	0	0	0	
27	0	0	0	4	0	54	0	12	4	0	0	1	
28	0	0	0	6	0	4	1	14	0	0	0	0	
29	0	0	0	1	25	1	8	0	27	0	0	0	
30	0		0	3	6	8	7	3	0	0	0	0	
31	0		0		6		6	2		0		0	Annual
Total	0	9	0	65	117	222	131	482	311	167	0	3	1,507
Max.	0	6	0	17	49	54	23	86	71	30	0	2	86

Year: 1985 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	8	0	0	1	12	53	0	0	
2	0	0	0	0	11	16	15	8	0	70	20	0	
3	0	0	0	0	1	0	7	3	0	3	0	0	
4	0	0	0	0	0	1	0	22	0	2	2	0	
5	0	0	0	0	0	5	1	5	0	0	0	0	
6	0	0	0	0	0	9	2	1	0	0	0	0	
7	0	0	0	0	0	2	15	3	0	0	0	0	
8	0	0	0	0	0	11	0	0	0	0	0	0	
9	0	0	0	8	0	3	1	0	1	0	0	0	
10	0	0	0	0	0	0	0	4	8	0	0	0	
11	0	0	0	0	0	27	1	0	11	1	0	0	
12	0	0	0	0	0	2	15	1	13	0	1	0	
13	0	0	0	0	0	3	1	19	28	0	7	0	
14	0	0	0	0	11	6	12	0	1	1	12	0	
15	0	0	0	0	2	3	31	11	9	0	39	0	
16	0	0	0	10	0	0	5	12	0	1	74	0	
17	0	0	0	1	0	1	17	16	0	0	47	0	
18	0	0	0	5	25	1	7	13	0	28	8	0	
19	0	0	0	0	2	24	1	7	0	21	3	0	
20	0	0	0	0	12	0	3	3	0	0	28	0	
21	0	0	0	0	30	2	31	2	0	0	1	0	
22	0	0	0	0	2	12	0	1	0	1	0	0	
23	0	0	0	0	9	23	31	0	0	0	0	0	
24	0	0	0	0	4	30	0	0	4	0	0	0	
25	0	0	0	0	11	2	21	4	19	30	0	0	
26	0	0	0	0	0	10	5	19	1	10	0	0	
27	0	0	0	10	0	0	2	1	125	3	0	0	
28	0	0	0	5	0	0	2	125	12	0	0	0	
29	0		0	1	0	3	12	11	9	0	0	0	
30	0		0	0	1	0	20	9	13	3	0	0	
31	0		0		0		24	13		0		0	Annual
Total	0	0	0	40	129	196	282	314	266	227	242	0	1,696
Max.	0	0	0	10	30	30	31	125	125	70	74	0	125

Daily Rainfall Record at Taunggyi

Year: 1986 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	13	0	0	9	33	26	0	0	
2	0	0	0	0	0	3	0	12	0	6	0	0	
3	0	0	7	0	0	0	0	21	0	0	0	0	
4	0	0	16	0	0	13	0	28	8	0	0	0	
5	0	0	1	0	0	0	13	11	63	18	0	0	
6	0	0	0	0	0	0	43	2	0	0	1	0	
7	0	0	0	0	0	6	3	2	101	0	0	0	
8	0	0	0	1	2	3	2	17	8	2	0	0	
9	0	0	0	0	2	6	1	8	23	25	2	0	
10	0	0	0	0	18	3	1	0	3	7	3	0	
11	0	0	0	0	0	4	37	5	2	7	11	4	
12	0	0	0	0	12	18	72	7	4	24	11	1	
13	0	0	0	1	0	53	11	24	1	3	0	0	
14	0	0	0	0	1	46	5	10	0	0	0	0	
15	0	0	0	0	58	3	0	4	0	0	0	0	
16	0	0	0	0	7	0	31	10	13	0	0	0	
17	0	0	0	0	0	1	3	1	15	0	0	0	
18	0	0	0	0	0	0	0	5	0	0	0	0	
19	0	0	0	0	0	2	0	0	72	0	0	0	
20	0	0	0	0	0	11	3	7	28	0	0	0	
21	0	0	0	0	0	0	12	0	0	0	0	0	
22	0	0	0	0	0	0	9	5	0	0	0	0	
23	0	0	0	0	2	0	2	1	0	0	0	0	
24	0	0	0	3	2	6	25	0	0	0	0	0	
25	0	0	0	14	0	5	0	1	0	3	0	0	
26	0	0	0	0	0	8	1	16	0	14	0	0	
27	0	0	0	0	0	3	10	10	0	0	0	0	
28	0	0	0	0	0	5	1	0	0	0	0	0	
29	0		0	3	0	0	2	6	0	0	0	0	
30	0		0	13	1	0	13	0	0	0	0	0	
31	0		0		0		19	2		0		26	Annual
Total	0	0	24	35	118	199	319	224	374	135	28	31	1,487
Max.	0	0	16	14	58	53	72	28	101	26	11	26	101

Year: 1987 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	0	30	15	6	19	0	1	0	
3	0	4	10	0	0	12	4	32	25	0	2	0	
4	0	3	0	0	6	5	2	2	0	26	32	0	
5	0	1	0	0	20	13	6	1	0	18	54	0	
6	0	1	0	0	1	4	9	0	0	31	7	0	
7	0	0	0	0	0	0	0	0	17	22	1	0	
8	0	0	0	25	0	8	0	1	106	2	16	0	
9	0	0	0	0	0	34	0	5	4	0	0	0	
10	0	0	0	0	0	6	1	15	20	0	5	0	
11	0	0	0	47	1	4	0	0	27	0	1	0	
12	0	0	0	2	0	14	5	7	8	0	0	0	
13	0	0	0	0	0	23	1	11	5	0	0	0	
14	0	0	0	0	0	5	2	1	71	0	5	0	
15	0	0	0	0	2	12	0	0	19	0	31	0	
16	0	0	2	0	0	8	2	2	26	0	5	0	
17	0	0	0	4	0	7	6	16	10	0	8	0	
18	0	0	0	0	0	19	8	25	2	0	0	0	
19	0	0	5	0	0	4	14	12	6	0	0	0	
20	0	0	0	0	1	0	2	5	4	0	0	0	
21	0	0	0	0	0	5	19	2	17	0	0	0	
22	0	0	0	0	0	0	1	14	15	0	0	0	
23	0	0	0	0	0	6	0	48	11	1	0	0	
24	0	0	0	0	0	0	13	21	2	2	0	0	
25	0	0	0	0	1	0	11	8	4	9	0	0	
26	0	0	0	0	0	0	11	1	1	5	0	0	
27	0	0	0	0	6	8	4	0	3	47	0	0	
28	2	0	0	22	0	2	3	20	0	6	0	0	
29	7		3	5	0	0	5	0	5	0	0	0	
30	0		0	14	0	1	0	0	0	0	0	0	
31	0		0		0		0	5		0		0	Annual
Total	9	9	20	119	38	230	144	260	427	169	168	0	1,593
Max.	7	4	10	47	20	34	19	48	106	47	54	0	106

Daily Rainfall Record at Taunggyi

Year: 1988 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	2	4	3	14	4	0	0	0	
2	0	0	0	0	31	32	1	19	1	0	0	0	
3	0	0	0	0	10	21	0	4	1	20	0	0	
4	0	0	0	0	0	24	2	2	0	0	1	0	
5	0	0	0	0	0	16	0	11	0	0	32	0	
6	0	0	0	0	2	3	5	2	0	14	0	0	
7	0	0	0	0	7	24	0	6	0	0	0	0	
8	0	0	0	0	6	1	9	3	4	0	0	0	
9	0	0	0	0	0	1	1	20	0	2	0	0	
10	0	0	0	0	0	3	0	7	1	30	0	0	
11	0	0	0	0	0	13	3	1	12	16	0	0	
12	0	0	0	0	0	26	40	0	13	1	0	0	
13	0	0	0	0	3	1	21	2	11	0	0	0	
14	0	0	0	0	15	1	7	1	19	1	0	0	
15	0	0	0	11	4	0	2	5	16	4	0	0	
16	0	0	0	0	20	0	2	51	3	7	0	0	
17	0	0	0	0	24	1	3	10	2	1	0	0	
18	0	0	0	0	18	5	29	15	0	2	24	0	
19	0	0	0	0	24	0	6	24	0	7	32	0	
20	0	0	0	0	1	5	20	6	0	9	7	0	
21	0	0	0	0	1	27	23	0	7	2	7	0	
22	0	0	0	0	0	1	13	1	0	3	0	0	
23	0	0	0	0	1	6	1	0	0	8	0	0	
24	0	0	0	0	0	1	0	0	10	0	0	0	
25	0	0	0	0	0	10	1	0	0	0	0	0	
26	0	0	0	0	0	6	5	2	0	15	0	0	
27	0	0	0	1	0	2	2	8	0	1	0	0	
28	0	0	0	1	1	5	8	0	0	2	1	0	
29	0	0	0	4	0	20	3	0	0	0	0	0	
30	0		0	3	0	2	2	0	0	0	0	0	
31	0		0		0		12	8		0		0	Annual
Total	0	0	0	20	170	261	224	222	104	145	104	0	1,250
Max.	0	0	0	11	31	32	40	51	19	30	32	0	51

Year: 1989 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	2	1	5	3	1	0	1	0	
2	0	0	0	0	0	9	0	0	55	0	0	0	
3	0	0	0	0	0	2	0	1	44	20	0	0	
4	0	0	0	0	0	5	4	8	7	0	0	0	
5	0	0	0	0	10	1	1	22	0	21	0	0	
6	0	0	0	0	12	3	1	35	0	2	0	0	
7	0	0	0	0	2	1	70	10	5	11	0	0	
8	0	0	0	0	0	0	5	0	4	17	0	0	
9	0	0	0	0	0	14	2	0	5	15	0	0	
10	0	0	0	0	0	22	0	6	2	4	0	0	
11	0	0	0	0	0	14	9	19	2	1	0	0	
12	0	0	2	0	1	18	10	25	10	2	0	0	
13	0	0	0	0	45	1	19	0	2	0	0	0	
14	0	0	0	0	4	4	70	1	21	8	0	0	
15	0	0	0	0	4	5	26	17	2	8	0	0	
16	0	0	0	0	0	7	11	52	4	92	0	0	
17	0	0	0	0	2	2	0	23	40	2	0	0	
18	0	0	0	0	9	1	32	1	21	0	0	0	
19	0	0	0	0	0	15	21	0	4	4	0	0	
20	0	0	0	0	17	1	33	0	8	1	0	0	
21	0	0	0	0	0	6	2	34	15	58	0	0	
22	0	0	0	0	0	0	3	7	0	0	0	0	
23	0	0	0	0	0	4	15	6	5	0	0	0	
24	0	0	0	0	1	0	18	3	1	0	0	0	
25	0	0	0	0	6	1	1	32	82	20	0	0	
26	0	0	0	15	0	14	9	6	3	3	0	0	
27	0	0	0	0	0	0	3	4	57	0	0	0	
28	0	0	0	0	5	15	2	4	0	0	0	0	
29	0		0	0	0	17	0	0	0	0	0	0	
30	0		0	23	0	4	5	13	15	0	0	0	
31	0		9		5		9	2		3		0	Annual
Total	0	0	11	38	125	187	386	334	415	292	1	0	1,789
Max.	0	0	9	23	45	22	70	52	82	92	1	0	92

Daily Rainfall Record at Taunggyi

Year: 1990 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	9	0	10	19	8	38	0	
2	0	0	0	0	0	1	11	0	6	1	3	0	
3	0	0	0	0	0	48	12	1	2	7	12	0	
4	0	0	0	0	0	43	18	25	1	0	2	0	
5	0	0	0	0	9	10	1	21	1	0	16	0	
6	0	0	0	0	0	7	0	21	0	2	3	0	
7	0	0	0	0	1	0	1	4	0	1	0	0	
8	0	0	1	0	1	0	1	2	14	2	1	0	
9	0	0	0	0	0	1	0	2	56	0	0	0	
10	0	0	0	0	52	0	0	0	7	18	14	0	
11	0	0	0	0	16	1	36	1	1	0	0	0	
12	0	0	0	0	7	4	4	0	15	0	0	0	
13	0	0	0	0	0	17	4	12	4	0	0	0	
14	0	0	0	0	1	4	1	113	0	6	0	0	
15	0	0	3	0	33	1	2	12	17	0	1	0	
16	0	0	0	0	18	0	19	2	44	0	0	0	
17	0	0	0	0	20	0	0	15	8	0	0	0	
18	0	0	0	0	3	2	0	0	1	82	0	0	
19	0	0	0	0	6	9	0	9	0	0	0	0	
20	0	0	0	0	7	2	3	5	0	0	0	0	
21	0	3	0	13	35	3	7	46	29	0	0	0	
22	0	3	0	15	4	23	38	0	4	0	0	0	
23	0	16	0	0	1	2	10	0	45	0	0	0	
24	0	0	0	1	16	6	1	0	0	0	1	0	
25	0	0	0	0	2	20	0	0	8	0	0	0	
26	0	0	0	24	1	9	1	1	7	0	0	0	
27	0	0	0	3	6	2	1	13	5	0	1	0	
28	0	0	0	1	1	0	2	4	6	0	0	0	
29	0		0	0	0	8	2	10	24	0	0	0	
30	0		0	0	4	1	2	1	6	4	0	0	
31	0		0		4		34	2		11		0	Annual
Total	0	22	4	57	248	233	211	332	330	142	92	0	1,671
Max.	0	16	3	24	52	48	38	113	56	82	38	0	113

Year: 1991 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	8	10	2	1	4	26	6	0	0	
2	0	0	0	9	0	14	1	18	1	21	1	0	
3	0	0	0	1	0	0	0	5	0	0	13	0	
4	0	0	0	0	3	20	0	7	3	7	17	0	
5	0	0	0	0	0	2	5	18	3	10	60	0	
6	0	0	0	0	0	22	1	0	0	6	9	0	
7	0	0	0	0	0	7	0	1	3	0	0	0	
8	0	0	0	0	0	19	0	0	31	0	0	0	
9	0	0	0	0	8	12	0	1	5	7	0	0	
10	0	0	0	0	11	3	0	2	11	7	0	0	
11	0	0	0	0	0	4	27	2	2	0	0	0	
12	0	0	0	0	0	14	4	4	7	19	21	0	
13	0	0	0	0	0	6	0	13	11	64	53	0	
14	0	0	0	0	0	2	5	17	2	23	14	0	
15	0	0	0	0	39	5	8	42	2	4	7	0	
16	0	0	0	0	0	0	3	2	12	0	0	0	
17	0	0	0	0	17	0	1	16	43	0	0	0	
18	0	0	0	0	1	9	2	1	2	3	0	0	
19	0	0	0	0	0	5	8	0	14	17	0	0	
20	0	0	0	0	0	1	9	0	40	0	0	0	
21	0	0	0	0	0	0	5	17	35	0	1	0	
22	0	0	0	0	0	2	9	4	9	5	0	0	
23	0	0	0	0	0	11	1	2	1	0	0	0	
24	0	0	0	0	0	2	7	2	37	4	0	0	
25	0	0	0	0	1	1	14	6	0	0	0	0	
26	0	0	0	18	1	27	2	43	0	0	0	16	
27	0	0	0	2	0	9	1	3	0	14	0	63	
28	0	0	0	5	4	26	4	9	0	38	0	0	
29	0		0	3	8	4	1	8	1	11	0	0	
30	0		0	14	13	1	4	19	15	0	0	0	
31	0		0		11		0	4		0		0	Annual
Total	0	0	0	60	127	230	123	270	316	266	196	79	1,667
Max.	0	0	0	18	39	27	27	43	43	64	60	63	64

Daily Rainfall Record at Taunggyi

Year: 1992 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	0	3	6	29	4	0	
2	0	0	0	0	0	0	0	11	21	1	0	7	
3	0	0	0	0	0	0	0	63	1	4	0	1	
4	0	0	0	0	0	0	5	14	25	4	3	0	
5	0	0	0	0	0	0	18	7	40	0	0	0	
6	0	0	0	0	0	0	9	72	6	0	4	0	
7	0	0	0	0	0	0	4	23	2	0	0	0	
8	0	0	0	0	0	0	3	33	27	0	0	0	
9	0	0	0	0	0	40	1	6	7	0	1	0	
10	0	0	0	0	0	9	7	8	33	0	2	0	
11	0	0	0	0	0	13	10	0	4	0	0	0	
12	0	0	0	0	1	1	1	0	3	3	0	0	
13	0	0	0	0	0	0	0	0	24	11	0	0	
14	0	0	0	0	0	0	0	2	48	0	0	0	
15	0	0	0	0	0	17	21	10	1	23	0	0	
16	0	0	0	0	6	15	33	10	22	37	0	0	
17	0	2	0	5	0	1	23	0	46	0	0	0	
18	0	0	0	18	0	2	5	0	6	9	0	0	
19	0	0	0	0	1	2	0	11	10	2	0	0	
20	0	0	0	0	40	1	0	2	3	0	0	0	
21	0	0	0	0	0	20	24	3	6	1	0	0	
22	0	0	0	0	5	0	3	1	10	14	5	0	
23	0	0	0	0	0	3	18	0	9	2	1	0	
24	0	0	0	0	0	8	37	2	2	0	0	0	
25	0	0	0	0	0	7	4	51	82	4	0	0	
26	0	0	0	0	0	2	12	59	0	34	2	0	
27	0	0	0	0	2	5	14	13	1	3	3	0	
28	0	0	0	0	7	6	15	18	41	0	8	0	
29	0	0	0	0	0	0	1	7	5	0	0	0	
30	0		0	0	0	0	14	2	14	0	0	0	
31	0		0		0		24	22		0		0	Annual
Total	0	2	0	23	62	152	306	453	505	181	33	8	1,725
Max.	0	2	0	18	40	40	37	72	82	37	8	7	82

Year: 1993 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	1	2	10	3	5	0	
2	0	0	0	0	35	0	7	14	29	14	0	0	
3	0	0	0	0	22	1	15	11	51	6	0	0	
4	0	0	0	0	29	0	0	5	52	6	0	0	
5	0	0	0	0	0	2	1	11	0	6	0	0	
6	0	0	0	0	20	0	0	1	2	7	0	0	
7	0	0	0	0	10	1	0	0	18	32	0	0	
8	0	0	0	0	0	7	1	8	42	10	0	0	
9	0	0	0	0	2	0	5	5	53	17	0	0	
10	0	0	0	0	11	0	3	26	15	0	0	0	
11	0	0	0	0	0	0	0	1	4	0	0	0	
12	0	0	5	0	3	6	2	0	12	5	0	0	
13	0	0	0	0	0	2	43	4	6	6	0	0	
14	0	0	0	0	0	39	15	2	23	0	0	0	
15	0	0	0	2	0	52	0	1	0	0	0	0	
16	0	0	0	0	2	1	4	1	7	9	0	0	
17	0	0	0	0	12	4	0	3	14	3	0	0	
18	0	1	0	0	2	3	0	4	0	5	0	0	
19	0	0	0	0	0	7	0	47	5	21	3	0	
20	0	0	0	0	0	1	2	3	5	21	0	0	
21	0	4	0	0	3	19	0	12	3	5	0	0	
22	0	2	0	17	0	2	0	3	3	2	0	0	
23	0	0	0	2	10	2	0	1	0	2	0	0	
24	0	0	0	0	1	5	18	9	1	20	0	0	
25	0	0	0	0	12	4	0	10	5	0	0	0	
26	0	0	0	7	0	7	0	3	30	0	0	0	
27	0	0	0	8	3	0	1	10	2	0	0	0	
28	0	0	0	8	5	0	6	2	9	0	0	0	
29	0		0	0	49	0	15	2	4	1	0	0	
30	0		0	0	15	3	0	20	0	14	0	0	
31	0		0		8		5	37		28		0	Annual
Total	0	7	5	44	254	168	144	258	405	243	8	0	1,536
Max.	0	4	5	17	49	52	43	47	53	32	5	0	53

Daily Rainfall Record at Taunggyi

Year: 1994 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	4	0	0	17	15	0	0	0	
2	0	0	0	0	0	0	10	4	4	0	0	0	
3	0	0	0	0	14	0	0	3	5	2	0	0	
4	0	0	0	0	7	2	1	9	0	0	0	0	
5	0	0	0	0	0	11	11	3	1	14	0	0	
6	0	0	0	0	28	56	0	30	3	30	0	1	
7	0	0	0	0	0	42	0	12	28	0	0	0	
8	0	0	0	0	0	8	13	9	17	0	0	0	
9	0	0	0	0	45	26	8	19	3	0	0	0	
10	0	0	0	0	3	0	1	1	4	0	0	0	
11	0	0	0	0	0	2	5	2	0	0	0	0	
12	0	0	0	0	1	1	2	0	37	0	0	0	
13	0	0	0	0	0	0	1	0	25	0	0	0	
14	0	0	0	0	0	0	2	24	1	0	0	0	
15	0	0	0	0	0	0	3	3	5	0	0	0	
16	0	0	0	0	5	5	15	15	13	0	0	0	
17	0	0	0	0	36	6	51	50	53	22	0	0	
18	0	0	0	1	10	4	5	13	0	42	0	0	
19	0	0	0	0	0	1	13	5	0	1	0	0	
20	0	0	0	11	0	2	5	15	0	11	0	0	
21	0	0	0	0	1	0	5	14	0	9	0	0	
22	0	0	0	0	0	0	3	8	0	0	0	0	
23	0	0	0	0	5	0	1	4	0	0	0	0	
24	0	0	0	0	1	5	0	9	0	0	0	0	
25	0	0	0	0	0	0	6	12	6	0	0	0	
26	0	0	10	0	0	2	1	12	3	0	10	0	
27	0	0	5	0	0	1	0	6	11	0	23	0	
28	0	0	7	17	0	2	21	13	39	0	0	0	
29	0		0	14	0	1	16	5	51	0	0	0	
30	0		0	2	5	3	6	50	13	0	0	0	
31	0		0		9		1	29		0		0	Annual
Total	0	0	22	45	174	180	206	396	337	131	33	1	1,525
Max.	0	0	10	17	45	56	51	50	53	42	23	1	56

Year: 1995 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	1	21	22	0	27	0	
2	0	0	0	0	11	1	2	28	7	6	13	0	
3	0	0	0	0	0	39	3	1	9	6	12	0	
4	0	0	0	0	0	4	2	0	25	0	0	0	
5	0	0	0	0	1	0	11	3	7	29	0	0	
6	0	0	0	8	15	0	0	9	28	55	0	0	
7	0	1	0	0	3	1	0	4	0	22	0	0	
8	0	0	0	0	0	0	3	58	3	0	0	0	
9	0	0	0	0	2	19	9	0	22	0	0	0	
10	0	0	0	0	0	20	6	57	9	0	0	0	
11	0	0	0	0	8	8	0	0	7	0	0	0	
12	0	0	0	0	12	8	4	15	4	0	1	0	
13	0	0	0	0	1	20	0	3	3	0	0	0	
14	0	0	0	0	31	1	0	1	0	0	53	0	
15	0	0	0	0	11	0	2	0	0	1	2	0	
16	0	0	0	0	2	1	0	8	4	0	0	0	
17	0	0	0	0	6	0	2	18	6	7	0	0	
18	0	0	0	0	13	15	10	0	0	6	0	0	
19	0	0	0	0	0	1	3	0	7	33	0	0	
20	0	0	0	0	0	9	1	0	11	1	5	0	
21	0	0	0	0	0	0	12	0	12	0	0	0	
22	0	0	0	0	0	0	1	2	2	8	0	0	
23	0	0	0	0	0	1	1	25	4	7	0	0	
24	0	0	0	0	0	0	0	28	34	3	0	0	
25	0	0	0	0	0	7	2	5	39	0	0	0	
26	0	0	0	0	0	0	20	23	0	4	12	0	
27	0	0	0	0	5	0	42	19	0	0	0	0	
28	0	0	1	0	0	0	3	0	0	0	0	0	
29	0		2	0	13	0	8	0	8	0	0	0	
30	0		0	0	13	0	19	0	0	2	0	0	
31	0		0		12		5	27		19		0	Annual
Total	0	1	3	8	159	155	172	355	273	209	125	0	1,460
Max.	0	1	2	8	31	39	42	58	39	55	53	0	58

Daily Rainfall Record at Taunggyi

Year: 1996 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	1	12	1	0	8	5	
2	0	0	0	0	0	0	12	6	30	0	6	2	
3	0	0	0	0	0	0	26	17	5	0	6	0	
4	0	0	0	0	5	0	0	0	2	5	7	0	
5	0	0	0	0	6	0	2	1	5	15	0	0	
6	0	0	0	0	0	0	0	4	0	0	27	0	
7	0	0	0	0	7	7	0	5	4	0	5	0	
8	0	0	0	0	1	33	0	1	3	7	0	0	
9	0	0	0	0	5	34	2	3	16	0	0	0	
10	0	0	0	0	0	7	0	3	0	3	0	0	
11	0	0	0	0	0	32	0	5	6	0	0	0	
12	0	0	0	0	0	5	0	3	0	9	0	0	
13	0	0	0	0	0	8	37	21	0	0	0	0	
14	0	0	0	1	0	0	10	5	0	3	0	0	
15	0	0	0	9	0	0	3	7	0	0	0	0	
16	0	0	0	0	2	5	0	17	19	31	0	0	
17	0	0	0	2	1	31	5	3	27	14	0	0	
18	0	0	0	1	0	8	0	10	9	0	0	0	
19	0	0	0	0	22	2	0	18	3	3	0	0	
20	0	0	0	0	0	12	7	27	2	2	1	0	
21	0	0	0	0	0	5	2	3	1	33	0	0	
22	0	0	0	19	0	3	0	16	0	0	0	0	
23	0	29	0	2	12	2	6	8	0	9	0	0	
24	0	20	0	15	5	0	3	30	7	0	0	0	
25	0	0	0	3	15	0	5	6	0	0	0	0	
26	0	0	0	0	13	27	14	2	2	0	0	0	
27	0	0	5	3	4	0	22	3	13	0	0	0	
28	0	0	37	19	23	0	15	0	0	0	0	0	
29	0	0	2	0	2	0	8	0	0	0	0	0	
30	0		0	0	2	1	10	0	0	0	1	0	
31	0		0		0		11	0		0		0	Annual
Total	0	49	44	74	125	222	201	236	155	134	61	7	1,308
Max.	0	29	37	19	23	34	37	30	30	33	27	5	37

Estimated Daily Basin Rainfall

(Upper Baluchaung UB-1)

Estimated Daily Basin Rainfall at UB-1

Year: 1970 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	1	1	16	17	1	0	21	
2	0	0	0	1	0	0	1	16	24	0	0	5	
3	0	0	0	2	0	9	0	2	21	0	4	2	
4	0	0	0	7	0	8	0	4	1	0	0	3	
5	0	0	0	17	6	7	12	11	11	0	0	0	
6	0	0	0	7	12	6	3	30	0	0	2	3	
7	0	0	0	0	17	3	12	32	40	0	3	0	
8	3	0	0	0	10	13	3	42	8	2	2	0	
9	0	0	0	0	0	27	8	3	8	13	1	3	
10	0	0	0	7	2	8	13	2	4	3	3	0	
11	0	0	0	0	0	12	20	11	0	1	3	1	
12	0	0	0	8	1	1	46	9	25	0	0	0	
13	0	0	0	0	0	7	34	4	27	4	10	0	
14	0	0	0	0	5	7	28	2	6	2	0	0	
15	0	0	0	0	2	21	39	1	2	18	0	0	
16	0	0	0	0	1	6	7	2	3	4	0	0	
17	0	0	0	0	7	1	15	2	5	1	0	0	
18	0	0	0	0	18	1	9	0	8	0	0	0	
19	0	0	0	0	33	7	11	1	10	0	0	0	
20	0	0	0	0	20	5	7	7	7	0	0	0	
21	0	0	0	0	17	1	14	11	5	2	0	0	
22	0	0	0	0	11	5	13	20	35	2	0	0	
23	0	0	0	0	13	3	21	2	1	1	1	0	
24	0	0	0	1	16	5	53	5	5	7	0	0	
25	0	0	0	1	16	3	32	10	0	0	0	0	
26	0	0	0	6	16	3	16	6	1	0	0	0	
27	0	0	0	0	4	12	11	7	21	9	0	0	
28	0	0	0	0	5	21	3	9	0	11	0	0	
29	0		0	0	0	26	6	18	8	0	0	0	
30	0		0	0	28	22	3	7	6	0	8	0	
31	0		0		3		0	4		1		0	Annual
Total	3	0	0	57	263	251	441	296	309	82	37	38	1,777
Max.	3	0	0	17	33	27	53	42	40	18	10	21	53

Year: 1971 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	10	6	40	5	0	1	1	
2	0	0	0	0	0	37	9	29	0	25	0	0	
3	0	0	0	0	0	18	11	10	16	25	0	0	
4	0	0	0	7	0	3	14	19	15	1	2	0	
5	0	0	0	0	0	14	2	6	17	0	0	0	
6	0	0	0	0	1	20	15	6	10	10	0	0	
7	0	0	1	0	12	35	2	5	1	0	20	0	
8	0	0	0	0	9	14	7	16	1	2	4	0	
9	0	0	0	0	9	13	2	10	16	16	1	0	
10	0	0	0	0	0	10	3	9	21	0	0	0	
11	0	0	0	0	0	18	7	7	3	0	1	0	
12	0	0	0	0	0	12	4	7	2	0	1	0	
13	0	0	0	0	4	5	8	9	0	0	0	0	
14	0	0	0	0	10	9	19	12	1	0	0	0	
15	0	0	0	0	0	9	32	6	10	0	0	0	
16	0	0	0	0	0	5	9	11	2	0	0	0	
17	0	0	4	0	10	1	6	6	9	0	0	5	
18	0	0	1	0	0	4	3	5	2	0	0	0	
19	0	0	0	5	1	18	10	8	4	0	0	0	
20	0	0	0	0	4	4	31	7	2	0	0	0	
21	0	0	0	11	42	5	57	10	0	0	0	16	
22	0	0	0	7	12	9	31	11	0	9	0	12	
23	0	0	0	1	2	10	14	3	1	0	0	2	
24	0	0	0	1	4	14	12	14	4	0	0	0	
25	0	0	0	0	13	11	40	6	20	0	0	0	
26	0	0	0	0	2	14	13	13	7	0	0	0	
27	0	0	0	0	8	4	17	29	1	2	0	0	
28	0	0	0	0	29	12	8	15	15	32	0	0	
29	4		0	12	12	4	16	15	18	2	0	0	
30	1		0	7	5	0	18	12	9	0	0	0	
31	0		0		15		22	34		2		0	Annual
Total	5	0	6	51	204	342	448	390	212	126	30	36	1,850
Max.	4	0	4	12	42	37	57	40	21	32	20	16	57

Estimated Daily Basin Rainfall at UB-1

Year: 1972 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	11	8	17	5	4	0	2	
2	0	0	0	0	0	0	3	1	9	26	6	3	
3	0	0	0	0	0	1	4	18	1	1	0	0	
4	0	0	0	6	1	8	6	5	3	14	12	0	
5	0	0	0	3	1	9	10	17	20	2	12	0	
6	0	0	0	6	0	24	6	5	0	1	6	0	
7	0	0	0	0	0	17	4	6	0	0	34	0	
8	0	0	0	0	0	16	2	8	1	13	6	0	
9	0	0	0	0	0	3	3	7	4	1	0	5	
10	0	0	0	0	17	11	7	1	0	0	0	0	
11	0	0	0	1	0	8	1	18	0	1	0	0	
12	0	0	0	6	0	6	6	12	3	0	0	0	
13	0	0	0	11	0	3	10	1	7	0	0	0	
14	0	0	0	4	0	3	8	16	1	2	0	0	
15	0	0	0	0	3	8	13	15	14	0	0	0	
16	0	0	0	0	1	1	55	28	8	4	0	1	
17	0	0	0	1	41	1	23	6	7	4	0	0	
18	0	0	0	0	0	1	8	9	6	4	0	0	
19	0	0	0	0	2	4	5	13	0	0	1	0	
20	0	0	0	0	0	7	10	13	2	0	6	0	
21	0	0	0	0	32	4	10	17	4	10	9	0	
22	0	0	0	0	0	5	1	27	9	18	3	0	
23	0	0	0	0	0	3	4	13	28	5	3	0	
24	0	0	0	0	0	3	9	9	0	16	2	0	
25	0	0	0	0	1	1	9	9	1	0	2	0	
26	0	0	5	0	5	0	9	10	1	3	16	0	
27	0	0	0	6	5	0	36	12	18	0	2	0	
28	0	0	0	7	15	12	29	2	25	0	14	0	
29	1	0	0	0	5	9	21	1	11	0	6	0	
30	12		0	0	10	18	13	3	14	0	2	0	
31	0		0		9		10	2		0		0	Annual
Total	13	0	5	51	148	197	343	321	202	129	142	11	1,562
Max.	12	0	5	11	41	24	55	28	28	26	34	5	55

Year: 1973 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	2	0	20	9	0	0	
2	0	0	0	0	0	2	6	21	7	20	0	0	
3	0	0	0	0	26	9	21	0	1	7	0	0	
4	0	0	0	0	0	8	2	4	3	0	0	0	
5	0	0	0	0	7	0	11	1	12	1	0	0	
6	0	0	0	0	0	3	11	0	16	0	5	0	
7	0	0	0	0	6	1	7	8	3	0	6	0	
8	0	0	0	0	37	19	1	6	0	0	6	0	
9	0	0	0	0	2	13	3	6	0	0	2	0	
10	0	0	0	0	15	16	34	22	5	7	5	0	
11	0	0	0	0	16	35	17	6	1	3	0	0	
12	0	0	0	0	2	2	2	4	0	0	1	0	
13	0	0	0	0	8	13	4	2	14	2	5	0	
14	0	0	0	0	22	14	13	3	2	0	0	0	
15	0	0	0	0	25	4	6	6	0	0	0	0	
16	0	0	0	0	24	32	4	9	0	0	0	0	
17	0	0	0	0	0	43	9	20	16	5	0	0	
18	0	0	0	0	19	30	13	16	6	0	0	0	
19	0	0	0	0	7	5	9	21	3	0	0	0	
20	0	0	0	0	15	6	13	11	27	4	3	0	
21	0	0	0	0	18	5	2	5	25	2	34	0	
22	0	0	0	0	0	2	6	6	11	0	6	0	
23	0	0	0	0	1	2	13	16	7	0	2	0	
24	0	0	0	0	0	0	5	34	19	0	0	0	
25	0	0	0	0	1	2	4	12	0	0	0	0	
26	0	0	1	17	0	5	4	8	0	10	0	0	
27	0	0	2	2	0	7	16	6	9	0	0	0	
28	0	0	0	0	12	4	7	48	5	6	0	0	
29	0		0	2	26	0	7	29	2	0	0	0	
30	0		0	0	16	0	12	5	9	0	0	0	
31	2		0		13		0	6		0		0	Annual
Total	2	0	3	21	318	282	264	341	223	76	75	0	1,605
Max.	2	0	2	17	37	43	34	48	27	20	34	0	48

Estimated Daily Basin Rainfall at UB-1

Year: 1974 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	7	5	3	1	2	12	2	10	0	
2	0	0	0	0	0	6	3	0	7	3	10	0	
3	0	0	0	0	0	1	5	1	11	0	1	0	
4	0	0	0	0	2	0	3	2	39	0	0	0	
5	0	0	0	0	1	0	1	3	6	34	0	0	
6	0	0	0	0	1	0	8	4	0	2	1	0	
7	0	0	0	0	0	11	17	20	17	0	1	0	
8	0	0	0	0	0	3	11	2	6	0	0	0	
9	0	0	0	0	0	37	7	9	7	1	7	0	
10	0	0	0	0	19	13	7	15	18	0	10	0	
11	0	0	0	0	3	5	9	23	1	0	6	0	
12	0	0	0	0	10	17	11	40	2	0	23	0	
13	0	0	0	0	10	4	10	15	4	0	10	0	
14	0	0	0	0	10	3	4	2	4	2	4	0	
15	0	0	0	1	0	15	4	1	14	0	2	0	
16	0	0	0	0	12	14	6	3	21	1	0	0	
17	0	0	0	0	0	13	7	20	5	0	1	0	
18	0	0	0	0	0	1	3	17	4	0	1	0	
19	0	0	0	0	11	11	13	23	5	2	0	0	
20	0	0	1	0	2	7	20	8	18	0	0	0	
21	0	0	0	0	10	10	4	3	8	0	0	0	
22	0	0	0	0	8	14	2	1	0	16	0	0	
23	0	0	11	0	19	16	3	38	0	0	0	0	
24	0	0	0	0	6	4	19	25	7	0	1	0	
25	0	0	0	7	7	5	14	5	5	2	0	0	
26	0	0	0	3	35	2	1	12	3	1	0	0	
27	0	0	0	4	6	5	9	11	9	5	0	0	
28	0	0	0	4	6	2	25	7	3	2	0	0	
29	0		26	0	4	4	17	6	5	1	2	0	
30	0		0	1	1	2	11	4	1	8	7	0	
31	0		3		6		11	9		7		0	Annual
Total	0	0	41	27	194	228	266	331	242	89	97	0	1,515
Max.	0	0	26	7	35	37	25	40	39	34	23	0	40

Year: 1975 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	7	4	1	15	34	25	6	
2	0	0	0	0	0	4	6	16	3	1	0	0	
3	0	0	0	0	0	20	7	36	5	0	0	0	
4	0	0	0	0	6	61	9	7	3	1	0	0	
5	0	0	0	0	7	4	4	4	11	1	0	0	
6	0	0	0	0	0	4	9	6	3	2	0	0	
7	0	0	0	0	16	8	20	21	12	4	7	0	
8	0	0	0	0	14	10	13	13	1	4	1	0	
9	0	0	0	0	25	1	8	5	16	15	4	0	
10	27	0	0	0	0	0	4	5	3	12	0	0	
11	33	0	0	0	9	2	0	12	18	4	18	0	
12	3	0	0	0	0	3	11	7	1	5	2	0	
13	0	0	0	0	1	2	8	4	15	2	1	0	
14	0	0	0	0	0	3	15	3	3	1	1	0	
15	0	0	0	0	0	3	18	2	11	1	0	0	
16	0	0	0	0	12	23	20	1	1	1	0	0	
17	0	0	0	0	1	13	16	12	2	0	0	0	
18	2	0	0	0	5	26	13	6	3	0	0	0	
19	1	0	0	0	7	21	11	26	11	0	0	0	
20	0	0	0	0	10	10	10	2	1	0	0	0	
21	0	0	0	0	12	11	5	4	6	0	0	0	
22	0	0	0	0	12	5	1	16	14	9	0	0	
23	0	0	0	0	12	13	2	0	12	13	0	0	
24	0	0	0	0	12	4	3	0	10	3	0	0	
25	0	0	0	0	4	2	0	34	4	13	0	0	
26	0	0	0	0	35	0	2	6	1	6	0	0	
27	0	0	0	0	16	10	3	8	4	2	0	0	
28	0	0	8	0	9	9	22	8	2	5	0	0	
29	0		0	0	3	6	1	9	4	4	0	0	
30	0		0	0	0	7	0	16	13	22	0	0	
31	0		0		0		0	16		11		0	Annual
Total	66	0	8	0	228	292	245	306	208	176	59	6	1,594
Max.	33	0	8	0	35	61	22	36	18	34	25	6	61

Estimated Daily Basin Rainfall at UB-1

Year: 1976 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	18	4	5	27	29	1	0	12	
2	0	0	0	0	7	0	6	10	2	0	1	0	
3	0	0	0	0	38	3	12	37	0	3	0	0	
4	0	0	0	0	25	9	17	11	9	26	0	0	
5	0	0	0	0	0	10	8	3	1	2	2	0	
6	0	0	0	0	0	27	16	4	3	2	1	0	
7	0	13	0	0	0	6	25	2	1	1	0	0	
8	0	0	0	0	2	12	29	6	6	1	6	0	
9	1	0	0	4	13	17	42	7	1	0	0	0	
10	0	0	0	4	1	23	15	9	3	0	0	0	
11	0	0	0	2	1	24	10	12	11	0	0	0	
12	0	0	0	0	1	19	3	7	1	0	0	0	
13	0	0	0	0	14	30	0	9	16	3	0	0	
14	0	0	0	3	39	0	1	17	18	0	0	0	
15	0	0	0	0	5	0	13	22	7	1	0	0	
16	0	0	0	0	0	4	8	10	3	0	0	0	
17	0	0	0	0	0	0	14	2	0	0	0	0	
18	0	0	0	0	1	4	9	1	0	2	0	0	
19	0	0	0	0	0	0	9	2	0	6	0	0	
20	0	0	0	0	0	4	11	3	15	21	0	0	
21	0	0	0	0	3	0	1	0	7	15	1	0	
22	0	0	0	4	2	0	3	1	21	34	1	0	
23	0	0	0	0	2	0	6	18	36	0	0	0	
24	0	0	0	0	5	1	11	2	20	0	0	0	
25	0	0	0	4	6	13	37	0	5	0	0	0	
26	0	0	2	0	5	1	14	1	8	0	0	0	
27	0	0	0	0	2	0	9	1	7	6	0	0	
28	0	0	0	0	3	0	3	17	18	1	0	0	
29	0	0	0	0	4	8	1	27	2	8	5	0	
30	0		0	0	6	8	8	12	9	0	4	0	
31	0		0		7		26	3		8		0	Annual
Total	1	13	2	21	210	227	372	283	259	141	21	12	1,562
Max.	1	13	2	4	39	30	42	37	36	34	6	12	42

Year: 1977 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	16	0	0	0	5	2	3	10	28	18	0	0	
2	0	0	0	12	0	0	10	6	6	1	0	0	
3	0	0	0	15	0	0	13	13	1	4	2	2	
4	0	0	0	4	0	1	10	11	11	0	2	0	
5	0	0	0	12	0	0	7	16	44	19	0	0	
6	0	0	0	0	0	3	8	10	3	4	0	0	
7	0	0	4	0	4	5	4	6	10	1	0	0	
8	0	0	0	7	1	5	5	1	16	26	0	0	
9	0	0	0	17	8	0	6	8	11	9	0	0	
10	0	0	1	10	4	0	7	2	3	6	0	0	
11	0	0	0	0	9	3	4	3	1	18	0	0	
12	0	0	0	0	7	1	1	4	19	5	0	0	
13	0	0	0	0	16	0	0	0	0	19	0	0	
14	0	0	0	2	19	2	2	2	0	0	0	0	
15	0	0	0	0	5	7	17	6	10	0	0	0	
16	0	0	0	0	1	2	12	2	25	2	0	0	
17	0	0	0	0	0	1	0	1	1	1	0	0	
18	0	0	0	0	3	6	21	1	1	0	0	0	
19	0	0	0	6	18	0	4	4	1	3	0	0	
20	0	0	0	0	0	1	0	1	1	2	0	0	
21	0	0	0	5	0	9	2	4	1	18	0	0	
22	0	0	0	0	0	19	5	7	9	7	0	0	
23	0	0	0	0	0	11	23	12	8	6	0	0	
24	0	0	0	0	11	16	15	15	0	34	0	0	
25	0	0	0	0	14	10	7	10	0	5	1	0	
26	0	0	0	0	13	39	9	0	0	0	3	5	
27	0	0	0	0	8	26	7	4	1	1	0	1	
28	0	0	0	0	7	3	7	3	0	8	0	13	
29	0		0	0	7	5	41	7	0	12	0	2	
30	0		0	0	0	2	34	14	2	1	0	3	
31	0		0		10		21	11		0		0	Annual
Total	16	0	5	90	170	179	305	194	213	230	8	26	1,436
Max.	16	0	4	17	19	39	41	16	44	34	3	13	44

Estimated Daily Basin Rainfall at UB-1

Year: 1978 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	1	0	0	2	2	18	13	0	0	0	
2	0	0	1	0	1	0	1	3	15	1	0	0	
3	0	0	0	0	0	7	18	17	6	2	0	0	
4	0	0	0	0	1	7	8	4	1	15	0	0	
5	0	0	0	0	0	7	9	6	12	3	0	0	
6	2	0	0	0	0	0	14	15	14	35	0	0	
7	0	0	0	0	2	6	4	6	1	2	2	0	
8	0	0	0	0	4	13	8	7	6	0	0	0	
9	0	0	0	0	1	7	11	20	21	0	0	0	
10	0	0	0	0	0	0	6	12	12	0	0	0	
11	0	0	0	0	3	4	10	3	3	0	0	0	
12	0	0	0	0	25	0	4	4	1	9	2	0	
13	0	0	0	0	1	0	0	4	0	0	0	0	
14	0	0	0	1	2	6	2	22	20	0	0	0	
15	0	0	0	0	0	9	19	8	8	0	0	0	
16	0	0	0	1	6	24	3	1	0	0	3	0	
17	0	0	0	9	4	4	10	1	1	0	0	0	
18	0	0	0	4	15	5	10	24	0	0	0	0	
19	0	0	0	0	12	4	7	8	0	0	0	0	
20	0	0	0	0	33	16	5	15	1	0	0	0	
21	0	2	0	0	10	6	7	17	0	5	0	0	
22	0	0	0	0	0	3	4	14	5	3	0	0	
23	0	0	0	0	4	9	11	2	25	7	0	0	
24	0	0	0	0	3	16	14	4	10	1	0	0	
25	0	0	0	0	0	43	7	8	9	1	0	0	
26	0	0	0	0	0	17	2	2	16	4	0	0	
27	0	8	0	0	2	12	5	5	12	4	0	0	
28	0	0	0	3	0	29	15	1	0	13	0	0	
29	0		0	0	1	38	13	24	0	0	0	0	
30	0		0	0	0	4	4	1	0	0	0	0	
31	0		0		8		9	5		0		0	Annual
Total	2	10	2	18	138	298	242	281	212	105	7	0	1,315
Max.	2	8	1	9	33	43	19	24	25	35	3	0	43

Year: 1979 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	4	18	36	17	4	1	4	2	
2	0	0	0	0	9	5	26	9	7	13	0	1	
3	0	0	0	0	0	0	10	5	12	0	0	2	
4	0	0	0	0	0	20	5	25	3	0	0	1	
5	0	0	0	0	0	4	15	20	4	0	0	0	
6	0	0	0	0	0	6	3	11	2	3	0	0	
7	0	0	0	0	0	2	7	9	4	29	0	0	
8	0	0	0	0	2	0	6	8	7	13	0	0	
9	0	0	0	0	0	4	5	4	4	0	0	1	
10	0	0	0	0	0	4	1	6	0	1	0	4	
11	0	0	0	0	2	4	8	1	0	13	0	0	
12	0	0	0	0	0	7	10	3	0	6	0	0	
13	0	0	0	0	0	6	20	7	0	4	0	0	
14	0	0	0	0	0	46	3	10	0	4	0	0	
15	0	0	0	0	0	27	2	16	0	4	0	0	
16	0	0	0	0	2	2	0	21	7	0	0	0	
17	0	0	0	0	0	5	1	9	4	2	0	0	
18	0	0	0	0	2	1	3	4	10	0	0	0	
19	0	0	0	0	0	18	3	14	9	1	0	0	
20	0	0	0	0	1	13	1	27	3	0	0	0	
21	0	0	0	2	0	2	1	8	12	0	0	0	
22	0	0	0	13	0	12	4	3	10	0	0	0	
23	0	0	0	0	0	10	7	3	3	0	0	0	
24	0	0	0	1	2	10	6	9	9	0	4	0	
25	0	0	0	9	25	11	0	20	2	0	1	0	
26	0	0	0	8	9	1	0	5	1	0	2	0	
27	0	0	0	4	10	13	2	3	4	0	1	0	
28	0	0	0	4	0	20	8	1	2	0	1	0	
29	0		0	3	0	18	12	0	19	0	6	0	
30	0		0	0	0	21	1	0	1	1	1	0	
31	0		0		1		0	15		2		0	Annual
Total	0	0	0	44	69	310	206	293	143	97	20	11	1,193
Max.	0	0	0	13	25	46	36	27	19	29	6	4	46

Estimated Daily Basin Rainfall at UB-1

Year: 1980 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	8	17	14	9	5	9	0	
2	0	0	2	0	0	5	5	3	16	6	3	0	
3	0	0	3	0	1	12	3	1	13	6	17	0	
4	0	0	0	0	72	12	1	8	13	6	18	0	
5	0	0	0	0	11	18	3	5	30	16	0	0	
6	0	0	0	0	10	19	0	5	5	1	0	0	
7	0	0	0	0	8	19	3	8	2	16	0	0	
8	0	0	0	0	0	1	5	3	19	8	0	0	
9	0	0	0	0	4	3	2	6	14	6	21	0	
10	0	0	0	0	3	3	5	6	2	0	0	0	
11	0	0	0	0	1	12	3	13	15	3	0	0	
12	0	0	0	0	0	19	2	2	7	6	0	0	
13	0	0	0	0	0	23	8	0	0	14	0	2	
14	0	0	0	0	0	14	6	1	0	13	1	3	
15	0	0	0	0	0	13	9	0	15	3	0	0	
16	0	0	0	0	2	7	5	2	15	10	0	0	
17	0	0	0	0	0	2	4	0	18	4	0	0	
18	0	0	0	0	0	2	1	3	0	3	0	0	
19	0	0	0	0	0	0	1	8	4	16	0	0	
20	0	0	0	0	3	11	9	10	0	8	0	0	
21	0	0	0	3	7	18	14	13	5	0	0	0	
22	0	0	0	0	2	16	13	7	11	0	1	0	
23	0	0	0	0	2	8	10	10	1	0	3	0	
24	0	0	0	0	14	2	32	5	9	0	17	0	
25	0	0	0	0	0	13	14	10	7	0	5	0	
26	0	0	0	0	8	3	1	26	9	0	2	0	
27	0	0	0	0	14	9	9	8	0	0	0	0	
28	0	0	0	0	8	5	1	4	9	0	0	0	
29	0	0	0	0	7	11	4	1	13	0	0	0	
30	0		0	1	10	12	25	12	15	0	0	0	
31	0		0		8		28	19		1		0	Annual
Total	0	0	5	4	195	300	243	213	276	151	97	5	1,489
Max.	0	0	3	3	72	23	32	26	30	16	21	3	72

Year: 1981 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	4	21	2	10	1	0	0	
2	0	0	0	0	7	15	23	5	11	3	0	0	
3	0	0	0	0	3	21	16	4	1	1	0	0	
4	0	0	0	0	8	21	4	5	5	3	0	0	
5	0	0	0	0	6	7	6	3	6	28	0	0	
6	0	0	0	0	3	0	25	5	8	2	13	0	
7	0	0	0	0	13	10	25	6	11	1	45	0	
8	0	0	0	0	0	22	0	4	10	2	2	0	
9	0	0	0	0	1	1	8	4	8	0	25	0	
10	0	11	3	0	0	2	9	10	0	0	3	0	
11	0	0	0	0	0	10	5	17	2	0	9	0	
12	0	0	0	3	0	9	8	19	0	1	0	0	
13	0	0	0	14	15	2	3	3	0	1	3	0	
14	0	0	0	1	31	2	1	5	0	23	1	0	
15	0	0	0	7	0	0	0	5	1	5	7	0	
16	0	0	0	5	0	1	0	6	1	0	0	1	
17	0	0	0	7	12	13	10	2	2	4	15	0	
18	0	0	0	3	21	9	3	0	1	13	13	1	
19	0	0	0	20	32	18	8	3	1	4	9	0	
20	0	0	0	0	12	7	6	13	6	0	2	1	
21	0	0	0	0	2	4	2	18	2	0	21	0	
22	0	0	0	0	12	3	5	17	6	0	3	0	
23	0	0	0	0	7	14	11	14	0	1	0	0	
24	0	0	0	0	1	10	0	9	0	12	0	0	
25	0	0	0	0	12	2	31	14	3	1	0	0	
26	0	0	0	3	9	5	18	2	0	1	0	0	
27	0	0	0	0	7	2	29	1	2	6	0	0	
28	0	0	0	1	13	3	23	1	2	2	0	0	
29	0		0	1	3	9	20	2	6	0	0	0	
30	0		0	0	0	20	12	1	6	0	0	0	
31	0		0		20		6	4		0		0	Annual
Total	0	11	3	65	250	246	338	204	111	115	171	3	1,517
Max.	0	11	3	20	32	22	31	19	11	28	45	1	45

Estimated Daily Basin Rainfall at UB-1

Year: 1982 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	38	12	19	8	8	0	0	
2	0	0	0	0	0	10	25	26	11	30	0	0	
3	0	0	0	0	0	5	33	7	66	3	0	0	
4	0	0	0	0	0	29	16	5	13	4	0	0	
5	0	0	0	0	0	5	4	7	15	4	0	0	
6	0	0	0	0	9	1	0	12	25	24	0	0	
7	0	0	0	0	19	0	0	33	5	4	0	0	
8	0	0	0	0	5	4	2	25	1	4	0	0	
9	0	0	0	0	5	7	1	11	8	5	0	0	
10	0	0	0	0	0	16	7	7	8	4	0	0	
11	0	0	0	15	0	2	3	7	0	2	7	0	
12	0	0	0	0	0	6	1	9	0	3	10	0	
13	0	0	0	0	3	28	3	23	1	10	14	0	
14	0	0	0	0	13	6	4	7	1	13	4	0	
15	0	0	0	0	12	15	8	4	0	0	0	0	
16	0	0	0	7	2	14	0	11	0	0	0	0	
17	0	0	0	0	18	12	3	8	2	0	0	0	
18	0	0	0	0	14	9	0	13	15	0	0	0	
19	0	0	0	1	8	8	10	11	5	0	0	0	
20	0	0	0	3	0	7	8	2	1	0	0	0	
21	0	0	0	0	25	5	1	9	0	3	0	0	
22	0	0	0	0	2	2	4	12	3	6	0	0	
23	0	0	0	0	5	8	9	28	11	0	0	0	
24	0	0	0	0	9	7	4	30	33	7	0	0	
25	0	0	0	0	14	10	6	0	28	3	0	0	
26	0	0	0	0	3	13	9	1	3	1	0	0	
27	0	0	0	0	0	9	13	2	4	0	1	0	
28	0	0	0	0	21	7	11	22	5	0	0	0	
29	0		0	0	20	5	17	11	2	0	0	0	
30	0		0	0	15	7	11	6	5	4	0	0	
31	0		0		5		9	1		6		0	Annual
Total	0	0	0	26	227	295	234	369	279	148	36	0	1,614
Max.	0	0	0	15	25	38	33	33	66	30	14	0	66

Year: 1983 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	9	14	14	16	1	2	0	
2	0	0	0	0	0	4	19	8	8	13	15	0	
3	0	1	0	0	0	4	9	6	10	0	27	0	
4	0	3	0	0	1	15	14	4	5	23	6	0	
5	0	1	0	0	0	6	8	9	6	20	9	0	
6	0	0	0	7	0	14	1	2	8	8	1	0	
7	0	0	1	8	0	3	3	2	7	2	3	0	
8	0	0	0	3	0	20	0	14	4	11	0	0	
9	0	0	0	6	0	32	0	11	5	38	7	0	
10	0	0	0	2	0	36	2	2	6	21	19	0	
11	0	0	0	0	0	30	0	0	1	4	27	0	
12	0	0	0	0	1	25	12	2	2	0	7	0	
13	0	0	0	0	8	16	7	12	18	1	20	0	
14	0	0	0	0	0	13	8	9	7	1	42	0	
15	0	0	0	0	0	14	2	1	9	10	22	0	
16	0	0	14	0	0	14	3	1	7	18	0	0	
17	0	0	0	0	10	9	6	14	7	1	1	0	
18	0	0	0	0	1	18	2	5	4	5	0	0	
19	0	0	0	0	0	7	4	3	5	7	1	0	
20	0	2	0	16	1	0	3	2	9	5	0	0	
21	0	0	1	8	0	1	9	2	13	19	2	0	
22	0	0	0	0	2	4	3	9	27	9	0	0	
23	0	0	0	0	1	9	1	7	4	1	0	0	
24	0	0	0	0	0	6	5	10	0	1	0	0	
25	0	0	0	0	0	9	13	4	0	0	0	0	
26	0	1	0	0	0	9	14	9	6	11	0	0	
27	0	0	0	0	7	2	4	18	5	0	0	36	
28	0	1	0	0	12	2	4	9	1	0	0	38	
29	0		0	0	34	6	7	5	2	4	0	3	
30	0		0	0	7	2	6	7	1	0	0	0	
31	0		0		16		9	22		2		0	Annual
Total	0	9	16	50	101	339	192	223	203	236	211	77	1,657
Max.	0	3	14	16	34	36	19	22	27	38	42	38	42

Estimated Daily Basin Rainfall at UB-1

Year: 1984 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	10	3	5	5	27	0	0	
2	0	0	0	0	0	37	7	13	19	44	0	0	
3	0	0	0	0	0	16	3	8	18	4	0	0	
4	0	0	0	0	0	40	3	9	4	4	0	0	
5	0	0	0	0	0	3	8	11	4	0	1	0	
6	0	0	0	0	27	14	4	15	9	0	2	0	
7	0	0	0	0	9	3	4	9	2	0	0	0	
8	0	4	0	0	1	9	4	11	3	6	0	0	
9	0	13	0	0	1	34	11	17	12	8	0	0	
10	0	0	0	0	9	12	30	2	0	13	0	0	
11	0	0	0	0	0	0	15	31	2	16	2	0	
12	0	0	0	0	0	4	27	8	6	23	0	0	
13	0	2	0	0	9	14	26	22	0	1	0	0	
14	0	0	0	0	3	5	38	7	0	4	0	0	
15	0	0	0	0	14	5	32	17	0	8	0	0	
16	0	0	0	0	17	12	11	24	3	5	0	0	
17	0	0	0	0	0	19	2	13	3	15	0	0	
18	0	0	0	0	0	35	8	8	0	8	0	0	
19	0	0	0	0	0	31	1	7	1	11	0	0	
20	0	0	0	0	0	27	0	18	2	13	0	0	
21	0	0	0	0	0	4	0	10	10	10	0	0	
22	0	0	0	20	0	8	3	6	9	8	0	0	
23	0	0	0	6	0	7	6	5	12	0	0	0	
24	0	0	0	2	2	18	2	17	8	0	0	0	
25	0	0	0	16	4	4	1	6	3	0	0	0	
26	0	0	0	31	0	12	2	17	12	0	0	0	
27	0	0	0	9	1	9	1	13	1	0	0	0	
28	0	0	0	15	13	11	5	10	0	0	0	0	
29	0	0	0	0	8	10	23	3	0	0	0	0	
30	0		0	2	18	4	2	9	2	0	0	0	
31	0		0		10		6	9		0		0	Annual
Total	0	19	0	101	146	417	288	360	150	228	5	0	1,714
Max.	0	13	0	31	27	40	38	31	19	44	2	0	44

Year: 1985 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	11	22	12	12	12	12	2	0	
2	0	0	0	0	11	7	4	9	1	10	3	0	
3	0	0	0	0	6	16	7	8	0	4	1	0	
4	0	0	0	0	2	28	9	31	0	1	1	0	
5	0	0	0	0	1	18	9	7	1	0	1	0	
6	0	0	0	0	0	11	18	8	11	0	5	0	
7	0	0	0	0	0	30	21	9	2	0	4	0	
8	0	0	0	0	0	41	4	4	3	1	5	0	
9	0	0	0	4	0	34	11	2	8	0	5	0	
10	0	0	0	0	0	12	5	11	7	0	2	0	
11	0	0	0	0	0	11	1	6	24	0	2	0	
12	0	0	0	0	0	15	2	1	37	2	4	0	
13	0	0	0	0	0	4	1	6	12	1	5	0	
14	0	0	0	0	24	4	1	4	0	2	14	0	
15	0	0	0	0	0	17	1	5	15	4	47	0	
16	0	0	0	3	3	9	8	5	18	0	34	0	
17	0	0	0	1	5	15	9	24	2	25	21	0	
18	0	0	0	10	3	12	1	50	0	21	14	0	
19	0	0	0	0	16	3	9	13	1	3	3	0	
20	0	0	0	7	17	3	10	9	0	0	4	0	
21	0	0	0	0	24	6	2	7	0	4	7	0	
22	0	0	0	4	13	11	0	10	0	25	0	0	
23	0	0	0	0	5	1	15	2	19	0	0	0	
24	0	0	0	0	7	12	0	1	11	10	0	0	
25	0	0	0	0	16	4	7	7	9	4	0	0	
26	0	0	0	14	2	13	1	8	4	6	0	0	
27	0	0	0	10	3	19	8	6	1	2	0	0	
28	0	0	0	3	0	26	9	14	4	0	0	0	
29	0		0	21	1	34	6	13	11	0	0	0	
30	0		0	9	12	31	4	7	27	0	0	0	
31	0		0		9		9	7		0		0	Annual
Total	0	0	0	86	191	469	204	306	240	137	184	0	1,817
Max.	0	0	0	21	24	41	21	50	37	25	47	0	50

Estimated Daily Basin Rainfall at UB-1

Year: 1986 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	2	0	2	5	3	12	0	0	
2	0	0	0	0	6	0	1	4	3	1	0	0	
3	0	0	19	0	0	0	2	4	2	1	0	0	
4	0	0	6	0	1	0	4	9	3	2	0	0	
5	0	0	0	0	2	9	1	6	12	1	2	0	
6	0	0	0	0	5	2	16	18	3	2	1	0	
7	0	0	0	0	7	8	11	2	65	0	0	0	
8	0	0	0	0	12	15	7	4	3	30	8	0	
9	0	0	0	1	0	5	5	0	9	15	8	0	
10	0	0	0	0	4	18	8	2	12	12	15	0	
11	0	0	0	10	2	9	3	5	8	18	16	12	
12	0	0	0	20	4	2	5	2	2	6	2	1	
13	0	0	0	0	0	29	4	9	1	17	0	0	
14	0	0	0	2	4	14	1	14	0	0	0	0	
15	0	0	0	0	15	6	1	6	4	0	0	0	
16	0	0	0	0	5	11	0	24	4	0	0	0	
17	0	0	0	0	10	20	1	3	1	0	0	0	
18	0	0	0	0	0	3	3	9	1	0	0	0	
19	0	0	0	0	0	4	12	12	0	0	0	0	
20	0	0	0	0	0	7	10	3	31	0	0	0	
21	0	0	0	0	4	7	10	9	13	0	0	0	
22	0	0	0	1	0	6	29	11	3	0	0	0	
23	0	0	0	0	2	3	21	10	7	2	0	0	
24	0	0	0	10	1	10	10	2	0	0	0	0	
25	0	0	0	9	5	15	8	2	0	0	0	0	
26	0	0	5	0	0	11	11	14	0	14	0	0	
27	0	0	0	3	0	15	15	0	0	12	0	0	
28	0	0	0	2	1	12	9	5	0	4	0	0	
29	0		0	5	0	10	2	3	3	0	0	0	
30	0		0	19	0	4	1	3	12	0	0	17	
31	0		0		0		0	4		0		7	Annual
Total	0	0	30	82	92	255	213	204	205	149	52	37	1,319
Max.	0	0	19	20	15	29	29	24	65	30	16	17	65

Year: 1987 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	3	0	0	0	0	15	8	33	6	2	0	0	
2	0	0	11	0	1	17	30	5	4	3	2	0	
3	0	0	1	0	10	2	21	8	8	1	17	0	
4	0	0	1	0	11	2	10	6	2	7	8	0	
5	0	1	0	0	11	2	18	4	3	3	26	0	
6	0	0	1	0	1	5	17	1	3	18	0	0	
7	0	0	0	6	0	2	8	0	12	10	0	0	
8	0	0	0	1	0	28	9	8	0	24	14	0	
9	0	0	0	0	0	7	14	4	25	15	2	0	
10	0	0	0	26	0	14	8	0	1	4	0	0	
11	0	0	0	56	0	16	13	1	2	0	2	0	
12	0	0	0	2	0	20	15	6	10	0	0	0	
13	0	0	0	1	1	5	7	4	0	0	2	0	
14	0	0	0	0	16	9	6	5	7	1	10	0	
15	0	0	0	0	0	5	3	0	8	0	3	0	
16	0	0	0	0	0	10	4	5	18	0	12	0	
17	0	0	0	0	0	3	0	9	23	0	3	0	
18	0	0	1	0	0	1	1	18	21	0	0	0	
19	0	0	0	0	0	7	9	17	3	4	1	0	
20	0	0	0	0	2	8	11	7	1	0	0	0	
21	0	0	0	0	1	4	19	4	14	1	0	0	
22	0	0	0	0	0	1	3	2	14	0	0	0	
23	0	0	0	0	0	0	6	23	9	2	0	0	
24	0	0	0	0	10	0	14	32	9	8	0	0	
25	0	0	0	0	3	0	18	49	0	1	0	0	
26	0	0	0	0	0	0	11	25	0	9	0	0	
27	14	0	0	6	0	1	15	17	2	6	0	0	
28	5	0	0	6	1	0	16	3	2	3	0	0	
29	3		0	6	0	2	2	11	1	0	0	0	
30	0		0	6	13	0	4	4	2	0	0	0	
31	0		0		9		7	5		0		0	Annual
Total	25	1	15	116	90	186	327	316	210	122	102	0	1,510
Max.	14	1	11	56	16	28	30	49	25	24	26	0	56

Estimated Daily Basin Rainfall at UB-1

Year: 1988 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	6	19	17	10	10	0	0	0	
2	0	0	0	0	1	17	14	5	5	11	0	0	
3	0	0	0	0	11	21	3	7	2	13	0	0	
4	0	0	0	0	11	10	2	6	2	2	0	0	
5	0	0	0	0	4	7	3	7	0	11	1	0	
6	0	0	0	0	12	4	6	6	10	2	0	0	
7	0	0	0	0	10	3	3	25	12	1	0	0	
8	0	0	0	0	0	6	6	16	5	1	0	0	
9	0	0	0	0	0	9	1	15	3	2	0	0	
10	0	0	0	0	0	9	11	15	2	5	0	0	
11	0	0	0	0	0	8	3	9	11	2	0	0	
12	0	0	0	0	1	18	20	5	18	1	0	1	
13	0	0	0	0	2	16	9	8	2	6	0	0	
14	0	0	0	17	12	0	9	8	2	18	0	0	
15	0	0	0	9	2	0	5	11	3	9	0	0	
16	0	2	0	1	6	0	13	8	3	6	2	0	
17	0	0	0	0	26	0	17	12	7	0	10	0	
18	0	8	0	0	54	2	12	4	0	15	24	0	
19	0	0	0	1	19	1	5	1	0	12	33	0	
20	0	0	0	0	13	10	9	2	0	2	21	0	
21	0	0	0	0	1	6	3	4	0	1	3	0	
22	0	0	0	0	7	7	6	6	0	2	0	0	
23	0	0	0	0	13	12	4	6	3	6	0	0	
24	0	0	0	0	7	19	8	4	0	1	0	0	
25	0	0	0	0	0	31	4	1	0	3	0	0	
26	0	0	0	0	0	47	2	0	0	9	0	0	
27	0	0	0	0	0	15	2	0	0	1	4	0	
28	0	0	0	0	0	11	0	3	3	0	0	0	
29	0	0	0	2	0	2	1	7	0	0	0	0	
30	0		0	17	0	4	16	5	0	0	0	0	
31	0		0		4		26	2		0		0	Annual
Total	0	10	0	47	222	314	240	218	103	142	98	1	1,395
Max.	0	8	0	17	54	47	26	25	18	18	33	1	54

Year: 1989 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	7	8	11	0	0	0	0	
2	0	0	0	0	2	3	5	5	0	15	0	0	
3	0	0	0	0	0	3	1	2	9	3	0	0	
4	0	0	0	0	0	4	4	5	3	17	0	0	
5	0	0	0	0	0	0	1	2	5	2	0	0	
6	0	0	0	0	0	1	6	5	1	2	0	0	
7	0	0	0	0	5	5	2	2	15	6	0	0	
8	0	0	0	0	0	1	1	6	15	8	0	0	
9	0	0	0	0	0	25	0	5	7	10	0	0	
10	0	0	0	0	4	10	1	19	2	0	1	0	
11	0	0	0	0	7	20	2	8	4	1	0	0	
12	0	0	0	0	18	4	11	4	3	0	0	0	
13	0	0	0	0	48	13	17	2	1	1	0	0	
14	0	0	2	0	6	14	2	9	0	22	0	0	
15	0	0	1	0	2	17	4	11	8	16	0	0	
16	0	0	0	0	0	14	7	13	2	6	0	0	
17	0	0	0	0	8	9	0	15	7	2	0	0	
18	0	0	0	0	10	9	2	1	2	4	0	0	
19	0	0	0	0	17	9	7	1	0	6	0	0	
20	0	0	0	0	0	2	2	10	13	10	0	0	
21	0	0	0	0	0	9	2	33	15	4	0	0	
22	0	0	0	0	0	1	10	7	3	1	0	0	
23	0	0	0	0	1	0	2	1	6	0	3	0	
24	0	0	0	0	6	1	2	4	18	2	0	0	
25	0	0	0	10	2	3	5	22	13	12	0	0	
26	0	0	0	7	8	0	6	15	10	8	0	0	
27	0	0	0	2	2	9	14	6	6	3	0	0	
28	0	0	0	0	0	3	2	26	5	0	0	0	
29	0		1	19	0	10	51	5	3	6	0	0	
30	0		0	22	7	10	54	5	16	1	1	0	
31	0		3		0		48	4		6		0	Annual
Total	0	0	7	60	156	215	303	243	187	174	5	0	1,350
Max.	0	0	3	22	48	25	54	33	18	22	3	0	54

Estimated Daily Basin Rainfall at UB-1

Year: 1990 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	13	13	25	0	16	0	
2	0	0	7	0	0	3	27	10	9	0	7	0	
3	0	0	4	0	0	0	18	28	21	1	0	0	
4	0	0	0	0	4	10	24	8	3	16	8	0	
5	0	0	0	0	8	14	6	16	4	0	6	0	
6	0	0	0	0	9	5	8	17	4	3	4	0	
7	0	0	0	0	8	4	11	1	2	6	2	0	
8	0	0	0	0	23	5	7	0	6	2	7	0	
9	0	0	0	0	36	19	3	1	8	0	5	0	
10	0	0	0	0	19	17	7	1	15	3	11	0	
11	0	0	0	0	17	5	7	1	22	0	0	0	
12	0	0	0	0	3	7	15	2	3	0	0	0	
13	0	0	0	0	5	8	11	1	1	8	0	0	
14	0	0	0	0	19	9	8	11	3	13	0	0	
15	0	0	1	0	44	4	12	4	27	0	0	0	
16	0	0	0	0	30	3	17	1	16	0	0	0	
17	0	0	0	0	38	8	7	0	2	0	0	0	
18	0	0	0	0	6	23	6	0	3	0	0	0	
19	0	0	0	0	10	6	7	0	0	0	0	0	
20	0	2	0	0	23	7	14	1	0	1	0	0	
21	0	3	0	15	7	7	7	4	0	0	0	0	
22	0	14	0	29	16	1	3	0	17	0	1	0	
23	0	2	0	7	16	7	4	0	14	0	0	0	
24	0	0	0	0	19	32	2	1	12	0	0	0	
25	0	0	0	1	0	30	6	1	5	0	1	0	
26	0	0	0	1	2	12	3	3	1	0	1	0	
27	0	2	0	9	1	3	7	4	6	0	0	0	
28	0	0	0	2	6	11	18	1	2	0	0	0	
29	0		0	0	13	12	11	3	4	4	0	0	
30	0		0	0	1	10	6	3	9	7	0	0	
31	0		0		11		16	12		8		0	Annual
Total	0	23	12	64	394	282	311	148	244	72	69	0	1,619
Max.	0	14	7	29	44	32	27	28	27	16	16	0	44

Year: 1991 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	4	14	19	5	4	2	20	0	0	
2	0	0	0	4	0	15	5	6	1	0	4	0	
3	0	0	0	0	8	9	1	16	2	1	19	0	
4	0	0	0	0	0	8	12	15	2	11	36	0	
5	0	0	0	0	0	48	14	4	1	10	40	0	
6	0	0	0	0	0	27	9	1	2	0	33	0	
7	0	0	2	0	3	19	5	0	4	15	6	0	
8	0	0	0	0	8	38	6	6	10	4	0	0	
9	0	0	0	0	8	15	0	5	2	6	0	0	
10	0	0	0	0	1	19	2	3	5	3	0	0	
11	0	0	0	0	0	26	3	5	2	1	0	0	
12	0	0	0	0	0	19	0	11	11	2	5	0	
13	0	0	0	0	0	25	0	3	11	10	1	0	
14	0	0	0	0	21	3	2	3	5	2	1	0	
15	0	0	0	0	7	18	1	4	14	7	1	0	
16	0	0	0	0	1	2	8	2	3	0	1	0	
17	0	0	0	0	6	3	10	0	14	0	0	0	
18	0	0	0	0	2	17	25	12	5	5	0	0	
19	0	0	0	0	0	7	24	0	2	4	0	0	
20	0	0	0	0	7	1	11	16	7	1	0	0	
21	0	0	0	12	0	0	17	7	41	8	1	0	
22	0	0	0	0	1	10	29	3	32	8	0	0	
23	0	0	0	0	0	18	15	7	11	2	0	0	
24	0	0	0	0	19	14	25	0	10	0	0	0	
25	0	0	0	0	1	35	20	4	1	0	0	8	
26	0	0	0	1	0	5	6	3	1	3	0	36	
27	0	0	0	27	24	4	1	5	0	1	0	58	
28	0	0	0	45	14	8	6	2	6	6	0	0	
29	0		0	5	11	12	13	7	16	4	0	0	
30	0		0	16	12	11	32	3	4	7	0	0	
31	0		0		27		13	1		1		0	Annual
Total	0	0	2	114	195	455	320	158	227	142	148	102	1,863
Max.	0	0	2	45	27	48	32	16	41	20	40	58	58

Estimated Daily Basin Rainfall at UB-1

Year: 1992 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	7	13	11	3	0	0	
2	0	0	0	0	0	18	4	20	13	6	0	0	
3	0	0	0	0	0	10	25	6	3	1	0	0	
4	0	0	0	0	0	0	31	9	1	7	0	0	
5	0	0	0	0	0	8	34	47	9	2	0	0	
6	0	0	0	0	0	0	29	88	6	0	0	0	
7	0	0	0	0	0	16	24	36	0	0	0	0	
8	0	0	0	0	0	10	24	17	12	0	1	0	
9	0	0	0	0	0	13	7	13	3	0	22	0	
10	0	0	0	0	0	4	11	1	12	0	39	0	
11	0	0	0	0	0	1	6	17	4	5	0	0	
12	0	0	0	0	1	10	3	1	4	0	0	0	
13	0	0	0	0	6	9	0	1	2	14	0	0	
14	0	0	0	0	12	3	1	11	0	7	0	0	
15	0	0	0	0	0	6	10	7	14	13	0	0	
16	0	0	0	11	7	1	10	10	51	18	3	0	
17	0	1	0	15	8	8	19	12	11	1	0	0	
18	0	2	0	0	10	5	5	5	15	3	5	0	
19	0	1	0	0	32	5	5	12	21	0	1	0	
20	0	0	0	0	28	10	12	8	17	1	0	0	
21	0	0	0	0	0	7	19	10	11	0	2	0	
22	0	0	0	0	8	2	17	3	13	13	2	0	
23	0	0	0	0	1	8	18	3	10	19	1	0	
24	0	0	0	0	2	31	10	2	29	8	0	0	
25	0	0	0	0	1	55	3	6	11	12	0	0	
26	0	0	0	0	28	19	3	9	0	1	3	0	
27	0	3	0	0	5	20	1	4	1	4	0	0	
28	0	0	0	0	15	2	13	0	0	2	3	0	
29	0	0	0	0	3	2	25	12	2	1	0	0	
30	0		0	2	3	2	18	0	6	0	0	0	
31	0		0		0		3	12		1		0	Annual
Total	0	7	0	28	170	285	397	395	292	142	82	0	1,798
Max.	0	3	0	15	32	55	34	88	51	19	39	0	88

Year: 1993 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	25	14	9	15	11	10	1	0	
2	0	0	0	0	31	7	4	14	19	2	0	0	
3	0	0	0	0	12	30	9	12	2	13	0	0	
4	0	0	0	0	9	46	2	20	21	3	0	0	
5	0	0	0	0	4	3	4	7	0	6	0	0	
6	0	0	0	0	27	1	3	10	14	6	0	0	
7	0	0	0	0	9	1	2	2	15	7	0	0	
8	0	0	0	0	0	37	11	7	5	2	0	0	
9	0	0	0	0	1	0	21	4	0	0	0	0	
10	0	0	0	0	9	3	7	8	1	21	0	0	
11	0	0	0	0	0	10	2	12	17	6	0	0	
12	0	0	3	0	4	5	2	7	19	4	0	0	
13	0	0	0	0	0	4	22	3	2	7	0	0	
14	0	0	0	0	0	8	9	1	2	0	0	0	
15	0	0	0	0	3	13	27	3	0	0	0	0	
16	0	0	0	0	4	8	4	8	0	0	0	0	
17	0	0	0	0	1	13	1	8	8	3	0	0	
18	0	0	0	0	3	19	1	8	0	16	0	0	
19	0	0	0	0	0	18	4	29	1	5	0	0	
20	0	0	0	0	0	22	9	28	22	0	0	0	
21	0	6	0	2	2	4	1	6	13	2	0	0	
22	0	5	0	4	14	9	6	2	7	6	0	0	
23	0	0	0	3	6	4	3	13	1	8	0	0	
24	0	0	0	1	8	3	9	7	0	10	0	0	
25	0	0	0	0	8	14	1	3	0	6	0	0	
26	0	0	0	2	11	3	3	3	12	4	0	0	
27	0	0	0	19	8	1	1	8	3	0	0	0	
28	0	0	0	19	2	0	5	0	8	3	0	0	
29	3		0	0	19	13	7	3	1	2	0	0	
30	0		0	0	24	6	1	36	9	23	0	0	
31	0		0		17		7	32		2		0	Annual
Total	3	11	3	50	261	319	197	319	213	177	1	0	1,554
Max.	3	6	3	19	31	46	27	36	22	23	1	0	46

Estimated Daily Basin Rainfall at UB-1

Year: 1994 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	18	4	6	8	16	1	0	0	
2	0	0	0	0	7	8	2	15	3	0	0	0	
3	0	0	0	1	11	0	3	5	5	0	0	0	
4	0	2	0	0	12	18	2	7	7	1	0	0	
5	0	0	0	0	7	1	17	27	16	13	0	0	
6	0	0	0	0	16	92	5	7	1	12	0	0	
7	0	0	0	0	0	11	2	18	2	7	0	0	
8	0	0	0	0	0	8	5	8	4	4	0	0	
9	0	0	0	0	8	3	3	9	10	0	0	0	
10	0	0	0	0	1	9	6	9	5	0	0	0	
11	0	0	0	0	0	14	14	12	6	0	0	0	
12	0	0	0	0	8	5	11	12	6	0	0	0	
13	0	0	0	0	0	26	9	6	14	0	0	0	
14	0	0	0	0	0	6	9	14	3	0	0	0	
15	0	0	0	0	3	10	6	7	7	0	0	0	
16	0	0	0	0	5	12	13	1	4	0	0	0	
17	0	0	0	0	1	29	13	11	5	2	0	0	
18	0	0	0	2	17	19	15	13	2	3	0	0	
19	0	0	0	0	2	7	10	9	10	1	0	0	
20	0	0	0	6	1	7	16	9	1	2	0	0	
21	0	0	0	9	4	12	11	10	0	1	0	0	
22	0	0	0	3	12	11	5	4	0	0	0	0	
23	0	0	0	3	0	1	2	9	1	0	0	0	
24	0	0	0	0	5	1	2	4	0	0	0	0	
25	0	0	0	0	2	1	11	7	0	0	0	0	
26	0	0	0	2	6	11	19	1	0	0	5	0	
27	0	0	1	13	7	12	9	2	1	0	13	0	
28	0	0	3	0	2	8	12	13	10	0	0	0	
29	0		4	1	10	2	21	3	7	0	0	0	
30	0		0	1	5	2	7	12	14	0	0	0	
31	0		0		1		4	19		0		0	Annual
Total	0	2	8	41	171	350	270	291	160	47	18	0	1,358
Max.	0	2	4	13	18	92	21	27	16	13	13	0	92

Year: 1995 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	1	9	26	5	0	43	0	
2	0	0	0	0	0	2	13	21	17	8	2	0	
3	0	0	0	0	0	16	17	7	11	14	0	0	
4	0	0	0	0	2	1	9	1	26	1	4	0	
5	0	0	0	12	2	7	26	1	12	33	0	0	
6	0	0	0	9	37	2	2	5	9	10	0	0	
7	0	0	0	0	6	0	2	11	0	15	0	0	
8	0	0	0	0	1	6	3	4	1	11	0	0	
9	0	0	0	0	3	6	3	2	3	0	0	0	
10	0	0	0	0	10	38	24	24	3	0	0	0	
11	0	0	0	0	29	18	8	5	1	0	0	0	
12	0	0	0	0	16	5	9	8	5	0	0	0	
13	0	0	0	0	0	7	8	10	8	0	7	0	
14	0	0	0	0	7	3	4	10	0	1	57	0	
15	0	0	0	0	19	6	4	4	3	1	5	0	
16	0	0	0	0	14	6	11	3	18	0	0	0	
17	0	0	0	0	17	4	13	9	1	0	3	0	
18	0	0	0	0	22	2	14	7	0	6	0	0	
19	0	0	0	0	8	9	16	6	5	21	1	0	
20	0	0	0	0	0	1	1	0	7	2	1	0	
21	0	0	0	0	0	3	2	0	2	10	0	0	
22	0	0	0	0	0	2	3	20	0	1	0	0	
23	0	0	0	0	0	7	4	8	3	10	0	0	
24	0	0	0	0	1	10	1	19	15	2	0	0	
25	0	0	0	0	2	8	0	4	64	0	0	0	
26	0	0	0	0	0	2	21	4	3	14	25	0	
27	0	0	0	0	2	4	13	10	0	0	1	0	
28	0	0	0	0	0	4	2	0	1	0	0	0	
29	0		0	0	0	2	24	0	0	0	0	0	
30	0		0	0	10	6	9	1	0	0	0	0	
31	0		0		6		13	17		0		0	Annual
Total	0	0	0	21	214	188	288	247	223	160	149	0	1,490
Max.	0	0	0	12	37	38	26	26	64	33	57	0	64

Estimated Daily Basin Rainfall at UB-1

Year: 1996 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	7	10	7	9	6	3	
2	0	0	0	0	0	0	21	9	20	0	4	1	
3	0	0	0	0	0	0	18	20	17	17	4	0	
4	0	0	0	0	11	0	0	0	1	12	5	0	
5	0	0	0	0	11	0	1	1	3	11	0	0	
6	0	0	0	0	1	0	0	5	0	0	19	0	
7	0	0	0	0	7	5	0	5	3	0	3	0	
8	0	0	0	0	8	33	4	2	4	5	0	0	
9	0	0	0	18	3	23	5	2	11	1	0	0	
10	0	0	0	0	0	19	0	3	0	2	0	0	
11	0	0	0	0	0	27	0	25	6	0	0	0	
12	0	0	0	0	0	3	0	2	3	6	0	0	
13	0	0	0	0	0	6	27	14	10	0	0	0	
14	0	0	0	1	0	0	11	6	0	3	0	0	
15	0	0	0	6	11	3	2	13	0	0	0	0	
16	0	0	0	0	1	10	0	13	13	27	0	0	
17	0	0	0	1	1	29	3	2	19	12	0	0	
18	0	0	0	1	0	7	0	7	6	0	0	0	
19	0	0	0	0	39	3	0	14	3	3	0	0	
20	0	0	0	0	0	8	5	27	1	1	1	0	
21	0	0	0	0	0	10	1	4	1	25	0	0	
22	0	0	0	13	0	2	0	14	0	0	0	0	
23	0	49	0	30	13	1	8	7	0	6	0	0	
24	0	21	0	12	10	0	9	29	13	1	0	0	
25	0	0	0	5	19	0	3	6	0	0	0	0	
26	0	0	0	3	11	19	31	1	6	0	0	0	
27	0	0	3	2	7	0	58	3	17	0	0	0	
28	0	0	56	16	16	2	24	1	0	0	0	0	
29	0	0	1	0	1	5	6	0	0	0	0	0	
30	0		0	0	1	2	7	0	0	0	1	0	
31	0		0		3		27	4		2		0	Annual
Total	0	70	60	108	174	217	278	249	164	143	43	4	1,510
Max.	0	49	56	30	39	33	58	29	20	27	19	3	58

Year: 1997 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	0	0	8	0	0	0	
2	0	0	0	0	0	0	0	10	13	0	0	0	
3	0	0	0	0	0	0	10	17	2	61	0	0	
4	0	0	0	0	1	0	2	17	12	0	0	0	
5	0	0	0	0	0	0	3	0	4	0	0	0	
6	0	0	0	0	0	0	17	0	10	0	0	0	
7	0	0	0	7	0	0	7	0	0	6	1	0	
8	0	0	0	0	0	0	4	0	0	0	0	0	
9	0	0	0	0	0	0	4	1	0	0	0	0	
10	0	0	0	0	0	0	1	26	0	0	0	0	
11	0	0	0	0	0	0	14	2	0	0	0	0	
12	0	0	0	0	0	0	2	0	0	0	0	0	
13	0	0	0	0	0	7	1	0	0	0	0	0	
14	0	0	0	0	0	17	0	0	0	0	0	0	
15	0	0	0	0	0	10	0	0	0	0	0	0	
16	0	0	0	0	0	0	10	4	0	0	0	0	
17	0	0	0	0	3	0	11	7	0	0	0	0	
18	0	0	0	0	4	6	11	10	2	0	0	0	
19	0	0	20	0	2	11	11	17	3	8	0	0	
20	0	0	0	0	5	5	7	7	0	0	0	0	
21	0	0	0	0	4	1	18	8	0	0	0	0	
22	0	0	25	0	0	0	9	0	0	8	0	0	
23	0	0	2	0	1	0	50	0	0	0	0	0	
24	0	0	29	0	0	0	90	0	14	0	0	0	
25	0	0	0	61	0	3	82	48	21	0	0	0	
26	0	0	0	0	44	1	0	5	0	0	0	0	
27	0	0	0	0	0	1	53	6	9	8	0	0	
28	0	0	0	0	0	19	0	8	13	0	0	0	
29	0		0	0	0	5	0	5	0	0	0	0	
30	0		0	0	32	9	10	0	0	0	0	0	
31	0		0		0		2	0		0		0	Annual
Total	0	0	76	68	96	95	429	198	111	91	1	0	1,165
Max.	0	0	29	61	44	19	90	48	21	61	1	0	90

Estimated Daily Basin Rainfall at UB-1

Year: 1998 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	4	6	4	0	0	0	0	
2	0	0	0	0	0	1	17	6	1	0	0	0	
3	0	0	0	0	1	0	7	10	4	0	1	0	
4	0	0	0	0	0	0	20	8	5	0	6	0	
5	0	0	0	0	3	1	21	5	1	0	0	0	
6	0	0	0	0	6	0	12	7	31	0	0	0	
7	0	0	0	0	0	0	27	6	32	0	0	0	
8	0	0	0	0	0	0	4	1	24	0	0	0	
9	0	0	0	0	0	5	3	11	19	0	0	0	
10	0	0	0	0	0	11	9	18	10	1	0	0	
11	0	0	0	0	0	0	11	15	8	0	0	0	
12	0	0	0	0	0	1	13	10	0	1	0	0	
13	0	0	0	0	0	3	6	12	0	1	0	0	
14	0	0	0	0	15	0	4	6	9	0	0	0	
15	0	0	0	0	0	17	10	2	0	15	0	0	
16	0	0	0	1	0	4	3	1	1	1	0	0	
17	0	0	0	0	0	1	5	3	1	0	0	0	
18	0	0	0	0	29	0	4	1	3	6	0	0	
19	0	0	0	0	2	1	3	8	0	2	0	0	
20	0	0	0	0	8	2	2	14	0	5	12	0	
21	0	0	0	0	13	3	0	1	2	0	10	0	
22	0	0	0	12	7	5	3	13	0	0	1	0	
23	0	0	0	3	2	4	1	8	0	3	0	0	
24	0	0	0	0	11	9	3	6	0	0	0	0	
25	0	0	0	0	3	5	3	7	6	5	0	0	
26	0	0	0	0	15	4	3	8	1	6	0	0	
27	0	0	0	0	15	5	10	12	0	13	0	0	
28	0	0	0	0	7	1	30	2	7	19	0	0	
29	0		0	0	30	9	2	1	0	3	0	0	
30	0		0	0	18	17	1	1	0	10	0	0	
31	0		4		0		6	0		2		0	Annual
Total	0	0	4	16	185	113	249	207	165	93	30	0	1,062
Max.	0	0	4	12	30	17	30	18	32	19	12	0	32

Year: 1999 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	1	2	7	0	7	0	
2	0	0	2	0	2	2	0	6	3	1	45	0	
3	0	0	0	0	11	0	2	11	2	4	49	0	
4	0	0	0	0	0	36	7	3	1	3	6	0	
5	0	0	0	0	4	17	1	8	2	3	2	0	
6	0	0	0	0	0	4	11	16	12	1	0	0	
7	0	0	0	0	1	0	7	27	14	5	4	6	
8	0	0	0	2	3	0	4	29	3	0	0	0	
9	0	0	0	16	1	0	4	49	27	0	2	0	
10	0	0	0	23	2	9	6	44	6	6	7	0	
11	2	0	0	0	15	2	5	13	23	6	0	0	
12	0	0	0	0	9	0	3	14	2	3	0	0	
13	0	0	0	1	13	1	5	22	0	3	0	0	
14	0	0	0	9	0	2	6	20	1	2	0	0	
15	0	0	0	7	3	42	6	7	1	0	0	0	
16	0	0	0	38	1	6	6	7	8	18	0	0	
17	0	0	0	7	29	1	14	7	7	3	0	0	
18	1	0	0	0	7	3	9	9	23	1	0	0	
19	0	0	0	0	3	1	10	6	7	0	0	0	
20	0	0	0	0	7	11	11	17	4	0	0	0	
21	0	0	0	0	36	17	9	6	13	0	0	0	
22	0	0	0	0	13	25	5	2	0	10	0	0	
23	0	0	0	0	1	25	2	23	0	0	0	0	
24	0	0	0	0	0	56	0	5	0	0	0	0	
25	0	0	0	0	4	17	5	23	14	0	0	0	
26	0	0	0	0	8	7	18	5	0	0	0	0	
27	0	0	0	0	8	9	9	4	9	3	0	0	
28	0	0	0	0	13	3	5	2	30	19	0	0	
29	0		0	1	17	4	4	13	24	18	0	0	
30	0		0	6	20	1	8	6	6	21	0	0	
31	0		0		6		19	11		52		0	Annual
Total	3	0	2	110	237	301	202	417	249	182	122	6	1,831
Max.	2	0	2	38	36	56	19	49	30	52	49	6	56

Estimated Daily Basin Rainfall at UB-1

Year: 2000 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	22	0	7	9	3	0	0	
2	0	0	0	0	8	14	5	0	8	3	0	0	
3	0	0	0	0	5	14	0	1	8	5	0	0	
4	0	0	0	0	0	3	1	1	3	1	0	0	
5	0	0	0	0	8	9	1	1	16	0	0	0	
6	0	0	0	0	5	18	8	16	12	5	0	0	
7	0	0	0	0	9	4	10	11	1	30	0	0	
8	0	0	0	0	5	1	7	4	6	1	0	0	
9	0	0	0	0	4	2	10	15	1	17	0	0	
10	0	0	0	0	0	3	7	17	1	2	0	0	
11	0	0	0	0	24	10	8	7	6	6	0	0	
12	0	0	0	0	10	14	16	4	0	10	0	0	
13	0	0	0	4	10	30	21	6	18	0	0	0	
14	0	0	0	2	2	30	10	6	3	10	0	0	
15	0	0	0	0	5	10	0	11	9	0	0	0	
16	0	0	0	0	3	18	1	5	0	0	0	0	
17	0	0	0	0	6	11	16	2	0	0	0	0	
18	0	0	0	0	4	2	19	1	0	1	0	0	
19	0	1	0	0	6	8	31	4	4	2	0	0	
20	0	0	0	0	13	2	14	4	0	0	0	0	
21	0	0	0	0	2	1	8	30	5	1	0	0	
22	0	0	0	0	1	9	9	22	7	0	0	0	
23	0	0	0	1	11	9	8	1	5	0	0	0	
24	0	0	0	0	7	18	8	6	0	4	0	0	
25	0	0	0	0	22	10	4	2	0	56	0	0	
26	0	0	0	0	33	6	3	0	3	0	0	0	
27	0	1	39	18	8	4	2	0	3	0	0	0	
28	0	0	0	7	4	4	2	29	4	0	7	0	
29	0	0	8	14	0	1	1	28	7	3	9	0	
30	0		2	0	3	5	7	28	7	4	0	0	
31	0		3		0		19	15		0		0	Annual
Total	0	2	52	46	218	292	256	284	146	164	16	0	1,476
Max.	0	1	39	18	33	30	31	30	18	56	9	0	56

Year: 2001 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	1	0	0	37	12	14	1	1	0	0	
2	0	0	0	0	0	30	3	15	4	0	40	0	
3	0	0	0	0	28	13	1	30	0	13	1	0	
4	0	0	0	0	3	2	0	31	2	13	6	0	
5	0	0	0	0	0	2	1	8	6	3	0	0	
6	0	0	0	0	10	3	17	5	4	2	2	0	
7	0	0	0	0	7	0	6	15	4	8	0	0	
8	0	0	0	0	2	3	6	9	0	9	0	0	
9	0	0	0	0	0	9	10	12	23	5	0	0	
10	0	0	0	0	3	5	11	7	20	46	2	0	
11	0	0	0	0	37	0	30	11	3	19	6	0	
12	0	0	0	0	0	7	6	49	0	10	0	0	
13	0	0	2	2	6	9	12	30	5	0	0	0	
14	0	0	7	0	45	3	8	14	0	0	5	0	
15	0	0	2	0	6	14	16	5	16	7	13	1	
16	0	0	2	0	12	12	9	7	4	9	0	2	
17	0	0	0	0	0	9	10	5	0	12	0	0	
18	0	0	0	0	22	6	7	6	3	2	0	0	
19	0	0	0	3	11	2	10	5	1	3	0	0	
20	0	0	0	0	7	6	13	6	1	0	0	0	
21	0	0	0	0	11	4	7	2	2	0	0	0	
22	0	0	0	0	18	3	26	2	6	0	0	0	
23	0	0	0	0	0	0	12	1	0	0	0	0	
24	0	0	0	0	0	1	7	1	2	0	0	4	
25	0	0	0	0	9	6	14	2	2	1	0	0	
26	0	0	0	0	0	0	3	4	6	4	0	0	
27	0	0	0	0	38	4	4	2	0	5	0	0	
28	0	0	0	0	15	2	2	20	0	10	0	0	
29	0		0	0	8	17	4	15	0	3	0	0	
30	0		0	0	50	13	10	1	3	14	0	0	
31	0		0		11		6	2		26		0	Annual
Total	0	0	14	5	359	222	283	336	118	225	75	7	1,644
Max.	0	0	7	3	50	37	30	49	23	46	40	4	50

