Public Works Department
Government of Meghalaya

Design of Major/Minor Bridges in the State of Meghalaya

under Meghalaya Integrated Transport Project

Bridge Over River Umngot, Meghalaya

(Jongksha-Kharang-Dienglieng-Nongjrong-Wahiajer Road)

Environmental Assessment Report

Date of Release	: 18/01/2021
Prepared	: USS
Checked	: RP / RP
Approved	: RBS

Consultant:

Projects Consulting India (P) Ltd
Engineers & Planners
An ISO 9001:2015 Certified Company
New Delhi 110 070
Email: info@pcindia.co
www.pcindia.co

LIST OF ABBREVIATIONS

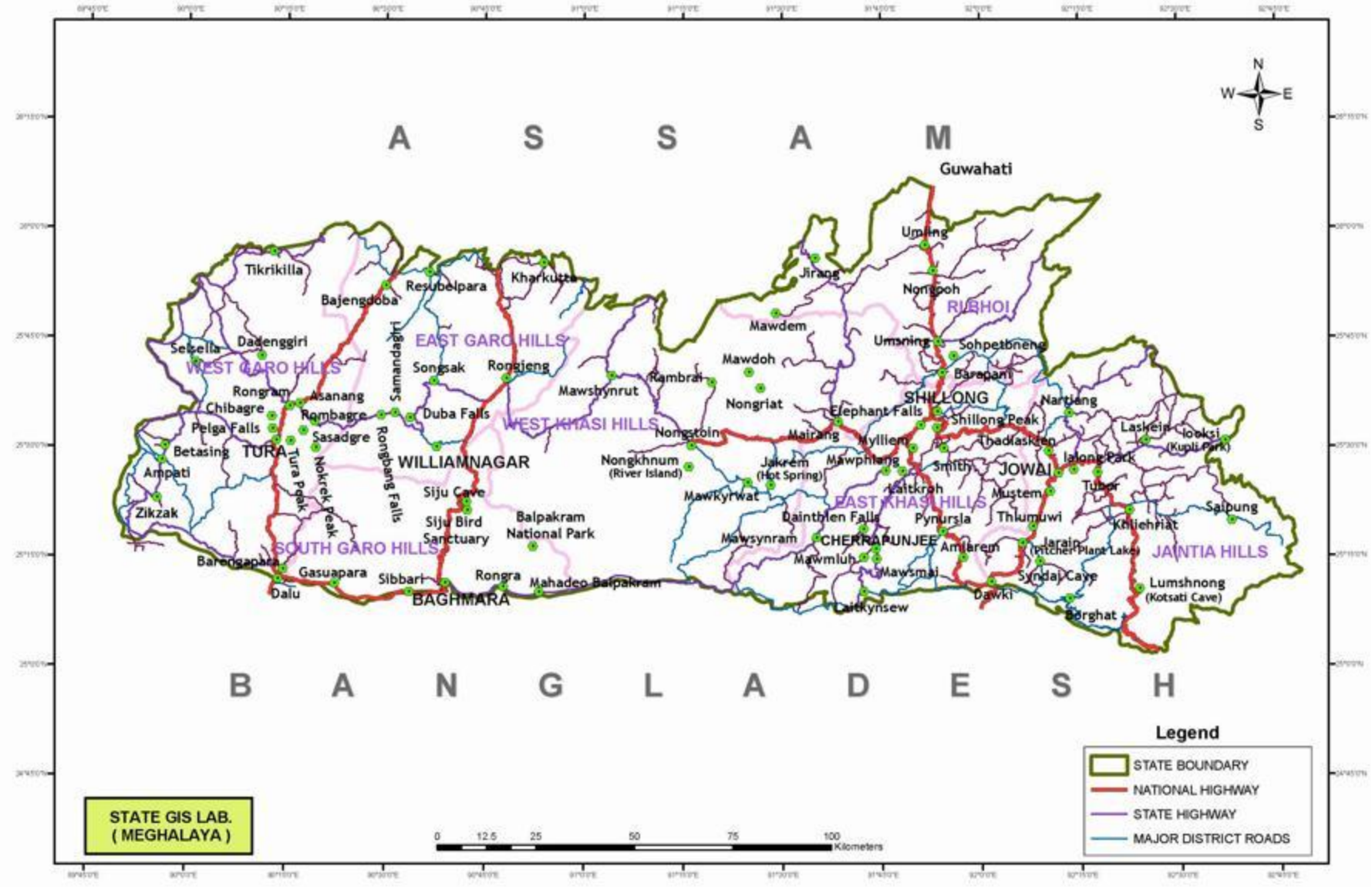
CPCB	-	Central Pollution Control Board
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EMP	-	Environmental Monitoring Plan
GoI	-	Government of India
IFC	-	International Finance Corporation
IRC	-	Indian Road Congress
MoEF&CC	-	Ministry of Environment and Forests & Climate Change
MoRT&H	-	Ministry of Road Transport and Highways
MPWD	-	Meghalaya Public Works Department
NBWL	-	National Board for Wildlife
NGO	-	Non-government Organization
NH	-	National Highway
OP	-	Operational Policy
PAF	-	Project Affected Person
PMGSY	-	Pardhan Mantri Gram Sadak Yojana
RF	-	Reserve Forest
ROW	-	Right of Way
SPCB	-	State Pollution Control Board
TOR	-	Terms of Reference

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Road network Mapof Meghalaya State



EXECUTIVE SUMMARY

1. The Government of Meghalaya, with financing and technical support from the World Bank, has conceptualised a project titled "Meghalaya Integrated Transport Project" (MITP). The objective of the project is to provide a well-connected efficient, good quality and safe transport network on long-term basis in a cost-effective manner maximizing economic and social outcomes. This will involve taking a whole-of-the-state approach of the entire transport sector and introduce innovations, efficiency, and