Estimated Daily Basin Rainfall at UB-1

Year: 2002 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	4	2	0	6	0	0	
2	0	0	0	0	0	0	4	1	0	1	7	0	
3	0	0	0	0	0	7	6	21	0	14	8	0	
4	0	0	0	0	0	5	8	3	11	3	14	0	
5	0	0	0	0	1	10	2	2	12	4	17	0	
6	0	0	0	0	4	13	2	8	1	15	0	0	
7	0	0	0	0	1	5	2	15	21	3	0	0	
8	0	0	0	0	25	7	1	8	12	0	0	0	
9	0	0	0	0	3	3	2	12	22	0	0	0	
10	4	0	0	0	0	1	4	10	2	0	0	0	
11	1	0	0	0	0	13	10	8	0	0	6	0	
12	0	0	0	4	14	2	10	13	8	0	0	0	
13	0	0	0	0	0	13	11	3	4	1	7	0	
14	0	0	0	4	19	2	32	13	23	2	1	0	
15	0	0	0	0	0	4	1	13	1	3	2	0	
16	0	0	0	0	7	6	21	16	2	3	0	3	
17	0	0	0	0	37	3	7	14	0	0	0	3	
18	0	0	0	0	36	7	2	0	13	0	0	0	
19	0	0	0	0	193	4	18	12	9	10	0	0	
20	0	0	0	0	51	8	19	22	4	2	1	0	
21	0	0	0	0	0	13	36	1	3	1	0	0	
22	0	0	0	0	0	7	49	1	19	0	0	0	
23	0	0	0	3	12	5	38	7	0	1	0	0	
24	0	0	0	0	7	6	19	38	0	9	0	0	
25	2	0	0	7	1	8	6	9	0	9	11	1	
26	0	0	0	0	2	7	1	28	2	32	18	1	
27	0	0	0	7	19	12	10	30	0	14	11	0	
28	0	0	0	0	14	2	5	18	0	2	11	0	
29	0		0	0	4	3	1	29	0	3	5	0	
30	0		0	0	1	4	0	18	1	0	2	0	
31	0		2		7		3	10		0		0	Annual
Total	7	0	2	25	458	180	334	385	170	138	121	8	1,828
Max.	4	0	2	7	193	13	49	38	23	32	18	3	193

Year: 2003 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	41	1	13	10	3	12	13	0	
2	21	0	0	0	1	17	3	7	4	6	10	0	
3	0	0	0	0	13	7	6	1	5	1	0	0	
4	0	0	0	0	0	13	10	6	0	4	0	0	
5	19	0	0	0	2	8	0	2	17	0	0	0	
6	0	6	0	0	0	23	7	0	2	1	0	0	
7	0	33	0	0	0	19	0	2	6	1	0	0	
8	0	1	0	0	0	2	0	3	2	5	0	0	
9	0	0	0	0	0	13	20	13	0	4	0	0	
10	0	0	0	0	12	10	4	9	29	0	0	0	
11	0	0	0	0	29	32	8	10	14	0	0	0	
12	0	0	0	0	0	18	0	11	9	0	0	0	
13	0	0	0	0	20	2	2	9	14	0	0	0	
14	0	0	0	0	11	0	7	8	22	1	0	0	
15	0	0	0	0	2	0	10	2	3	2	0	0	
16	0	0	0	0	11	2	1	1	2	0	0	0	
17	0	0	0	0	7	2	0	1	2	2	0	0	
18	0	0	0	1	10	9	3	10	0	0	0	0	
19	0	0	0	0	9	16	2	3	2	2	0	0	
20	0	0	0	0	2	7	2	11	6	22	0	0	
21	0	0	0	1	4	18	19	4	9	22	0	0	
22	0	0	0	0	1	12	1	6	1	3	0	0	
23	0	0	0	4	1	2	3	6	5	0	0	0	
24	0	0	0	0	25	2	20	5	4	14	0	0	
25	0	0	0	0	3	13	15	20	3	1	0	0	
26	0	0	0	0	0	29	16	0	2	0	0	0	
27	0	0	0	0	0	33	1	7	1	0	0	0	
28	0	0	0	0	0	26	9	7	0	0	0	0	
29	0		0	2	0	21	2	3	14	0	0	0	
30	0		0	2	0	31	16	1	0	5	0	0	
31	0		0		1		6	3		1		0	Annual
Total	40	40	0	10	205	388	206	181	181	109	23	0	1,383
Max.	21	33	0	4	41	33	20	20	29	22	13	0	41

Estimated Daily Basin Rainfall at UB-1

Year: 2004 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	21	5	19	5	3	0	0	
2	0	0	0	7	3	21	18	20	6	0	0	0	
3	0	0	0	0	0	11	3	8	1	0	0	0	
4	0	0	0	0	3	2	1	23	1	0	0	0	
5	0	0	0	0	8	0	4	21	2	5	0	0	
6	0	0	0	0	31	0	14	17	1	4	0	0	
7	0	0	0	0	47	10	2	7	2	3	0	0	
8	0	0	0	11	0	22	6	10	2	0	0	0	
9	0	0	0	0	2	9	8	9	6	3	0	0	
10	0	0	0	0	2	11	26	28	36	0	0	0	
11	0	0	0	2	0	0	19	21	39	0	0	0	
12	0	0	0	0	0	13	6	13	18	15	0	0	
13	0	0	0	0	0	6	4	3	8	7	0	0	
14	0	0	0	0	4	0	8	15	11	18	0	0	
15	0	0	0	0	16	0	11	12	63	4	0	0	
16	0	0	0	0	8	1	6	14	11	2	0	0	
17	0	0	0	10	0	8	0	6	9	0	0	0	
18	0	0	0	23	16	32	2	4	25	1	0	0	
19	0	0	0	51	8	30	6	8	12	13	0	0	
20	0	0	0	1	131	22	4	8	0	5	0	0	
21	0	0	0	0	10	28	11	7	13	0	0	0	
22	0	0	0	0	20	12	6	1	10	0	0	0	
23	0	0	0	0	0	26	12	0	6	0	0	0	
24	0	0	0	0	3	4	26	1	0	2	0	0	
25	0	0	0	0	0	0	16	2	0	0	0	0	
26	1	0	0	0	0	1	6	6	13	0	0	0	
27	0	0	0	0	5	5	7	9	17	0	0	0	
28	0	0	0	4	14	9	2	4	7	0	0	0	
29	0	0	0	12	64	5	6	13	4	0	21	0	
30	0		0	9	8	2	16	7	13	0	6	0	
31	0		0		3		16	3		0		0	Annual
Total	1	0	0	130	406	311	277	319	341	85	27	0	1,897
Max.	1	0	0	51	131	32	26	28	63	18	21	0	131

Year: 2005 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	9	10	7	11	13	21	0	
2	0	0	0	0	2	20	19	28	6	6	0	0	
3	0	0	0	0	1	10	19	10	2	0	0	0	
4	0	0	0	4	1	1	2	15	8	35	0	0	
5	0	0	0	0	0	8	3	13	2	18	0	0	
6	0	0	0	0	5	0	9	28	4	0	4	0	
7	0	0	3	0	2	2	8	20	4	0	3	0	
8	0	0	0	0	15	2	5	4	33	0	17	5	
9	0	0	0	0	1	13	4	14	31	0	5	2	
10	0	0	0	0	0	14	6	18	10	0	5	4	
11	0	0	0	5	0	36	6	7	10	0	1	0	
12	0	0	0	0	0	5	0	9	30	0	0	0	
13	0	0	0	0	10	3	2	44	8	0	0	0	
14	0	0	0	0	14	7	27	31	1	36	0	0	
15	0	0	5	0	0	7	2	4	1	8	0	0	
16	0	0	23	0	0	1	0	23	16	0	0	0	
17	0	0	0	0	0	2	0	18	1	17	0	0	
18	0	0	0	0	0	17	0	13	0	2	0	0	
19	0	0	0	0	0	6	1	5	34	6	0	0	
20	0	0	0	3	6	4	39	12	15	0	0	0	
21	0	0	0	19	15	7	8	33	8	0	3	0	
22	0	0	0	15	7	7	1	8	1	5	1	0	
23	0	0	0	0	9	3	19	5	13	8	0	2	
24	0	0	0	0	0	8	6	2	1	1	0	18	
25	0	0	0	0	1	12	11	5	3	7	0	17	
26	0	0	1	0	0	34	12	13	11	6	0	8	
27	0	0	0	8	2	27	9	1	1	2	0	4	
28	0	0	0	29	0	22	3	8	7	6	0	0	
29	0		0	1	0	14	19	3	46	11	0	0	
30	0		0	0	0	8	9	2	25	5	0	0	
31	0		0		21		4	2		2		0	Annual
Total	0	0	32	84	112	309	263	405	343	194	60	60	1,862
Max.	0	0	23	29	21	36	39	44	46	36	21	18	46

Estimated Daily Basin Rainfall at UB-1

Year: 2006 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	1	33	7	18	19	0	13	0	
2	0	0	0	0	4	13	11	26	11	0	3	0	
3	0	0	0	0	3	13	3	1	16	0	0	0	
4	0	0	0	0	0	7	8	7	0	0	0	0	
5	0	0	0	0	0	18	10	9	0	2	0	0	
6	0	0	0	0	0	15	41	3	0	47	0	0	
7	0	0	0	0	3	7	21	0	7	8	0	0	
8	0	0	0	0	2	7	29	8	0	22	8	0	
9	0	0	0	0	19	11	11	10	1	57	0	0	
10	0	0	0	0	4	17	10	1	5	34	1	0	
11	0	0	0	0	1	9	13	3	18	1	0	0	
12	0	0	0	0	0	8	14	3	1	2	0	0	
13	0	0	0	0	3	3	3	1	38	7	7	0	
14	0	0	0	0	37	0	1	6	10	14	0	0	
15	0	0	0	0	17	1	9	8	7	9	2	0	
16	0	0	0	0	4	2	5	1	6	3	0	0	
17	0	0	0	16	0	0	3	4	0	2	0	0	
18	0	0	0	4	0	7	31	3	9	5	0	0	
19	0	0	0	0	0	2	51	10	10	11	0	0	
20	0	0	0	3	0	8	23	15	28	18	0	0	
21	0	0	0	19	0	1	4	26	10	0	0	0	
22	0	0	0	0	0	17	6	7	1	1	0	0	
23	0	0	0	0	0	3	3	9	1	0	0	0	
24	0	0	0	0	2	15	0	3	1	0	0	0	
25	0	0	0	0	4	13	4	1	17	0	0	0	
26	0	0	0	0	12	25	21	8	16	0	0	0	
27	0	0	0	4	0	8	39	13	5	0	0	0	
28	0	0	0	26	6	3	35	12	4	0	0	0	
29	0		0	20	11	6	10	7	5	16	0	0	
30	0		0	31	13	9	2	2	9	0	0	0	
31	0		18		15		14	19		0		0	Annual
Total	0	0	18	123	161	281	442	244	255	259	34	0	1,817
Max.	0	0	18	31	37	33	51	26	38	57	13	0	57

Year: 2007 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	0	0	11	5	4	0	0	0	
2	0	4	0	0	0	10	14	7	5	0	1	0	
3	0	19	0	0	14	10	8	16	4	1	24	0	
4	0	0	0	0	19	12	16	19	14	2	26	0	
5	0	0	0	0	5	6	12	4	2	6	3	0	
6	0	0	0	0	1	0	19	10	11	15	1	0	
7	0	0	0	0	0	16	9	3	7	28	0	0	
8	0	0	0	0	6	20	5	4	3	8	0	0	
9	0	0	0	0	6	2	6	5	2	0	1	0	
10	0	0	0	0	25	4	0	8	2	4	0	0	
11	0	0	0	0	20	7	0	9	2	4	0	0	
12	0	0	0	0	9	14	1	12	13	16	0	0	
13	0	0	0	1	16	66	5	25	4	0	0	0	
14	0	0	0	0	9	10	8	20	11	0	1	0	
15	0	5	0	0	21	9	8	17	32	7	0	0	
16	0	0	0	6	6	9	8	8	35	3	0	0	
17	0	0	0	0	4	6	21	15	13	16	3	0	
18	0	0	0	0	8	1	15	1	17	1	0	0	
19	0	0	0	5	19	2	21	2	0	2	0	0	
20	0	0	0	1	16	24	9	0	1	11	0	0	
21	0	0	0	0	17	0	35	3	1	15	1	0	
22	0	0	0	0	20	0	11	19	1	3	4	0	
23	0	0	0	0	13	0	3	40	7	8	0	0	
24	0	0	0	0	0	1	5	20	1	8	0	0	
25	0	0	0	0	0	3	6	13	1	10	0	0	
26	0	0	0	0	0	8	2	12	15	0	0	0	
27	0	0	0	5	0	3	20	1	27	0	0	0	
28	0	0	0	3	12	38	0	1	6	0	0	0	
29	0		0	0	0	6	0	11	28	0	0	0	
30	0		0	0	6	17	0	6	6	0	0	0	
31	0		0		0		8	11		0		0	Annual
Total	0	28	0	21	272	304	286	327	275	168	65	0	1,746
Max.	0	19	0	6	25	66	35	40	35	28	26	0	66

Estimated Daily Basin Rainfall at UB-1

Year: 2008 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	3	0	0	3	7	7	2	11	1	50	0	
2	0	0	0	70	9	1	2	5	10	17	39	0	
3	0	0	0	0	1	9	17	15	17	4	38	0	
4	0	0	0	0	23	3	10	3	17	11	17	0	
5	0	0	0	0	0	62	8	2	1	0	0	0	
6	0	0	0	0	1	6	13	6	0	0	0	0	
7	0	0	0	0	0	21	19	3	34	0	0	0	
8	0	0	0	0	0	12	8	11	18	1	0	0	
9	0	0	0	0	2	7	6	27	18	0	0	0	
10	0	0	0	0	6	3	8	17	9	3	0	0	
11	0	0	0	0	6	1	4	13	0	1	0	0	
12	0	0	0	0	14	8	6	8	5	7	0	0	
13	0	0	0	0	2	2	6	17	4	2	0	0	
14	0	0	0	0	3	6	15	9	13	5	0	0	
15	0	0	0	0	2	23	13	6	4	0	0	0	
16	0	0	0	1	3	12	3	9	9	0	0	0	
17	0	0	0	0	16	34	6	13	9	1	0	0	
18	0	0	0	0	32	29	4	17	0	5	0	0	
19	0	0	0	0	1	18	13	6	21	0	0	0	
20	0	0	0	0	23	9	4	5	13	1	0	0	
21	0	0	0	0	5	0	8	3	7	48	0	0	
22	0	0	0	0	1	1	7	3	11	0	0	0	
23	0	0	0	0	0	3	19	2	2	1	0	0	
24	0	0	0	3	0	3	3	9	4	35	0	0	
25	0	0	12	0	0	3	5	1	1	29	0	0	
26	0	0	3	0	9	2	14	0	9	64	0	0	
27	4	0	0	0	5	11	3	2	3	23	0	0	
28	33	0	0	0	0	3	15	8	0	6	0	0	
29	1	0	0	0	4	16	16	8	0	3	0	0	
30	0		1	0	1	8	4	1	1	34	0	0	
31	0		0		11		3	1		2		0	Annual
Total	38	3	16	74	183	323	269	232	251	304	144	0	1,837
Max.	33	3	12	70	32	62	19	27	34	64	50	0	70

Year: 2009 (unit: mm)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	0	0	0	0	4	2	14	2	14	0	0	0	
2	0	0	0	0	0	3	25	11	18	1	0	0	
3	0	0	0	0	1	0	13	11	0	0	0	0	
4	0	0	0	0	6	15	11	0	13	27	0	0	
5	0	0	0	0	0	9	0	0	4	1	0	0	
6	0	0	0	0	1	13	23	38	4	0	0	0	
7	0	0	0	0	0	10	20	21	6	0	0	0	
8	0	0	0	0	0	28	16	46	23	5	1	0	
9	0	0	0	0	0	10	4	12	4	0	0	0	
10	0	0	0	0	0	1	0	2	2	0	0	0	
11	0	0	0	0	0	0	0	4	0	0	0	0	
12	0	0	0	0	17	0	2	3	0	2	0	0	
13	0	0	0	0	6	5	0	12	18	14	0	0	
14	0	0	0	1	15	7	9	18	8	9	0	0	
15	0	0	3	19	7	0	0	20	1	0	0	0	
16	0	0	0	4	0	1	12	0	4	1	0	0	
17	0	0	0	9	11	13	0	2	7	16	0	0	
18	0	0	0	10	6	23	2	18	20	0	0	0	
19	0	0	18	8	6	12	27	1	1	0	0	0	
20	0	0	0	14	7	5	4	14	14	20	0	0	
21	0	0	0	2	0	0	2	2	3	0	0	0	
22	0	0	0	5	5	0	2	6	3	3	0	0	
23	0	0	0	0	6	4	3	4	13	3	0	0	
24	0	0	0	7	0	5	1	23	1	0	0	0	
25	0	0	0	0	13	9	25	15	8	0	0	0	
26	0	0	0	0	12	5	21	6	0	0	0	0	
27	0	0	0	0	9	1	18	0	3	11	0	0	
28	0	0	3	0	0	4	42	1	4	6	0	0	
29	0		0	0	17	6	23	4	7	3	0	0	
30	0		0	1	33	4	29	0	0	2	0	0	
31	0		0		10		12	3		0		0	Annual
Total	0	0	24	80	192	195	360	299	203	124	1	0	1,478
Max.	0	0	18	19	33	28	42	46	23	27	1	0	46

Observed Daily Mean
Water Level Records
(Gauge Height)

at Upper Baluchaung G.S.
(by MEPE)

Observed Daily Gauge Height Records at Upper Baluchaung G.S. (by MEPE)

Year **2000** Station: Upper Baluchaung W.L. Gauging Station Unit: m

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	NA	NA	NA	NA	NA	NA	NA	NA	2.18	NA	1.95	1.84	
2	NA	NA	NA	NA	NA	NA	NA	NA	2.18	NA	1.92	1.84	
3	NA	NA	NA	NA	NA	NA	NA	NA	2.19	NA	1.89	1.84	
4	NA	NA	NA	NA	NA	NA	NA	NA	2.19	NA	1.89	1.84	
5	NA	NA	NA	NA	NA	NA	NA	NA	2.19	NA	1.89	1.84	
6	NA	NA	NA	NA	NA	NA	NA	NA	2.19	NA	1.89	1.84	
7	NA	NA	NA	NA	NA	NA	NA	NA	2.18	NA	1.88	1.83	
8	NA	NA	NA	NA	NA	NA	NA	NA	2.11	NA	1.88	1.83	
9	NA	NA	NA	NA	NA	NA	NA	NA	1.99	NA	1.88	1.83	
10	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.88	1.83	
11	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.88	1.82	
12	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.88	1.82	
13	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.88	1.82	
14	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.86	1.82	
15	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.86	1.82	
16	NA	NA	NA	NA	NA	NA	NA	NA	1.88	NA	1.86	1.82	
17	NA	NA	NA	NA	NA	NA	NA	NA	1.87	NA	1.86	1.82	
18	NA	NA	NA	NA	NA	NA	NA	NA	1.86	NA	1.86	1.82	
19	NA	NA	NA	NA	NA	NA	NA	NA	1.85	NA	1.86	1.82	
20	NA	NA	NA	NA	NA	NA	NA	NA	1.84	NA	1.86	1.82	
21	NA	NA	NA	NA	NA	NA	NA	NA	1.84	NA	1.86	1.82	
22	NA	NA	NA	NA	NA	NA	NA	NA	1.84	NA	1.86	1.82	
23	NA	NA	NA	NA	NA	NA	NA	NA	1.85	NA	1.86	1.82	
24	NA	NA	NA	NA	NA	NA	NA	NA	1.84	NA	1.86	1.82	
25	NA	NA	NA	NA	NA	NA	NA	NA	1.82	NA	1.86	1.82	
26	NA	NA	NA	NA	NA	NA	NA	NA	1.80	NA	1.85	1.82	
27	NA	NA	NA	NA	NA	NA	NA	2.00	1.78	NA	1.85	1.82	
28	NA	NA	NA	NA	NA	NA	NA	2.09	1.75	NA	1.85	1.82	
29	NA	NA	NA	NA	NA	NA	NA	2.15	1.75	NA	1.84	1.82	
30	NA	NA	NA	NA	NA	NA	NA	2.18	1.79	NA	1.84	1.82	
31	NA	NA	NA	NA	NA	NA	NA	2.19		NA		1.82	
Average								2.12	1.93		1.87	1.83	
Max.								2.19	2.19		1.95	1.84	

Year **2001** Station: Upper Baluchaung W.L. Gauging Station Unit: m

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	1.82	1.81	1.80	1.70	1.69	1.84	1.89	2.03	1.99	1.89	2.00	NA	
2	1.82	1.81	1.79	1.70	1.69	1.83	1.89	2.04	1.99	1.89	2.00	NA	
3	1.82	1.81	1.79	1.70	1.69	1.82	1.89	2.05	1.98	1.90	2.00	NA	
4	1.82	1.81	1.78	1.70	1.69	1.82	1.89	2.06	1.87	1.90	1.99	NA	
5	1.82	1.81	1.78	1.70	1.69	1.81	1.89	2.07	1.87	1.90	1.99	NA	
6	1.82	1.81	1.77	1.70	1.69	1.80	1.89	2.08	1.86	1.90	1.99	NA	
7	1.82	1.81	1.77	1.70	1.69	1.79	1.90	2.08	1.86	1.91	1.98	NA	
8	1.82	1.81	1.76	1.70	1.69	1.77	1.91	2.08	1.85	1.91	1.99	NA	
9	1.81	1.81	1.76	1.70	1.69	1.76	1.91	2.09	1.85	1.92	1.99	NA	
10	1.81	1.81	1.75	1.70	1.69	1.76	1.91	2.10	1.88	1.92	2.00	NA	
11	1.81	1.81	1.75	1.70	1.82	1.76	1.92	2.14	1.88	1.92	2.01	NA	
12	1.81	1.81	1.75	1.70	1.81	1.77	1.93	2.16	1.87	1.93	2.02	NA	
13	1.81	1.81	1.74	1.69	1.81	1.77	1.94	2.18	1.87	1.92	2.01	NA	
14	1.81	1.81	1.74	1.69	1.81	1.78	1.94	2.18	1.87	1.92	2.00	NA	
15	1.81	1.81	1.74	1.69	1.81	1.78	1.95	2.18	1.87	1.91	2.00	NA	
16	1.81	1.81	1.74	1.69	1.81	1.78	1.96	2.17	1.87	1.91	1.99	NA	
17	1.81	1.81	1.74	1.69	1.81	1.77	1.97	2.17	1.88	1.91	1.99	NA	
18	1.81	1.81	1.73	1.69	1.80	1.77	1.97	2.16	1.89	1.91	1.98	NA	
19	1.81	1.81	1.73	1.69	1.81	1.77	1.98	2.15	1.90	1.92	1.97	NA	
20	1.81	1.81	1.73	1.69	1.82	1.77	1.98	2.14	1.91	1.92	1.97	NA	
21	1.81	1.81	1.73	1.69	1.81	1.77	2.00	2.13	1.92	1.92	1.97	NA	
22	1.81	1.81	1.72	1.69	1.90	1.76	2.00	2.13	1.91	1.93	1.98	NA	
23	1.81	1.81	1.72	1.69	1.90	1.76	1.99	2.12	1.90	1.93	1.98	NA	
24	1.81	1.81	1.72	1.69	1.89	1.76	1.98	2.12	1.90	1.95	1.97	NA	
25	1.81	1.81	1.72	1.69	1.88	1.76	1.97	2.11	1.90	1.97	1.94	NA	
26	1.81	1.81	1.72	1.69	1.88	1.76	1.94	2.10	1.90	1.97	1.94	NA	
27	1.81	1.81	1.71	1.69	1.87	1.76	1.91	2.09	1.90	2.00	1.94	NA	
28	1.81	1.81	1.71	1.69	1.86	1.76	1.93	2.08	1.90	1.95	1.90	NA	
29	1.81		1.70	1.69	1.86	1.76	1.95	2.07	1.90	2.01	1.90	NA	
30	1.81		1.70	1.69	1.86	1.76	2.20	2.06	1.90	2.00	1.90	NA	
31	1.81		1.70		1.85		2.20	1.99		2.00		NA	
Average	1.81	1.81	1.74	1.69	1.79	1.78	1.95	2.11	1.89	1.93	1.98		
Max.	1.82	1.81	1.80	1.70	1.90	1.84	2.20	2.18	1.99	2.01	2.02		

Observed Daily Gauge Height Records at Upper Baluchaung G.S. (by MEPE)

Year **2002** Station: Upper Baluchaung W.L. Gauging Station Unit: m

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	NA	1.90	1.79	1.75	1.74	NA	NA	NA	NA	NA	NA	NA	
2	NA	1.90	1.79	1.75	1.74	NA	NA	NA	NA	NA	NA	NA	
3	NA	1.90	1.79	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
4	NA	1.90	1.78	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
5	NA	1.89	1.78	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
6	NA	1.89	1.78	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
7	NA	1.88	1.78	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
8	NA	1.87	1.78	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
9	NA	1.87	1.78	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
10	NA	1.87	1.77	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
11	NA	1.86	1.77	1.75	1.73	NA	NA	NA	NA	NA	NA	NA	
12	NA	1.86	1.77	1.75	1.77	NA	NA	NA	NA	NA	NA	NA	
13	NA	1.86	1.77	1.74	1.80	NA	NA	NA	NA	NA	NA	NA	
14	NA	1.86	1.77	1.74	1.80	NA	NA	NA	NA	NA	NA	NA	
15	NA	1.86	1.77	1.74	1.80	NA	NA	NA	NA	NA	NA	NA	
16	NA	1.85	1.77	1.74	1.80	NA	NA	NA	NA	NA	NA	NA	
17	NA	1.84	1.77	1.74	1.80	NA	NA	NA	NA	NA	NA	NA	
18	NA	1.83	1.77	1.74	1.80	NA	NA	NA	NA	NA	NA	NA	
19	NA	1.83	1.76	1.74	4.00	NA	NA	NA	NA	NA	NA	NA	
20	NA	1.83	1.76	1.74	4.00	NA	NA	NA	NA	NA	NA	NA	
21	NA	1.83	1.76	1.74	4.00	NA	NA	NA	NA	NA	NA	NA	
22	NA	1.83	1.76	1.74	3.00	NA	NA	NA	NA	NA	NA	NA	
23	NA	1.82	1.76	1.74	2.50	NA	NA	NA	NA	NA	NA	NA	
24	NA	1.82	1.76	1.74	2.50	NA	NA	NA	NA	NA	NA	NA	
25	NA	1.82	1.76	1.74	2.40	NA	NA	NA	NA	NA	NA	NA	
26	NA	1.80	1.75	1.74	2.40	NA	NA	NA	NA	NA	NA	NA	
27	NA	1.80	1.75	1.74	2.40	NA	NA	NA	NA	NA	NA	NA	
28	NA	1.80	1.75	1.74	2.30	NA	NA	NA	NA	NA	NA	NA	
29	NA		1.75	1.74	2.30	NA	NA	NA	NA	NA	NA	NA	
30	NA		1.75	1.74	2.30	NA	NA	NA	NA	NA	NA	NA	
31	NA		1.75		2.30	NA	NA	NA	NA	NA	NA	NA	
Average		1.85	1.77	1.74	2.19								
Max.		1.90	1.79	1.75	4.00								

Source: Department of Hydroelectric Power, Investigation Section Mandalay, MEPE

Calculated Daily Mean Discharge

at Upper Baluchaung G.S.
(Obs.H by MEPE)

(calculated by H-Q Rating Curve)

Calculated Daily Mean Discharge at Upper Baluchaung G.S. (by MEPE)

Year **2000** Station: Upper Baluchaung W.L. Gauging Station Unit: m^3/s

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	NA	NA	NA	NA	NA	NA	NA	NA	22.40	NA	13.94	10.59	
2	NA	NA	NA	NA	NA	NA	NA	NA	22.40	NA	12.98	10.59	
3	NA	NA	NA	NA	NA	NA	NA	NA	22.82	NA	12.06	10.59	
4	NA	NA	NA	NA	NA	NA	NA	NA	22.82	NA	12.06	10.59	
5	NA	NA	NA	NA	NA	NA	NA	NA	22.82	NA	12.06	10.59	
6	NA	NA	NA	NA	NA	NA	NA	NA	22.82	NA	12.06	10.59	
7	NA	NA	NA	NA	NA	NA	NA	NA	22.40	NA	11.76	10.31	
8	NA	NA	NA	NA	NA	NA	NA	NA	19.62	NA	11.76	10.31	
9	NA	NA	NA	NA	NA	NA	NA	NA	15.27	NA	11.76	10.31	
10	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.76	10.31	
11	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.76	10.04	
12	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.76	10.04	
13	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.76	10.04	
14	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.17	10.04	
15	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.17	10.04	
16	NA	NA	NA	NA	NA	NA	NA	NA	11.76	NA	11.17	10.04	
17	NA	NA	NA	NA	NA	NA	NA	NA	11.46	NA	11.17	10.04	
18	NA	NA	NA	NA	NA	NA	NA	NA	11.17	NA	11.17	10.04	
19	NA	NA	NA	NA	NA	NA	NA	NA	10.88	NA	11.17	10.04	
20	NA	NA	NA	NA	NA	NA	NA	NA	10.59	NA	11.17	10.04	
21	NA	NA	NA	NA	NA	NA	NA	NA	10.59	NA	11.17	10.04	
22	NA	NA	NA	NA	NA	NA	NA	NA	10.59	NA	11.17	10.04	
23	NA	NA	NA	NA	NA	NA	NA	NA	10.88	NA	11.17	10.04	
24	NA	NA	NA	NA	NA	NA	NA	NA	10.59	NA	11.17	10.04	
25	NA	NA	NA	NA	NA	NA	NA	NA	10.04	NA	11.17	10.04	
26	NA	NA	NA	NA	NA	NA	NA	NA	9.49	NA	10.88	10.04	
27	NA	NA	NA	NA	NA	NA	NA	15.61	8.96	NA	10.88	10.04	
28	NA	NA	NA	NA	NA	NA	NA	18.85	8.20	NA	10.88	10.04	
29	NA		NA	NA	NA	NA	NA	21.19	8.20	NA	10.59	10.04	
30	NA		NA	NA	NA	NA	NA	22.40	9.23	NA	10.59	10.04	
31	NA		NA		NA		NA	22.82		NA		10.04	
Average								20.17	13.89		11.51	10.18	
Max.								22.82	22.82		13.94	10.59	

Year **2001** Station: Upper Baluchaung W.L. Gauging Station Unit: m^3/s

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	10.04	9.76	9.49	7.00	6.77	10.59	12.06	16.66	15.27	12.06	15.61	NA	
2	10.04	9.76	9.23	7.00	6.77	10.31	12.06	17.01	15.27	12.06	15.61	NA	
3	10.04	9.76	9.23	7.00	6.77	10.04	12.06	17.37	14.93	12.36	15.61	NA	
4	10.04	9.76	8.96	7.00	6.77	10.04	12.06	17.74	11.46	12.36	15.27	NA	
5	10.04	9.76	8.96	7.00	6.77	9.76	12.06	18.10	11.46	12.36	15.27	NA	
6	10.04	9.76	8.71	7.00	6.77	9.49	12.06	18.48	11.17	12.36	15.27	NA	
7	10.04	9.76	8.71	7.00	6.77	9.23	12.36	18.48	11.17	12.67	14.93	NA	
8	10.04	9.76	8.45	7.00	6.77	8.71	12.67	18.48	10.88	12.67	15.27	NA	
9	9.76	9.76	8.45	7.00	6.77	8.45	12.67	18.85	10.88	12.98	15.27	NA	
10	9.76	9.76	8.20	7.00	6.77	8.45	12.67	19.23	11.76	12.98	15.61	NA	
11	9.76	9.76	8.20	7.00	10.04	8.45	12.98	20.79	11.76	12.98	15.95	NA	
12	9.76	9.76	8.20	7.00	9.76	8.71	13.30	21.59	11.46	13.30	16.30	NA	
13	9.76	9.76	7.95	6.77	9.76	8.71	13.61	22.40	11.46	12.98	15.95	NA	
14	9.76	9.76	7.95	6.77	9.76	8.96	13.61	22.40	11.46	12.98	15.61	NA	
15	9.76	9.76	7.95	6.77	9.76	8.96	13.94	22.40	11.46	12.67	15.61	NA	
16	9.76	9.76	7.95	6.77	9.76	8.96	14.26	21.99	11.46	12.67	15.27	NA	
17	9.76	9.76	7.95	6.77	9.76	8.71	14.59	21.99	11.76	12.67	15.27	NA	
18	9.76	9.76	7.71	6.77	9.49	8.71	14.59	21.59	12.06	12.67	14.93	NA	
19	9.76	9.76	7.71	6.77	9.76	8.71	14.93	21.19	12.36	12.98	14.59	NA	
20	9.76	9.76	7.71	6.77	10.04	8.71	14.93	20.79	12.67	12.98	14.59	NA	
21	9.76	9.76	7.71	6.77	9.76	8.71	15.61	20.39	12.98	12.98	14.59	NA	
22	9.76	9.76	7.47	6.77	12.36	8.45	15.61	20.39	12.67	13.30	14.93	NA	
23	9.76	9.76	7.47	6.77	12.36	8.45	15.27	20.00	12.36	13.30	14.93	NA	
24	9.76	9.76	7.47	6.77	12.06	8.45	14.93	20.00	12.36	13.94	14.59	NA	
25	9.76	9.76	7.47	6.77	11.76	8.45	14.59	19.62	12.36	14.59	13.61	NA	
26	9.76	9.76	7.47	6.77	11.76	8.45	13.61	19.23	12.36	14.59	13.61	NA	
27	9.76	9.76	7.23	6.77	11.46	8.45	12.67	18.85	12.36	15.61	13.61	NA	
28	9.76	9.76	7.23	6.77	11.17	8.45	13.30	18.48	12.36	13.94	12.36	NA	
29	9.76		7.00	6.77	11.17	8.45	13.94	18.10	12.36	15.95	12.36	NA	
30	9.76		7.00	6.77	11.17	8.45	23.23	17.74	12.36	15.61	12.36	NA	
31	9.76		7.00		10.88		23.23	15.27		15.61		NA	
Average	9.83	9.76	8.01	6.86	9.40	8.91	14.18	19.54	12.22	13.33	14.82		
Max.	10.04	9.76	9.49	7.00	12.36	10.59	23.23	22.40	15.27	15.95	16.30		

Calculated Daily Mean Discharge at Upper Baluchaung G.S. (by MEPE)

Year **2002** Station: Upper Baluchaung W.L. Gauging Station Unit: m^3/s

Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	NA	12.36	9.23	8.20	7.95	NA	NA	NA	NA	NA	NA	NA	
2	NA	12.36	9.23	8.20	7.95	NA	NA	NA	NA	NA	NA	NA	
3	NA	12.36	9.23	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
4	NA	12.36	8.96	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
5	NA	12.06	8.96	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
6	NA	12.06	8.96	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
7	NA	11.76	8.96	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
8	NA	11.46	8.96	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
9	NA	11.46	8.96	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
10	NA	11.46	8.71	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
11	NA	11.17	8.71	8.20	7.71	NA	NA	NA	NA	NA	NA	NA	
12	NA	11.17	8.71	8.20	8.71	NA	NA	NA	NA	NA	NA	NA	
13	NA	11.17	8.71	7.95	9.49	NA	NA	NA	NA	NA	NA	NA	
14	NA	11.17	8.71	7.95	9.49	NA	NA	NA	NA	NA	NA	NA	
15	NA	11.17	8.71	7.95	9.49	NA	NA	NA	NA	NA	NA	NA	
16	NA	10.88	8.71	7.95	9.49	NA	NA	NA	NA	NA	NA	NA	
17	NA	10.59	8.71	7.95	9.49	NA	NA	NA	NA	NA	NA	NA	
18	NA	10.31	8.71	7.95	9.49	NA	NA	NA	NA	NA	NA	NA	
19	NA	10.31	8.45	7.95	159.93	NA	NA	NA	NA	NA	NA	NA	
20	NA	10.31	8.45	7.95	159.93	NA	NA	NA	NA	NA	NA	NA	
21	NA	10.31	8.45	7.95	159.93	NA	NA	NA	NA	NA	NA	NA	
22	NA	10.31	8.45	7.95	68.87	NA	NA	NA	NA	NA	NA	NA	
23	NA	10.04	8.45	7.95	37.51	NA	NA	NA	NA	NA	NA	NA	
24	NA	10.04	8.45	7.95	37.51	NA	NA	NA	NA	NA	NA	NA	
25	NA	10.04	8.45	7.95	32.37	NA	NA	NA	NA	NA	NA	NA	
26	NA	9.49	8.20	7.95	32.37	NA	NA	NA	NA	NA	NA	NA	
27	NA	9.49	8.20	7.95	32.37	NA	NA	NA	NA	NA	NA	NA	
28	NA	9.49	8.20	7.95	27.62	NA	NA	NA	NA	NA	NA	NA	
29	NA		8.20	7.95	27.62	NA	NA	NA	NA	NA	NA	NA	
30	NA		8.20	7.95	27.62	NA	NA	NA	NA	NA	NA	NA	
31	NA		8.20		27.62		NA	NA		NA		NA	
Average		10.97	8.65	8.05	31.68								
Max.		12.36	9.23	8.20	159.93								

Source: Daily WL by Department of Hydroelectric Power, Investigation Section Mandalay, MEPE

Note: Gauge Height - Discharge rating curve

Q(1)= 18.90 *(H+ -1.0914)^2

Observed Discharge at Upper Baluchaung G.S. (by MEPE)

(Estimation sheets of H-Q Rating Curve)

Calculation Sheet of H - Q Rating Curve (1/2)

Rating Curve (I) from 27-Aug-2000 to 30-Apr-2002

Gauge Height for Using : 1.69 m ～ 2.20 m

Q= a^2 (H ± b/a)^2

Q= 18.905 （H － 1.091）^2

Basin	Baluchaung		River	Upper Baluchaung		Station	UB-1
No.of Data	Date	Time	H	H^2	Q	√Q	H√Q
1	27-Aug-2000		2.000	4.0000	14.9314	3.864117	7.728234
2	28-Aug-2000		1.750	3.0625	10.2787	3.206041	5.610572
3	29-Nov-2000		1.840	3.3856	13.6733	3.697743	6.803846
4	30-Dec-2000		1.820	3.3124	10.9780	3.313307	6.030218
5	30-Jan-2001		1.810	3.2761	9.5177	3.085077	5.583989
6	28-Feb-2001		1.810	3.2761	9.2405	3.039819	5.502073
7	31-Mar-2001		1.700	2.8900	3.3496	1.830191	3.111325
8	30-Apr-2001		1.690	2.8561	7.8370	2.799464	4.731095
9	31-May-2001		1.850	3.4225	14.1920	3.767227	6.969370
10	30-Jun-2001		1.760	3.0976	10.6060	3.256685	5.731766
11	30-Jul-2001		2.200	4.8400	23.5050	4.848196	10.666030
12	30-Aug-2001		2.060	4.2436	15.1130	3.887544	8.008341
13	30-Sep-2001		1.900	3.6100	11.5380	3.396763	6.453850
14	29-Oct-2001		2.010	4.0401	19.1010	4.370469	8.784643
15	28-Nov-2001		1.900	3.6100	8.4870	2.913246	5.535167
16	28-Feb-2002		1.800	3.2400	8.9950	2.999167	5.398500
17	31-Mar-2002		1.750	3.0625	8.2360	2.869843	5.022226
18	30-Apr-2002		1.740	3.0276	6.8560	2.618396	4.556010
Total			33.390	62.2527	206.4352	59.763295	112.227254

Calculation Sheet of H - Q Rating Curve (2/2)

Rating Curve (I) from 27-Aug-2000 to 30-Apr-2002

$n * [H\sqrt{Q}]$	=	18	*	112.227254	=	2,020.09
$[H] * [\sqrt{Q}]$	=	33.39	*	59.763295	=	1,995.50
$n * [H^2]$	=	18	*	62.252700	=	1,120.55
$[H]^2$	=	33.39	^{2}		=	1,114.89
$[H^2]*[\sqrt{Q}]$	=	62.252700	*	59.763295	=	3,720.43
$[H]*[H\sqrt{Q}]$	=	33.39	*	112.227254	=	3,747.27

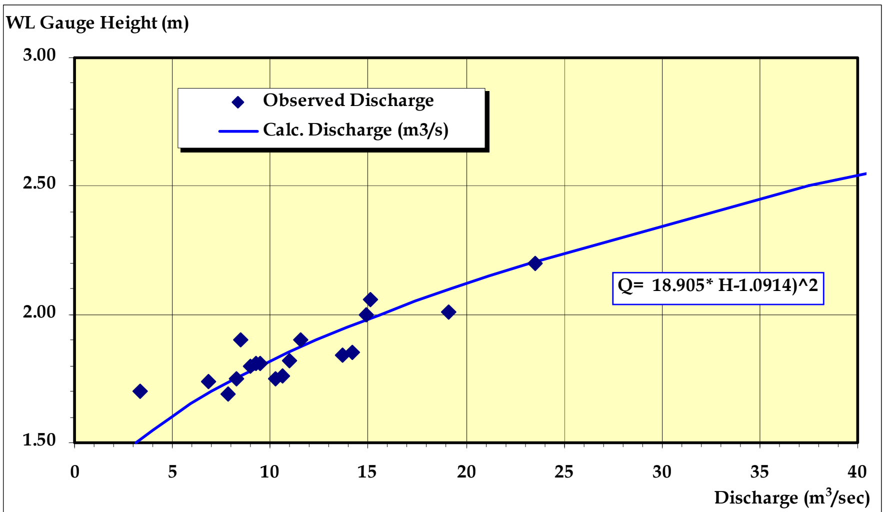
$$a = \frac{n*[H]*[H\sqrt{Q}]-[H][\sqrt{Q}]}{n[H^2]-[H]^2} = \frac{2{,}020.09 - 1{,}995.50}{1{,}120.55 - 1{,}114.89} = 4.3479$$

$$b = \frac{[H^2][\sqrt{Q}]-[H][H\sqrt{Q}]}{n*[H^2]-[H]^2} = \frac{3{,}720.43 - 3{,}747.27}{20{,}169.87 - 1{,}114.89} = -4.7453$$

$$a^2 = 4.3479^2 = 18.905$$

$$b/a = -4.7453 \,/\, 4.3479 = -1.091$$

$$Q = a^2 * (H \pm b/a)^2 = 18.905 \; (H \;\; -1.091 \;\;)^2$$



H-Q Rating Curve at Upper Baluchaung WL G.S.
(Q.Obs. data by Department of Hydroelectric Power, MEPE)

Observed Daily Water Level (Gauge Height) and Calculated Daily Discharge

at Indein New G.S. (by MGC)

(Daily Discharge was calculated by H-Q Rating Curve)

Observed Daily Gauge Height Data at Indein New WL.Station (MGC)

Year **2010** Station: Indein New W.L. Gauging Station Unit: cm

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	NA	82											
2	NA	82											
3	NA	82											
4	NA	82											
5	84	82											
6	84	82											
7	84	82											
8	84	82											
9	84	80											
10	84	80											
11	82	80											
12	82	80											
13	82	80											
14	82	80											
15	82	80											
16	82	80											
17	82	80											
18	82	80											
19	82	78											
20	82	78											
21	82	80											
22	82	80											
23	82	88											
24	82	88											
25	82	86											
26	82	86											
27	82	86											
28	82	86											
29	82												
30	82												
31	82												
Average	82.44	81.86											
Max.	84.00	88.00											

Source: Ministry of Agriculture and Forest, Irrigation Dept.

Calculated Daily Discharge at Indein New WL.Station (MGC)

Q = 0.002 * (H -29.13)^2

Year **2010** Station: Indein New W.L. Gauging Station Unit: m^3/s

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	NA	5.58											
2	NA	5.58											
3	NA	5.58											
4	NA	5.58											
5	6.01	5.58											
6	6.01	5.58											
7	6.01	5.58											
8	6.01	5.58											
9	6.01	5.17											
10	6.01	5.17											
11	5.58	5.17											
12	5.58	5.17											
13	5.58	5.17											
14	5.58	5.17											
15	5.58	5.17											
16	5.58	5.17											
17	5.58	5.17											
18	5.58	5.17											
19	5.58	4.77											
20	5.58	4.77											
21	5.58	5.17											
22	5.58	5.17											
23	5.58	6.92											
24	5.58	6.92											
25	5.58	6.46											
26	5.58	6.46											
27	5.58	6.46											
28	5.58	6.46											
29	5.58												
30	5.58												
31	5.58												
Average	5.68	5.57											
Max.	6.01	6.92											

Observed Discharge
at Indein New G.S.
(by MGC)

(Estimation sheets of H-Q Rating Curve)

Calculation Sheet of H - Q Rating Curve (1/2)

Rating Curve (I) from 05-Jan-2010 to 16-Mar-2010

Gauge Height for Using : 80.00 m ～ 85.00 m

Q= a^2 (H ± b/a)^2

Q= 0.002 （H － 29.126）^2

Basin	Baluchaung		River	Upper Baluchaung		Station	Indein New G.S
No.of Data	Date	Time	H	H^2	Q	√Q	H√Q
1	5-Jan-2010		84.000	7056.0000	5.9100	2.431049	204.208129
2	6-Jan-2010		84.000	7056.0000	5.9200	2.433105	204.380821
3	21-Feb-2010		80.000	6400.0000	5.2010	2.280570	182.445608
4	16-Mar-2010		85.000	7225.0000	6.3870	2.527251	214.816375
Total			333.000	27737.0000	23.4180	9.671976	805.850934

Calculation Sheet of H - Q Rating Curve (2/2)

Rating Curve (I) from 05-Jan-2010 to 16-Mar-2010

n * [H√Q]	=	4	*	805.850934	=	3,223.40
[H] * [√Q]	=	333.00	*	9.671976	=	3,220.77
n * [H^2]	=	4	*	27737.000000	=	110,948.00
[H^2]	=	333.00	2		=	110,889.00
[H^2]*[√Q]	=	27737.000000	*	9.671976	=	268,271.59
[H]*[H√Q]	=	333.00	*	805.850934	=	268,348.36

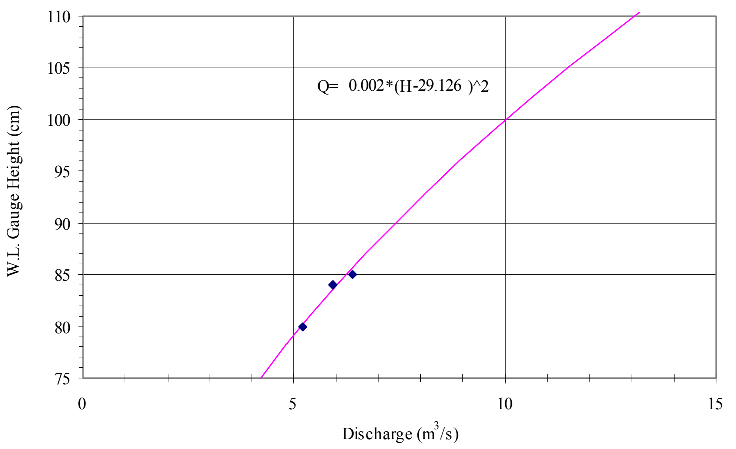
$$a = \frac{n*[H]*[H\sqrt{Q}]-[H][\sqrt{Q}]}{n[H^2]-[H]^2} = \frac{3,223.40 - 3,220.77}{110,948.00 - 110,889.00} = 0.0447$$

$$b = \frac{[H^2][\sqrt{Q}]-[H][H\sqrt{Q}]}{n*[H^2]-[H]^2} = \frac{268,271.59 - 268,348.36}{443,792.00 - 110,889.00} = -1.3012$$

$$a^2 = 0.0447^2 = 0.002$$

$$b/a = -1.3012 \,/\, 0.0447 = -29.126$$

$$Q = a^2 * (H \pm b/a)^2 = 0.002\ (H\ \ -29.126\ )^2$$



H-Q Rating Curve at Indein New G.S. (MGC)

Observed Monthly Discharge
and
Estimated Monthly Inflow
at Mobye Dam

Monthly Discharge Record at Mobye Dam

(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1971	32.8	25.9	18.4	12.0	15.0	27.3	55.6	116.5	150.7	123.9	68.1	41.9	57.3
1972	32.9	22.7	16.5	18.2	14.6	24.7	25.5	60.5	77.8	88.6	88.0	60.1	44.2
1973	35.3	23.5	19.5	16.2	24.8	28.7	44.0	87.2	231.7	182.2	124.0	75.1	74.4
1974	51.7	35.4	31.3	27.7	30.2	43.3	40.6	65.5	120.7	79.9	76.9	55.8	54.9
1975	54.3	37.0	28.3	21.7	28.4	43.8	54.8	80.2	160.6	157.4	103.9	59.3	69.1
1976	46.8	35.5	26.6	20.1	28.9	35.4	40.2	68.1	100.0	119.9	99.6	57.3	56.5
1977	43.0	32.2	28.7	26.7	32.0	27.0	30.2	44.2	91.0	129.0	128.1	62.9	56.3
1978	42.8	30.9	24.8	21.7	25.2	24.6	59.9	102.5	139.8	138.2	70.4	42.2	60.3
1979	33.0	29.6	23.1	21.5	22.3	28.0	34.0	44.4	43.9	47.3	30.9	25.2	31.9
1980	20.8	15.7	11.3	8.4	7.8	23.9	34.2	41.5	90.1	89.9	58.4	34.5	36.4
1981	24.4	22.0	14.1	9.8	18.2	23.7	33.1	52.6	63.9	64.0	91.2	73.5	40.9
1982	39.5	26.1	15.0	17.3	22.2	27.7	33.6	44.7	83.2	78.8	55.6	36.6	40.0
1983	29.3	23.2	18.9	14.7	13.1	30.8	33.7	38.1	62.7	89.7	120.0	90.8	47.1
1984	53.7	45.3	44.9	45.5	47.4	50.6	40.2	73.6	114.1	95.0	66.4	43.9	60.1
1985	26.1	27.2	16.9	22.0	11.9	37.6	44.5	66.6	76.1	84.9	107.0	97.3	51.5
1986	51.2	31.1	26.2	15.3	24.3	24.2	24.9	44.0	76.8	46.8	43.0	33.3	36.8
1987	30.8	24.5	15.6	14.7	16.8	26.1	24.3	40.6	68.9	82.9	69.1	43.8	38.2
1988	33.8	22.3	14.3	12.3	20.0	30.7	38.5	50.0	48.4	43.0	47.2	31.1	32.6
1989	20.8	21.3	9.8	5.6	8.4	17.8	22.4	37.5	70.3	94.9	75.0	45.5	35.8
1990	25.2	24.8	9.7	8.8	20.1	38.3	45.1	68.2	56.3	56.6	46.7	32.2	36.0
1991	23.6	16.0	11.2	9.3	6.0	23.2	29.6	59.7	74.2	77.9	107.7	65.7	42.0
1992	49.2	32.2	18.4	10.1	11.4	18.5	35.9	75.9	153.2	192.8	117.1	70.8	65.5
1993	42.6	27.2	22.6	22.3	21.3	29.8	30.9	38.4	58.4	69.5	56.7	48.4	39.0
1994	26.5	22.6	16.4	15.6	21.2	26.5	25.6	47.2	123.0	92.2	232.2	43.4	57.7
1995	23.4	18.4	12.9	13.0	22.3	31.3	39.6	59.3	80.5	92.8	73.9	46.9	42.9
1996	31.9	8.1	23.5	14.2	23.0	30.0	38.5	66.9	85.8	71.9	51.2	38.1	40.3
1997	28.7	24.1	16.8	10.7	20.8	16.9	34.3	61.7	81.5	85.8	52.8	41.8	39.7
1998	26.3	18.5	13.4	9.0	11.5	7.6	9.6	18.4	36.5	28.2	22.0	16.6	18.1
1999	13.4	9.3	4.7	8.5	12.4	19.7	12.1	34.7	58.0	70.0	111.9	49.1	33.7
2000	35.1	21.8	14.0	13.6	29.4	28.9	29.4	38.2	59.1	58.5	48.7	34.5	34.3
2001	25.9	23.7	19.3	11.5	23.0	46.0	53.5	94.1	92.0	105.1	49.6	56.8	50.0
2002	48.2	32.1	23.6	26.5	41.1	39.0	44.0	64.0	104.5	65.2	72.7	52.9	51.2
2003	41.4	34.4	23.5	24.3	37.9	33.0	33.2	37.5	60.6	64.5	48.5	31.4	39.2
2004	25.0	21.4	17.0	18.0	34.0	55.5	58.5	73.3	49.6	109.8	55.9	47.8	47.2
2005	32.8	25.1	21.8	25.5	24.6	37.2	34.8	65.1	113.1	114.3	80.9	66.2	53.5
2006	52.9	35.7	22.6	27.6	40.5	36.3	48.1	85.6	136.7	149.9	113.4	65.2	67.9
2007	49.7	40.6	29.7	27.8	47.4	49.5	60.5	67.9	84.3	106.6	78.5	68.2	59.2
2008	43.1	33.5	27.6	23.3	47.4	56.6	44.4	60.5	88.0	78.9	132.2	61.6	58.1
2009	45.0	48.9	52.4	25.5	29.5	43.5	44.1	62.1	88.9	74.4	41.6		50.5
Average	35.7	26.9	20.6	17.9	24.0	31.9	37.6	59.9	91.2	92.3	79.9	51.3	47.4

Estimated Monthly Inflow at Mobye Dam

(m^3/s)

Year	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual Mean
1971	48.6	24.9	15.9	10.5	11.3	20.2	43.7	93.7	116.9	95.0	51.8	37.7	47.5
1972	31.9	25.0	19.1	15.1	16.7	20.1	21.7	56.0	84.7	92.6	88.0	65.1	44.7
1973	31.8	24.4	16.2	13.1	23.4	24.0	40.7	86.2	198.6	148.7	103.5	70.0	65.0
1974	46.0	33.1	26.2	18.7	21.6	30.9	26.1	66.1	112.2	80.2	76.5	51.8	49.1
1975	48.6	31.0	21.2	9.7	19.9	36.6	44.2	75.1	150.3	130.5	89.5	56.9	59.5
1976	42.0	31.0	23.4	16.1	20.0	22.3	32.5	62.4	100.8	126.7	86.7	56.0	51.7
1977	38.6	28.5	23.5	21.8	23.7	17.1	24.8	36.8	90.2	135.8	110.6	62.1	51.1
1978	38.5	29.0	22.1	15.8	19.3	15.9	55.2	91.1	124.6	122.0	66.8	42.7	53.6
1979	28.7	23.9	16.3	16.3	13.1	16.5	22.9	32.3	33.8	38.4	23.6	17.9	23.6
1980	16.4	10.5	5.9	5.0	7.8	25.2	33.8	34.1	94.3	93.0	64.1	35.4	35.5
1981	24.3	20.9	16.2	14.1	19.6	36.3	14.6	54.3	63.9	66.1	94.6	66.9	41.0
1982	41.5	30.3	22.9	15.9	20.6	26.4	28.8	42.8	90.6	81.5	63.4	42.2	42.2
1983	32.4	27.9	23.4	16.9	14.9	27.6	30.4	35.3	61.3	90.0	132.4	78.3	47.6
1984	52.8	37.9	22.4	16.2	15.0	32.4	49.0	93.0	121.6	103.0	97.3	57.3	58.1
1985	26.6	29.7	17.3	21.2	10.0	33.6	40.2	64.5	76.1	94.7	98.9	85.6	49.9
1986	55.0	34.1	32.2	17.7	20.6	22.4	23.1	42.8	76.5	48.8	43.6	30.2	37.3
1987	25.3	23.0	14.7	16.3	12.1	16.5	15.0	32.3	63.4	84.8	72.2	43.8	34.9
1988	33.0	23.1	16.9	10.2	15.6	24.3	36.9	47.6	46.1	41.1	45.0	29.9	30.8
1989	20.1	20.6	9.5	5.5	8.2	17.2	21.6	35.9	66.2	88.2	70.5	43.4	33.9
1990	24.3	23.9	9.4	8.6	19.4	36.7	43.0	64.3	53.4	53.7	44.5	30.9	34.4
1991	22.8	15.5	10.9	9.0	5.8	22.4	28.5	56.5	69.7	73.1	99.4	62.0	39.6
1992	46.9	30.9	17.8	9.8	11.1	17.9	34.4	71.3	137.9	169.8	107.5	66.7	60.2
1993	40.7	26.2	21.8	21.5	20.6	28.7	29.7	36.8	55.3	65.5	53.8	46.1	37.2
1994	25.5	21.8	15.9	15.1	20.5	25.5	24.7	45.0	112.6	85.8	199.9	41.5	52.8
1995	22.6	17.8	12.5	12.6	21.5	30.1	37.9	56.2	75.4	86.4	69.5	44.7	40.6
1996	30.7	7.9	22.7	13.8	22.2	28.9	36.9	63.1	80.1	67.7	48.7	36.5	38.3
1997	27.6	23.3	16.3	10.4	20.1	16.4	32.9	58.4	76.3	80.1	50.2	40.0	37.7
1998	25.3	17.9	13.0	8.8	11.2	7.4	9.3	17.8	35.0	27.2	21.2	16.1	17.5
1999	13.0	9.0	4.6	8.3	12.0	19.1	11.7	33.3	55.0	65.9	103.1	46.8	31.8
2000	33.7	21.1	13.6	13.2	28.3	27.8	28.3	36.6	56.0	55.4	46.4	33.1	32.8
2001	25.0	22.9	18.7	11.2	22.2	43.9	50.8	87.5	85.6	97.1	47.2	53.9	47.2
2002	45.9	30.8	22.8	25.5	39.3	37.3	42.0	60.5	96.6	61.6	68.4	50.3	48.4
2003	39.6	33.0	22.7	23.4	36.3	31.7	31.9	35.9	57.4	60.9	46.2	30.2	37.4
2004	24.1	20.7	16.5	17.4	32.6	52.7	55.4	68.9	47.2	101.2	53.0	45.6	44.6
2005	31.5	24.2	21.1	24.6	23.7	35.6	33.4	61.5	104.1	105.1	75.8	62.5	50.3
2006	50.3	34.2	21.8	26.6	38.7	34.8	45.8	80.0	124.2	135.2	104.4	61.6	63.1
2007	47.3	38.8	28.6	26.8	45.2	47.1	57.3	64.0	78.8	98.5	73.6	64.3	55.9
2008	41.2	32.2	26.6	22.5	45.2	53.7	42.4	57.3	82.1	74.0	120.4	58.3	54.6
2009	42.9	46.6	49.8	24.6	28.4	41.5	42.1	58.7	82.9	69.9	39.8		47.9
Average	34.4	25.8	19.3	15.6	21.0	28.3	33.9	56.3	85.6	87.1	75.7	49.1	44.3

Source: Data from Jan.1971 to Jun.1988 was used data of recalculated discharge by NEWJEC.

Note: After 1988.Jul was revised by using relationship between observed discharge at Mobye dam and recalculated discharge by NEWJEC.

Simulated Daily Discharge

at UB-1

by Tank Model

(1970-2009)

Simulated Daily Discharge at UB-1 by Tank Model

Year **1970** (1-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	7.4	6.5	4.6	4.6	3.7	4.6	12.1	32.5	34.3	31.6	13.0	14.9	
2	7.4	6.5	4.6	4.6	3.7	4.6	9.3	35.3	38.1	30.6	13.0	13.9	
3	7.4	6.5	4.6	4.6	3.7	4.6	7.4	31.6	39.9	29.7	13.0	13.0	
4	7.4	6.5	4.6	4.6	3.7	4.6	6.5	31.6	37.1	30.6	13.0	12.1	
5	6.5	6.5	4.6	6.5	3.7	5.6	7.4	32.5	37.1	27.9	13.0	11.1	
6	6.5	6.5	4.6	6.5	3.7	5.6	7.4	39.0	33.4	26.0	13.0	10.2	
7	6.5	6.5	4.6	4.6	4.6	5.6	8.4	52.9	44.6	25.1	13.0	10.2	
8	6.5	6.5	4.6	4.6	5.6	6.5	7.4	73.3	41.8	23.2	13.0	10.2	
9	6.5	6.5	4.6	4.6	3.7	12.1	8.4	56.6	39.9	23.2	13.0	10.2	
10	6.5	6.5	4.6	4.6	3.7	11.1	9.3	44.6	37.1	22.3	12.1	10.2	
11	6.5	6.5	4.6	4.6	3.7	11.1	13.0	43.6	34.3	21.4	12.1	10.2	
12	6.5	6.5	4.6	4.6	3.7	8.4	29.7	43.6	39.0	20.4	12.1	10.2	
13	6.5	6.5	4.6	4.6	3.7	8.4	42.7	40.9	44.6	20.4	12.1	10.2	
14	6.5	6.5	4.6	4.6	3.7	7.4	45.5	39.0	42.7	18.6	12.1	10.2	
15	6.5	6.5	4.6	4.6	3.7	11.1	57.6	35.3	38.1	18.6	12.1	10.2	
16	6.5	6.5	4.6	4.6	3.7	9.3	41.8	34.4	36.2	17.6	12.1	10.2	
17	6.5	6.5	4.6	4.6	3.7	7.4	36.2	34.4	35.3	16.7	12.1	10.2	
18	6.5	6.5	4.6	4.6	4.6	5.6	26.9	33.4	35.3	16.7	12.1	10.2	
19	6.5	6.5	4.6	4.6	11.1	5.6	22.3	32.5	36.2	15.8	12.1	10.2	
20	6.5	6.5	4.6	4.6	12.1	5.6	20.4	32.5	35.3	14.9	12.1	10.2	
21	6.5	5.6	4.6	4.6	13.0	5.6	22.3	31.6	34.3	13.9	12.1	10.2	
22	6.5	5.6	4.6	4.6	11.1	5.6	23.2	34.3	41.8	13.9	11.1	9.3	
23	6.5	5.6	4.6	4.6	11.1	5.6	26.9	32.5	39.9	13.9	11.1	9.3	
24	6.5	5.6	4.6	4.6	12.1	5.6	58.5	30.6	38.1	13.9	11.1	8.4	
25	6.5	5.6	4.6	3.7	12.1	5.6	65.9	30.6	35.3	13.9	11.1	8.4	
26	6.5	5.6	4.6	3.7	13.0	5.6	58.5	30.6	32.5	13.9	11.1	8.4	
27	6.5	4.6	4.6	3.7	9.3	5.6	49.2	29.7	37.1	13.0	11.1	8.4	
28	6.5	4.6	4.6	3.7	7.4	9.3	37.1	30.6	34.4	13.0	11.1	8.4	
29	6.5		4.6	3.7	4.6	13.9	35.3	34.4	34.4	13.0	11.1	8.4	
30	6.5		4.6	3.7	10.2	15.8	33.4	32.5	33.4	13.0	11.1	8.4	
31	6.5		4.6		7.4		30.6	31.6		13.0		8.4	
Average	6.6	6.2	4.6	4.6	6.6	7.4	27.8	37.0	37.4	19.3	12.1	10.1	15.0
Max.	7.4	6.5	4.6	6.5	13.0	15.8	65.9	73.3	44.6	31.6	13.0	14.9	73.3

Year **1971** (2-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	6.5	6.5	4.6	4.6	8.4	8.4	70.5	50.1	28.8	13.9	12.1	
2	8.4	6.5	6.5	4.6	4.6	17.6	9.3	75.2	47.3	34.4	13.9	12.1	
3	8.4	6.5	6.5	4.6	4.6	18.6	10.2	65.0	48.3	37.1	13.9	12.1	
4	8.4	6.5	6.5	4.6	4.6	13.0	12.1	64.1	49.2	34.4	13.9	12.1	
5	8.4	6.5	6.5	4.6	4.6	13.0	10.2	54.8	52.0	31.6	13.9	11.1	
6	8.4	6.5	6.5	4.6	4.6	15.8	12.1	50.1	51.1	31.6	13.9	11.1	
7	8.4	6.5	6.5	4.6	4.6	30.6	10.2	47.4	47.3	28.8	15.8	11.1	
8	8.4	6.5	6.5	4.6	4.6	26.0	9.3	49.2	43.6	27.9	14.9	11.1	
9	8.4	6.5	6.5	4.6	4.6	22.3	8.4	47.4	45.5	30.6	13.9	11.1	
10	8.4	6.5	6.5	4.6	4.6	16.7	8.4	47.4	49.2	27.9	13.9	10.2	
11	8.4	6.5	6.5	4.6	4.6	17.6	8.4	46.4	46.4	27.9	13.9	10.2	
12	8.4	6.5	6.5	4.6	4.6	16.7	8.4	44.6	43.6	26.9	13.9	10.2	
13	8.4	6.5	6.5	4.6	4.6	14.9	8.4	44.6	40.8	26.9	13.9	10.2	
14	8.4	6.5	6.5	4.6	4.6	14.9	11.1	45.5	40.8	26.0	13.9	10.2	
15	8.4	6.5	6.5	4.6	4.6	13.9	17.6	44.6	40.8	24.1	13.0	10.2	
16	8.4	6.5	6.5	4.6	4.6	11.1	16.7	44.6	39.0	22.3	13.0	10.2	
17	8.4	6.5	6.5	4.6	4.6	9.3	14.9	44.6	38.1	21.4	13.0	10.2	
18	8.4	6.5	6.5	4.6	4.6	7.4	12.1	43.6	37.1	18.6	13.0	10.2	
19	8.4	6.5	6.5	4.6	4.6	11.1	12.1	42.7	36.2	17.6	13.0	10.2	
20	8.4	6.5	6.5	4.6	4.6	9.3	19.5	42.7	36.2	15.8	13.0	10.2	
21	8.4	6.5	5.6	4.6	12.1	8.4	52.0	41.8	35.3	14.9	13.0	11.1	
22	8.4	6.5	5.6	4.6	10.2	9.3	59.4	42.7	34.3	14.9	13.0	13.0	
23	8.4	6.5	5.6	4.6	6.5	9.3	50.1	39.9	32.5	14.9	13.0	12.1	
24	8.4	6.5	5.6	4.6	4.6	11.1	42.7	41.8	31.6	14.9	13.0	10.2	
25	8.4	6.5	5.6	4.6	5.6	12.1	62.2	39.9	32.5	14.9	12.1	10.2	
26	8.4	6.5	5.6	4.6	3.7	13.0	52.9	40.8	31.6	14.9	12.1	10.2	
27	7.4	6.5	4.6	4.6	3.7	11.1	50.1	46.4	27.9	13.9	12.1	9.3	
28	7.4	6.5	4.6	4.6	9.3	12.1	42.7	46.4	30.6	18.6	12.1	9.3	
29	7.4		4.6	4.6	8.4	11.1	42.7	46.4	32.5	16.7	12.1	9.3	
30	7.4		4.6	4.6	7.4	8.4	45.5	46.4	31.6	13.9	12.1	9.3	
31	7.4		4.6		8.4		50.1	62.2		13.9		9.3	
Average	8.2	6.5	6.0	4.6	5.6	13.8	25.1	48.7	40.1	22.8	13.3	10.6	17.2
Max.	8.4	6.5	6.5	4.6	12.1	30.6	62.2	75.2	52.0	37.1	15.8	13.0	75.2

Simulated Daily Discharge at UB-1 by Tank Model

Year **1972** (3-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	9.3	8.4	6.5	6.5	4.6	5.6	7.4	21.4	24.1	20.4	11.1	10.2	
2	9.3	8.4	6.5	6.5	4.6	4.6	5.6	15.8	25.1	26.0	11.1	10.2	
3	9.3	8.4	6.5	6.5	4.6	4.6	4.6	17.6	24.1	24.1	11.1	10.2	
4	9.3	8.4	6.5	5.6	4.6	4.6	4.6	15.8	23.2	26.0	11.1	10.2	
5	9.3	8.4	6.5	5.6	4.6	4.6	5.6	17.6	26.0	23.2	12.1	10.2	
6	9.3	8.4	6.5	5.6	4.6	9.3	5.6	15.8	24.1	21.4	12.1	10.2	
7	9.3	8.4	6.5	5.6	4.6	11.1	4.6	13.0	22.3	19.5	19.5	10.2	
8	9.3	8.4	6.5	5.6	4.6	13.0	4.6	13.0	22.3	21.4	17.6	10.2	
9	8.4	8.4	6.5	5.6	4.6	10.2	4.6	12.1	21.4	19.5	14.8	10.2	
10	8.4	8.4	6.5	5.6	4.6	10.2	4.6	11.1	21.4	19.5	12.1	10.2	
11	8.4	8.4	6.5	4.6	4.6	10.2	4.6	14.9	19.5	18.6	11.1	10.2	
12	8.4	7.4	6.5	4.6	4.6	7.4	4.6	15.8	18.6	18.6	11.1	10.2	
13	8.4	7.4	6.5	4.6	4.6	6.5	4.6	13.9	18.6	17.6	11.1	10.2	
14	8.4	7.4	6.5	4.6	4.6	4.6	4.6	15.8	17.6	15.8	11.1	10.2	
15	8.4	7.4	6.5	4.6	4.6	5.6	6.5	18.6	16.7	14.9	11.1	10.2	
16	8.4	7.4	6.5	4.6	4.6	4.6	26.0	23.2	17.6	13.9	11.1	10.2	
17	8.4	6.5	6.5	4.6	11.1	4.6	28.8	22.3	16.7	13.0	11.1	10.2	
18	8.4	6.5	6.5	4.6	7.4	4.6	19.5	22.3	15.8	13.0	11.1	10.2	
19	8.4	6.5	6.5	4.6	4.6	4.6	14.9	23.2	13.9	12.1	11.1	10.2	
20	8.4	6.5	6.5	4.6	4.6	4.6	14.9	24.1	13.9	12.1	11.1	10.2	
21	8.4	6.5	6.5	4.6	9.3	4.6	13.9	26.0	13.9	12.1	11.1	10.2	
22	8.4	6.5	6.5	4.6	5.6	4.6	10.2	35.3	13.0	14.8	11.1	9.3	
23	8.4	6.5	6.5	4.6	4.6	4.6	9.3	33.4	18.6	13.9	11.1	9.3	
24	8.4	6.5	6.5	4.6	4.6	4.6	9.3	30.6	15.8	15.8	11.1	9.3	
25	8.4	6.5	6.5	4.6	4.6	4.6	9.3	30.6	13.9	13.9	10.2	9.3	
26	8.4	6.5	6.5	4.6	4.6	4.6	9.3	31.6	13.0	12.1	11.1	9.3	
27	8.4	6.5	6.5	4.6	4.6	4.6	16.7	30.6	15.8	12.1	10.2	9.3	
28	8.4	6.5	6.5	4.6	4.6	4.6	26.9	28.8	21.4	12.1	12.1	9.3	
29	8.4	6.5	6.5	4.6	4.6	4.6	30.6	26.9	21.4	12.1	11.1	9.3	
30	8.4		6.5	4.6	4.6	8.4	25.1	25.1	22.3	12.1	10.2	9.3	
31	8.4		6.5		4.6		19.5	24.1		11.1		9.3	
Average	8.6	7.4	6.5	5.0	5.1	6.2	11.6	21.6	19.1	16.5	11.8	9.9	10.8
Max.	9.3	8.4	6.5	6.5	11.1	13.0	30.6	35.3	26.0	26.0	19.5	10.2	35.3

Year **1973** (4-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	9.3	6.5	6.5	4.6	4.6	7.4	8.4	11.1	39.9	26.0	13.0	10.2	
2	9.3	6.5	6.5	4.6	4.6	6.5	8.4	14.9	38.1	30.6	13.0	10.2	
3	9.3	6.5	6.5	4.6	7.4	7.4	9.3	12.1	34.4	29.7	12.1	10.2	
4	9.3	6.5	6.5	4.6	4.6	7.4	8.4	11.1	32.5	26.9	12.1	10.2	
5	9.3	6.5	6.5	4.6	4.6	6.5	9.3	11.1	35.3	25.1	12.1	10.2	
6	9.3	6.5	6.5	4.6	4.6	6.5	10.2	11.1	36.2	24.1	12.1	9.3	
7	9.3	6.5	6.5	4.6	4.6	6.5	9.3	11.1	34.3	24.1	12.1	9.3	
8	9.3	6.5	6.5	4.6	10.2	7.4	7.4	11.1	31.6	23.2	12.1	9.3	
9	9.3	6.5	6.5	4.6	7.4	9.3	7.4	10.2	29.7	22.3	11.1	9.3	
10	8.4	6.5	6.5	4.6	8.4	11.1	14.9	13.9	29.7	21.4	11.1	9.3	
11	8.4	6.5	6.5	4.6	9.3	19.5	16.7	13.0	29.7	21.4	11.1	9.3	
12	8.4	6.5	6.5	4.6	6.5	13.9	13.9	12.1	28.8	19.5	11.1	9.3	
13	8.4	6.5	6.5	4.6	5.6	13.9	12.1	12.1	28.8	18.6	11.1	9.3	
14	8.4	6.5	6.5	4.6	9.3	14.9	13.0	10.2	27.8	16.7	11.1	8.4	
15	8.4	6.5	6.5	4.6	13.9	12.1	12.1	10.2	26.0	14.9	11.1	8.4	
16	8.4	6.5	6.5	4.6	15.8	17.6	10.2	11.1	26.0	13.9	11.1	8.4	
17	8.4	6.5	6.5	4.6	11.1	39.9	10.2	14.9	26.0	13.0	11.1	8.4	
18	8.4	6.5	6.5	4.6	13.0	47.3	12.1	17.6	25.1	13.0	10.2	8.4	
19	8.4	6.5	5.6	4.6	11.1	31.6	12.1	20.4	24.1	13.9	10.2	8.4	
20	8.4	6.5	5.6	4.6	11.1	20.4	13.0	20.4	28.8	13.9	10.2	8.4	
21	8.4	6.5	5.6	4.6	13.0	17.6	11.1	18.6	32.5	13.9	15.8	8.4	
22	8.4	6.5	5.6	4.6	8.4	13.0	11.1	17.6	32.5	13.9	14.9	8.4	
23	8.4	6.5	5.6	4.6	5.6	11.1	12.1	19.5	30.6	13.0	12.1	8.4	
24	8.4	6.5	5.6	4.6	5.6	7.4	11.1	30.6	33.4	13.0	10.2	8.4	
25	7.4	6.5	5.6	4.6	5.6	8.4	11.1	29.7	29.7	13.0	10.2	8.4	
26	7.4	6.5	4.6	5.6	5.6	8.4	10.2	26.9	26.9	13.0	10.2	8.4	
27	7.4	6.5	4.6	4.6	5.6	8.4	13.0	26.0	26.9	13.0	10.2	8.4	
28	7.4	6.5	4.6	4.6	5.6	8.4	13.0	49.2	26.0	13.0	10.2	8.4	
29	7.4		4.6	4.6	9.3	8.4	13.0	57.6	25.1	13.0	10.2	8.4	
30	6.5		4.6	4.6	10.2	8.4	13.9	44.6	25.1	13.0	10.2	8.4	
31	6.5		4.6		10.2		12.1	35.3		13.0		8.4	
Average	8.4	6.5	5.9	4.7	8.1	13.6	11.3	19.9	30.0	18.0	11.4	8.9	12.2
Max.	9.3	6.5	6.5	5.6	15.8	47.3	16.7	57.6	39.9	30.6	15.8	10.2	57.6

Simulated Daily Discharge at UB-1 by Tank Model

Year **1974** (5-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	6.5	6.5	5.6	4.6	4.6	5.6	12.1	24.1	21.4	11.1	9.3	
2	8.4	6.5	6.5	4.6	4.6	4.6	5.6	9.3	24.1	21.4	13.0	9.3	
3	8.4	6.5	6.5	4.6	4.6	4.6	5.6	7.4	26.0	20.4	11.1	9.3	
4	8.4	6.5	6.5	4.6	4.6	4.6	5.6	7.4	37.1	19.5	11.1	9.3	
5	8.4	6.5	5.6	4.6	4.6	3.7	5.6	7.4	33.4	24.1	11.1	9.3	
6	8.4	6.5	5.6	4.6	4.6	3.7	5.6	7.4	28.8	22.3	11.1	9.3	
7	8.4	6.5	5.6	4.6	3.7	3.7	7.4	10.2	31.6	19.5	11.1	9.3	
8	8.4	6.5	5.6	4.6	3.7	3.7	8.4	8.4	29.7	18.6	10.2	9.3	
9	8.4	6.5	5.6	4.6	3.7	11.1	7.4	9.3	28.8	18.6	10.2	9.3	
10	8.4	6.5	5.6	4.6	4.6	11.1	7.4	11.1	32.5	17.6	10.2	9.3	
11	7.4	6.5	5.6	4.6	3.7	10.2	7.4	14.9	30.6	15.8	10.2	9.3	
12	7.4	6.5	4.6	4.6	3.7	11.1	8.4	31.6	27.9	14.9	14.9	9.3	
13	7.4	6.5	4.6	4.6	3.7	9.3	8.4	26.9	26.9	13.0	14.9	9.3	
14	7.4	6.5	4.6	4.6	3.7	7.4	7.4	18.6	26.0	12.1	13.0	9.3	
15	7.4	6.5	4.6	4.6	3.7	9.3	6.5	14.9	28.8	12.1	11.1	9.3	
16	7.4	6.5	4.6	4.6	3.7	10.2	5.6	12.1	31.6	12.1	10.2	9.3	
17	6.5	6.5	4.6	4.6	3.7	10.2	6.5	15.8	29.7	12.1	10.2	9.3	
18	6.5	6.5	4.6	4.6	3.7	7.4	5.6	16.7	27.8	12.1	10.2	9.3	
19	6.5	6.5	4.6	4.6	3.7	8.4	7.4	21.4	26.9	11.1	10.2	9.3	
20	6.5	6.5	4.6	4.6	3.7	7.4	10.2	18.6	29.7	11.1	10.2	8.4	
21	6.5	6.5	4.6	4.6	3.7	8.4	8.4	16.7	29.7	11.1	10.2	7.4	
22	6.5	6.5	4.6	4.6	3.7	9.3	6.5	13.9	26.9	12.1	10.2	7.4	
23	6.5	6.5	4.6	4.6	5.6	11.1	5.6	25.1	24.1	11.1	10.2	7.4	
24	6.5	6.5	4.6	4.6	4.6	9.3	9.3	34.4	24.1	11.1	10.2	7.4	
25	6.5	6.5	4.6	4.6	3.7	8.4	10.2	26.0	24.1	11.1	10.2	7.4	
26	6.5	6.5	4.6	4.6	11.1	6.5	7.4	26.0	23.2	11.1	10.2	7.4	
27	6.5	6.5	4.6	4.6	8.4	5.6	8.4	26.9	23.2	11.1	10.2	6.5	
28	6.5	6.5	4.6	4.6	6.5	5.6	13.0	25.1	23.2	11.1	10.2	6.5	
29	6.5		8.4	4.6	4.6	5.6	14.8	24.1	22.3	11.1	9.3	6.5	
30	6.5		5.6	4.6	3.7	5.6	14.9	22.3	21.4	11.1	9.3	6.5	
31	6.5		4.6		3.7		14.9	22.3		11.1		6.5	
Average	7.3	6.5	5.2	4.7	4.5	7.4	8.1	17.5	27.5	14.6	10.9	8.4	10.2
Max.	8.4	6.5	8.4	5.6	11.1	11.1	14.9	34.4	37.1	24.1	14.9	9.3	37.1

Year **1975** (6-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	6.5	4.6	4.6	3.7	3.7	6.5	8.4	25.1	26.9	20.4	10.2	
2	6.5	6.5	4.6	4.6	3.7	3.7	6.5	9.3	23.2	23.2	16.7	10.2	
3	6.5	6.5	4.6	4.6	3.7	5.6	6.5	17.6	22.3	20.4	13.9	10.2	
4	6.5	6.5	4.6	4.6	3.7	30.6	7.4	15.8	21.4	18.6	12.1	10.2	
5	6.5	6.5	4.6	4.6	3.7	17.6	6.5	13.0	22.3	18.6	12.1	10.2	
6	6.5	6.5	4.6	4.6	3.7	12.1	7.4	12.1	20.4	18.6	12.1	9.3	
7	6.5	6.5	4.6	4.6	3.7	10.2	11.1	15.8	21.4	18.6	12.1	9.3	
8	6.5	6.5	4.6	4.6	4.6	10.2	12.1	15.8	19.5	17.6	12.1	9.3	
9	6.5	6.5	4.6	4.6	9.3	7.4	11.1	13.9	22.3	17.6	12.1	9.3	
10	11.1	6.5	4.6	4.6	5.6	5.6	9.3	13.0	20.4	18.6	12.1	9.3	
11	17.6	6.5	4.6	4.6	5.6	4.6	7.4	13.0	24.1	16.7	13.0	9.3	
12	14.9	6.5	4.6	4.6	3.7	4.6	9.3	13.0	22.3	16.7	11.1	9.3	
13	12.1	6.5	4.6	4.6	3.7	4.6	9.3	12.1	24.1	15.8	11.1	9.3	
14	9.3	6.5	4.6	4.6	3.7	4.6	11.1	11.1	22.3	15.8	11.1	9.3	
15	7.4	6.5	4.6	4.6	3.7	5.6	13.0	10.2	23.2	14.9	11.1	9.3	
16	6.5	6.5	4.6	4.6	3.7	8.4	15.8	11.1	20.4	14.9	11.1	9.3	
17	7.4	6.5	4.6	4.6	3.7	9.3	16.7	12.1	19.5	13.9	12.1	9.3	
18	7.4	5.6	4.6	4.6	3.7	13.9	16.7	12.1	18.6	12.1	12.1	9.3	
19	7.4	5.6	4.6	4.6	3.7	15.8	15.8	17.6	19.5	12.1	12.1	9.3	
20	7.4	5.6	4.6	4.6	3.7	14.9	14.9	15.8	18.6	12.1	12.1	9.3	
21	7.4	5.6	4.6	3.7	3.7	13.9	13.9	14.9	18.6	12.1	12.1	9.3	
22	7.4	5.6	4.6	3.7	4.6	11.1	11.1	17.6	20.4	12.1	12.1	9.3	
23	7.4	5.6	4.6	3.7	4.6	12.1	9.3	14.9	21.4	13.0	11.1	9.3	
24	7.4	5.6	4.6	3.7	4.6	10.2	8.4	13.0	22.3	12.1	11.1	9.3	
25	7.4	4.6	4.6	3.7	2.8	7.4	8.4	20.4	20.4	13.9	10.2	8.4	
26	7.4	4.6	4.6	3.7	10.2	5.6	8.4	20.4	18.6	13.0	10.2	8.4	
27	6.5	4.6	4.6	3.7	11.1	7.4	8.4	19.5	19.5	11.1	10.2	8.4	
28	6.5	4.6	4.6	3.7	9.3	7.4	10.2	18.6	19.5	11.1	10.2	8.4	
29	6.5		4.6	3.7	5.6	7.4	8.4	19.5	18.6	11.1	10.2	8.4	
30	6.5		4.6	3.7	3.7	7.4	8.4	22.3	19.5	14.8	10.2	8.4	
31	6.5		4.6		3.7		8.4	24.1		16.7		8.4	
Average	7.9	6.0	4.6	4.3	4.8	9.4	10.2	15.1	21.0	15.6	12.0	9.2	10.0
Max.	17.6	6.5	4.6	4.6	11.1	30.6	16.7	24.1	25.1	26.9	20.4	10.2	30.6

Simulated Daily Discharge at UB-1 by Tank Model

Year **1976** (7-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	6.5	6.5	4.6	4.6	3.7	4.6	20.4	27.9	24.1	12.1	9.3	
2	8.4	6.5	6.5	4.6	4.6	3.7	4.6	18.6	25.1	22.3	12.1	9.3	
3	8.4	6.5	6.5	4.6	13.0	3.7	5.6	36.2	22.3	22.3	12.1	9.3	
4	8.4	6.5	6.5	4.6	15.8	3.7	8.4	28.8	22.3	26.9	12.1	9.3	
5	8.4	6.5	6.5	4.6	10.2	3.7	7.4	22.3	20.4	25.1	11.1	9.3	
6	8.4	6.5	5.6	4.6	6.5	9.3	9.3	20.4	18.6	23.2	11.1	9.3	
7	8.4	6.5	5.6	4.6	4.6	7.4	13.9	18.6	18.6	22.3	11.1	9.3	
8	8.4	6.5	5.6	4.6	4.6	8.4	22.3	18.6	18.6	21.4	11.1	9.3	
9	8.4	6.5	5.6	4.6	3.7	10.2	43.6	17.6	18.6	21.4	11.1	9.3	
10	8.4	6.5	5.6	4.6	4.6	13.0	35.3	18.6	17.6	20.4	11.1	9.3	
11	8.4	6.5	5.6	4.6	4.6	17.6	26.9	20.4	17.6	19.5	11.1	9.3	
12	8.4	6.5	5.6	4.6	3.7	21.4	15.8	19.5	17.6	18.6	11.1	9.3	
13	8.4	6.5	4.6	4.6	3.7	31.6	12.1	20.4	18.6	16.7	11.1	9.3	
14	7.4	6.5	4.6	4.6	11.1	15.8	9.3	22.3	21.4	14.9	11.1	9.3	
15	7.4	6.5	4.6	4.6	9.3	12.1	10.2	26.9	20.4	13.9	10.2	9.3	
16	7.4	6.5	4.6	4.6	6.5	8.4	10.2	26.0	18.6	13.0	10.2	9.3	
17	7.4	6.5	4.6	4.6	4.6	5.6	11.1	23.2	16.7	12.1	10.2	9.3	
18	7.4	6.5	4.6	4.6	4.6	4.6	11.1	21.3	15.8	12.1	10.2	8.4	
19	6.5	6.5	4.6	4.6	4.6	5.6	10.2	19.5	15.8	12.1	10.2	8.4	
20	6.5	6.5	4.6	4.6	3.7	5.6	11.1	19.5	14.9	14.8	10.2	8.4	
21	6.5	6.5	4.6	4.6	3.7	5.6	8.4	19.5	15.8	16.7	10.2	8.4	
22	6.5	6.5	4.6	4.6	3.7	5.6	7.4	19.5	18.6	23.2	10.2	8.4	
23	6.5	6.5	4.6	4.6	3.7	5.6	7.4	20.4	28.8	18.6	10.2	8.4	
24	6.5	6.5	4.6	4.6	3.7	4.6	9.3	19.5	32.5	15.8	10.2	8.4	
25	6.5	6.5	4.6	4.6	3.7	4.6	16.7	19.5	26.9	13.0	9.3	8.4	
26	6.5	6.5	4.6	4.6	3.7	4.6	16.7	18.6	26.9	12.1	9.3	8.4	
27	6.5	6.5	4.6	4.6	3.7	4.6	15.8	18.6	25.1	12.1	9.3	8.4	
28	6.5	6.5	4.6	4.6	3.7	4.6	13.9	18.6	27.9	12.1	9.3	8.4	
29	6.5	6.5	4.6	4.6	3.7	4.6	11.1	24.1	25.1	12.1	9.3	8.4	
30	6.5		4.6	4.6	3.7	4.6	11.1	24.1	26.9	12.1	9.3	8.4	
31	6.5		4.6		3.7		15.8	22.3		12.1		8.4	
Average	7.4	6.5	5.2	4.6	5.5	8.1	13.4	21.4	21.4	17.3	10.6	8.9	10.9
Max.	8.4	6.5	6.5	4.6	15.8	31.6	43.6	36.2	32.5	26.9	12.1	9.3	43.6

Year **1977** (8-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	9.3	6.5	5.6	4.6	4.6	3.7	6.5	26.0	16.7	11.1	10.2	8.4	
2	8.4	6.5	5.6	4.6	3.7	3.7	6.5	17.6	14.9	10.2	11.1	8.4	
3	7.4	6.5	5.6	6.5	3.7	3.7	8.4	17.6	12.1	10.2	11.1	8.4	
4	7.4	6.5	4.6	5.6	3.7	2.8	8.4	16.7	13.0	10.2	11.1	8.4	
5	7.4	6.5	4.6	7.4	3.7	2.8	7.4	17.6	27.8	12.1	11.1	8.4	
6	7.4	6.5	4.6	4.6	3.7	2.8	6.5	16.7	18.6	11.1	11.1	8.4	
7	7.4	6.5	4.6	4.6	3.7	2.8	5.6	13.9	16.7	10.2	11.1	7.4	
8	7.4	6.5	4.6	4.6	3.7	2.8	5.6	11.1	18.6	14.9	10.2	7.4	
9	6.5	6.5	4.6	7.4	3.7	2.8	5.6	11.1	20.4	14.9	11.1	7.4	
10	6.5	6.5	4.6	7.4	3.7	2.8	5.6	9.3	16.7	13.9	11.1	7.4	
11	6.5	6.5	4.6	5.6	3.7	2.8	4.6	8.4	14.9	16.7	11.1	7.4	
12	6.5	6.5	4.6	4.6	3.7	2.8	4.6	7.4	18.6	14.9	11.1	7.4	
13	6.5	6.5	4.6	4.6	3.7	2.8	4.6	7.4	15.8	17.6	11.1	6.5	
14	6.5	6.5	4.6	4.6	6.5	2.8	4.6	8.4	14.9	13.9	11.1	6.5	
15	6.5	6.5	4.6	4.6	5.6	2.8	5.6	8.4	15.8	11.1	11.1	6.5	
16	6.5	6.5	4.6	4.6	3.7	2.8	6.5	8.4	22.3	10.2	10.2	6.5	
17	6.5	6.5	4.6	4.6	3.7	2.8	4.6	8.4	19.5	10.2	10.2	6.5	
18	6.5	6.5	4.6	4.6	3.7	2.8	8.4	8.4	17.6	10.2	10.2	6.5	
19	6.5	6.5	4.6	4.6	3.7	2.8	7.4	8.4	15.8	10.2	10.2	6.5	
20	6.5	6.5	4.6	4.6	3.7	2.8	4.6	8.4	16.7	10.2	10.2	6.5	
21	6.5	6.5	4.6	4.6	3.7	2.8	4.6	8.4	16.7	11.1	10.2	6.5	
22	6.5	6.5	4.6	4.6	3.7	4.6	4.6	8.4	16.7	11.1	10.2	6.5	
23	6.5	6.5	4.6	4.6	3.7	5.6	8.4	8.4	16.7	11.1	10.2	6.5	
24	6.5	6.5	4.6	4.6	3.7	7.4	10.2	11.1	15.8	18.6	10.2	6.5	
25	6.5	5.6	4.6	4.6	3.7	7.4	8.4	12.1	14.9	16.7	10.2	6.5	
26	6.5	5.6	4.6	4.6	5.6	18.6	8.4	9.3	13.9	13.0	9.3	6.5	
27	6.5	5.6	4.6	4.6	4.6	25.1	7.4	8.4	13.0	11.1	8.4	6.5	
28	6.5	5.6	4.6	4.6	3.7	13.9	7.4	8.4	12.1	11.1	8.4	7.4	
29	6.5		4.6	4.6	3.7	11.1	18.6	8.4	11.1	13.0	8.4	6.5	
30	6.5		4.6	4.6	3.7	8.4	32.5	10.2	10.2	11.1	8.4	6.5	
31	6.5		4.6		3.7		33.4	12.1		11.1		6.5	
Average	6.8	6.4	4.7	5.0	4.0	5.4	8.6	11.1	16.3	12.4	10.3	7.1	8.2
Max.	9.3	6.5	5.6	7.4	6.5	25.1	33.4	26.0	27.8	18.6	11.1	8.4	33.4

Simulated Daily Discharge at UB-1 by Tank Model

Year **1978** (9-year) Station Upper Baluchaung W.L. Station Unit: m3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	5.6	4.6	3.7	2.8	2.8	15.8	12.1	17.6	13.9	11.1	6.5	
2	6.5	5.6	4.6	3.7	2.8	2.8	11.1	10.2	19.5	13.9	11.1	6.5	
3	6.5	4.6	4.6	3.7	2.8	2.8	13.0	12.1	19.5	13.0	10.2	6.5	
4	6.5	4.6	4.6	3.7	2.8	2.8	12.1	10.2	17.6	13.0	10.2	6.5	
5	6.5	4.6	4.6	3.7	2.8	2.8	11.1	10.2	18.6	13.0	10.2	6.5	
6	6.5	4.6	4.6	3.7	2.8	2.8	11.1	12.1	20.4	20.4	10.2	6.5	
7	6.5	4.6	4.6	3.7	2.8	2.8	9.3	11.1	18.6	17.6	10.2	6.5	
8	6.5	4.6	4.6	3.7	2.8	2.8	8.4	11.1	18.6	14.9	10.2	6.5	
9	6.5	4.6	4.6	3.7	2.8	2.8	10.2	13.9	22.3	13.0	10.2	6.5	
10	6.5	4.6	4.6	3.7	2.8	2.8	8.3	13.9	24.1	12.1	10.2	6.5	
11	6.5	4.6	4.6	3.7	2.8	2.8	9.3	13.0	22.3	12.1	9.3	6.5	
12	6.5	4.6	4.6	3.7	5.6	2.8	7.4	11.1	20.4	12.1	9.3	6.5	
13	6.5	4.6	4.6	3.7	2.8	2.8	5.6	10.2	18.6	12.1	8.4	6.5	
14	6.5	4.6	4.6	3.7	2.8	2.8	5.6	13.9	22.3	11.1	8.4	6.5	
15	6.5	4.6	4.6	3.7	2.8	2.8	8.3	13.9	22.3	10.2	8.4	6.5	
16	6.5	4.6	4.6	3.7	2.8	6.5	6.5	12.1	19.5	10.2	8.4	6.5	
17	6.5	4.6	4.6	3.7	2.8	5.6	7.4	10.2	18.6	11.1	8.4	6.5	
18	6.5	4.6	4.6	3.7	2.8	3.7	7.4	15.8	17.6	11.1	8.4	6.5	
19	6.5	4.6	4.6	3.7	3.7	2.8	7.4	14.9	17.6	10.2	8.4	6.5	
20	6.5	4.6	4.6	3.7	10.2	5.6	6.5	16.7	16.7	10.2	8.4	6.5	
21	6.5	4.6	4.6	3.7	8.4	4.6	6.5	19.5	15.8	10.2	8.4	6.5	
22	6.5	4.6	4.6	3.7	4.6	3.7	5.6	20.4	14.9	10.2	7.4	6.5	
23	6.5	4.6	4.6	3.7	2.8	3.7	6.5	17.6	17.6	10.2	7.4	6.5	
24	6.5	4.6	4.6	3.7	2.8	6.5	8.3	16.7	17.6	10.2	7.4	6.5	
25	6.5	4.6	4.6	3.7	2.8	19.5	8.3	17.6	17.6	10.2	6.5	6.5	
26	6.5	4.6	4.6	3.7	2.8	19.5	6.5	16.7	19.5	10.2	6.5	6.5	
27	5.6	4.6	4.6	3.7	2.8	14.9	6.5	15.8	20.4	11.1	6.5	6.5	
28	5.6	4.6	4.6	3.7	2.8	26.9	9.3	14.9	16.7	11.1	6.5	6.5	
29	5.6		4.6	3.7	2.8	42.7	10.2	19.5	14.9	11.1	6.5	6.5	
30	5.6		3.7	2.8	2.8	25.1	8.4	17.6	13.9	11.1	6.5	6.5	
31	5.6		3.7		2.8		9.3	16.7		11.1		6.5	
Average	6.4	4.7	4.6	3.7	3.4	7.8	8.6	14.2	18.7	12.0	8.6	6.5	8.3
Max.	6.5	5.6	4.6	3.7	10.2	42.7	15.8	20.4	24.1	20.4	11.1	6.5	42.7

Year **1979** (10-year) Station Upper Baluchaung W.L. Station Unit: m3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	4.6	4.6	3.7	2.8	3.7	30.6	7.4	11.1	9.3	8.4	6.5	
2	6.5	4.6	4.6	3.7	2.8	2.8	35.3	8.4	12.1	10.2	8.4	6.5	
3	6.5	4.6	4.6	3.7	2.8	2.8	26.0	7.4	13.0	9.3	8.4	6.5	
4	6.5	4.6	4.6	3.7	2.8	5.6	15.8	13.0	12.1	9.3	8.4	6.5	
5	6.5	4.6	4.6	3.7	2.8	3.7	16.7	14.8	11.1	9.3	8.4	6.5	
6	6.5	4.6	4.6	3.7	2.8	3.7	13.9	14.8	11.1	9.3	7.4	6.5	
7	6.5	4.6	4.6	3.7	2.8	2.8	12.1	13.9	11.1	13.9	7.4	6.5	
8	6.5	4.6	4.6	3.7	2.8	2.8	10.2	13.0	10.2	14.9	7.4	6.5	
9	6.5	4.6	4.6	3.7	2.8	2.8	8.3	11.1	10.2	11.1	7.4	6.5	
10	5.6	4.6	4.6	3.7	2.8	2.8	6.5	11.1	10.2	9.3	7.4	6.5	
11	5.6	4.6	4.6	3.7	2.8	2.8	6.5	8.4	10.2	11.1	7.4	6.5	
12	5.6	4.6	4.6	3.7	2.8	2.8	7.4	7.4	9.3	11.1	7.4	6.5	
13	5.6	4.6	3.7	3.7	2.8	2.8	11.1	8.4	9.3	10.2	7.4	5.6	
14	5.6	4.6	3.7	2.8	2.8	12.1	8.3	9.3	9.3	9.3	7.4	5.6	
15	5.6	4.6	3.7	2.8	2.8	19.5	6.5	11.1	10.2	9.3	7.4	5.6	
16	5.6	4.6	3.7	2.8	2.8	12.1	6.5	14.9	10.2	9.3	7.4	5.6	
17	4.6	4.6	3.7	2.8	2.8	10.2	6.5	14.9	10.2	9.3	6.5	5.6	
18	4.6	4.6	3.7	2.8	2.8	7.4	6.5	13.0	10.2	9.3	6.5	5.6	
19	4.6	4.6	3.7	2.8	2.8	9.3	5.6	13.9	11.1	9.3	6.5	5.6	
20	4.6	4.6	3.7	2.8	2.8	10.2	5.6	18.6	9.3	9.3	6.5	4.6	
21	4.6	4.6	3.7	2.8	2.8	7.4	5.6	16.7	11.1	9.3	6.5	4.6	
22	4.6	4.6	3.7	2.8	2.8	8.4	5.6	13.9	11.1	9.3	6.5	4.6	
23	4.6	4.6	3.7	2.8	2.8	8.4	6.5	12.1	10.2	9.3	6.5	4.6	
24	4.6	4.6	3.7	2.8	2.8	8.4	6.5	12.1	11.1	9.3	6.5	4.6	
25	4.6	4.6	3.7	2.8	5.6	8.4	6.5	16.7	9.3	9.3	6.5	4.6	
26	4.6	4.6	3.7	2.8	4.6	5.6	6.5	15.8	9.3	8.4	6.5	4.6	
27	4.6	4.6	3.7	2.8	4.6	8.4	6.5	13.0	9.3	8.4	6.5	4.6	
28	4.6	4.6	3.7	2.8	2.8	11.1	6.5	12.1	9.3	8.4	6.5	4.6	
29	4.6		3.7	2.8	2.8	13.0	6.5	11.1	11.1	8.4	6.5	4.6	
30	4.6		3.7	2.8	2.8	14.9	6.5	11.1	9.3	8.4	6.5	4.6	
31	4.6		3.7		2.8		6.5	12.1		8.4		4.6	
Average	5.4	4.6	4.1	3.2	3.0	7.2	10.2	12.3	10.4	9.7	7.2	5.6	6.9
Max.	6.5	4.6	4.6	3.7	5.6	19.5	35.3	18.6	13.0	14.9	8.4	6.5	35.3

Simulated Daily Discharge at UB-1 by Tank Model

Year **1980** (11-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	4.6	4.6	3.7	2.8	2.8	1.9	10.2	16.7	13.9	20.4	12.1	10.2	
2	4.6	4.6	3.7	2.8	2.8	1.9	8.4	13.9	15.8	20.4	12.1	10.2	
3	4.6	4.6	3.7	2.8	2.8	2.8	6.5	11.1	15.8	19.5	13.0	10.2	
4	4.6	4.6	3.7	2.8	26.9	4.6	5.6	10.2	15.8	19.5	15.8	10.2	
5	4.6	4.6	3.7	2.8	16.7	7.4	5.6	9.3	24.1	21.4	13.0	10.2	
6	4.6	4.6	3.7	2.8	13.0	9.3	5.6	8.4	18.6	18.6	11.1	10.2	
7	4.6	4.6	3.7	2.8	10.2	11.1	5.6	8.4	15.8	21.4	11.1	10.2	
8	4.6	4.6	3.7	2.8	6.5	8.4	5.6	7.4	18.6	21.4	11.1	10.2	
9	4.6	4.6	3.7	2.8	4.6	6.5	5.6	7.4	21.4	20.4	13.0	9.3	
10	4.6	4.6	3.7	2.8	3.7	4.7	5.6	7.4	17.6	18.6	11.1	9.3	
11	4.6	4.6	3.7	2.8	3.7	5.6	4.6	9.3	20.4	17.6	11.1	9.3	
12	4.6	4.6	3.7	2.8	3.7	8.4	4.6	7.4	20.4	16.7	11.1	9.3	
13	4.6	3.7	3.7	2.8	3.7	12.1	4.6	7.4	17.6	18.6	11.1	9.3	
14	4.6	3.7	3.7	2.8	3.7	12.1	4.6	7.4	16.7	20.4	11.1	9.3	
15	4.6	3.7	2.8	2.8	2.8	11.1	4.6	6.5	18.6	18.6	11.1	9.3	
16	4.6	3.7	2.8	2.8	2.8	9.3	4.6	7.4	20.4	19.5	11.1	9.3	
17	4.6	3.7	2.8	2.8	2.8	6.5	4.6	7.4	23.2	17.6	11.1	9.3	
18	4.6	3.7	2.8	2.8	2.8	5.6	4.6	7.4	21.4	16.7	11.1	9.3	
19	4.6	3.7	2.8	2.8	2.8	3.7	4.6	7.4	20.4	19.5	11.1	8.4	
20	4.6	3.7	2.8	2.8	2.8	4.7	4.6	7.4	17.6	19.5	11.1	8.4	
21	4.6	3.7	2.8	2.8	2.8	7.4	5.6	9.3	17.6	17.6	10.2	8.4	
22	4.6	3.7	2.8	2.8	2.8	9.3	7.4	9.3	20.4	16.7	10.2	8.4	
23	4.6	3.7	2.8	2.8	1.9	8.4	7.4	10.2	18.6	15.8	10.2	8.4	
24	4.6	3.7	2.8	2.8	1.9	7.4	13.9	9.3	19.5	14.9	11.1	8.4	
25	4.6	3.7	2.8	2.8	1.9	8.4	13.9	10.2	19.5	14.9	10.2	8.4	
26	4.6	3.7	2.8	2.8	1.9	6.5	10.2	14.9	19.5	13.0	10.2	8.4	
27	4.6	3.7	2.8	2.8	1.9	6.5	11.1	13.9	17.6	12.1	10.2	7.4	
28	4.6	3.7	2.8	2.8	1.9	5.6	8.3	12.1	18.6	11.1	10.2	7.4	
29	4.6	3.7	2.8	2.8	1.9	6.5	6.5	9.3	20.4	11.1	10.2	6.5	
30	4.6		2.8	2.8	1.9	8.4	12.1	12.1	22.3	11.1	10.2	6.5	
31	4.6		2.8		1.9		16.7	14.9		11.1		6.5	
Average	4.6	4.1	3.2	2.8	4.6	7.1	7.2	9.7	18.9	17.3	11.3	8.9	8.3
Max.	4.6	4.6	3.7	2.8	26.9	12.1	16.7	16.7	24.1	21.4	15.8	10.2	26.9

Year **1981** (12-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	6.5	4.6	4.6	3.7	4.6	12.1	15.8	16.7	10.2	9.3	9.3	
2	6.5	6.5	4.6	4.6	3.7	7.4	14.9	13.9	16.7	10.2	9.3	9.3	
3	6.5	6.5	4.6	4.6	3.7	10.2	15.8	13.0	15.8	10.2	9.3	9.3	
4	6.5	6.5	4.6	4.6	3.7	13.0	13.9	13.0	14.9	10.2	8.4	9.3	
5	6.5	6.5	4.6	4.6	3.7	11.1	12.1	12.1	13.9	13.9	8.4	9.3	
6	6.5	6.5	4.6	4.6	3.7	8.4	15.8	12.1	13.9	13.0	8.4	9.3	
7	6.5	6.5	4.6	4.6	3.7	9.3	21.3	11.1	15.8	11.1	19.5	9.3	
8	6.5	6.5	4.6	4.6	3.7	13.0	14.9	12.1	16.7	11.1	15.8	8.4	
9	6.5	6.5	4.6	4.6	3.7	9.3	13.9	12.1	16.7	11.1	20.4	7.4	
10	6.5	6.5	4.6	4.6	3.7	7.4	13.0	13.0	13.9	11.1	16.7	7.4	
11	6.5	6.5	4.6	4.6	3.7	7.4	11.1	15.8	13.9	11.1	15.8	7.4	
12	6.5	6.5	4.6	4.6	3.7	8.4	11.1	19.5	13.0	10.2	13.0	7.4	
13	6.5	6.5	4.6	4.6	3.7	6.5	9.3	17.6	13.0	10.2	11.2	7.4	
14	6.5	6.5	4.6	4.6	9.3	5.6	7.4	15.8	12.1	13.0	9.3	7.4	
15	6.5	5.6	4.6	4.6	5.6	5.6	8.4	14.9	11.1	12.1	9.3	7.4	
16	6.5	5.6	4.6	4.6	3.7	5.6	8.4	16.7	10.2	10.2	9.3	7.4	
17	6.5	5.6	4.6	4.6	3.7	5.6	8.4	14.9	10.2	10.2	11.2	7.4	
18	6.5	5.6	4.6	3.7	7.4	5.6	8.4	14.9	10.2	11.1	12.1	7.4	
19	6.5	5.6	4.6	6.5	13.0	9.3	7.4	13.9	10.2	10.2	13.0	7.4	
20	6.5	5.6	4.6	4.6	12.1	8.4	7.4	14.9	10.2	10.2	11.2	7.4	
21	6.5	4.6	4.6	3.7	8.4	7.4	7.4	17.6	10.2	10.2	14.9	7.4	
22	6.5	4.6	4.6	3.7	8.4	5.6	7.4	20.4	11.1	10.2	13.0	7.4	
23	6.5	4.6	4.6	3.7	6.5	7.4	7.4	22.3	10.2	10.2	10.2	7.4	
24	6.5	4.6	4.6	3.7	3.7	8.4	7.4	21.4	10.2	10.2	9.3	7.4	
25	6.5	4.6	4.6	3.7	4.6	6.5	13.0	23.2	10.2	10.2	9.3	7.4	
26	6.5	4.6	4.6	3.7	4.6	5.6	14.9	21.4	10.2	10.2	9.3	7.4	
27	6.5	4.6	4.6	3.7	3.7	5.6	20.4	18.6	10.2	10.2	9.3	7.4	
28	6.5	4.6	4.6	3.7	5.6	5.6	26.9	16.7	10.2	10.2	9.3	7.4	
29	6.5		4.6	3.7	3.7	5.6	27.8	16.7	10.2	10.2	9.3	6.5	
30	6.5		4.6	3.7	3.7	8.4	23.2	16.7	10.2	10.2	9.3	6.5	
31	6.5		4.6		4.6		18.6	16.7		9.3		6.5	
Average	6.5	5.8	4.6	4.4	5.2	7.6	13.2	16.1	12.4	10.7	11.5	7.8	8.8
Max.	6.5	6.5	4.6	6.5	13.0	13.0	27.8	23.2	16.7	13.9	20.4	9.3	27.8

Simulated Daily Discharge at UB-1 by Tank Model

Year **1982** (13-year) Station Upper Baluchaung W.L. Station Unit: m3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	6.5	4.6	4.6	3.7	14.9	9.3	14.9	27.8	26.9	13.9	10.2	
2	6.5	6.5	4.6	4.6	3.7	13.0	13.9	18.6	28.8	33.4	13.0	10.2	
3	6.5	6.5	4.6	4.6	3.7	10.2	23.2	16.7	62.2	30.6	13.0	10.2	
4	6.5	6.5	4.6	4.6	3.7	15.8	21.3	13.9	54.8	28.8	13.0	10.2	
5	6.5	5.6	4.6	4.6	3.7	12.1	15.8	13.9	52.0	26.9	13.0	10.2	
6	6.5	5.6	4.6	4.6	3.7	8.4	11.1	13.9	57.6	31.6	13.0	10.2	
7	6.5	5.6	4.6	4.6	4.6	5.6	8.4	22.3	45.5	29.7	13.0	10.2	
8	6.5	5.6	4.6	4.6	3.7	5.6	7.4	30.6	40.8	27.8	13.0	10.2	
9	6.5	5.6	4.6	3.7	3.7	5.6	8.4	25.1	39.0	26.9	13.0	10.2	
10	6.5	5.6	4.6	3.7	2.8	8.4	8.4	20.4	38.1	26.0	13.0	10.2	
11	6.5	5.6	4.6	3.7	2.8	5.6	8.4	19.5	35.3	25.1	13.0	9.3	
12	6.5	4.6	4.6	3.7	2.8	5.6	8.4	19.5	33.4	25.1	12.1	9.3	
13	6.5	4.6	4.6	3.7	2.8	11.1	8.4	24.1	32.5	25.1	13.9	8.4	
14	6.5	4.6	4.6	3.7	2.8	9.3	8.4	24.1	32.5	26.9	13.0	8.4	
15	6.5	4.6	4.6	3.7	2.8	11.1	8.4	22.3	31.6	24.1	12.1	8.4	
16	6.5	4.6	4.6	3.7	2.8	11.1	8.4	23.2	32.5	24.1	12.1	8.4	
17	6.5	4.6	4.6	3.7	3.7	11.1	7.4	23.2	31.6	24.1	11.1	8.4	
18	6.5	4.6	4.6	3.7	5.6	10.2	7.4	24.1	30.6	23.2	11.1	8.4	
19	6.5	4.6	4.6	3.7	4.6	9.3	7.4	26.0	29.7	21.4	11.1	8.4	
20	6.5	4.6	4.6	3.7	2.8	9.3	7.4	23.2	28.8	20.4	11.1	8.4	
21	6.5	4.6	4.6	3.7	6.5	9.3	7.4	24.1	27.8	19.5	11.1	8.4	
22	6.5	4.6	4.6	3.7	3.7	7.4	7.4	25.1	26.0	18.6	11.1	8.4	
23	6.5	4.6	4.6	3.7	2.8	7.4	7.4	31.6	25.1	16.7	11.1	8.4	
24	6.5	4.6	4.6	3.7	2.8	7.4	7.4	41.8	32.5	15.8	11.1	8.4	
25	6.5	4.6	4.6	3.7	4.6	8.4	7.4	32.5	37.1	15.8	11.1	8.4	
26	6.5	4.6	4.6	3.7	2.8	9.3	7.4	28.8	33.4	14.9	11.1	8.4	
27	6.5	4.6	4.6	3.7	2.8	9.3	9.3	26.9	30.6	13.9	10.2	8.4	
28	6.5	4.6	4.6	3.7	4.6	9.3	10.2	31.6	29.7	13.0	10.2	8.4	
29	6.5		4.6	3.7	7.4	8.4	12.1	31.6	26.9	13.0	10.2	8.4	
30	6.5		4.6	3.7	8.4	7.4	12.1	29.7	26.9	13.0	10.2	8.4	
31	6.5		4.6		6.5		12.1	27.8		13.9		8.4	
Average	6.5	5.1	4.6	4.0	4.0	9.2	9.9	24.2	35.4	22.5	12.0	9.0	12.2
Max.	6.5	6.5	4.6	4.6	8.4	15.8	23.2	41.8	62.2	33.4	13.9	10.2	62.2

Year **1983** (14-year) Station Upper Baluchaung W.L. Station Unit: m3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	6.5	6.5	4.6	4.6	8.4	7.4	10.2	17.6	11.1	13.9	13.0	
2	8.4	6.5	6.5	4.6	4.6	6.5	11.1	10.2	15.8	10.2	13.9	13.0	
3	8.4	6.5	6.5	4.6	4.6	5.6	11.1	9.3	16.7	10.2	19.5	13.0	
4	8.4	6.5	6.5	4.6	4.6	7.4	12.1	8.4	14.9	13.0	17.6	13.0	
5	8.4	6.5	6.5	4.6	4.6	7.4	12.1	9.3	13.9	16.7	17.6	12.1	
6	8.4	6.5	6.5	4.6	4.6	8.4	10.2	8.4	13.9	15.8	15.8	12.1	
7	8.4	6.5	6.5	4.6	4.6	6.5	8.4	7.4	13.0	13.0	14.9	12.1	
8	8.4	6.5	6.5	4.6	4.6	10.2	8.4	9.3	12.1	14.9	13.9	12.1	
9	8.4	6.5	5.6	4.6	4.6	15.8	8.4	10.2	11.1	25.1	13.0	12.1	
10	8.4	6.5	5.6	4.6	3.7	32.5	8.4	8.4	11.1	29.7	16.7	12.1	
11	8.4	6.5	5.6	4.6	3.7	39.9	7.4	7.4	10.2	23.2	22.3	12.1	
12	8.4	6.5	5.6	4.6	3.7	41.8	7.4	8.4	10.2	19.5	20.4	12.1	
13	8.4	6.5	5.6	4.6	3.7	36.2	7.4	9.3	12.1	18.6	24.1	12.1	
14	8.4	6.5	5.6	4.6	3.7	28.8	7.4	9.3	12.1	17.6	42.7	12.1	
15	7.4	6.5	5.6	4.6	3.7	24.1	7.4	8.4	13.0	18.6	46.4	12.1	
16	7.4	6.5	4.6	4.6	3.7	21.4	7.4	8.4	12.1	22.3	30.6	12.1	
17	7.4	6.5	4.6	4.6	3.7	17.6	7.4	9.3	12.1	19.5	27.9	12.1	
18	7.4	6.5	4.6	4.6	3.7	19.5	7.4	9.3	11.1	20.4	25.1	11.1	
19	7.4	6.5	4.6	4.6	3.7	16.7	7.4	9.3	11.1	20.4	22.3	11.1	
20	6.5	6.5	4.6	5.6	3.7	12.1	7.4	9.3	11.1	19.5	21.4	11.1	
21	6.5	6.5	4.6	5.6	3.7	9.3	7.4	9.3	13.0	23.2	22.3	11.1	
22	6.5	6.5	4.6	4.6	3.7	7.4	7.4	9.3	18.6	22.3	22.3	11.1	
23	6.5	6.5	4.6	4.6	3.7	8.4	7.4	9.3	15.8	20.4	21.4	11.1	
24	6.5	6.5	4.6	4.6	3.7	7.4	7.4	10.2	13.9	18.6	21.4	11.1	
25	6.5	6.5	4.6	4.6	3.7	8.4	7.4	9.3	12.1	18.6	20.4	11.1	
26	6.5	6.5	4.6	4.6	3.7	8.4	9.3	10.2	12.1	18.6	17.6	11.1	
27	6.5	6.5	4.6	4.6	3.7	6.5	8.4	13.9	11.1	18.6	16.7	17.6	
28	6.5	6.5	4.6	4.6	3.7	6.5	7.4	13.9	11.1	17.6	14.9	32.5	
29	6.5		4.6	4.6	10.2	7.4	7.4	12.1	11.1	16.7	13.9	22.3	
30	6.5		4.6	4.6	8.4	7.4	7.4	12.1	11.1	15.8	13.0	18.6	
31	6.5		4.6		9.3		8.4	15.8		14.9		15.8	
Average	7.5	6.5	5.3	4.7	4.5	14.8	8.3	9.8	12.8	18.2	20.8	13.4	10.6
Max.	8.4	6.5	6.5	5.6	10.2	41.8	12.1	15.8	18.6	29.7	46.4	32.5	46.4

Simulated Daily Discharge at UB-1 by Tank Model

Year **1984** (15-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	13.0	9.3	8.4	6.5	6.5	7.4	10.2	18.6	34.3	21.4	14.9	11.1	
2	12.1	9.3	8.4	6.5	6.5	14.9	10.2	19.5	38.1	34.4	14.9	11.1	
3	11.1	9.3	8.4	6.5	6.5	14.9	8.4	19.5	39.9	26.9	14.9	11.1	
4	11.1	9.3	8.4	6.5	6.5	34.3	9.3	20.4	37.1	25.1	14.9	11.1	
5	11.1	9.3	8.4	6.5	6.5	20.4	9.3	21.4	35.3	23.2	14.9	11.1	
6	11.1	9.3	8.4	6.5	9.3	17.6	9.3	23.2	35.3	20.4	13.9	11.1	
7	11.1	9.3	7.4	6.5	9.3	13.9	9.3	22.3	34.4	19.5	13.9	11.1	
8	11.1	9.3	7.4	6.5	6.5	13.0	9.3	23.2	33.4	19.5	13.9	11.1	
9	11.1	9.3	7.4	6.5	6.5	22.3	10.2	25.1	34.4	19.5	13.9	10.2	
10	11.1	9.3	7.4	6.5	5.6	17.6	16.7	23.2	31.6	21.4	13.9	10.2	
11	11.1	9.3	7.4	6.5	5.6	13.9	18.6	29.7	31.6	24.1	13.9	10.2	
12	11.1	9.3	6.5	6.5	4.6	12.1	23.2	27.9	30.6	28.8	13.9	10.2	
13	11.1	9.3	6.5	6.5	4.6	12.1	31.6	31.6	30.6	25.1	13.9	10.2	
14	11.1	9.3	6.5	6.5	4.6	10.2	49.2	31.6	29.7	23.2	13.9	10.2	
15	11.1	9.3	6.5	6.5	4.6	9.3	57.6	34.3	27.8	23.2	13.0	10.2	
16	11.1	8.4	6.5	6.5	6.5	10.2	48.3	39.9	26.9	22.3	13.0	10.2	
17	11.1	8.4	6.5	6.5	4.6	13.0	33.4	38.1	26.0	24.1	13.0	10.2	
18	11.1	8.4	6.5	6.5	4.6	22.3	30.6	36.2	24.1	25.1	13.0	10.2	
19	11.1	8.4	6.5	6.5	4.6	34.4	26.9	34.4	22.3	26.0	13.0	10.2	
20	11.1	8.4	6.5	6.5	4.6	40.8	25.1	37.1	22.3	26.9	13.0	9.3	
21	11.1	8.4	6.5	6.5	4.6	25.1	22.3	38.1	22.3	26.9	13.0	9.3	
22	11.1	8.4	6.5	8.4	4.6	19.5	22.3	36.2	21.4	26.0	13.0	9.3	
23	11.1	8.4	6.5	8.4	4.6	16.7	22.3	34.3	22.3	25.1	13.0	9.3	
24	10.2	8.4	6.5	6.5	4.6	17.6	22.3	36.2	22.3	23.2	12.1	9.3	
25	9.3	8.4	6.5	9.3	4.6	14.9	22.3	35.3	21.4	23.2	12.1	9.3	
26	9.3	8.4	6.5	15.8	4.6	14.9	21.4	38.1	21.4	22.3	11.1	9.3	
27	9.3	8.4	6.5	14.9	4.6	14.9	20.4	38.1	19.5	22.3	11.1	9.3	
28	9.3	8.4	6.5	14.9	4.6	13.9	20.4	38.1	18.6	21.4	11.1	9.3	
29	9.3	8.4	6.5	10.2	4.6	13.9	22.3	35.3	17.6	18.6	11.1	9.3	
30	9.3		6.5	9.3	6.5	12.1	19.5	36.2	17.6	17.6	11.1	9.3	
31	9.3		6.5		6.5		18.6	36.2		15.8		9.3	
Average	10.8	8.8	7.0	7.8	5.6	17.3	21.9	30.9	27.7	23.3	13.2	10.1	15.4
Max.	13.0	9.3	8.4	15.8	9.3	40.8	57.6	39.9	39.9	34.4	14.9	11.1	57.6

Year **1985** (16-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	8.4	6.5	5.6	8.4	9.3	32.5	14.9	27.8	27.9	13.9	13.0	
2	8.4	8.4	6.5	5.6	8.4	8.4	22.3	13.9	25.1	27.9	13.9	13.0	
3	8.4	8.4	6.5	5.6	6.5	10.2	20.4	14.9	23.2	26.9	13.9	13.0	
4	8.4	7.4	6.5	4.6	4.6	15.8	21.4	22.3	23.2	24.1	13.0	13.0	
5	8.4	7.4	6.5	4.6	4.6	16.7	22.3	20.4	22.3	22.3	13.0	13.0	
6	8.4	7.4	6.5	4.6	4.6	14.9	24.1	19.5	22.3	22.3	13.0	13.0	
7	8.4	7.4	6.5	4.6	4.6	24.1	26.9	19.5	22.3	21.4	13.0	13.0	
8	8.4	7.4	6.5	4.6	4.6	43.6	25.1	17.6	21.4	21.4	13.0	13.0	
9	8.4	6.5	6.5	4.6	4.6	51.1	25.1	15.8	21.4	20.4	13.0	13.0	
10	8.4	6.5	6.5	4.6	4.6	40.8	23.2	17.6	20.4	19.5	13.0	13.0	
11	8.4	6.5	6.5	4.6	4.6	31.6	20.4	17.6	25.1	17.6	13.0	13.0	
12	8.4	6.5	6.5	4.6	4.6	26.9	19.5	15.8	34.3	16.7	13.0	13.0	
13	8.4	6.5	6.5	4.6	4.6	17.6	18.6	15.8	31.6	15.8	13.0	13.0	
14	8.4	6.5	6.5	4.6	6.5	15.8	19.5	14.9	28.8	14.9	13.0	12.1	
15	8.4	6.5	6.5	4.6	4.6	16.7	19.5	14.9	29.7	13.9	26.0	12.1	
16	8.4	6.5	6.5	4.6	4.6	15.8	19.5	14.9	31.6	13.9	39.9	12.1	
17	8.4	6.5	6.5	4.6	4.6	15.8	19.5	19.5	28.8	16.7	39.9	12.1	
18	8.4	6.5	6.5	4.6	4.6	15.8	19.5	40.8	26.0	20.4	35.3	12.1	
19	8.4	6.5	6.5	4.6	4.6	13.0	18.6	36.2	24.1	18.6	24.1	12.1	
20	8.4	6.5	6.5	4.6	6.5	10.2	18.6	30.6	23.2	15.8	22.3	12.1	
21	8.4	6.5	6.5	4.6	10.2	9.3	17.6	28.8	23.2	14.9	21.4	12.1	
22	8.4	6.5	6.5	4.6	10.2	10.2	17.6	28.8	22.3	19.5	16.7	12.1	
23	8.4	6.5	6.5	4.6	8.4	9.3	16.7	26.0	24.1	16.7	14.9	12.1	
24	8.4	6.5	6.5	4.6	6.5	10.2	16.7	23.2	25.1	17.6	13.9	12.1	
25	8.4	6.5	6.5	4.6	8.4	9.3	15.8	25.1	25.1	15.8	13.9	12.1	
26	8.4	6.5	6.5	4.6	5.6	11.1	14.9	25.1	24.1	15.8	13.9	12.1	
27	8.4	6.5	6.5	5.6	5.6	13.9	13.9	24.1	22.3	13.9	13.9	12.1	
28	8.4	6.5	6.5	4.6	5.6	17.6	13.9	26.0	22.3	13.9	13.9	12.1	
29	8.4		5.6	9.3	5.6	30.6	13.9	27.8	22.3	13.9	13.9	11.1	
30	8.4		5.6	9.3	5.6	40.8	13.0	27.8	27.9	13.9	13.9	11.1	
31	8.4		5.6		5.6		13.0	26.9		13.9		11.1	
Average	8.4	6.9	6.4	5.1	5.9	19.2	19.5	22.2	25.0	18.3	17.4	12.4	13.9
Max.	8.4	8.4	6.5	9.3	10.2	51.1	32.5	40.8	34.3	27.9	39.9	13.0	51.1

Simulated Daily Discharge at UB-1 by Tank Model

Year **1986** (17-year) Station Upper Baluchaung W.L. Station Unit: m³/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	11.1	8.4	7.4	6.5	4.6	4.6	7.4	7.4	7.4	11.1	9.3	7.4	
2	11.1	8.4	7.4	6.5	4.6	4.6	6.5	7.4	7.4	10.2	9.3	7.4	
3	11.1	8.4	9.3	6.5	4.6	4.6	6.5	7.4	7.4	9.3	8.4	7.4	
4	11.1	8.4	8.4	6.5	4.6	4.6	6.5	7.4	7.4	9.3	8.4	7.4	
5	11.1	8.4	7.4	6.5	4.6	4.6	6.5	7.4	7.4	9.3	8.4	7.4	
6	11.1	8.4	6.5	6.5	4.6	4.6	6.5	11.1	7.4	9.3	8.4	6.5	
7	11.1	8.4	6.5	6.5	4.6	4.6	8.4	9.3	32.5	9.3	8.4	6.5	
8	11.1	8.4	6.5	6.5	4.6	5.6	8.4	8.4	19.5	13.9	8.4	6.5	
9	11.1	8.4	6.5	6.5	4.6	4.6	7.4	7.4	17.6	14.9	8.4	6.5	
10	11.1	8.4	6.5	6.5	4.6	8.4	7.4	7.4	17.6	15.8	10.2	6.5	
11	11.1	8.4	6.5	6.5	4.6	8.4	6.5	7.4	15.8	17.6	13.0	6.5	
12	10.2	8.4	6.5	9.3	4.6	5.6	6.5	7.4	13.9	15.8	10.2	6.5	
13	10.2	8.4	6.5	7.4	4.6	12.1	6.5	7.4	12.1	16.7	8.4	6.5	
14	10.2	8.4	6.5	6.5	4.6	12.1	6.5	9.3	10.2	13.9	8.4	6.5	
15	10.2	8.4	6.5	6.5	4.6	10.2	6.5	8.4	10.2	12.1	8.4	6.5	
16	10.2	8.4	6.5	6.5	4.6	11.1	6.5	13.9	10.2	10.2	8.4	6.5	
17	9.3	8.4	6.5	6.5	4.6	13.9	6.5	11.1	10.2	10.2	8.4	6.5	
18	9.3	8.4	6.5	6.5	4.6	11.1	6.5	11.1	10.2	10.2	8.4	6.5	
19	9.3	8.4	6.5	6.5	4.6	9.3	6.5	12.1	10.2	10.2	8.4	6.5	
20	9.3	8.4	6.5	6.5	4.6	8.4	7.4	10.2	14.9	9.3	8.4	6.5	
21	9.3	8.4	6.5	6.5	4.6	7.4	7.4	10.2	15.8	9.3	8.4	6.5	
22	9.3	8.4	6.5	6.5	4.6	7.4	13.9	11.1	13.9	9.3	7.4	6.5	
23	9.3	8.4	6.5	5.6	4.6	5.6	15.8	12.1	13.0	9.3	7.4	6.5	
24	9.3	8.4	6.5	5.6	4.6	6.5	14.9	9.3	11.1	9.3	7.4	6.5	
25	9.3	8.4	6.5	5.6	4.6	9.3	13.9	8.4	10.2	9.3	7.4	6.5	
26	8.4	8.4	6.5	5.6	4.6	9.3	13.0	10.2	10.2	9.3	7.4	6.5	
27	8.4	8.4	6.5	5.6	4.6	11.1	13.9	8.4	10.2	11.1	7.4	6.5	
28	8.4	8.4	6.5	5.6	4.6	12.1	13.0	7.4	10.2	10.2	7.4	6.5	
29	8.4		6.5	5.6	4.6	12.1	10.2	7.4	10.2	9.3	7.4	6.5	
30	8.4		6.5	6.5	4.6	10.2	8.4	7.4	10.2	9.3	7.4	8.4	
31	8.4		6.5		4.6		7.4	7.4		9.3		8.4	
Average	9.9	8.4	6.7	6.4	4.6	8.1	8.7	9.0	12.2	11.1	8.4	6.8	8.4
Max.	11.1	8.4	9.3	9.3	4.6	13.9	15.8	13.9	32.5	17.6	13.0	8.4	32.5

Year **1987** (18-year) Station Upper Baluchaung W.L. Station Unit: m³/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	7.4	4.6	4.6	3.7	2.8	4.6	3.7	14.8	20.4	19.5	10.2	10.2	
2	6.5	4.6	4.6	3.7	2.8	7.4	9.3	13.0	19.5	18.6	10.2	10.2	
3	6.5	4.6	4.6	3.7	2.8	4.6	12.1	12.1	19.5	17.6	11.1	10.2	
4	6.5	4.6	4.6	3.7	2.8	2.8	11.1	11.1	17.6	16.7	12.1	9.3	
5	6.5	4.6	4.6	3.7	2.8	2.8	12.1	9.3	16.7	15.8	17.6	9.3	
6	6.5	4.6	4.6	3.7	2.8	2.8	13.0	7.4	16.7	16.7	14.8	9.3	
7	6.5	4.6	4.6	3.7	2.8	2.8	12.1	6.5	17.6	15.8	12.1	9.3	
8	6.5	4.6	4.6	3.7	2.8	7.4	10.2	6.5	16.7	20.4	13.9	8.4	
9	6.5	4.6	4.6	3.7	2.8	6.5	11.1	6.5	21.4	21.4	12.1	8.4	
10	6.5	4.6	4.6	7.4	2.8	7.4	11.1	6.5	19.5	20.4	11.1	8.4	
11	5.6	4.6	4.6	30.6	2.8	10.2	11.1	6.5	17.6	17.6	11.1	8.4	
12	5.6	4.6	4.6	15.8	2.8	12.1	12.1	6.5	18.6	14.9	11.1	8.4	
13	5.6	4.6	4.6	11.1	2.8	10.2	10.2	6.5	16.7	14.9	11.1	8.4	
14	5.6	4.6	3.7	7.4	2.8	9.3	9.3	6.5	16.7	14.9	11.1	8.4	
15	5.6	4.6	3.7	6.5	2.8	7.4	7.4	6.5	17.6	13.9	11.1	8.4	
16	5.6	4.6	3.7	4.6	2.8	7.4	5.6	6.5	20.4	13.0	11.1	8.4	
17	5.6	4.6	3.7	3.7	2.8	5.6	4.6	6.5	24.1	12.1	11.1	7.4	
18	4.6	4.6	3.7	3.7	2.8	3.7	4.6	9.3	27.9	11.1	11.1	7.4	
19	4.6	4.6	3.7	3.7	2.8	3.7	4.6	13.0	26.0	10.2	11.1	7.4	
20	4.6	4.6	3.7	3.7	2.8	4.6	4.6	12.1	22.3	10.2	11.1	7.4	
21	4.6	4.6	3.7	3.7	2.8	3.7	8.4	10.2	25.1	10.2	11.1	7.4	
22	4.6	4.6	3.7	3.7	2.8	3.7	6.5	8.4	26.0	10.2	11.1	7.4	
23	4.6	4.6	3.7	2.8	2.8	3.7	6.5	13.0	26.0	10.2	10.2	6.5	
24	4.6	4.6	3.7	2.8	2.8	3.7	7.4	20.4	26.0	11.1	10.2	6.5	
25	4.6	4.6	3.7	2.8	2.8	3.7	10.2	49.2	23.2	10.2	10.2	6.5	
26	4.6	4.6	3.7	2.8	2.8	3.7	11.1	49.2	20.4	10.2	10.2	6.5	
27	5.6	4.6	3.7	2.8	2.8	3.7	12.1	42.7	20.4	10.2	10.2	6.5	
28	5.6	4.6	3.7	2.8	2.8	3.7	13.9	27.9	20.4	10.2	10.2	6.5	
29	4.6		3.7	2.8	2.8	3.7	10.2	25.1	20.4	10.2	10.2	6.5	
30	4.6		3.7	2.8	2.8	3.7	8.3	22.3	19.5	10.2	10.2	6.5	
31	4.6		3.7		2.8		8.3	21.4		10.2		6.5	
Average	5.5	4.6	4.1	5.4	2.8	5.3	9.1	14.9	20.7	13.8	11.3	7.9	8.8
Max.	7.4	4.6	4.6	30.6	2.8	12.1	13.9	49.2	27.9	21.4	17.6	10.2	49.2

Simulated Daily Discharge at UB-1 by Tank Model

Year **1988** (19-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	6.5	4.6	4.6	3.7	4.6	13.9	13.0	11.1	8.4	8.4	7.4	
2	6.5	6.5	4.6	4.6	3.7	7.4	15.8	12.1	10.2	8.4	8.4	7.4	
3	6.5	6.5	4.6	4.6	3.7	11.1	12.1	11.1	10.2	9.3	8.4	7.4	
4	6.5	6.5	4.6	4.6	3.7	10.2	9.3	10.2	10.2	8.4	8.4	7.4	
5	6.5	6.5	4.6	4.6	3.7	8.4	7.4	11.1	10.2	9.3	7.4	7.4	
6	6.5	5.6	4.6	4.6	3.7	6.5	7.4	10.2	10.2	8.4	7.4	7.4	
7	6.5	5.6	4.6	4.6	3.7	5.6	6.5	14.9	11.1	8.4	7.4	7.4	
8	6.5	5.6	4.6	3.7	3.7	4.6	6.5	16.7	11.1	8.4	7.4	7.4	
9	6.5	5.6	4.6	3.7	3.7	5.6	6.5	17.6	10.2	8.4	7.4	7.4	
10	6.5	5.6	4.6	3.7	2.8	5.6	6.5	17.6	10.2	8.4	7.4	7.4	
11	6.5	5.6	4.6	3.7	2.8	5.6	6.5	16.7	10.2	8.4	7.4	6.5	
12	6.5	5.6	4.6	3.7	2.8	8.4	9.3	14.9	13.9	8.4	7.4	6.5	
13	6.5	4.6	4.6	3.7	2.8	10.2	9.3	13.9	12.1	8.4	7.4	6.5	
14	6.5	4.6	4.6	4.6	2.8	6.5	9.3	13.9	10.2	10.2	7.4	6.5	
15	6.5	4.6	4.6	5.6	2.8	4.6	8.4	15.8	10.2	10.2	7.4	6.5	
16	6.5	4.6	4.6	3.7	2.8	4.6	10.2	15.8	10.2	10.2	7.4	6.5	
17	6.5	4.6	4.6	3.7	5.6	4.6	12.1	16.7	10.2	8.4	6.5	6.5	
18	6.5	4.6	4.6	3.7	24.1	4.6	13.0	15.8	10.2	10.2	12.1	6.5	
19	6.5	4.6	4.6	3.7	22.3	4.6	11.1	13.9	10.2	12.1	18.6	6.5	
20	6.5	4.6	4.6	3.7	15.8	4.6	11.1	12.1	10.2	10.2	22.3	6.5	
21	6.5	4.6	4.6	3.7	10.2	4.6	9.3	12.1	9.3	8.4	15.8	6.5	
22	6.5	4.6	4.6	3.7	8.4	4.6	9.3	13.0	9.3	8.4	12.1	6.5	
23	6.5	4.6	4.6	3.7	8.4	5.6	7.4	13.0	9.3	8.4	9.3	6.5	
24	6.5	4.6	4.6	3.7	7.4	9.3	8.4	13.0	9.3	8.4	7.4	6.5	
25	6.5	4.6	4.6	3.7	3.7	14.9	8.4	13.0	9.3	8.4	7.4	6.5	
26	6.5	4.6	4.6	3.7	3.7	38.1	8.4	13.9	9.3	8.4	7.4	6.5	
27	6.5	4.6	4.6	3.7	3.7	32.5	8.4	13.0	9.3	8.4	7.4	6.5	
28	6.5	4.6	4.6	3.7	3.7	24.1	7.4	13.0	9.3	8.4	7.4	6.5	
29	6.5	4.6	4.6	3.7	3.7	15.8	7.4	12.1	9.3	8.4	7.4	5.6	
30	6.5		4.6	4.6	3.7	13.0	7.4	12.1	9.3	8.4	7.4	5.6	
31	6.5		4.6		3.7		13.0	11.1		8.4		5.6	
Average	6.5	5.2	4.6	4.1	5.8	9.7	9.2	13.7	10.2	8.8	9.0	6.7	7.8
Max.	6.5	6.5	4.6	5.6	24.1	38.1	15.8	17.6	13.9	12.1	22.3	7.4	38.1

Year **1989** (20-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	5.6	4.6	3.7	3.7	4.6	2.8	4.6	55.7	10.2	9.3	10.2	7.4	
2	5.6	4.6	3.7	2.8	2.8	2.8	3.7	37.1	10.2	11.1	10.2	7.4	
3	5.6	4.6	3.7	2.8	2.8	2.8	3.7	21.3	11.1	10.2	9.3	7.4	
4	5.6	4.6	3.7	2.8	2.8	2.8	3.7	15.8	11.1	13.9	9.3	7.4	
5	4.6	4.6	3.7	2.8	2.8	2.8	3.7	13.0	10.2	12.1	9.3	7.4	
6	4.6	4.6	3.7	2.8	2.8	2.8	3.7	11.1	10.2	11.1	9.3	6.5	
7	4.6	4.6	3.7	2.8	2.8	2.8	3.7	9.3	11.1	10.2	9.3	6.5	
8	4.6	4.6	3.7	2.8	2.8	2.8	3.7	7.4	13.0	11.1	9.3	6.5	
9	4.6	4.6	3.7	2.8	2.8	5.6	3.7	6.5	13.0	13.0	9.3	6.5	
10	4.6	4.6	3.7	2.8	2.8	5.6	3.7	10.2	11.1	11.1	9.3	6.5	
11	4.6	4.6	3.7	2.8	2.8	8.4	3.7	10.2	10.2	11.1	9.3	6.5	
12	4.6	4.6	3.7	2.8	3.7	5.6	3.7	8.3	10.2	11.1	8.4	6.5	
13	4.6	4.6	3.7	2.8	13.9	6.5	5.6	6.5	9.3	10.2	8.4	6.5	
14	4.6	4.6	3.7	2.8	11.1	7.4	4.6	7.4	9.3	12.1	8.4	6.5	
15	4.6	4.6	3.7	2.8	7.4	9.3	3.7	8.3	9.3	14.9	8.4	6.5	
16	4.6	4.6	3.7	2.8	3.7	10.2	3.7	10.2	9.3	13.9	8.4	6.5	
17	4.6	4.6	3.7	2.8	3.7	9.3	3.7	11.1	8.4	12.1	8.4	6.5	
18	4.6	4.6	3.7	2.8	3.7	8.4	3.7	9.3	8.4	11.1	8.4	6.5	
19	4.6	4.6	3.7	2.8	5.6	8.4	3.7	7.4	8.4	11.1	8.4	6.5	
20	4.6	4.6	3.7	2.8	3.7	5.6	3.7	8.4	8.4	12.1	8.4	6.5	
21	4.6	4.6	3.7	2.8	3.7	5.6	3.7	15.8	11.1	11.1	8.4	6.5	
22	4.6	4.6	3.7	2.8	3.7	3.7	3.7	13.9	9.3	10.2	7.4	6.5	
23	4.6	4.6	3.7	2.8	3.7	2.8	3.7	12.1	9.3	10.2	7.4	6.5	
24	4.6	4.6	3.7	2.8	2.8	3.7	3.7	10.2	12.1	10.2	7.4	6.5	
25	4.6	4.6	3.7	2.8	2.8	3.7	3.7	13.9	13.9	10.2	7.4	6.5	
26	4.6	4.6	3.7	2.8	2.8	3.7	3.7	14.9	13.9	10.2	7.4	6.5	
27	4.6	4.6	3.7	2.8	2.8	3.7	3.7	13.9	12.1	10.2	7.4	6.5	
28	4.6	4.6	3.7	2.8	2.8	3.7	9.3	13.0	10.2	10.2	7.4	6.5	
29	4.6		3.7	4.6	2.8	3.7	30.6	13.0	8.4	10.2	7.4	6.5	
30	4.6		3.7	8.4	2.8	3.7	57.6	11.1	11.1	10.2	7.4	6.5	
31	4.6		3.7		2.8		72.4	11.1		10.2		6.5	
Average	4.8	4.6	3.7	3.1	3.9	5.0	8.8	13.5	10.5	11.2	8.5	6.7	7.0
Max.	5.6	4.6	3.7	8.4	13.9	10.2	72.4	55.7	13.9	14.9	10.2	7.4	72.4

Simulated Daily Discharge at UB-1 by Tank Model

Year **1990** (21-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	5.6	4.6	4.6	3.7	2.8	5.6	14.9	25.1	16.7	13.9	12.1	9.3	
2	5.6	4.6	4.6	3.7	2.8	5.6	19.5	25.1	16.7	13.9	12.1	8.4	
3	5.6	4.6	4.6	3.7	2.8	5.6	23.2	29.7	19.5	13.0	10.2	8.4	
4	5.6	4.6	3.7	3.7	2.8	5.6	29.7	28.8	17.6	13.9	10.2	8.4	
5	5.6	4.6	3.7	2.8	2.8	6.5	22.3	29.7	15.8	13.0	10.2	8.4	
6	5.6	4.6	3.7	2.8	2.8	5.6	22.3	31.6	13.9	12.1	10.2	8.4	
7	5.6	4.6	3.7	2.8	2.8	6.5	23.2	27.9	13.0	12.1	10.2	8.4	
8	4.6	4.6	3.7	2.8	5.6	6.5	22.3	26.0	13.0	12.1	10.2	8.4	
9	4.6	4.6	3.7	2.8	12.1	9.3	19.5	24.1	13.0	12.1	10.2	8.4	
10	4.6	4.6	3.7	2.8	13.0	12.1	19.5	22.3	15.8	12.1	11.1	8.4	
11	4.6	4.6	3.7	2.8	13.0	10.2	19.5	22.3	19.5	12.1	10.2	8.4	
12	4.6	4.6	3.7	2.8	9.3	9.3	22.3	22.3	16.7	12.1	10.2	8.4	
13	4.6	4.6	3.7	2.8	7.4	9.3	22.3	21.4	13.9	12.1	10.2	8.4	
14	4.6	4.6	3.7	2.8	9.3	9.3	21.4	21.4	13.0	13.0	10.2	8.4	
15	4.6	4.6	3.7	2.8	25.1	8.4	22.3	21.4	18.6	11.1	10.2	8.4	
16	4.6	4.6	3.7	2.8	31.6	6.5	25.1	20.4	20.4	11.1	10.2	8.4	
17	4.6	4.6	3.7	2.8	43.6	7.4	24.1	19.5	17.6	11.1	10.2	8.4	
18	4.6	4.6	3.7	2.8	26.9	11.1	22.3	18.6	15.8	11.1	10.2	8.4	
19	4.6	4.6	3.7	2.8	19.5	10.2	21.3	17.6	14.9	11.1	10.2	8.4	
20	4.6	4.6	3.7	2.8	23.2	9.3	24.1	15.8	13.9	11.1	9.3	8.4	
21	4.6	4.6	3.7	2.8	15.8	9.3	24.1	14.9	13.9	11.1	9.3	8.4	
22	4.6	5.6	3.7	9.3	15.8	6.5	22.3	13.0	14.9	11.1	9.3	8.4	
23	4.6	4.6	3.7	8.4	14.9	6.5	21.4	13.0	16.7	11.1	9.3	8.4	
24	4.6	4.6	3.7	5.6	15.8	14.9	21.4	12.1	18.6	11.1	9.3	7.4	
25	4.6	4.6	3.7	3.7	12.1	21.3	20.4	11.1	16.7	10.2	9.3	7.4	
26	4.6	4.6	3.7	2.8	7.4	18.6	20.4	11.1	14.9	10.2	9.3	7.4	
27	4.6	4.6	3.7	2.8	5.6	15.8	20.4	11.1	14.9	10.2	9.3	7.4	
28	4.6	4.6	3.7	2.8	5.6	15.8	22.3	11.1	13.9	10.2	9.3	7.4	
29	4.6		3.7	2.8	5.6	14.9	22.3	12.1	13.9	10.2	9.3	6.5	
30	4.6		3.7	2.8	5.6	14.9	21.4	12.1	13.9	10.2	9.3	6.5	
31	4.6		3.7		5.6		24.1	12.1		10.2		6.5	
Average	4.9	4.7	3.8	3.4	11.9	9.9	22.0	19.5	15.7	11.6	10.0	8.1	10.5
Max.	5.6	5.6	4.6	9.3	43.6	21.3	29.7	31.6	20.4	13.9	12.1	9.3	43.6

Year **1991** (22-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	6.5	4.6	4.6	13.9	12.1	18.6	30.6	15.8	21.4	12.1	12.1	
2	6.5	6.5	4.6	4.6	9.3	12.1	17.6	30.6	14.9	18.6	12.1	12.1	
3	6.5	6.5	4.6	4.6	8.4	12.1	15.8	32.5	13.9	16.7	13.9	12.1	
4	6.5	6.5	4.6	4.6	5.6	10.2	16.7	33.4	13.0	18.6	21.3	12.1	
5	6.5	6.5	4.6	4.6	4.6	31.6	19.5	30.6	12.1	19.5	39.0	12.1	
6	6.5	6.5	4.6	4.6	4.6	36.2	19.5	29.7	12.1	16.7	49.2	12.1	
7	6.5	6.5	4.6	4.6	4.6	33.4	17.6	26.9	12.1	19.5	36.2	12.1	
8	6.5	6.5	4.6	4.6	4.6	46.4	17.6	26.9	12.1	18.6	24.1	12.1	
9	6.5	6.5	4.6	4.6	4.6	40.8	15.8	26.0	12.1	17.6	19.5	12.1	
10	6.5	6.5	4.6	4.6	4.6	37.1	15.8	25.1	12.1	16.7	15.8	12.1	
11	6.5	6.5	4.6	4.6	4.6	39.9	14.9	25.1	12.1	17.6	14.9	12.1	
12	6.5	6.5	4.6	4.6	4.6	37.1	14.9	25.1	12.1	17.6	13.9	11.1	
13	6.5	6.5	4.6	4.6	3.7	39.9	13.9	24.1	13.0	16.7	14.9	11.1	
14	6.5	6.5	4.6	4.6	4.6	25.1	12.1	23.2	13.0	16.7	14.9	11.1	
15	6.5	5.6	4.6	4.6	4.6	25.1	11.1	23.2	14.8	16.7	14.9	10.2	
16	6.5	5.6	4.6	4.6	3.7	16.7	10.2	22.3	13.0	15.8	13.9	10.2	
17	6.5	5.6	4.6	4.6	3.7	13.9	10.2	22.3	15.8	15.8	13.9	10.2	
18	6.5	5.6	4.6	3.7	3.7	15.8	13.9	21.4	13.9	14.9	13.9	10.2	
19	6.5	5.6	4.6	3.7	3.7	13.9	17.6	21.4	13.0	14.9	13.9	10.2	
20	6.5	5.6	4.6	3.7	3.7	11.1	18.6	21.4	13.0	13.9	13.9	10.2	
21	6.5	5.6	4.6	3.7	3.7	7.4	20.4	20.4	22.3	13.0	13.9	10.2	
22	6.5	4.6	4.6	3.7	3.7	8.4	28.8	20.4	35.3	13.0	13.0	10.2	
23	6.5	4.6	4.6	3.7	3.7	12.1	27.9	21.4	28.8	13.0	13.0	10.2	
24	6.5	4.6	4.6	3.7	4.6	13.9	36.2	19.5	24.1	13.0	13.0	10.2	
25	6.5	4.6	4.6	3.7	3.7	23.2	39.9	19.5	20.4	13.0	13.0	10.2	
26	6.5	4.6	4.6	3.7	3.7	18.6	29.7	19.5	17.6	13.0	13.0	18.6	
27	6.5	4.6	4.6	7.4	5.6	17.6	26.9	19.5	15.8	13.0	13.0	50.1	
28	6.5	4.6	4.6	22.3	6.5	16.7	26.0	18.6	14.9	13.0	13.0	31.6	
29	6.5		4.6	13.9	6.5	17.6	26.9	18.6	18.6	13.0	13.0	20.4	
30	6.5		4.6	14.9	7.4	19.5	35.3	17.6	17.6	12.1	12.1	16.7	
31	6.5		4.6		11.1		33.4	16.7		12.1		14.9	
Average	6.5	5.8	4.6	5.7	5.4	22.2	20.8	23.7	16.0	15.7	17.2	13.9	13.1
Max.	6.5	6.5	4.6	22.3	13.9	46.4	39.9	33.4	35.3	21.4	49.2	50.1	50.1

Simulated Daily Discharge at UB-1 by Tank Model

Year **1992** (23-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	13.0	9.3	6.5	6.5	4.6	5.6	10.2	26.9	35.3	34.3	16.7	13.0	
2	11.1	9.3	6.5	6.5	4.6	6.5	8.4	29.7	37.1	33.4	14.9	13.0	
3	11.1	8.4	6.5	6.5	4.6	7.4	13.0	28.8	34.3	33.4	14.9	13.0	
4	11.1	8.4	6.5	6.5	4.6	5.6	21.3	27.9	31.6	32.5	14.9	13.0	
5	11.1	8.4	6.5	6.5	4.6	5.6	36.2	49.2	32.5	31.6	14.9	13.0	
6	11.1	8.4	6.5	6.5	4.6	5.6	42.7	106.8	31.6	31.6	14.9	13.0	
7	10.2	8.4	6.5	6.5	4.6	6.5	43.6	107.7	30.6	29.7	13.9	13.0	
8	10.2	8.4	6.5	6.5	4.6	7.4	44.5	92.8	30.6	27.9	13.9	13.0	
9	10.2	8.4	6.5	6.5	4.6	9.3	31.6	79.8	29.7	26.0	15.8	13.0	
10	10.2	8.4	6.5	6.5	4.6	7.4	24.1	60.3	30.6	24.1	25.1	13.0	
11	10.2	8.4	6.5	6.5	4.6	5.6	19.5	59.4	28.8	23.2	20.4	13.0	
12	10.2	8.4	6.5	6.5	4.6	6.5	16.7	50.1	26.9	22.3	17.6	12.1	
13	10.2	8.4	6.5	6.5	4.6	6.5	13.0	47.3	26.0	21.4	14.9	12.1	
14	10.2	8.4	6.5	6.5	4.6	5.6	11.1	46.4	26.9	21.4	13.9	11.1	
15	10.2	8.4	6.5	6.5	4.6	5.6	13.0	45.5	26.0	22.3	13.9	11.1	
16	9.3	8.4	6.5	5.6	4.6	5.6	13.0	45.5	41.8	25.1	13.9	11.1	
17	9.3	8.4	6.5	7.4	4.6	5.6	17.6	45.5	37.1	23.2	13.9	11.1	
18	9.3	8.4	6.5	5.6	4.6	5.6	15.8	44.6	37.1	21.4	13.9	11.1	
19	9.3	8.4	6.5	5.6	10.2	5.6	15.8	43.6	42.7	19.5	13.9	11.1	
20	9.3	8.4	6.5	5.6	13.9	5.6	16.7	43.6	45.5	20.4	13.9	11.1	
21	9.3	8.4	6.5	5.6	9.3	5.6	20.4	44.6	40.8	19.5	13.9	11.1	
22	9.3	8.4	6.5	5.6	8.4	5.6	22.3	42.7	41.8	18.6	13.9	11.1	
23	9.3	8.4	6.5	4.6	5.6	5.6	24.1	41.8	40.8	22.3	13.9	11.1	
24	9.3	7.4	6.5	4.6	4.6	12.1	24.1	39.9	51.1	21.4	13.9	11.1	
25	9.3	7.4	6.5	4.6	4.6	38.1	21.4	39.0	46.4	22.3	13.9	11.1	
26	9.3	7.4	6.5	4.6	7.4	34.4	20.4	39.9	41.8	20.4	13.9	11.1	
27	9.3	7.4	6.5	4.6	7.4	34.4	18.6	38.1	39.9	19.5	13.9	11.1	
28	9.3	7.4	6.5	4.6	8.4	18.6	20.4	36.2	36.2	18.6	13.0	11.1	
29	9.3	6.5	6.5	4.6	6.5	14.9	26.0	36.2	34.3	17.6	13.0	11.1	
30	9.3		6.5	4.6	5.6	12.1	27.9	35.3	34.3	17.6	13.0	11.1	
31	9.3		6.5		5.6		25.1	35.3		17.6		10.2	
Average	10.0	8.2	6.5	5.8	5.8	10.2	21.9	48.7	35.7	23.9	14.9	11.8	17.0
Max.	13.0	9.3	6.5	7.4	13.9	38.1	44.5	107.7	51.1	34.3	25.1	13.0	107.7

Year **1993** (24-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	10.2	8.4	6.5	6.5	9.3	13.0	8.4	10.2	26.9	19.5	13.0	10.2	
2	10.2	8.4	6.5	6.5	14.9	11.1	7.4	12.1	32.5	18.6	13.0	10.2	
3	10.2	8.4	6.5	6.5	13.0	16.7	8.4	13.0	26.9	20.4	13.9	10.2	
4	10.2	8.4	6.5	6.5	11.1	40.8	7.4	16.7	30.6	18.6	13.9	10.2	
5	10.2	8.4	6.5	6.5	9.3	24.1	7.4	14.9	26.9	17.6	13.0	10.2	
6	10.2	8.4	6.5	6.5	13.9	14.9	7.4	14.9	28.8	17.6	13.0	10.2	
7	10.2	8.4	6.5	6.5	12.1	12.1	7.4	13.0	31.6	17.6	13.0	9.3	
8	10.2	8.4	6.5	6.5	8.4	21.4	8.4	13.0	28.8	16.7	13.0	8.4	
9	9.3	8.4	6.5	6.5	5.6	14.9	12.1	12.1	26.0	16.7	13.0	8.4	
10	9.3	8.4	6.5	6.5	5.6	11.1	11.1	12.1	24.1	19.5	13.0	8.4	
11	9.3	8.4	6.5	6.5	5.6	11.1	9.3	13.9	26.9	18.6	13.0	8.4	
12	9.3	8.4	6.5	6.5	5.6	10.2	8.4	13.0	30.6	17.6	13.0	8.4	
13	9.3	8.4	6.5	6.5	5.6	8.4	12.1	12.1	27.8	17.6	13.0	8.4	
14	9.3	8.4	6.5	6.5	5.6	8.4	12.1	10.2	26.0	15.8	12.1	8.4	
15	9.3	8.4	6.5	6.5	5.6	9.3	17.6	10.2	24.1	15.8	12.1	8.4	
16	9.3	8.4	6.5	6.5	5.6	9.3	14.9	10.2	24.1	15.8	12.1	8.4	
17	9.3	8.4	6.5	6.5	5.6	10.2	12.1	11.1	24.1	14.9	11.1	8.4	
18	9.3	8.4	6.5	5.6	5.6	13.0	11.1	11.1	23.2	15.8	11.1	8.4	
19	9.3	8.4	6.5	5.6	4.6	15.8	10.2	17.6	23.2	13.9	11.1	8.4	
20	9.3	8.4	6.5	5.6	4.6	18.6	11.1	23.2	24.1	13.9	11.1	8.4	
21	8.4	8.4	6.5	5.6	4.6	14.9	10.2	19.5	26.0	13.9	11.1	8.4	
22	8.4	8.4	6.5	5.6	4.6	13.9	10.2	15.8	26.0	13.0	11.1	8.4	
23	8.4	8.4	6.5	5.6	4.6	12.1	10.2	16.7	22.3	13.0	10.2	8.4	
24	8.4	7.4	6.5	4.6	4.6	9.3	10.2	16.7	21.4	13.0	10.2	8.4	
25	8.4	7.4	6.5	4.6	4.6	11.1	10.2	15.8	21.4	13.0	10.2	8.4	
26	8.4	7.4	6.5	4.6	4.6	9.3	10.2	13.9	20.4	13.0	10.2	8.4	
27	8.4	7.4	6.5	6.5	4.6	7.4	10.2	13.9	20.4	13.0	10.2	8.4	
28	8.4	7.4	6.5	9.3	4.6	7.4	9.3	13.0	20.4	13.0	10.2	8.4	
29	8.4		6.5	6.5	5.6	7.4	9.3	13.0	19.5	13.0	10.2	8.4	
30	8.4		6.5	4.6	10.2	7.4	9.3	20.4	19.5	15.8	10.2	8.4	
31	8.4		6.5		11.1		9.3	30.6		13.9		8.4	
Average	9.2	8.2	6.5	6.2	7.1	13.1	10.1	14.6	25.2	15.8	11.8	8.7	11.4
Max.	10.2	8.4	6.5	9.3	14.9	40.8	17.6	30.6	32.5	20.4	13.9	10.2	40.8

Simulated Daily Discharge at UB-1 by Tank Model

Year **1994** (25-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	6.5	6.5	4.6	4.6	3.7	6.5	12.1	26.0	12.1	9.3	6.5	
2	8.4	6.5	6.5	4.6	4.6	3.7	6.5	13.9	24.1	12.1	9.3	6.5	
3	8.4	6.5	6.5	4.6	5.6	3.7	6.5	12.1	23.2	12.1	9.3	6.5	
4	8.4	6.5	6.5	4.6	5.6	4.6	6.5	12.1	22.3	12.1	9.3	6.5	
5	8.4	6.5	5.6	4.6	5.6	3.7	7.4	16.7	24.1	12.1	9.3	6.5	
6	8.4	6.5	5.6	4.6	7.4	49.2	6.5	16.7	22.3	13.9	9.3	6.5	
7	8.4	6.5	5.6	4.6	3.7	36.2	6.5	19.5	20.4	13.9	9.3	6.5	
8	8.4	6.5	5.6	4.6	3.7	24.1	7.4	17.6	19.5	13.0	9.3	6.5	
9	8.4	6.5	5.6	4.6	3.7	14.9	7.4	17.6	20.4	12.1	9.3	6.5	
10	8.4	6.5	5.6	4.6	3.7	13.0	7.4	18.6	20.4	12.1	9.3	6.5	
11	8.4	6.5	5.6	4.6	3.7	13.0	8.4	19.5	20.4	12.1	8.4	6.5	
12	7.4	6.5	4.6	4.6	3.7	11.1	9.3	20.4	19.5	11.1	8.4	6.5	
13	7.4	6.5	4.6	4.6	3.7	14.9	9.3	20.4	21.4	11.1	8.4	6.5	
14	7.4	6.5	4.6	4.6	3.7	13.0	10.2	22.3	19.5	11.1	8.4	6.5	
15	7.4	6.5	4.6	4.6	3.7	11.1	9.3	22.3	19.5	11.1	8.4	6.5	
16	7.4	6.5	4.6	4.6	3.7	12.1	10.2	19.5	19.5	11.1	8.4	6.5	
17	6.5	6.5	4.6	4.6	3.7	18.6	12.1	21.4	18.6	11.1	8.4	6.5	
18	6.5	6.5	4.6	4.6	3.7	20.4	13.0	23.2	18.6	11.1	7.4	6.5	
19	6.5	6.5	4.6	4.6	3.7	15.8	13.0	23.2	18.6	11.1	7.4	6.5	
20	6.5	6.5	4.6	4.6	3.7	13.9	13.9	24.1	18.6	11.1	7.4	6.5	
21	6.5	6.5	4.6	4.6	3.7	13.9	13.9	24.1	17.6	11.1	7.4	6.5	
22	6.5	6.5	4.6	4.6	3.7	13.0	12.1	22.3	18.6	10.2	7.4	6.5	
23	6.5	6.5	4.6	4.6	3.7	10.2	10.2	23.2	16.7	10.2	6.5	6.5	
24	6.5	6.5	4.6	4.6	3.7	7.4	8.4	21.4	14.9	10.2	6.5	6.5	
25	6.5	6.5	4.6	4.6	3.7	6.5	9.3	21.4	13.9	10.2	6.5	6.5	
26	6.5	6.5	4.6	4.6	3.7	7.4	12.1	19.5	13.0	10.2	6.5	6.5	
27	6.5	6.5	4.6	4.6	3.7	8.4	12.1	19.5	12.1	10.2	6.5	6.5	
28	6.5	6.5	4.6	4.6	3.7	8.4	13.0	20.4	12.1	10.2	6.5	6.5	
29	6.5		4.6	4.6	3.7	6.5	15.8	19.5	12.1	10.2	6.5	6.5	
30	6.5		4.6	4.6	3.7	6.5	14.9	21.4	13.9	10.2	6.5	6.5	
31	6.5		4.6		3.7		12.1	25.1		9.3		6.5	
Average	7.3	6.5	5.1	4.6	4.1	13.0	10.0	19.7	18.7	11.3	8.0	6.5	9.6
Max.	8.4	6.5	6.5	4.6	7.4	49.2	15.8	25.1	26.0	13.9	9.3	6.5	49.2

Year **1995** (26-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	4.6	4.6	3.7	2.8	2.8	3.7	15.8	9.3	12.1	18.6	11.1	
2	6.5	4.6	4.6	3.7	2.8	2.8	4.6	19.5	12.1	12.1	15.8	11.1	
3	6.5	4.6	4.6	3.7	2.8	2.8	7.4	14.8	13.0	13.9	12.1	11.1	
4	6.5	4.6	4.6	3.7	2.8	2.8	7.4	13.0	17.6	12.1	11.1	11.1	
5	6.5	4.6	4.6	3.7	2.8	2.8	12.1	10.2	16.7	19.5	10.2	10.2	
6	6.5	4.6	4.6	4.6	8.4	2.8	8.4	9.3	16.7	19.5	10.2	10.2	
7	6.5	4.6	4.6	3.7	6.5	2.8	6.5	10.2	14.9	20.4	11.1	10.2	
8	6.5	4.6	4.6	3.7	3.7	2.8	4.6	8.4	12.1	20.4	10.2	10.2	
9	6.5	4.6	4.6	3.7	2.8	2.8	3.7	7.4	11.1	17.6	10.2	10.2	
10	5.6	4.6	4.6	3.7	2.8	10.2	9.3	12.1	11.1	15.8	10.2	10.2	
11	5.6	4.6	4.6	3.7	8.4	11.1	9.3	10.2	11.1	13.9	10.2	10.2	
12	5.6	4.6	4.6	3.7	9.3	10.2	8.4	10.2	11.1	13.9	10.2	10.2	
13	5.6	4.6	3.7	2.8	5.6	8.4	8.4	10.2	11.1	13.9	10.2	10.2	
14	5.6	4.6	3.7	2.8	3.7	6.5	6.5	12.1	10.2	13.9	26.0	10.2	
15	5.6	4.6	3.7	2.8	7.4	5.6	5.6	10.2	10.2	13.0	19.5	10.2	
16	5.6	4.6	3.7	2.8	8.4	5.6	6.5	9.3	12.1	12.1	15.8	10.2	
17	4.6	4.6	3.7	2.8	9.3	3.7	8.4	9.3	10.2	10.2	13.9	10.2	
18	4.6	4.6	3.7	2.8	12.1	3.7	9.3	9.3	9.3	10.2	12.1	10.2	
19	4.6	4.6	3.7	2.8	10.2	3.7	11.1	10.2	10.2	13.0	11.1	10.2	
20	4.6	4.6	3.7	2.8	6.5	3.7	8.4	8.4	10.2	11.1	11.1	9.3	
21	4.6	4.6	3.7	2.8	3.7	3.7	5.6	8.4	10.2	12.1	11.1	9.3	
22	4.6	4.6	3.7	2.8	3.7	3.7	4.6	11.1	9.3	10.2	11.1	8.4	
23	4.6	4.6	3.7	2.8	3.7	3.7	4.6	11.1	9.3	11.1	11.1	8.4	
24	4.6	4.6	3.7	2.8	3.7	3.7	4.6	13.9	10.2	10.2	11.1	8.4	
25	4.6	4.6	3.7	2.8	3.7	3.7	4.6	12.1	37.1	10.2	11.1	8.4	
26	4.6	4.6	3.7	2.8	3.7	3.7	6.5	11.1	23.2	11.1	13.9	8.4	
27	4.6	4.6	3.7	2.8	3.7	3.7	8.4	11.1	18.6	10.2	12.1	8.4	
28	4.6	4.6	3.7	2.8	3.7	3.7	5.6	9.3	15.8	10.2	11.1	8.4	
29	4.6		3.7	2.8	2.8	3.7	10.2	8.4	13.9	10.2	11.1	8.4	
30	4.6		3.7	2.8	2.8	3.7	10.2	8.4	12.1	10.2	11.1	8.4	
31	4.6		3.7		2.8		10.2	10.2		10.2		8.4	
Average	5.4	4.6	4.1	3.2	5.1	4.5	7.2	10.8	13.3	13.1	12.5	9.7	7.8
Max.	6.5	4.6	4.6	4.6	12.1	11.1	12.1	19.5	37.1	20.4	26.0	11.1	37.1

Simulated Daily Discharge at UB-1 by Tank Model

Year **1996** (27-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	7.4	6.5	5.6	4.6	5.6	3.7	5.6	19.5	11.1	10.2	9.3	7.4	
2	7.4	6.5	5.6	4.6	5.6	3.7	8.4	16.7	13.9	10.2	9.3	7.4	
3	7.4	6.5	5.6	4.6	3.7	3.7	10.2	20.4	16.7	11.1	9.3	6.5	
4	7.4	6.5	5.6	4.6	3.7	3.7	7.4	14.9	13.9	12.1	9.3	6.5	
5	7.4	6.5	5.6	4.6	3.7	3.7	5.6	12.1	12.1	13.0	9.3	6.5	
6	7.4	6.5	4.6	4.6	3.7	3.7	5.6	9.3	11.1	11.1	11.1	6.5	
7	7.4	6.5	4.6	4.6	3.7	3.7	5.6	8.4	11.1	10.2	9.3	6.5	
8	6.5	6.5	4.6	4.6	3.7	9.3	5.6	7.4	11.1	10.2	9.3	6.5	
9	6.5	6.5	4.6	5.6	3.7	12.1	5.6	7.4	11.1	10.2	9.3	6.5	
10	6.5	6.5	4.6	4.6	3.7	13.9	5.6	7.4	12.1	10.2	8.4	6.5	
11	6.5	6.5	4.6	4.6	3.7	22.3	5.6	12.1	11.1	10.2	8.4	6.5	
12	6.5	6.5	4.6	4.6	3.7	12.1	4.6	10.2	11.1	10.2	8.4	6.5	
13	6.5	6.5	4.6	4.6	3.7	11.1	8.4	11.1	11.1	9.3	8.4	6.5	
14	6.5	6.5	4.6	4.6	3.7	7.4	9.3	11.1	11.1	9.3	8.4	6.5	
15	6.5	6.5	4.6	4.6	3.7	5.6	7.4	12.1	11.1	9.3	8.4	6.5	
16	6.5	6.5	4.6	4.6	3.7	5.6	5.6	13.0	11.1	13.0	8.4	6.5	
17	6.5	6.5	4.6	4.6	3.7	12.1	5.6	10.2	14.9	13.9	8.4	6.5	
18	6.5	6.5	4.6	4.6	3.7	10.2	5.6	11.1	13.9	11.1	8.4	6.5	
19	6.5	6.5	4.6	4.6	10.2	7.4	5.6	13.0	12.1	10.2	8.4	6.5	
20	6.5	6.5	4.6	4.6	6.5	7.4	5.6	17.6	11.1	9.3	7.4	6.5	
21	6.5	5.6	4.6	4.6	3.7	8.4	4.6	14.9	10.2	13.9	7.4	6.5	
22	6.5	5.6	4.6	4.6	3.7	6.5	4.6	15.8	10.2	11.1	7.4	6.5	
23	6.5	15.8	4.6	11.1	3.7	5.6	4.6	14.9	10.2	10.2	7.4	6.5	
24	6.5	19.5	4.6	11.1	3.7	5.6	4.6	19.5	10.2	9.3	7.4	6.5	
25	6.5	13.9	4.6	9.3	6.5	5.6	4.6	17.6	10.2	9.3	7.4	6.5	
26	6.5	10.2	4.6	7.4	6.5	6.5	10.2	14.9	10.2	9.3	7.4	6.5	
27	6.5	8.4	4.6	5.6	5.6	5.6	37.1	13.9	12.1	9.3	7.4	6.5	
28	6.5	6.5	17.6	8.4	7.4	5.6	38.1	12.1	10.2	9.3	7.4	6.5	
29	6.5	5.6	12.1	5.6	3.7	5.6	26.0	11.1	10.2	9.3	7.4	6.5	
30	6.5		9.3	5.6	3.7	5.6	17.6	11.1	10.2	9.3	7.4	6.5	
31	6.5		6.5		3.7		26.0	11.1		9.3		6.5	
Average	6.7	7.6	5.7	5.6	4.5	7.4	9.9	13.0	11.6	10.4	8.4	6.6	8.1
Max.	7.4	19.5	17.6	11.1	10.2	22.3	38.1	20.4	16.7	13.9	11.1	7.4	38.1

Year **1997** (28-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	4.6	4.6	3.7	2.8	2.8	1.9	13.9	10.2	7.4	6.5	4.6	
2	6.5	4.6	4.6	3.7	2.8	2.8	1.9	13.9	13.0	7.4	6.5	4.6	
3	6.5	4.6	4.6	3.7	2.8	2.8	1.9	15.8	12.1	24.1	6.5	4.6	
4	6.5	4.6	4.6	3.7	2.8	2.8	1.9	15.8	13.0	15.8	6.5	4.6	
5	6.5	4.6	4.6	3.7	2.8	2.8	1.9	13.0	12.1	12.1	6.5	4.6	
6	6.5	4.6	4.6	3.7	2.8	2.8	2.8	11.1	13.0	9.3	6.5	4.6	
7	6.5	4.6	4.6	3.7	2.8	2.8	2.8	7.4	11.1	9.3	6.5	4.6	
8	6.5	4.6	4.6	3.7	2.8	2.8	1.9	8.4	11.1	7.4	6.5	4.6	
9	6.5	4.6	4.6	3.7	2.8	2.8	1.9	8.4	10.2	7.4	6.5	4.6	
10	5.6	4.6	4.6	3.7	2.8	2.8	1.9	12.1	10.2	7.4	5.6	4.6	
11	5.6	4.6	4.6	3.7	2.8	2.8	2.8	11.1	9.3	8.4	5.6	4.6	
12	5.6	4.6	4.6	3.7	2.8	2.8	1.9	9.3	8.4	8.4	4.6	4.6	
13	5.6	4.6	3.7	3.7	2.8	2.8	1.9	9.3	8.4	8.4	4.6	4.6	
14	5.6	4.6	3.7	3.7	2.8	3.7	1.9	9.3	8.4	8.4	4.6	4.6	
15	5.6	4.6	3.7	3.7	2.8	4.6	1.9	8.4	8.4	8.4	4.6	4.6	
16	5.6	4.6	3.7	3.7	2.8	2.8	1.9	8.4	7.4	7.4	4.6	4.6	
17	4.6	4.6	3.7	3.7	2.8	2.8	1.9	7.4	7.4	7.4	4.6	4.6	
18	4.6	4.6	3.7	2.8	2.8	2.8	3.7	7.4	7.4	7.4	4.6	4.6	
19	4.6	4.6	5.6	2.8	2.8	2.8	4.6	11.1	7.4	7.4	4.6	4.6	
20	4.6	4.6	3.7	2.8	2.8	2.8	3.7	11.1	7.4	7.4	4.6	4.6	
21	4.6	4.6	3.7	2.8	2.8	2.8	6.5	11.1	7.4	7.4	4.6	4.6	
22	4.6	4.6	7.4	2.8	2.8	2.8	7.4	8.4	7.4	7.4	4.6	4.6	
23	4.6	4.6	5.6	2.8	2.8	2.8	26.9	7.4	7.4	7.4	4.6	4.6	
24	4.6	4.6	12.1	2.8	2.8	2.8	84.5	7.4	7.4	7.4	4.6	4.6	
25	4.6	4.6	8.4	19.5	2.8	2.8	118.8	16.7	12.1	7.4	4.6	4.6	
26	4.6	4.6	5.6	11.1	10.2	1.9	78.9	15.8	9.3	7.4	4.6	4.6	
27	4.6	4.6	3.7	7.4	6.5	1.9	92.8	13.9	9.3	7.4	4.6	4.6	
28	4.6	4.6	3.7	4.6	2.8	2.8	60.3	13.0	11.1	7.4	4.6	4.6	
29	4.6		4.6	2.8	2.8	2.8	36.2	13.0	8.4	7.4	4.6	4.6	
30	4.6		4.6	2.8	7.4	2.8	27.8	10.2	7.4	6.5	4.6	4.6	
31	4.6		4.6		3.7		17.6	10.2		6.5		4.6	
Average	5.4	4.6	4.9	4.4	3.3	2.8	19.5	11.0	9.4	8.6	5.3	4.6	7.0
Max.	6.5	4.6	12.1	19.5	10.2	4.6	118.8	16.7	13.0	24.1	6.5	4.6	118.8

Simulated Daily Discharge at UB-1 by Tank Model

Year **1998** (29-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	4.6	3.7	2.8	2.8	1.9	4.7	2.8	3.7	5.6	6.5	5.6	3.7	
2	4.6	3.7	2.8	2.8	1.9	2.8	5.6	3.7	5.6	6.5	5.6	3.7	
3	4.6	3.7	2.8	2.8	1.9	2.8	4.6	4.7	5.6	6.5	5.6	3.7	
4	4.6	3.7	2.8	2.8	1.9	2.8	8.4	5.6	5.6	6.5	5.6	3.7	
5	4.6	3.7	2.8	2.8	1.9	2.8	12.1	4.7	5.6	6.5	5.6	3.7	
6	3.7	3.7	2.8	2.8	1.9	2.8	11.1	4.7	10.2	6.5	5.6	3.7	
7	3.7	2.8	2.8	2.8	1.9	2.8	16.7	4.7	16.7	6.5	5.6	3.7	
8	3.7	2.8	2.8	2.8	1.9	2.8	11.1	3.7	24.1	6.5	4.6	3.7	
9	3.7	2.8	2.8	2.8	1.9	2.8	8.4	4.7	25.1	6.5	4.6	3.7	
10	3.7	2.8	2.8	1.9	1.9	2.8	8.4	8.4	18.6	6.5	4.6	3.7	
11	3.7	2.8	2.8	1.9	1.9	2.8	8.4	9.3	15.8	5.6	4.6	3.7	
12	3.7	2.8	2.8	1.9	1.9	2.8	8.4	10.2	11.1	5.6	3.7	2.8	
13	3.7	2.8	2.8	1.9	1.9	1.9	7.4	11.1	8.3	5.6	3.7	2.8	
14	3.7	2.8	2.8	1.9	1.9	1.9	6.5	9.3	9.3	5.6	3.7	2.8	
15	3.7	2.8	2.8	1.9	1.9	2.8	6.5	7.4	7.4	5.6	3.7	2.8	
16	3.7	2.8	2.8	1.9	1.9	1.9	5.6	5.6	6.5	5.6	3.7	2.8	
17	3.7	2.8	2.8	1.9	1.9	1.9	4.7	4.6	6.5	5.6	3.7	2.8	
18	3.7	2.8	2.8	1.9	5.6	1.9	3.7	4.6	6.5	5.6	3.7	2.8	
19	3.7	2.8	2.8	1.9	2.8	1.9	3.7	4.6	6.5	5.6	3.7	2.8	
20	3.7	2.8	2.8	1.9	1.9	1.9	3.7	7.4	6.5	5.6	3.7	2.8	
21	3.7	2.8	2.8	1.9	3.7	1.9	3.7	5.6	6.5	5.6	4.6	2.8	
22	3.7	2.8	2.8	1.9	2.8	1.9	3.7	7.4	6.5	5.6	3.7	2.8	
23	3.7	2.8	2.8	1.9	1.9	1.9	3.7	7.4	6.5	5.6	3.7	2.8	
24	3.7	2.8	2.8	1.9	1.9	1.9	3.7	7.4	6.5	5.6	3.7	2.8	
25	3.7	2.8	2.8	1.9	1.9	1.9	3.7	7.4	6.5	5.6	3.7	2.8	
26	3.7	2.8	2.8	1.9	1.9	1.9	3.7	7.4	6.5	5.6	3.7	2.8	
27	3.7	2.8	2.8	1.9	3.7	1.9	3.7	9.3	6.5	5.6	3.7	2.8	
28	3.7	2.8	2.8	1.9	2.8	1.9	9.3	7.4	6.5	9.3	3.7	2.8	
29	3.7		2.8	1.9	8.4	1.9	6.5	5.6	6.5	7.4	3.7	2.8	
30	3.7		2.8	1.9	10.2	3.7	4.7	5.6	7.4	8.4	3.7	2.8	
31	3.7		2.8		6.5		4.7	5.6		6.5		2.8	
Average	3.9	3.0	2.8	2.1	2.8	2.4	6.4	6.4	9.1	6.2	4.3	3.1	4.4
Max.	4.6	3.7	2.8	2.8	10.2	4.7	16.7	11.1	25.1	9.3	5.6	3.7	25.1

Year **1999** (30-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	2.8	2.8	1.9	1.9	1.9	3.7	5.6	7.4	30.6	26.0	31.6	12.1	
2	2.8	2.8	1.9	1.9	1.9	2.8	4.6	7.4	27.9	23.2	53.8	12.1	
3	2.8	2.8	1.9	1.9	1.9	2.8	4.6	8.3	26.0	22.3	74.3	12.1	
4	2.8	2.8	1.9	1.9	1.9	9.3	4.6	7.4	26.0	21.4	53.8	12.1	
5	2.8	2.8	1.9	1.9	1.9	10.2	4.6	7.4	26.0	22.3	37.1	11.1	
6	2.8	2.8	1.9	1.9	1.9	8.4	4.6	11.1	26.0	22.3	28.8	11.1	
7	2.8	2.8	1.9	1.9	1.9	4.7	4.6	15.8	27.8	21.4	27.9	11.1	
8	2.8	2.8	1.9	1.9	1.9	2.8	4.6	25.1	26.0	21.4	25.1	11.1	
9	2.8	2.8	1.9	2.8	1.9	2.8	4.6	51.1	31.6	21.4	24.1	11.1	
10	2.8	2.8	1.9	7.4	1.9	2.8	4.6	65.9	30.6	20.4	23.2	11.1	
11	2.8	2.8	1.9	4.6	1.9	2.8	5.6	52.9	34.3	19.5	21.4	11.1	
12	2.8	2.8	1.9	1.9	1.9	2.8	5.6	44.6	30.6	19.5	22.3	11.1	
13	2.8	1.9	1.9	1.9	2.8	2.8	5.6	46.4	27.8	18.6	21.4	11.1	
14	2.8	1.9	1.9	1.9	1.9	2.8	5.6	46.4	26.0	17.6	21.4	11.1	
15	2.8	1.9	1.9	1.9	1.9	10.2	5.6	37.1	24.1	15.8	20.4	11.1	
16	2.8	1.9	1.9	11.1	1.9	8.4	5.6	31.6	24.1	15.8	19.5	11.1	
17	2.8	1.9	1.9	9.3	5.6	5.6	6.5	29.7	24.1	14.9	17.6	10.2	
18	2.8	1.9	1.9	5.6	3.7	3.7	7.4	29.7	27.9	13.9	15.8	10.2	
19	2.8	1.9	1.9	4.7	1.9	2.8	7.4	27.9	27.9	13.9	13.9	10.2	
20	2.8	1.9	1.9	2.8	1.9	4.7	8.3	30.6	26.0	13.0	13.9	10.2	
21	2.8	1.9	1.9	2.8	9.3	7.4	8.3	30.6	26.9	12.1	13.0	10.2	
22	2.8	1.9	1.9	2.8	8.4	11.2	7.4	27.8	25.1	12.1	13.0	9.3	
23	2.8	1.9	1.9	2.8	4.6	14.9	5.6	32.5	23.2	12.1	13.0	9.3	
24	2.8	1.9	1.9	2.8	1.9	47.4	5.6	30.6	22.3	12.1	13.0	9.3	
25	2.8	1.9	1.9	2.8	1.9	40.9	5.6	35.3	23.2	12.1	12.1	9.3	
26	2.8	1.9	1.9	1.9	2.8	26.9	7.4	32.5	22.3	12.1	12.1	9.3	
27	2.8	1.9	1.9	1.9	2.8	18.6	7.4	30.6	21.4	11.1	12.1	9.3	
28	2.8	1.9	1.9	1.9	2.8	13.9	6.5	29.7	27.9	13.0	12.1	9.3	
29	2.8		1.9	1.9	5.6	11.1	5.6	30.6	31.6	15.8	12.1	9.3	
30	2.8		1.9	1.9	8.4	8.4	6.5	30.6	29.7	18.6	12.1	9.3	
31	2.8		1.9		6.5		9.3	30.6		44.6		9.3	
Average	2.8	2.3	1.9	3.1	3.2	9.9	6.0	29.8	26.8	18.1	23.0	10.5	11.5
Max.	2.8	2.8	1.9	11.1	9.3	47.4	9.3	65.9	34.3	44.6	74.3	12.1	74.3

Simulated Daily Discharge at UB-1 by Tank Model

Year **2000** (31-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	9.3	7.4	6.5	4.6	4.6	6.5	7.4	10.2	25.1	12.1	11.1	9.3	
2	9.3	7.4	6.5	4.6	4.6	8.4	7.4	8.4	24.1	12.1	11.1	9.3	
3	9.3	7.4	6.5	4.6	4.6	9.3	7.4	8.4	24.1	12.1	11.1	8.4	
4	9.3	7.4	6.5	4.6	4.6	7.4	7.4	8.4	21.4	12.1	11.1	8.4	
5	9.3	7.4	6.5	4.6	4.6	7.4	6.5	8.4	24.1	12.1	11.1	8.4	
6	9.3	6.5	6.5	4.6	4.6	10.2	6.5	8.4	24.1	12.1	11.1	8.4	
7	9.3	6.5	6.5	4.6	4.6	8.4	6.5	9.3	22.3	16.7	11.1	8.4	
8	9.3	6.5	6.5	4.6	4.6	5.6	6.5	8.4	21.4	13.9	10.2	7.4	
9	9.3	6.5	6.5	4.6	4.6	4.6	7.4	11.1	20.4	16.7	10.2	7.4	
10	8.4	6.5	6.5	4.6	4.6	4.6	7.4	13.9	19.5	14.8	10.2	7.4	
11	8.4	6.5	6.5	4.6	6.5	4.6	7.4	13.0	19.5	13.9	10.2	7.4	
12	8.4	6.5	6.5	4.6	6.5	6.5	10.2	11.1	19.5	14.8	10.2	7.4	
13	8.4	6.5	6.5	4.6	6.5	13.0	13.0	11.1	20.4	12.1	10.2	6.5	
14	8.4	6.5	6.5	4.6	4.6	20.4	13.0	11.1	19.5	13.9	10.2	6.5	
15	8.4	6.5	6.5	4.6	4.6	15.8	10.2	12.1	20.4	12.1	10.2	6.5	
16	8.4	6.5	6.5	4.6	4.6	17.6	8.4	11.1	18.6	12.1	10.2	6.5	
17	8.4	6.5	6.5	4.6	4.6	15.8	11.1	10.2	18.6	12.1	9.3	6.5	
18	8.4	6.5	6.5	4.6	4.6	12.1	13.0	9.3	17.6	12.1	9.3	6.5	
19	8.4	6.5	6.5	4.6	4.6	12.1	19.5	10.2	17.6	11.1	9.3	6.5	
20	8.4	6.5	6.5	4.6	4.6	9.3	18.6	10.2	16.7	11.1	9.3	6.5	
21	8.4	6.5	6.5	4.6	4.6	7.4	16.7	15.8	15.8	11.1	9.3	6.5	
22	8.4	6.5	6.5	4.6	4.6	7.4	14.9	19.5	13.9	11.1	9.3	6.5	
23	8.4	6.5	6.5	4.6	4.6	8.4	13.9	15.8	13.9	11.1	9.3	6.5	
24	8.4	6.5	5.6	4.6	4.6	11.1	13.0	14.9	13.9	11.1	9.3	6.5	
25	8.4	6.5	5.6	4.6	7.4	11.1	11.1	12.1	13.0	24.1	9.3	6.5	
26	8.4	6.5	5.6	4.6	13.0	10.2	9.3	10.2	12.1	18.6	9.3	6.5	
27	8.4	6.5	13.0	5.6	11.1	9.3	7.4	10.2	12.1	14.8	9.3	6.5	
28	8.4	6.5	9.3	5.6	8.4	8.4	7.4	15.8	11.1	13.0	9.3	6.5	
29	8.4	6.5	9.3	8.4	4.6	7.4	8.4	20.4	11.1	11.1	9.3	6.5	
30	8.4		7.4	5.6	4.6	7.4	8.4	30.6	12.1	11.1	9.3	6.5	
31	7.4		5.6		3.7		10.2	29.7		11.1		6.5	
Average	8.6	6.7	6.8	4.9	5.5	9.6	10.2	12.9	18.1	13.2	10.0	7.1	9.5
Max.	9.3	7.4	13.0	8.4	13.0	20.4	19.5	30.6	25.1	24.1	11.1	9.3	30.6

Year **2001** (32-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	6.5	5.6	4.6	4.6	3.7	35.3	11.1	12.1	23.2	11.1	14.8	11.1	
2	6.5	5.6	4.6	3.7	3.7	41.8	9.3	14.9	22.3	11.1	26.0	11.1	
3	6.5	5.6	4.6	3.7	5.6	33.4	7.4	20.4	23.2	11.1	19.5	11.1	
4	6.5	5.6	4.6	3.7	3.7	17.6	7.4	34.4	22.3	13.0	19.5	11.1	
5	6.5	4.6	4.6	3.7	2.8	13.9	7.4	27.9	21.4	12.1	15.8	11.1	
6	6.5	4.6	4.6	3.7	2.8	11.1	8.4	24.1	20.4	11.1	13.9	11.1	
7	6.5	4.6	4.6	3.7	2.8	9.3	7.4	26.0	21.4	11.1	13.0	10.2	
8	6.5	4.6	4.6	3.7	2.8	6.5	7.4	26.9	20.4	12.1	13.0	10.2	
9	6.5	4.6	4.6	3.7	2.8	7.4	8.4	27.9	22.3	11.1	13.0	10.2	
10	6.5	4.6	4.6	3.7	2.8	6.5	9.3	25.1	25.1	22.3	13.0	10.2	
11	6.5	4.6	4.6	3.7	8.4	6.5	15.8	26.0	23.2	25.1	13.0	9.3	
12	6.5	4.6	4.6	3.7	4.6	6.5	13.9	49.2	19.5	21.3	13.0	9.3	
13	6.5	4.6	4.6	3.7	3.7	6.5	13.9	58.5	19.5	17.6	12.1	9.3	
14	6.5	4.6	4.6	3.7	13.9	6.5	13.0	52.9	18.6	15.8	12.1	9.3	
15	6.5	4.6	4.6	3.7	10.2	7.4	13.9	41.8	20.4	14.8	12.1	9.3	
16	6.5	4.6	4.6	3.7	9.3	9.3	13.0	38.1	19.5	14.8	12.1	9.3	
17	6.5	4.6	4.6	3.7	5.6	9.3	13.0	35.3	17.6	15.8	12.1	9.3	
18	6.5	4.6	4.6	3.7	9.3	8.4	12.1	34.4	17.6	13.9	12.1	9.3	
19	6.5	4.6	4.6	3.7	9.3	6.5	12.1	33.4	16.7	13.0	12.1	9.3	
20	6.5	4.6	4.6	3.7	7.4	6.5	13.0	32.5	15.8	12.1	12.1	9.3	
21	6.5	4.6	4.6	3.7	7.4	6.5	13.0	30.6	15.8	12.1	12.1	9.3	
22	6.5	4.6	4.6	3.7	9.3	6.5	16.7	28.8	14.9	12.1	12.1	9.3	
23	6.5	4.6	4.6	3.7	5.6	6.5	16.7	28.8	13.9	12.1	12.1	9.3	
24	6.5	4.6	4.6	3.7	3.7	7.4	14.9	27.9	13.0	12.1	12.1	9.3	
25	6.5	4.6	4.6	3.7	3.7	7.4	15.8	27.9	12.1	12.1	11.1	9.3	
26	6.5	4.6	4.6	3.7	3.7	7.4	13.0	26.9	12.1	12.1	11.1	9.3	
27	6.5	4.6	4.6	3.7	9.3	7.4	11.1	26.0	12.1	11.1	11.1	9.3	
28	6.5	4.6	4.6	3.7	10.2	7.4	9.3	26.9	12.1	11.1	11.1	8.4	
29	6.5		4.6	3.7	8.4	8.4	9.3	27.9	12.1	11.1	11.1	8.4	
30	5.6		4.6	3.7	26.0	10.2	10.2	26.0	12.1	12.1	11.1	8.4	
31	5.6		4.6		18.6		10.2	23.2		18.6		8.4	
Average	6.4	4.8	4.6	3.7	7.1	11.0	11.5	30.4	18.0	13.8	13.3	9.6	11.2
Max.	6.5	5.6	4.6	4.6	26.0	41.8	16.7	58.5	25.1	25.1	26.0	11.1	58.5

Simulated Daily Discharge at UB-1 by Tank Model

Year **2002** (33-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	8.4	6.5	6.5	4.6	4.6	8.4	7.4	20.4	43.6	24.1	13.0	12.1	
2	8.4	6.5	6.5	4.6	4.6	8.4	8.4	20.4	40.8	23.2	13.0	12.1	
3	8.4	6.5	6.5	4.6	4.6	8.4	8.4	23.2	37.1	22.3	13.0	12.1	
4	8.4	6.5	6.5	4.6	4.6	8.4	8.4	21.4	38.1	22.3	14.9	12.1	
5	8.4	6.5	6.5	4.6	4.6	8.4	8.4	19.5	39.0	21.4	17.6	12.1	
6	8.4	6.5	6.5	4.6	4.6	9.3	8.4	20.4	36.2	22.3	14.9	12.1	
7	8.4	6.5	6.5	4.6	4.6	9.3	8.4	22.3	39.9	20.4	13.0	12.1	
8	8.4	6.5	6.5	4.6	7.4	9.3	8.4	22.3	40.8	20.4	13.0	12.1	
9	8.4	6.5	6.5	4.6	4.6	8.4	9.3	23.2	43.6	19.5	13.0	12.1	
10	8.4	6.5	6.5	4.6	4.6	8.4	9.3	24.1	40.8	17.6	13.0	12.1	
11	8.4	6.5	6.5	4.6	4.6	8.4	9.3	23.2	37.1	16.7	13.0	12.1	
12	8.4	6.5	6.5	4.6	4.6	8.4	9.3	24.1	37.1	14.9	13.0	12.1	
13	8.4	6.5	6.5	4.6	4.6	9.3	10.2	22.3	37.1	13.9	13.0	12.1	
14	8.4	6.5	5.6	4.6	5.6	8.4	17.6	24.1	41.8	13.9	13.0	12.1	
15	8.4	6.5	5.6	4.6	3.7	8.4	13.9	25.1	38.1	13.9	13.0	12.1	
16	8.4	6.5	5.6	4.6	3.7	8.4	16.7	27.9	36.2	13.9	13.0	12.1	
17	8.4	6.5	5.6	4.6	10.2	8.4	15.8	28.8	34.3	13.9	13.0	11.1	
18	8.4	6.5	5.6	4.6	18.6	8.4	13.0	26.0	35.3	13.9	13.0	11.1	
19	8.4	6.5	5.6	4.6	159.7	8.4	14.9	27.9	35.3	13.0	13.0	11.1	
20	8.4	6.5	5.6	4.6	148.5	8.4	17.6	30.6	34.3	13.0	12.1	11.1	
21	7.4	6.5	4.6	4.6	99.3	9.3	30.6	28.8	32.5	13.0	12.1	11.1	
22	7.4	6.5	4.6	4.6	65.0	9.3	55.7	26.9	36.2	13.0	12.1	11.1	
23	7.4	6.5	4.6	4.6	46.4	8.4	65.0	26.9	33.4	13.0	12.1	11.1	
24	7.4	6.5	4.6	4.6	29.7	8.4	56.6	35.3	32.5	13.0	12.1	11.1	
25	7.4	6.5	4.6	4.6	19.5	9.3	41.8	33.4	31.6	13.0	12.1	11.1	
26	6.5	6.5	4.6	4.6	14.8	8.4	27.9	42.7	30.6	20.4	14.9	11.1	
27	6.5	6.5	4.6	4.6	15.8	10.2	27.9	54.8	29.7	20.4	15.8	11.1	
28	6.5	6.5	4.6	4.6	15.8	8.4	26.0	54.8	27.9	17.6	15.8	11.1	
29	6.5		4.6	4.6	12.1	7.4	23.2	63.1	26.0	15.8	14.9	11.1	
30	6.5		4.6	4.6	10.2	7.4	21.4	61.3	25.1	13.9	13.0	11.1	
31	6.5		4.6		8.4		19.5	52.9		13.0		11.1	
Average	7.8	6.5	5.6	4.6	24.2	8.6	19.9	30.9	35.7	16.8	13.4	11.6	15.6
Max.	8.4	6.5	6.5	4.6	159.7	10.2	65.0	63.1	43.6	24.1	17.6	12.1	159.7

Year **2003** (34-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	10.2	8.4	6.5	6.5	11.1	4.6	34.3	13.0	10.2	11.1	10.2	6.5	
2	13.0	8.4	6.5	6.5	7.4	5.6	20.4	12.1	10.2	11.1	11.1	6.5	
3	11.1	8.4	6.5	6.5	8.4	5.6	17.6	10.2	10.2	11.1	10.2	6.5	
4	10.2	8.4	6.5	6.5	4.6	6.5	15.8	10.2	10.2	11.1	10.2	6.5	
5	13.9	8.4	6.5	6.5	4.6	6.5	12.1	10.2	11.1	11.1	10.2	6.5	
6	12.1	8.4	6.5	6.5	4.6	11.1	10.2	10.2	10.2	11.1	10.2	6.5	
7	10.2	14.9	6.5	6.5	4.6	13.0	8.4	10.2	10.2	11.1	10.2	6.5	
8	10.2	12.1	6.5	6.5	4.6	10.2	7.4	10.2	9.3	11.1	10.2	6.5	
9	10.2	10.2	6.5	6.5	4.6	10.2	11.1	10.2	9.3	11.1	10.2	6.5	
10	10.2	8.4	6.5	6.5	4.6	11.1	10.2	11.1	13.9	11.1	10.2	6.5	
11	10.2	8.4	6.5	6.5	9.3	16.7	10.2	12.1	14.9	11.1	10.2	6.5	
12	10.2	8.4	6.5	6.5	5.6	18.6	8.4	13.0	15.8	11.1	9.3	6.5	
13	10.2	8.4	6.5	6.5	8.4	13.0	8.4	13.0	16.7	11.1	9.3	6.5	
14	10.2	8.4	6.5	6.5	8.4	10.2	8.4	13.0	19.5	11.1	9.3	6.5	
15	10.2	8.4	6.5	6.5	5.6	7.4	8.4	11.1	16.7	11.1	8.4	6.5	
16	10.2	8.4	6.5	6.5	6.5	5.6	8.4	10.2	13.9	10.2	8.4	6.5	
17	10.2	8.4	6.5	6.5	5.6	5.6	8.4	10.2	12.1	10.2	8.4	6.5	
18	10.2	8.4	6.5	5.6	5.6	5.6	8.4	10.2	10.2	10.2	8.4	6.5	
19	9.3	8.4	6.5	5.6	5.6	8.4	8.4	10.2	10.2	10.2	8.4	6.5	
20	9.3	8.4	6.5	5.6	4.6	7.4	7.4	11.1	10.2	12.1	8.4	6.5	
21	9.3	8.4	6.5	5.6	5.6	11.1	8.4	10.2	10.2	16.7	8.4	6.5	
22	9.3	8.4	6.5	5.6	5.6	12.1	7.4	10.2	10.2	13.9	8.4	6.5	
23	8.4	8.4	6.5	5.6	4.6	9.3	7.4	10.2	10.2	11.1	6.5	6.5	
24	8.4	7.4	6.5	5.6	7.4	7.4	10.2	10.2	10.2	13.9	6.5	6.5	
25	8.4	7.4	6.5	4.6	4.6	9.3	12.1	13.9	10.2	11.1	6.5	6.5	
26	8.4	7.4	6.5	4.6	4.6	14.9	13.9	12.1	11.1	10.2	6.5	6.5	
27	8.4	7.4	6.5	4.6	4.6	25.1	10.2	12.1	11.1	10.2	6.5	6.5	
28	8.4	7.4	6.5	4.6	4.6	31.6	10.2	12.1	11.1	10.2	6.5	6.5	
29	8.4		6.5	4.6	4.6	32.5	8.4	10.2	11.1	10.2	6.5	6.5	
30	8.4		6.5	4.6	4.6	40.9	13.0	10.2	11.1	10.2	6.5	6.5	
31	8.4		6.5		4.6		12.1	10.2		10.2		6.5	
Average	9.8	8.6	6.5	5.9	5.8	12.6	11.1	11.1	11.7	11.2	8.7	6.5	9.1
Max.	13.9	14.9	6.5	6.5	11.1	40.9	34.3	13.9	19.5	16.7	11.1	6.5	40.9

Simulated Daily Discharge at UB-1 by Tank Model

Year **2004** (35-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	6.5	4.6	4.6	3.7	3.7	17.6	16.7	26.9	27.8	37.1	13.9	11.1	
2	6.5	4.6	4.6	3.7	3.7	20.4	19.5	28.8	26.9	34.3	13.9	11.1	
3	6.5	4.6	4.6	3.7	3.7	17.6	17.6	27.9	26.0	34.3	13.9	11.1	
4	6.5	4.6	4.6	3.7	3.7	13.9	16.7	31.6	25.1	33.4	13.9	11.1	
5	6.5	4.6	4.6	3.7	3.7	10.2	16.7	39.0	25.1	32.5	13.9	11.1	
6	6.5	4.6	4.6	3.7	8.4	7.4	17.6	39.0	24.1	31.6	13.9	11.1	
7	6.5	4.6	4.6	3.7	23.2	8.4	16.7	33.4	23.2	31.6	13.9	11.1	
8	6.5	4.6	4.6	3.7	12.1	13.0	15.8	33.4	21.4	30.6	13.0	11.1	
9	6.5	4.6	4.6	3.7	8.4	12.1	15.8	33.4	22.3	27.9	13.0	10.2	
10	5.6	4.6	4.6	3.7	5.6	12.1	21.4	39.9	27.9	26.9	13.0	10.2	
11	5.6	4.6	4.6	3.7	3.7	9.3	24.1	46.4	41.8	25.1	13.0	10.2	
12	5.6	4.6	3.7	2.8	3.7	11.1	22.3	44.6	41.8	24.1	13.0	10.2	
13	5.6	4.6	3.7	2.8	3.7	10.2	20.4	39.0	34.4	25.1	13.0	10.2	
14	5.6	4.6	3.7	2.8	3.7	7.4	21.4	39.9	33.4	27.9	13.0	10.2	
15	5.6	4.6	3.7	2.8	3.7	8.4	22.3	40.9	73.3	26.0	13.0	10.2	
16	5.6	4.6	3.7	2.8	3.7	8.4	21.4	42.7	61.3	24.1	13.0	10.2	
17	4.6	4.6	3.7	2.8	3.7	8.4	19.5	40.8	51.1	23.2	13.0	9.3	
18	4.6	4.6	3.7	6.5	3.7	13.9	18.6	39.0	57.6	22.3	12.1	9.3	
19	4.6	4.6	3.7	26.9	3.7	19.5	18.6	38.1	51.1	22.3	12.1	9.3	
20	4.6	4.6	3.7	13.0	79.8	24.1	17.6	37.1	42.7	22.3	12.1	9.3	
21	4.6	4.6	3.7	9.3	55.7	33.4	17.6	37.1	43.6	21.4	12.1	9.3	
22	4.6	4.6	3.7	6.5	47.3	27.9	17.6	35.3	42.7	21.4	12.1	9.3	
23	4.6	4.6	3.7	4.6	25.1	37.1	18.6	33.4	41.8	19.5	12.1	9.3	
24	4.6	4.6	3.7	3.7	15.8	25.1	23.2	32.5	39.9	18.6	11.1	9.3	
25	4.6	4.6	3.7	3.7	10.2	22.3	25.1	32.5	36.2	16.7	11.1	9.3	
26	4.6	4.6	3.7	3.7	6.5	20.4	23.2	31.6	38.1	15.8	11.1	9.3	
27	4.6	4.6	3.7	3.7	4.6	18.6	22.3	30.6	40.8	14.9	11.1	9.3	
28	4.6	4.6	3.7	3.7	5.6	19.5	20.4	30.6	39.9	14.9	11.1	9.3	
29	4.6	4.6	3.7	3.7	31.6	18.6	19.5	30.6	38.1	14.9	13.0	9.3	
30	4.6		3.7	4.6	20.4	16.7	21.4	30.6	39.9	14.9	13.0	8.4	
31	4.6		3.7		13.9		24.1	28.8		13.9		8.4	
Average	5.4	4.6	4.0	5.0	13.7	16.4	19.8	35.3	38.0	24.2	12.7	9.9	15.8
Max.	6.5	4.6	4.6	26.9	79.8	37.1	25.1	46.4	73.3	37.1	13.9	11.1	79.8

Year **2005** (36-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Day	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	8.4	7.4	6.5	5.6	4.6	5.6	14.9	11.1	32.5	48.3	26.0	13.0	
2	8.4	7.4	6.5	4.6	4.6	8.4	16.7	16.7	31.6	43.6	23.2	13.0	
3	8.4	7.4	6.5	4.6	4.6	8.4	17.6	15.8	30.6	38.1	22.3	13.0	
4	8.4	7.4	6.5	4.6	4.6	5.6	13.9	16.7	29.7	51.1	22.3	13.0	
5	8.4	7.4	6.5	4.6	4.6	5.6	12.1	16.7	29.7	52.0	21.4	13.0	
6	8.4	6.5	6.5	4.6	4.6	3.7	11.1	25.1	28.8	44.6	20.4	13.0	
7	8.4	6.5	6.5	4.6	4.6	3.7	11.1	29.7	27.9	40.8	20.4	13.0	
8	8.4	6.5	6.5	4.6	4.6	3.7	10.2	22.3	34.4	37.1	19.5	12.1	
9	8.4	6.5	6.5	4.6	4.6	3.7	8.4	23.2	40.9	35.3	19.5	12.1	
10	8.4	6.5	6.5	4.6	4.6	5.6	8.4	26.0	38.1	35.3	18.6	12.1	
11	8.4	6.5	6.5	4.6	4.6	14.9	8.4	25.1	38.1	34.3	18.6	12.1	
12	8.4	6.5	6.5	4.6	4.6	12.1	7.4	24.1	48.3	33.4	17.6	12.1	
13	8.4	6.5	6.5	4.6	4.6	9.3	7.4	44.6	42.7	32.5	17.6	12.1	
14	8.4	6.5	6.5	4.6	4.6	8.4	11.1	56.6	39.0	39.9	15.8	12.1	
15	8.4	6.5	6.5	4.6	4.6	7.4	9.3	41.8	34.3	38.1	14.9	12.1	
16	8.4	6.5	9.3	4.6	4.6	5.6	7.4	48.3	38.1	34.3	14.9	11.1	
17	8.4	6.5	7.4	4.6	4.6	4.6	7.4	48.3	35.3	36.2	14.9	11.1	
18	8.4	6.5	6.5	4.6	4.6	7.4	7.4	45.5	32.5	34.3	14.9	11.1	
19	8.4	6.5	6.5	4.6	4.6	6.5	7.4	39.9	39.9	32.5	13.9	11.1	
20	8.4	6.5	6.5	4.6	4.6	5.6	13.9	39.9	40.8	30.6	13.9	11.1	
21	8.4	6.5	6.5	6.5	4.6	5.6	13.0	52.9	39.0	29.7	13.9	11.1	
22	8.4	6.5	6.5	8.4	4.6	5.6	10.2	46.4	36.2	28.8	13.9	11.1	
23	8.4	6.5	6.5	5.6	4.6	4.6	13.0	42.7	38.1	27.9	13.9	11.1	
24	8.4	6.5	6.5	4.6	4.6	4.6	12.1	38.1	35.3	27.9	13.9	13.0	
25	8.4	6.5	6.5	4.6	4.6	6.5	12.1	38.1	33.4	26.9	13.9	15.8	
26	8.4	6.5	5.6	4.6	4.6	13.0	13.0	39.0	34.3	26.0	13.9	15.8	
27	8.4	6.5	5.6	4.6	4.6	20.4	12.1	35.3	32.5	26.0	13.9	14.9	
28	8.4	6.5	5.6	10.2	4.6	24.1	10.2	35.3	32.5	25.1	13.9	13.0	
29	8.4		5.6	7.4	3.7	22.3	13.0	33.4	44.6	24.1	13.0	11.1	
30	8.4		5.6	4.6	3.7	16.7	13.0	32.5	52.0	24.1	13.0	11.1	
31	8.4		5.6		4.6		11.1	31.6		23.2		11.1	
Average	8.4	6.7	6.4	5.2	4.6	8.6	11.1	33.6	36.4	34.3	16.9	12.3	15.4
Max.	8.4	7.4	9.3	10.2	4.6	24.1	17.6	56.6	52.0	52.0	26.0	15.8	56.6

Simulated Daily Discharge at UB-1 by Tank Model

Year **2006** (37-year) Station Upper Baluchaung W.L. Station Unit: m³/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	11.1	8.4	8.4	6.5	13.0	13.0	9.3	34.4	30.6	25.1	23.2	13.0	
2	11.1	8.4	8.4	6.5	9.3	13.0	9.3	44.6	30.6	24.1	23.2	13.0	
3	11.1	8.4	7.4	6.5	6.5	13.0	8.4	34.4	31.6	24.1	23.2	13.0	
4	11.1	8.4	7.4	6.5	5.6	11.1	8.4	33.4	28.8	23.2	22.3	13.0	
5	11.1	8.4	7.4	6.5	5.6	13.0	8.4	34.4	26.0	22.3	20.4	13.0	
6	11.1	8.4	7.4	6.5	5.6	13.9	17.6	32.5	24.1	31.6	18.6	11.1	
7	11.1	8.4	7.4	6.5	5.6	12.1	22.3	28.8	24.1	29.7	16.7	11.1	
8	11.1	8.4	6.5	6.5	4.6	11.1	33.4	29.7	24.1	32.5	16.7	11.1	
9	11.1	8.4	6.5	6.5	5.6	11.1	25.1	30.6	23.2	65.9	15.8	11.1	
10	11.1	8.4	6.5	6.5	4.6	13.0	19.5	28.8	23.2	75.2	14.9	11.1	
11	11.1	8.4	6.5	6.5	4.6	12.1	18.6	26.9	24.1	54.8	14.9	11.1	
12	11.1	8.4	6.5	6.5	4.6	11.1	18.6	26.9	22.3	39.9	14.9	11.1	
13	10.2	8.4	6.5	6.5	4.6	8.4	14.9	26.9	31.6	39.0	14.9	11.1	
14	10.2	8.4	6.5	6.5	10.2	6.5	12.1	26.0	30.6	39.9	14.9	11.1	
15	10.2	8.4	6.5	6.5	11.1	6.5	11.1	24.1	28.8	39.0	14.9	11.1	
16	10.2	8.4	6.5	6.5	8.4	6.5	11.1	24.1	26.9	38.1	13.9	11.1	
17	10.2	8.4	6.5	7.4	5.6	6.5	9.3	23.2	24.1	34.3	13.9	11.1	
18	10.2	8.4	6.5	6.5	5.6	6.5	15.8	23.2	25.1	33.4	13.9	11.1	
19	10.2	8.4	6.5	6.5	5.6	6.5	40.8	22.3	26.0	35.3	13.9	11.1	
20	10.2	8.4	6.5	6.5	4.6	6.5	40.8	23.2	31.6	38.1	13.9	11.1	
21	9.3	8.4	6.5	8.4	4.6	6.5	26.0	28.8	30.6	35.3	13.9	11.1	
22	9.3	8.4	6.5	6.5	4.6	7.4	21.4	26.9	27.8	33.4	13.9	11.1	
23	9.3	8.4	6.5	6.5	4.6	6.5	18.6	27.9	25.1	31.6	13.9	11.1	
24	9.3	8.4	6.5	6.5	4.6	8.4	17.6	26.0	24.1	31.6	13.0	11.1	
25	9.3	8.4	6.5	5.6	4.6	10.2	15.8	23.2	27.8	30.6	13.0	10.2	
26	9.3	8.4	6.5	5.6	4.6	13.9	20.4	24.1	30.6	29.7	13.0	10.2	
27	9.3	8.4	6.5	5.6	4.6	13.0	33.4	26.9	28.8	27.9	13.0	10.2	
28	8.4	8.4	6.5	9.3	4.6	10.2	51.1	27.8	27.8	26.0	13.0	10.2	
29	8.4		6.5	12.1	4.6	9.3	42.7	26.9	26.9	26.0	13.0	10.2	
30	8.4		6.5	19.5	4.6	9.3	31.6	25.1	26.9	24.1	13.0	10.2	
31	8.4		7.4		6.5		31.6	27.8		23.2		10.2	
Average	10.1	8.4	6.8	7.2	5.9	9.9	21.4	28.1	27.1	34.3	15.7	11.2	15.6
Max.	11.1	8.4	8.4	19.5	13.0	13.9	51.1	44.6	31.6	75.2	23.2	13.0	75.2

Year **2007** (28-year) Station Upper Baluchaung W.L. Station Unit: m³/sec

Month / Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	10.2	8.4	6.5	6.5	4.6	5.6	13.9	13.9	28.8	31.6	16.7	12.1	
2	9.3	8.4	6.5	6.5	4.6	5.6	14.9	13.9	28.8	28.8	15.8	12.1	
3	9.3	10.2	6.5	6.5	4.6	5.6	13.0	16.7	26.9	26.9	17.6	12.1	
4	9.3	8.4	6.5	6.5	6.5	7.4	14.9	19.5	28.8	26.0	22.3	12.1	
5	9.3	8.4	6.5	6.5	5.6	6.5	14.9	17.6	26.9	26.0	20.4	12.1	
6	9.3	8.4	6.5	6.5	4.6	5.6	16.7	18.6	28.8	27.9	17.6	12.1	
7	9.3	8.4	6.5	6.5	4.6	7.4	14.9	17.6	27.9	33.4	14.9	12.1	
8	9.3	8.4	6.5	6.5	4.6	11.1	13.0	16.7	26.9	32.5	15.8	11.1	
9	9.3	8.4	6.5	6.5	4.6	8.4	11.1	15.8	25.1	29.7	15.8	11.1	
10	9.3	8.4	6.5	5.6	7.4	7.4	10.2	15.8	25.1	28.8	15.8	11.1	
11	9.3	8.4	6.5	5.6	9.3	6.5	8.4	16.7	24.1	27.9	14.9	11.1	
12	9.3	8.4	6.5	5.6	8.4	8.4	8.4	18.6	24.1	29.7	14.9	11.1	
13	9.3	8.4	6.5	5.6	9.3	39.0	8.4	22.3	24.1	26.9	14.9	11.1	
14	8.4	8.4	6.5	5.6	8.4	28.8	8.4	26.0	24.1	26.0	14.9	11.1	
15	8.4	8.4	6.5	5.6	11.1	21.4	8.4	27.9	31.6	26.0	14.9	11.1	
16	8.4	7.4	6.5	5.6	9.3	17.6	8.4	26.9	44.6	25.1	13.9	11.1	
17	8.4	7.4	6.5	4.6	7.4	14.9	12.1	26.9	40.8	26.9	13.9	11.1	
18	8.4	7.4	6.5	4.6	7.4	11.1	14.9	25.1	41.8	24.1	13.9	11.1	
19	8.4	7.4	6.5	4.6	9.3	8.4	17.6	22.3	34.3	24.1	13.9	11.1	
20	8.4	7.4	6.5	4.6	11.1	13.0	16.7	20.4	29.7	25.1	13.9	11.1	
21	8.4	7.4	6.5	4.6	12.1	9.3	27.8	19.5	28.8	26.0	13.9	11.1	
22	8.4	6.5	6.5	4.6	13.9	8.4	21.4	23.2	26.9	25.1	13.9	11.1	
23	8.4	6.5	6.5	4.6	13.0	7.4	17.6	35.3	26.9	25.1	13.9	11.1	
24	8.4	6.5	6.5	4.6	9.3	7.4	16.7	39.0	26.0	25.1	13.9	11.1	
25	8.4	6.5	6.5	4.6	5.6	7.4	16.7	36.2	26.0	25.1	13.9	11.1	
26	8.4	6.5	6.5	4.6	5.6	7.4	14.9	35.3	26.9	22.3	13.0	11.1	
27	8.4	6.5	6.5	4.6	5.6	7.4	18.6	32.5	32.5	22.3	13.0	10.2	
28	8.4	6.5	6.5	4.6	5.6	13.9	16.7	28.8	31.6	22.3	13.0	10.2	
29	8.4		6.5	4.6	5.6	13.0	13.9	29.7	36.2	21.4	13.0	10.2	
30	8.4		6.5	4.6	5.6	13.9	13.9	29.7	34.3	20.4	13.0	10.2	
31	8.4		6.5		5.6		13.9	30.6		17.6		9.3	
Average	8.8	7.8	6.5	5.4	7.4	11.2	14.2	23.8	29.6	26.0	15.0	11.2	13.9
Max.	10.2	10.2	6.5	6.5	13.9	39.0	27.8	39.0	44.6	33.4	22.3	12.1	44.6

Simulated Daily Discharge at UB-1 by Tank Model

Year **2008** (29-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	9.3	8.4	6.5	6.5	4.6	4.6	9.3	8.4	13.9	19.5	63.1	13.0	
2	9.3	8.4	6.5	30.6	4.6	4.6	7.4	8.4	14.9	19.5	77.0	13.0	
3	9.3	8.4	6.5	16.7	4.6	4.6	10.2	11.1	16.7	18.6	87.3	13.0	
4	9.3	8.4	6.5	13.0	6.5	4.6	11.1	9.3	18.6	19.5	77.0	13.0	
5	9.3	8.4	6.5	9.3	4.6	23.2	10.2	9.3	16.7	16.7	57.5	13.0	
6	9.3	8.4	6.5	7.4	4.6	14.9	11.1	9.3	14.9	15.8	44.6	13.0	
7	9.3	8.4	6.5	6.5	4.6	18.6	13.9	9.3	22.3	15.8	41.8	13.0	
8	9.3	8.4	6.5	7.4	4.6	15.8	13.0	10.2	24.1	14.9	38.1	13.0	
9	9.3	8.4	6.5	7.4	4.6	13.9	12.1	15.8	26.0	13.9	36.2	13.0	
10	9.3	8.4	6.5	7.4	4.6	11.1	11.1	18.6	25.1	13.0	34.3	13.0	
11	9.3	8.4	6.5	6.5	4.6	8.4	9.3	18.6	22.3	12.1	34.3	13.0	
12	9.3	8.4	6.5	5.6	4.6	8.4	9.3	17.6	21.4	12.1	33.4	13.0	
13	8.4	8.4	6.5	5.6	4.6	6.5	8.4	18.6	20.4	12.1	34.3	12.1	
14	8.4	8.4	6.5	5.6	4.6	5.6	10.2	18.6	21.4	12.1	33.4	12.1	
15	8.4	8.4	6.5	5.6	4.6	10.2	12.1	17.6	21.4	12.1	31.6	12.1	
16	8.4	7.4	6.5	5.6	4.6	11.1	10.2	17.6	22.3	12.1	29.7	12.1	
17	8.4	7.4	6.5	5.6	4.6	18.6	9.3	19.5	22.3	11.1	27.9	12.1	
18	8.4	7.4	6.5	5.6	11.1	27.9	8.4	22.3	20.4	11.1	26.0	12.1	
19	8.4	7.4	6.5	4.6	7.4	28.8	10.2	21.4	24.1	11.1	24.1	12.1	
20	8.4	7.4	6.5	4.6	11.1	20.4	8.4	20.4	26.9	11.1	23.2	12.1	
21	8.4	6.5	6.5	4.6	8.4	14.9	8.4	19.5	26.0	20.4	21.4	12.1	
22	8.4	6.5	6.5	4.6	5.6	11.1	8.4	17.6	26.9	16.7	19.5	12.1	
23	8.4	6.5	6.5	4.6	4.6	8.4	12.1	16.7	24.1	13.9	17.6	12.1	
24	8.4	6.5	6.5	4.6	4.6	7.4	10.2	17.6	23.2	21.3	15.8	12.1	
25	8.4	6.5	6.5	4.6	4.6	6.5	9.3	16.7	21.4	31.6	14.9	12.1	
26	8.4	6.5	6.5	4.6	4.6	6.5	11.1	16.7	22.3	69.6	13.9	12.1	
27	8.4	6.5	6.5	4.6	4.6	6.5	10.2	16.7	21.4	64.1	13.9	12.1	
28	14.9	6.5	6.5	4.6	4.6	6.5	12.1	15.8	21.4	46.4	13.9	11.1	
29	12.1	6.5	6.5	4.6	4.6	9.3	13.9	15.8	20.4	31.6	13.9	11.1	
30	10.2		6.5	4.6	4.6	9.3	12.1	14.9	20.4	47.3	13.0	11.1	
31	9.3		6.5		4.6		10.2	13.9		33.4		11.1	
Average	9.1	7.6	6.5	7.1	5.4	11.6	10.4	15.6	21.4	21.9	33.8	12.3	13.5
Max.	14.9	8.4	6.5	30.6	11.1	28.8	13.9	22.3	26.9	69.6	87.3	13.0	87.3

Year **2009** (40-year) Station Upper Baluchaung W.L. Station Unit: m^3/sec

Month Day	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual
1	11.1	8.4	6.5	6.5	4.6	8.4	6.5	20.4	24.1	17.6	11.1	8.4	
2	11.1	8.4	6.5	6.5	4.6	6.5	12.1	18.6	26.0	15.8	11.1	8.4	
3	11.1	8.4	6.5	6.5	4.6	4.6	12.1	18.6	24.1	14.9	11.1	8.4	
4	11.1	8.4	6.5	6.5	4.6	6.5	12.1	14.9	25.1	18.6	11.1	8.4	
5	11.1	8.4	6.5	6.5	4.6	7.4	9.3	11.1	24.1	15.8	11.1	8.4	
6	10.2	8.4	6.5	6.5	4.6	9.3	13.0	20.4	22.3	13.9	10.2	8.4	
7	10.2	8.4	6.5	6.5	4.6	9.3	15.8	25.1	22.3	13.9	10.2	8.4	
8	10.2	8.4	6.5	6.5	4.6	13.9	15.8	50.1	26.9	13.0	10.2	8.4	
9	10.2	8.4	6.5	6.5	4.6	13.0	13.0	41.8	25.1	13.0	10.2	8.4	
10	10.2	8.4	6.5	6.5	4.6	10.2	10.2	28.8	23.2	12.1	10.2	8.4	
11	10.2	8.4	6.5	6.5	4.6	7.4	7.4	25.1	20.4	12.1	10.2	8.4	
12	10.2	8.4	6.5	6.5	4.6	5.6	6.5	22.3	20.4	12.1	10.2	8.4	
13	10.2	8.4	6.5	6.5	4.6	5.6	6.5	25.1	23.2	12.1	10.2	8.4	
14	10.2	8.4	6.5	6.5	5.6	5.6	6.5	27.9	23.2	13.0	10.2	8.4	
15	10.2	8.4	6.5	8.4	5.6	5.6	6.5	30.6	20.4	12.1	10.2	8.4	
16	9.3	8.4	6.5	7.4	4.6	5.6	6.5	27.9	20.4	12.1	9.3	8.4	
17	9.3	8.4	6.5	7.4	4.6	5.6	6.5	26.0	21.4	13.0	9.3	8.4	
18	9.3	8.4	6.5	7.4	4.6	10.2	6.5	28.8	25.1	12.1	9.3	8.4	
19	9.3	8.4	7.4	8.4	4.6	10.2	10.2	26.9	22.3	12.1	9.3	8.4	
20	9.3	8.4	6.5	9.3	4.6	9.3	8.4	28.8	24.1	13.9	9.3	7.4	
21	9.3	8.4	6.5	7.4	4.6	6.5	6.5	26.0	22.3	12.1	9.3	7.4	
22	8.4	8.4	6.5	7.4	4.6	5.6	6.5	25.1	21.4	12.1	9.3	7.4	
23	8.4	8.4	6.5	5.6	4.6	5.6	6.5	24.1	23.2	11.1	9.3	7.4	
24	8.4	7.4	6.5	5.6	4.6	5.6	6.5	28.8	21.4	11.1	9.3	7.4	
25	8.4	7.4	6.5	5.6	4.6	6.5	9.3	31.6	21.4	11.1	9.3	6.5	
26	8.4	7.4	6.5	5.6	4.6	6.5	13.0	29.7	19.5	11.1	9.3	6.5	
27	8.4	7.4	6.5	4.6	4.6	6.5	15.8	26.9	19.5	11.1	8.4	6.5	
28	8.4	7.4	6.5	4.6	4.6	6.5	32.5	25.1	19.5	11.1	8.4	6.5	
29	8.4		6.5	4.6	5.6	6.5	35.3	24.1	18.6	11.1	8.4	6.5	
30	8.4		6.5	4.6	12.1	6.5	40.8	23.2	18.6	11.1	8.4	6.5	
31	8.4		6.5		10.2		33.4	23.2		11.1		6.5	
Average	9.6	8.2	6.5	6.5	5.1	7.4	12.8	26.0	22.3	12.8	9.8	7.8	11.3
Max.	11.1	8.4	7.4	9.3	12.1	13.9	40.8	50.1	26.9	18.6	11.1	8.4	50.1

Simulated Monthly Discharge

at UB-1

by Tank Model

(1970-2009)

Simulated Monthly Discharge at UB-1 by Tank Model

Year \ Month	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun.	7 Jul.	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Annual Mean
1970	6.62	6.17	4.64	4.58	6.62	7.43	27.75	37.04	37.37	19.34	12.07	10.12	15.05
1971	8.20	6.50	6.02	4.64	5.57	13.80	25.09	48.69	40.10	22.79	13.34	10.63	17.19
1972	8.59	7.36	6.50	5.04	5.12	6.19	11.65	21.62	19.06	16.52	11.78	9.91	10.80
1973	8.35	6.50	5.93	4.67	8.14	13.55	11.29	19.85	30.04	17.96	11.45	8.89	12.24
1974	7.28	6.50	5.24	4.67	4.52	7.39	8.08	17.54	27.48	14.61	10.86	8.44	10.22
1975	7.88	6.00	4.64	4.33	4.79	9.44	10.23	15.09	20.98	15.63	12.00	9.22	10.03
1976	7.43	6.50	5.15	4.64	5.48	8.14	13.44	21.41	21.38	17.30	10.58	8.86	10.88
1977	6.83	6.37	4.73	5.04	3.98	5.44	8.56	11.10	16.27	12.37	10.33	7.07	8.18
1978	6.35	4.71	4.58	3.68	3.38	7.76	8.62	14.25	18.72	12.01	8.64	6.50	8.28
1979	5.39	4.64	4.07	3.18	2.99	7.21	10.17	12.30	10.43	9.67	7.15	5.57	6.92
1980	4.64	4.09	3.20	2.78	4.64	7.06	7.21	9.70	18.94	17.28	11.26	8.89	8.31
1981	6.50	5.77	4.64	4.36	5.18	7.58	13.20	16.08	12.41	10.72	11.46	7.79	8.83
1982	6.50	5.14	4.64	3.96	3.98	9.22	9.91	24.22	35.37	22.45	11.97	9.01	12.22
1983	7.49	6.50	5.33	4.70	4.52	14.79	8.29	9.82	12.84	18.20	20.79	13.41	10.56
1984	10.78	8.83	7.01	7.80	5.60	17.26	21.95	30.93	27.66	23.30	13.21	10.09	15.39
1985	8.35	6.86	6.41	5.07	5.90	19.21	19.46	22.16	25.03	18.32	17.42	12.37	13.91
1986	9.91	8.35	6.74	6.41	4.64	8.14	8.69	8.98	12.16	11.08	8.42	6.77	8.35
1987	5.54	4.64	4.10	5.38	2.78	5.35	9.13	14.94	20.70	13.84	11.35	7.94	8.82
1988	6.50	5.19	4.64	4.05	5.84	9.68	9.25	13.65	10.18	8.84	9.04	6.71	7.81
1989	4.76	4.64	3.71	3.06	3.95	5.01	8.83	13.47	10.46	11.17	8.48	6.65	7.04
1990	4.85	4.67	3.80	3.43	11.88	9.92	21.98	19.49	15.71	11.61	10.02	8.05	10.51
1991	6.50	5.80	4.64	5.69	5.36	22.18	20.75	23.66	15.96	15.66	17.20	13.89	13.14
1992	9.97	8.19	6.50	5.85	5.84	10.18	21.89	48.72	35.67	23.87	14.88	11.83	17.00
1993	9.19	8.19	6.50	6.16	7.13	13.15	10.09	14.64	25.15	15.81	11.85	8.74	11.38
1994	7.31	6.50	5.09	4.64	4.07	12.96	10.03	19.70	18.72	11.28	8.01	6.50	9.58
1995	5.39	4.64	4.07	3.18	5.06	4.48	7.24	10.80	13.34	13.06	12.50	9.67	7.81
1996	6.71	7.62	5.66	5.57	4.49	7.42	9.88	12.96	11.57	10.45	8.36	6.56	8.11
1997	5.39	4.64	4.88	4.36	3.32	2.81	19.50	10.95	9.43	8.59	5.26	4.64	7.02
1998	3.86	2.98	2.78	2.14	2.82	2.39	6.41	6.41	9.09	6.17	4.30	3.11	4.38
1999	2.78	2.25	1.86	3.13	3.18	9.91	5.98	29.85	26.83	18.05	23.05	10.51	11.48
2000	8.59	6.66	6.80	4.86	5.48	9.59	10.18	12.87	18.14	13.17	9.99	7.13	9.46
2001	6.44	4.77	4.64	3.74	7.12	11.04	11.52	30.40	18.01	13.77	13.30	9.64	11.25
2002	7.84	6.50	5.63	4.64	24.19	8.57	19.94	30.90	35.73	16.80	13.40	11.62	15.55
2003	9.85	8.62	6.50	5.91	5.81	12.56	11.13	11.08	11.73	11.23	8.67	6.50	9.13
2004	5.39	4.64	4.04	5.04	13.74	16.43	19.80	35.33	37.96	24.16	12.72	9.94	15.80
2005	8.35	6.67	6.44	5.17	4.58	8.63	11.10	33.63	36.36	34.25	16.92	12.34	15.43
2006	10.12	8.35	6.80	7.21	5.93	9.87	21.44	28.06	27.13	34.34	15.72	11.23	15.58
2007	8.77	7.76	6.50	5.41	7.43	11.17	14.22	23.84	29.64	25.99	15.04	11.17	13.95
2008	9.13	7.62	6.50	7.12	5.36	11.60	10.41	15.60	21.44	21.94	33.75	12.31	13.54
2009	9.58	8.19	6.53	6.50	5.15	7.40	12.82	26.02	22.31	12.81	9.77	7.78	11.26
Mean	7.25	6.16	5.20	4.79	5.89	9.80	13.18	20.69	21.69	16.41	12.41	8.95	11.06

Summary of Results of Daily Simulation by Tank Model

Year	Q Max. (m^3/s)	Q Min (m^3/s)	Q Ave. (m^3/s)	Q.Ave. (mm)	Rainfall (mm)	Runoff Coefficient
1970	73.3	3.71	15.05	592	1,777	0.333
1971	75.2	3.71	17.19	676	1,850	0.365
1972	35.3	4.64	10.80	426	1,562	0.273
1973	57.6	4.64	12.24	481	1,605	0.300
1974	37.1	3.71	10.22	402	1,515	0.265
1975	30.6	2.78	10.03	395	1,594	0.248
1976	43.6	3.71	10.88	429	1,562	0.275
1977	33.4	2.78	8.18	322	1,436	0.224
1978	42.7	2.78	8.28	326	1,315	0.248
1979	35.3	2.78	6.92	272	1,193	0.228
1980	26.9	1.86	8.31	328	1,489	0.220
1981	27.8	3.71	8.83	347	1,517	0.229
1982	62.2	2.78	12.22	481	1,614	0.298
1983	46.4	3.71	10.56	415	1,657	0.251
1984	57.6	4.64	15.39	607	1,714	0.354
1985	51.1	4.64	13.91	547	1,817	0.301
1986	32.5	4.64	8.35	328	1,319	0.249
1987	49.2	2.78	8.82	347	1,510	0.230
1988	38.1	2.78	7.81	308	1,395	0.221
1989	72.4	2.78	7.04	277	1,350	0.205
1990	43.6	2.78	10.51	413	1,619	0.255
1991	50.1	3.71	13.14	517	1,863	0.277
1992	107.7	4.64	17.00	670	1,798	0.373
1993	40.8	4.64	11.38	447	1,554	0.288
1994	49.2	3.71	9.58	377	1,358	0.277
1995	37.1	2.78	7.81	307	1,490	0.206
1996	38.1	3.71	8.11	320	1,510	0.212
1997	118.8	1.86	7.02	276	1,165	0.237
1998	25.1	1.86	4.38	172	1,062	0.162
1999	74.3	1.86	11.48	451	1,831	0.246
2000	30.6	3.71	9.46	373	1,476	0.253
2001	58.5	2.78	11.25	442	1,644	0.269
2002	159.7	3.71	15.55	612	1,828	0.335
2003	40.9	4.64	9.13	359	1,383	0.260
2004	79.8	2.78	15.80	623	1,897	0.328
2005	56.6	3.71	15.43	607	1,862	0.326
2006	75.2	4.64	15.58	613	1,817	0.337
2007	44.6	4.64	13.95	548	1,746	0.314
2008	87.3	4.64	13.54	534	1,837	0.291
2009	50.1	4.64	11.26	443	1,478	0.300
Max.	**159.7**	**4.64**	**17.19**	**676**	**1,897**	**0.373**
Min.	**25.1**	**1.86**	**4.38**	**172**	**1,062**	**0.162**
Ave.	**54.9**	**3.53**	**11.06**	**435**	**1,575**	**0.272**

Average Vol. of Qsim = 348.8 mil.m^3
C.A.= 802 km^2
specific discharge = 1.38 m^3/sec/100 km^2

Estimated Design Floods

by

SCS Unit Hydrograph

Design Flood Hydrograph at Proposed Regulating Dam Site

CA= 767 km^2

Time [hr]	Flood Discharge [m^3/s] 1/2yr	1/5yr	1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
1	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
2	20.1	20.2	20.2	20.3	20.5	20.6	21.5	22.2
3	20.4	20.6	20.7	20.9	21.4	22.0	24.7	26.8
4	20.9	21.2	21.5	21.8	23.0	24.2	29.9	34.2
5	21.5	22.1	22.6	23.2	25.2	27.3	37.4	45.0
6	22.5	23.4	24.2	25.2	28.6	32.0	48.5	60.9
7	23.8	25.2	26.6	28.2	33.3	38.7	64.2	83.5
8	25.6	27.7	29.6	32.0	39.5	47.4	84.8	113.1
9	27.8	30.8	33.5	36.7	47.2	58.3	110.6	150.1
10	30.5	34.5	38.1	42.5	56.6	71.5	141.9	195.0
11	33.6	38.7	43.5	49.1	67.4	86.6	177.8	246.6
12	37.4	43.8	49.9	57.0	80.3	104.8	220.8	308.4
13	44.2	53.2	61.6	71.6	104.1	138.2	299.9	421.9
14	51.8	63.7	74.8	87.9	130.7	175.6	388.4	549.0
15	60.4	75.5	89.5	106.2	160.4	217.4	487.5	691.3
16	69.5	88.0	105.2	125.7	192.2	262.0	593.1	843.0
17	80.9	103.6	124.8	149.9	231.7	317.5	724.6	1,031.7
18	93.8	121.3	147.0	177.5	276.5	380.6	873.9	1,246.2
19	106.3	138.4	168.5	204.1	319.9	441.5	1,018.3	1,453.5
20	117.6	154.0	188.0	228.3	359.3	496.9	1,149.5	1,641.8
21	127.1	167.0	204.2	248.4	392.2	543.1	1,258.8	1,798.8
22	131.9	173.6	212.6	258.9	409.1	566.9	1,315.2	1,879.8
23	135.2	178.1	218.2	265.8	420.4	582.7	1,352.8	1,933.8
24	134.8	177.6	217.5	264.9	419.0	580.8	1,348.3	1,927.3
25	133.0	175.2	214.5	261.2	413.0	572.3	1,328.1	1,898.3
26	128.6	169.1	207.0	251.8	397.6	550.8	1,277.1	1,825.1
27	122.8	161.1	196.9	239.4	377.4	522.3	1,209.5	1,728.1
28	115.9	151.7	185.1	224.7	353.4	488.6	1,129.9	1,613.7
29	108.3	141.2	172.0	208.4	327.0	451.4	1,041.8	1,487.2
30	100.6	130.6	158.7	192.0	300.2	413.7	952.6	1,359.1
31	93.1	120.3	145.8	176.0	274.1	377.1	865.7	1,234.4
32	85.5	110.0	132.8	159.9	247.8	340.2	778.4	1,109.1
33	78.3	100.0	120.3	144.4	222.7	304.9	694.7	988.9
34	71.1	90.2	108.0	129.1	197.8	269.9	611.8	869.8
35	65.1	81.9	97.6	116.2	176.7	240.3	541.7	769.0
36	59.4	74.0	87.7	104.0	156.8	212.3	475.4	673.9
37	54.6	67.5	79.5	93.8	140.2	188.9	420.1	594.6
38	50.3	61.6	72.2	84.7	125.4	168.1	370.7	523.6
39	46.3	56.2	65.3	76.2	111.6	148.7	324.9	457.7
40	42.7	51.1	59.0	68.4	98.8	130.8	282.4	396.8
41	39.5	46.8	53.6	61.6	87.8	115.3	245.7	344.1
42	36.9	43.2	49.1	56.1	78.9	102.7	215.9	301.3
43	34.7	40.1	45.2	51.3	70.9	91.6	189.6	263.5
44	32.6	37.3	41.7	46.9	63.8	81.6	165.8	229.3
45	30.8	34.8	38.5	43.0	57.4	72.6	144.6	198.9
46	29.3	32.8	36.1	39.9	52.5	65.6	128.0	175.1
47	28.1	31.1	34.0	37.3	48.2	59.6	113.9	154.8
48	27.1	29.7	32.2	35.1	44.5	54.5	101.7	137.3
49	26.1	28.4	30.6	33.1	41.4	50.0	91.1	122.1
50	25.4	27.4	29.3	31.5	38.7	46.3	82.2	109.3
51	24.7	26.5	28.1	30.1	36.4	43.1	74.6	98.5
52	24.1	25.6	27.0	28.7	34.2	40.0	67.3	88.0
53	23.5	24.7	25.9	27.4	32.0	36.9	60.0	77.4
54	22.9	24.0	25.0	26.2	30.1	34.2	53.7	68.3
55	22.6	23.5	24.4	25.5	28.9	32.5	49.7	62.6
56	22.3	23.1	23.9	24.9	27.9	31.1	46.4	57.9
57	22.0	22.8	23.5	24.3	27.1	29.9	43.5	53.8
58	21.8	22.5	23.1	23.9	26.3	28.9	41.0	50.2
59	21.6	22.2	22.7	23.4	25.5	27.7	38.2	46.1
60	21.3	21.8	22.3	22.8	24.6	26.5	35.4	42.1
61	21.1	21.5	21.9	22.3	23.8	25.4	32.7	38.2
62	20.9	21.2	21.5	21.9	23.1	24.3	30.2	34.6
63	20.7	21.0	21.2	21.5	22.4	23.4	28.1	31.6
64	20.6	20.8	21.0	21.2	22.0	22.8	26.6	29.5
65	20.5	20.7	20.8	21.0	21.7	22.3	25.5	27.9
66	20.4	20.6	20.7	20.9	21.4	22.0	24.8	26.9
67	20.4	20.5	20.6	20.8	21.3	21.8	24.3	26.2
68	20.3	20.5	20.6	20.7	21.2	21.7	23.9	25.6
69	20.3	20.4	20.5	20.7	21.1	21.5	23.6	25.1
70	20.3	20.4	20.5	20.6	21.0	21.4	23.2	24.7
71	20.3	20.4	20.4	20.5	20.9	21.3	23.0	24.3
72	20.2	20.3	20.4	20.5	20.8	21.2	22.7	23.9
Max.	135.2	178.1	218.2	265.8	420.4	582.7	1,352.8	1,933.8

Time [hr]	Flood Volume [10^{6}m^3] 1/2yr	1/5yr	1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
0	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
1	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
2	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08
3	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.10
4	0.08	0.08	0.08	0.08	0.08	0.09	0.11	0.12
5	0.08	0.08	0.08	0.08	0.09	0.10	0.13	0.16
6	0.08	0.08	0.09	0.09	0.10	0.12	0.17	0.22
7	0.09	0.09	0.10	0.10	0.12	0.14	0.23	0.30
8	0.09	0.10	0.11	0.12	0.14	0.17	0.31	0.41
9	0.10	0.11	0.12	0.13	0.17	0.21	0.40	0.54
10	0.11	0.12	0.14	0.15	0.20	0.26	0.51	0.70
11	0.12	0.14	0.16	0.18	0.24	0.31	0.64	0.89
12	0.13	0.16	0.18	0.21	0.29	0.38	0.79	1.11
13	0.16	0.19	0.22	0.26	0.37	0.50	1.08	1.52
14	0.19	0.23	0.27	0.32	0.47	0.63	1.40	1.98
15	0.22	0.27	0.32	0.38	0.58	0.78	1.75	2.49
16	0.25	0.32	0.38	0.45	0.69	0.94	2.14	3.03
17	0.29	0.37	0.45	0.54	0.83	1.14	2.61	3.71
18	0.34	0.44	0.53	0.64	1.00	1.37	3.15	4.49
19	0.38	0.50	0.61	0.73	1.15	1.59	3.67	5.23
20	0.42	0.55	0.68	0.82	1.29	1.79	4.14	5.91
21	0.46	0.60	0.74	0.89	1.41	1.95	4.53	6.48
22	0.47	0.63	0.77	0.93	1.47	2.04	4.73	6.77
23	0.49	0.64	0.79	0.96	1.51	2.10	4.87	6.96
24	0.49	0.64	0.78	0.95	1.51	2.09	4.85	6.94
25	0.48	0.63	0.77	0.94	1.49	2.06	4.78	6.83
26	0.46	0.61	0.75	0.91	1.43	1.98	4.60	6.57
27	0.44	0.58	0.71	0.86	1.36	1.88	4.35	6.22
28	0.42	0.55	0.67	0.81	1.27	1.76	4.07	5.81
29	0.39	0.51	0.62	0.75	1.18	1.63	3.75	5.35
30	0.36	0.47	0.57	0.69	1.08	1.49	3.43	4.89
31	0.34	0.43	0.52	0.63	0.99	1.36	3.12	4.44
32	0.31	0.40	0.48	0.58	0.89	1.22	2.80	3.99
33	0.28	0.36	0.43	0.52	0.80	1.10	2.50	3.56
34	0.26	0.32	0.39	0.46	0.71	0.97	2.20	3.13
35	0.23	0.29	0.35	0.42	0.64	0.86	1.95	2.77
36	0.21	0.27	0.32	0.37	0.56	0.76	1.71	2.43
37	0.20	0.24	0.29	0.34	0.50	0.68	1.51	2.14
38	0.18	0.22	0.26	0.30	0.45	0.61	1.33	1.88
39	0.17	0.20	0.24	0.27	0.40	0.54	1.17	1.65
40	0.15	0.18	0.21	0.25	0.36	0.47	1.02	1.43
41	0.14	0.17	0.19	0.22	0.32	0.42	0.88	1.24
42	0.13	0.16	0.18	0.20	0.28	0.37	0.78	1.08
43	0.12	0.14	0.16	0.18	0.26	0.33	0.68	0.95
44	0.12	0.13	0.15	0.17	0.23	0.29	0.60	0.83
45	0.11	0.13	0.14	0.15	0.21	0.26	0.52	0.72
46	0.11	0.12	0.13	0.14	0.19	0.24	0.46	0.63
47	0.10	0.11	0.12	0.13	0.17	0.21	0.41	0.56
48	0.10	0.11	0.12	0.13	0.16	0.20	0.37	0.49
49	0.09	0.10	0.11	0.12	0.15	0.18	0.33	0.44
50	0.09	0.10	0.11	0.11	0.14	0.17	0.30	0.39
51	0.09	0.10	0.10	0.11	0.13	0.16	0.27	0.35
52	0.09	0.09	0.10	0.10	0.12	0.14	0.24	0.32
53	0.08	0.09	0.09	0.10	0.12	0.13	0.22	0.28
54	0.08	0.09	0.09	0.09	0.11	0.12	0.19	0.25
55	0.08	0.08	0.09	0.09	0.10	0.12	0.18	0.23
56	0.08	0.08	0.09	0.09	0.10	0.11	0.17	0.21
57	0.08	0.08	0.08	0.09	0.10	0.11	0.16	0.19
58	0.08	0.08	0.08	0.09	0.09	0.10	0.15	0.18
59	0.08	0.08	0.08	0.08	0.09	0.10	0.14	0.17
60	0.08	0.08	0.08	0.08	0.09	0.10	0.13	0.15
61	0.08	0.08	0.08	0.08	0.09	0.09	0.12	0.14
62	0.08	0.08	0.08	0.08	0.08	0.09	0.11	0.12
63	0.07	0.08	0.08	0.08	0.08	0.08	0.10	0.11
64	0.07	0.07	0.08	0.08	0.08	0.08	0.10	0.11
65	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.10
66	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.10
67	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09
68	0.07	0.07	0.07	0.07	0.08	0.08	0.09	0.09
69	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09
70	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09
71	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09
72	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.09
Total	13.02	15.91	18.62	21.82	32.24	43.19	95.09	134.25

Design Flood Hydrograph at Proposed Regurating UB-1 Intake Site

CA= 802 km^2

Time [hr]	Flood Discharge [m^3/s] 1/2yr	1/5yr	1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
0	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
1	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
2	21.1	21.1	21.2	21.2	21.4	21.6	22.5	23.2
3	21.3	21.5	21.6	21.8	22.4	23.0	25.8	28.0
4	21.8	22.1	22.5	22.8	24.0	25.3	31.3	35.8
5	22.5	23.1	23.6	24.3	26.4	28.6	39.1	47.0
6	23.5	24.4	25.3	26.4	29.9	33.5	50.7	63.7
7	24.9	26.4	27.8	29.4	34.8	40.4	67.1	87.3
8	26.8	29.0	31.0	33.4	41.3	49.5	88.7	118.3
9	29.1	32.2	35.0	38.4	49.4	60.9	115.7	157.0
10	31.9	36.0	39.9	44.4	59.2	74.7	148.4	203.9
11	35.2	40.5	45.5	51.3	70.5	90.6	185.9	257.8
12	39.1	45.8	52.1	59.6	84.0	109.6	230.9	322.4
13	46.2	55.6	64.4	74.9	108.8	144.5	313.6	441.1
14	54.2	66.6	78.2	92.0	136.6	183.6	406.1	574.1
15	63.2	78.9	93.6	111.1	167.8	227.3	509.7	722.8
16	72.7	92.0	110.0	131.4	200.9	273.9	620.2	881.4
17	84.6	108.3	130.5	156.8	242.2	332.0	757.6	1,078.8
18	98.1	126.8	153.7	185.6	289.2	397.9	913.8	1,303.1
19	111.1	144.7	176.2	213.4	334.5	461.7	1,064.8	1,519.8
20	123.0	161.0	196.6	238.7	375.7	519.6	1,201.9	1,716.7
21	132.9	174.6	213.6	259.8	410.1	567.8	1,316.3	1,880.9
22	138.0	181.6	222.3	270.7	427.8	592.7	1,375.2	1,965.6
23	141.4	186.2	228.2	277.9	439.6	609.3	1,414.5	2,022.0
24	140.9	185.7	227.5	277.0	438.2	607.3	1,409.8	2,015.2
25	139.1	183.2	224.3	273.2	431.8	598.4	1,388.7	1,984.9
26	134.5	176.8	216.4	263.3	415.8	575.9	1,335.4	1,908.4
27	128.4	168.5	205.9	250.3	394.6	546.1	1,264.7	1,806.9
28	121.2	158.6	193.5	234.9	369.6	510.9	1,181.4	1,687.3
29	113.2	147.7	179.8	217.9	341.9	472.0	1,089.3	1,555.0
30	105.2	136.6	165.9	200.7	313.9	432.6	996.0	1,421.1
31	97.3	125.8	152.4	184.0	286.6	394.3	905.2	1,290.7
32	89.5	115.0	138.9	167.2	259.2	355.8	814.0	1,159.7
33	81.9	104.6	125.8	151.0	232.9	318.8	726.5	1,034.0
34	74.4	94.3	112.9	135.0	206.8	282.2	639.7	909.4
35	68.1	85.6	102.0	121.5	184.8	251.2	566.4	804.1
36	62.1	77.4	91.7	108.7	164.0	222.0	497.1	704.7
37	57.1	70.5	83.1	98.1	146.6	197.6	439.3	621.7
38	52.6	64.4	75.5	88.5	131.1	175.8	387.6	547.5
39	48.5	58.7	68.3	79.7	116.7	155.5	339.7	478.6
40	44.6	53.5	61.7	71.5	103.3	136.8	295.3	414.9
41	41.3	48.9	56.0	64.4	91.8	120.6	256.9	359.8
42	38.6	45.2	51.4	58.7	82.5	107.4	225.8	315.1
43	36.2	42.0	47.3	53.6	74.2	95.8	198.2	275.5
44	34.1	39.0	43.6	49.0	66.7	85.3	173.4	239.8
45	32.2	36.4	40.3	44.9	60.1	75.9	151.2	208.0
46	30.7	34.3	37.7	41.7	54.8	68.6	133.9	183.1
47	29.4	32.6	35.5	39.0	50.4	62.4	119.1	161.8
48	28.3	31.1	33.6	36.7	46.6	57.0	106.3	143.6
49	27.3	29.7	32.0	34.6	43.3	52.3	95.3	127.7
50	26.5	28.6	30.6	32.9	40.5	48.4	86.0	114.3
51	25.9	27.7	29.4	31.5	38.1	45.0	78.0	103.0
52	25.2	26.8	28.3	30.0	35.8	41.8	70.4	92.0
53	24.5	25.9	27.1	28.6	33.5	38.6	62.7	80.9
54	24.0	25.1	26.2	27.4	31.5	35.8	56.1	71.5
55	23.6	24.6	25.5	26.6	30.2	34.0	51.9	65.4
56	23.3	24.2	25.0	26.0	29.2	32.6	48.5	60.5
57	23.0	23.8	24.6	25.5	28.3	31.3	45.5	56.2
58	22.8	23.5	24.2	25.0	27.5	30.2	42.9	52.5
59	22.6	23.2	23.7	24.4	26.6	28.9	39.9	48.2
60	22.3	22.8	23.3	23.9	25.7	27.7	37.0	44.0
61	22.1	22.5	22.9	23.4	24.9	26.5	34.2	39.9
62	21.8	22.2	22.5	22.9	24.1	25.4	31.5	36.2
63	21.6	21.9	22.2	22.5	23.5	24.5	29.4	33.1
64	21.5	21.7	22.0	22.2	23.0	23.9	27.9	30.9
65	21.4	21.6	21.8	22.0	22.6	23.3	26.7	29.2
66	21.4	21.5	21.7	21.8	22.4	23.0	25.9	28.1
67	21.3	21.5	21.6	21.8	22.3	22.8	25.4	27.4
68	21.3	21.4	21.5	21.7	22.1	22.6	25.0	26.8
69	21.2	21.4	21.5	21.6	22.0	22.5	24.6	26.3
70	21.2	21.3	21.4	21.5	21.9	22.3	24.3	25.8
71	21.2	21.3	21.4	21.5	21.8	22.2	24.0	25.4
72	21.2	21.3	21.3	21.4	21.8	22.1	23.8	25.0
Max.	141.4	186.2	228.2	277.9	439.6	609.3	1,414.5	2,022.0

Time [hr]	Flood Volume [10^{6}m^3] 1/2yr	1/5yr	1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
0	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
3	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
4	0.08	0.08	0.08	0.08	0.09	0.09	0.11	0.13
5	0.08	0.08	0.09	0.09	0.09	0.10	0.14	0.17
6	0.08	0.09	0.09	0.10	0.11	0.12	0.18	0.23
7	0.09	0.10	0.10	0.11	0.13	0.15	0.24	0.31
8	0.10	0.10	0.11	0.12	0.15	0.18	0.32	0.43
9	0.10	0.12	0.13	0.14	0.18	0.22	0.42	0.57
10	0.11	0.13	0.14	0.16	0.21	0.27	0.53	0.73
11	0.13	0.15	0.16	0.18	0.25	0.33	0.67	0.93
12	0.14	0.16	0.19	0.21	0.30	0.39	0.83	1.16
13	0.17	0.20	0.23	0.27	0.39	0.52	1.13	1.59
14	0.20	0.24	0.28	0.33	0.49	0.66	1.46	2.07
15	0.23	0.28	0.34	0.40	0.60	0.82	1.83	2.60
16	0.26	0.33	0.40	0.47	0.72	0.99	2.23	3.17
17	0.30	0.39	0.47	0.56	0.87	1.20	2.73	3.88
18	0.35	0.46	0.55	0.67	1.04	1.43	3.29	4.69
19	0.40	0.52	0.63	0.77	1.20	1.66	3.83	5.47
20	0.44	0.58	0.71	0.86	1.35	1.87	4.33	6.18
21	0.48	0.63	0.77	0.94	1.48	2.04	4.74	6.77
22	0.50	0.65	0.80	0.97	1.54	2.13	4.95	7.08
23	0.51	0.67	0.82	1.00	1.58	2.19	5.09	7.28
24	0.51	0.67	0.82	1.00	1.58	2.19	5.08	7.25
25	0.50	0.66	0.81	0.98	1.55	2.15	5.00	7.15
26	0.48	0.64	0.78	0.95	1.50	2.07	4.81	6.87
27	0.46	0.61	0.74	0.90	1.42	1.97	4.55	6.50
28	0.44	0.57	0.70	0.85	1.33	1.84	4.25	6.07
29	0.41	0.53	0.65	0.78	1.23	1.70	3.92	5.60
30	0.38	0.49	0.60	0.72	1.13	1.56	3.59	5.12
31	0.35	0.45	0.55	0.66	1.03	1.42	3.26	4.65
32	0.32	0.41	0.50	0.60	0.93	1.28	2.93	4.17
33	0.29	0.38	0.45	0.54	0.84	1.15	2.62	3.72
34	0.27	0.34	0.41	0.49	0.74	1.02	2.30	3.27
35	0.24	0.31	0.37	0.44	0.67	0.90	2.04	2.89
36	0.22	0.28	0.33	0.39	0.59	0.80	1.79	2.54
37	0.21	0.25	0.30	0.35	0.53	0.71	1.58	2.24
38	0.19	0.23	0.27	0.32	0.47	0.63	1.40	1.97
39	0.17	0.21	0.25	0.29	0.42	0.56	1.22	1.72
40	0.16	0.19	0.22	0.26	0.37	0.49	1.06	1.49
41	0.15	0.18	0.20	0.23	0.33	0.43	0.92	1.30
42	0.14	0.16	0.18	0.21	0.30	0.39	0.81	1.13
43	0.13	0.15	0.17	0.19	0.27	0.34	0.71	0.99
44	0.12	0.14	0.16	0.18	0.24	0.31	0.62	0.86
45	0.12	0.13	0.15	0.16	0.22	0.27	0.54	0.75
46	0.11	0.12	0.14	0.15	0.20	0.25	0.48	0.66
47	0.11	0.12	0.13	0.14	0.18	0.22	0.43	0.58
48	0.10	0.11	0.12	0.13	0.17	0.21	0.38	0.52
49	0.10	0.11	0.12	0.12	0.16	0.19	0.34	0.46
50	0.10	0.10	0.11	0.12	0.15	0.17	0.31	0.41
51	0.09	0.10	0.11	0.11	0.14	0.16	0.28	0.37
52	0.09	0.10	0.10	0.11	0.13	0.15	0.25	0.33
53	0.09	0.09	0.10	0.10	0.12	0.14	0.23	0.29
54	0.09	0.09	0.09	0.10	0.11	0.13	0.20	0.26
55	0.08	0.09	0.09	0.10	0.11	0.12	0.19	0.24
56	0.08	0.09	0.09	0.09	0.11	0.12	0.17	0.22
57	0.08	0.09	0.09	0.09	0.10	0.11	0.16	0.20
58	0.08	0.08	0.09	0.09	0.10	0.11	0.15	0.19
59	0.08	0.08	0.09	0.09	0.10	0.10	0.14	0.17
60	0.08	0.08	0.08	0.09	0.09	0.10	0.13	0.16
61	0.08	0.08	0.08	0.08	0.09	0.10	0.12	0.14
62	0.08	0.08	0.08	0.08	0.09	0.09	0.11	0.13
63	0.08	0.08	0.08	0.08	0.08	0.09	0.11	0.12
64	0.08	0.08	0.08	0.08	0.08	0.09	0.10	0.11
65	0.08	0.08	0.08	0.08	0.08	0.08	0.10	0.10
66	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
67	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
68	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
69	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09
70	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09
71	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09
72	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09
Total	13.61	16.64	19.47	22.82	33.71	45.16	99.43	140.38

Design Flood Hydrograph at Proposed Regurating UB-2 Intake Site

CA= 822 km^2

Time [hr]	Flood Discharge $[m^3/s]$ 1/2yr	1/5yr	1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
0	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4
1	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4
2	21.6	21.6	21.7	21.7	21.9	22.1	23.1	23.8
3	21.9	22.0	22.2	22.4	23.0	23.6	26.5	28.7
4	22.4	22.7	23.0	23.4	24.6	25.9	32.1	36.7
5	23.1	23.7	24.2	24.9	27.0	29.3	40.1	48.2
6	24.1	25.1	26.0	27.1	30.6	34.3	51.9	65.2
7	25.5	27.1	28.5	30.2	35.7	41.4	68.8	89.5
8	27.4	29.7	31.8	34.3	42.3	50.8	90.9	121.2
9	29.8	33.0	35.9	39.4	50.6	62.4	118.6	160.9
10	32.7	36.9	40.9	45.5	60.7	76.6	152.1	209.0
11	36.1	41.5	46.6	52.6	72.2	92.8	190.6	264.3
12	40.0	47.0	53.4	61.1	86.1	112.3	236.7	330.5
13	47.4	57.0	66.0	76.8	111.5	148.1	321.4	452.1
14	55.6	68.3	80.2	94.2	140.0	188.1	416.3	588.4
15	64.7	80.9	95.9	113.8	171.9	233.0	522.4	740.8
16	74.5	94.3	112.8	134.7	206.0	280.8	635.7	903.4
17	86.7	111.0	133.7	160.7	248.3	340.3	776.5	1,105.7
18	100.5	130.0	157.5	190.2	296.4	407.9	936.6	1,335.6
19	113.9	148.4	180.6	218.7	342.9	473.2	1,091.3	1,557.7
20	126.0	165.0	201.5	244.7	385.1	532.5	1,231.9	1,759.5
21	136.2	178.9	218.9	266.3	420.3	582.0	1,349.1	1,927.8
22	141.4	186.1	227.9	277.4	438.4	607.5	1,409.5	2,014.6
23	144.9	190.9	233.9	284.8	450.5	624.5	1,449.8	2,072.4
24	144.5	190.3	233.1	284.0	449.1	622.5	1,445.0	2,065.5
25	142.6	187.7	229.9	280.0	442.6	613.4	1,423.3	2,034.4
26	137.9	181.3	221.8	269.9	426.2	590.3	1,368.7	1,956.0
27	131.6	172.7	211.0	256.5	404.4	559.7	1,296.3	1,852.0
28	124.2	162.5	198.3	240.8	378.8	523.7	1,210.9	1,729.4
29	116.1	151.3	184.3	223.4	350.4	483.8	1,116.5	1,593.8
30	107.8	140.0	170.1	205.7	321.7	443.4	1,020.9	1,456.5
31	99.8	129.0	156.2	188.6	293.7	404.1	927.8	1,322.9
32	91.7	117.9	142.3	171.3	265.6	364.6	834.3	1,188.6
33	83.9	107.2	129.0	154.8	238.7	326.8	744.6	1,059.8
34	76.2	96.7	115.8	138.4	212.0	289.2	655.7	932.1
35	69.8	87.8	104.6	124.5	189.4	257.5	580.5	824.2
36	63.6	79.3	94.0	111.4	168.1	227.5	509.5	722.3
37	58.5	72.3	85.2	100.5	150.3	202.5	450.3	637.2
38	53.9	66.0	77.3	90.8	134.4	180.1	397.3	561.2
39	49.7	60.2	70.0	81.7	119.6	159.4	348.2	490.6
40	45.7	54.8	63.3	73.3	105.9	140.2	302.6	425.2
41	42.3	50.1	57.4	66.0	94.1	123.6	263.3	368.8
42	39.6	46.3	52.7	60.2	84.5	110.1	231.4	322.9
43	37.1	43.0	48.5	55.0	76.0	98.2	203.2	282.4
44	34.9	40.0	44.7	50.3	68.4	87.4	177.7	245.8
45	33.0	37.3	41.3	46.1	61.6	77.8	155.0	213.2
46	31.4	35.2	38.7	42.8	56.2	70.3	137.2	187.7
47	30.1	33.4	36.4	40.0	51.7	63.9	122.0	165.9
48	29.0	31.8	34.5	37.6	47.7	58.4	109.0	147.2
49	28.0	30.5	32.8	35.5	44.3	53.6	97.6	130.9
50	27.2	29.3	31.4	33.7	41.5	49.6	88.1	117.2
51	26.5	28.4	30.1	32.2	39.0	46.2	80.0	105.5
52	25.8	27.5	29.0	30.8	36.7	42.9	72.2	94.3
53	25.1	26.5	27.8	29.3	34.3	39.5	64.3	82.9
54	24.6	25.7	26.8	28.1	32.3	36.7	57.5	73.2
55	24.2	25.2	26.2	27.3	31.0	34.9	53.2	67.1
56	23.9	24.8	25.6	26.7	29.9	33.4	49.7	62.0
57	23.6	24.4	25.2	26.1	29.0	32.1	46.6	57.6
58	23.4	24.1	24.8	25.6	28.2	30.9	43.9	53.8
59	23.1	23.8	24.3	25.0	27.3	29.7	40.9	49.4
60	22.9	23.4	23.9	24.5	26.4	28.4	37.9	45.1
61	22.6	23.1	23.5	23.9	25.5	27.2	35.0	40.9
62	22.4	22.7	23.1	23.4	24.7	26.0	32.3	37.1
63	22.2	22.5	22.7	23.0	24.0	25.1	30.1	33.9
64	22.1	22.3	22.5	22.8	23.6	24.4	28.6	31.7
65	21.9	22.1	22.3	22.5	23.2	23.9	27.3	29.9
66	21.9	22.1	22.2	22.4	23.0	23.6	26.6	28.8
67	21.8	22.0	22.1	22.3	22.8	23.4	26.1	28.1
68	21.8	21.9	22.1	22.2	22.7	23.2	25.6	27.5
69	21.8	21.9	22.0	22.1	22.6	23.0	25.2	26.9
70	21.7	21.9	22.0	22.1	22.5	22.9	24.9	26.4
71	21.7	21.8	21.9	22.0	22.4	22.8	24.6	26.0
72	21.7	21.8	21.9	22.0	22.3	22.7	24.4	25.7
Max.	144.9	190.9	233.9	284.8	450.5	624.5	1,449.8	2,072.4

Time [hr]	Flood Volume $[10^6 m^3]$ 1/2yr	1/5yr	1/10yr	1/20yr	1/100yr	1/200yr	1/1000yr	PMF
0	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09
3	0.08	0.08	0.08	0.08	0.08	0.08	0.10	0.10
4	0.08	0.08	0.08	0.08	0.09	0.09	0.12	0.13
5	0.08	0.09	0.09	0.09	0.10	0.11	0.14	0.17
6	0.09	0.09	0.09	0.10	0.11	0.12	0.19	0.23
7	0.09	0.10	0.10	0.11	0.13	0.15	0.25	0.32
8	0.10	0.11	0.11	0.12	0.15	0.18	0.33	0.44
9	0.11	0.12	0.13	0.14	0.18	0.22	0.43	0.58
10	0.12	0.13	0.15	0.16	0.22	0.28	0.55	0.75
11	0.13	0.15	0.17	0.19	0.26	0.33	0.69	0.95
12	0.14	0.17	0.19	0.22	0.31	0.40	0.85	1.19
13	0.17	0.21	0.24	0.28	0.40	0.53	1.16	1.63
14	0.20	0.25	0.29	0.34	0.50	0.68	1.50	2.12
15	0.23	0.29	0.35	0.41	0.62	0.84	1.88	2.67
16	0.27	0.34	0.41	0.48	0.74	1.01	2.29	3.25
17	0.31	0.40	0.48	0.58	0.89	1.22	2.80	3.98
18	0.36	0.47	0.57	0.68	1.07	1.47	3.37	4.81
19	0.41	0.53	0.65	0.79	1.23	1.70	3.93	5.61
20	0.45	0.59	0.73	0.88	1.39	1.92	4.43	6.33
21	0.49	0.64	0.79	0.96	1.51	2.10	4.86	6.94
22	0.51	0.67	0.82	1.00	1.58	2.19	5.07	7.25
23	0.52	0.69	0.84	1.03	1.62	2.25	5.22	7.46
24	0.52	0.69	0.84	1.02	1.62	2.24	5.20	7.44
25	0.51	0.68	0.83	1.01	1.59	2.21	5.12	7.32
26	0.50	0.65	0.80	0.97	1.53	2.12	4.93	7.04
27	0.47	0.62	0.76	0.92	1.46	2.01	4.67	6.67
28	0.45	0.59	0.71	0.87	1.36	1.89	4.36	6.23
29	0.42	0.54	0.66	0.80	1.26	1.74	4.02	5.74
30	0.39	0.50	0.61	0.74	1.16	1.60	3.68	5.24
31	0.36	0.46	0.56	0.68	1.06	1.45	3.34	4.76
32	0.33	0.42	0.51	0.62	0.96	1.31	3.00	4.28
33	0.30	0.39	0.46	0.56	0.86	1.18	2.68	3.82
34	0.27	0.35	0.42	0.50	0.76	1.04	2.36	3.36
35	0.25	0.32	0.38	0.45	0.68	0.93	2.09	2.97
36	0.23	0.29	0.34	0.40	0.61	0.82	1.83	2.60
37	0.21	0.26	0.31	0.36	0.54	0.73	1.62	2.29
38	0.19	0.24	0.28	0.33	0.48	0.65	1.43	2.02
39	0.18	0.22	0.25	0.29	0.43	0.57	1.25	1.77
40	0.16	0.20	0.23	0.26	0.38	0.50	1.09	1.53
41	0.15	0.18	0.21	0.24	0.34	0.44	0.95	1.33
42	0.14	0.17	0.19	0.22	0.30	0.40	0.83	1.16
43	0.13	0.15	0.17	0.20	0.27	0.35	0.73	1.02
44	0.13	0.14	0.16	0.18	0.25	0.31	0.64	0.88
45	0.12	0.13	0.15	0.17	0.22	0.28	0.56	0.77
46	0.11	0.13	0.14	0.15	0.20	0.25	0.49	0.68
47	0.11	0.12	0.13	0.14	0.19	0.23	0.44	0.60
48	0.10	0.11	0.12	0.14	0.17	0.21	0.39	0.53
49	0.10	0.11	0.12	0.13	0.16	0.19	0.35	0.47
50	0.10	0.11	0.11	0.12	0.15	0.18	0.32	0.42
51	0.10	0.10	0.11	0.12	0.14	0.17	0.29	0.38
52	0.09	0.10	0.10	0.11	0.13	0.15	0.26	0.34
53	0.09	0.10	0.10	0.11	0.12	0.14	0.23	0.30
54	0.09	0.09	0.10	0.10	0.12	0.13	0.21	0.26
55	0.09	0.09	0.09	0.10	0.11	0.13	0.19	0.24
56	0.09	0.09	0.09	0.10	0.11	0.12	0.18	0.22
57	0.08	0.09	0.09	0.09	0.10	0.12	0.17	0.21
58	0.08	0.09	0.09	0.09	0.10	0.11	0.16	0.19
59	0.08	0.09	0.09	0.09	0.10	0.11	0.15	0.18
60	0.08	0.08	0.09	0.09	0.09	0.10	0.14	0.16
61	0.08	0.08	0.08	0.09	0.09	0.10	0.13	0.15
62	0.08	0.08	0.08	0.08	0.09	0.09	0.12	0.13
63	0.08	0.08	0.08	0.08	0.09	0.09	0.11	0.12
64	0.08	0.08	0.08	0.08	0.08	0.09	0.10	0.11
65	0.08	0.08	0.08	0.08	0.08	0.09	0.10	0.11
66	0.08	0.08	0.08	0.08	0.08	0.08	0.10	0.10
67	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
68	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
69	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
70	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.10
71	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09
72	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09
Total	13.95	17.05	19.95	23.39	34.56	46.28	101.91	143.88

Supporting Report

Geological Investigation

REPORT ON GEOLOGICAL INVESTIGATION OF DRILLING AND MAPPING AT UPPER BALU CHAUNG HYDROPOWER PROJECT

May, 2010

Suntac Geo-engineering Services

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CONTENT

TABLE OF CONTENTS Page

FIGURE

APPENDIX

REPORT ON GEOLOGICAL INVESTIGATION OF DRILLING AND MAPPING AT UPPER BALU CHAUNG HYDROPOWER PROJECT

1. Introduction

Suntac Technologies Co., Ltd was contracted with Minn Anawrahta Group Co., Ltd (Neo Energy Development Co., Ltd) to conduct sub-surface investigation of drilling and geological mapping at Upper Balu chaung Hydropower project area in the Southern Shan State. In the first week of January 2010, a drilling team was assigned to carry out for drilling and mapping in the Upper Balu chaung area previously selected by Neo Energy Development Co., Ltd. A total of eight drill holes covering a depth of 200 m have been completed by Suntac Technologies Co., Ltd drilling team. The sub-surface information are explained applying relevant drill hole logging diagrams deducted from drill core samples.

2. The Objectives

The objective of the present investigation is to delineate the surface and sub-surface geologic information in order to assist further engineering and geotechnical calculation.

3. Location of the Investigation Area.

Upper Balu chaung Hydropower project area is located approximately 400 Km North-West of Yangon. The project area is described in Government’s 1 inch to 4 miles Topographic Map sheet 93/D .Fig (1) is also illustrated as location of Upper Balu chaung Hydropower project site from Satellite Image. The area is accessible by Yangon to Nyaung Shwe and by boat to Inding via Nyaung Shwe.Inding to project area can be reached by car road.

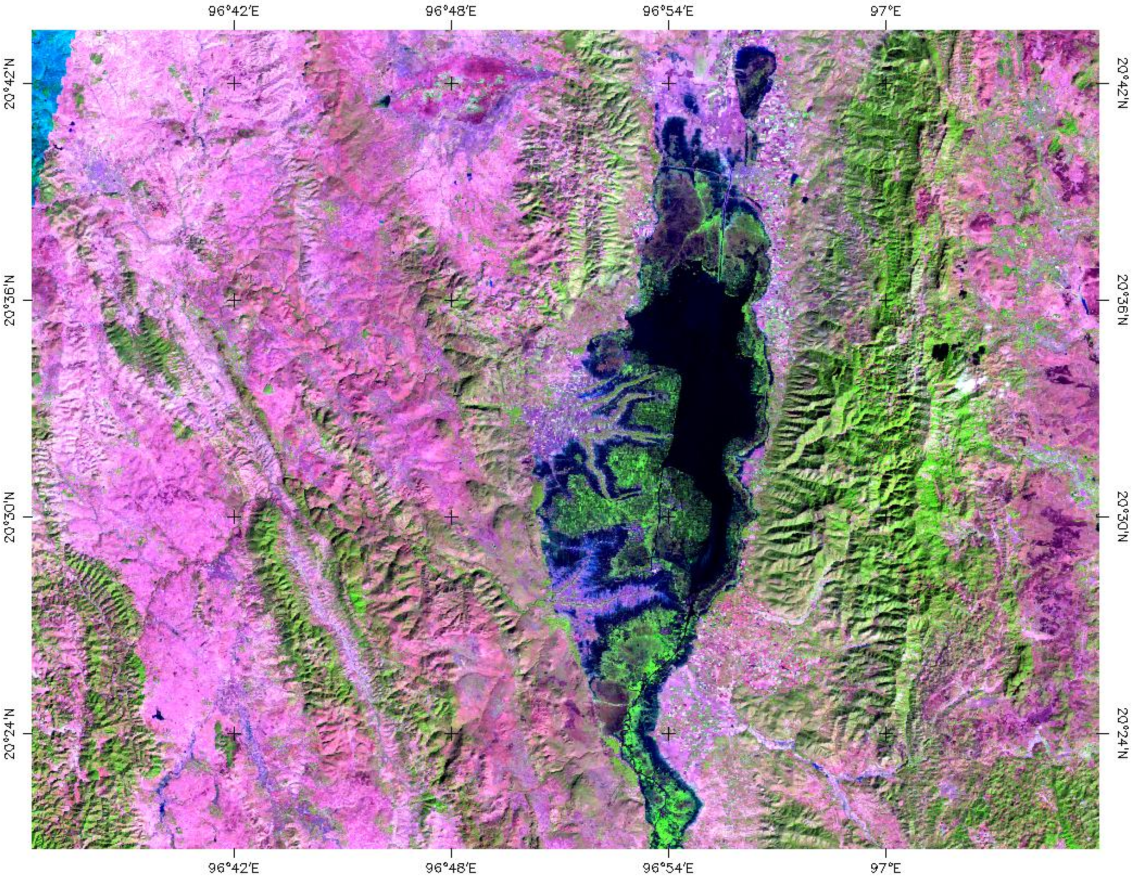


Fig (1) Satellite Image of Upper Balu chaung Hydropower Project Area.

3.1 Character of Surrounding Country

The present investigated area, practically from the western part of the Inlay Lake, consists of almost northwest trending hills and mountain ranges. Chhibber (1934) reported that Inle Lake.-This lake lies in the State of Yawnghwe on the Shan Plateau, at a height of 3,000 feet above sea-level in lat .22° 35' N, long. 96° 57' E. The lake occupies the central part of a trough between two ranges of hills, which, like the ranges of that part of Burma, run almost due north and south. At its way southward; like the stream on the western side it disappears into the ground, but at some considerable distance south of the lake. The lake is, in a sense, the centre of a closed system, without direct communication with any of the important river-system of Burma, but , in a wider sense, it may be considered to belong to the water system of the Salween.

It is about 14 miles long and about 4 miles broad. The depth varies with the seasons. In March it is nowhere greater than 12 feet, and the average depth is not more than 7 feet ; but at the end of the rainy season the greatest depth must be at least 20 feet .The bottom is overgrown with long and tangled weeds which rise nearly to the surface. The water is remarkable for its extreme clearness. I t is thus possible, when there is no breeze, to watch the animals at t he bottom almost as if they were in an aquarium. All the silt brought down by the streams is deposited before it reaches the middle of the lake. No precise details are available as to the temperature of the water. Annandale found it remarkably constant at the beginning of March, not varying more than 2° F. The average surface temperature was about 71° F. (21·7° C.) at that season, and the average bottom temperature one degree F. lower ; the average air temperature being about 73° F. (22.8° C).It is impossible to state the exact dimensions of the lake because of two facts: firstlv, because its size increases greatly in the wet season; secondly, because it has not at any time of the year what may be called a solid margin, for it is completely surrounded by float ing islands formed by the growth and decay of vegetation. These islands, which are massed together round the edge of the lake, are one of its most characteristic features.

The presence of the floating islands, cultivated or in their natural state, divides the lake into two regions, an open central region and the swampy marginal one. The faunas of these two regions, according to the late Dr. Annandale, are very distinct.

He was also able to recognize an intermediate zone where the two regions meet. Origin and History of the Inle Lake.-The lake belongs to the type known as solution lakes-lakes with their basins hollowed out of limestone by the dissolving action of water. The common feature of such lakes is presence somewhere In their bottom of a " sink " or a deep pit down which the whole or a part. of the water is liable to disappear. No sink exist s in the Inle Lake at present, but the point at which the river flows out of it and disappears underground may very possibly have, at one period, been beneath it s waters. It is likely, however, that very large tract of t he country to the south of the lake must at one time have been covered by its waters and have been gradually filled in by the deposition of silt and the formation of peat , especially by the latter agency.

The lake must thus at one time have covered a much greater area than it does at present, and it must have been much deeper , though we may have no evidence as to the height to which its water reached. It may have been over a hundred miles long and several hundred feet deep. Moreover, it is by means the only Jake that once existed in the neighborhood indeed, superficial deposit s in the emptied basins scattered amongst the hills of the Shan Plateau make it evident that the country was once a regular lake country. Some of the lakes must have disappeared at a remote period, but others have dried up recently, perhaps even in historical times. There are traditions which seem to point to this having occurred at He-ho. The deposition of silt and the formation of peat have not been the only factors that have led to the disappearance of Water flow the basins.' Another cause has been the eating through of limestone by water rendered a cid by the decay of vegetation, The He-ho stream flows down into the lower down through an ancient limestone ridge, and it is not improbable that the water may have been finally drained from the upper plain by its cutting through its ridge in a comparatively short time under exceptionally favorable conditions.

The tectonic and structure features of the Upper Balu chaung area is illustrated in Fig (2).

TECTONIC MAP OF MYANMAR AND SURROUNDING REGIONS

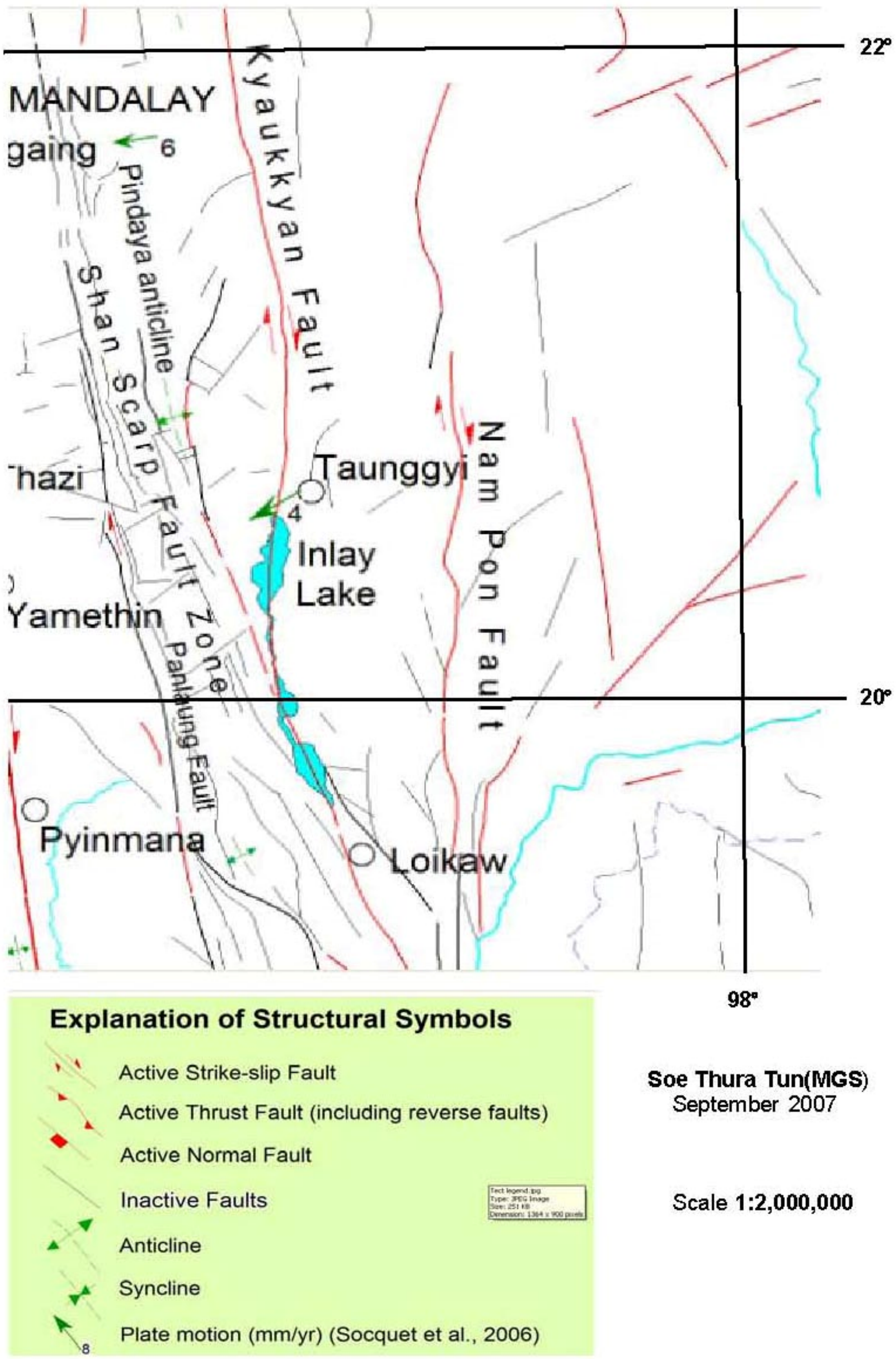
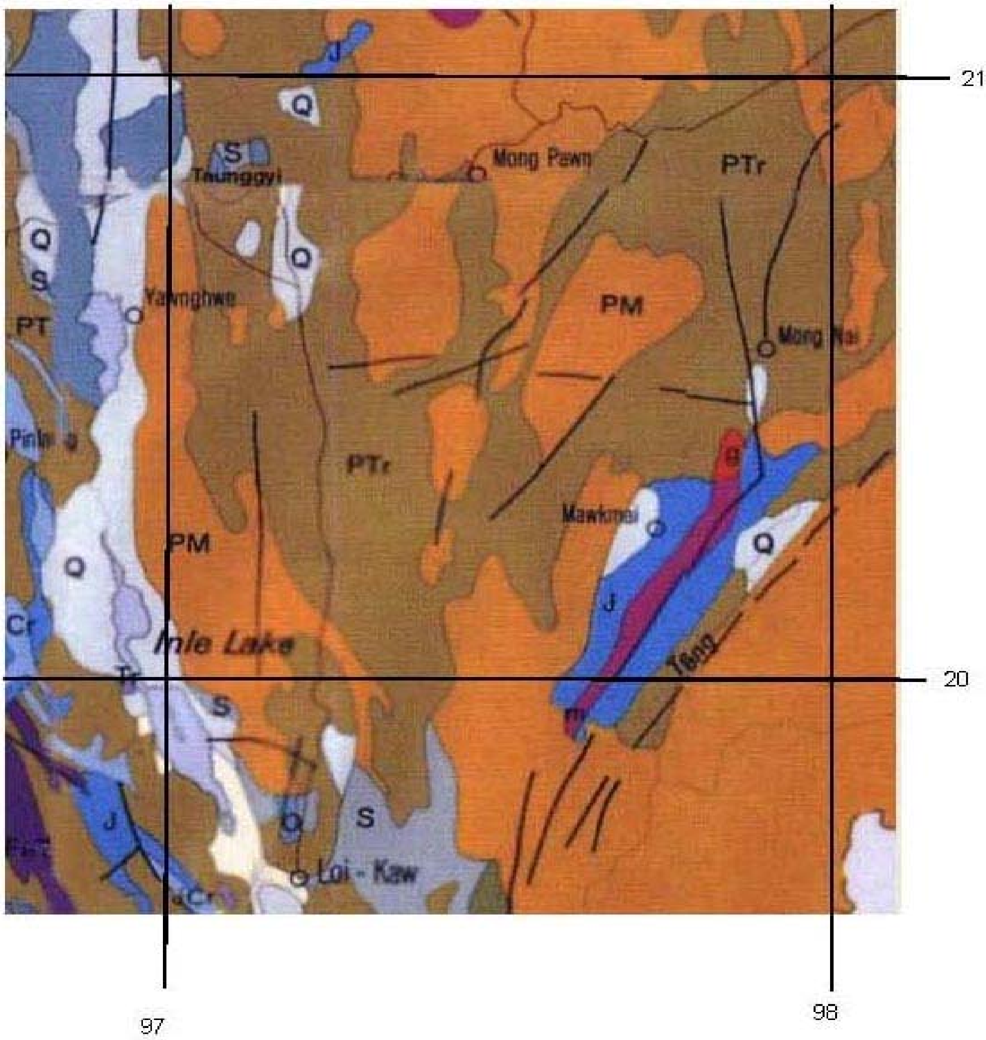


Fig (2) Tectonic and Structural Features of Upper Balu chaung Area.

4. Regional Geological Setting

Myanmar is situated in an area of complex plate tectonic setting. As a result of plate tectonic evolution, the country has been divided from west to east into four major tectonic units, the Arkan Coastal Zone, Indo-Burman Range, Inner Burma Basin and Sino-Burman Ranges, forming the north-south elongated structures. The geotectonic units have pronounced topographic expressions, thus correlating with major geomorphic and physiographic units. Correspondingly, from west to east, there are four north-south linear geomorphic provinces, namely The Arankan Coastal Belt, The Western Ranges, The Central Lowlands and Eastern Highlands. The present Investigated area is situated in the Eastern Highlands. The regional geologic setting has been reported in Geology of Burma by H.L. Chhibber (1934) and F.Bender (1983).The regional geology of the part of the present investigated area is illustrated in fig (3) after F.Bender(1983).



Quarternary	Q	
Cretaceous	Cr	Flysh-type sediments and Globotruncana limestones of Indoburman Ranges, Orbitolina-limestones of Northern Burma, and Kabawshales of innerbueman Tertiary Basins
Jurassic	J	Namyau Series, Loi-an Series, and equlvalents
Triassic	Tr	Bawgyo Group, kamawkala limestone, and equlvalents
Paleozoic-l Mezoic	PM	Undifferentiated sediments of Eastern Burma
Permian- Triassic	P-Tr	Pindaya Group (S-Shan State) Naung Kangyi Formation (N-Shan State)
Silurian	S	Mibayaaung Group (S Shan State) Panghsa-pye Formation and Nanhsin Formation (N-Shan State)
Ordovician	O	Pindaya group (S shan state) Naung Kangyi Formation(N Shan State)

Reference : Geology of Burma by F.Bender (1983)

Fig (3) Regional Geologic Setting of Balu chaung Area.

The Sino-Burman Ranges or the Eastern Highlands belt is an important tectonic domain of Myanmar. Covering almost half of the country, it comprises the Shan plateau and the Tenasserim area. The rocks are mostly Paleozoic sediments folded and partially metamorphosed. In the Paleozoic, there are two important carbonate series (a) the Ordovician-Siluriun carbonate series and (b) the so-called "plateau limestone" of Carboniferous-Permian age.(ESCAFE,1996). As can be seen from Geological Map of Burma, the present investigated area is mainly comprised in Shan Dolomite Group or Plateau limestone group.

The upper Plateau limestone previously regarded as Permo-Carboniferous age (La Touche, 1913) consists of dark grey or bluish limestone with Fusulina and Products, occurring only in isolated masses and almost inseparable from the lower Plateau limestone beds. It was once believed that the lower Plateau limestone, being dolomite, is of Devonian age and the upper Plateau limestone, being calcitic, is of Permo-Carboniferous age. However the discovery of Triassic fossils in the dolomitic part of the so-called Lower Plateau limestone at Na-Hkan by M.R. Sondhi(in Fermor, 1933)suggestd that La Touche's two fold division of the Plateau limestone is impractical. Pascoe (1959) makes some reviews of Plateau limestone and proposed three fold subdivisions of Plateau limestone, a lower dolomitic, a middle calcitic and an upper dolomitic units.

The next important study of Plateau limestone was by Bown and sonhdi(1934) in the area between Kalaw and Taunggyi in the Southern Shan State. However the lithologic description of the Permo-Carboniferous limestone of Brown and Sonhdi were similar in every respect to that of La Touche's so-called lower Plateau limestone. According to Brown and Sonhdi, the Permo-Carboniferous limestone, the outcrop of which are more extensive in the Southern Shan State than in the Northern Shan State.

The IGS/DGSE (British-Burmese) Team, in the Neyaunga and Nyaunggyat area, Yengan Township Southern Shan State in 1971-1972 was able to sub-divide the rocks into three lithostratigraphic units of Formation rank as Thitsipin Formation, Nwabangyi Formation and NatteikFormation (Garson et.al 1976). However Thitsipin limestone the lower part of Nwabangyi Dolomite is undoubtedly included in the Permian System (DGSE, 1982).

5. <u>Geology of the Investigated Area</u>

According to the Geology Map of Burma (Bender, 1983) indicated that the present study area of Upper Balu chaung Hydropower project area is mainly consisted in Shan Dolomite Group. The lithologic similarity of carbonate rocks in the present investigated area could be tentatively equivalent as Thitsipin limestone Formation. The name Thitsipin limestone Formation was given by Garson et.al (1976) to the limestone at Thitsipin village in Ye-Ngan Township. The formation unconformably overlies Silurian and other lower Paleozoic rocks. Ridge sides are commonly steep and vertical and the surface of the formation is extremely irregular, lacking surface drainage; swallow holes are common. In contrast, where the formation has been dolomitised it forms a gently rolling landscape of open grassland with some shrubs but very few trees. (DGSE, 1982)

In the dolomitised part it is pale grey to pale blue, fine grained dolomite intensely brecciated and often veined with calcite. The bedding is largely obscured.

According to the geologic outcrop mapping (1:2000) reveals that the following lithologic units have been observed in Upper Hydropower project area. See Geologic outcrop Map of Area 1, 2 and 3.

(1) Travertine limestone

(2) Clastic Sedimentary rocks(Mudstone, Siltstone and Sandstone)

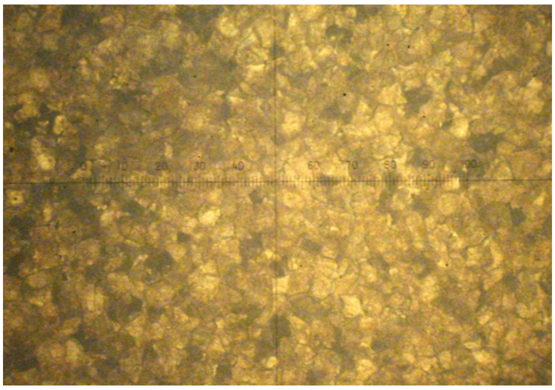
(3) Carbonate Rocks(Dolomitic limestone)

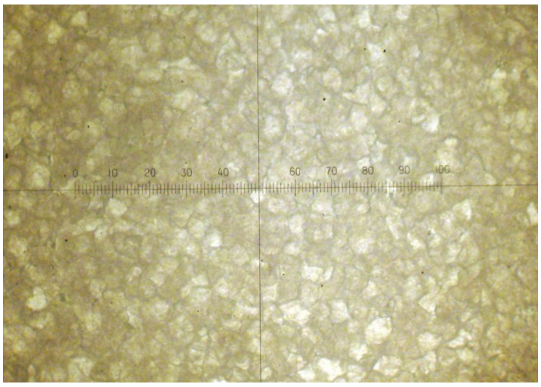
Clastic Sedimentary rocks of Mudstone, Siltstone and Sandstone are well crop out at 270991E and 2264975 N. Clastic sedimentary rocks are observed as thin to medium bedded and moderately weathered. Good exposures are observed at road cut of Minlon village (East). Travertine limestone or Tufa unit is well exposed along the course of Balu chaung. The carbonate unit of dolomitic limestone is widely distributed in uphill and along the water way of Balu chaung. This unit is massive, compact, highly brecciaed and jointed. Dolomitic limestone fractures are mostly occurred as Limonite or iron stained. Small calcite vein-lets are also associated with dark grey dolomitic limestone.

5.1 Petrographic Study

The petrographic study of mapped area (1:2000) has been described as follow.

Petrographic Interpretation of Sample 1.





(a) (b)

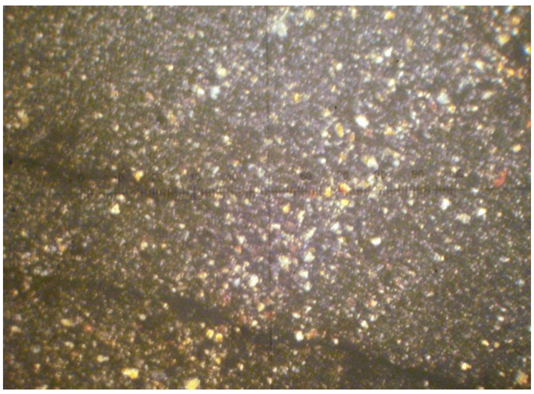
Thin Section of Dolostone (a) XN and (b) PPL

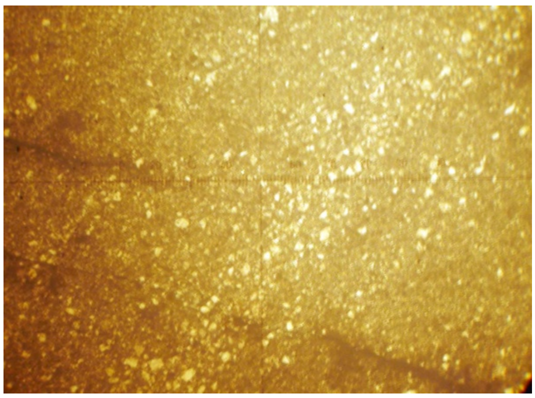
The rock is mainly composed of dolomite (90%) and the other constituents comprise the cement and the unidentifiable fossil fragments. The dolomites are medium grained and unimodal in crystal size distribution. The fabric of rock unit shows the planner (idiotopic) subhedral. Based on the composition, the rock can be regarded as Dolostone (Dolomite), the Lower Plateau Limestone and Carboniferous in age. The brief descriptions of megascopic and microscopic characteristics are represented in Table below.

Characteristics of Sample No. 1 (Dolostone)

1	**Sample No.**	1				
2	**Rock Name**	dolostone				
3	**Possible Formation**	Lower Plateau Limestone				
4	**Possible Age**	Carboniferous				
5	**Weather color**	black				
6	**Fresh color**	grey				
7	**Rock condition**	brecciate	induated	soft	√-medium	compact
8	**Major Components**	Wt %				
	- Carbonate grains					
	- Clay					
	- silt					
	- sand					
	- bioclast	5	unidentifiable relic			
	- cements/matrix					
	- opaque/others	5				
	- ooids					
	- Lithoclast					
	- dolomite	90				
	Total	100				
9	**Texture (shape & size)**	subhedral rhombic medium-grained				
10	**Burrow/primary sedimentary structure**					
11	**Fossils**	unidentifiable bioclast relic				

Petrographic Interpretation of Sample 2.





(a) (b)

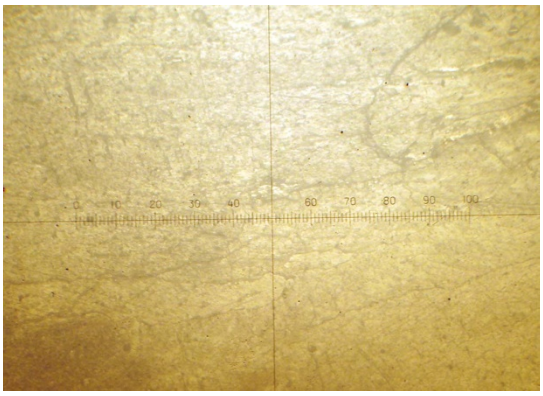
Thin Section of Siltstone (a) XN and (b) PPL

The rock is mainly composed of silt (80%), and sand (15%). Accordingly the composition, the rock can be distinguished as Siltstone. It also shows laminated character being defined by the parallel and sub-parallel alignment of the different grain size of silt-sized and sand-sized materials. Dislocation of layers of sediments is observed in this thin section. The possible formation of this rock unit is Namhsim Formation and Silurian in age(?). The fossil evident is still need to prove for age determination. The descriptions of megascopic and microscopic characteristics can be observed in Table below.

Characteristics of Sample No. 2 (Siltstone)

1	**Sample No.**	2				
2	**Rock Name**	Siltstone				
3	**Possible Formation**	Namhsim Formation (?)				
4	**Possible Age**	Silurian (?)				
5	**Weather color**	black				
6	**Fresh color**	buff				
7	**Rock condition**	brecciate	indurated	soft	√-medium	compact
8	**Major Components**	Wt %				
	- Carbonate grains					
	- Clay					
	- silt	80				
	- sand	15				
	- bioclast					
	- cements/matrix					
	- opaque/others					
	- ooids					
	- Lithoclast					
	- dolomite/iron	5				
	Total	100				
9	**Texture (shape & size)**	clastic sediments silt and sand size; fine to medium-grained				
10	**Burrow/primary sedimentary structure**	sand lineation parallel to bedding				
11	**Fossils**					

Petrographic Interpretation of Sample 3.



(a) (b)

Thin Section of Travertine (a) XN and (b) PPL

The rock essentially consists of calcite (about 95%). The grains of calcite are coarse and tabular to fibrous in form, giving the parallel lamination of each other. The clay sediments are sometimes observed between lamination of calcites. Based on those characteristics this rock is Travertine. The descriptions of megascopic and microscopic characteristics can be observed in Table below.

Characteristics of Sample No. 3 (Travertine)

1	**Sample No.**	3				
2	**Rock Name**	Travertine				
3	**Possible Formation**					
4	**Possible Age**					
5	**Weather color**	pale yellow				
6	**Fresh color**	white and pale yellow				
7	**Rock condition**	brecciate	indurated	√-soft	medium	compact
8	**Major Components**	Wt %				
	- Carbonate grains	95	2set of cleavages; elongated grains; parallel grains to each other			
	- Clay					
	- silt					
	- sand					
	- bioclast					
	- cements/matrix					
	- opaque/others	5				
	- ooids					
	- Lithoclast					

	- dolomite		
	Total	100	
9	**Texture (shape & size)**	laminated very coarse-grained	
10	**Burrow/primary sedimentary structure**	parallel lamination to each other; clay between lamination	
11	**Fossils**		

6. <u>Diamond Core Drilling</u>

6.1 Scope of Drilling Procedure

This procedure covers the guidelines, requirements, and procedures for core drilling, coring, and sampling of rock for the purposes of site investigation. The borehole could be vertical, horizontal, or angled. It is described in the context of obtaining data for the design, construction, or maintenance of structures, and applies to the surface drilling and drilling from adits and exploratory tunnels, and as well to apply to core drilling in hard and soft rock.

6.2 Brief Description of Drilling Procedure

Drilling

Drilling is accomplished by circulating a drilling medium through the drill bit while rotating and lowering or advancing the string of drill rods as downward force is applied to a cutting bit. The bit cuts and breaks up material as it penetrates the formation, and the drilling medium picks up the cuttings generated by the cutting action of the bit. The drilling medium, with cuttings, then flows outward through the annular space between the drill rods and drill hole, and carries the cuttings to the ground surface, thus cleaning the hole. The string of drill rods and bit is advanced downward, deepening the hole as the operation proceeds.

In drilling works, there exist the two kinds of drilling medium, namely fluid drilling and air drilling.

Fluid drilling

It is carried out by circulating water or water-based fluid with additives.Additives such as bentonite or polymers are frequently added to water to lubricate and cool the bit and to circulate (transport) cuttings to the surface. Drill fluid can also act to prevent cave or collapse of the drill hole. After the drilling fluid reaches the surface, it flows to a ditch or effluent pipe and into a setting pit where the cuttings settle to the bottom. Cuttings are sometimes run through a shaker to remove the larger particles.

From the setting pit, the drilling fluid overflows into the main pit, from which it is picked up by the suction line of mud pump and recirculated through the drill string.

Coring

Coring is the process of recovering cylindrical cores of rock by means of rotating a hollow steel tube (core barrel) equipped with a coring bit. The drilled core is carefully collected in the core barrel as the drilling progresses.

Sampling

Once the core has been cut and the core barrel is full, the drill rods or overshot assembly are pulled and the core retrieved. Samples are packaged and shipped for testing.

Significance and Use

Rock cores are samples of record of the existing subsurface condition at the given borehole locations. Samples are expected to yield significant indications about geological, physical, and engineering nature of the subsurface for use in design and construction of an engineered structure. The core samples need to be preserved using specific procedures for a stipulated time. The period of storage depends upon the nature and significance of the engineered structure. Rock cores always need to be handled such that their properties are not altered in any way due to mechanical damage or changes in ambient conditions of moisture and temperature or other environmental factors.

Apparatus of Drill Rig and Accessories

Essential components of the drilling equipment include the drilling rig with rotary power, hoisting system, casing rods, drill rods, core barrels with bits and liners, and pumps with circulating system. In addition, equipment should include necessary tools for hoisting and coupling & uncoupling the drill string and other miscellaneous items such as prefabricated mud pit and racks for rod stacking and layout. Normally, a drilling platform of planking is built up around the drilling site.

Rock coring operations can proceed at high rotation rates. It is imperative that the drill rig, rods, and core barrels are straight and have a balanced centre of gravity to avoid whipping and resulting damage to cores and expensive.

Drilling Rig

The drilling rig provides the rotary power and downward (or advance) force or hold-back force on the core barrel to core the rock. The preferred diamond drill coring equipments are designs with hydraulic or gear-driven variable speed hollow spindle rotary drill heads, although some core rigs are manufactured with gear or chain pulldown/retract system. Precise control over bit pressure can best be accomplished by a variable setting hydraulic pulldown/retract system. Hydraulic system are often equipped with a detent valve, which allows downfeed (or advance) rate to be set at a certain speed regardless of tool weight or down pressure exerted on the coring bit. Hydraulic feed drill rig should be supplied with a hydraulic pressure gauge that can be related to bit pressures.

Deep hole drill rig should be equipped with hydraulic holdback control so, if required, the full weight of drill rods is not exerted on the bit when drilling downward. Diamond drill rigs can apply high rotation rate as high as 1000 rpm. Most diamond core drills are equipped with a mast and powered hoist for housing heavy drill string. A second wireline hoist is helpful for wireline drilling.

The drill rig frame is either skid or truck mounted and should be equipped with a slide base for ease and working around the drill hole. In special cases, the drilling rig may be mounted on a trailer, barge (for overwater drilling), or columns (for underground work). Some drill rigs are designed to be broken down into several pieces for transport into a remote area. The drilling rig power unit may be powered by hydraulics, air, electricity, gas, or diesel. Most surface skid or truck mounted rigs are diesel or gas powered.

Drilling directions are rarely vertical in underground applications, and smaller rigs are frequently equipped with swivel head to accommodate drilling at angles. Special accommodation must be made for holding and breaking rods when drilling at high angles into crowns of adits. Either top drive drill or column mount machines with hydraulic or pneumatic rod jacks are equipped to handle up holes. For confined space drilling operations, drills are column mounted or mounted on small skids. Special power sources may be required for underground due to air quality considerations.

The platform may need to be constructed at the drilling site to provide a firm base upon which the drill rig is then placed. Platforms are also constructed in the vicinity of the drill hole for workers to hold equipment, serve as a datum, and to allow safe operations.

Selection of Drilling Media

The two primary methods for circulating drill cuttings are water or water-based fluids or air with or without additives. The predominant method of drilling is water-based fluids. Water-based drilling is effective in a wide range of conditions both above and below the water table. Air drilling is selected when water-sensitive soil such as swelling clays or low density collapsible soils are encountered. Air drilling may also be required above the water table if special testing is required in the unsaturated zone. Air drilling is also convenient in highly fractured rocks and porous formations where water-based fluid losses are unacceptable.

The primary functions of the drill fluid are:

1. Remove drill cuttings,
2. Stabilize the borehole,
3. Cool and lubricate the bit,
4. Control fluid loss,
5. Drop cuttings into a setting pit,
6. Facilitate logging of the borehole, and
7. Suspend cuttings in the drill hole during coring,

No single drill fluid mixture can satisfy all of the above requirements perfectly.

So we should consider the best suited materials that could be used in drilling medium.

The pressure host conducts the drilling fluid or air from the circulation pump or compressor to the swivel which directs the drilling fluid or air to a rotating Kelly or drill-rod column.

Rotary Drilling with Water-based Drilling Fluids

The mud pit is a reservoir for the drilling fluid, and, if properly designed and used, provides sufficient flow velocity reduction to allow separation of drill cuttings from the fluid before recirculation. The mud pit can be a shallow, open metal tank with baffles or an excavated pit with some type of liner, and designed to prevent loss of drilling fluid. The mud pit can be used as a mixing reservoir for the initial quantity of drilling fluid, and, in some circumstances, for adding water and additives to the drilling fluid as drilling progresses. It may be necessary to have additional storage tanks for preparing fluids while drilling progresses.

The suction line, sometimes equipped with a foot valve or strainer, or both, conducts the drilling fluid from the mud pit to the fluid circulation pump which in turn must be able to lift the drilling fluid from the mud pit and move it through the system against variable pumping heads at a flow rate to provide an annular velocity that is adequate to transport drill cuttings out of the drill hole.

Water-based Drilling Fluids

The four main classes of water-based drilling fluids are:

(i) Clean, fresh water,

(ii) Water with clay (bentonite) additives,

(iii) Water with polymeric additives, and

(iv) Water with both clay and polymer additives.

- (i) Clean fresh water alone is often not acceptable for core drilling due to poor bit lubrication, erosion due to high velocities required for lifting cuttings, and excessive water loss. In water-sensitive soils, it is desirable to use drill additives to form drill hole wall cakes and prevent moisture penetration. In some cases, water may be required for piezometer installations where other fluid additives are not acceptable for piezometer and well installations.
- (ii) Bentonitic drill muds are often used in rotary drilling applications. The bentonite should be added to water with vigorous mixing and recirculation to ensure uniform properties and to reach a dispersed deflocculated state. For diamond core drilling, low viscosity is usually required due to small clearances. The viscosity of a fluid-mud mixture is related to the solids content and particle shapes and alignment of the additives. During the high speed rotary drilling process, solids have a tendency to spin out and collect inside the drill rods. For diamond drilling, low solids content is desirable. If mass is required to balance high hydrostatic pressures, additives such as barite or ilmenite can be added to keep solids contents low.
- (iii) The need for low solids contents and good lubrication properties point to the use of polymer drill fluids. Natural or synthetic polymer fluids are the best additives for diamond core drilling. Polymer chains such as those from guar gum exhibit flow thinning characteristics in high velocity and shear conditions. Polymer fluids can be weighted with salts to balance hydrostatic pressures. Detergents or

deflocculating agents can be added to discharge lines to assist in dropping cuttings to maintain fluid properties.

-(iv) Fluid management requires considerable experience for successful drilling and sampling. Important fluid parameters include viscosity and density, and these parameters can be tested to improve fluid properties. Test method and test procedures are available for testing drill fluids. Fluid design can be improved by consultation with manufacturers, suppliers, and by review of literature. Because of a large number of suppliers, varying grades of drill fluid products, and varying requirements of each project, providing an exact procedure for design and mixing of drill fluids, is impossible.

Hole Diameters

Selection of hole diameter and core size is the most important consideration when planning a coring program. Most rock coring operations are performed with casings and core barrels whose sizes have been standardized by the Diamond Core Drill Manufacturers Association. For each size of hole, there is a family of casings, core barrels, bits, casing bits, and drill rods. The nesting of casings, barrels, and rods allows for tapering or telescoping of a drill hole through difficult formations. Since the core barrel must pass through the casings selected, anticipating the necessity for telescoping the hole is important so a large enough diameter is selected at the start.

Core diameter, barrel design, bit design, and drilling method have a direct influence on sample quality. Usually when drilling in delicate formations, larger diameter samples provide higher quality samples. Often, obtaining samples of the weaker seam or joints in the rock is critical to design. A larger diameter core barrel can often reduce shearing stresses imparted to a seam or joint in the core and thus reduce mechanical breakage. For core operations related to most surface drilling project investigations, minimum core size would correspond to “N” sized borings.

Casing Installation

For most coring operations, setting casings in overburden materials will be necessary, especially near the surface to control drill fluid circulation. Typically, water sensitive soils and loose overburden soils are protected by casings that are set in competent bedrock or to firm seating at an elevation below the water-sensitive formation. The casing used should allow for unobstructed passage of the largest core barrel to be used, and should be free of upsets in inside diameter.

Casing and drill rod selection should be based on uphole (or outflow) velocity of the circulation system selected. Uphole (or outflow) velocity should be sufficient to bring up all drill cuttings. Casing or temporary drill hole support can be accomplished through several methods. One casing advancement technique is to drill incrementally ahead of the casing and then drive the casing to the previous depth. Driven casings should be equipped with a hardened shoe to protect end threads. The inside diameter of the shoe should be flush with the casing inside diameter to avoid hang-ups of the core barrel. In some cases, water-sensitive zones may require cementing for stabilization. Casing can be equipped with diamond casing shoes that allow the casing to be advanced with rotary drilling.

The casing shoe should have the same inside diameter as the casing. Casing "shoes" should not be confused with casing "bits".

Casing bits are only acceptable for temporary, rotary installation of casing where coring operations are not required, such as temporary installation of a large diameter telescoped casing. Casing "bits" have an inside diameter that is not large enough to pass a core barrel of the same nominal hole size. Hollow stem augers may be used as casing through overburden soils. Liners may be used inside large diameter casings or augers to increase fluid circulation velocity and optimize cuttings return. If liners are used, they should not driven and care should be taken to maintain true hole alignment.

Drill Rods

Drill rods selection should be based on consideration of the uphole (or outflow) velocity of the circulating fluids for the circulation system selected. Uphole velocity should be sufficient to bring up all drilling cuttings. Most drilling operations are done with DCDMA drilling rods. Drill rods are normally constructed of tubular steel and have a flush outside wall diameter. Drill rod sections usually have threaded female connections at each end. The rods are connected by either removable or welded pins (in one end) strengthened by addition of material at the inside walls. Some drill rod pins are constructed of high strength steel because the joints are a weak link and are subject to failure. Some larger rods are composed of composite materials to reduce weight. Wireline drill rod dimensions are not standardized and are specific to individual manufacturers.

Wireline Core Barrels

Wireline drilling for investigation in rock is a principal system used for deep rock coring applications using surface mounted drill rigs. In the wireline system, the drill rods are only removed from the hole to replace the coring bit, to free a stuck inner barrel, or to adjust the headspace of the inner barrel. The inner core barrel can be removed and replaced without removing the drill rods, allowing for continuous coring. The drill rods also act as a casing, and fluid is circulated from the bit through the annulus between the drill hole and drill rod. The inner barrel assembly is locked into the lead section of wireline drill rod by means of a retrievable overhsot latching mechanism. A latching device locks into a complementary recess in the wall of the leading outer tube such that the outer tube could be rotated without causing the rotation of the inner tube. After the core run, the overshot mechanism is lowered through the rods and latches into a spearhead on the top of the core barrel assembly and is hoisted to the surface with cable and wireline winch. The inner tube assembly consists of an inner tube with removable core lifter case and core lifter at one end, and a removable inner tube head swivel bearing, suspension adjustment, and a latching device with a release mechanism at the opposite end. If continuous coring is not required, the retrievable inner core barrel assembly can be replaced with a pilot bit for hole advancement.

Wireline coring systems are designed for long life bits with wide kerf and impregnated or surface set diamonds. Both internal discharge and face bits are available. The inner core barrel has a dual shut-off valve that stops fluid circulation to alert the driller of a core blockage.

The advantages of wireline drilling are:

- significant reduction in rod handling time compared with conventional core barrel
- increased coring bit life with decreased diamond loss
- high core recovery
- Caving is reduced and rods aid to stabilize the drill hole walls
- Rods are flush or near flush both inside and outside and can be used as temporary casing
- Various in-hole instrumentation packages can be sent through the end of the drill string to test the bottom of the hole. Wireline packer systems can be used for pressure water test.
- Two inner barrel assemblies can be used for maximum productivity in continuous coring operations.

The disadvantages of wireline drilling are:

- Equipment is more expensive than conventional equipment,
- and wireline systems are complicated and operations require additional training.

Most manufacturers offer a triple tube barrel, which is preferred for most operations. The third tube is a split inner liner that facilitates sample handling. Some wireline barrels systems are convertible from soil sampling to rock sampling operation.

These barrels are equipped with soil barrels that can lead in front of the core bit. Some systems are equipped with spring loaded soil core barrels. These systems are advantageous when soils or soft rock are encountered.

Core Barrel Bits

One of the most important equipment decisions in rock core drilling is the bit selection. Both the bit and reaming shell act together to cut the hole. There are many bit design factors involved when selecting the proper bit for good core recovery. Factors included in selection are:

Diamond type—source,

Diamond matrix (surface set or impregnated),

Rock hardness, grain size, and formation,

Drill power, and Barrel type.

Bit selection is a trial and error process that may require several iterations. After a bit is selected, it is tried with the drill to be used. Penetration rate and bit life should be evaluated and a different design selected if necessary. Important features of diamond drilling bits include crown shape, diamonds, and waterways. The crown is the end of the bit that contains a kerf equipped with cutting media. A round or semi-round kerf is frequently used with conventional core barrels. Flat, stepped, or v-ring designs are often used with wireline drilling with impregnated bits.

Important features of the diamonds themselves are the size, quality, quantity, setting, and matrix quality. Surface set bits are used in most conventional coring operations. The size of diamonds is expressed in equivalent stones per carat. The typical SPC range is from 20 to 100 for surface set bits, with the finer stones being used for harder rock matrixes.

Larger diamonds are used for softer, more friable formations. Impregnated bits are fragments mixed with metal and pressed and sintered into the bit. The diamond fragments are throughout the crown and the bit is, in a sense, self-sharpening. Impregnated bits are used in more severe drilling conditions and in wireline drilling where long life is essential. Waterway design is also an important aspect of bit selection. Surface channel routing of the fluids from inside gage to outside is typical in conventional and wireline drilling for most crystalline rocks that are not sensitive to fluid erosion. Face discharge bits should be used for soft friable formations where fluid erosion is detrimental. Stepface discharge configurations further inhibit core erosion. Special flush discharge air ports are used with air and air-foam drilling operations. The softer the matrix, the larger the waterways must be to avoid blocking and plugging.

For very soft materials, it is not necessary to use diamonds as the cutting media. Diamonds can often be replaced with tungsten carbide or polycrystalline inserts for coring soft materials. Carbide and polycrystalline bits often have cutting teeth arranged in a saw tooth fashion. Polycrystalline bits (diamond grown to tungsten carbide substrates that are soldered or furnaced onto the crown) have replaced natural diamonds for coring in some softer sedimentary formations. Some core barrels, such as the large diameter series, can readily be changed from diamond rock coring to carbide soil sampling modes.

Manufacturers are an excellent resource to assist in selecting the matrix and style of bit, depending on rock conditions, drill power, and barrel type. Most manufacturers have a method for rating diamond matrices and bits into different series and groups.

Reaming Shells

The reaming shell is a subassembly of a row or strip of material placed on the outside of the core barrel for some distance behind the core bit. It is designed to ream and enlarge the hole to a final diameter and must allow for adequate fluid circulation to the surface. The shell also acts as a collar or centralizer for the barrel. Manufacturers should be consulted for appropriate reaming shell designs for the formations to be drilled. They may be surface set with diamond bits, impregnated with diamond particles, inserted with tungsten carbide strips or slugs, hard faced with various types of hard surfacing materials, or furnished blank, as appropriate to the formation being cored.

Core Lifters

Core lifters are used to break the core from parent material at the end of a core run. As coring progresses, the lifter floats up in its beveled recessed slot in the shoe. After an increment of core has been drilled that corresponds to core barrel length, the rotation is stopped. Fluid is circulated until cuttings are cleared, and then the drill pipe is steadily retracted. The lifter will slide down the beveled shoe and impart an increasing grip on the core. The core frequently breaks near the base of the hole, and often a snap can be felt in the drill pipe as the core breaks from parent material. Core lifters of the split ring type, either plain or hard surfaced, are recommended and must be maintained in good condition, along with core lifter cases or inner tubes extensions or inner tube shoes.

Basket or finger type lifters with any necessary adapters may be used with core barrels if directed by the engineer or the geologist.

Core Boxes

These are durable waxed cardboard or wooden boxes with partitioned compartments for storing the core samples.

Auxiliary Equipment

The following auxiliary equipment is typically used for the rock core drilling project:

- Drilling bits— roller rock bits, drag bits, chopping bits, boulder busters, and fishtail bits; pipe wrenches, core barrel wrenches, chain tong, strap wrench, watch, RPM counter, lubrication equipment, core splitters, rod wicking, extruders, hand sieves or strainers, and marking and packaging tools;
- Rod holding equipment—closed pulling ring, open iron ring, knife edge holding dog, holding iron, chucking rods, safety foot clamp, manila rope, bolt, and clevis pins;
- Fluid circulation equipment—hoses, positive displacement pump along with packing and seals, water swivel, pressure gages, flow meters, water-level meters, and mud pit; and
- Drill area, platform, and leveling—cribbing, planking, lumber, saw horses, metal saw horses with chain vise.

Procedure

- Perform site inspections to determine locations of boreholes, and to select disposal sites for waste products during drilling.
- Evaluate applicable methods for environmental protection and traffic regulation during core drilling.
- Determine site accessibility and availability of water for core drilling operation. Check around the drill site for overhead obstructions or hazards, such as power lines, before raising the mast. A survey of underground and all other utilities is required before drilling to evaluate hazards.
- Fabricate and assemble the drill mounting platform. The platform can take a variety of forms. The type of platform will depend on the terrain encountered, the stipulated depth of the borehole, and the accessibility of the drill site. Specialized mountings such as a barge or stilts or specially constructed towers are necessary to mount platforms for drilling over water. For water-based fluid drilling operation, a mud pit is positioned to collect and filter fluid return flow. An initial quantity of drilling fluid is mixed, usually using the mud pit as the primary mixing reservoir.
- For air-based circulation systems, the dust collector or cyclone separator is positioned and “sealed” to the ground surface.
- Case any interval of the borehole that penetrates the overburden. This will prevent collapsing of loose materials into the borehole or loss of drill fluid. The

casing should extend through the overburden and extend at least 5 ft (1.5 m) into the rock. Casing may be omitted if the borehole will stand open without caving. Deeper casing(s) or nested casing(s) may be required to facilitate adequate drill hole fluid circulation and hole control. Records of casing(s) lengths and depth intervals installed should be maintained and documented.

- Surface casings can be installed using a variety of drilling methods. Hollow-stem auger drilling has been used successfully for surface casing and has an added benefit of obtaining samples of the overburden soils. The surface casing is normally backfilled, pressed, or sealed in place wit bentonite or cement, or both.
- A datum for measuring drill hole depth should be established and documented. This datum normally consists of a stake driven into stable ground surface, the top of the surface casing, or the drilling deck. If there is possibility for movement of the surface casing, it should not be used as a datum. If the hole is to be later surveyed for elevation, record and report the height of the datum to the ground surface.
- The core barrel is assembled following manufacturers ‘instructions. Keep core barrels cleaned and lubricated and free from damage, dents, or other defects that might affect core quality. Inspect barrels for wear, clearances, dents, or galls. Check condition of core lifters, fluid passages, relief holes, ball checks, valve rubbers, and inner barrel stabilizers, if present. Assemble and disassemble core barrels with the correct tools for the job.
- The inner tube of double tube core barrels must be positioned correctly for proper operation. For both conventional and wireline systems where fluid circulates between the bit and lifter case, check that the proper clearance is maintained for circulation. For wireline systems, this will require engaging the inner barrel while the outer barrel is held vertically. If clearances are not correct, they should be adjusted using the adjustment screw on top of the barrel assembly.
- For swivel type inner barrels, inspect the bearing assemblies and confirm the inner barrel is free to rotate smoothly when assembled.
- An initial assembly of lead drill rod and core barrel is attached to the drill mechanism through a spindle or below the drill head, and placed within the top of the surface casing. Hole depth is determined by keeping track of the length of the rod-bit assemblies and comparing its position relative to the established surface datum. Hole depth for increments of drilling, coring, and sampling is recorded on the drill log. The drilling-fluid circulation pump or air compressor is activated, causing drilling fluid or air to circulate through the system.
- Drilling fluid or air circulation is initiated and rotation and axial force are applied to the drill rod and bit until drilling progresses to a depth where:

  (1) when the core sample has fully entered the core barrel or blockage is apparent,

  (2) sampling or in-situ testing will be performed, or

  (3) the length of the drill-rod column limits further penetration.
- Maintain fluid circulation at a rate suitable for the formation to be drilled. Fluid should be circulated at a rate sufficient to circulate cuttings and cool the bit.

Fluid pressures should be monitored during drilling. Avoid drilling at excessive advance rate, which could cause plugging of the bit and core blockage and damage. Changes in fluid return and circulation pressures may indicate occurrence of excessive erosion, formation fluid loss, or formation fracturing. Any abrupt changes or anomalies in fluid pressure should be noted and documented, including depth(s) of occurrence(s).

- Maintain air circulation at a rate suitable for the formation, and avoid circulation losses. Add water or foam as necessary to maintain circulation. Zones of low air return or no air return should be documented. Should airblast erosion occur, depth(s) of the occurrence(s) should be noted and documented. Air is particularly susceptible to blocking off circulation and causing uplift to occur very quickly.
- Samples of drill cuttings can be collected for analysis of materials penetrated. If cuttings samples are obtained, the depth(s) and interval(s) should be documented.
- The selection of proper rotation rate and down feed (advance) or holdback pressure depends on many factors. The drilling process is iterative in nature. Diamond drilling in a harder matrix usually requires higher rotation rates and down force pressures. With the correct material and equipment configurations, diamond bit performance is generally optimum at rotation rates of at least 400 rpm or greater. Rates of up to 1000 rpm can be used, depending on the material. However, too high a rate can cause tearing of the formation and core recovery problems. Softer materials with other bits such as polycrystalline, require slower rotation rates. Vibration is extremely important to the drill hole and core quality and must be minimized. Sufficient thrust needs to be transmitted to the bit so that bit elements can cut the rock. The goal is to find the rotation rate and thrust that will result in high quality core and acceptable bit life. Monitor advance or down force pressure, or holdback pressures, and rotation rates of drill rods during drilling. Observe the penetration rate and drill cuttings as they relate to the geologic strata being penetrated. Document occurrences of any significant abrupt changes and anomalies during drilling.
- Rotation is stopped, the advance or down force pressure is released, and circulation is continued for a short time until the drill cuttings are removed from the borehole annulus. Circulation is stopped and the barrel is rested on the hole bottom to determine hole depth. - Remove the core barrel and the core from the borehole. Disassemble the core barrel and remove the core.
- With double tube barrels, when the barrel is retracted, the core lifter grips the core and the core is normally broken from the base material at the base of the hole. The core lifter is located inside the barrel above the bit typically about 0.1ft. When the core is broken there will be a small pedestal of core left in the hole. As long as the lifter is not slipping, and core is goods quality, successive recoveries will be close to 100%. If for some reason, the lifter case slips, there will be low recovery recorded and there will be a longer pedestal on the subsequent sampling event. If there appears to be excessive core on the subsequent run, or there is visible evidence of the lifter slipping, these occurrences should be noted. If it is obvious the pedestal was present, the length can be accounted for in determination of recovery of the previous ren.

These occurrences and corrections should be appropriately noted in the drill report.

- With single tube core barrels in shallow drilling operations, the core can be broken with a wedge and lifted by wire hoop to the surface. - Reassemble the core barrel and return it to the borehole. Check for proper barrel conditions. The use of two barrels can greatly speed coring operations; as one barrel is cleaned and reassembled the other is in use in coring.
- Drilling depth is increased by attaching an additional drill-rod section(s) to the top of the previously advanced drill-rod column and resuming drilling operations.

Rock Core Handling

Use of split inner barrel liners greatly increases the efficiency of handling of cores, especially in broken formations. Cores can be transferred into plastic half rounds for logging and sealing. Log, preserve, and place core samples in core boxes in accordance with Practice.

Rock Core Recovery

Rock core shall be recovered continuously in the borehole. If recovery drops below 100 %, modify the drilling procedure, that is, adjust the drilling RPM, down feed pressure, the drilling fluid type and flow, or change the type and the size of core barrel or bit used, until core recovery is improved to a level acceptable to the project geologist or project engineer. Minimize mechanical breaks in the core during core drilling as much as possible.

Poor Recovery

Stop core drilling when recovery equals or falls below 50 %. If recovering samples is important, select a better core barrel or bit design. In some cases, it may be necessary to attempt soil sampling techniques. If conditions prevent advance of the drill hole to the stipulated depth, the borehole shall be cemented and redrilled, or reamed and cased, cased and advanced with a smaller size drill bit and core barrel, or abandoned, as directed by the engineer or geologist. Prepare boring logs and place the rock sample in core boxes, and mark and pack them in accordance with Practice.

6.3 Summary of Drilling Work at Upper Balu chaung Hydropowe Project

Sr	description	starting date	finishing date	Meter	Easting	Northing
1	BH1 (Intake 2)	24.1.10	1.2.10	20	271714	2265063
2	BH2 (Power House 1)	6.2.10	8.2.10	20	270996	2264969
3	BH3 (Intake 1,Left Abutment)	23.2.10	1.3.10	40	269075	2266382

4	BH4 (Intake 1, Right Abutment)	10.3.10	14.3.10	40	269055	2266366
5	BH5 (Intake Stream 2, Abutment)	16.3.10	21.3.10	40	269074	2266346
6	BH6 (Power House 1)	26.3.10	29.3.10	20	270991	2264975
7	BH7 (Power House 2)	1.4.10	2.4.10	15	272953	2264212
8	BH8 (Power House 2)	3.4.10	4.4 10	5	272984	2264236

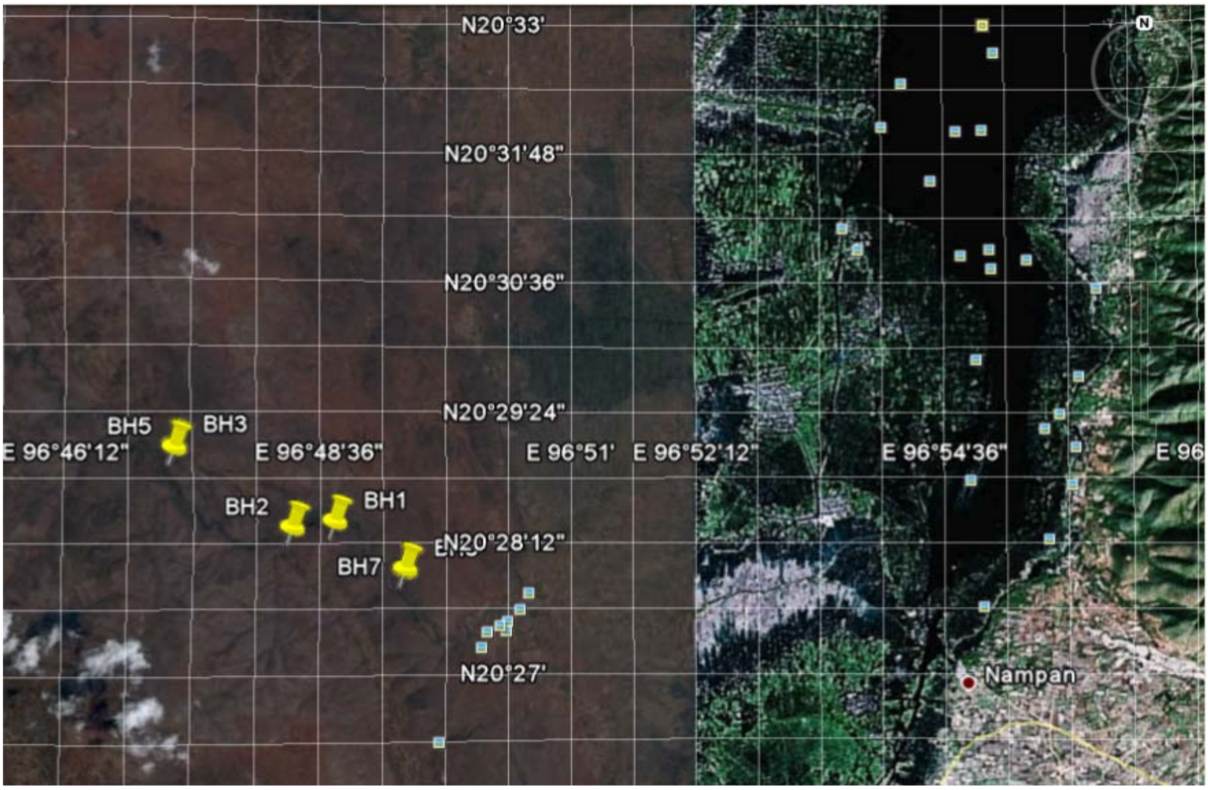


Fig (4) Bore Holes Locality in Upper Balu chaung Hydropower Project.

Photo Records of Drilling Performance at Upper Balu chaung Hydropower project

Photo(1) Drilling operation at BH3 drill site.

Photo(2) Drill site mobilization from BH2 to BH3 drill site.

Photo (3) Under construction of BH5 drill pad at Balu chaung stream section

Photo(4) Clastic sedimentary rocks appeared on access road cutting. Lookingwest..

Photo(5). Field performance of Nippon Koei consultant team at BH4

Photo(6) Drill core examination (Neo Energy Development Co., ltd & Nippon Koei consultant team)

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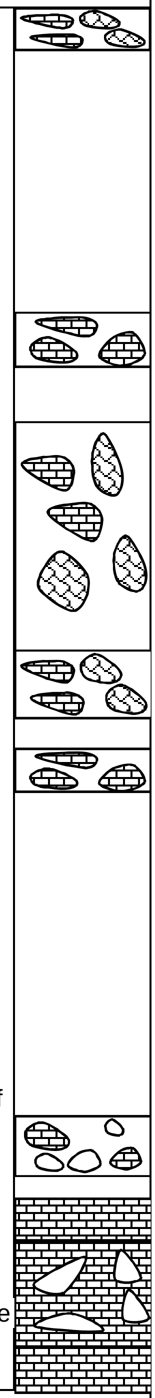
Appendix - A Drill Hole Log

DRILL HOLE LOG FORM

Project Upper Balu Chaung Hydroelectrical Power Project	**Sheet** 1
	Bore Hole No : BH 1
Location: 271714E, 2265063N (Right bank)	**Hole orientation :** Vertical
RL :	**Hole Diameter :** NQ
	Water level 6.09m

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
								0-3.5m fragement	
								of dolomitic Lst	
1								& travertine Lst.	
2									
					1				
3									
	3.5m	0.3m	0.0m	3.5m		8.57%	0.00%	**3.5-4.5m** fragment	
4								of dolomitic Lst	
	1m	0.4m	3.5m	4.5m		4%	0.00%		
5								**4.5-7.0m** fragment	
								of dolomitic Lst &	
								travertine Lst	
6								4.65-6.0m core loss	
								& 6.90-7.00m core loss	
7	2.5m	0.9m	4.5m	7.0m		36%	5.20%	**7.0-8.0m** travertine Lst	
								& fragment of dolomitic	
								Lst	
8	1m	0.72m	7.0m	8.0m	2	72%	32%		
								8.0-10.0m fragment of	
								dolomitic Lst	
9								8.35-12.0m core loss	
10									
11									
12	4.0m	0.35m	8.0m	12m		8.75%	0.00%	**12.0-13.0m** fragment of	
								dolomitic Lst & gravel	
13	1.0m	0.72m	12m	13m	3	72%	0.00%	**13.0-13.15m** dolomitic	
	0.15m	0.15m	13m	13.15m		100%	0.00%	Lst	
14									
	1.00m	0.96m	13.15m	14.15m		96.00%	40.00%	**13.15-14.45m** limestone	
								breccia with calcite	
15								vein let	



DRILL HOLE LOG FORM

Sheet 2

Project Upper Balu Chaung Hydroelectrical Power Project | **Bore Hole No :** BH 1

Location: 271714E, 2265063N (Right bank) | **Hole orientation :** Vertical

RL : | **Hole Diameter :** NQ

Water level 6.09m

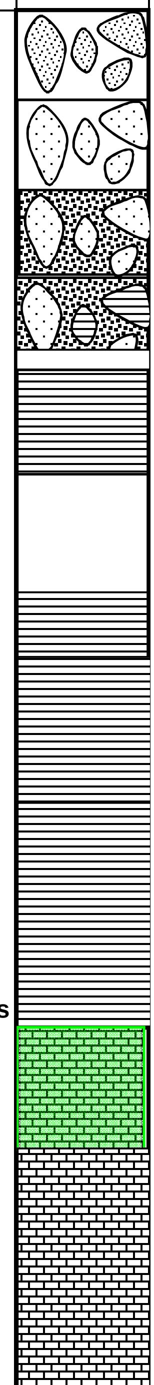
Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
								14.15-16.15m dolomitic Lst	
16									
	2.0m	1.41m	14.15m	16.15m		70.50%	65%		
								16.15-19.15m dolomitic Lst	
17									
18					4				
19									
	3.0m	2.67m	16.15m	19.15m		89.00%	75.66%		
								19.15-20.0m dolomitic Lst	
20	0.85m	0.6m	19.15m	20.0m		70.58%	0.00%		

DRILL HOLE LOG FORM

Project :	**Upper Balu Chaung Hydroelectrical Power Project**	**Sheet**	**1**
		Bore Hole No :	**BH 2**
Location:	**270996E, 2264969N (Left bank)**	**Hole orientation :**	**Vertical**
RL :		**Hole Diameter :**	**NQ**
		Water level	**ND**

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description
	0.9m	0.12m	0.00m	0.9m		13.33%	0.00%	**0-0.9m** Silty soil & fragment of siltstone
1								
2	1.1m	0.43m	0.9m	2.0m		39.09%	0.00%	**0.9-2.0m** fragment of sandstone
	0.8m	0.14m	2.0m	2.8m		17.50%	0.00%	**2.0m-28m** fragment of calcareous Sst
3					1			
	1.0m	0.61m	2.8m	3.8m		61.00%	0.00%	**2.8-3.8m** fragment of calcareous sandstone & mudstone (3.4-3.8m coreloss)
4								
5	1.2m	1.00m	3.8m	5.0m		83.33%	0.00%	**3.8-5.0m calcareous** mudstone
6								
7	2.0m	0.7m	5.0m	7.0m		35.00%	29.50%	**5.0-7.0m calcareous** mudstone (5.0-6.3m coreloss)
8					2			
	1.5m	1.4m	7.0m	8.5m		93.33%	10.66%	**7.0-8.5m calcareous** mudstone
9								
10								
11	2.5m	1.7m	8.5m	11.0m		68%	42%	**8.5-11.0m calcareous** mudstone
12								
13					3			
	2.5m	2.10m	11.0m	13.5m		84%	50.80%	**11.0-13.5m** chloride bearing Lst ,limonite stained on fractured surface
14								
15								

Log



DRILL HOLE LOG FORM

Project:	Upper Balu Chaung Hydroelectrical Power Project	Sheet	2
Location:	270996E, 2264969N (Left bank)	Bore Hole No :	BH 2
RL :		Hole orientation :	Vertical
		Hole Diameter :	NQ
		Water level	ND

Depth (m)	Core Run (m)	Length of Core (m)	Sample No		Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
			Begin	End					
16	3.00m	2.1m	13.5m	16.00m		84%	90.00%	**13.5-16.0m** dolomitic Lst	
17									
18					4				
19	3.00m	2.30m	16.00m	19.00m		7.66%	40%	**16.0-19.0m** chloride bearing Lst	
20	1.00m	1.00m	19.00m	20.00m		100%	66%	**19.0-20.0m** calcareous mudstone	

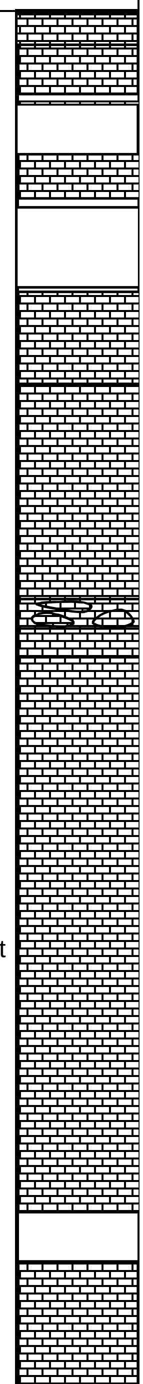
DRILL HOLE LOG FORM

Project :	**Upper Balu Chaung Hydroelectrical Power Project**	**Sheet**	**1**
Location:	**269075E, 2266382N (Left bank)**	**Bore Hole No :**	**BH 3**
RL :		**Hole orientation :**	**Vertical**
		Hole Diameter :	**NQ**
		Water level	**19.39m**

Depth (m)	Core Run (m)	Length of Core (m)	Sample No		Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
			Begin	End					
								0.0 to 7.62m,Soil,	
								and overburden.	
1								Mainly observed as	
								cut and fill material	
								from earthwork.	
2								(drill site preparation)	
3					1				
4									
5									
6									
7								7.62-9.85m coreloss	
								9.85 to10.0m light	
								grey dolomitic lst	
8					2			with calcite vein let.	
								10 to 10.56m coreloss	
								10.56-11.0m dolomitic	
9								lst light grey with very	
								small calcite vein let	
								11.00-11.04m	
10	2.38m	0.15m	7.62m	10.00m		6.30%	0.00%	crashed dolomitic lst	
								11.04-11.30m	
								dolomitic lst 11.30-	
11								11.39m fragment	
								of dolomitic lst.11.39-	
								12.25 dolomitic lst	
12								12.25-12.87m	
								fragment of dolomitic	
								lst, 12.87-13.00m	
13	3.00m	2.11m	10.00m	13.00m		70.33%	28.00%	dolomitic lst 10.0-	
								10.88m coreloss	
								13.0-13.53m dolomitic	
14	1.00m	0.27m	13.00m	14.00m	3	64.00%	27.00%	lst light to dark grey	
								with very small calcite	
								vein let. 13.53-13.69m	
15								fragment of dolomitic	
								lst.13.69-14.00m	
								dolomitic lst iron	
								stained on fracture	

DRILL HOLE LOG FORM

		Sheet	2
Project :	**Upper Balu Chaung Hydroelectrical Power Project**	**Bore Hole No :**	**BH3**
Location:	**269075E, 2266382N (Left bank)**	**Hole orientation :**	**Vertical**
RL :		**Hole Diameter :**	**NQ**
		Water level	**19.39m**

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
16	2.00m	1.13m	14.00m	16.00m		95.00%	56.50%	13.00-13.36mcoreloss 14.10-15.30m dolomitic lst light grey with calcite vein let 15.30-15.38m dolomitic lst.15.38-15.82m, dolomitic lst open spaces are filled with secondary calcite vein.15.82-16.0m fragment of dolomitic lst 14.00m to 14.10m coreloss 16.00-17.00m dolomitic lst light grey 16.00-16.67m coreloss 17.90-18.0m fragment of dolomitic lst. 18.0m 19.0m dolomitic lst light grey with small calcite vein let 17.00m to 17.90m core loss 19.0-20.0m dolomitic lst light grey with small calcite vein let.21.0-21.44m dolomtic lst light to dark grey. 21.44-21.73m fragment of dolomitic lst 21.73-22.00m dolomitic lst light to dark grey. 22.0-25.0m dolomitic lst light to dark grey with small calcite vein let	
17	1.00m	0.24m	16.00m	17.00m		24.00%	0.00%		
18					4				
19	2.00m	0.59m	17.00m	19.00m		55.00%	29.50%		
20									
21									
22	3.00m	2.03m	19.00m	22.00m		100.00%	67.66%		
23									
24									
25	3.00m	3.00m	23.00m	25.00m	5	100.00%	59.00%		
26									
27									
28	3.00m	3.00m	25.00m	28.00m		100.00%	67.66%		
29									
30									

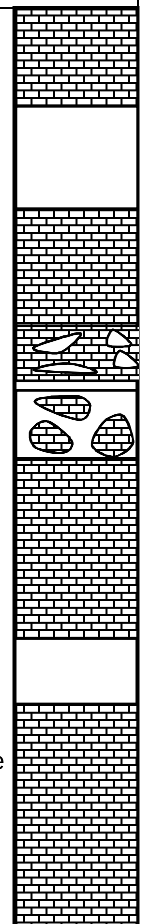
b

DRILL HOLE LOG FORM

Project : Upper Balu Chaung Hydroelectrical Power Project	**Sheet** 3
	Bore Hole No : BH3
Location: 269075E, 2266382N (Left bank)	**Hole orientation :** Vertical
RL :	**Hole Diameter :** NQ
	Water level 19.39m

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description
								28.0to28.57 coreloss
	2.40m	1.83m	28.00m	30.40m	6	76.25%	30.00%	28.57to30.4m
31	0.7m	0.7m	30.40m	31.00m		100.00%	73.33%	yellowishto light grey
								dolomitic Lst,
								with calite vein
32								let. 31.0 to 32.2 m
								coreloss, 32.2 to.
								33.5m dark grey
33					7			dolomitic lst with
								calcite vien let
34	3.00m	1.8m	31.00m	34.00m		60.00%	49.33%	33.5 to 34.0m light
								grey to yellowish,
								dolomitic Lst breccia,
35	1.00m	0.59m	34.00m	35.00m		59.00%	13.00%	34.0 to 34.41m core
								loss.34.41 to34.81m
								fragment of dolomitic
36								lst with boxwork
								texture and
								limonite stained.
37	2.00m	1.85m	35.00m	37.00m		92.50%	46.00%	34.81 to 35.0m
								dolomitic lst.35.0 to
								36.85m light to dark
38	1.00m	0.49m	37.00m	38.00m	8	49.00%	0.00%	grey dolomitic lst with
								calcite vein let,limonite
								stained on fracture
39								surface.
								37.0 to 37.51m
								coreloss.
40	2.00m	0.63m	38.00m	40.00m		100.00%	31.50%	37.51 to 38.0m light
								grey dolomitic lst with
								calcite vein let,
								limonite stained on
								fracture surface.
								38.0 to 39.5m, light to
								dark grey dolomitic lst
								with calcite vein let
								limonite stained on
								fracture surface.
								39.5 to 40.0m dark
								grey dolomitic lst
								with calcite vein let.

Log



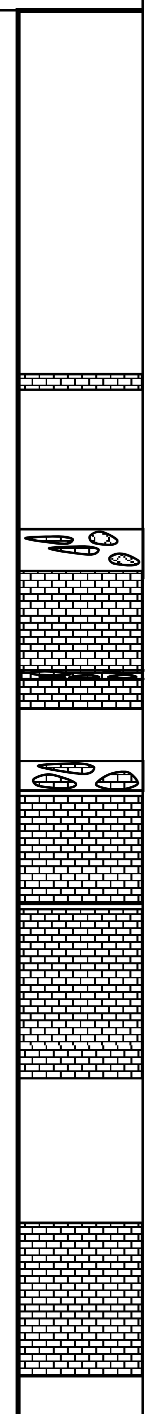
DRILL HOLE LOG FORM

Sheet 1

Project : Upper Balu Chaung Hydroelectrical Power Project
Location: 269055E, 2266366N (Right bank)
RL :

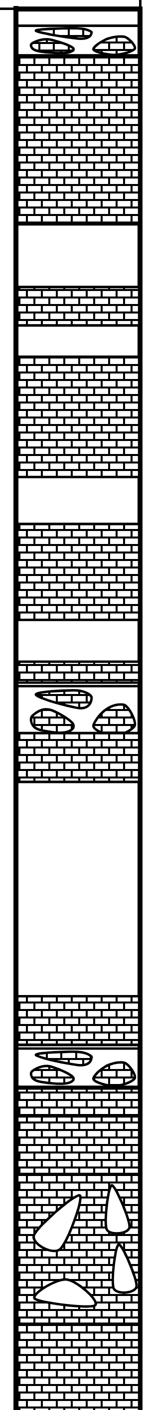
Bore Hole No : BH 4
Hole orientation : Vertical
Hole Diameter : NQ
Water level 15.50m

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
1									
2									
3	3.00m	0.14m	0.00m	3.00m	1	4.66%	0%	Soil,Overburden and	
								back fill material.	
4									
5									
6	3.00m	0.65m	3.00m	6.00m		21.66%	3.33%	3.00 to3.85m core	
								loss,3.85 to 4.00m	
								darkgrey dolomitic lst	
7	1.00m	1.00m	6.00m	7.00m		100%	20%	with small calcite vein	
								4.0 to 5.50mcoreloss	
	0.50m	0.50m	7.00m	7.50m		100%	0.00%	7.0 to 7.15m,	
8					2			fragment of dolomitic	
								lst & gravel.7.15 to	
	1.00m	0.50m	7.50m	8.50m		50%	0.00%	7.23m light grey to	
9								dark grey dolomitic lst.	
								7.23 to 7.50m	
	1.00m	1.00m	8.50m	9.50m		100%	76%	,fragment of dolmitic lst	
10								7.5 to 8.0m coreloss	
								8.0m to 8.35m	
								dolomitic lst fragments.	
11	1.50m	1.50m	9.50m	11.00m		100%	50%	8.35 to 8.5m light grey	
								dolomitic lst with	
								calcite vein let.	
12								8.5 to 9.5m dark grey	
								dolomitic lst with small	
								calcite veins.	
13					3			11.0 to 11.31m,dark	
								grey dolomitic lst,	
								11.31 to 12.87m	
14	3.00m	1.42m	11.00m	14.0m		47.66%	21.00%	coreloss,12.87 to	
								14.00m, dark grey	
								dolomitic lst with	
15								calcite vein let.	
								14.00 to 14.47m	
								light grey, dolomitic	
								lst with calcite veins	



DRILL HOLE LOG FORM

Project : Upper Balu Chaung Hydroelectrical Power Project		**Sheet**	**2**
Location:	**269055E, 2266366N (Right bank)**	**Bore Hole No :**	**BH4**
RL :		**Hole orientation :**	**Vertical**
		Hole Diameter :	**NQ**
		Water level	**15.50m**

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
	1.50m	0.8m	14.00m	15.50m		53.33%	17.33%	14.47 to 15.17m	
								coreloss,15.17 to	
16								15.50m dolomitic lst	
								fragments.	
								Light grey dolomitic	
17	1.50m	1.50m	15.50m	17.00m		100.00%	50.66%	lst with small calcite	
								vein let.17.00 to	
								17.30m light grey	
18					4			dolomitic lst,17.30	
	1.30m	0.60m	17.00m	18.30m		46.15%	12.30%	to 18.00m coreloss,	
								18.00 to18.30m,	
19								dark grey dolomitic.	
	1.20m	0.80m	18.30m	19.50m		66.66%	0.00%	lst with calcite veins.	
								18.30 to 18.70m	
20	0.50m	0.50m	19.50m	20.00m		100.00%	86.00%	coreloss,18.70 to	
								19.10 light to dark	
								grey dolomitic lst.	
21								19.10 to 19.50m	
								light to dark grey	
	1.60m	1.10m	20.00m	21.60m		68.75%	20.62%	dolomitic lst wih	
22								calcite vein let.	
								19.50 to 20.00m light	
								grey dolomitic lst	
23					5			20.0 to 20.50m	
	1.70m	1.30m	21.60m	23.30m		76.47%	25.88%	coreloss,22.10 to	
								22.13m light gry	
24								dolomitic lst,22.13 to	
								22.70m dolomitic lst	
								fragments.22.7 to	
25								23.2m dark grey	
								dolomitic lst with	
								calcite vein let.23.0 to	
26	2.70m	0.5m	23.30m	26.00m		18.51%	3.70%	23.28m dolomitic lst	
								fragments.23.28 to	
	0.80m	0.80m	26.00m	26.80m		100%	0%	23.30m darkgrey	
27								dolomitic lst with	
								calcite vein let.23.3 to	
	0.70m	0.70m	26.80m	27.50m		100%	0%	25.50m coreloss.	
28					6			25.50 to 26.00m light	
								grey dolomitic lst	
								with calcite vein let.	
29	1.50m	1.50m	27.50m	29.00m		100%	43.33%	26.00 to 26.80m	
								dolomiticlst fragments.	
								26.80 to 27.50m,light	
30								grey dolomitic lst	
								limonite stained on	
								fractured surface.	
								27.5 to 29.00m	

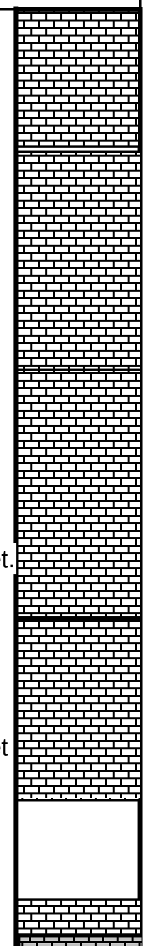
DRILL HOLE LOG FORM

Sheet	3
Bore Hole No :	BH4
Hole orientation :	Vertical
Hole Diameter :	NQ
Water level	15.50m

Project : Upper Balu Chaung Hydroelectrical Power Project
Location: 269055E, 2266366N (Right bank)
RL :

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description
31								Dolomitic lst breccia with calcite vein let. limonite stained on fracture surface..
	2.50m	2.50m	29.00m	31.50m		100%	0.00%	
32								
33					7			31.50 to 34.0m, light grey, dolomitic lst with calcite vein let. limonite stained on fracture surface..
34	2.50m	2.50m	31.50m	34.00m		100%	16.40%	
35								
36								34.00 to 36.50m light grey, dolomitic lst with calcite vein let. limonite stained on fracture surface..
	2.60m	2.60m	34.00m	36.50m		100%	68.40%	
37								
38					8			Dark grey, dolomitic lst with calcite vein let iron stained on fracture surface.
	2.00m	2.00m	36.50m	38.50m		100%	36.40%	
39								38.5o to 39.50m coreloss.39.50 to 39.84m light to dark grey,dolomitic lst breccia with calcite vein let. 39.84 to 40.00m, black, carbonaceous dolomitic lst.
40	1.50m	0.50m	38.50m	40.00m		33.33%	9.33%	

Log



DRILL HOLE LOG FORM

Project : Upper Balu Chaung Hydroelectrical Power Project
Location: 269074E, 2266346N (Stream section)
RL :

Sheet 1
Bore Hole No : BH 5
Hole orientation : Vertical
Hole Diameter : NQ
Water level 7.23m

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
								0.00 to 0.40m core loss,0.40 to 1.80m	
1	1.00m	0.60m	0.00m	1.00m		60.00%	40%	Travertine lst.	
								1.80 to 2.00m	
	0.80m	0.80m	1.00m	1.80m		100.00%	88.75%	travertine lst	
2								2.0 to 2.30m	
	0.70m	0.40m	1.80m	2.50m		57.14%	22.85%	coreloss.2.3 to	
								2.50m travertine lst.	
3	0.50m	0.50m	2.50m	3.00m	1	100.00%	70%	2.5 to 3.00m travertine lst.	
4	1.00m	0.17m	3.00m	4.00m		17.00%	17%	3.0 to3.85m coreloss 3.83 to 4.00m travertine lst	
5								4.0 to 6.56m coreloss 6.56 to 7.00m	
6								travertine lst	
7	3.00m	0.44m	4.00m	7.00m		14.66%	10.66%		
8					2				
9								7.0 to 12.5m coreloss 12.5 to 12.6m gravel. 12.6 to 13.00m	
10								travertine lst.	
11									
12									
13	6.00m	0.50m	7.00m	13.00m	3	8.33%	0.00%	13.0 to 13.50m corloss, 13.5 to 13.60m gravel.13.6	
14	1.00m	0.50m	13.00m	14.00m		50.00%	18.00%	to 14.00m travertine lst.14.0 to 14.38m coreloss, 14.38 to	
15								14.60m travertine lst,	

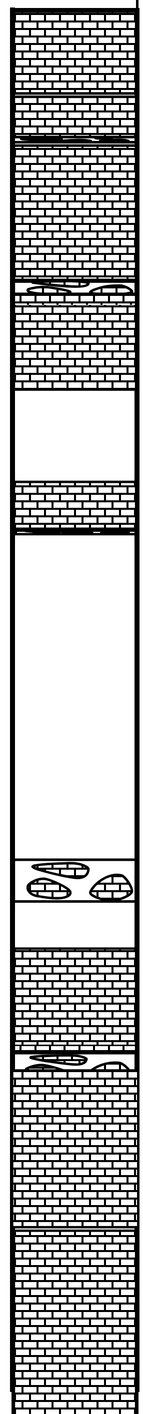
DRILL HOLE LOG FORM

Project : Upper Balu Chaung Hydroelectrical Power Project
Location: 269074E, 2266346N (Stream section)
RL :

Sheet 2
Bore Hole No : BH5
Hole orientation : Vertical
Hole Diameter : NQ
Water level 7.23m

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description
								14.65 to 15.80m dark
	1.80m	0.42m	14.00m	15.80m		23.33%	0.00%	grey dolomitic lst with
16								calcite vein let.
	0.50m	0.50m	15.80m	16.30m		100.00%	58.00%	15.8 to15.83m gravel.
								15.83 to16.30m, dark
17	0.70m	0.45m	16.30m	17.00m		64.28%	21.42%	grey dolomitic lst with
								calcite vein let.16.3
	0.80m	0.80m	17.00m	17.80m		100.00%	81.25%	to 16.35m gravel.
18					4			16.35 to 17.00m light
								grey dolomitic lst,iron
								stained on fracture.
19								17.0 to 17.80m Light
	1.50m	1.50m	17.80m	19.30m		100.00%	36.66%	grey dolomitic lst.
								17.8 to 18.00m
20								dolomitic lst fragment
								18.0 to 19.00m light
	1.20m	0.50m	19.30m	20.50m		41.66%	0.00%	to dark grey dolomitic
21								with calcite vein let.
								19.0 to 20.00m
	1.30m	0.04m	20.50m	21.80m		21.42%	0.00%	coreloss.20 to 20.50m
22								dark grey dolomitic lst
								20.0-20.54m,fragment
								of dolomitic lst.20.54
23								to 21.80m coreloss
								21.8 to24.0mcoreloss
24								24.0 to24..60m
								dolomitic lst fragments
	2.80m	0.40m	21.8m	24.60m		14.28%	0.00%	24.6 to 25.00m
25					5			coreloss.25.0 to 25.8
								m,light to dark grey
	1.20m	0.80m	24.60m	25.80m		66.66%	0.00%	dolomitic lst.with
26								calcite vein let.
	0.30m	0.30m	25.80m	26.10m		100.00%	0.00%	25.8 to 26.10m ,
								yellowish to light grey
27								dolomitic lst.
28	1.90m	1.90m	26.10m	28.00m	6	100.00%	60.00%	26.10 to 26.26m,
								dolomitic lst fragment
								26.36 to 28.00m light
29								grey dolomitic lst
								with calcite vein let &
								iron stained on
30								fracture surface.

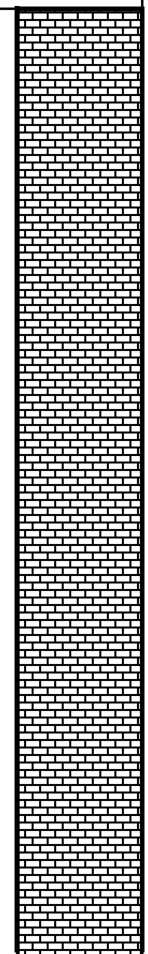
Log



DRILL HOLE LOG FORM

Sheet	3
Bore Hole No :	BH5
Hole orientation :	Vertical
Hole Diameter :	NQ
Water level	7.23m

Project : Upper Balu Chaung Hydroelectrical Power Project
Location: 269074E, 2266346N (Stream section)
RL :

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
31	3.00m	3.00m	28.00m	31.00m		100.00%	84.33%	28.0 to 31.00m, light to dark grey dolomitic lst with calcite vein let and iron stained on fracture surface	
32									
33					7				
34	3.00m	3.00m	31.00m	34.00m		100.00%	48.00%	31.0 to 34.00m, light to dark grey dolomitic lst breccia with calcite vein let and iron stained on f racture surface	
35									
	1.40m	1.40m	34.00m	35.40m		100.00%	55.71%	34.0 to 35.40m, dark grey dolomitic lst with calcite vein let & iron stained on fracture surface.	
36									
37									
38					8				
	3.00m	3.00m	35.40m	38.40m		100.00%	61.00%	35.4 to 38.40m dolomitic lst with calcite vein let & iron stained on fracture surface.	
39									
40	1.60m	1.60m	38.40m	40.00m		100.00%	57.50%	38.4 to 40.00 m dark grey dolomitic lst with calcite vein let .	

DRILL HOLE LOG FORM

Project : Upper Balu Chaung Hydroelectrical Power Project
Location: 270991E, 2264975N (Left bank, Extension hole)
RL :

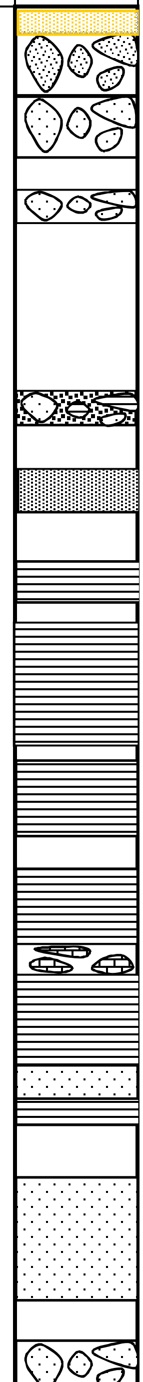
Sheet 1
Bore Hole No : BH 6
Hole orientation : Vertical
Hole Diameter : NQ
Water level ND

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)
	0.50m	0.50m	0.00m	0.50m		100.00%	0.00%
1							
	1.20m	0.70m	0.50m	1.70m		58.33%	0.00%
2							
	0.60m	0.20m	1.70m	2.30m		33.33%	0.00%
3					1		
4							
	2.20m	0.30m	2.30m	4.50m		13.63%	0.00%
5							
	1.00m	0.50m	4.50m	5.50m		50.00%	15.00%
6							
	1.00m	0.40m	5.50m	6.50m		40.00%	19.00%
7	0.50m	0.30m	6.50m	7.00m		60.00%	0.00%
8	1.00m	1.00m	7.00m	8.00m	2	100.00%	0.00%
9	1.00m	0.80m	8.00m	9.00m		80.00%	35.00%
10							
	1.20m	0.90m	9.00m	10.20m		75.00%	19.16%
11	1.80m	1.80m	10.20m	11.00m		100%	0.00%
	0.60m	0.60m	11.00m	11.60m		100.00%	0.00%
12							
	0.60m	0.60m	11.60m	12.20m		100.00%	48.33%
13					3		
14	1.80m	1.30m	12.20m	14.00m		72.22%	22.22%
15	1.00m	0.50m	14.00m	15.00m		50.00%	0.00%

Geologic Description

0.0 -0.50m yellowish silty soil, fragments of siltstone, highly weathered.0.5 to 1.00m coreloss. 1.0 to 1.70m fragment of sandstone. 1.7 to 2.10m coreloss 2.1 to 2.30m Sst fragment.2.3 to 4.20m coreloss.4.2 to 4.50m fragments of Sst & calcareous mudstone 4.5 to 5.00m coreloss 5.0 to 5.50m reddish brown to buff colored calcereous siltstone 5.5 to 6.10m coreloss 6.1 to 6.50m yellowish,calcereous mudstone. 6.5 to 6.70m coreloss,6.7 to 7.00m yellowish colored calcereous mudstone.7.0 to 8.00m reddish brown calcereous mudstone 8.0 to 8.20m coreloss 8.2 to 9.00m reddish brown calcareous mudstone.9.0 to 9.30m coreloss.9.3 to 10.2m reddish brown to purple, calcareous mudstone 10.2 to 10.40m dolomitic lst fragment 10.4 to 11.00m reddish brown calceoeous mudstone 11.0 to 11.60 m reddish brown calcareous mudstone & buff colored Sst. 11.6 to12.20m buff colored calcareous mudstone.12.2 to 12.70m coreloss.12.7

Log



DRILL HOLE LOG FORM

Project:	**Upper Balu Chaung Hydroelectrical Power Project**	**Sheet**	**2**
Location:	**270991E, 2264975N (Left bank, Extension hole)**	**Bore Hole No :**	**BH 6**
RL :		**Hole orientation :**	**Vertical**
		Hole Diameter :	**NQ**
		Water level	**ND**

Depth (m)	Core Run (m)	Length of Core (m)	Sample No		Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
			Begin	End				14.00mcalcareousSst	
								14.0 to 14.50mcorelos	
								14.5 to 15.00m Sst	
16								fragments. 15.0 to	
	1.20m	1.20m	15.00m	16.20m		100.00%	59.16%	16.20m,calcareous	
								mudstone.	
17								16.2 to 16.7m,	
	1.20m	0.70m	16.20m	17.40m		58.33%	16.66%	coreloss.16.7 to	
								17.40m calcareous	
18					4			mudstone. highly	
								weathered.	
	1.20m	1.00m	17.40m	18.6m		83.33%	27.50%	17.4 to 17.60m,	
19								coreloss.17.6 to	
								18.60m calcareous	
								mudstone.	
20	1.40m	1.40m	18.60m	20.00m		100.00%	27.85%	18.6 to 20.00m,	
								calcareous mudstone	
								very soft & highly	
								weathered.	

DRILL HOLE LOG FORM

		Sheet	1
Project :	Upper Balu Chaung Hydroelectrical Power Project	**Bore Hole No :**	**BH 7**
Location:	272953E, 2264212N (Right bank)	**Hole orientation :**	**Vertical**
RL :		**Hole Diameter :**	**NQ**
		Water level	**ND**

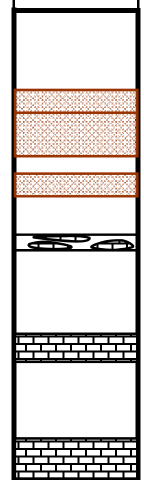
Depth (m)	Core Run (m)	Length of Core (m)	Sample No		Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
			Begin	End					
	0.50m	0.35m	0.00m	0.50m		70.00%	0.00%	0.0 to0.15mcoreloss.	
								0.15 to0.50m reddish	
1								brown silty soil.	
								0.5 to 1.00mcoreloss	
	1.50m	0.50m	0.50m	1.50m		33.33%	0.00%	1.00 to 1.50m reddish	
2								brown siltysoil.	
	0.60m	0.60m	1.50m	2.10m		100.00%	0.00%	1.5 to 2.00m,reddish	
	0.40m	0.40m	2.10m	2.50m		100.00%	0.00%	brown siltysoil.	
3					1			2.0 to 2.10m,light	
	0.8m	0.30m	2.50m	3.30m		37.50%	0.00%	grey dolomitic lst,	
								fragment.2.1 to 2.50m	
4						17.64%	0.00%	reddish brown siltysoil.	
								2.5 to 3.00m coreloss	
								3.0 to 3.30m fragment	
5	1.70m	0.30m	3.30m	5.00m				dark grey dolomitic	
								lst.3.3 to4.70m	
								coreloss 4.7 to 5.00m	
6								fragments of	
								dolomitic lst.	
								5.0 to 5.70mcoreloss	
7	2.00m	0.30m	5.00m	7.00m		15.00%	5.00%	5.7 to 7.00m light	
								to dark grey dolomitic	
								lst with small calcite	
8	1.00m	1.00m	7.00m	8.00m	2	100.00%	52.00%	veins.	
								7.0 to 8.00m light	
								to dark grey dolomitic	
9								lst with small calcite	
								vein let.8.0 to 8.46m	
								coreloss 8.46 to	
10	2.00m	1.54m	8.00m	10.00m		77.00%	30.00%	10.00m, light to dark	
								grey dolomitic lst,	
11								10.0 to 11.00m	
								coreloss.11.0 to	
	1.50m	0.50m	10.00m	11.50m		33.33%	8.00%	11.20m, dark grey	
12								dolomitic lst.11.2 to	
								11.50m, fragments	
								of dolomitic lst.	
13	1.50m	1.20m	11.50m	13.00m	3	80.00%	0.00%	11.5 to 11.80m	
								coreloss.11.8 to	
								13.00m, dark grey	
14								dolomitic lst with	
								calcite vein let.	
								13.0 to 13.55m	
15	2.00m	1.45m	13.00m	15.00m		72.50%	52.50%	coreloss.13.55 to	
								15.00m, dark grey	
								dolomitic lst with	
								calcite vein let.	

DRILL HOLE LOG FORM

Sheet 1

Project : Upper Balu Chaung Hydroelectrical Power Project
Bore Hole No : BH 8
Location: 272984E, 2264236N (Right bank)
Hole orientation : Vertical
RL :
Hole Diameter : NQ
Water level ND

Depth (m)	Core Run (m)	Length of Core (m)	Sample No Begin	Sample No End	Box No	Core Recovery (%)	RQD (%)	Geologic Description	Log
								0 to 0.76m coreloss	
								.0.76 to 1.00m,	
1	1.00m	0.24m	0.00m	1.00m		24.00%	0.00%	yellowish brown	
								silty soil with pebbles	
	0.50m	0.5m	1.00m	1.50m		100.00%	0.00%	1.00 to 1.50m,,	
2	0.50m	0.24m	1.50m	2.00m		48.00%	0.00%	yellowish brown	
								silty soil with pebbles	
	0.50m	0.20m	2.00m	2.50m		40.00%	0.00%	1.5 to 1.76m coreloss	
3					1			.1.76 to 2.00m,	
								reddish brown	
	1.20m	0.20m	2.50m	3.70m		16.70%	0.00%	silty soil.2.0 to	
4								2.30m coreloss	
	1.30m	0.60m	3.70m	5.00m		46.15%	0.00%	2.30 to 2.50m,	
								dolomitic lst fragment.	
5								2.5 to 3.50m coreloss	
								3.5 to 3.70m, light	
								grey dolomitic lst.	
6								3.7 to 4.40m coreloss	
								4.4 to 5.00m,light	
								grey dolomitic lst.	
7								bed rock(?).	
8									
9									
10									
11									
12									
13									
14									
15									



Appendix - B Soil Test Result

Summary of Laboratory Test Result for Balu Chaung Hydropowr Project

Sr No	Test pit No	Location		Elevation (M)	Moisture Content	Wet Dentisty (g/cc)	Dry Density g/cc	Plastic limit (%)	Liquid Limit (%)	Plasticity Index (%)	UCS Unconfined Compressive Strength (kg/cm^2)	C Cohesion (kg/cm^2)	ϕ Angle of Internal Friction	Specific gravity
		Eastern	Northern											
1	2	269045	2266399	1136	21.5	1.94	1.6	19.13	27.95	8.82	0.59	0.23	8.6	2.61
2	2	269045	2266399	1138	29.94	1.85	1.43	27.42	46	18.58	0.89	0.48	9.3	2.44
3	1	269120	2266363	1139	15.95	1.7	1.47	29.22	46.6	17.38	1.9	1.67	21.4	2.47
4	1	269120	2266363	1136	16.75	1.82	1.56	23.59	35.85	12.26	2.82	1.18	26.4	2.39
5	2	269045	2266399	1137	22.53	1.89	1.54	20.32	29	8.68	0.4	0.29	4.3	2.61
6	1	269120	2266363	1137	23.22	1.93	1.56	21.43	34.5	13.07	0.92	0.44	8.5	2.57
7	1	269120	2266363	1138	22.07	1.98	1.62	28.33	44.5	16.17	1.76	1.19	6.4	2.47
8	1	269120	2266363	1140	29.31	1.8	1.39	34.12	53.1	16.98	1.13	0.75	7.4	2.46
9	1	269120	2266363	1135	24.62	1.89	1.51	24.51	30.25	5.74	0.63	0.56	6	2.61

Test Pit-2 Elevation-1136 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm

Sample Area A_0 = 9.6211 Cm^2

Soil size =<4.75 mm

Motor speed =1.2 mm / min

Load ring constant 0.143 Kg / div

Deform dial reading	Load dial reading 1 σ 1	Load dial reading 2 σ 2	Load dial reading 3 σ 3	Load dial reading 4 σ 4	Δ L (Cm) DDR X 0.001	Unit strain ϵ =ΔL/ L0	Area correction factor (1-ϵ)	Corrected Area $A' = A_0 / (1-ϵ)$	Deviator stress Δσ1 (Kg / Cm^2) 1	Deviator stress Δσ2 (Kg / Cm^2) 2	Deviator stress Δσ3 (Kg / Cm^2) 3	Deviator stress Δσ4 (Kg / Cm^2) 4
50	10	27	32	65	0.05	0.0069	0.99306	9.688	0.1476	0.3985	0.4723	0.9594
100	13	32	35	87	0.10	0.0139	0.98611	9.757	0.1905	0.4690	0.5130	1.2751
150	15	35	37	91	0.15	0.0208	0.97917	9.826	0.2183	0.5094	0.5385	1.3244
200	18	38	41	94	0.20	0.0278	0.97222	9.896	0.2601	0.5491	0.5925	1.3583
250	20	40	44.5	97	0.25	0.0347	0.96528	9.967	0.2869	0.5739	0.6384	1.3917
300	22	43	48.5	100	0.30	0.0417	0.95833	10.039	0.3134	0.6125	0.6908	1.4244
350	24	45	52.5	102	0.35	0.0486	0.95139	10.113	0.3394	0.6363	0.7424	1.4423
400	26	48	56.5	104	0.40	0.0556	0.94444	10.187	0.3650	0.6738	0.7931	1.4599
450	28	50	60	105.5	0.45	0.0625	0.93750	10.263	0.3902	0.6967	0.8361	1.4701
500	30	52	64	107	0.50	0.0694	0.93056	10.339	0.4149	0.7192	0.8852	1.4799
550	32	54	67.5	106	0.55	0.0764	0.92361	10.417	0.4393	0.7413	0.9266	1.4551
600	34	55	70.5	111	0.60	0.0833	0.91667	10.496	0.4632	0.7493	0.9605	1.5123
650	36	58	73.5	113	0.65	0.0903	0.90972	10.576	0.4868	0.7842	0.9938	1.5279
700	37	59	77	114.5	0.70	0.0972	0.90278	10.657	0.4965	0.7917	1.0332	1.5364
750	39	60	80	116	0.75	0.1042	0.89583	10.740	0.5193	0.7989	1.0652	1.5445
800	40	61	83	118	0.80	0.1111	0.88889	10.824	0.5285	0.8059	1.0966	1.5590
850	42	62	85	119.5	0.85	0.1181	0.88194	10.909	0.5506	0.8127	1.1142	1.5665
900	43	64	87.5	121	0.90	0.1250	0.87500	10.996	0.5592	0.8323	1.1380	1.5736
950	44	65	90	122.5	0.95	0.1319	0.86806	11.084	0.5677	0.8386	1.1612	1.5805
1000	45	65.5	92.5	123.5	1.00	0.1389	0.86111	11.173	0.5759	0.8383	1.1839	1.5807
1050	46	66	95	124	1.05	0.1458	0.85417	11.264	0.5840	0.8379	1.2061	1.5743
1100	47	67	96.5	124.5	1.10	0.1528	0.84722	11.356	0.5918	0.8437	1.2152	1.5678
								$\Delta\sigma_{Max}$	0.5918	0.8437	1.2152	1.5807

UCS =0.59 Kg/cm2

C=0.23Kg/cm2

Ø =8.6°

Test Pit-2 Elevation-1137 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm   Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial reading	Load dial reading 1 σ 1	Load dial reading 2 σ 2	Load dial reading 3 σ 3	Load dial reading 4 σ 4	Δ L (Cm) DDR X 0.001	Unit strain ϵ =ΔL/ L0	Area correctio factor (1-ϵ)	Corrected Are $A' = A_0 / (1-\epsilon$	Deviator stre (Kg / Cm^2	Deviator stre (Kg / Cm^2	Deviator stre (Kg / Cm^2	Deviator stress Δσ4 (Kg / Cm^2) 4
50	8	22.5	26.5	36	0.05	0.0069	0.99306	9.688	0.1181	0.3321	0.3911	0.5314
100	9	26	30	54	0.10	0.0139	0.98611	9.757	0.1319	0.3811	0.4397	0.7915
150	10.5	29	32	58	0.15	0.0208	0.97917	9.826	0.1528	0.4221	0.4657	0.8441
200	12.5	31	34	60.5	0.20	0.0278	0.97222	9.896	0.1806	0.4480	0.4913	0.8742
250	14	33.5	37	63	0.25	0.0347	0.96528	9.967	0.2009	0.4806	0.5308	0.9039
300	15.5	36	40	66	0.30	0.0417	0.95833	10.039	0.2208	0.5128	0.5698	0.9401
350	18	37.5	42	69	0.35	0.0486	0.95139	10.113	0.2545	0.5303	0.5939	0.9757
400	19	39.5	44	71	0.40	0.0556	0.94444	10.187	0.2667	0.5545	0.6176	0.9967
450	20	42	45.5	73	0.45	0.0625	0.93750	10.263	0.2787	0.5852	0.6340	1.0172
500	21.5	44	48	74.5	0.50	0.0694	0.93056	10.339	0.2974	0.6086	0.6639	1.0304
550	23	46	52	76	0.55	0.0764	0.92361	10.417	0.3157	0.6315	0.7138	1.0433
600	24	47	53	77	0.60	0.0833	0.91667	10.496	0.3270	0.6404	0.7221	1.0491
650	25	49	55	78.5	0.65	0.0903	0.90972	10.576	0.3380	0.6625	0.7437	1.0614
700	26.5	50.5	57	80	0.70	0.0972	0.90278	10.657	0.3556	0.6776	0.7648	1.0734
750	27.5	52	60	81	0.75	0.1042	0.89583	10.740	0.3662	0.6924	0.7989	1.0785
800	28	54	62	82	0.80	0.1111	0.88889	10.824	0.3699	0.7134	0.8191	1.0834
850	29.5	55	64	83	0.85	0.1181	0.88194	10.909	0.3867	0.7210	0.8389	1.0880
900	30	56	65.5	83.5	0.90	0.1250	0.87500	10.996	0.3902	0.7283	0.8518	1.0859
950	31	57	67.5	84.5	0.95	0.1319	0.86806	11.084	0.4000	0.7354	0.8709	1.0902
1000	31	58.5	69	85	1.00	0.1389	0.86111	11.173	0.3968	0.7487	0.8831	1.0879
1050	31	60	71	85.5	1.05	0.1458	0.85417	11.264	0.3936	0.7617	0.9014	1.0855
1100	30.5	60.5	73	86	1.10	0.1528	0.84722	11.356	0.3841	0.7618	0.9192	1.0829
								$\Delta\sigma_{Max}$	0.4000	0.7618	0.9192	1.0902

UCS =0.40kg/cm^2

C=0.29Kg/cm2

Ø =4.3°

Test Pit-2 Elevation-1138 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial	Load dial	Load dial	Load dial	Load dial	Δ L (Cm)	Unit strain	Area correctio	Corrected Are	Deviator stre	Deviator stre	Deviator stre	Deviator stress Δσ4
reading	reading 1	reading 2	reading 3	reading 4	DDR X 0.001	ε =ΔL/ L0	factor (1-ε)	$A' = A_0 / (1-ε)$	(Kg / Cm^2	(Kg / Cm^2	(Kg / Cm^2)	(Kg / Cm^2) 4
	σ 1	σ 2	σ 3	σ 4								
50	15	35	57	85	0.05	0.0069	0.99306	9.688	0.2214	0.5166	0.8413	1.2546
100	19	47	71.5	106	0.10	0.0139	0.98611	9.757	0.2785	0.6889	1.0480	1.5536
150	24	55	80	122	0.15	0.0208	0.97917	9.826	0.3493	0.8004	1.1643	1.7755
200	29	62	88	134	0.20	0.0278	0.97222	9.896	0.4191	0.8959	1.2716	1.9363
250	30.5	68	94.5	141	0.25	0.0347	0.96528	9.967	0.4376	0.9756	1.3558	2.0229
300	38	73	100.5	145	0.30	0.0417	0.95833	10.039	0.5413	1.0398	1.4315	2.0654
350	41.5	78	105.5	148.5	0.35	0.0486	0.95139	10.113	0.5868	1.1030	1.4918	2.0999
400	45	82	110	151	0.40	0.0556	0.94444	10.187	0.6317	1.1511	1.5441	2.1196
450	48.5	86	114	154	0.45	0.0625	0.93750	10.263	0.6758	1.1983	1.5885	2.1459
500	51.5	90	119	157	0.50	0.0694	0.93056	10.339	0.7123	1.2448	1.6459	2.1715
550	54	94	122.5	160	0.55	0.0764	0.92361	10.417	0.7413	1.2904	1.6817	2.1964
600	56.5	97	126	162.5	0.60	0.0833	0.91667	10.496	0.7698	1.3216	1.7167	2.2140
650	58.5	99.5	129	164.5	0.65	0.0903	0.90972	10.576	0.7910	1.3454	1.7443	2.2243
700	61	102	132	168	0.70	0.0972	0.90278	10.657	0.8185	1.3686	1.7712	2.2542
750	62.5	105	135	170	0.75	0.1042	0.89583	10.740	0.8322	1.3981	1.7975	2.2635
800	64	107.5	137.5	172	0.80	0.1111	0.88889	10.824	0.8455	1.4203	1.8166	2.2724
850	65.5	109.5	140	173	0.85	0.1181	0.88194	10.909	0.8586	1.4354	1.8352	2.2678
900	67	111	142.5	174.5	0.90	0.1250	0.87500	10.996	0.8714	1.4436	1.8532	2.2694
950	68	113	144.5	175	0.95	0.1319	0.86806	11.084	0.8773	1.4579	1.8643	2.2579
1000	69	115	147	176	1.00	0.1389	0.86111	11.173	0.8831	1.4719	1.8814	2.2526
1050	47	117	149	177	1.05	0.1458	0.85417	11.264	0.5967	1.4854	1.8916	2.2471
1100	70.5	118.5	150.5	178	1.10	0.1528	0.84722	11.356	0.8878	1.4922	1.8952	2.2414
								$\Delta\sigma_{Max}$	0.8878	1.4922	1.8952	2.2724

UCS =0.89Kg/cm^2

C=0.48Kg/cm^2

Ø =9.3°

Test Pit-1 Elevation-1135m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm   Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial reading	Load dial reading 1 σ 1	Load dial reading 2 σ 2	Load dial reading 3 σ 3	Load dial reading 4 σ 4	Δ L (Cm) DDR X 0.001	Unit strain ε =ΔL/ L0	Area correctio factor (1-ε)	Corrected Are $A' = A_0 / (1-ε)$	Deviator stre (Kg / Cm^2	Deviator stre (Kg / Cm^2	Deviator stre (Kg / Cm^2)	Deviator stress Δσ4 (Kg / Cm^2) 4
50	7.5	29	34	51.5	0.05	0.0069	0.99306	9.688	0.1107	0.4280	0.5018	0.7601
100	10	35.5	42	60	0.10	0.0139	0.98611	9.757	0.1466	0.5203	0.6156	0.8794
150	13.5	41.5	49.5	66	0.15	0.0208	0.97917	9.826	0.1965	0.6040	0.7204	0.9605
200	17	47.5	56	75	0.20	0.0278	0.97222	9.896	0.2457	0.6864	0.8092	1.0838
250	21	53.5	63	82	0.25	0.0347	0.96528	9.967	0.3013	0.7676	0.9039	1.1765
300	24.5	59	69	88	0.30	0.0417	0.95833	10.039	0.3490	0.8404	0.9828	1.2535
350	28	65	75	93	0.35	0.0486	0.95139	10.113	0.3959	0.9191	1.0605	1.3151
400	32	70	81	99	0.40	0.0556	0.94444	10.187	0.4492	0.9826	1.1370	1.3897
450	35.5	76	86.5	104	0.45	0.0625	0.93750	10.263	0.4947	1.0590	1.2053	1.4492
500	38.5	81	92	110.5	0.50	0.0694	0.93056	10.339	0.5325	1.1203	1.2724	1.5283
550	41	85.5	96	116	0.55	0.0764	0.92361	10.417	0.5628	1.1737	1.3179	1.5924
600	43.5	89.5	101.5	122	0.60	0.0833	0.91667	10.496	0.5927	1.2194	1.3829	1.6622
650	45	93.5	106	126	0.65	0.0903	0.90972	10.576	0.6085	1.2642	1.4333	1.7037
700	47	97.5	110	130.5	0.70	0.0972	0.90278	10.657	0.6307	1.3083	1.4760	1.7511
750	47	101	113.5	133	0.75	0.1042	0.89583	10.740	0.6258	1.3448	1.5112	1.7709
800	44	103.5	117	138	0.80	0.1111	0.88889	10.824	0.5813	1.3674	1.5458	1.8232
850	33	106	120	142	0.85	0.1181	0.88194	10.909	0.4326	1.3895	1.5730	1.8614
900		108.5	123	145	0.90	0.1250	0.87500	10.996	0.0000	1.4111	1.5996	1.8858
950		111	126	148	0.95	0.1319	0.86806	11.084	0.0000	1.4321	1.6257	1.9095
1000		112.5	128.5	150	1.00	0.1389	0.86111	11.173	0.0000	1.4399	1.6446	1.9198
1050		113.5	130.5	152	1.05	0.1458	0.85417	11.264	0.0000	1.4410	1.6568	1.9297
1100		115	133	153	1.10	0.1528	0.84722	11.356	0.0000	1.4481	1.6748	1.9266
								$\Delta\sigma_{Max}$	0.6307	1.4481	1.6748	1.9297

UCS =0.63Kg/cm^2

C=0.56Kg/cm^2

Ø =6°

Test Pit-1 Elevation-1136m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial reading	Load dial reading 1 σ 1	Load dial reading 2 σ 2	Load dial reading 3 σ 3	Load dial reading 4 σ 4	Δ L (Cm) DDR X 0.001	Unit strain ε =ΔL/ L0	Area correctio factor (1-ε)	Corrected Are $A' = A_0 / (1-ε)$	Deviator stre (Kg / Cm²)	Deviator stre (Kg / Cm²)	Deviator stre (Kg / Cm²)	Deviator stress Δσ4 (Kg / Cm²) 4
50	74	85	120	230	0.05	0.0069	0.99306	9.688	1.0922	1.2546	1.7712	3.3948
100	137	200	254	320	0.10	0.0139	0.98611	9.757	2.0080	2.9313	3.7228	4.6901
150	188	276	338	361	0.15	0.0208	0.97917	9.826	2.7361	4.0168	4.9191	5.2538
200	195	311	380	391	0.20	0.0278	0.97222	9.896	2.8178	4.4940	5.4911	5.6501
250	160	332	404	423	0.25	0.0347	0.96528	9.967	2.2955	4.7632	5.7962	6.0688
300		346	422	449	0.30	0.0417	0.95833	10.039	0.0000	4.9284	6.0109	6.3955
350		355	438	465	0.35	0.0486	0.95139	10.113	0.0000	5.0199	6.1936	6.5754
400		365	449	481.5	0.40	0.0556	0.94444	10.187	0.0000	5.1237	6.3028	6.7590
450		369	461	501	0.45	0.0625	0.93750	10.263	0.0000	5.1417	6.4237	6.9810
500		375	472	516	0.50	0.0694	0.93056	10.339	0.0000	5.1866	6.5282	7.1368
550		378.5	482	531	0.55	0.0764	0.92361	10.417	0.0000	5.1960	6.6168	7.2894
600		381	490.5	549	0.60	0.0833	0.91667	10.496	0.0000	5.1910	6.6828	7.4799
650		383	499	566	0.65	0.0903	0.90972	10.576	0.0000	5.1787	6.7471	7.6531
700		385.5	507	582	0.70	0.0972	0.90278	10.657	0.0000	5.1727	6.8030	7.8093
750		388.5	512	598	0.75	0.1042	0.89583	10.740	0.0000	5.1728	6.8172	7.9623
800		390	518.5	612	0.80	0.1111	0.88889	10.824	0.0000	5.1526	6.8503	8.0855
850		390	524.5	633	0.85	0.1181	0.88194	10.909	0.0000	5.1123	6.8754	8.2977
900		392.5	530	646	0.90	0.1250	0.87500	10.996	0.0000	5.1046	6.8928	8.4014
950		395	535	620	0.95	0.1319	0.86806	11.084	0.0000	5.0963	6.9026	7.9993
1000		397	538.5		1.00	0.1389	0.86111	11.173	0.0000	5.0811	6.8922	0.0000
1050		398.5	542.5		1.05	0.1458	0.85417	11.264	0.0000	5.0592	6.8874	0.0000
1100		399	547		1.10	0.1528	0.84722	11.356	0.0000	5.0244	6.8880	0.0000
								$\Delta\sigma_{Max}$	2.8178	5.1960	6.9026	8.4014

UCS =2.82Kg/cm^2

C=1.18Kg/cm^2

Ø =26.4°

Test Pit-1 Elevation-1137 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm   Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial	Load dial	Load dial	Load dial	Load dial	Δ L (Cm)	Unit strain	Area correctio	Corrected Are	Deviator stre	Deviator stre	Deviator stre	Deviator stress Δσ4
reading	reading 1	reading 2	reading 3	reading 4	DDR X 0.001	ε =ΔL/ L0	factor (1-ε)	$A' = A_0 / (1-ε)$	(Kg / Cm^2)	(Kg / Cm^2)	(Kg / Cm^2)	(Kg / Cm^2) 4
	σ 1	σ 2	σ 3	σ 4								
50	12.5	21.5	22	42	0.05	0.0069	0.99306	9.688	0.1845	0.3173	0.3247	0.6199
100	17	27.5	30	59	0.10	0.0139	0.98611	9.757	0.2492	0.4031	0.4397	0.8647
150	21	32.5	36	70	0.15	0.0208	0.97917	9.826	0.3056	0.4730	0.5239	1.0187
200	25	38	42	80	0.20	0.0278	0.97222	9.896	0.3613	0.5491	0.6069	1.1560
250	29.5	42.5	48	87	0.25	0.0347	0.96528	9.967	0.4232	0.6097	0.6887	1.2482
300	34	47	54	99	0.30	0.0417	0.95833	10.039	0.4843	0.6695	0.7692	1.4101
350	38	52	60	105.5	0.35	0.0486	0.95139	10.113	0.5373	0.7353	0.8484	1.4918
400	43	57.5	66	112	0.40	0.0556	0.94444	10.187	0.6036	0.8072	0.9265	1.5722
450	48	62.5	73	118	0.45	0.0625	0.93750	10.263	0.6688	0.8709	1.0172	1.6442
500	52	67	79.5	123	0.50	0.0694	0.93056	10.339	0.7192	0.9267	1.0996	1.7012
550	56	71	85	130	0.55	0.0764	0.92361	10.417	0.7688	0.9747	1.1669	1.7846
600	59	75	91	136	0.60	0.0833	0.91667	10.496	0.8038	1.0218	1.2398	1.8529
650	62.5	79.5	96	141	0.65	0.0903	0.90972	10.576	0.8451	1.0749	1.2980	1.9065
700	65.5	83.5	102	146.5	0.70	0.0972	0.90278	10.657	0.8789	1.1204	1.3686	1.9658
750	68	86.5	108	150	0.75	0.1042	0.89583	10.740	0.9054	1.1517	1.4380	1.9972
800	69.5	89.5	112	153	0.80	0.1111	0.88889	10.824	0.9182	1.1824	1.4797	2.0214
850	70	93	117	156	0.85	0.1181	0.88194	10.909	0.9176	1.2191	1.5337	2.0449
900	69	96	121	158	0.90	0.1250	0.87500	10.996	0.8974	1.2485	1.5736	2.0548
950	67	99	125.5	160.5	0.95	0.1319	0.86806	11.084	0.8644	1.2773	1.6192	2.0708
1000		101	129.5	161.5	1.00	0.1389	0.86111	11.173	0.0000	1.2927	1.6574	2.0670
1050		103.5	133	162	1.05	0.1458	0.85417	11.264	0.0000	1.3140	1.6885	2.0567
1100		105.5	136	163	1.10	0.1528	0.84722	11.356	0.0000	1.3285	1.7126	2.0526
								$Δσ_{Max}$	0.9182	1.3285	1.7126	2.0708

UCS =0.92Kg/cm^2

C=0.44Kg/cm^2

Ø =8.5°

Test Pit-1 Elevation-1138 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial reading	Load dial reading 1 σ 1	Load dial reading 2 σ 2	Load dial reading 3 σ 3	Load dial reading 4 σ 4	Δ L (Cm) DDR X 0.001	Unit strain ϵ =ΔL/ L0	Area correctio factor (1-ϵ)	Corrected Are $A' = A_0 / (1-ϵ$	Deviator stre (Kg / Cm^2	Deviator stre (Kg / Cm^2	Deviator stre (Kg / Cm^2	Deviator stress Δσ4 (Kg / Cm^2) 4
50	27	48	63	100	0.05	0.0069	0.99306	9.688	0.3985	0.7085	0.9299	1.4760
100	45	75	80	141	0.10	0.0139	0.98611	9.757	0.6596	1.0993	1.1725	2.0666
150	63	96	94	170	0.15	0.0208	0.97917	9.826	0.9169	1.3971	1.3680	2.4741
200	80	115	120	191	0.20	0.0278	0.97222	9.896	1.1560	1.6618	1.7340	2.7600
250	94.5	132	139	209	0.25	0.0347	0.96528	9.967	1.3558	1.8938	1.9942	2.9985
300	107	145	155	221.5	0.30	0.0417	0.95833	10.039	1.5241	2.0654	2.2078	3.1550
350	116.5	159.5	169	230	0.35	0.0486	0.95139	10.113	1.6474	2.2554	2.3898	3.2523
400	123	169.5	181	238	0.40	0.0556	0.94444	10.187	1.7266	2.3793	2.5408	3.3409
450	126	177	191	244	0.45	0.0625	0.93750	10.263	1.7557	2.4664	2.6614	3.3999
500	126.5	184.5	199	250	0.50	0.0694	0.93056	10.339	1.7496	2.5518	2.7524	3.4577
550	126.5	190.5	206	254	0.55	0.0764	0.92361	10.417	1.7366	2.6151	2.8279	3.4869
600	124	196	213	257	0.60	0.0833	0.91667	10.496	1.6894	2.6704	2.9020	3.5015
650	118	201	220	259	0.65	0.0903	0.90972	10.576	1.5955	2.7178	2.9747	3.5020
700		205	225	260.5	0.70	0.0972	0.90278	10.657	0.0000	2.7507	3.0191	3.4954
750		209	230	262	0.75	0.1042	0.89583	10.740	0.0000	2.7828	3.0624	3.4885
800		213	234	264	0.80	0.1111	0.88889	10.824	0.0000	2.8141	3.0915	3.4879
850		216	238	266.5	0.85	0.1181	0.88194	10.909	0.0000	2.8314	3.1198	3.4934
900		219.5	242.5	269	0.90	0.1250	0.87500	10.996	0.0000	2.8547	3.1538	3.4984
950		222	246.5	271	0.95	0.1319	0.86806	11.084	0.0000	2.8643	3.1803	3.4964
1000		225	249.5	272	1.00	0.1389	0.86111	11.173	0.0000	2.8797	3.1933	3.4813
1050		228	251.5	273	1.05	0.1458	0.85417	11.264	0.0000	2.8946	3.1929	3.4659
1100		231	254	273.5	1.10	0.1528	0.84722	11.356	0.0000	2.9088	3.1985	3.4440
								$\Delta\sigma_{Max}$	1.7557	2.9088	3.1985	3.5020

UCS =1.76Kg/cm^2

C=1.19Kg/cm^2

Ø =6.4°

Test Pit-1 Elevation-1139 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm   Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm²   Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial reading	Load dial reading 1 σ 1	Load dial reading 2 σ 2	Load dial reading 3 σ 3	Load dial reading 4 σ 4	Δ L (Cm) DDR X 0.001	Unit strain ε =ΔL/ L0	Area correctio factor (1-ε)	Corrected Are $A' = A_0 / (1-ε$	Deviator stre (Kg / Cm²)	Deviator stre (Kg / Cm²)	Deviator stre (Kg / Cm²)	Deviator stress Δσ4 (Kg / Cm²) 4
50	94	110	148	185	0.05	0.0069	0.99306	9.688	1.3874	1.6236	2.1845	2.7306
100	129.5	209	212	290	0.10	0.0139	0.98611	9.757	1.8980	3.0633	3.1072	4.2504
150		289	270	350	0.15	0.0208	0.97917	9.826	0.0000	4.2060	3.9294	5.0937
200		346	342	400	0.20	0.0278	0.97222	9.896	0.0000	4.9998	4.9420	5.7801
250		390	395	439	0.25	0.0347	0.96528	9.967	0.0000	5.5954	5.6671	6.2984
300		410	436	470.5	0.30	0.0417	0.95833	10.039	0.0000	5.8400	6.2103	6.7017
350		416	463	501	0.35	0.0486	0.95139	10.113	0.0000	5.8825	6.5471	7.0845
400		414	483	529	0.40	0.0556	0.94444	10.187	0.0000	5.8115	6.7801	7.4258
450		300	497	556	0.45	0.0625	0.93750	10.263	0.0000	4.1803	6.9253	7.7474
500			508	575	0.50	0.0694	0.93056	10.339	0.0000	0.0000	7.0261	7.9528
550			516	591	0.55	0.0764	0.92361	10.417	0.0000	0.0000	7.0835	8.1131
600			524	603	0.60	0.0833	0.91667	10.496	0.0000	0.0000	7.1393	8.2156
650			529	615	0.65	0.0903	0.90972	10.576	0.0000	0.0000	7.1528	8.3156
700			531	625	0.70	0.0972	0.90278	10.657	0.0000	0.0000	7.1250	8.3863
750			533	600	0.75	0.1042	0.89583	10.740	0.0000	0.0000	7.0968	7.9889
800			533.5		0.80	0.1111	0.88889	10.824	0.0000	0.0000	7.0484	0.0000
850			533.5		0.85	0.1181	0.88194	10.909	0.0000	0.0000	6.9934	0.0000
900			530		0.90	0.1250	0.87500	10.996	0.0000	0.0000	6.8928	0.0000
950					0.95	0.1319	0.86806	11.084	0.0000	0.0000	0.0000	0.0000
1000					1.00	0.1389	0.86111	11.173	0.0000	0.0000	0.0000	0.0000
1050					1.05	0.1458	0.85417	11.264	0.0000	0.0000	0.0000	0.0000
1100					1.10	0.1528	0.84722	11.356	0.0000	0.0000	0.0000	0.0000
								$\Delta\sigma_{Max}$	1.8980	5.8825	7.1528	8.3863

UCS =1.90Kg/cm^2

C=1.67Kg/cm^2

Ø =21.4°

Test Pit-1 Elevation-1140 m

Triaxial Compression Strength Test (UU, CU, CD Method)

Sample Height L_0 = 7.2 Cm Soil size =<4.75 mm

Sample Area A_0 = 9.6211 Cm^2 Motor speed =1.2 mm / min

Load ring constant = 0.143 Kg / div

Deform dial	Load dial	Load dial	Load dial	Load dial	Δ L (Cm)	Unit strain	Area correctio	Corrected Are	Deviator stre	Deviator stre	Deviator stre	Deviator stress Δσ4
reading	reading 1	reading 2	reading 3	reading 4	DDR X 0.001	$\epsilon = \Delta L / L0$	factor (1-ε)	$A' = A_0 / (1-\epsilon)$	(Kg / Cm^2	(Kg / Cm^2	(Kg / Cm^2)	(Kg / Cm^2) 4
	σ 1	σ 2	σ 3	σ 4								
50	15.5	40	45	95	0.05	0.0069	0.99306	9.688	0.2288	0.5904	0.6642	1.4022
100	23.5	59	63	120	0.10	0.0139	0.98611	9.757	0.3444	0.8647	0.9234	1.7588
150	30	71	78	131	0.15	0.0208	0.97917	9.826	0.4366	1.0333	1.1352	1.9065
200	38	82	90	142	0.20	0.0278	0.97222	9.896	0.5491	1.1849	1.3005	2.0519
250	45	91	100	150	0.25	0.0347	0.96528	9.967	0.6456	1.3056	1.4347	2.1521
300	51	100	108	155	0.30	0.0417	0.95833	10.039	0.7264	1.4244	1.5383	2.2078
350	57	106	118	161	0.35	0.0486	0.95139	10.113	0.8060	1.4989	1.6686	2.2766
400	62.5	112	125	166	0.40	0.0556	0.94444	10.187	0.8773	1.5722	1.7547	2.3302
450	67.5	118	132	170.5	0.45	0.0625	0.93750	10.263	0.9406	1.6442	1.8393	2.3758
500	72	124	138	175	0.50	0.0694	0.93056	10.339	0.9958	1.7150	1.9087	2.4204
550	75.5	129	143	178	0.55	0.0764	0.92361	10.417	1.0364	1.7709	1.9631	2.4435
600	79	133	148	181	0.60	0.0833	0.91667	10.496	1.0763	1.8121	2.0164	2.4660
650	82	136	152.5	184.5	0.65	0.0903	0.90972	10.576	1.1087	1.8389	2.0620	2.4947
700	84	140	156.5	188	0.70	0.0972	0.90278	10.657	1.1271	1.8785	2.0999	2.5226
750	84.5	143	160.5	191	0.75	0.1042	0.89583	10.740	1.1251	1.9040	2.1370	2.5431
800	84	146	163	195	0.80	0.1111	0.88889	10.824	1.1098	1.9289	2.1535	2.5763
850	79	148	167	198	0.85	0.1181	0.88194	10.909	1.0356	1.9401	2.1891	2.5955
900		150	170	201	0.90	0.1250	0.87500	10.996	0.0000	1.9508	2.2109	2.6141
950		152	173	203	0.95	0.1319	0.86806	11.084	0.0000	1.9611	2.2321	2.6191
1000		155	175.5	204	1.00	0.1389	0.86111	11.173	0.0000	1.9838	2.2462	2.6110
1050		157.5	178	205	1.05	0.1458	0.85417	11.264	0.0000	1.9996	2.2598	2.6026
1100		158.5	181	206	1.10	0.1528	0.84722	11.356	0.0000	1.9959	2.2792	2.5940
								$\Delta\sigma_{Max}$	1.1271	1.9996	2.2792	2.6191

UCS 1.13Kg/cm^2

C=0.75Kg/cm^2

Ø =7.4°

GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 1 Elevation 1135 m Date 9/5/2010

Soil wt, Ws = 480 g Description Clayey silt and sand

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	34.6	34.6	0	0.00	0.00	100.00
8	2.36	34.6	45.7	11.1	2.31	2.31	97.69
10	2	34.6	41.1	6.5	1.35	3.67	96.33
20	0.85	34.6	57.4	22.8	4.75	8.42	91.58
40	0.425	34.6	53.7	19.1	3.98	12.40	87.60
60	0.25	34.6	46.9	12.3	2.56	14.96	85.04
80	0.18	34.6	44.5	9.9	2.06	17.02	82.98
100	0.15	34.6	53	18.4	3.83	20.85	79.15
140	0.106	34.6	48.8	14.2	2.96	23.81	76.19
200	0.075	34.6	74.1	39.5	8.23	32.04	67.96
Pan		34.6	358	323.4	67.38	99.42	0.58

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit	1	Elevation	1135 m	Date	9/5/2010	Sp.gr =	2.61	Factor CT =	7.7
Soil wt, Ws =	50 g	Zero correction = - 5				Factor a =	1.01	Dispersing agent = Na_2SiO_3 1 cc	
Soil hydrometer 151H		Temperature = 35 °C		Meniscus correction = 1		K value =	0.01	Description - Clayey silt and sand	

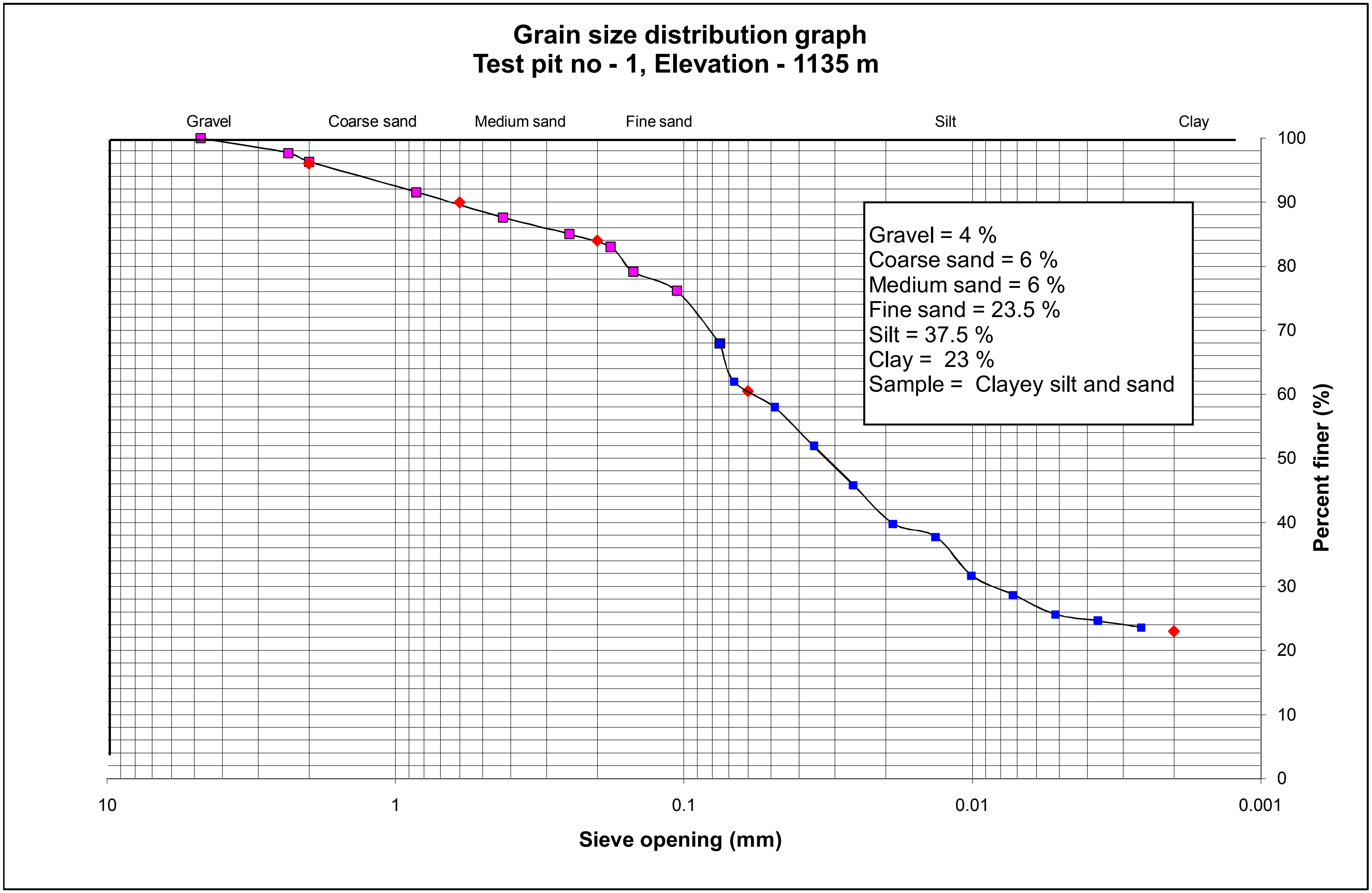
Elapsed time t (min)	**Reading Ra**	**Corrected reading, Rc**	**Corrected for Meniscus, R**	**% Finer**	**Effective Depth, L, cm**	**L/t**	**√L/t**	**Diameter mm**	**Corrected % Finer**
0.25	18	30.7	19	62.01	11.3	45.20	6.72	0.0672	62.01
0.50	16	28.7	17	57.97	11.8	23.60	4.86	0.0486	57.97
1	13	25.7	14	51.91	12.6	12.60	3.55	0.0355	51.91
2	10	22.7	11	45.85	13.4	6.70	2.59	0.0259	45.85
4	7	19.7	8	39.79	14.2	3.55	1.88	0.0188	39.79
8	6	18.7	7	37.77	14.4	1.80	1.34	0.0134	37.77
15	3	15.7	4	31.71	15.2	1.01	1.01	0.0101	31.71
30	1.5	14.2	2.5	28.68	15.65	0.52	0.72	0.0072	28.68
60	0	12.7	1	25.65	16	0.27	0.52	0.0052	25.65
120	-0.5	12.2	0.5	24.64	16.15	0.13	0.37	0.0037	24.64
240	-1	11.7	0	23.63	16.3	0.07	0.26	0.0026	23.63

Rc= Ra- Zero correction + CT

R = Ra + Meniscus correction

% Finer = Rc (a) / Ws

Diameter D = K √L/t


Grain size distribution graph
Test pit no - 1, Elevation - 1135 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 4 %
Coarse sand = 6 %
Medium sand = 6 %
Fine sand = 23.5 %
Silt = 37.5 %
Clay = 23 %
Sample = Clayey silt and sand
100
90
80
70
60
50
40
30
20
10
0
Percent finer (%)
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 1 Elevation 1136 m Date 9/5/2010

Soil wt, Ws = 165 g Description Sand, silt and clay

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	52.4	52.4	0	0.00	0.00	100.00
8	2.36	52.4	54.5	2.1	1.27	1.27	98.73
10	2	52.4	54.7	2.3	1.39	2.67	97.33
20	0.85	52.4	62.9	10.5	6.36	9.03	90.97
40	0.425	52.4	68.9	16.5	10.00	19.03	80.97
60	0.25	52.4	57.7	5.3	3.21	22.24	77.76
80	0.18	52.4	53.3	0.9	0.55	22.79	77.21
100	0.15	52.4	54.3	1.9	1.15	23.94	76.06
140	0.106	52.4	54.5	2.1	1.27	25.21	74.79
200	0.075	52.4	59	6.6	4.00	29.21	70.79
Pan		52.4	168	115.6	70.06	99.27	0.73

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit	1	Elevation	1136 m	Date	9/5/2010	Sp.gr =	2.39	Factor CT =	6
Soil wt, Ws =	50 g	Zero correction = - 5				Factor a =	1.052	Dispersing agent = Na_2SiO_3 1 cc	
Soil hydrometer 151H		Temperature = 33 °C		Meniscus correction = 1		K value =	0.01166	Description - Sand, silt and clay	

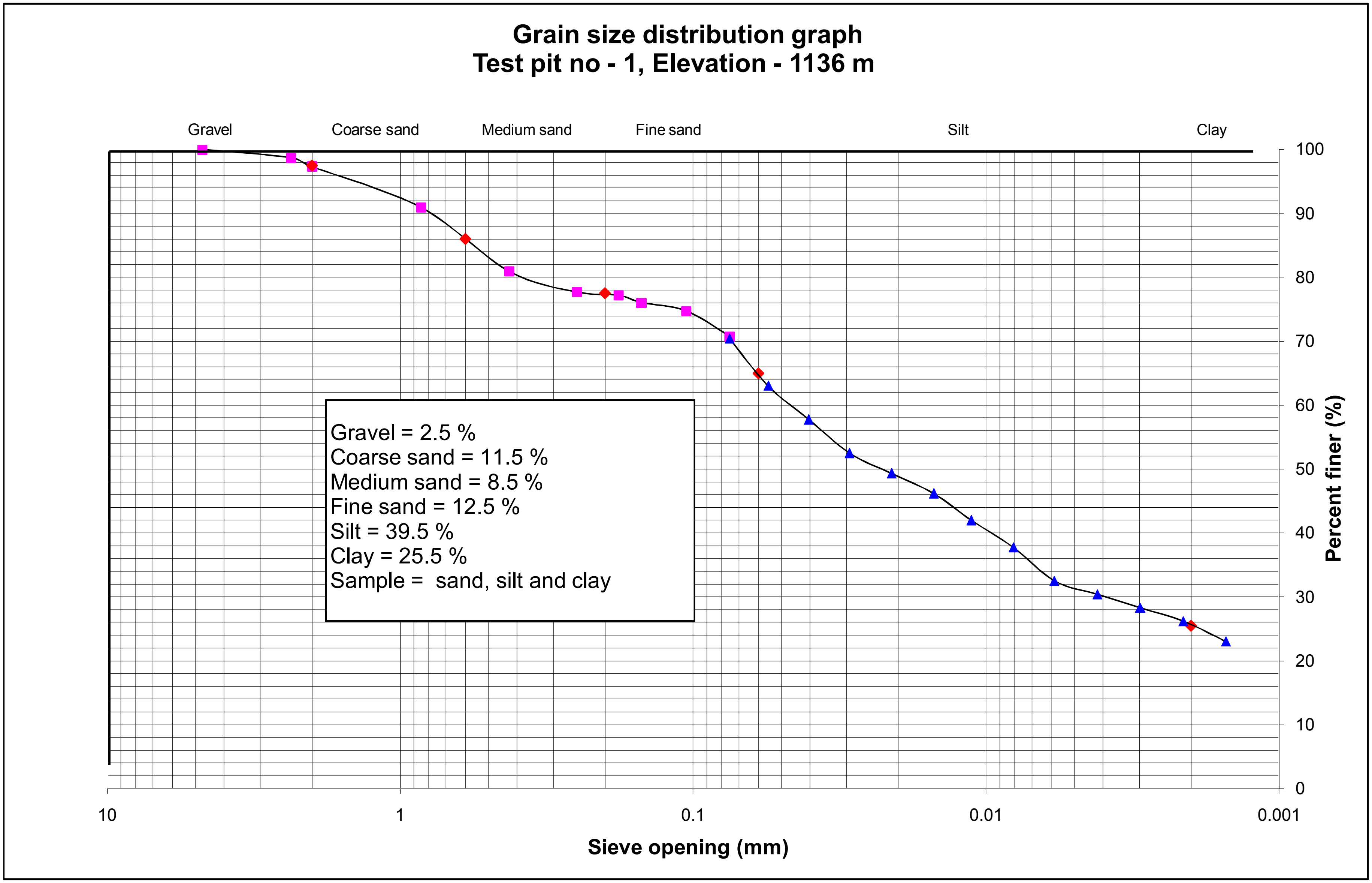
Elapsed time t (min)	Reading Ra	Corrected reading, Rc	Corrected for Meniscus, R	% Finer	Effective Depth, L, cm	L/t	√L/t	Diameter mm	Corrected % Finer
0.25	21.5	32.5	22.5	68.38	10.35	41.40	6.43	0.0750	70.38
0.50	18	29	19	61.02	11.3	22.60	4.75	0.0554	63.02
1	15.5	26.5	16.5	55.76	11.95	11.95	3.46	0.0403	57.76
2	13	24	14	50.50	12.6	6.30	2.51	0.0293	52.50
4	11.5	22.5	12.5	47.34	13	3.25	1.80	0.0210	49.34
8	10	21	11	44.18	13.4	1.68	1.29	0.0151	46.18
15	8	19	9	39.98	13.9	0.93	0.96	0.0112	41.98
30	6	17	7	35.77	14.4	0.48	0.69	0.0081	37.77
60	3.5	14.5	4.5	30.51	15.1	0.25	0.50	0.0058	32.51
120	2.5	13.5	3.5	28.40	15.35	0.13	0.36	0.0042	30.40
240	1.5	12.5	2.5	26.30	15.65	0.07	0.26	0.0030	28.30
480	0.5	11.5	1.5	24.20	15.9	0.03	0.18	0.0021	26.20
960	-1	10	0	21.04	16.3	0.02	0.13	0.0015	23.04

Rc= Ra- Zero correction + CT

R = Ra + Meniscus correction

% Finer = Rc (a) / Ws

Diameter D = K √L/t



Grain size distribution graph
Test pit no - 1, Elevation - 1136 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 2.5 %
Coarse sand = 11.5 %
Medium sand = 8.5 %
Fine sand = 12.5 %
Silt = 39.5 %
Clay = 25.5 %
Sample = sand, silt and clay
100
90
80
70
60
50
40
30
20
10
0
Percent finer (%)
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 1 Elevation 1137 m Date 10/5/2010

Soil wt, Ws = 285 g Description Clayey silt

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	52.4	52.4	0	0.00	0.00	100.00
8	2.36	52.4	52.4	0	0.00	0.00	100.00
10	2	52.4	52.4	0	0.00	0.00	100.00
20	0.85	52.4	52.8	0.4	0.14	0.14	99.86
40	0.425	52.4	53.4	1	0.35	0.49	99.51
60	0.25	52.4	53.2	0.8	0.28	0.77	99.23
80	0.18	52.4	53.1	0.7	0.25	1.02	98.98
100	0.15	52.4	54.2	1.8	0.63	1.65	98.35
140	0.106	52.4	55.1	2.7	0.95	2.60	97.40
200	0.075	52.4	67.8	15.4	5.40	8.00	92.00
Pan		52.4	312	259.6	91.09	99.09	0.91

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit	1	Elevation	1137 m	Date	10/5/2010	Sp.gr =	2.57	Factor CT =	6.8
Soil wt, Ws =	50 g	Zero correction = - 5				Factor a =	1.016	Dispersing agent = Na_2SiO_3 1 cc	
Soil hydrometer 151H		Temperature = 34 °C		Meniscus correction = 1		K value =	0.01038	Description - Clayey silt	

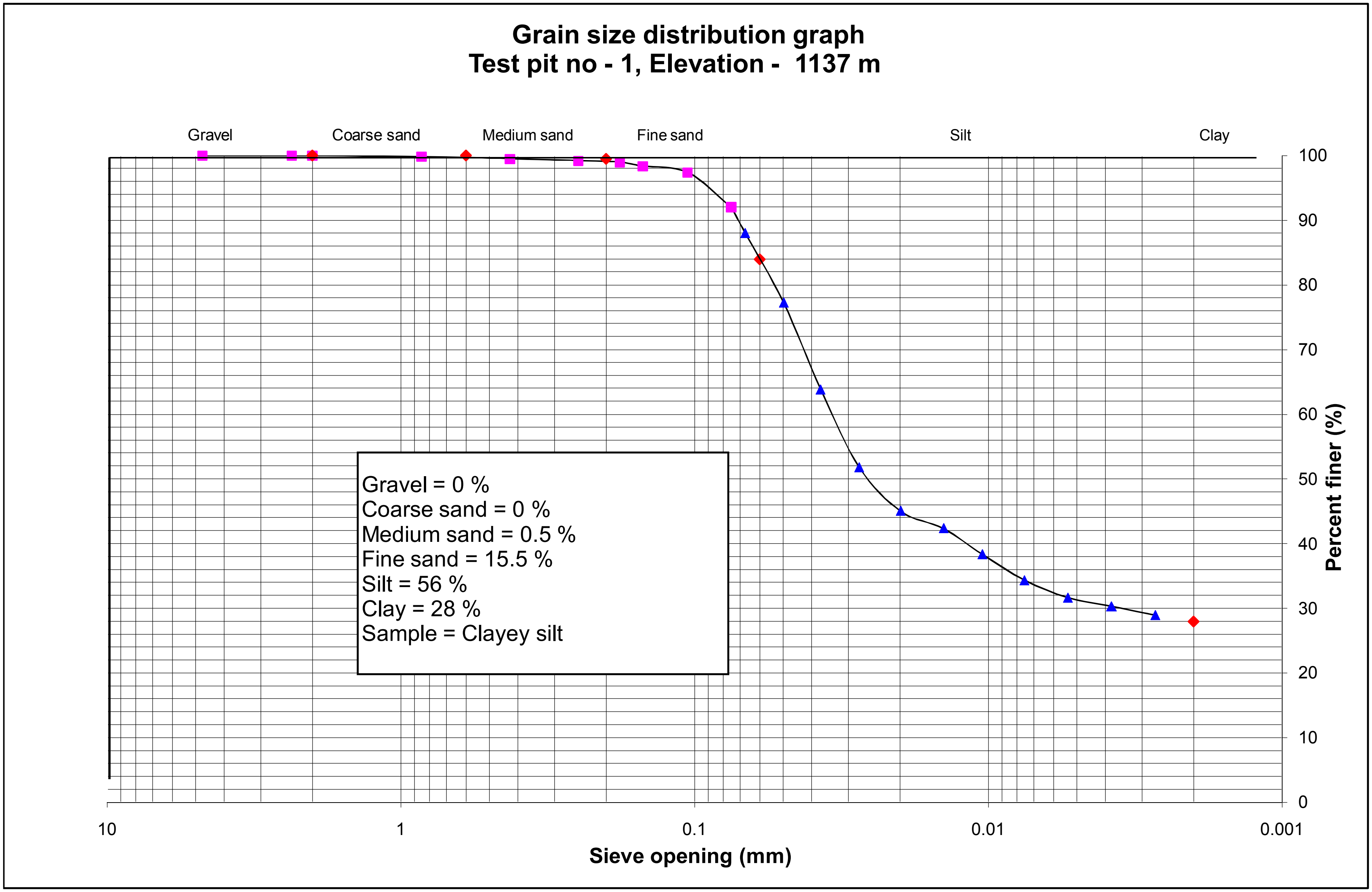
Elapsed time t (min)	**Reading Ra**	**Corrected reading, Rc**	**Corrected for Meniscus, R**	**% Finer**	**Effective Depth, L, cm**	**L/t**	**√L/t**	**Diameter mm**	**Corrected % Finer**
0.25	21	32.8	22	66.65	10.5	42.00	6.48	0.0673	87.98
0.50	17	28.8	18	58.52	11.5	23.00	4.80	0.0498	77.25
1	12	23.8	13	48.36	12.9	12.90	3.59	0.0373	63.84
2	7.5	19.3	8.5	39.22	14.05	7.03	2.65	0.0275	51.77
4	5	16.8	6	34.14	14.7	3.68	1.92	0.0199	45.06
8	4	15.8	5	32.11	15	1.88	1.37	0.0142	42.38
15	2.5	14.3	3.5	29.06	15.35	1.02	1.01	0.0105	38.36
30	1	12.8	2	26.01	15.8	0.53	0.73	0.0075	34.33
60	0	11.8	1	23.98	16	0.27	0.52	0.0054	31.65
120	-0.5	11.3	0.5	22.96	16.15	0.13	0.37	0.0038	30.31
240	-1	10.8	0	21.95	16.3	0.07	0.26	0.0027	28.97
480	-1.5	10.3	-0.5	20.93					

Rc= Ra- Zero correction + CT

R = Ra + Meniscus correction

% Finer = Rc (a) / Ws

Diameter D = K √L/t


Grain size distribution graph
Test pit no - 1, Elevation - 1137 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 0 %
Coarse sand = 0 %
Medium sand = 0.5 %
Fine sand = 15.5 %
Silt = 56 %
Clay = 28 %
Sample = Clayey silt
Percent finer (%)
100
90
80
70
60
50
40
30
20
10
0
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS (Sieve analysis)

Location Upper Balu chaung

Test pit 1 | Elevation 1138 m | Date 10/5/2010

Soil wt, Ws = 545 g | Description Sandy silt and clay

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	34.45	34.45	0	0.00	0.00	100.00
8	2.36	34.45	74.3	39.85	7.31	7.31	92.69
10	2	34.45	47.1	12.65	2.32	9.63	90.37
20	0.85	34.45	68.8	34.35	6.30	15.94	84.06
40	0.425	34.45	54.3	19.85	3.64	19.58	80.42
60	0.25	34.45	41.8	7.35	1.35	20.93	79.07
80	0.18	34.45	38.1	3.65	0.67	21.60	78.40
100	0.15	34.45	43.3	8.85	1.62	23.22	76.78
140	0.106	34.45	39.7	5.25	0.96	24.18	75.82
200	0.075	34.45	42.9	8.45	1.55	25.73	74.27
Pan		34.45	437.2	402.75	73.90	99.63	0.37

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit	1	Elevation	1138 m	Date	10/5/2010	Sp.gr =	2.47	Factor CT =	6
Soil wt, Ws =	50 g	Zero correction = - 5				Factor a =	1.036	Dispersing agent = Na_2SiO_3 1 cc	
Soil hydrometer 151H		Temperature = 33 °C		Meniscus correction = 1		K value =	0.01122	Description - Sandy silt and clay	

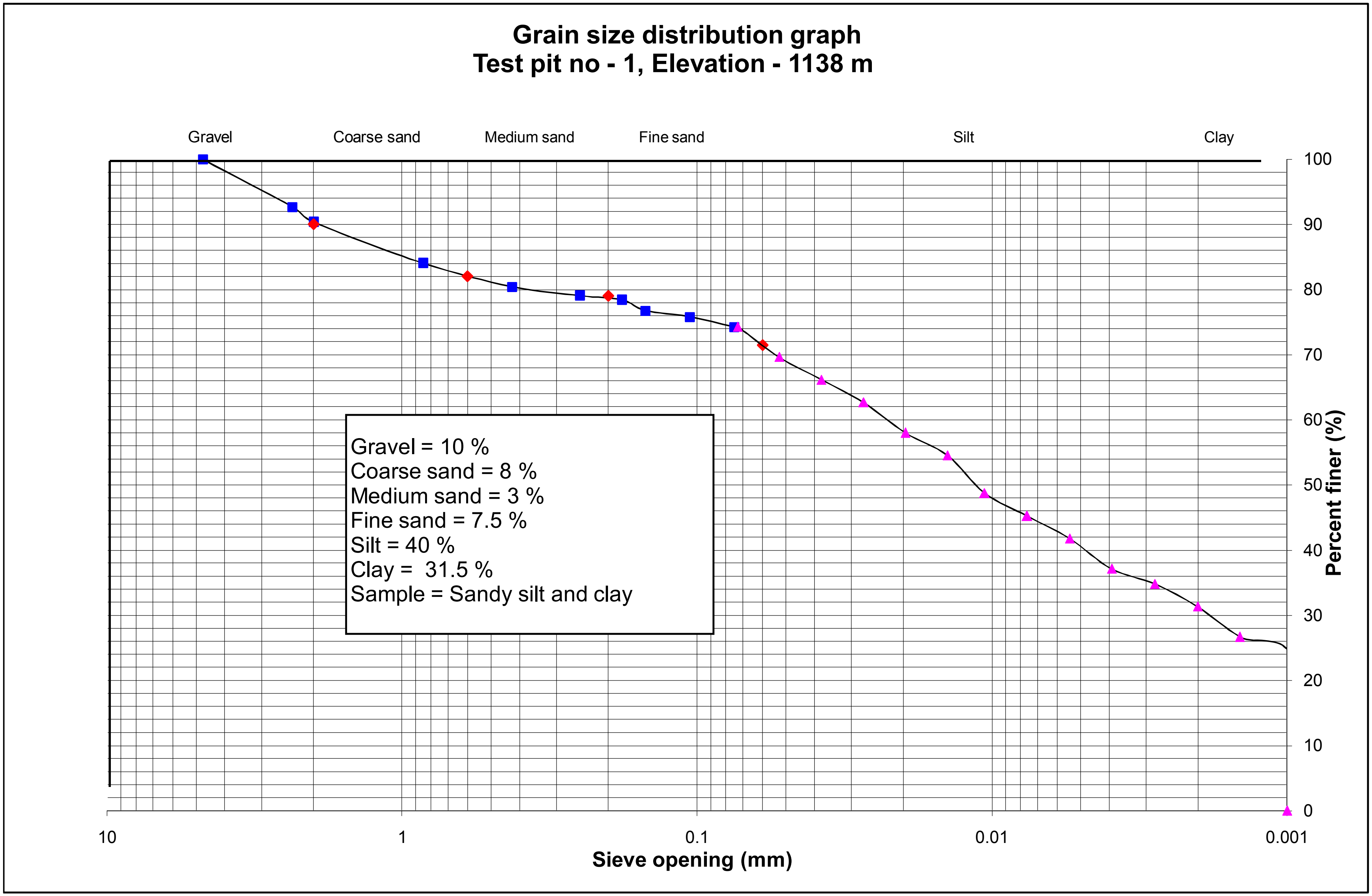
Elapsed time t (min)	Reading Ra	Corrected reading, Rc	Corrected for Meniscus, R	% Finer	Effective Depth, L, cm	L/t	√L/t	Diameter mm	Corrected % Finer
0.25	21	32	22	66.30	10.5	42.00	6.48	0.0727	74.26
0.50	19	30	20	62.16	11	22.00	4.69	0.0526	69.62
1	17.5	28.5	18.5	59.05	11.4	11.40	3.38	0.0379	66.14
2	16	27	17	55.94	11.8	5.90	2.43	0.0273	62.66
4	14	25	15	51.80	12.3	3.08	1.75	0.0197	58.02
8	12.5	23.5	13.5	48.69	12.75	1.59	1.26	0.0142	54.54
15	10	21	11	43.51	13.4	0.89	0.95	0.0106	48.73
30	8.5	19.5	9.5	40.40	13.8	0.46	0.68	0.0076	45.25
60	7	18	8	37.30	14.2	0.24	0.49	0.0055	41.77
120	5	16	6	33.15	14.7	0.12	0.35	0.0039	37.13
240	4	15	5	31.08	15	0.06	0.25	0.0028	34.81
480	2.5	13.5	3.5	27.97	15.35	0.03	0.18	0.0020	31.33
960	0.5	11.5	1.5	23.83	15.9	0.02	0.13	0.0014	26.69
2220	-1	10	0	20.72	16.3	0.01	0.09	0.0010	23.21

Rc= Ra- Zero correction + CT

R = Ra + Meniscus correction

% Finer = Rc (a) / Ws

Diameter D = K √L/t



Grain size distribution graph
Test pit no - 1, Elevation - 1138 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 10 %
Coarse sand = 8 %
Medium sand = 3 %
Fine sand = 7.5 %
Silt = 40 %
Clay = 31.5 %
Sample = Sandy silt and clay
100
90
80
70
60
50
40
30
20
10
0
Percent finer (%)
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 1 Elevation 1139 m Date 11/5/2010

Soil wt, Ws = 195 g Description Clayey silt

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	52.4	52.6	0.2	0.10	0.10	99.90
8	2.36	52.4	53.8	1.4	0.72	0.82	99.18
10	2	52.4	53.4	1	0.51	1.33	98.67
20	0.85	52.4	57.2	4.8	2.46	3.79	96.21
40	0.425	52.4	59	6.6	3.38	7.18	92.82
60	0.25	52.4	54.1	1.7	0.87	8.05	91.95
80	0.18	52.4	53.6	1.2	0.62	8.67	91.33
100	0.15	52.4	54.5	2.1	1.08	9.74	90.26
140	0.106	52.4	54.3	1.9	0.97	10.72	89.28
200	0.075	52.4	58.1	5.7	2.92	13.64	86.36
Pan		52.4	220.3	167.9	86.10	99.74	0.26

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit 1 Elevation 1139m Date 11/5/2010 Sp.gr = 2.47 Factor CT = 5.3

Soil wt, Ws = 50 g Zero correction = - 5 Factor a = 1.036 Dispersing agent = Na_2SiO_3 1 cc

Soil hydrometer 151H Temperature = 32 °C Meniscus correction = 1 K value = 0.01142 Description - Clayey silt

Elapsed time t (min)	**Reading Ra**	**Corrected reading, Rc**	**Corrected for Meniscus, R**	**% Finer**	**Effective Depth, L, cm**	**L/t**	**√L/t**	**Diameter mm**	**Corrected % Finer**
0.25	22	32.3	23	66.93	10.2	40.80	6.39	0.0729	86.00
0.50	20	30.3	21	62.78	10.7	21.40	4.63	0.0528	80.67
1	17	27.3	18	56.57	11.5	11.50	3.39	0.0387	72.69
2	14	24.3	15	50.35	12.3	6.15	2.48	0.0283	64.70
4	12	22.3	13	46.21	12.9	3.23	1.80	0.0205	59.37
8	11	21.3	12	44.13	13.1	1.64	1.28	0.0146	56.71
15	10	20.3	11	42.06	13.4	0.89	0.95	0.0108	54.05
30	7.5	17.8	8.5	36.88	14.05	0.47	0.68	0.0078	47.39
60	5	15.3	6	31.70	14.7	0.25	0.49	0.0057	40.74
120	4	14.3	5	29.63	15	0.13	0.35	0.0040	38.07
240	3	13.3	4	27.56	15.2	0.06	0.25	0.0029	35.41
480	1	11.3	2	23.41	15.8	0.03	0.18	0.0021	30.09
960	-0.5	9.8	0.5	20.31	16.15	0.02	0.13	0.0015	26.09

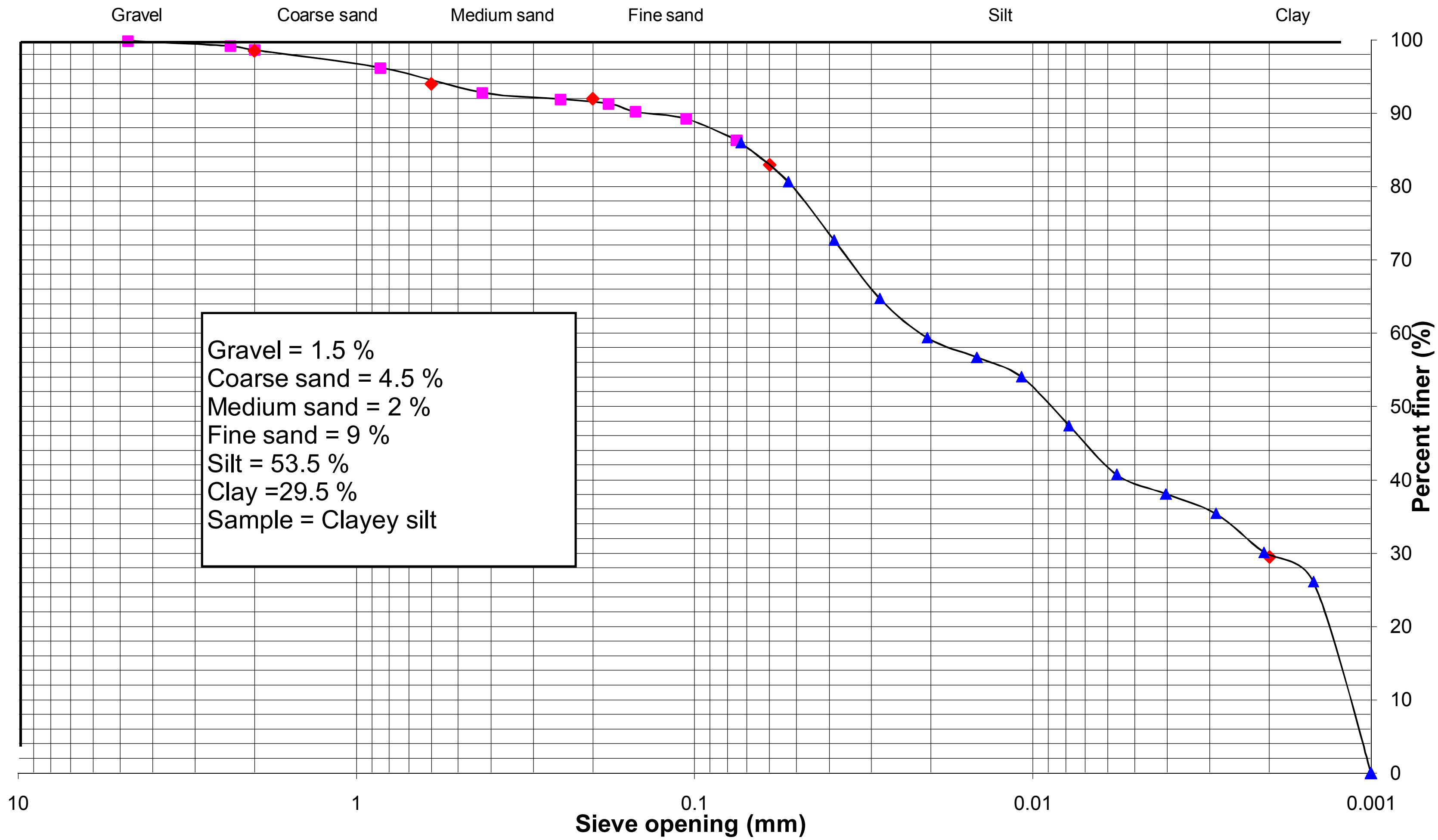
Rc= Ra- Zero correction + CT

R = Ra + Meniscus correction

% Finer = Rc (a) / Ws

Diameter D = K √L/t

Grain size distribution graph
Test pit no - 1, Elevation - 1139 m



GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 1 Elevation 1140 m Date 7/5/2010

Soil wt, Ws = 460 g Description Silt

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	33.6	33.6	0	0.00	0.00	100.00
8	2.36	33.6	34.8	1.2	0.26	0.26	99.74
10	2	33.6	35.8	2.2	0.48	0.74	99.26
20	0.85	33.6	43.4	9.8	2.13	2.87	97.13
40	0.425	33.6	45.3	11.7	2.54	5.41	94.59
60	0.25	33.6	44.2	10.6	2.30	7.72	92.28
80	0.18	33.6	43.2	9.6	2.09	9.80	90.20
100	0.15	33.6	44.9	11.3	2.46	12.26	87.74
140	0.106	33.6	44.5	10.9	2.37	14.63	85.37
200	0.075	33.6	49	15.4	3.35	17.98	82.02
Pan		33.6	407	373.4	81.17	99.15	0.85

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit	1	Elevation	1140 m	Date	7/5/2010	Sp.gr =	2.46	Factor CT =	6.4
Soil wt, Ws =	50 g	Zero correction = - 4				Factor a =	1.038	Dispersing agent = Na_2SiO_3 1 cc	
Soil hydrometer 151H		Temperature = 33.5 °C		Meniscus correction = 1		K value =	0.01116	Description -Silt	

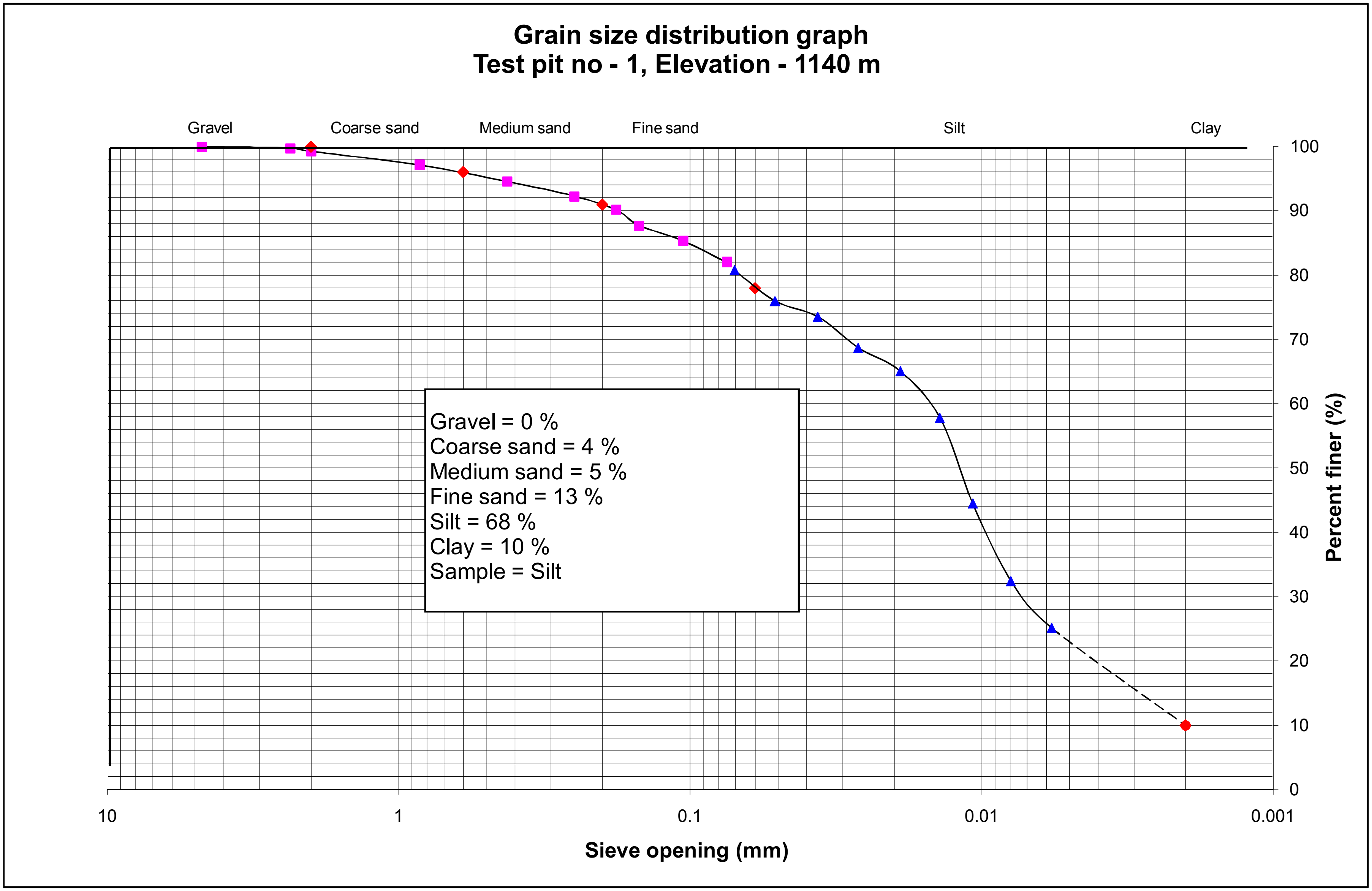
Elapsed time t (min)	Reading Ra	Corrected reading, Rc	Corrected for Meniscus, R	% Finer	Effective Depth, L, cm	L/t	√L/t	Diameter mm	Corrected % Finer
0.25	23	33.4	24	69.34	10	40.00	6.32	0.0706	80.78
0.50	21	31.4	22	65.19	10.5	21.00	4.58	0.0511	75.94
1	20	30.4	21	63.11	10.7	10.70	3.27	0.0365	73.52
2	18	28.4	19	58.96	11.3	5.65	2.38	0.0265	68.69
4	16.5	26.9	17.5	55.84	11.65	2.91	1.71	0.0190	65.06
8	13.5	23.9	14.5	49.62	12.45	1.56	1.25	0.0139	57.80
15	8	18.4	9	38.20	13.9	0.93	0.96	0.0107	44.50
30	3	13.4	4	27.82	15.2	0.51	0.71	0.0079	32.41
60	0	10.4	1	21.59	16	0.27	0.52	0.0058	25.15
120	-2	8.4	-1	17.44					

Rc= Ra- Zero correction + CT

R = Ra + Meniscus correction

% Finer = Rc (a) / Ws

Diameter D = K √L/t


Grain size distribution graph
Test pit no - 1, Elevation - 1140 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 0 %
Coarse sand = 4 %
Medium sand = 5 %
Fine sand = 13 %
Silt = 68 %
Clay = 10 %
Sample = Silt
100
90
80
70
60
50
40
30
20
10
0
Percent finer (%)
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 2 Elevation 1136 m Date 8/5/2010

Soil wt, Ws = 445 g Description Fine sand and silt

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	34.6	34.6	0	0.00	0.00	100.00
8	2.36	34.6	34.7	0.1	0.02	0.02	99.98
10	2	34.6	34.7	0.1	0.02	0.04	99.96
20	0.85	34.6	34.7	0.1	0.02	0.07	99.93
40	0.425	34.6	37.8	3.2	0.72	0.79	99.21
60	0.25	34.6	39.7	5.1	1.15	1.93	98.07
80	0.18	34.6	38.7	4.1	0.92	2.85	97.15
100	0.15	34.6	52.8	18.2	4.09	6.94	93.06
140	0.106	34.6	54.2	19.6	4.40	11.35	88.65
200	0.075	34.6	85.4	50.8	11.42	22.76	77.24
Pan		34.6	376.7	342.1	76.88	99.64	0.36

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

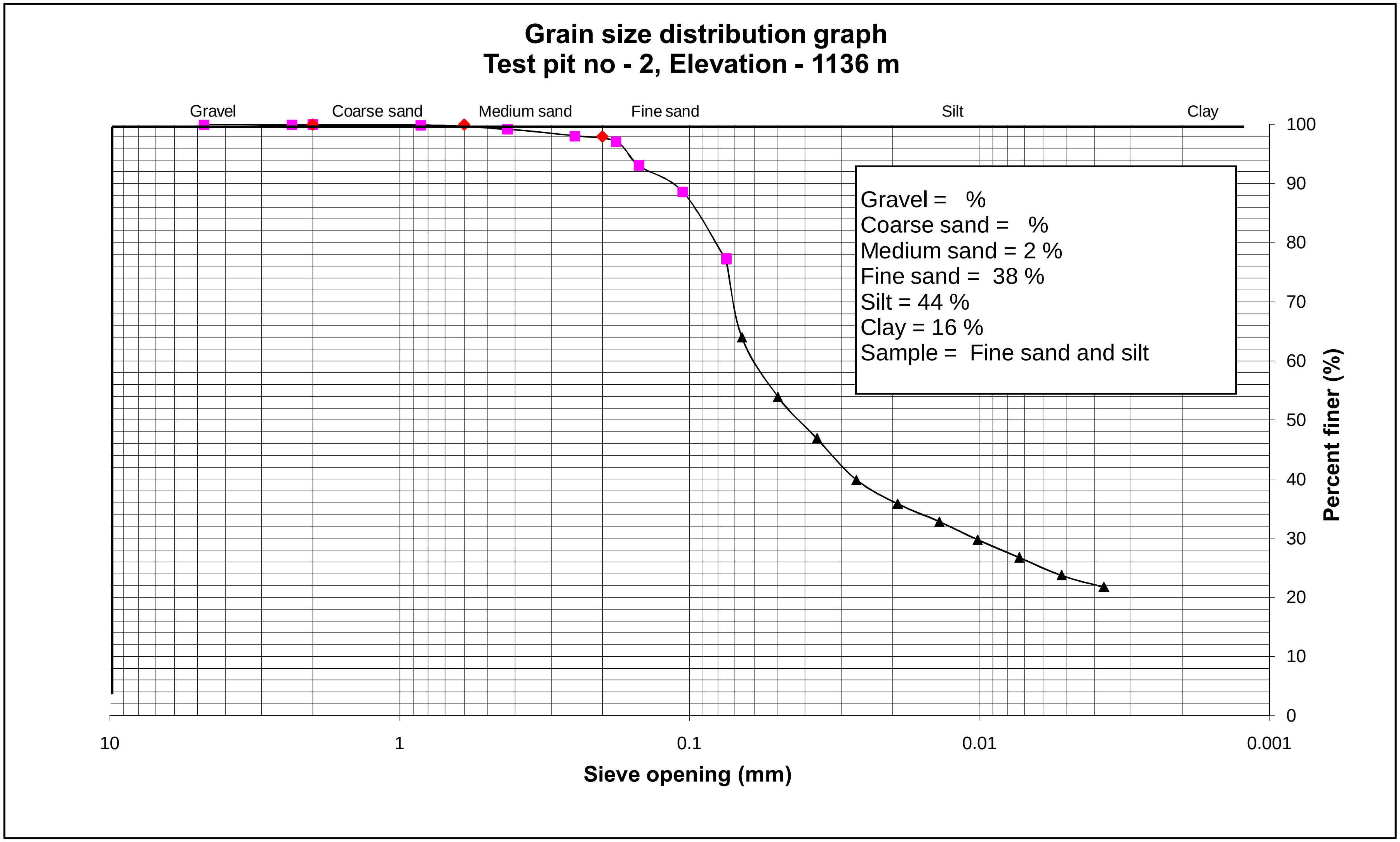
Test pit 2 Elevation 1136 m Date 8/5/2010 Sp.gr = 2.62 Factor CT = 6.8

Soil wt, Ws = 50 g Zero correction = - 5 Factor a = 1.006 Dispersing agent = Na_2SiO_3 1 cc

Soil hydrometer 151H Temperature = 34 °C Meniscus correction = 1 K value = 0.0101 Description - Fine sand and silt

Elapsed time t (min)	Reading Ra	Corrected reading, Rc	Corrected for Meniscus, R	% Finer	Effective Depth, L, cm	L/t	√L/t	Diameter mm	Corrected % Finer
0.25	20	31.8	21	63.98	10.7	42.80	6.54	0.0661	63.98
0.50	15	26.8	16	53.92	12.1	24.20	4.92	0.0497	53.92
1	11.5	23.3	12.5	46.88	13	13.00	3.61	0.0364	46.88
2	8	19.8	9	39.84	13.9	6.95	2.64	0.0266	39.84
4	6	17.8	7	35.81	14.4	3.60	1.90	0.0192	35.81
8	4.5	16.3	5.5	32.80	14.85	1.86	1.36	0.0138	32.80
15	3	14.8	4	29.78	15.2	1.01	1.01	0.0102	29.78
30	1.5	13.3	2.5	26.76	15.65	0.52	0.72	0.0073	26.76
60	0	11.8	1	23.74	16	0.27	0.52	0.0052	23.74
120	-1	10.8	0	21.73	16.3	0.14	0.37	0.0037	21.73
240	-1.5	10.3	-0.5	20.72					
480	-2	9.8	-1	19.72					

Rc= Ra- Zero correction + CT R = Ra + Meniscus correction


Grain size distribution graph
Test pit no - 2, Elevation - 1136 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = %
Coarse sand = %
Medium sand = 2 %
Fine sand = 38 %
Silt = 44 %
Clay = 16 %
Sample = Fine sand and silt
100
90
80
70
60
50
40
30
20
10
0
Percent finer (%)
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS (Sieve analysis)

Location Upper Balu chaung

Test pit 2 Elevation 1137 m Date 8/5/2010

Soil wt, Ws = 565 g Description Clayey silt and fine sand

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	34.3	34.3	0	0.00	0.00	100.00
8	2.36	34.3	34.6	0.3	0.05	0.05	99.95
10	2	34.3	34.4	0.1	0.02	0.07	99.93
20	0.85	34.3	35.1	0.8	0.14	0.21	99.79
40	0.425	34.3	37.4	3.1	0.55	0.76	99.24
60	0.25	34.3	40.2	5.9	1.04	1.81	98.19
80	0.18	34.3	41.5	7.2	1.27	3.08	96.92
100	0.15	34.3	77.5	43.2	7.65	10.73	89.27
140	0.106	34.3	64.4	30.1	5.33	16.05	83.95
200	0.075	34.3	136.7	102.4	18.12	34.18	65.82
Pan		34.3	405.8	371.5	65.75	99.93	0.07

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit 2 Elevation 1137 m Date 8/5/2010 Sp.gr = 2.61 Factor CT = 6.8

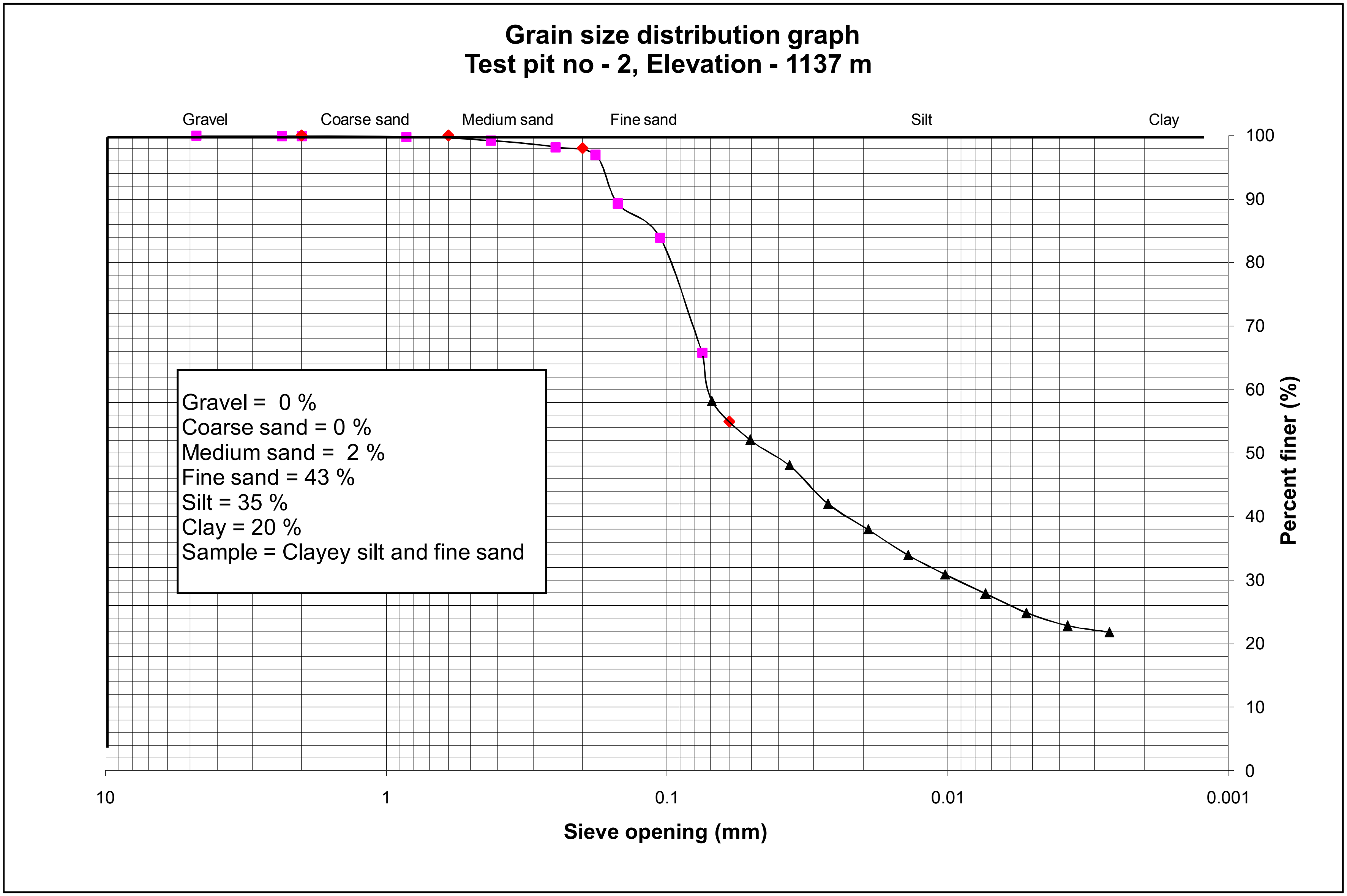
Soil wt, Ws = 50 g Zero correction = - 5 Factor a = 1.01 Dispersing agent = Na_2SiO_3 1 cc

Soil hydrometer 151H Temperature = 34 °C Meniscus correction = 1 K value = 0.0102 Description - Clayey silt and fine sand

Elapsed time t (min)	Reading Ra	Corrected reading, Rc	Corrected for Meniscus, R	% Finer	Effective Depth, L, cm	L/t	√L/t	Diameter mm	Corrected % Finer
0.25	17	28.8	18	58.18	11.5	46.00	6.78	0.0692	58.18
0.50	14	25.8	15	52.12	12.3	24.60	4.96	0.0506	52.12
1	12	23.8	13	48.08	12.9	12.90	3.59	0.0366	48.08
2	9	20.8	10	42.02	13.7	6.85	2.62	0.0267	42.02
4	7	18.8	8	37.98	14.2	3.55	1.88	0.0192	37.98
8	5	16.8	6	33.94	14.7	1.84	1.36	0.0138	33.94
15	3.5	15.3	4.5	30.91	15.1	1.01	1.00	0.0102	30.91
30	2	13.8	3	27.88	15.5	0.52	0.72	0.0073	27.88
60	0.5	12.3	1.5	24.85	15.9	0.27	0.51	0.0053	24.85
120	-0.5	11.3	0.5	22.83	16.15	0.13	0.37	0.0037	22.83
240	-1	10.8	0	21.82	16.3	0.07	0.26	0.0027	21.82
480	-1.5	10.3	-0.5	20.81					

Rc= Ra- Zero correction + CT R = Ra + Meniscus correction

% Finer = Rc (a) / Ws Diameter D = K √L/t


Grain size distribution graph
Test pit no - 2, Elevation - 1137 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 0 %
Coarse sand = 0 %
Medium sand = 2 %
Fine sand = 43 %
Silt = 35 %
Clay = 20 %
Sample = Clayey silt and fine sand
100
90
80
70
60
50
40
30
20
10
0
Percent finer (%)
10
1
0.1
0.01
0.001
Sieve opening (mm)

GRAIN SIZE DISTRIBUTION ANALYSIS **(Sieve analysis)**

Location Upper Balu chaung

Test pit 2 Elevation 1138 m Date 9/5/2010

Soil wt, Ws = 460 g Description Silt and clay

Sieve No	Sieve Opening, mm	Wt of Container, g	Wt of Container and Soil, g	Wt of Soil Retained, g	% Retained	Cummulative % Retained	% Finer
4	4.75	33.5	33.5	0	0.00	0.00	100.00
8	2.36	33.5	33.7	0.2	0.04	0.04	99.96
10	2	33.5	33.8	0.3	0.07	0.11	99.89
20	0.85	33.5	34.9	1.4	0.30	0.41	99.59
40	0.425	33.5	36	2.5	0.54	0.96	99.04
60	0.25	33.5	34.9	1.4	0.30	1.26	98.74
80	0.18	33.5	34.2	0.7	0.15	1.41	98.59
100	0.15	33.5	35.8	2.3	0.50	1.91	98.09
140	0.106	33.5	36.6	3.1	0.67	2.59	97.41
200	0.075	33.5	43.8	10.3	2.24	4.83	95.17
Pan		33.5	471	437.5	95.11	99.93	0.07

GRAIN SIZE DISTRIBUTION ANALYSIS (Hydrometer test)

Location Upper Balu chaung Project, Southern Shan State

Test pit	2	Elevation	1138 m	Date	9/5/2010	Sp.gr =	2.44	Factor CT =	7.7
Soil wt, Ws =	50 g	Zero correction = - 5				Factor a =	1.042	Dispersing agent = Na_2SiO_3 1 cc	
Soil hydrometer 151H		Temperature = 35 °C		Meniscus correction = 1		K value =	0.01095	Description - Silt and clay	

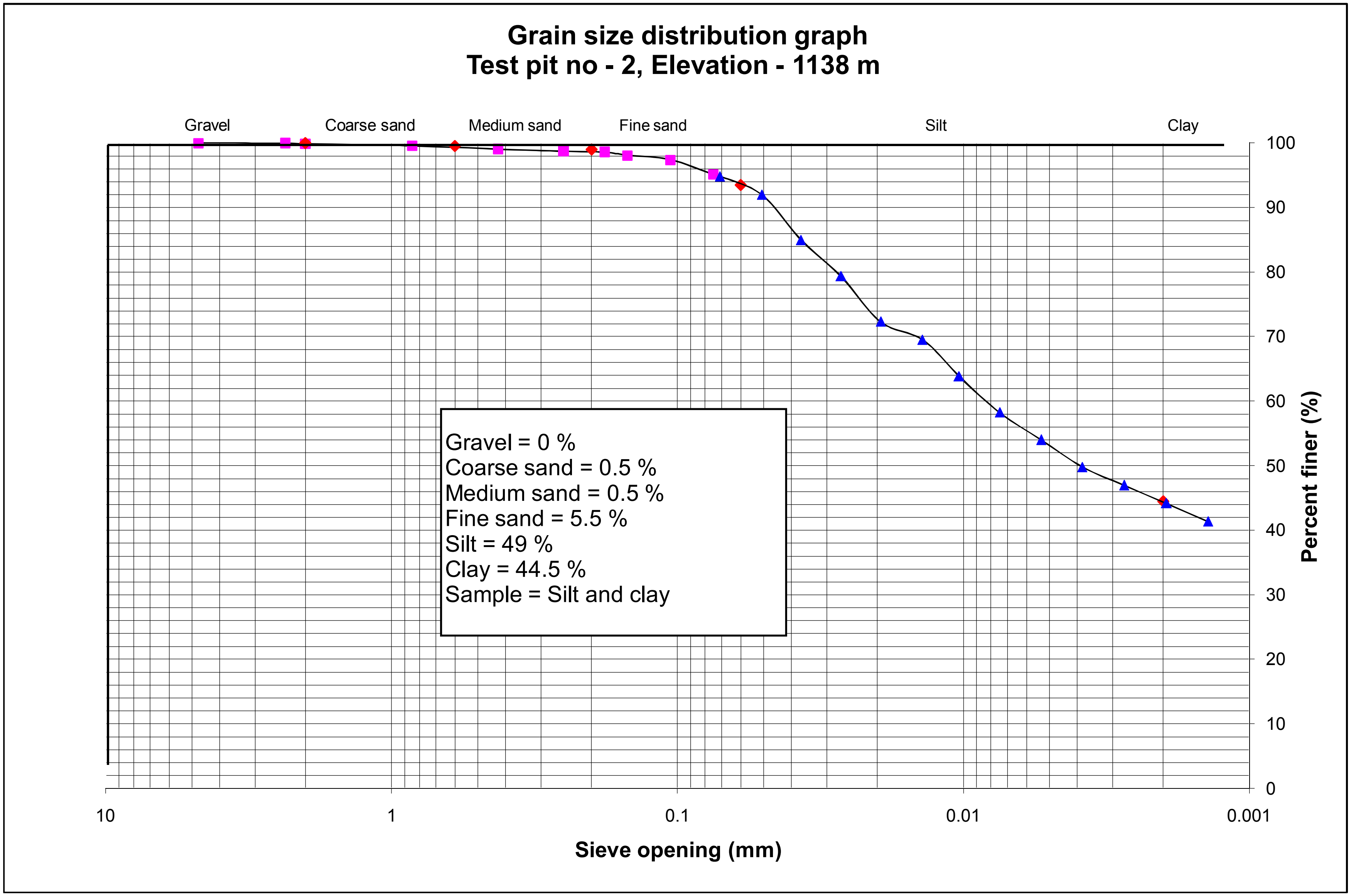
Elapsed time t (min)	Reading Ra	Corrected reading, Rc	Corrected for Meniscus, R	% Finer	Effective Depth, L, cm	L/t	√L/t	Diameter mm	Corrected % Finer
0.25	21	33.7	22	70.23	10.5	42.00	6.48	0.0710	94.81
0.50	20	32.7	21	68.15	10.7	21.40	4.63	0.0507	92.00
1	17.5	30.2	18.5	62.94	11.4	11.40	3.38	0.0370	84.96
2	15.5	28.2	16.5	58.77	11.95	5.98	2.44	0.0268	79.34
4	13	25.7	14	53.56	12.6	3.15	1.77	0.0194	72.30
8	12	24.7	13	51.47	12.9	1.61	1.27	0.0139	69.49
15	10	22.7	11	47.31	13.4	0.89	0.95	0.0103	63.86
30	8	20.7	9	43.14	13.9	0.46	0.68	0.0075	58.24
60	6.5	19.2	7.5	40.01	14.3	0.24	0.49	0.0053	54.02
120	5	17.7	6	36.89	14.7	0.12	0.35	0.0038	49.80
240	4	16.7	5	34.80	15	0.06	0.25	0.0027	46.98
480	3	15.7	4	32.72	15.2	0.03	0.18	0.0019	44.17
960	2	14.7	3	30.63	15.5	0.02	0.13	0.0014	41.36
1920	0	12.7	1	26.47	16	0.01	0.09	0.0010	35.73

Rc= Ra- Zero correction + CT

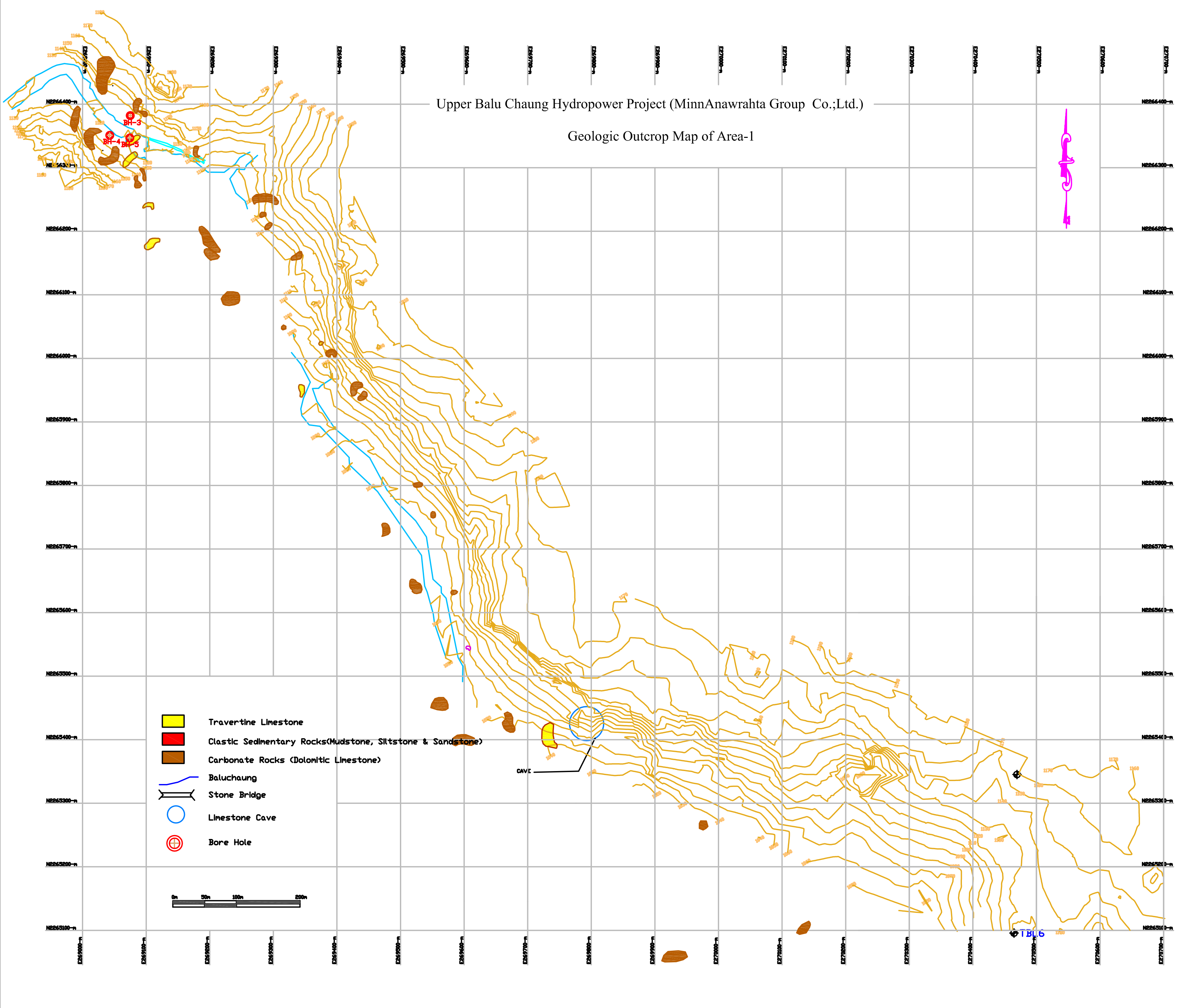
R = Ra + Meniscus correction

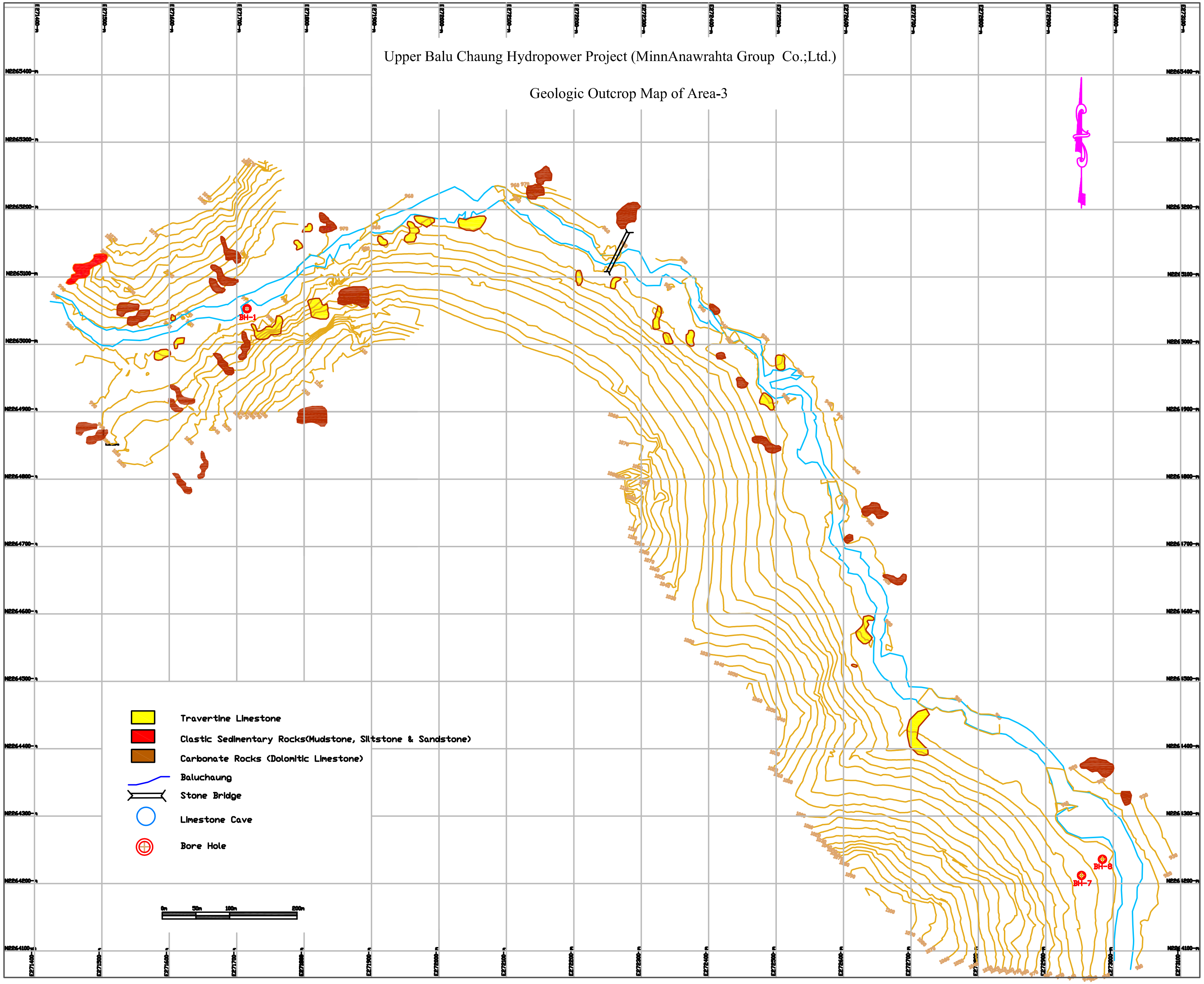
% Finer = Rc (a) / Ws

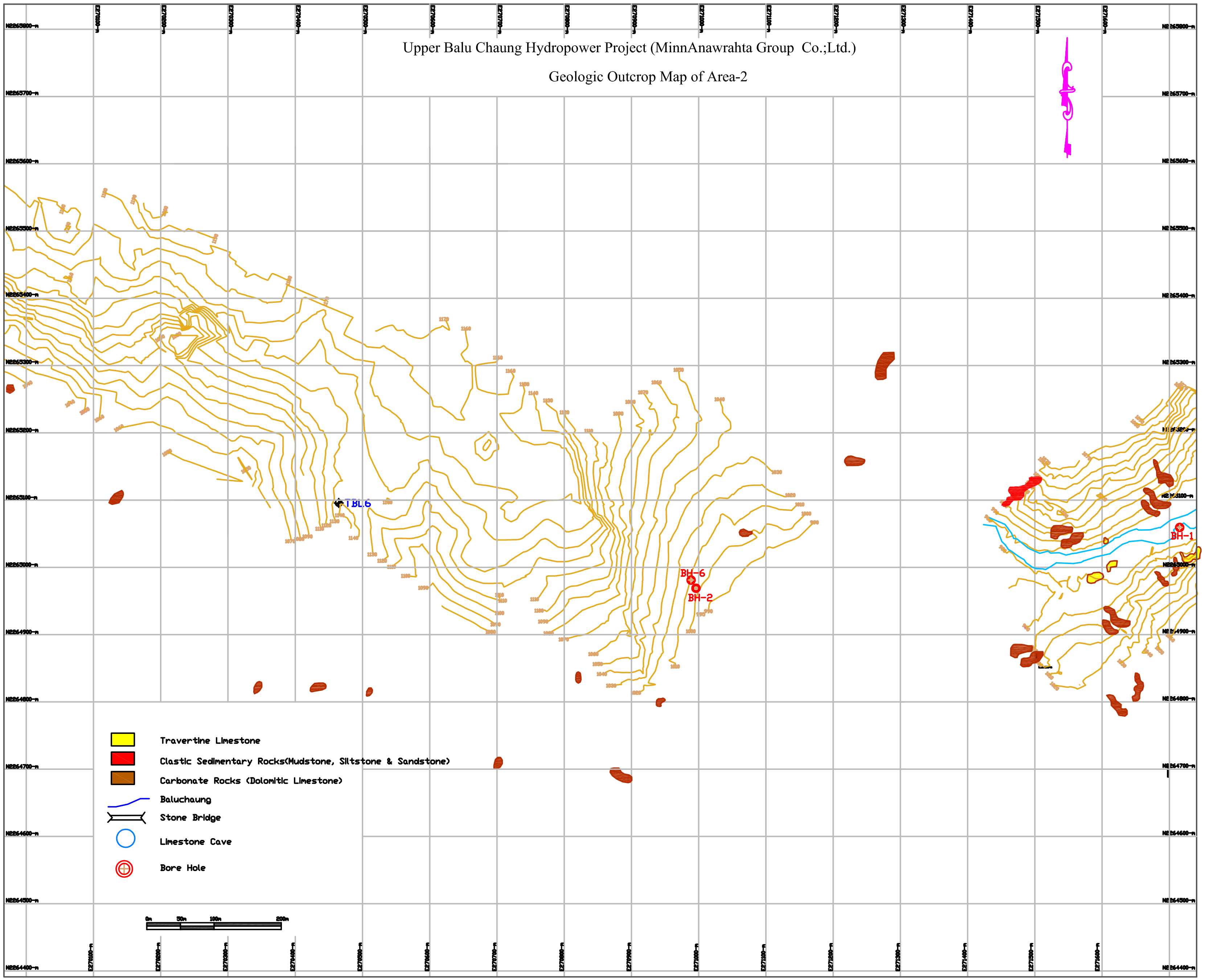
Diameter D = K √L/t


Grain size distribution graph
Test pit no - 2, Elevation - 1138 m
Gravel
Coarse sand
Medium sand
Fine sand
Silt
Clay
Gravel = 0 %
Coarse sand = 0.5 %
Medium sand = 0.5 %
Fine sand = 5.5 %
Silt = 49 %
Clay = 44.5 %
Sample = Silt and clay
100
90
80
70
60
50
40
30
20
10
0
10
1
0.1
0.01
0.001
Sieve opening (mm)
Percent finer (%)

Appendix - C Geologic Outcrop Map


Upper Balu Chaung Hydropower Project (MinnAnawrahta Group Co.;Ltd.)
Geologic Outcrop Map of Area-1
Travertine Limestone
Clastic Sedimentary Rocks(Mudstone, Siltstone & Sandstone)
Carbonate Rocks (Dolomitic Limestone)
Baluchaung
Stone Bridge
Limestone Cave
Bore Hole
BH-3
BH-4
BH-5
CAVE
TBL6
0m
50m
100m
200m


Upper Balu Chaung Hydropower Project (MinnAnawrahta Group Co.;Ltd.)
Geologic Outcrop Map of Area-3
Travertine Limestone
Clastic Sedimentary Rocks(Mudstone, Siltstone & Sandstone)
Carbonate Rocks (Dolomitic Limestone)
Baluchaung
Stone Bridge
Limestone Cave
Bore Hole
BH-1
BH-7
BH-8


Upper Balu Chaung Hydropower Project (MinnAnawrahta Group Co.;Ltd.)
Geologic Outcrop Map of Area-2
TBL6
BH-6
BH-2
BH-1
Travertine Limestone
Clastic Sedimentary Rocks(Mudstone, Siltstone & Sandstone)
Carbonate Rocks (Dolomitic Limestone)
Baluchaung
Stone Bridge
Limestone Cave
Bore Hole

SUNTAC TECHNOLOGIES

GEOLOGICAL INVESTIGATION OF UPPER BALU CHAUNG HYDROPOWER PROJECT

May, 2010

Suntac Geo-engineering Services

Room (5,7) / Bidg (5), MIT Park, Hlaing Universities Campus,Hlaing P.O (11052), Yangon, Myanmar.
Tel : +951 – 652245, 652287, 652310, 652312,
Fax: +951-652287
E-mail : suntac.group@suntac.com.mm

CONTENT

Table of Contents Page

FIGURE

REPORT ON GEOLOGICAL INVESTIGATION OF UPPER BALU CHAUNG HYDROPOWER PROJECT

1. Introduction

This report was prepared to describe the geology of the Upper Balu Chaung Hydropower Project area. The investigated area includes the eastern and western banks of the upper Balu Chaung located between Pat Tu Bauk village, Kalaw Township, Sein Thaung village, Pin Laung Township, and Min Lon village, Shwe Nyaung Township, with the length of 10 km and the width of about 4 km. The catchment area of the dam that is in project is investigated in April 2010.

2. Methodology

The purposes of this investigation emphasized on geology of this area. The field investigation and petrological studies are carried out for upper Balu chaung catchment area.

3. Geology

3.1 Geological Succession

By the petrological study, three main formations are exposed in this area as Upper Plateau Limestone, Lower Plateau Limestone and Namhsim Formation (Fig.1).

Geological succession	Age
Alluvial	Quaternary
Upper Plateau Limestone	Permian - Triassic
Lower Plateau Limestone	Carboniferous
Namhsim Formation	Silurian

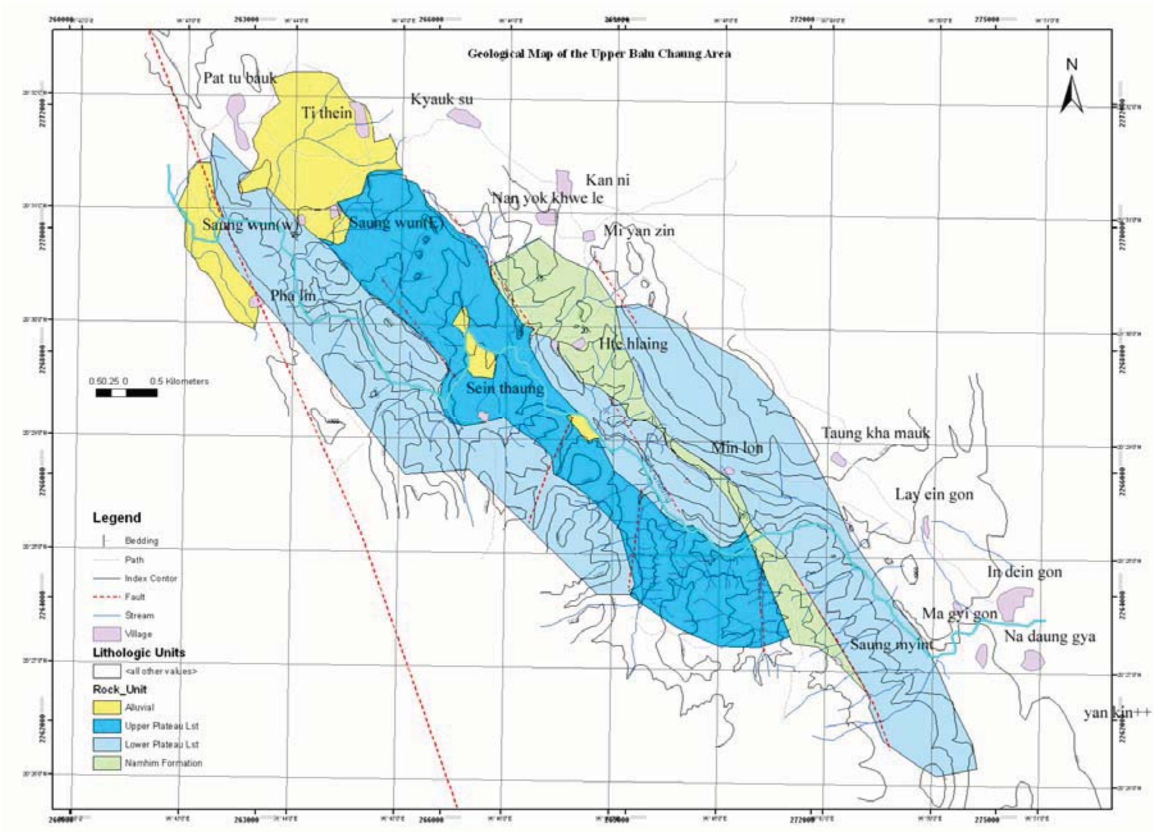


Figure 1. Geological Map of the Project area

3.1.1 Namhsim Formation

Distribution

This formation occupies the central part of the project area, from north of Hte Hlaing to south of Min Lon (Upper). The good exposures can be seen in the stream located in NE of Hte Hlaing village, N of Min Lon (Upper) village and E of Min Lon (Lower) village.

Lithology

This Formation is composed of white to yellow colored, fine to medium-grained sandstone (Fig.2), buff colored siltstone (Fig.3) and thin-layered shale (Fig.4). The whole sequence shows the clastic nature. Sandstone are well sorted, sometimes very coarse-grained, some are poorly cemented. They are also thin to thick bedded, varying from 2 inches to 1 ft. This Formation mostly dips in SSW with dip amount of 20˚ - 30˚.

Fig.2 Cross laminated sandstone

Fig.3 Buff color siltstone

Fig.4 Thin bedded shale and sandstone

3.1.2 Lower Plateau Limestone

Distribution

This formation is well cropped out in the western and eastern parts of this project area. This unit mostly occurs as massive and karst topography can be found because of differential weathering and cut by fault scarp (Fig.5). This formation conformably overlies on Namhsim Formation. It can be correlated with Thisipin Limestone Formation (Northern Shan State).

Lithology

This unit consists of carbonate rocks and some are strained by buff to cheery colored silt. This unit is partially dolomitized. The carbonate rocks are pale to dark grey in color and massive in nature. Different facies can be found as thin bedded, partly laminated, pale grey colored limestone (Fig.6), light grey and fine-grained dolomitic calcarenites (Fig.7), dark grey micritic limestone(Fig.8), and brecciated limestone with angular limestone fragment (Fig.9). Solution channel as sinkholes are also found in this unit, especially at the locality, (both sides of Balu Chaung) where it is favorable by cross cut of joint sets or conjugated faults (Fig.10).

Fig.5 Karst topography in Lower Plateau Lst

Fig.6 Thin bedded laminated Lst

Fig.7 Dolomitic calcarenites

Fig.8 Brecciated Lst

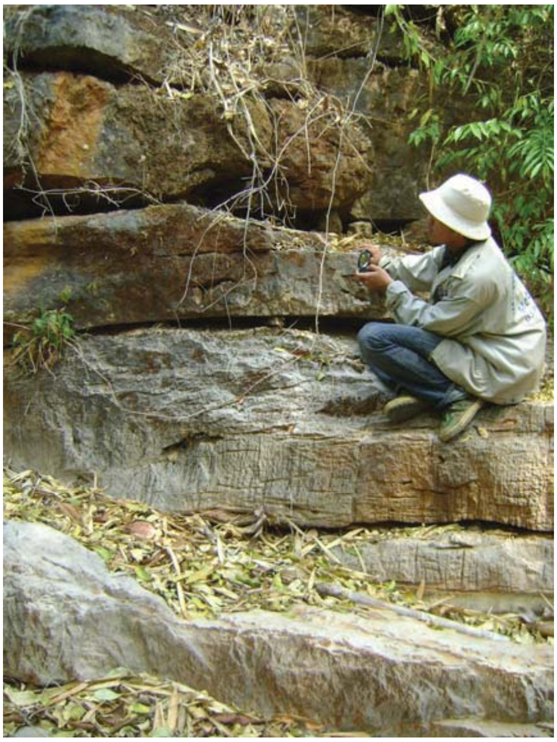


Fig.9 Dark grey micritic Lst

Fig.10 Solution channel, near Pat Tu bauk

3.1.3 Upper Plateau Limestone

Distribution

This formation is exposed in the middle part of the study area, especially in the East of Saung Wun (E) and Saung Wun (W) villages, and West of Min Lon (Upper) village. In some places, limestone exposures are covered by terra rossa soil. In certain localities, this formation forms rolling hill because of its highly jointed nature. This formation is correlated with Nwabangyi Limestone Formation (Northern Shan State).

Lithology:

This unit also consists of carbonate rocks, and in places where no dolomitization occur the reddish brown terra rossa soil are present (Fig.11). The surfaces of this formation are very irregular, lacking surfaces drainage because swallow-hole are common. Where it has dolomitized, it forms a gently rolling landscape of open glass land (Fig.12). It is lithographic fine-grained and especially light grey to pale yellow colour, mostly massive nature (Fig.13). If it is dolomitized, the soil cover is thin and dark brown to black colored, and criss-cross joint is formed (Fig.14).

Fig.11 The reddish brown terra rossa soil

Fig.12 Rolling landscape and scarcity of vegetation in dolomitic Lst

Fig.13 Nature of Upper Plateau Lst

Fig.14 Highly brecciated Lst

3.2 Geological Structures

3.2.1 Faults

Regionally, the project area is located between the right-lateral Sagaing Fault in the West and Kyaukkyan Fault system in the east, both of which run NS and nearly NS directions. Although the Sagaing Fault is a little bit far (above 70km) from present area, Kyaukkyan Fault is very close to this area. Moreover, 8.2M earthquake happened in 1912 was originated from Kyaukkyan Fault (Fig.15). Therefore, it is needed to consider the seismic hazards that can affect to the project area.

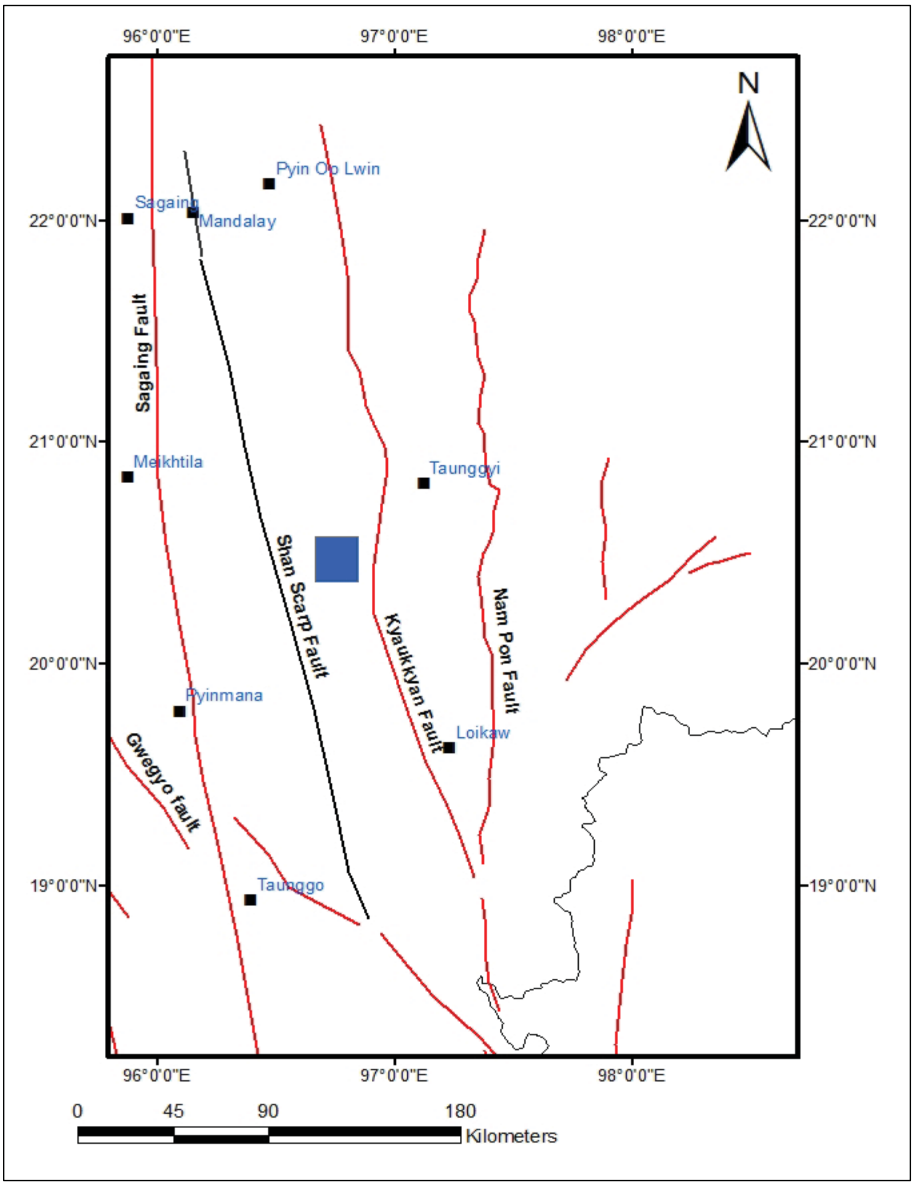


Fig.15 Regional structural setting of the Project area (The blue colored rectangle represents the project area)

Locally, normal faults and strike-slip faults are observed in this area. Most of the normal faults run in NW-SE direction while the other fault systems strike in nearly N-S direction. A few minor faults are also found, running E-W direction and the conjugated fault were formed dilational job by affected of Kyaukkyan fault. The another fault systems are strike-slip faults and these faults are occurred as the minor faults, especially between major normal fault systems, in the West of Hte Haling village and in the South and East of Sein Thaung village. They are believed to result from the different phases of movement of the two parallel normal fault systems.

4. Conclusion and Recommendation

The geological investigation and petrological studying on this area is about 10km along upper Balu chaung. There are three formations exposed. Alluvial deposits were found as flood plane deposits and gravely sand. The flood plane deposits can be used as burrow soil, the gravely sand can be seen as usefully on its size and deposits nature but it is strongly recommended that it cannot be used as construction material for dam site because of the composition of limestone gravel and sand. The massive Lower Plateau Limestone is mostly exposed along the east and west banks of upper Balu chaung. Within this formation, solution channels as sinkholes or springs were formed by effect of favorable joint sets or fault. Upper Plateau Limestone is exposed in the middle parts of this area, the criss-cross jointed limestone can be used as the construction materials for temporary building. Namhsim Formation is exposed in Minlon village, composed of clastic sedimentary rocks as siltstone, sandstone. Based on fault and lineaments, the dam site construction need to be considering on seismicity of local area, it is lied closely near by active Kyaukkyan fault system.

Upper Balu Chaung Hydropower Drill And Test Pit Location Data

Pt.No	Easting	Northing	Elevation	Remark
1	271710.6885	2265065.5001	973.5845	BH-1
2	270911.0147	2264985.1696	1052.9435	Test Pit-1
3	270985.0268	2264971.7556	1005.3296	BH-6
4	270996.0201	2264967.9645	1001.9447	BH-2
5	269045.1873	2266337.7028	1126.2252	BH-4
6	269072.7417	2266347.6211	1121.6481	BH-5
7	269077.0034	2266378.8239	1126.0900	BH-3
8	269064.1599	2266411.0206	1133.7941	BH-9
9	269014.8990	2266347.5004	1136.5048	BH-10
10	271724.2242	2265036.6430	975.1695	BH-12
11	271691.1221	2265098.4974	980.4831	BH-11
12	272935.7308	2264188.1754	931.2284	Test Pit-2
13	272950.8546	2264208.8994	925.3167	BH-7
14	272988.0567	2264225.6705	913.5360	BH-8
1	270864.2472	2264999.2262	1104.9091	STN-05D
2	270826.2859	2265049.6858	1136.0886	STN-05E
3	271619.8272	2265018.0894	977.9525	STN-07A
4	271668.7134	2265012.4412	982.4540	STN-07B
5	272974.9299	2264225.9652	918.0562	STN-0705
6	272974.9051	2264195.6125	920.8295	STN-0706

Test Pit PT-02

Location : UB-2 Penstock

Survey Point : X = 272935.721

Y= 2264118.132

Dimension : Length=1.5 m, Width= 1m

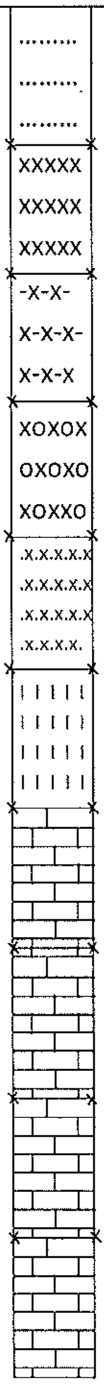
Reduced Level :

Depth : 4 m

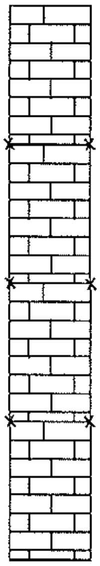
Period : 2.5.2010 to 5.5.2010

Field Geological Description

Surface



Depth (m)	Description
0 – 0.2	Dark brownish grey organic soil with wood fragments
0.2 – 0.5	Fine grained reddish brown silty soil with lime fragments
0.5 -1.0	Fine grained yellowish brown silty clay with Lime fragments
1.0 – 1.4	Fine grained yellowish brown silty clay
1.4 – 1.6	Fine grained brownish grey residual soil with lime fragments
1.6 – 2.0	Fine grained brownish grey residual soil with lime fragments
2.0 – 2.2	Completely weathered residual soil with rock fragments
2.2 – 2.5	Completely weathered reddish brown residual soil
2.5 – 2.7	Completely weathered reddish brown residual soil
2.7 – 2.8	Moderately weathered reddish brown Limestone with cracks and fill with calcite and soil



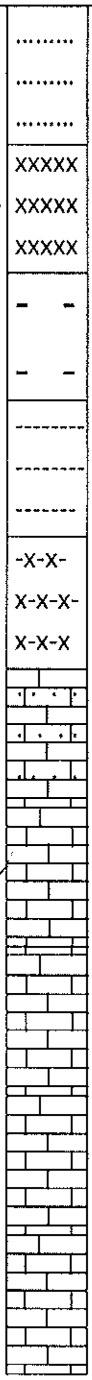
2.8 – 3.0	Very strong fresh surface Limestone bedrock condition
3.0 -3.5	Slightly weathered fresh Limestone with little cracks
3.5 – 3.8	Strong fresh surface Limestone with no crack
3.8 – 4.0	Very strong fresh surface Limestone bedrock condition

Test Pit PT-01

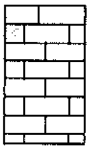
Location	:	UB-1 Penstock
Survey	:	X = 270,910.954
		Y= 2264, 985.207
Dimension	:	Length=1.5 m, Width= 1m
Reduced Level	:	
Depth	:	5 m
Period	:	30.4.2010 to 1.5.2010

Field Geological Description

Surface



Depth (m)	Description
0 – 0.2	Dark brownish grey organic (humus) soil
0.2 – 0.5	Fine grained brown sitty soil
0.5 -1.0	Fine grained yellowish brown silty clay
1.0 - 2.0	Fine grained reddish brown silty clay with rock fragments
2.0 – 2.5	Reddish brown residual soil with high clay content
2.5 – 3.0	Completely weathered clayey soil with Limestone rock fragments.
3.0 – 3.5	Moderately weathered reddish brown Limestone
3.5 – 4.0	Slightly weathered brown Limestone
4.0 – 4.2	Strong fresh surface Limestone with little cracks and fill with calcite small veins
4.2 – 4.6	Very strong fresh surface Limestone with no cracks

4.6 – 5.0  Very strong fresh surface Limestone bedrock condition

Test Pit PT-01

Location : UB-1 Penstock

Survey point : X = 270,910.954

Y = 2264,985.207

Dimension : Length = 1.5 m, Width = 1 m

Reduced Level :

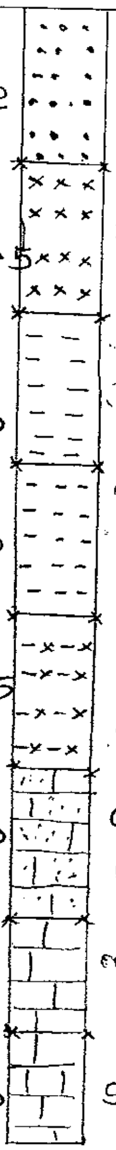
Depth : 5m

Period : 30.4.2010 to 1.5.2010

Field Geological Description

N

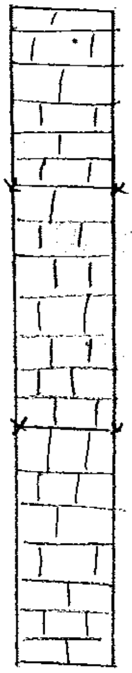
Surface



Depth (m)	Description
0-0.2	Dark brownish grey organic (humus) soil
0.2-0.5	fine grained brown silty soil
0.5-1.0	fine grained yellowish brown silty clay
1.0-2.0	fine grained reddish brown silty clay with rock fragments
2.0-2.5	reddish brown residual soil with high clay content
2.5-3.0	completely weathered clayey soil with limestone rock fragments.
3.0-3.5	moderately weathered reddish brown limestone
3.5-4.0	slightly weathered brown limestone

Not to Scale

Depth (m)



4.0 - 4.2 strong fresh surface limestone with little cracks and fill with calcite small veins

4.2 - 4.6 very strong fresh surface limestone with no cracks

4.6 - 5.0 very strong fresh surface limestone bedrock condition

လေးစားစွာဖြင့်,

3.5.2010

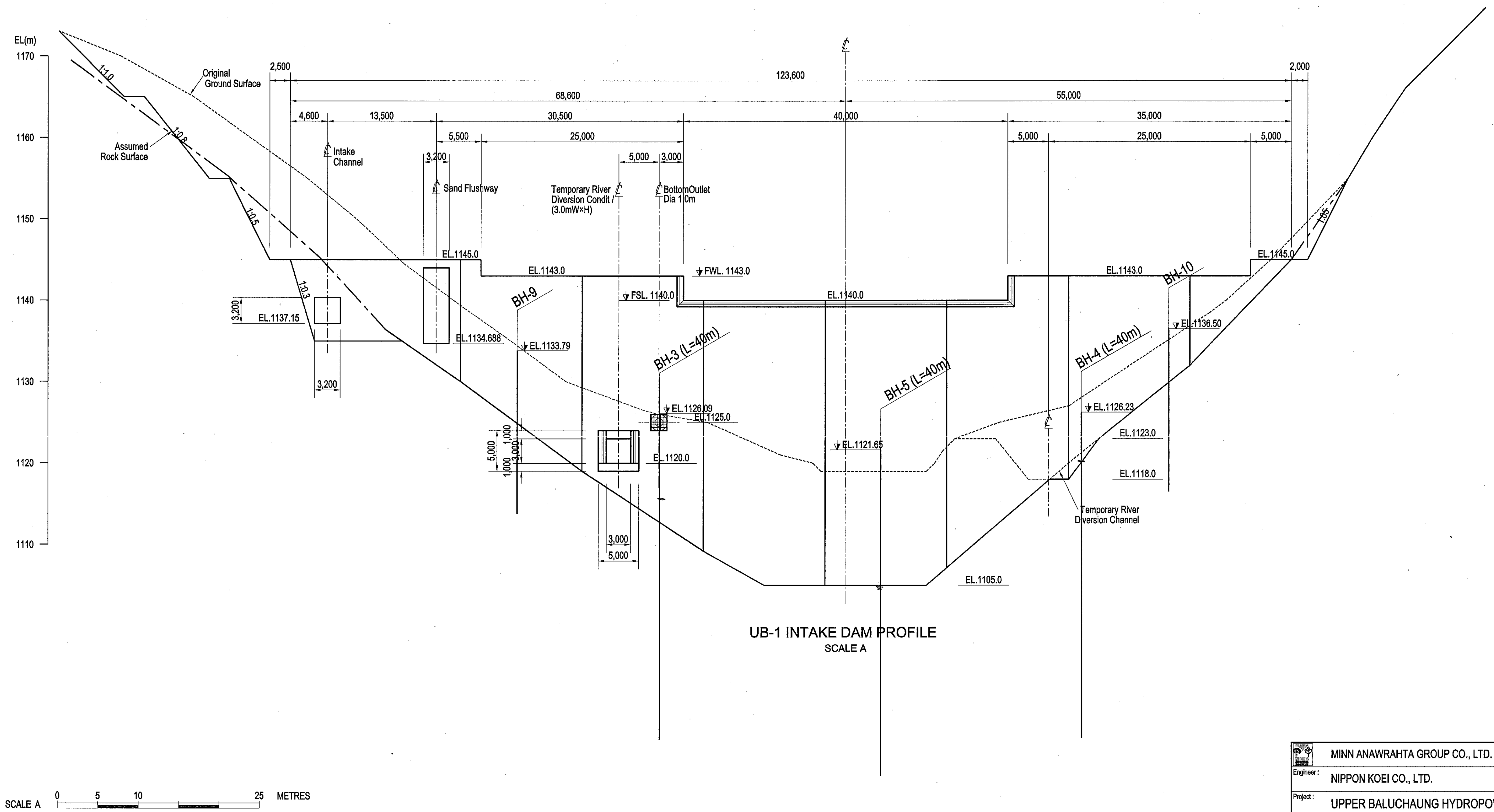
Htun Zaw (E.E)

INTAKE DAM PLAN

SCALE A

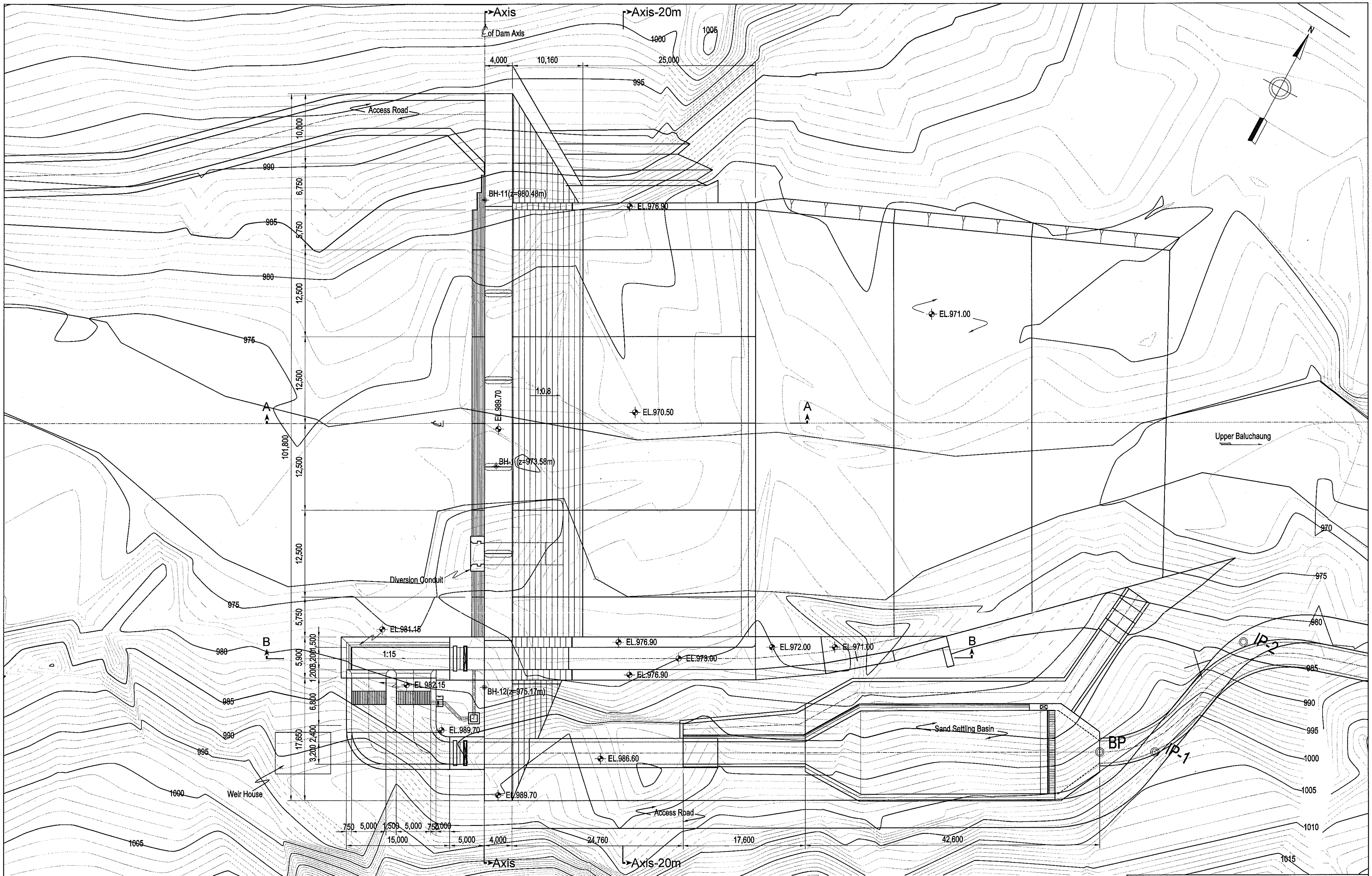
SCALE A 0 10 20 50 METRES

	MINN ANAWRAHTA GROUP CO., LTD.	
Engineer :	NIPPON KOEI CO., LTD.	Dwg No. : UB-05
Project :	UPPER BALUCHAUNG HYDROPOWER PROJECT	
Title :	UB-1 INTAKE DAM PLAN	



UB-1 INTAKE DAM PROFILE
SCALE A

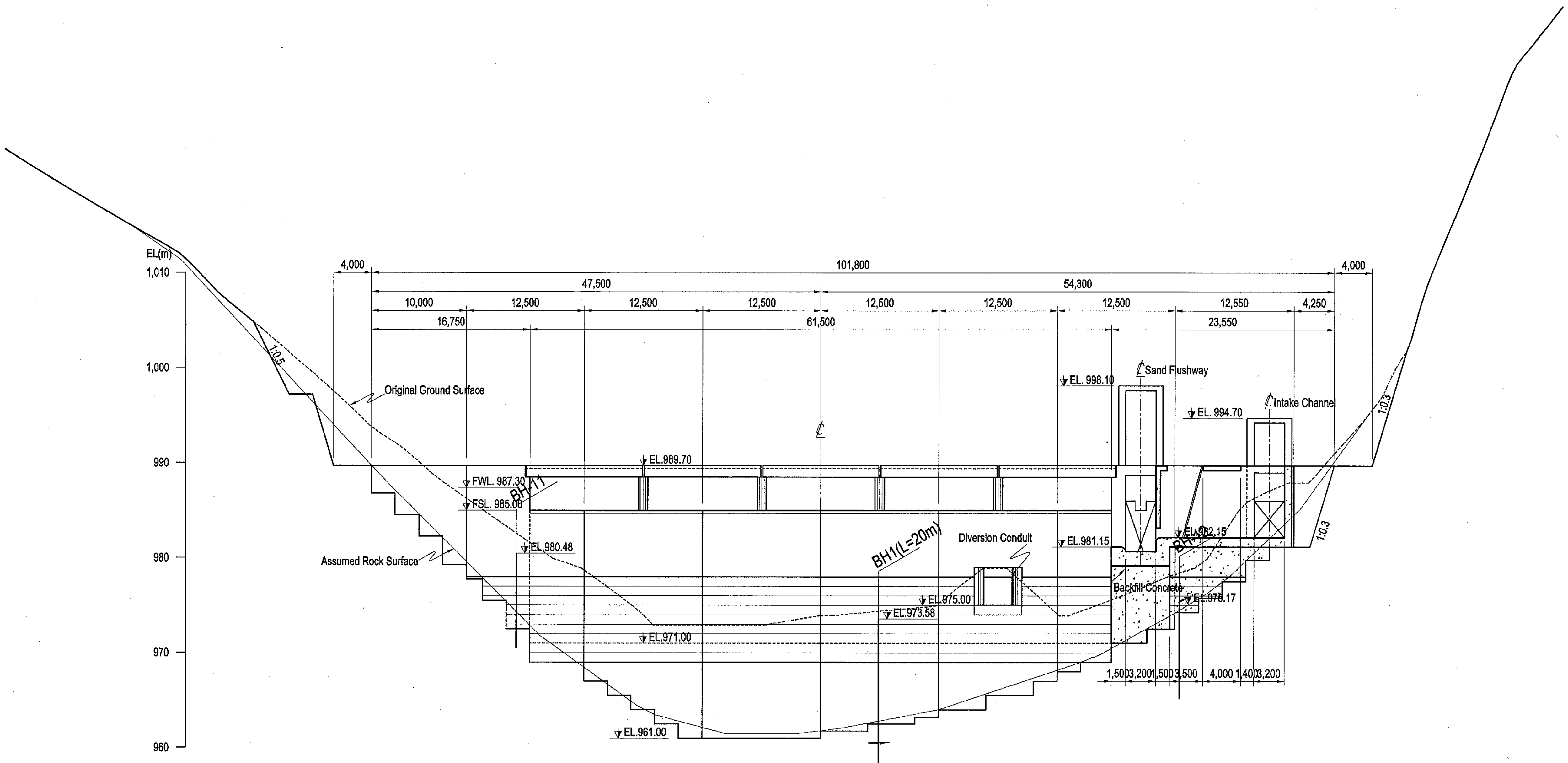
MINN ANAWRAHTA GROUP CO., LTD.	
Engineer: NIPPON KOEI CO., LTD.	Dwg No.: UB-06
Project: UPPER BALUCHAUNG HYDROPOWER PROJECT	
Title: UB-1 INTAKE DAM PROFILE	



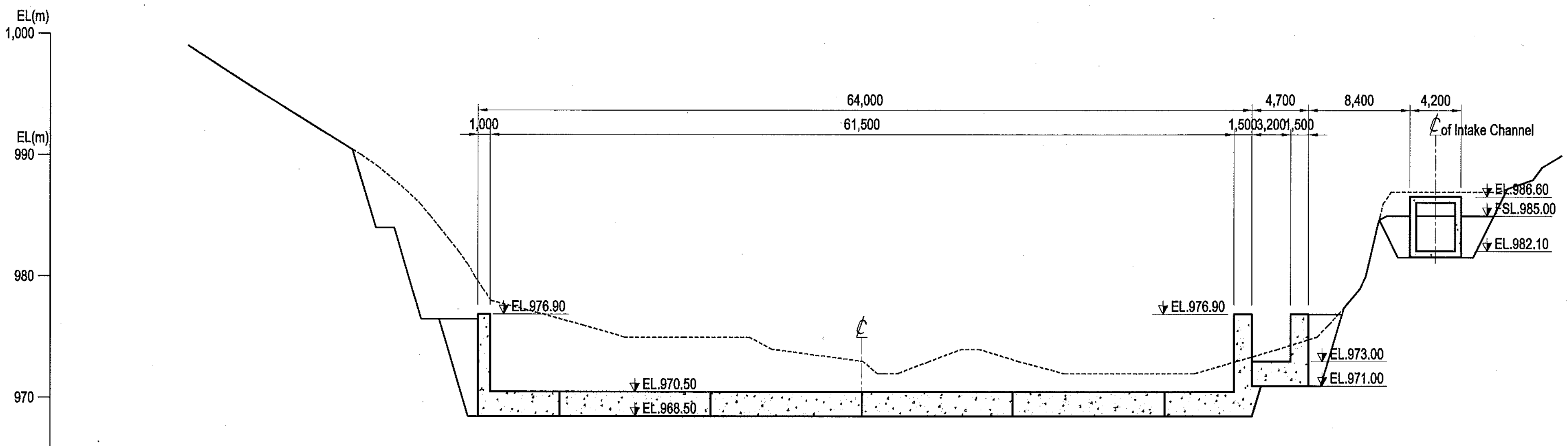
INTAKE WEIR PLAN
SCALE A

SCALE A 0 5 10 25 METRES

MINN ANAWRAHTA GROUP CO., LTD.	
Engineer: NIPPON KOEI CO., LTD.	Dwg No.: UB-34
Project: UPPER BALUCHAUNG HYDROPOWER PROJECT	
Title: UB-2 INTAKE WEIR PLAN	



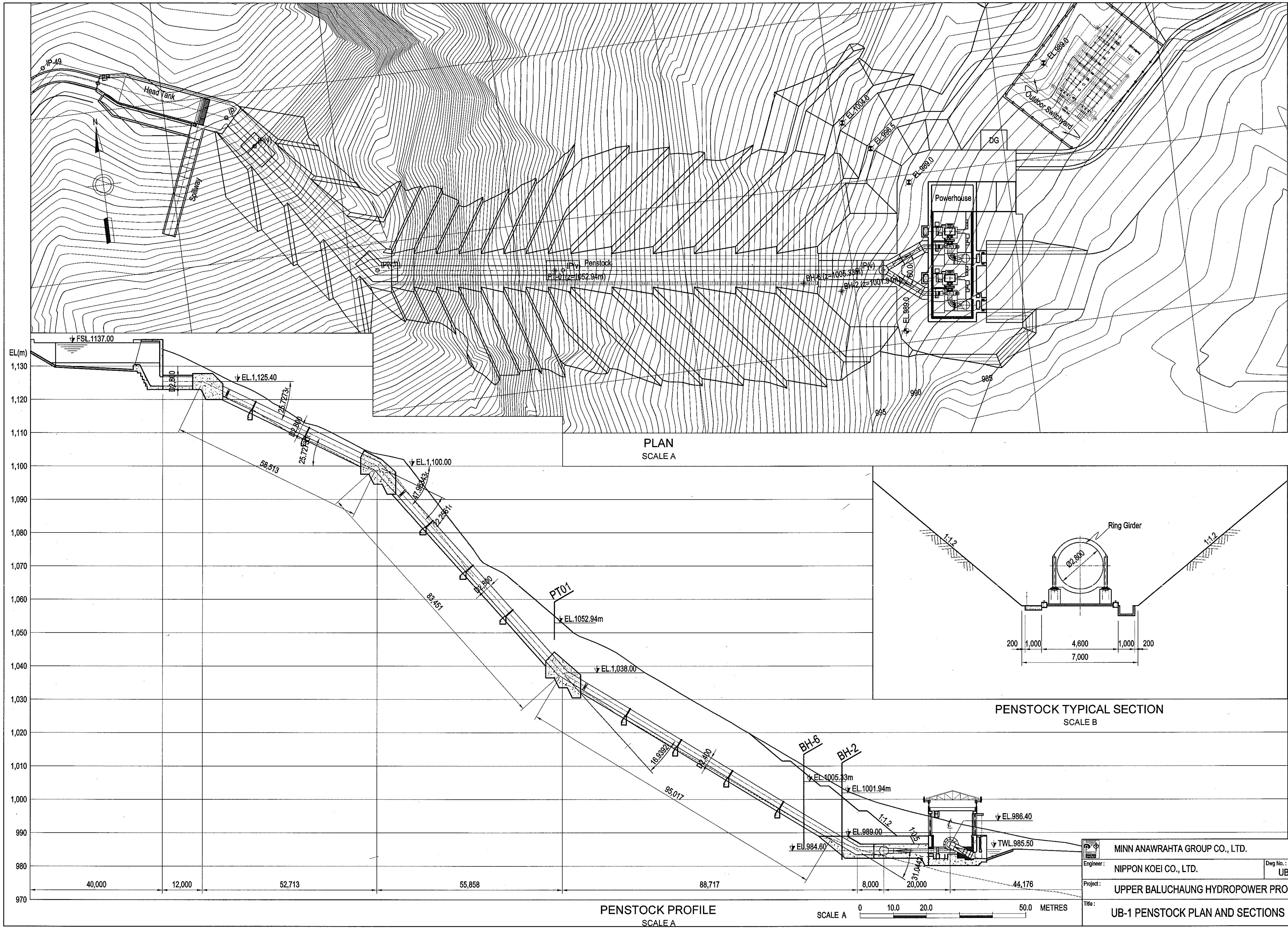
UB-2 WEIR FRONT VEIW
SCALE A



20m D/S from Weir Axis
SCALE A

SCALE A 0 5 10 25 METRES

	MINN ANAWRAHTA GROUP CO., LTD.
Engineer :	NIPPON KOEI CO., LTD. — Dwg No. : UB-36
Project :	UPPER BALUCHAUNG HYDROPOWER PROJECT
Title :	UB-2 INTAKE WEIR SECTIONS (2)



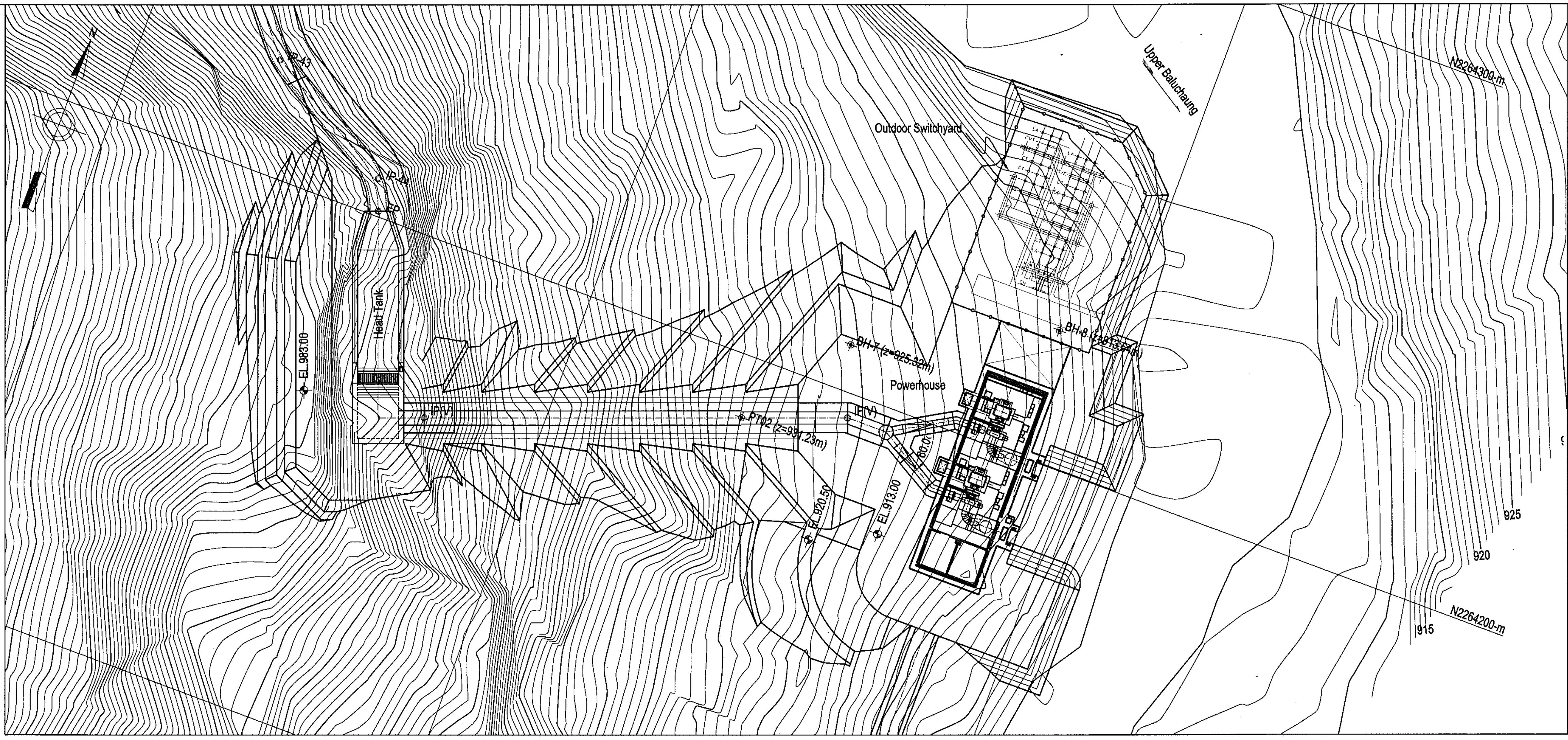
MINN ANAWRAHTA GROUP CO., LTD.

Engineer: NIPPON KOEI CO., LTD.

Dwg No.: UB-28

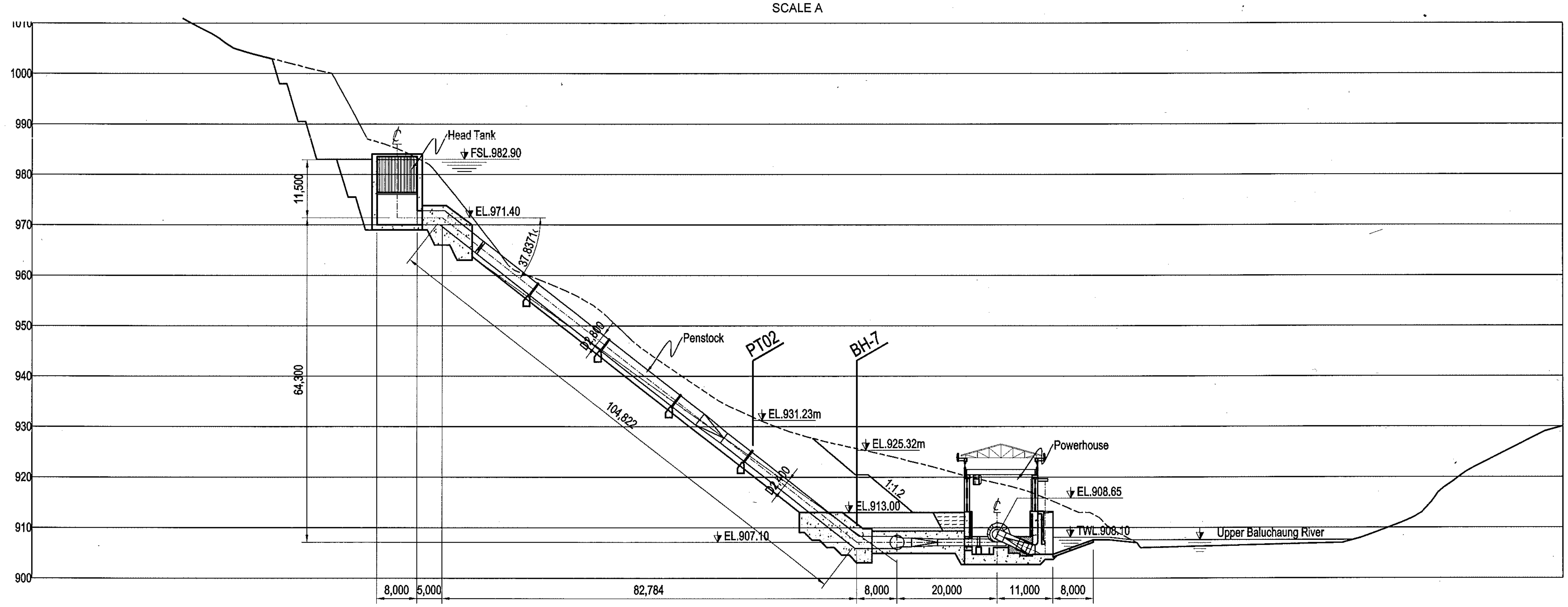
Project: UPPER BALUCHAUNG HYDROPOWER PROJECT

Title: UB-1 PENSTOCK PLAN AND SECTIONS



PENSTOCK PLAN

SCALE A



PENSTOCK PROFILE

SCALE A

SCALE A 0 10 20 50 METRES

	MINN ANAWRAHTA GROUP CO., LTD.
Engineer:	NIPPON KOEI CO., LTD. Dwg No.: UB-47
Project:	UPPER BALUCHAUNG HYDROPOWER PROJECT
Title:	UB-2 PENSTOCK PLAN AND PROFILE

CONSTRUCTION MATERIAL TESTLABORATORY
(SOIL)

ITC

IRRIGATION TECHNOLOGY CENTER, BAGO
IRRIGATION DEPARTMENT

SUMMARY SOIL TEST RESULT

Project: အထက်ဘီလူးချောင်း စီမံကိန်း (Upper Balu Chaung Hydropower Project)

Job.No ... 13/ 2010
Date ... 3.5.2010

SR. NO.	LOCATION & FIELD DESCRIPTION	GRAIN SIZE DISTRIBUTION				ATTERBERG'S LIMIT			SP:GR	STANDARD PROCTOR COMPACTION Corrected w% & ρ_d		TRIAXIAL COMPRESSION		DIRECT SHEAR		PERMEABILITY	SOIL TYPE	CRUMB TEST
	Minn Lone SOIL	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	LL (%)	PL (%)	PI (%)		O.M.C (%)	M.D.D pcf	C kgf/cm²	φ Degree	C kgf/cm²	φ Degree	K cm/sec		Grade
1.	မင်းလုံး (Borrow)	19.50	54.00	26.50	-	57.40	26.07	31.33	2.69	23.85	96.35	-	-	0.59	20°33'	-	CH	-
2.	Thandaung သန်းတောင် မြေစေး Borrow	12.00	70.00	18.00	-	34.40	20.06	14.34	2.68	17.40	108.20	-	-	0.47	22°37'	-	CL	-
	Minn Lone SAND	Silt & Clay (%)	Fine Sand (%)	Coarse Sand (%)	Gravel (%)	Cu	Cc	-	-	-	-	-	-	-	-	-	SOIL TYPE	-
1.	မင်းလုံး (Borrow)	10.00	24.00	45.00	21.00	14.86	1.26	-	-	-	-	-	-	-	-	-	SW	-
2.	Thandaung soil သန်းတောင် မြေစေး	0.15	14.85	50.00	35.00	5.63	1.35	-	-	-	-	-	-	-	-	-	SP	-
3.	Thandaung Sand သန်းတောင် (Mixed Sample)	2.04	9.96	31.00	57.00	13.44	0.59	-	-	-	-	-	-	-	-	-	GP	-

Attached: Grading Curve (5) N0s.

Checked By... (Than Than Oo)
Staff Officer (Lab)
Water & Soil Mechanics Laboratory
Irrigation Technology Centre Bago.

Submitted By... (ဝေအောင်မိုး)
S.S.A.E (Lab:)

CONSTRUCTION MATERIAL TEST LABORATORY (SOIL)

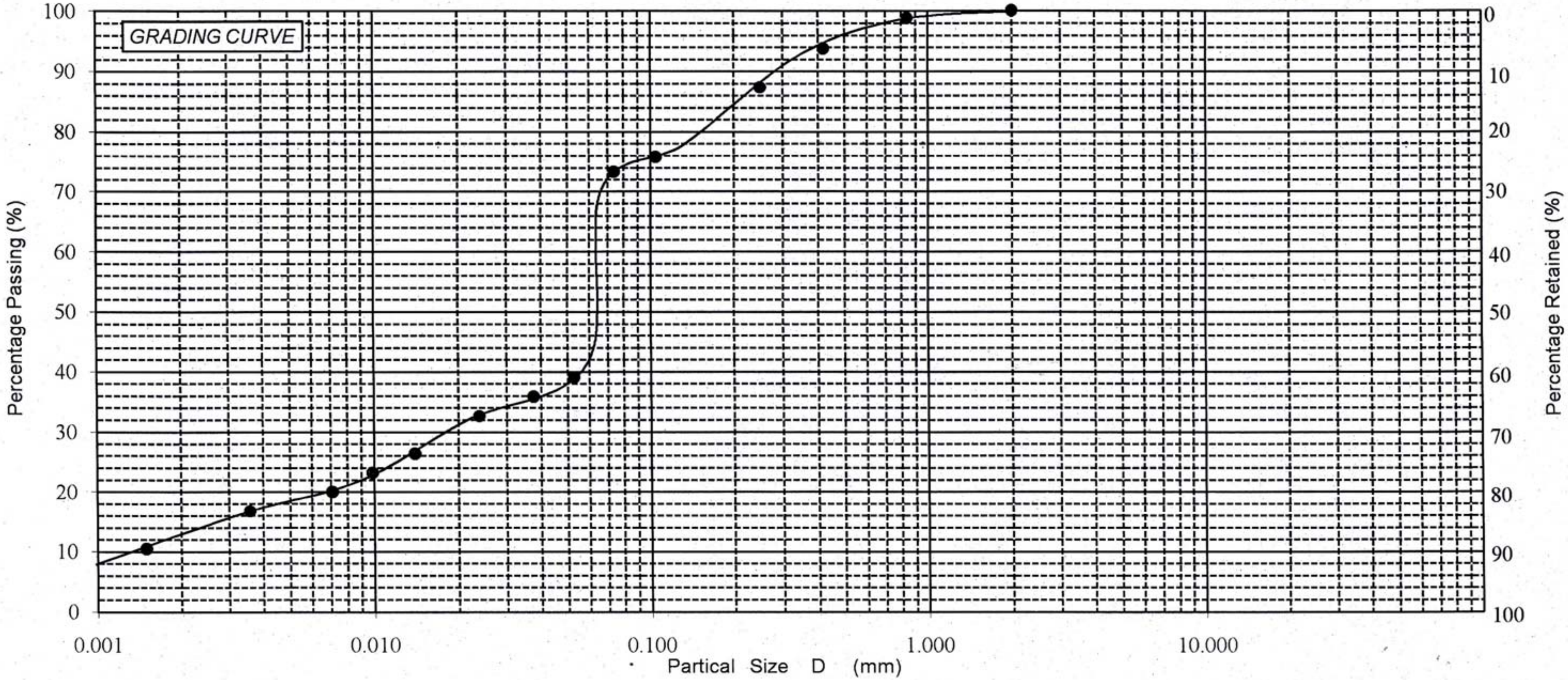
ITC
IRRIGATION TECHNOLOGY CENTER, BAGO
IRRIGATION DEPARTMENT

PARTICAL SIZE ANALYSIS TEST

TEST NO.

DATE: 28.5.2010

PROJECT: အထက်ဘီလူးချောင်း (Upper Balu chaung) LOCATION: မင်းလုံး Borrow (Soil) Minnlone



Colloids	Clay	Silt	Fine Sand	Coarsed Sand	Fine Gravel	Gravel	Cobble

0.001mm | 0.005mm | 0.074mm | 0.42mm | 2.00mm | 4.76mm | 75.0mm

Remark:s:

Clay = 19.5 % Silt = 54.0 % Sand = 26.5 %

TESTED BY :	A.M.C
CHECKED BY:	Than Than Oo, S.O (Lab.)

CONSTRUCTION MATERIAL TEST LABORATORY
(SOIL)

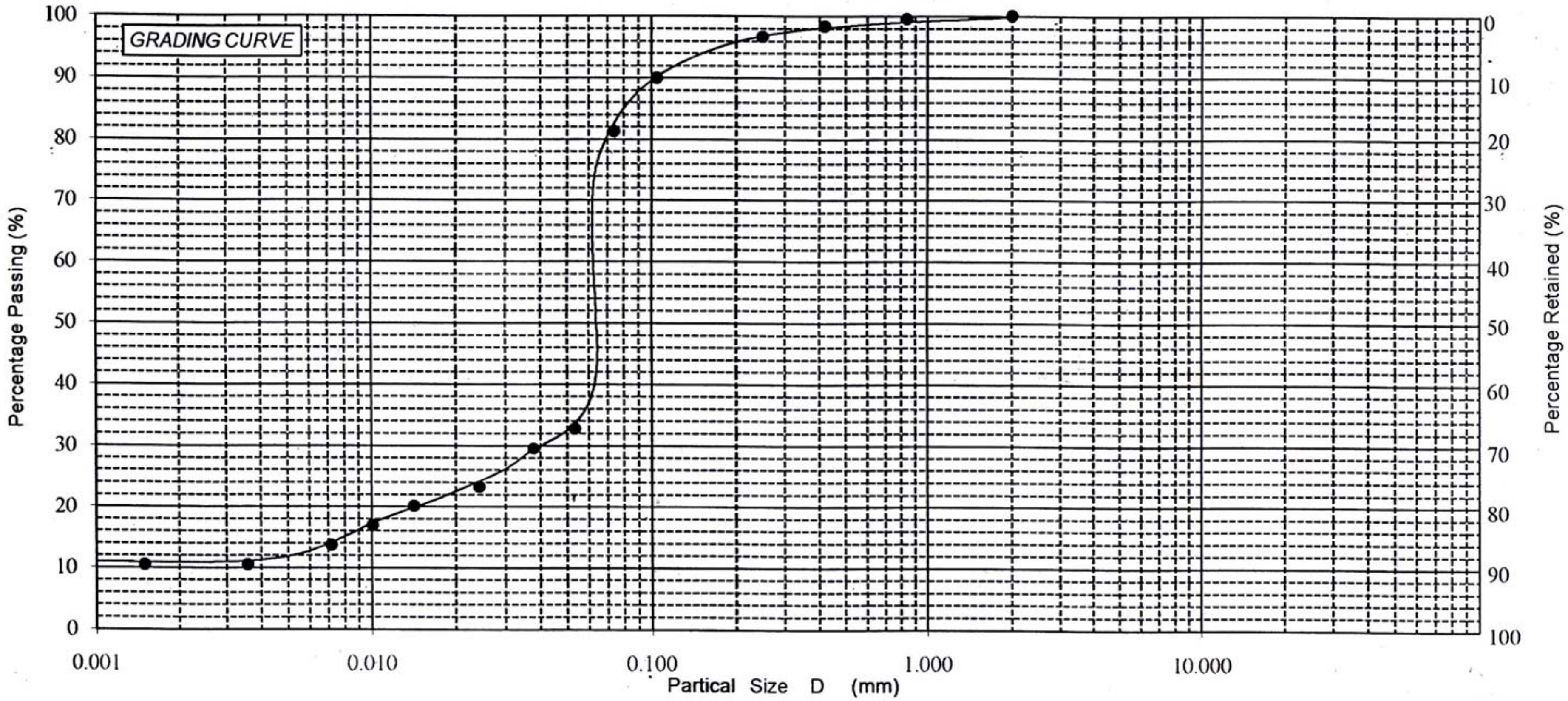
ITC

IRRIGATION TECHNOLOGY CENTER, BAGO
IRRIGATION DEPARTMENT

PARTICAL SIZE ANALYSIS TEST

TEST NO. DATE: 28.5.2010

PROJECT: အထက်ဘီလူးချောင်း Upper Baluchaung LOCATION: သန်းတောင်းမြေစေး(Soil) Thandaung



Colloids	Clay	Silt	Fine Sand	Coarsed Sand	Fine Gravel	Gravel	Cobble

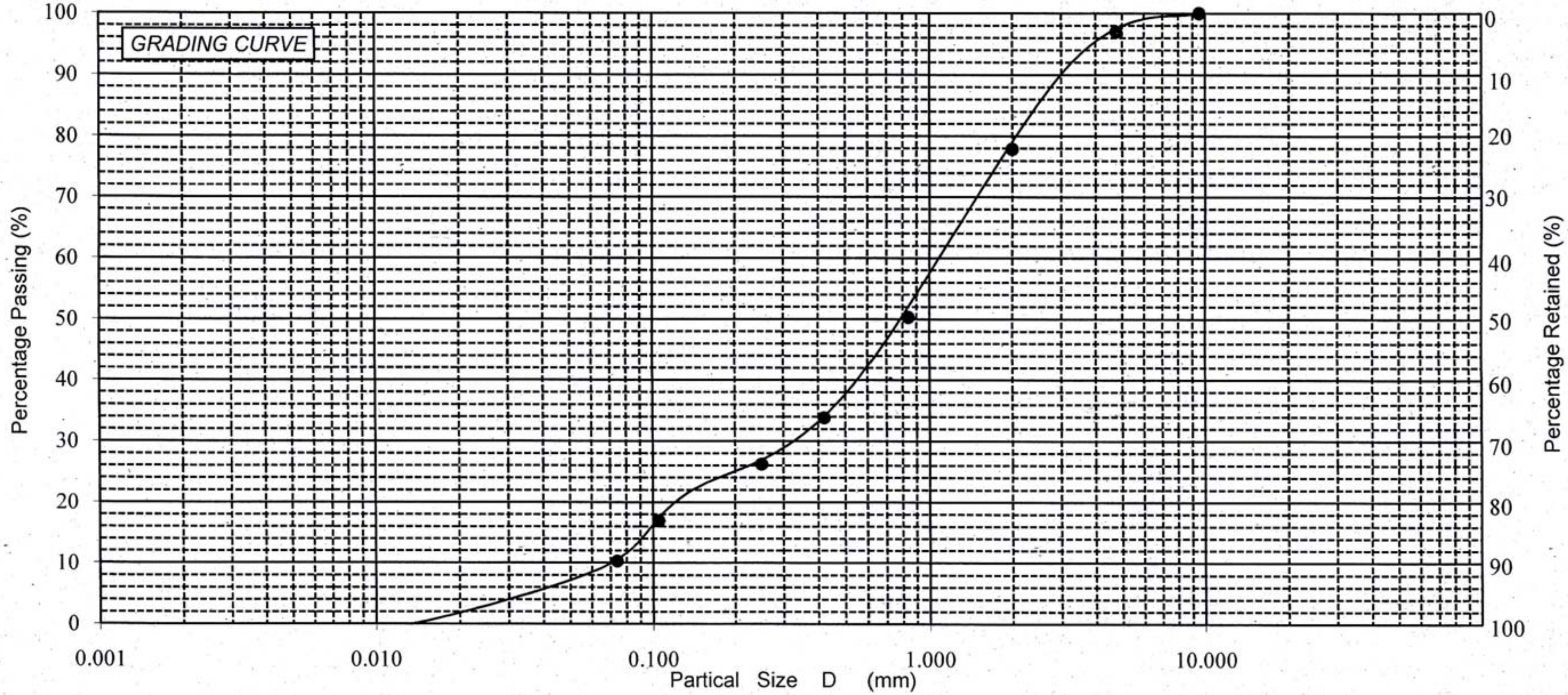
0.001mm 0.005mm 0.074mm 0.42mm 2.00mm 4.76mm 75.0mm

Remark:s:

Clay = 12.0 % Silt = 70.0 % Sand = 18.0 %

TESTED BY :	A.M.C
CHECKED BY:	Than Than Oo, S.O (Lab.)

CONSTRUCTION MATERIAL TEST LABORATORY (SOIL) **IRRIGATION TECHNOLOGY CENTER, BAGO** **IRRIGATION DEPARTMENT**	**PARTICAL SIZE ANALYSIS TEST**
	TEST NO. DATE: 28.5.10
	PROJECT: အထက်ဘီလူးချောင်း (Upper Balu Chaung) LOCATION: မင်းလုံး Borrow (Sand) Minhu lone



Colloids	Clay	Silt	Fine Sand	Coarsed Sand	Fine Gravel	Gravel	Cobble
0.001mm	0.005mm	0.074mm	0.42mm	2.00mm	4.76mm	75.0mm	

Remarks: D_{10} = 0.074mm C_u = 14.86 O.K Gravel = 21.0 %	Fine Sand = 24.0%	TESTED BY : A.M.C
D_{30} = 0.32 mm		
D_{60} = 1.10 mm C_c = 1.26 O.K Coarse Sand = 45.0%	Silt & Clay = 10.0 %	CHECKED BY: Than Than Oo, S.O (Lab)

CONSTRUCTION MATERIAL TEST LABORATORY
(SOIL)

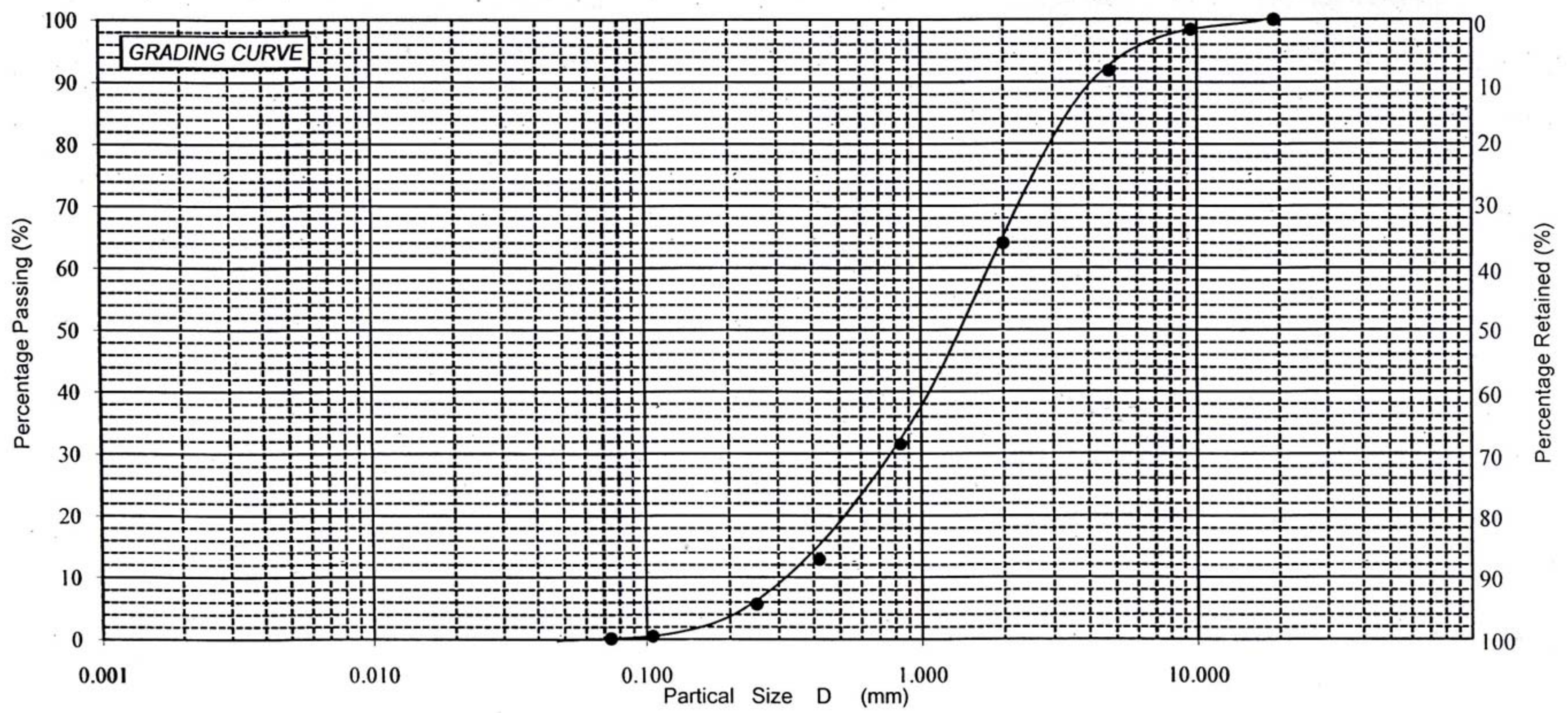
ITC

IRRIGATION TECHNOLOGY CENTER, BAGO
IRRIGATION DEPARTMENT

PARTICAL SIZE ANALYSIS TEST

TEST NO. DATE: 28.5.10

PROJECT: အထက်ဘီလူးချောင်း (Upper Balu Chaung) LOCATION: သန်းတောင်းမြေစေး (Sand) Thandaung



Colloids	Clay	Silt	Fine Sand	Coarsed Sand	Fine Gravel	Gravel	Cobble
	0.001mm	0.005mm	0.074mm	0.42mm	2.00mm	4.76mm	75.0mm

Remarks: D_{10} = 0.32 mm C_u = 5.63 Not o.k Gravel = 35.0 % Fine Sand = 14.85 %

D_{30} = 0.78 mm

D_{60} = 1.80 mm C_c = 1.35 O.K Coarse Sand = 50.0 % Silt & Clay = 0.15 %

TESTED BY : A.M.C

CHECKED BY: Than Than Oo, S.O (Lab)

CONSTRUCTION MATERIAL TEST LABORATORY
(SOIL)

ITC

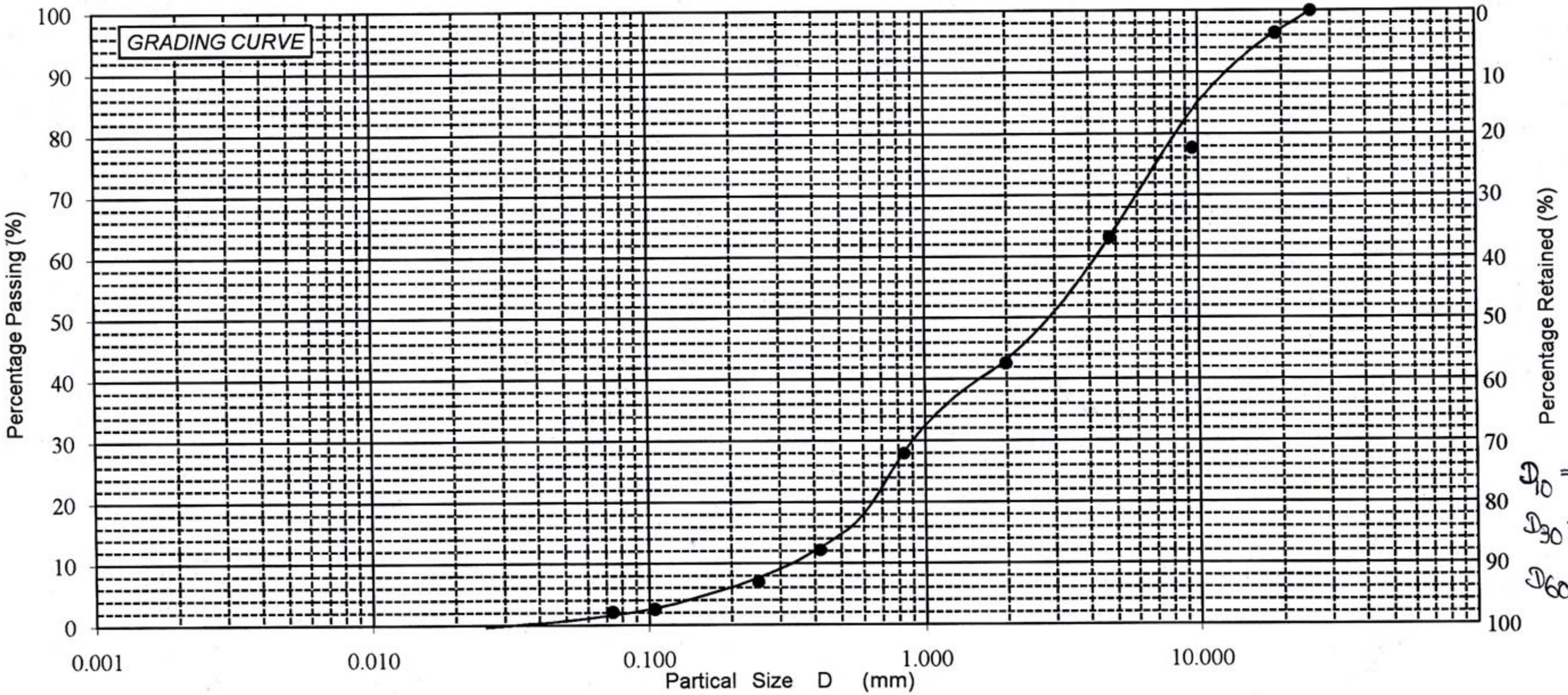
IRRIGATION TECHNOLOGY CENTER, BAGO
IRRIGATION DEPARTMENT

PARTICAL SIZE ANALYSIS TEST

TEST NO.

DATE: 9.6.10

PROJECT: အထက်ဘီးလူးချောင်း (Upper Balu chaung) LOCATION: သန်းတောင်၊ Mixed Sample (Thandaung) Sand



D_{10} = 0.32 mm

D_{30} = 0.90 mm

D_{60} = 4.30 mm

Colloids	Clay	Silt	Fine Sand	Coarsed Sand	Fine Gravel	Gravel	Cobble

0.001mm 0.005mm 0.074mm 0.42mm 2.00mm 4.76mm 75.0mm

Remarks:

Silt & Clay = 2.04 %

Fine Sand = 9.96 %

Coarse Sand = 31.0 %

Gravel = 57.0 %

C_u = 13.44

C_c = 0.59

TESTED BY : A.M.C

CHECKED BY: Than Than Oo, S.O (Lab)

Filter Criteria

Project - အထက်ဘီလူးချောင်း (Upper Balu chaung Hydrowpower Project).

Location - မင်းလုံး (Borrow) Min Lone

Sand and Soil

(Sand)

D_{15} (f) = 0.095 mm

D_{50} (f) = 0.780 mm

D_{85} (f) = 2.50 mm

(Soil)

D_{15} (b) = 0.0028 mm

D_{50} (b) = 0.065 mm

D_{85} (b) = 0.21 mm

Piping Check

$$\frac{D_{15}(f)}{D_{85}(b)} = \frac{0.095}{0.21} = 0.45 \quad (\quad < 5) \text{ ok}$$

Permeability Check

$$\frac{D_{15}(f)}{D_{15}(b)} = \frac{0.095}{0.0028} = 33.93 \quad (5 \sim 40) \text{ ok}$$

$$\frac{D_{50}(f)}{D_{50}(b)} = \frac{0.78}{0.065} = 12.00 \quad (9 \sim 30) \text{ ok}$$

Filter Criteria

Project - အထက်ဘီလူးချောင်း (Upper Balu chaung Hydropower Project).

Location - သန်းတောင်းမြေစေး (Borrow) Thandaung

Sand and Soil

(Sand)

D_{15} (f) = 0.420 mm

D_{50} (f) = 1.400 mm

D_{85} (f) = 3.40 mm

(Soil)

D_{15} (b) = 0.008 mm

D_{50} (b) = 0.064 mm

D_{85} (b) = 0.08 mm

Piping Check

$$\frac{D_{15}\,(f)}{D_{85}\,(b)} = \frac{0.420}{0.08} = 5.25 \qquad (\;< 5)\text{ not ok}$$

Permeability Check

$$\frac{D_{15}\,(f)}{D_{15}\,(b)} = \frac{0.42}{0.008} = 52.5 \qquad (5 \sim 40)\text{ not ok}$$

$$\frac{D_{50}\,(f)}{D_{50}\,(b)} = \frac{1.40}{0.064} = 21.88 \qquad (9 \sim 30)\text{ ok}$$

CONCRETE LABORATORY
IRRIGATION TECHNOLOGY CENTRE
IRRIGATION DEPARTMENT. BAGO.

SUMMARY TEST RESULTS SHEET OF AGGREGATE

Project Name - Neo Energy Oasis Development Co., Ltd. Date - 10.6.10

Sr. No.	Sample Name	Sp.Gr	Absorption (%)	F.M	Unit Weight gm/cc	Organic Impurities	Clay lumps (%)	A.M.F (%)	Abrasion (%)	Salt Content	5 Cycle Soundness(%)	Flakiness Index (%)	Elongation Index (%)	Soft Stone (%)
1.	Quarry - I	2.78	1.31	7.96	1.50	-	-	-	31.00	-	-	-	-	-
2.	Quarry - II	2.82	0.59	7.94	1.52	-	-	-	29.65	-	-	-	-	-
3.	Quarry - III	2.74	0.33	7.96	1.49	-	-	-	31.45	-	-	-	-	-
4.														
5.														

Remarks

Sp.Gr = Specific Gravity
F . M = Fineness Modulus
A. F. M = Amount Material Finer Than No.200 (0.074 mm) Sieve

Checked By -

(ခင်သီတာ)
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ဆည်မြောင်းပညာရပ်ဖွံ့ဖြိုးမှုလေ့ကျင့်ရေးဌာန
ပဲခူးမြို့ ။

IRRIGATION TECHNOLOGY CENTRE
CONCRETE RESEARCH LABORATORY
BAGO

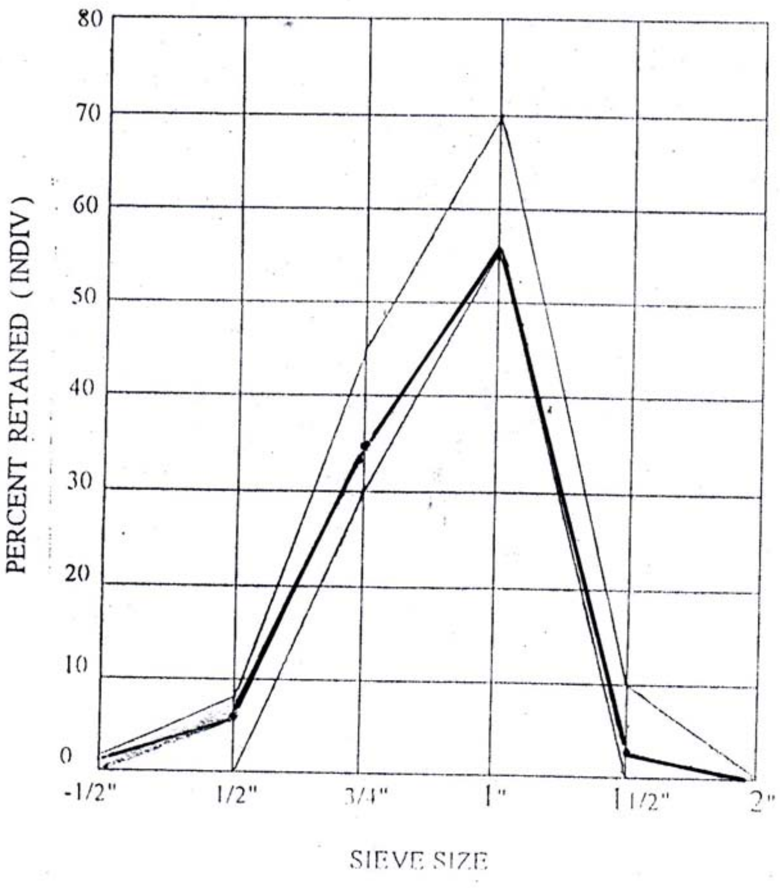
SAMPLE = Quarry-I

LOCATION =

DATE 28.5.10

Test I

3/4" - 1 1/2" AGGREGATE		
NOS. OF SAMPLE TESTED		
PERCENTAGE RETAINED		
SIEVE SIZE	AVERAGE % RETAINED (INDV)	SPECIFIED LIMITS % RETAINED (INDV)
2"	-	0
1 1/2"	2.93	0 - 10
1"	55.85	55 - 70
3/4"	34.10	30 - 45
1/2"	5.32	0 - 8
(-) 1/2"	1.80	0 - 2



CHECKED BY

Test I F.M = 7.95

Test II F.M = 7.96

Avg: F.M = 7.96

TESTED BY

(ခင်သီတာ)
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ဆည်မြောင်းပညာရပ်ဖွံ့ဖြိုးမှုလေ့ကျင့်ရေးဌာန
ပဲခူးမြို့ ။

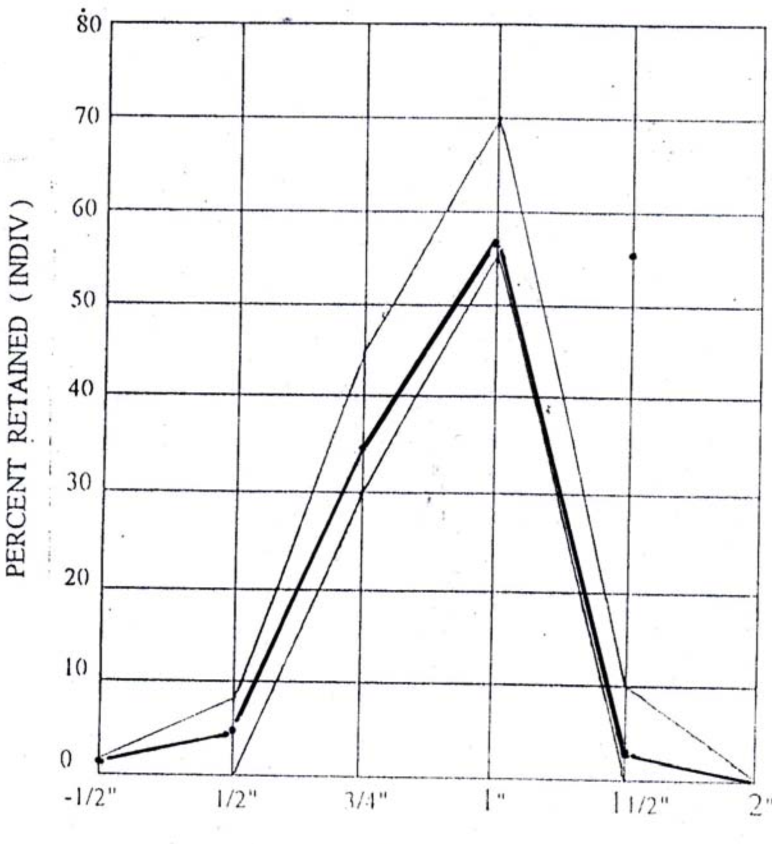
(အေးချို)
လ/ထ ဦးစီးမှူး (ဓါတ်ခွဲ)

IRRIGATION TECHNOLOGY CENTRE
CONCRETE RESEARCH LABORATORY
BAGO

SAMPLE = Quarry - I   DATE 28.5.10
LOCATION =

Test II

3/4" - 1 1/2" AGGREGATE		
NOS. OF SAMPLE TESTED		
PERCENTAGE RETAINED		
SIEVE SIZE	AVERAGE % RETAINED (INDV)	SPECIFIED LIMITS % RETAINED (INDV)
2"	-	0
1 1/2"	3.35	0 - 10
1"	55.95	55 - 70
3/4"	34.20	30 - 45
1/2"	4.55	0 - 8
(-) 1/2"	1.95	0 - 2



CHECKED BY

Test II F.M = 7.96

TESTED BY

(ဒေါ်ချို)

လ/ထ ဦးစီးမှူး (ဓါတ်ခွဲ)

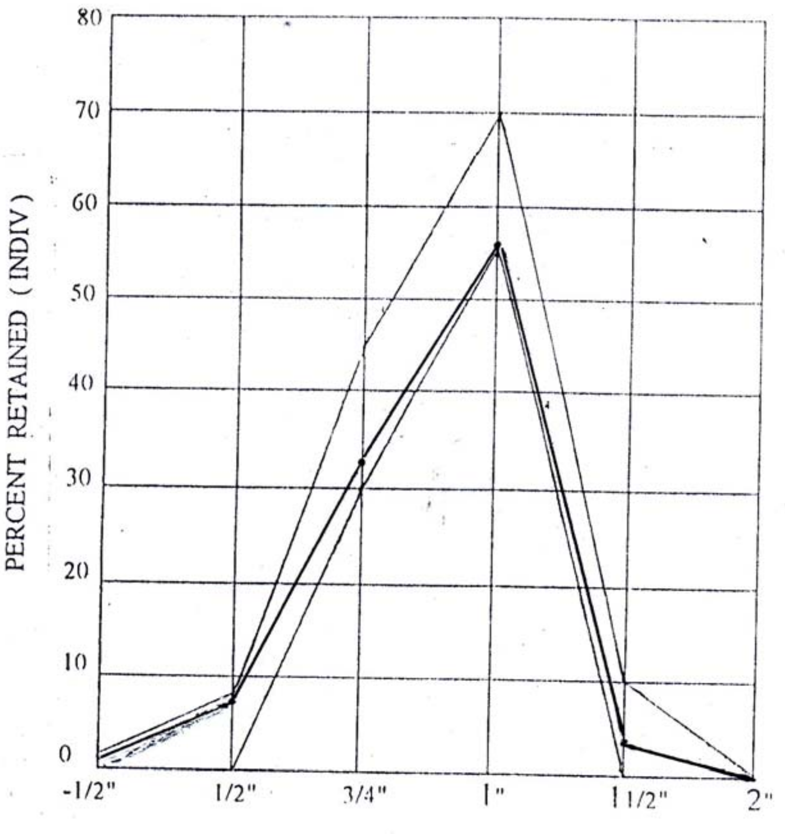
IRRIGATION TECHNOLOGY CENTRE
CONCRETE RESEARCH LABORATORY
BAGO

SAMPLE = Quarry - II
LOCATION =

DATE 28.5.10

Test I

3/4" - 1 1/2" AGGREGATE		
NOS. OF SAMPLE TESTED		
PERCENTAGE RETAINED		
SIEVE SIZE	AVERAGE % RETAINED (INDV)	SPECIFIED LIMITS % RETAINED (INDV)
2"	-	0
1 1/2"	3.47	0 - 10
1"	55.88	55 - 70
3/4"	31.80	30 - 45
1/2"	7.00	0 - 8
(-) 1/2"	1.85	0 - 2



CHECKED BY

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ပဲခူးမြို့

Test I F.M = 7.94
Test II F.M = 7.94
Avg. F.M = 7.94

TESTED BY

(ဇော်ချို)
လ/ထ ဦးစီးမှူး (ဓါတ်ခွဲ)

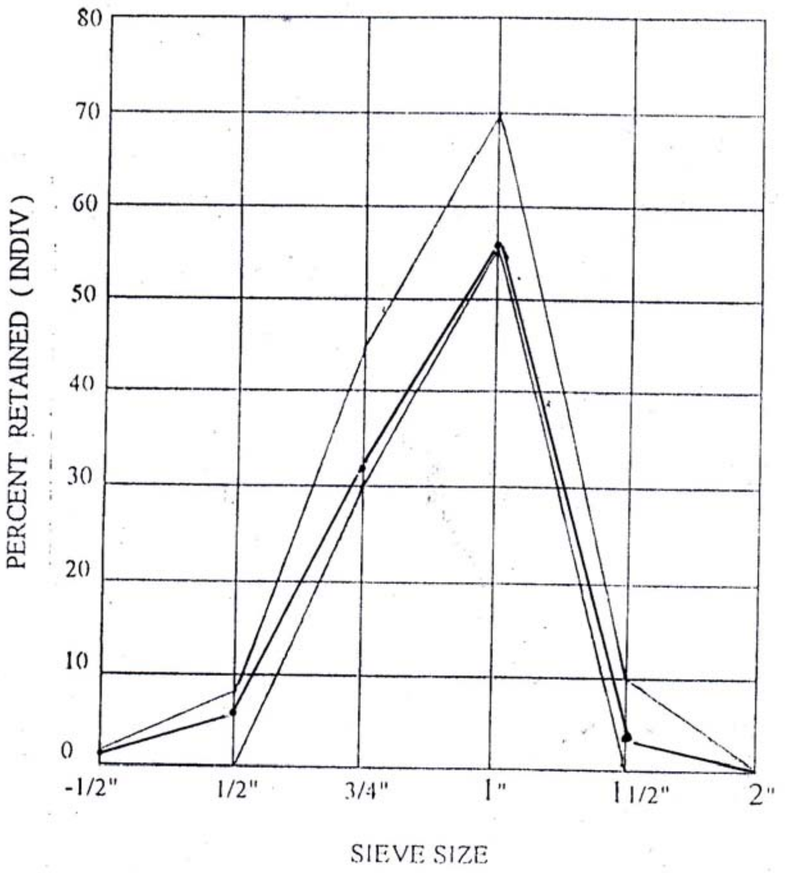
IRRIGATION TECHNOLOGY CENTRE
CONCRETE RESEARCH LABORATORY
BAGO

SAMPLE = Quarry II
LOCATION =

DATE 28.5.10

Test II

3/4" - 1 1/2" AGGREGATE		
NOS. OF SAMPLE TESTED		
PERCENTAGE RETAINED		
SIEVE SIZE	AVERAGE % RETAINED (INDV)	SPECIFIED LIMITS % RETAINED (INDV)
2"	-	0
1 1/2"	3.65	0 - 10
1"	56.65	55 - 70
3/4"	31.15	30 - 45
1/2"	6.65	0 - 8
(-) 1/2"	1.90	0 - 2



CHECKED BY

Test II F.M = 7.94

TESTED BY

(ဆေးချို)

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ဆည်မြောင်းပညာရပ်ဖွံ့ဖြိုးမှုဌာန ကျွန်ုပ်ရေးဌာန
ပဲခူးမြို့

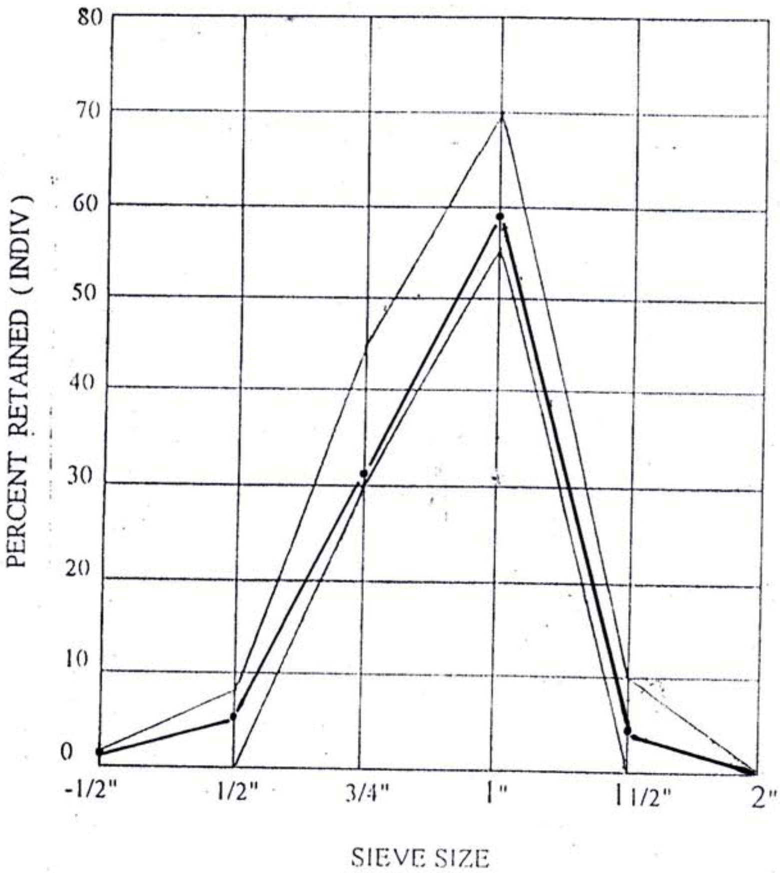
IRRIGATION TECHNOLOGY CENTRE
CONCRETE RESEARCH LABORATORY
BAGO

SAMPLE = Quarry - III
LOCATION =

DATE 28.5.10

Test I

3/4" - 1 1/2" AGGREGATE		
NOS. OF SAMPLE TESTED		
PERCENTAGE RETAINED		
SIEVE SIZE	AVERAGE % RETAINED (INDV)	SPECIFIED LIMITS % RETAINED (INDV)
2"	-	0
1 1/2"	3.8	0 - 10
1"	59.45	55 - 70
3/4"	30.48	30 - 45
1/2"	4.17	0 - 8
(-) 1/2"	2.10	0 - 2



CHECKED BY

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ပဲခူးမြို့ ။

Test I F.M = 7.96
Test II F.M = 7.95
Avg: F.M = 7.96

TESTED BY

(ဒေါ်ချို)
လ/က ဦးစီးမှူး (ဓါတ်ခွဲ)

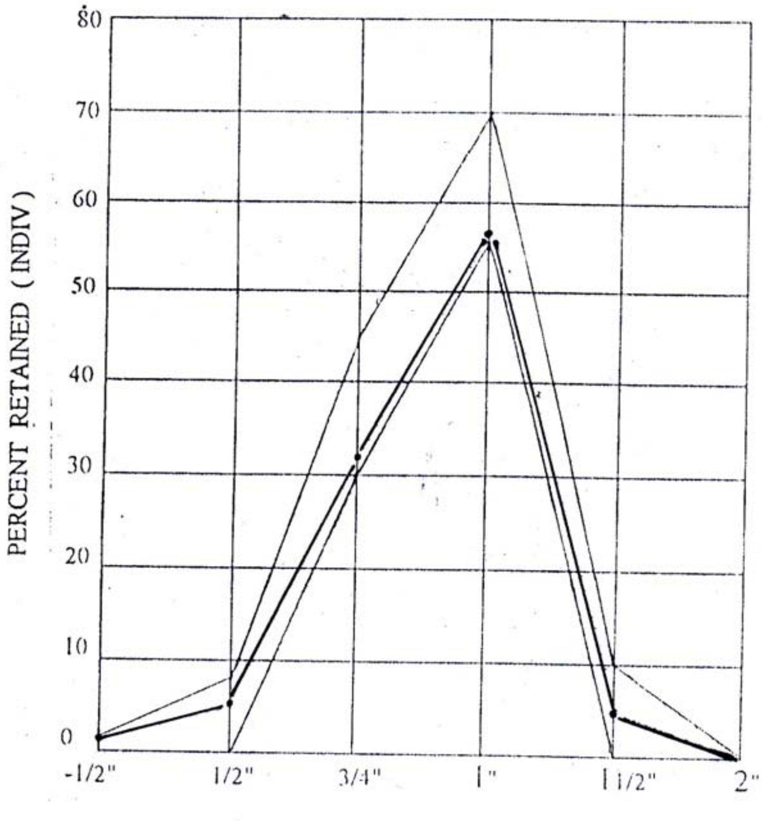
IRRIGATION TECHNOLOGY CENTRE
CONCRETE RESEARCH LABORATORY
BAGO

SAMPLE = Quarry - III
LOCATION =

DATE 28.5.10

Test II

3/4" - 1 1/2" AGGREGATE		
NOS. OF SAMPLE TESTED		
PERCENTAGE RETAINED		
SIEVE SIZE	AVERAGE % RETAINED (INDV)	SPECIFIED LIMITS % RETAINED (INDV)
2"	-	0
1 1/2"	3.83	0 - 10
1"	56.75	55 - 70
3/4"	31.95	30 - 45
1/2"	5.57	0 - 8
(-) 1/2"	1.90	0 - 2



CHECKED BY

Test II F.M = 7.95

TESTED BY

([illegible])
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ဆည်မြောင်းပညာရပ်ဖွံ့ဖြိုးမှုလေ့ကျင့်ရေးဌာန
ပဲခူးမြို့ ။

([illegible])
[illegible] (ဓါတ်ခွဲ)

Upper Baluchaung Hydropower Project Neo Energy Oasis Development Co., Ltd.
အထက်ဘီလူးချောင်းရေအားလျှပ်စစ်စီမံကိန်း

Sr. No.	Rock Name		Dimension Ø (cm)	H (cm)	Weight (gm)	Specific Gravity	Absorption (%)	Compressive Strength (kg/cm²)	(psi)	Remark
1.	Quarry - I	(1)	5	10.00	534.85	2.72	1.54	814.66	11584.47	
		(2)	5	5.00	277.48	2.78	1.50	947.05	13467.05	
		(3)	5	10.14	564.76	2.82	1.48	957.23	13611.81	
2.	Quarry - II	(1)	5	5.00	276.06	2.81	0.44	1059.06	15059.83	
		(2)	5	10.07	556.37	2.79	0.57	916.50	13032.63	
		(3)	5	11.00	607.32	2.81	0.38	1710.79	24327.43	
3.	Quarry - III	(1)	5	9.00	482.44	2.71	0.33	661.91	9412.36	
		(2)	5	10.05	540.59	2.73	0.32	936.86	13322.15	
		(3)	5	9.00	489.57	2.76	0.30	1079.43	15349.49	

Tested By

Checked By

Appendix 8

EIA Team Member

Environmental Consultant

Implementation of Preliminary EIA Assessment –

Leading Organization - Resource & Environment Myanmar Co., Ltd. (REM)

(REM) is located in the city of Yangon, Myanmar, in the country it is a leading resources and environment consulting firm that composed of geoscientists, engineers, biologist, botanist, socio-economic experts, cultural heritage experts, environmental engineers and physical resources management specialist.

Address	:	**Resource & Environment Myanmar Co., Ltd.** No. 702 B, Delta Plaza, Shwegonedaing Road, Bahan, Yangon.
Telephone	:	959-73013448
Facsimile	:	01-552901
Email	:	service@enviromyanmar.net
Contact Person	:	Mr. Thura Aung
Designation	:	General Manager

Secondary Organization – Sustainable Environment Myanmar Co., Ltd. (SEM)

The SEM provide Environmental & Social/Health Impact Assessment service for development projects in Myanmar. SEM has resources and capacity to handle environmental management issues as per the provisions of Environmental Conservation Laws 2012 including, EIA, ESMP, environmental monitoring and auditing.

Sustainable Environment Myanmar
Company Limited (SEM)

Address: B 503 Delta Plaza, Shwegondaing Road, Bahan, Yangon

Tel: +959 261328891

Email: services@sustainablemyanmar.com

Participants of Environmental Impact Assessment

The following table shows list of participants involved in the present ESIA study of Upper Baluchaung Hydropower Project.

Resource and Environment Myanmar Project Team Member.

No.	Name	Position	Organization	Responsibility
1	U Thura Aung	GM/Principal Consultant	Resource & Environment Myanmar Ltd.	Physical Environment, Environmental Baseline Data
2	U Ngwe Moe	Principal Consultant	Resource & Environment Myanmar Ltd.	Environmental, Health and Safety
3	U Zaw Naing Oo	MD/Principal Consultant	Sustainable Environment Myanmar Ltd.	Environmental Impact Assessment & Environmental Management
4	U Than Oo	GM/Principal consultant	Sustainable Environment Myanmar Ltd.	Hydropower Analyst
5	U Zay Maung Thein	Principal Consultant	Sustainable Environment Myanmar Ltd.	Avifauna
6	Dr. Tin Tin Khaing	Principal Consultant	Sustainable Environment Myanmar Ltd.	Vegetation and Flora
7	Daw Swe Wut Hmone	Consultant	Sustainable Environment Myanmar Ltd.	Vegetation
8	Daw Naing Naing Win	Senior Consultant	Sustainable Environment Myanmar Ltd.	Wild Life
9	Daw Than Than Htay	Senior Consultant	Sustainable Environment Myanmar Ltd.	Entomologist
10	Daw Myat Thet Khaing	Consultant	Sustainable Environment Myanmar Ltd.	Aquatic Ecology
11	U Chit Myo Lwin	Senior Consultant	Sustainable Environment Myanmar Ltd.	Environmental Geology
12	U Myat Ko Ko Hein	Consultant	Sustainable Environment Myanmar Ltd.	Forest
13	U Thet Naing Aung	Senior Consultant	Sustainable Environment Myanmar Ltd.	Avifauna
14	U Kyaw Naing Oo	Senior Consultant	Sustainable Environment Myanmar Ltd.	Herpetofauna
15	U Nyan Lin Maung	Consultant	Sustainable Environment Myanmar Ltd.	Water Quality
16	Daw Poe Mon Mon Kyaw	Consultant	Sustainable Environment Myanmar Ltd.	Environmental Engineer, EHS
17	Daw Phyo Khinzar Wint	Senior Consultant	Sustainable Environment Myanmar Ltd.	EIA report compilation
18	Daw Nu Yin	Senior Consultant	Sustainable Environment Myanmar Ltd.	SIA and Public Consultation
19	Daw Myat Thitsar Naing	Senior Consultant	Sustainable Environment Myanmar Ltd.	SIA and Public Consultation
20	Dr. Nyomie Razak	Principal Consultant	Sustainable Environment Myanmar Ltd.	SIA and Cultural
21	U Soe Yu Htun	Senior	Resource & Environment	Air and Noise

		Consultant	Myanmar Ltd.	
22	U De Hlaing Zaw	Consultant	Resource & Environment Myanmar Ltd.	Soil
23	U Nay Min Aung	Consultant	Resource & Environment Myanmar Ltd.	Water Quality

All these EIA members fully committed through their specialized subject for this project.

Name: U Thura Aung

Present Position: Project Manager

Nationality: Myanmar

Profession: Geologist

Specialisation:
- Social Consideration and Environmental Baseline Survey
- Myanmar Geosciences Society
- Consultant Geologist

Qualifications:
- B.Sc. (Geology) (1994) University of Yangon (Myanmar)
- B.Sc. (Hons.) (Geology), Yangon University, Myanmar (2003)
- M.Sc. (Geology), Yangon University, Myanmar (2007)
- M.Res. (Geology), Yangon University, Myanmar (2009)

Selected Relevant Experience in Present Employment Since 2004

2004 - 2009	Demonstrator, Department of Geology, Yangon University, Myanmar
2009 - 2010	Consultant, Resource and Environment Myanmar Co. Ltd.
2010 – 2011	Consultant Geologist, Siam Cement Group Co. Ltd., Thailand
2012 to date	Senior Consultant, Resource and Environment Myanmar Co., Ltd.

POSITION	Project Manager
NAME	Thura Aung (Mr.)
DATE OF BIRTH	2 May 1976 (37 years)
NATIONALITY	Myanmar
QUALIFICATION	M.Res. (Geology), Yangon University, Myanmar (2009) M.Sc. (Geology), Yangon University, Myanmar (2007) B.Sc. (Hons.) (Geology), Yangon University, Myanmar (2003)
EXPERIENCE	
2012 to date	Senior Consultant, Resource and Environment Myanmar Co., Ltd.
2010 – 2011	Consultant Geologist, Siam Cement Group Co. Ltd., Thailand
2009 - 2010	Consultant, Resource and Environment Myanmar Co. Ltd.
2004 - 2009	Demonstrator, Department of Geology, Yangon University, Myanmar
CURRENT BASE	Yangon, Myanmar/ Yangon, Myanmar

Language

Burmese mother tongue and English Languages.

No301, Bld 6

Dagonlwin Rd, Myittar Nyunt,

Tarmwe, Yangon, Union of Myanmar

Telephone: 95-9-49345127

Email: nmoehse@gmail.com

CAREER PROFILE

NGWE MOE

Environmental & Safety Advisor

SUMMARY OF EXPERIENCE

Career surrounds onshore pipeline construction and operational HSE management in the Oil and Gas industry.

Primary Management Areas: Development - Execution – Monitoring of QHSE Procedures, and Comprehensive HSE Programs. Working Management Experience: Direct Hire, Subcontract, and Owner Representative Roles within domestic and international projects.

Individual Areas Within HSE Management: Development / Implementation of HSE-MS and EMS, Tracking performance, Accident investigation, Operating plant safety, onshore pipeline construction safety , basic safety training, Environmental Baseline data collection and monitoring in line with comprehensive understanding of international standards / regulations/ codes and practices.

The listed experience below would cover all basic craft disciplines found within a substantial project environment and technical background necessary to manage their associated risks effectively.

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INDUSTRY EXPERIENCE

Onshore pipeline construction HSE Management
Onshore Gas Processing
Onshore Pipelines Construction
Jetty Construction
Operational HSE Management
Nearshore Excavation

SPECIFIC SKILL AREA

Terrestrial and Marine Environmental Management
Environmental Management and Monitoring
Development of HSE procedures
EPCIC HSE Management
FEED HSE Management

PERSONAL DATA

Country of Origin: Union of Myanmar

Marital Status: Married

Health: Excellent

DOB: May 9, 1968

EDUCATION - CAREER TRAINING

Bachelor of Chemical Engineering (YIT)

Diploma in Environmental Engineering (Yangon Technical University)

DETAILED PROFESSIONAL EXPERIENCE

Project Director/Environmental Consultant

Myanmar Environment Institute
Taking Responsible for project management on Building Resilience and Adaptation to Climate Extremes and Disasters Program (BRACED).
Member of Investigation Committee for Immediate Assessment on Environmental and Social Management of the Letpadaung Taung Copper Project (December, 2012 - January, 2013)

Environmental & Safety Advisor

Hyundai Heavy Industries
Jan 2012 – Nov. 2012
Barzan Offshore Project
Raslaffan Industrial City, , Qatar

Taking responsibility and holding accountability in area of environmental and safety aspects of onshore pipeline construction , shore pulling and near shore trenching work activities by advising to company

Carrier comprise following duties

- Implementation of environmental management and monitoring established by client for the project
- Compliance to Qatar regulatory requirement , Raslaffan City and client HSE & EMS
- Environmental monitoring comprising following components such as noise, air, water, land pollution, desert flora and fauna conservation , marine mammal observation . sea turtle hatching , coastal environmental preservation
- Protection rare and endangered species of seasonal and inhabitants fauna identified in project area
- Adhere to commitment of Barzan offshore ESHIA
- Company HSE Management system implementation
- Arranging contractor environmental and safety audit for ongoing construction activities
- Facilitating environmental and safety trainings to company and contractor employees on a regular basis
- Promote environmental awareness among various level of project employees

Environmental & Safety Coordinator

Daewoo International Corporation (Myanmar E&P)

October 2007 – November 2011

Development of Shwe Gas Fields

Yangon,

Initially recruited to assist in finalization of ongoing EIA along with follow-up Myanmar – Ramree island, Myanmar

EMMP development and assisted third-party consultant Worley

Development consisted of integrated Drilling Platform (DP) and a Central Processing Platform (CPP) in 111m of water, Mya field will be developed from two subsea drilling centers, Mya North in 196m of water and Mya South in 600m. Shwe Phyu development will be by a Wellhead Platform (WHP) and single subsea well step out. Gas will be transported via infield pipelines to the Shwe CPP and an export pipeline from Shwe CPP to landfall at Kyauk Phyu on Ramree Island where Onshore Gas Terminal is located .

Parsons with development of a corporate HSE-MS program utilizing ISO / OSHAS 1800 principles

In pre-FEED phase of project life, various environmental baselines studies including onshore terrestrial baseline data collection, area scoping, marine baseline data collection, near shore coral surveys and assisted in the preparation of EIA and EMMP for upstream , midstream and onshore, jetty and supply base were conducted and participated in those studies as Company Representative.

During FEED, assisted in the review of related safety study documents and setting up project environmental specification.

In the current detail design phase, assisting Project HSE Manager for preparation of safety working procedures, project HSE guidelines and HSE plans for different locations where work activities are present.

In the current EPCIC Phase of the project, Safety and environmental monitoring continue together with Onshore HSE teams for the implementation of Contractor performance in the area of

- Jetty Construction
- OGT Construction
- Nearshore Trenching
- Road Safety

Brief Job Description :

- Recording HSE Statistics and HSE performance and all HSE related issues and reporting to HSE Superintendent
- Observation of regular toolbox talks, STOP card system, and providing on-the-job safety training and facilitating in development of risk assessment, JSA, JHA conducted by contractor HSE teams
- Organizing Fire drill / Emergency Exercise in Office
- Assisting HSE Superintendent in establishing Safety Program / Project Safety Plan
- Assisting / Participating in Accident Investigation Team and notification the finding and lessons leant in order to prevent reoccurrence
- Coaching local Contractors to acquire the required standard of competencies
- Safety Orientation /Induction to new comers/ visitors/ contractor in regard with Daewoo HSE MS
- Actively seeking improved HSE practices through the benchmarking and active participation in HSE related seminars and organizations.
- Actively Participating in baseline marine and terrestrial environmental survey ,data collection activities in onshore /offshore areas for the production of EIA/ EMMP
- Administering Environmental Management and Monitoring Plan and applying mitigation measures to downsize any adverse impacts and non- conformances to meet the requirement of Daewoo HSE Policy and Objectives
- Assisting HSE Manager in verifying that emergency numbers, including physicians and hospital locations, aviation providers, HSE related law and regulations governed locally
- Site HSE Monitoring in the scopes of earthwork, concrete foundation, blasting ,ROW clearance, Jetty demolition and construction, Construction camps, building construction

- Monitoring the contractor's implementation and performance on Environmental related potential activities in line with the guideline mentioned Environmental Management and Monitoring Plans of Shwe Project so as to ensure that potential impacts are well managed and mitigated to a level of acceptability.

HSE Supervisor

June 2004 – April 2005

22-KM MOL Reroute Project Al Hashedi , Sana'a, Yemen

Contacted by Al Hashedi for Trading and Contracting as contractor HSE Supervisor to oversee a majority of HSE activities on onshore pipeline construction project for client Canadian Nexen located in southern region of Yemen.

Thought onshore 24" pipeline length is 22 km , basically it is rerouted project, working environment is surrounded by the steep slopes, hilly region , desert temperature and other critical terrain features .
Operatives reached up to 300 in the peak and managing HSE was a very challenging due to the nature of area and environment, culture of people, and safety concept and perception of local work forces.

Brief job descriptions are as follows

- Preparedness of Safety Document (Safe Working Practices and Procedures, Risk Assessment , Method Statement)
- Daily PSI, Toolbox talks and Equipment Checklists
- Coordinating with Client Safety Management Team and complying necessary safety requirement.
- Implementation of Safety Management System
- Promoting safety awareness and developing safe working environment for working in steep slopes and rocky hills
- Conducting safety audit, inspections and monitoring camp facilities and worksites on a daily basis.
- Organizing ERP drills, exercises and safety meetings
- Safety Orientations to new comers and visitors

Safety Officer (onshore)

Yetagun Offshore Gas Project
September 2003 – June 2004
Union of Myanmar

Petronas Carigali Myanmar Limited

Recruited by Petronas who took over the operatorship of Yetagun Project from Premier Oil as national Safety Officer and assigned to the onshore HSE field management in Pipeline Operating Center.

The project included one offshore production platform located 120 km off Myanmar water , midstream pipeline, onshore pipeline operating center and other facilities ,68-km onshore pipeline and metering station. Gas is produced and then sold to PTTEP located in Thailand through offshore and onshore pipeline.

Establishment of full safety systems and internal programs for later project stages was primary mandate.

Project comprised Onshore Pipeline Operation Center, Metering Station, 68 KM Onshore Pipeline and other associated infrastructure.

Primary objective of onshore operation include acceptance of gas in from offshore production platform via midstream pipeline and depressurized upon receiving and then sent to metering station for final gas sale..

Brief Job Description:

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- Implementation of Pipeline Operating Center(POC), Metering Station
- Complying KPI (Key Performance Indicator) and UAUC
- Maintaining Safety Item Action List (SAIL) and updating
- Ensuing SMS and safety guide lines are in place and being followed thoroughly
- Promoting Safety Awareness and initiative safety activities
- Reporting Accident/Incident and Safety Achievement Statistics
- Performing work site safety inspection, work permit audits, risk assessments, Safety Inductions and Tool box talks.
- Enhancing safe working practice in work sites.
- Taking responsibility for the development and organizing
- Safety related Training programs for staffs and contractors.
- Follow up action with immediate Corrective Actions so as to minimize risks and control the hazardous situations
- Conducting ERP and coordinated with other parties for joint exercises.

Environmentalist (onshore)

Yetagun Offshore Project (Gas Production)
June 2000 – Sept 2003
Union of Myanmar ,
Premier Oil Myanmar Limited

Contracted with Premier Oil for managing and monitoring of onshore EMS. Work scope included implementation of Yetagun onshore and offshore environmental management system and monitoring along 68-km length onshore ROW which passes through deep and pristine monsoon forest which is located southern tip of Union of Myanmar. Work rotation was 4-weeks on and then off 4-weeks.

Brief Job Description:

- Implementation of Company Environmental Management System and Waste management Procedure
- Monitoring in Project area , ROW and Pipe Line Operating Center
- Monitoring the sustainable development of local flora and fauna in rain forest (along 68 KM pipeline corridor)
- Co-coordinated with government authorities and NGOs for the preservation of rain forest
- Monitoring wildlife activities, illegal logging, hunting activities, wildlife trading , etc and recording
- Maintaining and documenting Environmental Statistics
- Promoting environmental awareness in Company staff and local community
- Conducting environmental tool box talks, workshops and participating in seminars
- Monitoring ROW and access road maintenance activities on a daily basic
- Monitoring road safety, remote work permit audits
- Implementation of safety working practices & enhancing safety and environmental awareness among local staff and community

Professional Training Completed

- HUET and Sea Survival
- Introduction to Oil &Gas Operation
- Tripod Beta Practitioner
- Problem Solving &Decision Making Level
- Gas Cylinder Handling
- Hazardous Substance Control
- Defensive Driving &Vehicle Management
- Advance Fire Fighting
- Radiation Awareness
- HSE training for Supervisors
- Safety Management
- PPE Program
- Emergency Action Plan
- Fire Prevention Plan
- Marine Mammal Observer
- Coastal Protection

CBTA Advanced Training

- Risk Assessment
- Permit To Work Supervisor Level
- Mechanical And Electrical Isolation
- Confine Space Entry
- Emergency Response Plan
- Waste Management
- Fire Safety
- Manual Handling
- Identification, Evaluation And Control Of Hazards
- Use Of Breathing Apparatus
- Gas Tester
- Site Defensive Driving
- Environmental Management Plan

References Furnished Upon Request

Name of Consultant	-	Zaw Naing Oo
Present Position	-	Principal Consultant, Physical Environment, Managing Director
Name of Firm	-	Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	-	Myanmar
Profession	-	Environmental Scientist and Environmental Geology, Environmental Management
Date of Birth	-	22 – 03-68
Years with Firm/Entity	-	2007 Nationality - Myanmar

Membership in Professional Society
- Myanmar Geosciences Society (MGS)
- Faculty Member of Myanmar Environment Institute (MEI)

Detailed of Tasks Assigned
- Project management for ESIA study
- Environmental Baseline study for soil, water, air and noise
- Environmental Management
- Preparation of ESIA Report

Profile

Zaw Naing Oo obtained his M.Sc. degree in geosciences and became professional geologist in Myanmar since 1997. He worked as a teaching staff in Geology Department, Yangon University during 1997 to 2007. At present he is a Director for Resource & Environment Myanmar Ltd. as well as EC Member of Myanmar Environment Institute. He has twenty years of experience in the field of Geosciences and currently he works as a principal consultant in an area of Environmental Impact Assessment and Environmental Management in various projects.

Recently, he works as a Managing Director in SEM and he has also managed multi-disciplinary planning, environmental monitoring and audit and environmental management projects.

Professional History

2009 to date - Director, Principal Consultant, EIA and EMP, Resource & Environment Myanmar Co., Ltd.

2007 – 2009 - Project Manager, Soil Investigation Pte. Ltd., Singapore

1997 – 2007 - Demonstrator, Assistant Lecturer, Geology Department, Yangon University

Demonstrator/ Consultant Geologist: Practical works on petrology, aerial photo interpretation and remote sensing for undergraduate students Feasibility study, surveying, geotechnical investigation, geological mapping, data base and reporting of Ta-sang Hydropower project, Union of Myanmar.

Assistant Lecturer: Conduct lecture on Petrology and Mineralogy of Gold Deposit, Structural Geology, Remote Sensing and GIS Application in mineral exploration, Field leader for undergraduate geology students, field training in various parts of Myanmar, Geology and geotechnical investigation of upper Bu village multipurpose dam project, Union of Myanmar,

Coordinator- "Application of Geographic Information Systems and Remote Sensing in Agriculture" jointly organized by dept. of geography and Myanmar Agriculture Service, Bago Division.

Land Survey and Physical Resource Specialist (2003-2005) - MDX Group of Companies, Bangkok, Thailand Responsible for desk study including preparation for necessary documents, information, maps, data entry sheets and managements

Project Manager: Site Investigation for Downtown Line MRT Project, Site Investigation for Project C916- Construction of Station and Tunnel at Beauty World Station

Reporting SI work and Rock Mass Quality for design and construction of MRT Station and Tunnel

Additional SI Work for C-855 Tunnel Section Reporting for SI work for design and construction of Station and Tunnel, Supervise & reporting CPT test, Supervise and reporting geophysical works (resistivity and surface wave) along the tunnel line.

Selected Relevant Experience in an Environmental and Social Impact Assessment

Environmental Impact Assessment and Environmental Management on:

S/n	Project name	Owner of the project	Person to contact and telephone	Completion time	Remarks
1	EIA of Myanmar-China Gas Pipeline Project	CNPC IEM (Intern. Environmental Management Co. Ltd.)	Ron Livingston (MD) 662 6366390	November, 2010	Submitted to Myanma Oil and Gas Enterprise
2	ESHIA of Mai Khot Coal Power Project	IPC (Italian Thai Power Co. Ltd.)	Vudtichai Eksangsri (CVO) 66 85 2495 655	October, 2010	Submitted to Ministry of Energy
4	ESHIA of Upper Yeywar – Shwezaryan 230 kV Transmission Line	Ministry of Electric Power (1) & GK Power Systems Ltd.	Zeya Thura Mon (MD) +(95-1) 502016-18	September, 2011	Submitted to Ministry of Electric Power Enterprise
5	ESHIA of Baluchaung-Shwemyo 230 kV Transmission Line	Ministry of Electric Power (1) & GK Power Systems Ltd.	Zeya Thura Mon (MD) +(95-1) 502016-18	November, 2011	Submitted to Ministry of Electric Power Enterprise
6	Socioeconomic Assessment for Rakhine Region	Myanmar Engineering Society	U Than Myint +95 9 5136467	November, 2011	UNDP Multi Hazard Project
8	Environmental Baseline Survey of Dawei Deep Sea Port and Industrial Development	Italian Thai Devlopment and Team Engineering Consultant	Dr. Sirinimit Boonyuen (MD, Env Unit) +662-509-9000 ext. 2305	May, 2012	Submitted to the Special Economic Zone Committee
9	ESHIA of Thaketa Gas Turbine Project	BKB Co. Ltd.	Dr. Sone Han (Local Rep./ Proj. Director) +95 9 5183631	May, 2012	Submitted to MIC
10	SIA of Main Road Project, Dawei	Italian Thai Development and Seatac Group	Pracha Jantarasarsophon tsiajao@yahoo.com	July, 2012	Submitted to the Special Economic Zone Committee
11	ESHIA of Modi Taung Gold Project	National Prosperity Co. Ltd.	Thiha Zaw Lin Project Director	March, 2012	Submitted to MIC
12	EIA of 500 MW CCPP at Hlawga	Htoo & HIE, China	Zhuang Jinxiang 18669086755 zhuangjx_love@126.com	Feb. 2013	Submitted to MIC
13	EIA of MCC Cement Plant, Mawlamyaing	SCG Thailand & Pacific Link Myanmar	Mr. Mongkon, mongkonp@scg.co.th	April, 2013	Submitted to MIC
14	IEE for the Project of Manufacturing of construction materials and factory utensils (Welded H-Beams and Pipes)	Prime Metal Company Ltd.	U Tin Maung Tun 09-5177264	April, 2013	Submitted to MIC
15	IEE for the project of Manufacturing of Garment at Hlaingtharyar, Yangon	South Bay Manufacturing Co., Ltd	Mr, Rong, 01-544021	June, 2013	Submitted to MIC

16	IEE for the project of Manufacturing of Garment at Intagaw, Bago	Hung Kiu (Myanmar) Garment Manufacturing	Mr. Ng Hung Yau, 959 - 5116258	July, 2013	Submitted to MIC
17	IEE for the project of Manufacturing of Garment at Pathein City	Hakers Enterprise (Myanmar) Co., Ltd.	Daw Nan San Seng, 01 534876	August, 2013	Submitted to MIC
17	IEE for the project of Manufacturing of Garment at Dagon South, Yangon	Myanmar Sein Pann Manufacturing	Daw Tin Tin Win, 01-554003	August, 2013	Submitted to MIC
18	Environmental Impact Assessment of Shweli River II Hydropower Project (in progress)	Hydrolancang International Energy Company Ltd. and KHIDI	Mr. Guo	October, 2013	Submitted to MOEP
19	Environment and Social Consideration study on the Project for Rehabilitation study on the Project for Rehabilitation of Education College in the Republic of the Union of Myanmar	Yamashita Sekkei Inc. and KRI International Corp.	Mr. Yasumatu yasumatus@yamashitasekkei.co.jp	February, 2014	Submitted to MOE
20	Environmental & Social Information Collection Survey for the Project for the Strategic Urban Development Pan of the Greater Yangon	Nippon Koei Co., Ltd	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	September, 2013	JICA
21	Actual Environmental Survey for Feasibility Study for the Construction of Bago River	ALMEC Corporation, NIPPON KOEI Co., Ltd.	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	April, 2014	Ministry of Construction
22	Actual Environmental Survey for Feasibility Study for the Construction of Thaketa River Bridge	ALMEC Corporation, NIPPON KOEI Co., Ltd.	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	April, 2014	Ministry of Construction
23	ESIA for Baseline study of Thilawa Special Economic Zone Class A	Nippon Koei Co., Ltd.	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	December, 2013	MOECAF
24	Environmental and Social Survey for Environmental Impact Assessment Studies under the Project for Electric Power Development in the Thilawa Area	Nippon Koei Co., Ltd.	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	September, 2014	MOECAF
25	Environmental Baseline Survey for environmental and social consideration for energy sector rehabilitation program in Myanmar	Nippon Koei Co., Ltd.	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	October, 2014	MOECAF
26	Survey for Preparation of Abbreviated Resettlement Plan for Feasibility study	Nippon Koei Co., Ltd.	Mr. Shunsuke HIEDA hieda-sh@n-koei.jp	September, 2014	Ministry of Construction

	for the construction of new Thaketa and Bago River Bridge				
27	ESIA of Upper Yeywa Hydropower Project	Department of Hydropower Implementation (DHPI), Ministry of Electric Power (MOEP).	U Hein Htet, Director MOEP	March, 2015	MOEP
28	Environmental Baseline Data Collection, Social Economic Study and Public Consultation Activity for Myingyan IPP Project	Jointly work with ERM Hong Kong	Mr. Craig Reid, Partner Craig.Reid@erm.com	On Going	MOECAF
29	IEE for 500 kV Transmission line between Meikhtila and Bago and Hlaingtharyar	Tokyo Electric Power Company Inc.	Mr. Masaharu Yogo, JICA Project Team Leader. masashi_kawamura@tokyoengicon.co.jp	Feb. 2014	MOECAF
30	ESIA of Ngaw Chan Kha Hydropower Project	YPIC International Co., Ltd.	Mr. Gaoqihui qihuigao@qq.com	August, 2015	MOECAF
31	ESIA of Mongwa Hydropower Project, Northern Shan State	Mongwa Hydropower Station Development Company	U Hla Thaung Hp; 09250188897	Sepetember, 2014	MOEP
32	Preliminary ESIA of Upper Baluchaung Hydropower Project	Neo Energy Oasis Development Company Ltd.	U Min Htun, Executive Director	September 2015	MOEP
33	Environmental Impact Assessment for PCML Offshore Exploration Drilling Campaign in Block M12, offshore of Yangon, Myanmar (Joint work with CHEMSAIN KONSULTANT SDN BHD, Malaysia)	PC MYANMAR (HONG KONG) LIMITED	Mr. Mohammad Shaufi bin Dahlan, Head of Drilling (Drilling Department) shaufi_dahlan@petronas.com.my	December, 2013	MOGE
34	ESIA of Oil and Gas Exploration of IOR 4, Myanaung (Joint work with ERM Hong Kong)	MPRL E&P Pte Ltd	Mr. Craig Reid, Partner, ERM Hong Kong Craig.Reid@erm.com	September, 2015	MOGE
35	ESIA of Oil and Gas Exploration of IOR 6, Pyay (Joint work with ERM Hong Kong)	MPRL E&P Pte Ltd	Mr. Craig Reid, Partner, ERM Hong Kong Craig.Reid@erm.com	September, 2015	MOGE
36	ESIA of Development of Mann Oil Field(Joint work with ERM Hong Kong)	MPRL E&P Pte Ltd	Mr. Craig Reid, Partner ERM Hong Kong Craig.Reid@erm.com	September, 2015	MOGE

Education - Diploma in Environmental Management
- M.Sc., Yangon University, 1998 (Geology/ Economic Geology)
- B.Sc., Yangon University, 1992
- Environmental Management Systems Auditor/Lead Auditor Training Course (ISO 14001:2004)

Language - Burmese mother tongue and English

THAN OO, (MR.)

Permanent Address:
2B, Shwe Kain Nayee Housing Estate
Na Nataw Street, Kamayut Township
Yangon, Myanmar
Tel : +951 503571 , (HP) +959 4211 70514
Oothanoo67@gmail.com
star.thanoo@gmail.com

Objectives

Primary Objectives:

To work in a friendly environment with HIGH competencies

To utilize all my knowledge and experiences with enthusiasm to be an effective manager of a winning team/business or enterprise

To explore all my best to good use of society

Ultimate Goals:

To achieve success in Business and Life (**A man with vision**)

To consolidate professional success and make Business work (**To operate intuition hand in hand with sensitivity, planning, strategic thinking, perseverance, and discipline**)

To gain Ultimate Successes (**Ability to present ideas and persuade others quickly, clearly and concisely**)

Work Experiences

Oct 2014 To June 2015

FULL-TIME Business Consultant
MJBC, M&J Business Consulting

Teaching and Consulting for Production Management as below;
"Monozukuri" and Customer's Viewpoint
Daily Management and Start up Checking
5S Management
Standardization Management
Operation Standard
Change point Management
Claim Management
Visual Management
Problem-Solving Methods
Improvement and QC Circle

Jan 2014 To July 2014

Energy Specialist
E Guard Environmental Services
High Level ESHIA Study for a Coal Fired Power Plant Project in Myanmar engaged with ERM
Preparatory Survey on Thilawa SEZ Development Project (2,000 ha)
Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA)

engaged with ERM (Japan)
Environment Management Plan (EMP) Sawbwa VT Limited: Garment Factory, Yangon Industry Zone, Mingalardon Garden City

Oct 2013 To Jan 2014

ENERGY SALES DIRECTOR

Schneider Electric Oversea Asia (Myanmar)

Responsible for MV equipments and solutions such as 11/33 kV Switchgears, Transformers, DS and Reclosers, IEDs, SCMS and products: Evolis, HVX, SF F400 etc...

Nov 2012
To Sep 2013

SENIOR MANAGER, POWER GENERATION

PRIMUS ENERGY

SUPREME GROUP OF COMPANIES

(Project Engineering - E.P.C - Power generation - Construction & Development - Agriculture - Environmental & Water Engineering)

We were working together with international firms such as Toshiba, Siemens for Transmission sector, Sinohydro Corporation, EGCO and PTTI for power generation sector. For power generation projects, we made preliminary survey by our own facilities and FS by internal consultants from our partners. We were involving in some CCGT/ CCPP plants and some hydro power projects. Our significant achievement was in Kyauk Se Fast Track 100 MW Gas Turbines contract with APR Energy.

March 2012
To October 2012

DIRECTOR, ENGINEERING

GLOBAL QUALITY MANAGEMENT (GQM) PTE LTD.
SOLUNA INTERNATIONAL PTE LTD
Focuses : International Trading, Energy and Power, Generation and Transmission Businesses
Particular Interest Projects:
(1) OPGW Supply, Tools & Equipments and live line installation
(2) SCADA / EMS initiation and Power Automation
(3) Power Barges & Gas turbines
(4) Gas & Steam turbines (CCPP) Major Overhaul Services

Aug 2011
To Nov 2011

DEPUTY FACTORY SUPERINTENDENT

Honda (Myanmar) Wood Mill & Parquet and Plywood Factory (Sagaing)
Great Wall Foodstuff Industry Company Limited (Mandalay & Maddayar)
DUTIES:
Factory expansion, new machineries installation, reviewing organization structure and assigning duties and responsibilities

June 2010
To
July 2011

RESEARCH ASSOCIATE

School of Electrical and Electronics Engineering
NANYANG TECHNOLOGICAL UNIVERSITY
50 NANYANG AVENUE, #04-00 SINGAPORE 639798

DEVELOPMENT OF POWER ELECTRONICS AND CONVERTERS, Distributed Energy Resources (DER) integration and Renewable Energy Applications, Microgrids Design and Operation, Economic Reliability and Security studies for the future Grid

“POWER CONVERTER AND GRID ARCHITECTURAL DESIGN FOR FUTURE INTELLIGENT DISTRIBUTION NETWORKS”

SUPPORTED BY AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH (ASTAR), Singapore's leading agency fostering world-class scientific research and talent for a vibrant knowledge-based Singapore.

May 2007 – June 2010

SENIOR ELECTRICAL ENGINEER AND PROJECT MANAGER
Gulf Energy Technology and Projects
P.O.Box – 10161, Al-Nawar Building, Salwa Road, Doha, Qatar

MORE THAN 3 Years Professional experiences in Tendering, Cost estimation and control of Erection, commissioning and testing of electrical installation, Facilities Management and Maintenance of various petro-chemical plant in Qatar

PROJECT EXECUTED/ ONGOING (PARTIAL LIST)

- ✓ Installation of pumps for Corrshield injection to PE coolant system, QCHEM (Completed- From the beginning to the end)
- ✓ Supervision of Electrical Installation for Qatalum Site Project, Messaieed
- ✓ Installation of ATS panel and cable laying, Termination at Industrial Area, Harliburton Worldwide (Completed – From the beginning to the end)
- ✓ Change of Junctions boxes in Turbine Hood to suit use of water mist for the fire protection at PS2/PS3, QP Offshore (Completed)
- ✓ Lighting Maintenance at Gas Operations, Maesaieed on call off basis for 3 years, Qatar Petroleum (On going)
- ✓ Contract No.:GC071053A0, Maintenance of the Street/Outdoor lighting installations on a call-off basis within Dukhan Fields, Qatar Petroleum (On going)
- ✓ Contract No. GC08114100: Maintenance of Street Lighting System in Mesaieed for five years, Qatar Petroleum (On going)
- ✓ Contract No. 9401342: Supply of Electrical and Automation Technicians for a period of 5 years, Qatar Petrochemical Company (On going)

REMARK: For the detailed project list, please see attachment.

December 2005 – April 2007

FOR CONSULTANCY (SENIOR ELECTRICAL ENGINEER)
Starlite Joint Venture - Exhibition, Lighting and Interior Design
Bangkok - Thailand

August 2004 – April 2007

LABORATORY MANAGER
Research Laboratory, Energy Technology
Electric Power System Management
Energy Program, School of Environmental, Resources and Developments
Asian Institute of Technology (AIT), Thailand

- Responsible for teaching in specific laboratory sessions and Tutorials for post graduate level

- Assist teaching in laboratory sessions and Classes
- Laboratory equipments set-up
- Working for the contracted projects and Energy Park with Professors, Supervisor, Research Associates and Technicians
- Participate Conferences, Workshops and Seminars

December 2002 – February 2006

ELECTRICAL MAINTENANCE CONSULTANT (PART TIME ON CONTRACT BASIS)
Thai Malleable Iron & Steel Co., Ltd.
Klong Luang, Pathumthani, Thailand

- Maintaining Electrical, Electronics and computers for Robots and other machines
- Troubleshooting the electrical problem of PC based machines such as Molding machine, Core making machine, Auto-tapping machines, Induction Furnaces
- Drawing such as machine parts, Layouts, Control circuits, Power Line Diagram
- Preparing Preventive maintenance scheme and daily, weekly and monthly checklists
- Documentation for ISO 9002
- Facilities Maintenance

April 1996 – December 2002

PROJECT ENGINEER (MAINTENANCE MANAGER)
Thai Malleable Iron & Steel Co., Ltd.
Klong Luang, Pathumthani, Thailand

- Incharge for all Electrical installations, commissioning & Testing till the project got Site Acceptance.
- To make sure all the machines are installed properly and test the Electrical suppliers before the machines were operated.
- Also leaded this project with additional responsibilities of Safety and Quality Control.

March 1995 – February 1996

DESIGN AND PRODUCTION ENGINEER
Myanmar Electric and Trading Co-operative Ltd.,
Yangon, Myanmar (Burma)

- Supervising the production of the Electrical Appliances
- Designing printed circuit board (PCB) and repairing the Electrical Appliances

March 1994 – February 1995

INSTALLATION AND SERVICING ENGINEER
Challenger Engineering Group
Yangon, Myanmar (Burma)

- Installation of Ai-conditioning and Refrigeration for domestic use
- Servicing the Air-conditioners and Refrigerators

EDUCATION

January 2003 – August 2004

ASIAN INSTITUTE OF TECHNOLOGY
Bangkok, Thailand
Master of Engineering in Electric Power System Management **(GPA 3.33/4)**

January 1985 - March 1994

YANGON INSTITUTE OF TECHNOLOGY
Insein, Myanmar
Bachelor of Engineering in Electric Power **(FINAL GPA 4.5/5)**

March 1977 – March 1984

NO (6) STATE HIGH SCHOOL
Myaungmya, Ayeyarwaddy Division., Myanmar (Burma)
Basic Education High Level (Passed with 3 Distinctions)

PROFESSIONAL MEMBERSHIPS

- **Member MES 2011 to Present.**
- **Member IEEE, from** 2004 to 2007.
- **Student Member IEEE, from** 2003 to 2004.
- **Member IEEE**, from 2000 to 2002.
- **Associate Member MES** (Myanmar Engineering Society) from 2001 to 2007.
- **Junior Member MES** (Myanmar Engineering Society) from 1996 to 2001.
-

Awards & Achievements

- **Grade A Electrical Engineer License, State of Qatar (2009)**
- **Prospect Burma Partial Scholarship Award (2004)**
- **Prospect Burma Partial Scholarship Award (2003)**
- **AIT Fellowship (from January 2003 to August 2004)**
- **AIT Research Initiative Grant (from January 2004 to August 2004)**
- **First Grade of Electrician Registration Certificate (since 1995)**
  Electrical Inspection Department, Ministry of No 1. Industry
  Government of Union of Myanmar

PUBLICATIONS AND REPORTS

Thesis (Master)

- "**Low Frequency Power System Oscillation Damping using a Unified Power Flow Controller**" Asian Institute of Technology, ET04-4, August 2004.

Report

- **Than Oo** and Le Van Phu, "**Dispersed or Distributed Generator Placement in Power Distribution System using Genetic Algorithm"** Electric Power System Management, AIT, October 2003.
- **Than Oo**, "**Small-signal Stability Analysis in the Electric Power System"** Electric Power System Management, AIT, April 2004
- **Than Oo**, "**Initial Investigation of Sites Arrangement for AIT Micro-grid Project"** Electric Power System Management, AIT, July 2005.
- **Than Oo**, "**Recommendation Report for Upgrading Sub-station No. 1"** Electric Power System Management, AIT, October 2005.
- **Than Oo**, "**Demonstration Project for Advanced PV connected micro-grid"** A draft Proposal, Energy Technology, AIT, February 2007.

Conference

- Elena May Yee Yap, Majid Al-Dabbagh, Sarath K. Kapuduwage , **Than Oo** and Nemat, Talebi, "**HVDC and FACTS for power delivery through long transmission lines "** PES in south Africa, 16 June 2005.

Journal

- N. Minthulananthan, **Than Oo** and Le Van Phu, "**Distributed Generator Placement in Power Distribution System using Genetic Algorithm to Reduce Losses"** TIJSAT, 9(3), (July- September 2004), 55-62.
- N. Minthulananthan and **Than Oo**, "**Distributed Generator Placement to Maximize the Loadability of Distribution System"** International Journal of Electrical Engineering Education IJEEE 43/2, April 2006, Manchester University Press, Oxford Road, Manchester M13 9NR.

REFERENCES

1. **Dr. Loh Poh Chiang, Andrew (**Associate Professor)
   School of Electrical & Electronic Engineering
   Division of Power Engineering
   NANYANG TECHNOLOGICAL UNIVERSITY
   50 NANYANG AVENUE, SINGAPORE 639798
   Tel: +65 67905403
   Fax: +65 67933318

2. **Mr. Samir El-Attawi (**General Manager)
   Gulf Energy Technology and Projects
   PO Box 10161, Behind Salam Petrol Building
   Bin Umran, Doha, Qatar
   Tel: +974 4127514
   Fax: +974 4863351

3. **Dr. Faleh N. Al-Thani (**Owner and Chair person)
   Gulf Energy Technology and Projects
   PO Box 10161, No5, Al-Nawar Building
   Salwa Road, Doha, Qatar
   Tel: +974 4553287
   Fax: +974 4551627

4. **Mr. Ricky Tan (**Managing Director)
   Starlite Joint Venture
   1326, 1328 Soi Intramara 26, Suthisarnvintchai Rd.
   Dindaeng, Bangkok 10400
   Tel: (662) 693 8544
   Fax: (662) 693 9549, 693 9550
   E-mail: starlite@ksc.th.com

5. **Dr. Minthulanathan Nadarajah**
   School of Information Technology & Electrical Engineering
   The University of Queensland, Australia
   Email: mithulan@itee.uq.edu.au

6. **Associate Prof. Dr Weerakorn Ongsakul**
   Electric Power System Management,
   School of Environment, Resources and Development (SERD)
   Asian Institute of Technology
   E-mail: **ongsakul@ait.ac.th**
   Tel.: (662) 5245421

7. Mr. Surapong Srethbhakdi (Executive Director)
Thai Malleable Iron & Steel Co., Ltd and T. M Autocast Co., Ltd.
469/19 Rama III Road, Yanawa, Thailand
Tel: (662) 2853086-87, 2853089-90
Fax: (662) 285308

LOCAL REFERENCES (PARTIAL LIST)

1. U Thein Thura, Deputy Chief Engineer, MEPE
2. Dr Win Myint, A SE, MEPE
3. U Than Soe, SE, MEPE (Ahlone GT)
4. U Aye Kyaw Kyaw, Director, Arkarthit Enterprise
5. U Myint Aung, MD, Royal Marine Engineering Co. Ltd.
6. U Khin Aung, MD, Tech Supply & Trading
7. U WIN SEIN, Advocate of the Supreme Court
8. U TIN THAUNG, Advocate, Business & Legal Consultant
9. U Kyaw Min, Manager, Siemens Limited (Yangon Branch)
10. U Sai Naw Aung, MD, Aung Chantha Trading
11. U Ye Phone Hlaing, MD, Suntac Technologies
12. U Khin Maung Myint, MD, Yoma Engineering Services
13. U Nyi Nyi Lwin, MD, Myanma Power Spectrum
14. Daw Thandar Ne Win, MD, Global Quality Management
15. U Zaw Naing Thein, Vice Chairman, Supreme Group of Companies

Declaration

I hereby declare that the information furnished above is true to the best of my knowledge and belief.

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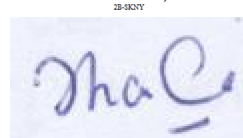

Curriculum Vitae (CV) for Key Expert

1. General:

Position Title and No.:	Senior Ecologist (Bird Specialist)
Name of Key Expert:	U Zay Maung Thein
Name of the Firm proposing the Key Expert:	Resource & Environment Myanmar Co., Ltd.
Date of Birth:	23rd December,1947
Nationality:	Myanmar
Country of Citizenship/Residence:	Myanmar

2. Education:

St. Joseph's Convent High School (Taungoo)
B.Sc. Geology (1966-1969) at Art and Science University (Yangon)
P.D.P.E.G. (1985-1986) at Oxford Polytechnic (U.K)
M.Sc. (Petroleum Geology) (1986-1987) at Aberdeen University (U.K)

3. Employment Record relevant to the assignment:

Period	*Employing organization and your title/ position*	*Country*	*Summary of* **activities** *performed relevant to the Assignment:*
1994-2009	Mandalay Branch Office Manager at Golden Express Your Co., Ltd.	Myanmar	
1970-1994	Demonstrator, Assistant Lecturer at Arts and Sciences University (Mandalay), Myit Kyina Degree Collage, Yangon University.	Myanmar	
	Contact information for reference:	Norihiko INOUE,General Manager of Environmental Science & Engineering Dept. thura@enviromyanmar. net	

4. Membership in Professional Associations and Publications: _

5. Language Skills:

	Speaking	*Reading*	*Writing*
English			
Myanmar	native	native	native

6. Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks

No.	*Title*	*Client*	*Poisson*	*Period*
1	Mongwa Hydropower Project (GOMW), Shan Region, Myanmar, Environmental and Social Impact Assessment (ESIA)			
2	Thayet Cement Project			
3	Mine Wa Hydropower Project	Special Region No.4 Government		
4	Upper Baluchaung Hydropower Project	Neo Energy Co., Ltd.		
5	Thilawa SEZ Class B	Nippon Koei		
6	Thayet Cement Plant	Myanmar Jidong Co., Ltd.		
7	Namtu-Bawdwin Mining Project	Win Myint Mo Co., Ltd.		

End of document

Present Position - Principal Consultant, Ecologist (Flora)

Name - Dr. Tin Tin Khaing

Date of birth - 13th August, 1966

Religion - Buddhist

Position - Lecturer

Department - Botany, Sagaing University

Education - B.Sc(Hons), Yangon University

M.Sc, Yangon University

Ph.D, Mandalay University

Home address **- Teacher Hostel, Sagaing University**

Phone No **- 09 444036432**

Email **- tintinkhaing@gmail.com**

ESIA Experiences:

- **Floristic Study on Angiospermae of Kyaukse Township in Mandalay Region.**
- **ESIA study for Coal Fired Power Plant Project in Tachilaik Township, 2014**
- **ESIA study for 5000 ton/day Cement Project in Kyaukse Township, 2014**

Name of Consultant	-	Daw Swe Wut Hmone
Present Position	-	Consultant, Ecological Environment
Name of Firm	-	Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	-	Myanmar
Profession	-	Ecologist
Date of Birth	-	10.5.1991
Years with Firm/Entity	-	2015

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Profile

Swe Wut Hmone researched the Isolation and Characterization of *Bradyrhizobium* from root nodules of *Arachis hypogia* and obtained her M.Sc. degree in Yadanabon University.
Recently, she works as an ecological consultant in Sustainable Environment Myanmar.

Selected Relevant Experience in an Environmental and Social Impact Assessment

S/n	Project name	Owner of the project	Person to contact and telephone	Completion time	Remarks
1.	5000 t/d cement plant in Kyaukse Township	Myanmar Conch Co., Ltd.		In Progress	
2.	Reclamation project for Sittwe city development (EIA)	Su Htoo Pan Co., Ltd.	Myint Han 959 49213286	In Progress	
3.	ESIA of Baluchaung Hydropower Project	Neo Energy Oasis Development Co.,Ltd.			
4.	Cement plant of Thayet (EIA)	Myanmar Jidong	Aprial Thazin 095081666		
5.	Star City Project of Thilawa (EIA)	SEZ Co., Ltd	Steve Pearmain (MD)		
6.	Thilawa (Dry and Rainy Season) (EIA)	Noppon Koei Co., Ltd.	Nippon Koei www.n-koei.co.jp.		
7.	Mining Project of Namtu (EIA)	Win Myint Mo Co.,Ltd.			

Education - M.Sc (Botany) (Credit), Yadanabon University, 2014
- B.Sc (Botany) (Hons), Yadanabon University, 2012

Other Qualification - Computer Basic, Environmental Studies Level-1, Basic Concepts and Application of Statistics Using SPSS Software

Language - Burmese mother tongue and English

Name of Consultant	-	Naing Naing Win
Present Position	-	Consultant Ecologist
Name of Firm	-	Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	-	Myanmar
Profession	-	Entomology
Date of Birth	-	17.7.1985
Years with Firm/Entity	-	2015 Nationality - Myanmar

Membership in Professional Society - BANCA (Biodiversity and Nature Conservation Association

Detailed of Tasks Assigned - Environmental Baseline study for fauna

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Profile

Naing Naing Win has earned her MSc degree in Zoology (specialization in Entomology) from the university of Dagon in 2008.After graduation she has involved in many EIA and SIA projects. She has also involved in many projects by MSR (Myanmar Survey Research) covering social scientist topics such as HIV study monitoring condom uses in female sexworkers 2013; KAP survey of UNICEF projects on child soldier protection and vaccination campaign(2013); UNICEF project on water sanitation and personal hygiene campaign; also involved in Focus Group Discussion on water sanintation and personal hygiene(2013);worked as supervisor on opinion poll survey on political point of view of the local people(2015) sponsored by CSIS. As regards EIA,SIA survey works she has participated in many developmental projects in many part of country. At the moment she is an entomologist for Fauna & Flora International (Myanmar), an INGO.

Professional **History**

Selected Relevant Experience in an Environmental and Social Impact Assessment

Environmental Impact Assessment and Environmental Management on:

S/n	Project name	Owner of the project / Organization	Person to contact and telephone	Completion time	Remarks
1	ESIA of Myintsone Hydropower project in Kachin State	BANCA (Biodiversity And Nature Conservation Association)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2009	
2	Resettlement Action Plan of Myintsone hydropower project in Kachin State	BANCA (Biodiversity And Nature Conservation Association)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2010	
3	ESIA of Kunlon hydropower project	BANCA (Biodiversity And Nature Conservation Association)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2010	
4	Resettlement Action Plan of Myintsone hydropower project in Kunlon Hydropower project	BANCA (Biodiversity And Nature Conservation Association)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2010	

5	Spoon-billed sandpiper project in Sittwe Town, Rakhine State.	BANCA (Biodiversity And Nature Conservation Association)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2011	
6	Baseline survey on Female sex workers project in Mandalay Division.	MSR (Myanmar Survey Research)	MSR (Consultant) +95 1 370436	2011	
7	Baseline data collection and baseline reporting of Opinion poll project in Mandalay Division	MSR (Myanmar Survey Research)	MSR (Consultant) +95 1 370436	2013	
8	Baseline data collection and baseline reporting of FGD project in Myaing Township, Magwe Region	MSR (Myanmar Survey Research)	MSR (Consultant) +95 1 370436	2013	
9	Baseline data collection and baseline reporting of UNICEF Project in Sittwe Town, Rakhine State	MSR (Myanmar Survey Research)	MSR (Consultant) +95 1 370436	2013	
10	Baseline studies on fauna ecology and reporting (Biodiversity in extinction area at Tanintharyi)	BANCA (Biodiversity And Nature Conservation Association)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2013	
11	Documentary in Mooeyungyi wildlife Sanctuary	BANCA (Biodiversity And Nature Conservation Association)	Dr. Thiri Dawei Aung (BANCA) +959 420080479	2013	
12	Baseline data collection and baseline reporting of UNICEF Project in Sittwe Town, Rakkhine State	MSR (Myanmar Survey Research)	Dr. Htin Hla (EIA consultant) +95 9 420080979	2013	
13	Baseline data collection and baseline reporting of Opinion poll project in Bago Division	CSIS (Centre for Strategic and International Studies)	Daw Mya Nandar (project) +95 9 458043214	2014	
14	Resettlement Action Plan of Kalawa	MESC (Myanmar Environment Sustainable Co., Ltd.)	U Myint Kyaw Thura (MD) 09420105071	2015	
15	Baseline studies on fauna ecology and reporting (Biodiversity survey in EMawbun, Kachin State)	FFI (Fauna and Flora International)	FFI (Flora and Fauna International)	2015	
16	EIA of Baluchaung Hydropower Project, Southern Shan State	Neo Energy Oasis Development Co., Ltd.		2015	
17	EIA of Start City Project, Thanlyin Township	SLP Environment Co., Ltd (EIA consultant)	EIA consultant: Steve Pearmain (MD) www.slpenvironmental.com	2015	
18	EIA of Thayet Cement Plant, Thayet Town,	Myanmar Jidong Cement Co., Ltd. (Thayet BOT	Myanmar Jidong		

	Magwe Region	Cement Project) (Client) & D'Appolonia S.p.A (ESIA consultant)	Cement Co., Ltd. April Thazin +959 5081666		
19	EIA of Namatu_Bawdwin Mine Project, Shan State)	Win Myint Mo Co., Ltd.		2015	
20	EIA monitoring survey of Thilawa Class A and B	Nippon Koei Co., Ltd.	Nippon Koei www.n-koei.co.jp	2015	

Education - M.Sc., Dagon University, 2008 (Zoology)
- B.Sc(Hons) ., Dagon University, 2006

Language **-** Burmese mother tongue and English, Rakhine

Name of Consultant - Ma Than Than Htay

Present Position - Consultant Ecologist

Name of Firm - Sustainable Environment Myanmar Co., Ltd. (SEM)

Nationality - Myanmar

Profession - Entomology

Date of Birth - 6.12.1985

Years with Firm/Entity - 2015

Nationality - Myanmar

Membership in Professional Society -BANCA (Biodiversity and Nature Conservation)

Detailed of Tasks Assigned Environmental Baseline study for fauna

Profile

She earned her M.Sc (Zoology) degree in 2008 from Dagon University. She worked as an entomologist and social scientist in environmental conservation projects. Her specialization is entomology. At the moment she is involved in EIA and SIA works in many developmental projects. She has also participated in opinion survey polls regarding the current political situation in the country; which political party is popular with the people and which political leader/ leaders they like best etc.

Professional History

Selected Relevant Experience in an Environmental and Social Impact Assessment

Environmental Impact Assessment and Environmental Management on:

S/n	Project name	Owner of the project	Person to contact and telephone	Completion time	Remarks
1	EIA of Myintsone Project ESIA of Myintsone Hydropower project in Kachin State	BANCA (Biodiversity And Nature Conservation Association	Dr.Htin Hla (Banca) 09420080797	2009,December	
2	EIA of Kunlon Project ESIA of Kunlon hydropower project	BANCA (Biodiversity And Nature Conservation Association	Dr.Htin Hla (Banca) 09420080797	2010,February	
4	Baseline data collection and baseline reporting in Resettlement Action Plan of Myintsone hydropower project in Kachin State	BANCA (Biodiversity And Nature Conservation Association	Dr.Htin Hla (Banca) 09420080797	2010,March	
5	Baseline data collection and baseline reporting in Resettlement Action Plan of Myintsone hydropower project in Kunlon Hydropower project	BANCA (Biodiversity And Nature Conservation Association	Dr.Htin Hla (Banca) 09420080797	2010,October	

6	Resettlement Action Plan of Kalawa	MESC(Myanmar Environment Sustainable Co.Ltd	Myint Kyaw Thura(MD) 09420105071	2015,February	
7	Baseline studies on biodiversity and reporting (EIA of reclamation works at Sittwe, Rakhine State	Su Htoo San Co., Ltd	U Myint Han (Director)	April, 2015	
8	EIA of Star City Project, Thanlyn	SLP Environment Co., Ltd (EIA consultant)	EIA consultant: Steve Pearmain (MD) www.slpenvironmental.com	August, 2015	

Education -- M.Sc., Dagon University, 2008(Zoology)
- B.Sc(Hons)., Dagon University, 2006

Language **-** Burmese mother tongue and English, Rakhine

Chit Myo Lwin

Name of Consultant	-	Chit Myo Lwin
Present Position	-	Project Manager
Name of Firm	-	Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	-	Myanmar
Profession	-	Environmental Geology
Date of Birth	-	19 September 1988
Years with Firm/Entity	-	2009 Nationality - Myanmar

Membership in Professional Society - Myanmar Geosciences Society (MGS)
- Faculty Member of Myanmar Environment Institute (MEI)

Detailed of Tasks Assigned - Collect Environmental Baseline Data and prepare baseline data report
- Manage baseline data team and co-ordination with Client

Profile

Mr. Chit Myo Lwin obtained his B.Sc. degree in geosciences and became professional geologist in Myanmar since 2009. At present he is a project manager of Sustainable Environment Myanmar Co., Ltd. He has six years of experience in the field of Geosciences and EIA, and currently he works as a project team leader of environmental baseline data collection team in an area of Environmental Impact Assessment and Environmental Management in various projects.

Professional History

2014 to date - Project Manager, Principal Consultant, EIA and EMP, Resource & Environment Myanmar Co., Ltd.

2013 – 2014 - Geoscientist and project coordinator in Siam Cement Company (SCG)

2009 - 2013 - Physical Environmental Consultant, Resource and Environment Myanmar Co., Ltd.

Geoscientist : Conduct project on gold mineral exploration in Ba Mauk Township (Upper Sagaing Region), Limestone exploration in Mon and Kayin States, geology and geotechnical investigation of Tanintharyi hydropower project, raw material exploration for cement in MCL cement plant (Mawlamyine) in Union of Myanmar.

Coordinator : Project coordinator between developer and contractors for cement plant (Siam Cement Plant in Mawlamyine) and negotiation with government and local people for project development at site as well.

Consultant : Physical environmental consultant in EIA surveys of different projects such as oil and gas sector, multi-hydropower project, gas turbine project, cement plant, city development, deep sea port project and so on.

Project Manager: EIA study for Kyaukse Cement Plant, Sittwe Reclamation for city development

Selected Relevant Experience in the Environmental and Social Impact Assessment, and Geoscience

Environmental Impact Assessment and Environmental Management on:

S/n	Project name	Owner of the project	Person to contact and telephone	Completion time	Remarks
1	Gold exploration in Bank Mauk Tsp.	Care Mineral Cooperation (CMC)	Than Tun (MD) 959 5151309	June, 2009	Submitted to Ministry of Mine
2	EIA of Myanmar-China Gas Pipeline Project	CNPC IEM (Intern. Environmental Management Co. Ltd.)	Ron Livingston (MD) 662 6366390	November , 2010	Submitted to Myanma Oil and Gas Enterprise
3	Geotechnical and geological surveys in Hydropower project at Taninthar yi	ITD (Italian Thai Development Co. Ltd.)		April, 2011	ITD (Italian Thai Development Co. Ltd.)
4	ESHIA of Mai Khot Coal Power Project	IPC (Italian Thai Power Co. Ltd.)	Vudtichai Eksangsri (CVO) 66 85 2495 655	October, 2010	Submitted to Ministry of Energy
5	ESHIA of Upper Yeywar – Shwezaryan 230 kV Transmission Line	Ministry of Electric Power (1) & GK Power Systems Ltd.	Zeya Thura Mon (MD) +(95-1) 502016-18	September , 2011	Submitted to Ministry of Electric Power Enterprise
6	ESHIA of Baluchaung-Shwemyo 230 kV Transmission Line	Ministry of Electric Power (1) & GK Power Systems Ltd.	Zeya Thura Mon (MD) +(95-1) 502016-18	November , 2011	Submitted to Ministry of Electric Power Enterprise
7	Socioeconomic Assessment for Rakhine Region	Myanmar Engineering Society	U Than Myint +95 9 5136467	November , 2011	UNDP Multi Hazard Project
8	Environmental Baseline Survey of Dawei Deep Sea Port and Industrial Development	Italian Thai Devlopment and Team Engineering Consultant	Dr. Sirinimit Boonyuen (MD, Env Unit) +662-509-9000 ext. 2305	May, 2012	Submitted to the Special Economic Zone Committee
9	ESHIA of Thaketa Gas Turbine Project	BKB Co. Ltd.	Dr. Sone Han (Local Rep./ Proj. Director) +95 9 5183631	May, 2012	Submitted to MIC
10	SIA of Main Road Project, Dawei	Italian Thai Development and Seatac Group	Pracha Jantarasarsophon tsiajao@yahoo.com	July, 2012	Submitted to the Special Economic Zone Committee
11	ESHIA of Modi Taung Gold Project	National Prosperity Co. Ltd.	Thiha Zaw Lin Project Director	March, 2012	Submitted to MIC
112	EIA of 500 MW CCPP at Hlawga	Htoo & HIE, China	Zhuang Jinxiang 18669086755 zhuangjx_love@126.com	Feb. 2013	Submitted to MIC
13	5000 t/d cement plant in Mawlamyine as geoscientist and coordinator	Siam Cement Company	Mongkon Pornchunchoovongm ongkonp@scg.co.th	Oct 2013-May 2014	
14					
15	ESIA for Baseline study of Thilawa Special Economic	Nippon Koei Co., Ltd.	-	December , 2013	MOECAF

	Zone Class A				
16	Environmental and Social Survey for Environmental Impact Assessment Studies under the Project for Electric Power Development in the Thilawa Area	Nippon Koei Co., Ltd.		September , 2014	MOECAF
17	Environmental Baseline Survey for environmental and social consideration for energy sector rehabilitation program in Myanmar	Nippon Koei Co., Ltd.		October, 2014	MOECAF
18	Survey for Preparation of Abbreviated Resettlement Plan for Feasibility study for the construction of new Thaketa and Bago River Bridge	Nippon Koei Co., Ltd.		September , 2014	Ministry of Construction
19	ESIA of Upper Yeywa Hydropower Project	Department of Hydropower Implementation (DHPI), Ministry of Electric Power (MOEP).			MOEP
20	5000 t/d cement plant of Kyaukse	Myanmar Conch Co., Ltd.		2015	MOECAF
21	Reclamation project for city development in Sittwe	Su Htoo San Co., Ltd.		2015	MOECAF

Education - Diploma in Geographic Information System & Remote Sensing
B.Sc. (Geology)

Language **-** Burmese mother tongue and English

Curriculum Vitae (CV)

1. General:

Position Title and No.:	Consultant (Forest & Vegetation)
Name of Key Expert:	Myat Ko Ko Hein (Mr)
Name of the Firm proposing the Key Expert:	Sustainable Environment Myanmar Co., Ltd.
Date of Birth:	7th February, 1992
Nationality:	Myanmar
Country of Citizenship/Residence:	Myanmar

2. Education: B.Sc. (Forestry)

3. Employment Record relevant to the assignment:

Period	***Employing organization and your title/ position***	***Country***	***Summary of* activities *performed relevant to the Assignment:***
2015 - present	Resource &Environment Myanmar Co., Ltd. Consultant (Forest & vegetation)	Myanmar	Responsible for ecology survey for IEE and ESIA studies.
March 2014 - August 2014	E-Guard Environmental Services Co., Ltd. Assistant Technician (Air Quality, water quality, noise measurement & data analysis)	Myanmar	Responsible for physical environment for IEE and EIA studies.

Contact information for reference: Zaw Naing Oo, Director of Resource and Environment Myanmar Ltd. zawnaingoo@enviromyanmar.net

4. Membership in Professional Associations and Publications:

5. Language Skills:

Language	*Speaking*	*Reading*	*Writing*
English	Fair	Fair	Fair
Myanmar	Native	Native	Native

6. Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks

No.	***Title***	***Client***	***Poisson***	***Period***
1	Air quality, vibration and noise measure for Domestic Terminal, Yangon.	Joint with private company	Assistant Environmental Technician (Air quality, noise and vibration)	June 2014
2	Caustic Soda Plant, Tha Htone	Joint with MSR (Myanmar Survey Research)	Assistant Environmental Technician (Air quality)	July 2014
3	Yangon Circular Railway Upgrade Project	JICA	Assistant Environmental Technician (Air quality, noise)	29 Aug 2014
4	Thilawa SEZ Class A	Nippon Koei	Assistant Environmental Technician (Air quality & noise)	15 Aug 2014
5	Miela Hydropower Project	Special Region No.4 Government	Consultant (Forest & vegetation)	February 2015
6	Sittwe Reclamation Project	Su Htoo San Co.,Ltd and BXT Construction and Development Company	Consultant (Forest & vegetation)	April 2015
7	Star City Yangon Resident	Thanlyin Estate Development Ltd.	Consultant (Forest & vegetation)	September 2015
8	Upper Baluchaung Hydropower Project	Neo Energy Co., Ltd.	Consultant (Forest & vegetation)	June 2015
9	Thilawa SEZ Class B	Nippon Koei	Consultant (Forest & vegetation)	October 2015
10	Thayet Cement Plant	Myanmar Jidong Co., Ltd.	Consultant (Forest & vegetation)	September 2016
11	Namtu-Bawdwin Mining Project	Win Myint Mo Co., Ltd.	Consultant (Forest & vegetation)	December 2016

End of document

Thet Naing Aung, B.Sc.

Consultant

Born on 25.6.1986

Proposed Position: **Wildlife Expert**

Years in firm since: 2010

In profession since: 2008

Specialisation

Birds and Mammals

Benthos

Biodiversity

Environmental Impact Assessment

Education

2006- B.Sc., Bago University, Myanmar

Zoology

Language (1 to 5, 5=excellent)

Language	Reading (1-5)	Speaking (1-5)	Writing (1-5)
Myanmar	5	5	5
English	5	5	4

Professional Experience

- Environmental Impact Assessment for Ayeyarwady River Confluence Hydropower project (2009)

- Environmental Impact Assessment for Industry and Dawei deep sea port project (2011)

- Environmental Impact Assessment for Shwe Li II Hhydropower Project (2012)

- Environmental Impact Assessment for SCG cement factory project, Mon State in Myanar (2012)

-Environmental Impact Assessment for Letpadaung Copper Mine project, Sagaing Region, Myanmar (2013)

-Initial Environmental Examination for Tin and Tungsten Separator Plant, Loikaw Township, Kayar State (2013)

-Environmental and Social Impact Assessment of Ngawchankha Hydropower project, Kachin State in Myanmar (2014)

Kyaw Naing Oo

Name of Consultant - Kyaw Naing Oo

Nationality - Myanmar

Profession - Mammalogy

Date of Birth - 30.11.1985

Education - B .Sc (Zoology)

Language **-** Burmese mother tongue, English(Fair) and Kayin(Fluent).

Membership in Professional Society - BANCA (Biodiversity and Nature Conservation Association)

Detailed of Tasks Assigned - Environmental Baseline study for fauna

Other Traning -GIS Training (BANCA 2010) & HCV (High Conservation Value) traing

Profile

Kyaw Naing Oo has earned her B.Sc degree in Zoology (specialization in Mammalogy) from the University of Maubin University in 2008.After graduation he has involved in many EIA and Wild life conservation projects. Other Qualification are (GIS) Sort Ware training Basic (2010) and HCV (High Conservation Value) From FFI (Flora and Fauna International 2015).

He has also involved in many projects by BANCA (ECOLOGY specialist 2009 to 2010, Burma, Nature's Lost Kingdom Documentary Film, BBC natural history unit by BANCA (Camera trapping and Mammalogist) also involved in Consultatant of Ecology and Social (EANCA and MESC Co,.Ltd and SEM Co,. Ltd. from 2013 to up to now), EIA, SIA survey works she has participated in many developmental projects in many part of country. Other he is an mammalogist and Camera trapping (Fauna & Flora International (Myanmar), an INGO.(2013 to 2015)

Professional **History**

Selected Relevant Experience in an Environmental and Social Impact Assessment Environmental Impact Assessment and Environmental Management on:

Environmental Impact Assessment and Environmental Management on:

Period	**Organization or client**	**Position**	**Responsibilities**
Dec, 2009	BANCA (Biodiversity And Nature Conservation Association)	Consultant (Ecology)	Baseline Studies on fauna survey and baseline survey reporting (ESIA of Myintsone Hydropower project in Kachin State)
Feb, 2010	BANCA (Biodiversity And Nature Conservation Association)	Surveyor (Social)	Baseline data collection and baseline reporting in Resettlement Action Plan of Myintsone hydropower project in Kachin State
March, 2010	BANCA (Biodiversity And Nature Conservation Association)	Consultant (Ecology)	Baseline Studies on Fauna survey and baseline survey reporting (ESIA of Kunlon hydropower project
Oct, 2010	BANCA (Biodiversity	Surveyor	Baseline data collection and baseline reporting in

	And Nature Conservation Association)	(Social)	Resettlement Action Plan of Myintsone hydropower project in Kunlon Hydropower project
May2012-July 2012.	BANCA (Biodiversity And Nature Conservation Association)	Surveyor	Population Status and Distribution of Gurney's Pitta(*Pittas gurneyis)* in Tanintharyi Division.
Dec, 2013	BANCA (Biodiversity And Nature Conservation Association)	Camera trapping	Burma, Nature's Lost Kingdom Documentary Film, BBC natural history unit.(BANCA).
2,March, 2013	BANCA (Biodiversity And Nature Conservation Association)	ECOLOGY consultant	Baseline data collection and baseline reporting of Coal fire Project of Myeik township, Tanintharyi Division.
13, September, 2013	ENCA(Environmental and Nature Conservation Association)	ECOLOGY consultant (Mammalogy)	Baseline data collection and baseline reporting of Pin Nyaung Township, Southern Shan State).
5,May, 2015	FFI(Flora and Fauna International)	Gurneypitta Surveyor	Baseline data collection and Camera trapping of Gurney pitta and Wildlife species conservation in Proposed of Lenya National Park and Ngawun Reserve forest , Tanintharyi Division.
15,march, 2015	FFI(Flora and Fauna International)	Tiger(Camera Trapping) Junior Consultant	Baseline data collection and Camera trapping of Tiger and Wildlife species conservation in Proposed of Lenya National Park and Ngawun Reserve forest , Tanintharyi Division.
Jan, 2013	BANCA (Biodiversity And Nature Conservation Association)	Consultant (Fauna Ecology)	Documentary in Mooeyungyi wildlife Sanctuary
2015,February	MESC (Myanmar Environment Sustainable Co., Ltd.)	Consultant (Fauna Ecology)	Resettlement Action Plan of Kalawa
July, 2015	Neo Energy Oasis Development Co., Ltd.	Senior Consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Baluchaung Hydropower Project, Southern Shan State)
Aug, 2015	SLP Environment Co., Ltd (EIA consultant)	Senior consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Start City Project, Thanlyin Township)
September, 2015	Myanmar Jidong Cement Co., Ltd. (Thayet BOT Cement Project) (Client) & D'Appolonia S.p.A (ESIA consultant)	Senior Consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Thayet Cement Plant, Thayet Town, Magwe Region)
Dec, 2015	Nippon Koei Co., Ltd.	Senior Consultant (Fauna Ecology)	Baseline studies on biological environment and reporting (EIA monitoring survey of Thilawa Class A and B)
19 , August,2016	Neo Energy Oasis Development Co., Ltd.	Senior Consultant	Baseline studies on fauna ecology and reporting (EIA of Baluchaung Hydropower Project, Southern Shan

		(Fauna Ecology)	State)
28,August,2016	MESC(Myanmar Environment Sustainable Co,.ltd.	Senior Consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Mining Project, Kayar State)
25,September, 2016	Sustainable Environment Myanmar (SEM CO,.Ltd)	Senior Consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Gas Turbine of CCPP Power Plant Project, Dawei Township Tanintharyi Division)
9,October, 2016	Sustainable Environment Myanmar (SEM CO,.Ltd)	Senior Consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Petroleum Pipe line Project,MinBu Township Magwe Region.
	MESC(Myanmar Environment Sustainable Co,.ltd.	Senior Consultant (Fauna Ecology)	Baseline studies on fauna ecology and reporting (EIA of Knap Project ,Kanma Township Magwe Region.

Curriculum Vitae (CV)

1. General:

Position Title and No.:	Consultant (Microbiology)
Name of Key Expert:	Nyan Linn Maung (Mr)
Name of the Firm proposing the Key Expert:	Resource & Environment Myanmar Co., Ltd.
Date of Birth:	8th June, 1988
Nationality:	Myanmar
Country of Citizenship/Residence:	Myanmar

2. Education: B.Sc (Microbiology)

3. Employment Record relevant to the assignment:

Period	*Employing organization and your title/ position*	*Country*	*Summary of* activities *performed relevant to the Assignment:*
2015 - present	Resource &Environment Myanmar Co., Ltd. Consultant (Microbiology)	Myanmar	Responsible for ecology survey for IEE and EIA studies.
2012 - 2014	Resource and Environment Myanmar Co., Ltd. Assistant Environmental Technician	Myanmar	Responsible for physical environment for IEE and EIA studies.

Contact information for reference: Zaw Naing Oo, Director of Resource and Environment Myanmar Ltd.
zawnaingoo@enviromyanmar.net

4. Membership in Professional Associations and Publications:

5. Language Skills:

Language	*Speaking*	*Reading*	*Writing*
English	Fair	Fair	Fair
Myanmar	Native	Native	Native

6. Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks

No.	***Title***	***Client***	***Poisson***	***Period***
1	Shweli Hydropower project	KHIDI Kunming Engineering Co., Ltd.	Assistant Environmental Technician	September 2012
2	Letpadaung Taung Ecology and Traffic Survey	-	Assistant Environmental Technician	December 2012
3	Dawei new Terminal	-	Assistant Environmental Technician	2014
4	Naw Chan Hka Hydropower	Power China Kunming Cooperation Co., Ltd.	Assistant Environmental Technician	2014
5	Air, Noise, Soil and water quality survey for Thilawa (SEZ)	Nippon Koei	Assistant Environmental Technician	2014
6	Myingyan (IPP) project	-	Assistant Environmental Technician	-
7	Tachileik coal mine	-	Assistant Environmental Technician	-
8	Upper Yeywa environmental survey	-	Assistant Environmental Technician	-
9	Miela Hydropower project	Special Region No.4 Government	Consultant	February 2015
10	Sittwe reclamation project	Su Htoo San Co.,Ltd and BXT Construction and Development Company	Consultant	September 2016
11	Star City Yangon Resident	Thanlyin Estate Development Ltd.	Consultant	September 2015
12	Upper Baluchaung Hydropower Project	Neo Energy Co., Ltd.	Consultant	June 2015
13	Thilawa SEZ Class B	Nippon Koei	Consultant	October 2015
14	Thayet Cement Plant	Myanmar Jidong Co., Ltd.	Consultant	September 2016
15	Namtu-Bawdwin Mining Project	Win Myint Mo Co., Ltd.	Consultant	December 2016

End of document

Name	-	Poe Mon Mon Kyaw
Present Position	-	Health and Safety Manager
Name of Firm	-	Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	-	Myanmar
Profession	-	Social Survey
Date of Birth	-	2.1.1992
Years with Firm/Entity	-	2014
Membership in Professional Society	-	Myanmar Engineering Society
Detailed of Tasks Assigned	-	Environmental Health and Safety Management

Profile

Poe Mon Mon Kyaw obtained her A.G.T.I diploma in Civil in 2011. She worked for Myanmar Earthquake Committee as an assistant technical Engineer about one year and Golden Hexagon construction Co., Ltd as a site engineer about five months. At present she is working at Sustainable Environment Myanmar Company Limited as Health and Safety Manager.

Professional History

2013-2014	-	Technical Assistant Engineer Myanmar Earthquake Committee (MEC)
2014 Jan-Aug	-	Site Engineer Golden Hexagon Construction.Co,Ltd.
2014 Aug to Date	-	Health and Safety Manager Sustainable Environment Myanmar

Selected Relevant Experience in Environmental and Social Impact Assessment

Sr.	Period	Title	Responsibility
1	2013-2014	Myanmar Earthquake Committee, Myanmar Engineering Society	Practical works on the project of Earthquake Risk Assessment in Bago, Sagaing and Taungoo, Myanmar National Building Code Project and Detailed Measure of the Shwedagon Pagoda Project.
2	Jan-Aug 2014	Golden Hexagon Construction	Inspector and supervisor in construction of 6 storied building Quantity surveyor in construction site and draft AutoCAD designer on progress of construction site
3	Mar-2015	Myanmar Conch Cement Co. Ltd	Baseline data collection of safety, health and environment condition at factory and reporting for environmental management and safety, occupational health (EIA & EMP project for cement plant in Thandawmyat Taung, Kyaukse Township)
4	July-2015	Neo Energy Oasis Development Co., Ltd.	Baseline data collection of safety, health and environment condition at factory and reporting for environmental management and safety, occupational health (EIA of Baluchaung Hydropower Project, Southern Shan State)

5	Sept 2015	Myanmar Jidong Cement Co., Ltd. (Thayet BOT Cement Project) (Client) & D'Appolonia S.p.A (ESIA consultant)	Baseline data collection of safety, health, and environment at cement factory and environmental management planing (ESA of Thayet Cement Plant, Thayet Town, Magwe Region)
6	Jan 2016	ERM-Siam Co., Ltd. (IEE consultant) & Myanmar Industrial Estate Holding Pte. Ltd. (Client)	Baseline data collection of socio-economic and HSE condition at villages and baseline reporting (IEE project of Water Treatment Plant Project as part of the Intial Development Phase of DSEZ)

Education - AGTI (Civil Engineering) Technical University (Thanlyin) , 3rd Year (Physics)

Language **-** Burmese, English.

CURRICULUM VITAE: MISS PHYOE KHIANG ZAR WINT

Personal Information

Citizenship:	Myanmar
NRC No :	13/ Ta Ka Na (Naing) 245525
Passport No:	MB227438
Date of birth:	December 12, 1991
Religion:	Buddhism
Marital Status:	Single
Contact Tel:	95-9-428327828, 95-9-972533395
E-mails:	crystalrose.wint@gmail.com
Address:	No.125, Hnin Si Road , Pyi Taw Tar Quarter, Taunggyi

Personal Profile

I am a punctual and reliable person who works well under pressure. I am able to work both in a team environmental and on my initiative. I have a friendly disposition and have a good sense of humour. My goal is to work for a reputable employer in a reception or administration role.

Key Skills

- ✓ Strong communication skills
- ✓ Effective at self time management
- ✓ Money handling experience
- ✓ Experience of customer services
- ✓ Excellent team player
- ✓ Preparing for Stakeholder Meeting and engagement

Educational Background

Bachelor of Engineering (Electronic Communication)	Dec 2013 Taunggyi Technological University, Myanmar
Bachelor of Technology(Electronic Communication)	Dec 2010- 2012 Taunggyi Technological University, Myanmar
A.G.T.I (Electronic Communication) (Associates ship of Government Technical Institute	Dec 2007-2009 Taunggyi Technological University, Myanmar

Attended Training and workshops

- I office 2007
- Advanced office 2013
- Auto CAD Course
- Adobe Photoshop 7.0 Cs, Page Maker
- Switch, Html, Macromedia Dream weavers
- Geographic Information System
- Certificate of Environmental Monitoring for Industrial Water Pollution
- Certificate of Environmental Engineering and Management Training
- Training on Environmental Perimeter Air Station (EPAS)
- Basic First Aid Training
- Awareness for ISO 9001:2008
- Certificate of Participation in Recognition of Dedication and Commitment as a Youth Ambassador of Mekong River Project 2016, Chiang Rai, Thailand.

Employment Record

Company Name:	**Eguard Environmental Services Co., Ltd.**
Position:	Project Associate
Period:	1 Dec 2013 – 31 May 2016
Responsibilities:	Water Sampling, Monitoring, Analysis and Air Quality data interpretation, Stakeholder Meeting Engagement and Environmental Quality Monitoring, Conducting report for Environmental Report
Company Name:	**Resource and Environmental Myanmar Co., Ltd.**
Position:	Consultant
Period:	6 July 2016- Up to now
Responsibilities:	Conducting various environmental report, Assist Seniors Consultant in report section

Word Undertaken/ Tasks Assigned

Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Upgrading of Yangon Circular Railway Project 2016 Yangon JICA Upgrading of Railway Project Associate Water Sampling, Monitoring, Analysis and Air Quality data interpretation
Name of assignment or project: Year: Location: Client: Main project features: Position held:	Semikone Port Project 2016 Yangon ERM Hong Kong Port Project Associate

Activities performed:	Water Sampling, Monitoring, Analysis and Air Quality data interpretation, Stakeholder Meeting
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Mongton Dam Water Quality and Hydrology Survey 2015 Hpa Ann, Than Lwin River SMEC Hydro Power Dam and Transmission project Project Associate Soil, Sediment and Water Quality Sampling
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed	Korea Myanmar Friendship (Dala Bridge) 2016 Dala Korea Environmental and Social Impact Assessment Project Associate Environmental Quality Monitoring
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Water & Wastewater Quality Survey 2015 Mandalay Safege, ADB, MCDC Mandalay Urban Development Project Project Associate Water Sampling and Monitoring
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Dry Zone Water Supply Project 2014 Dry zone JICA Water Supply in Dry Zone Project Associate Water Quality Data Analysis and Interpretation
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Inlay Hotel Project 2014 Inlay Project Associate IEE Report Project Associate Water Sampling and Monitoring, Participating in Public Hearing Meeting

Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Yangon Circular Railway Upgrading Project 2014 Yangon JICA, MRD Upgrade Yangon Rail Road Engineer (Instrumentation and data acquisition) Water Sampling and Monitoring
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Mekong Highway Project 2014 Hpa Ann JICA Upgrade Highway Engineer (Instrumentation and Data Acquisition) Water and Air Quality Analysis
Name of assignment or project: Year: Location: Client: Main project features: Position held: Activities performed:	Thilawa 200Ha SEZ Development project 2013 Thilawa JICA Special Economic Zone Engineer (Instrumentation and Data Acquisition) Water and Air Quality Analysis
Other Local Project:	Industry, Factories

Personal Strengths

- Leadership drive
- Dynamic team player
- Sense of responsibility
- Highly initiative, dedicated and organized mind with a positive attitude
- Knowing own limits and coping well under pressure
- Keen to learn more and continuously upgrade
- Research skill in Environmental and health related issues

Activities and Interests

Reading, listening to music and other outdoor and volunteering activities

Language Skills

Myanmar (Native)
English (Fluent 4 skills)

Name of Consultant	- Nu Yin
Present Position	- Senior Social Consultant
Name of Firm	- Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	- Myanmar
Profession	- Social Survey
Date of Birth	- 20- 05- 1984
Years with Firm/Entity	- 2015
Nationality	- Myanmar
Membership in Professional Society	- None
Detailed of Tasks Assigned	- Social Questionnaire Surveys, Focus Group Discussion, Key Informant Interview, Case Study.

Profile

Nu Yin obtained her B.A degree in Business Management in 2008. She worked for Myanmar Marketing Research and Development Co., Ltd as a research supervisor in social research about seven years. At present she is working at Sustainable Environment Myanmar Company Limited as a SIA team.

Professional History

July, 2008 - 31st Dec, 2011	- Team Leader as project staff
1st Feb, 2012 - 16th July, 2015	- Research Supervisor (Myanmar Marketing Research and Development Co., Ltd.)
17th July, 2015 - Present	- SIA team member (Sustainable Environment Myanmar Co., Ltd.)

Selected Relevant Experience in an Environmental and Social Impact Assessment

Field Research Involvement in social field on:

Sr.	Period	Title	Responsibility
1	2008	Myanmar Rapid Village Tract Assessment on Nargis (Tripartite Core Group).	Team member in Social Survey
2	2008	Study on Monitoring of 4 Cleans Media Outlets of Myanmar Motion Picture Organization (UNICEF).	Team member in Social Survey
3	2008	Disabilities Survey – Part 1(Department of Social Welfare, TLMI, EDEC and YDRC).	Team member in Social Survey
4	2009	Study on Monitoring of 4 Cleans Media Outlets of Myanmar Motion Picture Organization (UNICEF).	Team Leader in Social Survey

5	2009	Disabilities Survey – Part 2(Department of Social Welfare, TLMI, EDEC and YDRC).	Team member in Social Survey
6	2010	SC_ECCD_Eco-Impact (Save the Children).	Team member in Social Survey
7	2011	(Reducing Economic Vulnerability through an Equitable/Inclusive Approach to Livelihoods) REVEAL Baseline Survey - Part – A (HelpAge International).	Team member in Social Survey
8	2011	(Reducing Economic Vulnerability through an Equitable/Inclusive Approach to Livelihoods) REVEAL Baseline Survey - Part – B (HelpAge International).	Team Leader in Social Survey
9	2011	PRIDE_Baseline Assessment for PwD Economic situation study (TLMI).	Team Leader in Social Survey
10	2012	HDI_Human Development Initiative survey (UNDP).	Team Leader in Social Survey
11	2012	Community Development in Myanmar Access to Services for Rural Livelihood (UNDP).	Team member in Social Survey
12	2012	Poverty Dynamic & Causality Study Project (UNDP).	Supervise in Social Survey Team
13	2012	HAI- Reveal - Market Chain Analysis (HelpAge International).	Supervise in Social Survey Team
14	2012	Agricultural Activities, Small Enterprises and Land Use Study in Kyaukpadaung, Nyaung Oo, Pakokku and Myaing Townships (PETRONAS).	Team member in Social Survey
15	2013	Pilot Census Supervision (UNFPA).	Supervision in Pilot Census Survey
16	2013	Identification and Assessment of Available Financial and Related Supportive Non-Financial Services and their Providers and their Role in the Successful Economic Reintegration of Discharged Underage Recruits and Other Vulnerable Working Age Children and Youth (ILO).	Moderate in Focus Group Discussion
17	2013	Project Nimbus: Malaria Ethnographic Study in Mon State (SC Johnson).	Moderate in Focus Group Discussion
18	2015	"I do. Do you?" Campaign – Exploring Existing Knowledge of Malaria and Testing Concepts.	Moderate in Focus Group Discussion
19	2015	Opinion Poll_ Voting Trends for 2015 Election.	Supervise in Social Survey Team
20	2015	Development of Digital Financial Service in Myanmar (Enclude).	Moderate in Focus Group Discussion and Key Informant Interview
21	2015	ESIA Survey for Overhaul and Expansion Thayet Cement Plant Project Myanmar Jidong Cement Co., Ltd	Stakeholder Meeting & Social survey

Data Quality Control Involvement in social field on:

1	2012	HDI Impact/Outcome Assessment (UNDP).	Data Quality Control in Social Survey
2	2012	PTTEPI - SEP Opinion Survey Project (PTTEPI).	Data Quality Control in Social Survey
3	2012	Microfinance Survey Project Phase 2 (YGA).	Data Quality Control in Social Survey
4	2012	End of project Evaluation (CARE).	Data Quality Control in Social Survey
5	2012	Socio Economic Activities Opinion attitude and Expectation Survey (PTTEPI).	Data Quality Control in Social Survey
6	2012	Population-based Maternal and Child Health Survey in Delta Region (Data Processing and Reporting) UNOPS (JIMNCH).	Data Quality Control in Social Survey
7	2013	Evaluation of WE BHLOOM Project (CARE).	Data Quality Control in Social Survey
8	2013	Environment and Social Impact (Malteser).	Data Quality Control in Social Survey
9	2013	EVS _End Line Project (HelpAge International).	Data Quality Control in Social Survey
10	2013	Farm Production - Phase I (UNOPS).	Data Quality Control in Social Survey
11	2014	Library Survey in Myanmar the Asia Foundation (TAF).	Data Quality Control in Social Survey
12	2014	WASH KAP IDP Camp survey (Malteser).	Data Quality Control in Social Survey
13	2014	Creating an Enabling post-Conflict Environment and Facilitating the safe Return of Internally Displaced Persons and Refugees (IDP) in Kayin State (HelpAge International).	Data Quality Control in Social Survey
14	2014	Validation and Evaluation Study for the CVT Capacity Building Project (CVT).	Data Quality Control in Social Survey
15	2014	Usage and Attitude of Tractor _Kubota (Nielsen (Thailand)).	Data Quality Control in Social Survey
16	2014	Farm Production - Phase II (UNOPS).	Data Quality Control in Social Survey
17	2014	TOTAL_Yadana Socio-Economic Programs’Outcome/Impact Assessment Survey (TOTAL Oil&Gas).	Data Quality Control in Social Survey
18	2014	Leasable project (Data Processing).	Data Quality Control in Social Survey
19	2014	Hilsa Fisher families in livelihood assessment.	Data Quality Control in Social Survey

20	2014	Civil Society-Led Community Based Livelihood Resources Development in the Dry Zone (Phase II).	Data Quality Control in Social Survey
21	2014	Baseline survey in Kayin State.	Data Quality Control in Social Survey
22	2014	Building Local Capacities for a livelihood Systems Approach in the Ayeyarwaddy Delta.	Data Quality Control in Social Survey

Education - B.A (Business Management)
Language - Burmese mother tongue and English

Myat Thitsar Naing

Name	-	Myat Thitsar Naing
Present Position	-	Social
Name of Firm	-	Sustainable Environment Myanmar Co., Ltd. (SEM)
Nationality	-	Myanmar
Profession	-	Reporting
Date of Birth	-	3.12.1991
Years with Firm/Entity	-	July, 2015
Membership in Professional Society	-	None
Detailed of Tasks Assigned	-	SIA Questionnaire Surveys, Stakeholder Meetings, Translation, Reporting

Profile

Myat Thitsar Naing obtained her B.A (Hons) degree in English in 2011, M.A degree in English in 2014 and became professional teacher in Myanmar since 2011. She worked as an English teacher (Part Time) in ILBC from 2011to 2014. She worked as a class teacher in Excellent Myanmar Private School in 2014. She has four years of experience in the teaching field. She attended Basic Diplomatic Skills (BDS 31/2013) at Myanmar Embassy and also studied Human Resource Management at F.A.M.E Education Centre. She got Diploma in Human Resource Management by IQN, UK and changed the carrier. At present she is an admin and social consultant for Sustainable Environment Myanmar Company Limited.

Professional History

2015	-	Admin and Social Consultant, Sustainable Environment Myanmar Co., Ltd.
2014	-	Class teacher (Year 4), Excellent Myanmar Private School
2011- 2014	-	English Teacher (Part time), ILBC
2011- up to now	-	Freelance Teacher
Education	-	B.A (Hons) English in 2011, Dagon University
	-	M.A English in 2014, Dagon University
	-	Diploma in Human Resource Management by IQN,UK
	-	Certificate in Basic concepts and application of statistic using SPSS software
	-	Certificate in Interprising Leadership for State-Building (E-301)
	-	Certificate in Diplomatic Skills (31/2013), Myanmar Embassy
	-	Certificate in Basic Computer Course (KMD)

Selected Relevant Experience in Environmental and Social Impact Assessment

Sr.	Period	Organization or client	Position	Responsibilities	Verification Source – contact details of the organization / client
1	2011-2014	ILBC	Teacher	Teaching the English language	Address: Lay Daungkan Rd, Yangon, Myanmar (Burma) Phone: +95 1 545 720
2	2014	EMPS	Class Teacher	Teaching English, Mathematics and Science	Padonmar Street, 15/D, Dagon Township, Yangon http://www.facebook.com/schoolexcellentmyanmar/
3	Sept 2015	Myanmar Jidong Cement Co., Ltd. (Thayet BOT Cement Project) (Client) &	Social Expert	Stakeholder meeting and social survey in ESIA survey for Overhaul and Expansion Thayet Cement Plant Project	Ph: 095081666

		D'Appolonia S.p.A (ESIA consultant)			
4	Aug 2015	SLP Environment Co., Ltd (EIA consultant)	Senior Consultant	Baseline data collection of Socio-economic survey (EIA) and baseline reporting (Star City Project, Thanlyn)	EIA consultant: Steve Pearmain (MD) www.slpenvironmental.com
5	Jan , 2016	ERM-Siam Co., Ltd. (IEE consultant) & Myanmar Industrial Estate Holding Pte. Ltd. (Client)	Consultant (Social Survey)	Baseline data collection of socio-economic and reporting (IEE project of Water Treatment Plant Project as part of the Intial Development Phase of DSEZ)	Kamonthip Ma-oon (Principal Consultant) Kamonthip.Ma-oon@erm.com

Language **-** Burmese, English.

Curriculum Vitae

Name : Nyomie Razak

Specialization : Cultural and Social Impact Assessment Specialist

Personal Data	
Date of Birth	5-1-1971
Gender	Female
Marital Status	Married
NRC Number	12/ Ma Ya Ka (N) 107753
Present Employment	Principal Consultant (Cultural Assessment), Sustainable Environment Myanmar Co., Ltd.
	Member, Myanmar Environment Institute
Postal Address	5 B, Nagayon Pagoda Road, Mayangon, Yangon, Myanmar
Contacts: Tel/ Fax/ e-mail	Tel: +951-651176; + 959-43164398 nyomie.razak5@gmail.com

Educational Achievement
Ph. D (History)(2009) B.A. (1995); MA (History)(2003); M. Res. (2004); Univ. of Yangon

Professional Experiences	
Experience in Environmental Research	• Cultural impact assessment for 860 km Myanmar-China Gas Line (CNPC) (2009) • Social impact assessment for Mong Hkok Coal Power Project (2010) • Social impact assessment for Dawei Deep Sea Port and Industrial Zone Development Project (2012) • Cultural assessment for Yangon City (2012) • Immediate Cultural Assessment for Letpadaung Copper Project (2012) • Cultural impact assessment for Mawlamyine Cement Project (2013) • Cultural impact assessment for Rehabilitation of Taungoo Education College, Taungoo, Bago Region (2013) • Social and Cultural Impact Assessment for Upgrading of Thayet Cement Plant, Thayet, Magway Region
Employment History	• 2006 to 2009; Research Assistant Grade 2; Universities' Historical Research Department • 2009 – 2011: Senior Consultant; Resource & Environment Myanmar Co. Ltd.

	• 2012-2013: Principal Consultant; Resource & Environment Myanmar Co. Ltd.
Other Research	• History of Myanma Oil Industry (1962-2002) (2009) (PhD thesis) • History of Social Welfare of Mann Oilfield Workers (1970-88) (2004) (M. Res. thesis)

Some selected tasks:

- Cultural impact assessment for 860 km Myanmar-China Gas Line (CNPC) (2009)

Responsibility – review the legislative requirements for cultural impact assessment

- Identify the cultural sites which passed through the gas pipe line
- Arrange public consultation meeting in Township levels (Rakhine State, Magway Region, Mandalay Region and Shan State)

- Immediate Cultural Assessment for Letpadaung Copper Project (2012)

  - Letpadaung Taung is located in Salingyi Township, opposite river side of Chindwin against Monywa, the capital of Sagaing Region, Union of Myanmar. It is among four deposits of Monywa Copper Geological Complex namely Letpadaung Taung, Kyesin Taung, Sabei Taung and Sabei Taung (south).
  - Letpadaung Taung is the largest copper ore deposit of Myanmar possessing a total of 1478 million tons of mineral resources and as well as one of the largest undeveloped copper deposit of the world.

Cultural Assessment for Very Famous (Historic) Pagoda and associated facilities including ordination hall

- Review on legislative requirements
- Recorded cultural history (historical background of cultural properties)
- Site visit to impacted cultural heritage buildings
- Assessment of Impact
- Consultation with relevant authority (GAD, Ministry of Culture, and Township level Authority, Communities)
- Assistant for relocation of cultural properties

Social Lead for the project “Upgrading of Thayet Cement Plant, in Thayet, Magway Region.

- Organize stakeholder meeting and lead public consultation Meeting
- Collect Socio-economic data

1. **General:**

Position Title and No.:	Environmental Technician (Air Quality)
Name of Key Expert:	Soe Yu Htun (Mr)
Name of the Firm proposing the Key Expert:	Resource & Environment Myanmar Co., Ltd.
Date of Birth:	28th February, 1989
Nationality:	Myanmar
Country of Citizenship/Residence:	Myanmar

2. **Education:** B.Sc. (Geology)

3. **Employment Record relevant to the assignment:**

3 years professional experience since 2012

Period	***Employing organization and your title/ position***	***Country***	***Summary of* activities *performed relevant to the Assignment:***
2010 - Present	Resource &Environment Myanmar Co., Ltd. Environmental Technician	Myanmar	Responsible for studies on environmental and air monitoring fields including EIA in Myanmar.
	Contact information for reference:	Zaw Naing Oo, Director of Resource and Environment Myanmar Ltd. zawnaingoo@enviromyanmar.net	

4. **Membership in Professional Associations and Publications:** Life Member, Myanmar Geosciences Society

5. **Language Skills:**

	Speaking	*Reading*	*Writing*
English	Intermediate	Intermediate	Intermediate
Myanmar	Native	native	native

6. Reference to Prior Work/Assignments that Best Illustrates Capability to Handle the Assigned Tasks (Example)

No.	***Title***	***Client***	***Poisson***	***Period***
1	Mandalay EMP project	Mandalay ECD (Environmental Conservative Department)	Assistant project manager	Nov. 2014 to Oct.2015
2	Myin Gyan IPP project (Independent Power Plan) (EIA)	ERM Co,.ltd	Assistant project manager	June.2014 to May 2015
3	Thaung Khone Core Fire Power Plant project (EIA)	JICA	Assistant project manager	August.2014 to Nov 2014
4	Thilawa SEZ Zone A Development Monitoring project (EIA) Phase_1 construction stage	MJTD	Assistant project manager	Jan.2014 to Dec 2015

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Appendix 9

Hydrology Data Update

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးနှင့် ရေစီးနှုန်းများ

Date - 9.10.2015

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
16.9.2015	6:00	895.27	12:00	895.27	6:00	895.27
17.9.2015	6:00	895.26	12:00	895.26	6:00	895.26
18.9.2015	6:00	895.25	12:00	895.25	6:00	895.25
19.9.2015	6:00	895.25	12:00	895.25	6:00	895.25
20.9.2015	6:00	895.25	12:00	895.25	6:00	895.25
21.9.2015	6:00	895.25	12:00	895.25	6:00	895.25
22.9.2015	6:00	895.25	12:00	895.25	6:00	895.25
23.9.2015	6:00	895.24	12:00	895.23	6:00	895.23
24.9.2015	6:00	895.23	12:00	895.23	6:00	895.23
25.9.2015	6:00	895.27	12:00	895.27	6:00	895.27
26.9.2015	6:00	895.27	12:00	895.27	6:00	895.27
27.9.2015	6:00	895.27	12:00	895.27	6:00	895.27
28.9.2015	6:00	895.46	12:00	895.47	6:00	895.47
29.9.2015	6:00	895.50	12:00	895.50	6:00	895.50
30.9.2015	6:00	895.51	12:00	895.51	6:00	895.51

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ဇုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးနှင့် ရေစီးနှုန်းများ

Date -25.11.2015

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
16.10.2015	6:00	896.47	12:00	896.46	6:00	896.36
17.10.2015	6:00	896.34	12:00	896.34	6:00	896.32
18.10.2015	6:00	896.25	12:00	896.25	6:00	896.22
19.10.2015	6:00	895.58	12:00	895.58	6:00	895.57
20.10.2015	6:00	895.50	12:00	895.49	6:00	895.49
21.10.2015	6:00	895.47	12:00	895.46	6:00	895.46
22.10.2015	6:00	895.41	12:00	895.40	6:00	895.40
23.10.2015	6:00	895.36	12:00	895.36	6:00	895.36
24.10.2015	6:00	895.36	12:00	895.36	6:00	895.36
25.10.2015	6:00	895.35	12:00	895.35	6:00	895.35
26.10.2015	6:00	895.35	12:00	895.35	6:00	895.35
27.10.2015	6:00	895.34	12:00	895.34	6:00	895.33
28.10.2015	6:00	895.33	12:00	895.33	6:00	895.33
29.10.2015	6:00	895.33	12:00	895.33	6:00	895.33
30.10.2015	6:00	895.34	12:00	895.34	6:00	895.34
31.10.2015	6:00	895.35	12:00	895.35	6:00	895.35

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးများ

Date - 3.12.2015

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
16.11.2015	6:00	895.28	12:00	895.28	6:00	895.28
17.11.2015	6:00	895.28	12:00	895.28	6:00	895.28
18.11.2015	6:00	895.27	12:00	895.27	6:00	895.27
19.11.2015	6:00	895.27	12:00	895.27	6:00	895.26
20.11.2015	6:00	895.25	12:00	895.25	6:00	895.25
21.11.2015	6:00	895.24	12:00	895.24	6:00	895.24
22.11.2015	6:00	895.24	12:00	895.24	6:00	895.24
23.11.2015	6:00	895.24	12:00	895.24	6:00	895.24
24.11.2015	6:00	895.24	12:00	895.24	6:00	895.24
25.11.2015	6:00	895.23	12:00	895.23	6:00	895.23
26.11.2015	6:00	895.23	12:00	895.23	6:00	895.23
27.11.2015	6:00	895.23	12:00	895.23	6:00	895.23
28.11.2015	6:00	895.22	12:00	895.22	6:00	895.37
29.11.2015	6:00	895.22	12:00	895.22	6:00	895.22
30.11.2015	6:00	895.22	12:00	895.22	6:00	895.22

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးများ

Date - 17.12.2015

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
1.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
2.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
3.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
4.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
5.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
6.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
7.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
8.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
9.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
10.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
11.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
12.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
13.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
14.12.2015	6:00	895.22	12:00	895.22	6:00	895.22
15.12.2015	6:00	895.22	12:00	895.22	6:00	895.22

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးများ

Date - 11.2.2016

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
16.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
17.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
18.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
19.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
20.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
21.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
22.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
23.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
24.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
25.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
26.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
27.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
28.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
29.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
30.1.2016	6:00	895.20	12:00	895.20	6:00	895.20
31.1.2016	6:00	895.20	12:00	895.20	6:00	895.20

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း (ကာ-၈)

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးများ

Date - 29.2.2016

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
1.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
2.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
3.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
4.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
5.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
6.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
7.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
8.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
9.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
10.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
11.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
12.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
13.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
14.2.2016	6:00	895.20	12:00	895.20	6:00	895.20
15.2.2016	6:00	895.20	12:00	895.20	6:00	895.20

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း (က-၈)

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co;Ltd.

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း) တွင်

စိုက်ထူထားသော ရေမှတ်တိုင်၏ ရေမှတ်တန်ဖိုးများ

Date - 6.4.2016

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
16.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
17.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
18.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
19.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
20.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
21.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
22.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
23.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
24.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
25.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
26.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
27.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
28.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
29.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
30.3.2016	6:00	895.18	12:00	895.18	6:00	895.18
31.3.2016	6:00	895.18	12:00	895.18	6:00	895.18

Remark - Water Level values of gauge readings mention in table are above mean sea level in meter.

ပြုစုသူ

Htay

ဒေါ်သန်းသန်းဌေး

SAE (Civil)

အတည်ပြုသူ

ဦးဟန်မင်းထွန်း(က.စ)

လက်ထောက်အထွေထွေမန်နေဂျာ

NEO Energy Oasis Development Co.,Ltd

Upper Baluchaung Hydropower Project

သန်းတောင်ကျေးရွာအနီး သန်းတောင်ချောင်းနေရာ (ငုတ်ချောင်း D/S ပိုင်း)တွင် စိုက်ထူထားသော
ရေမှတ်တိုင်၏ရေမှတ်တန်ဖိုးများ

Date 13.5.2016

Date	နံနက်		နေ့လည်		ညနေ	
	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)	အချိန်	Water Level (Meter)
16.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
17.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
18.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
19.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
20.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
21.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
22.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
23.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
24.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
25.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
26.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
27.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
28.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
29.4.2016	6:00	874.78	12:00	874.78	6:00	874.78
30.4.2016	6:00	874.78	12:00	874.78	6:00	874.78

Remark - Water Level Values of gauge readings mentation in table are above mean sea level in meter.

ပြုစုသူ

နှင်းရီ (AS)

အတည်ပြုသူ

13/5/16

ဟန်မင်းထွန်း (AGM)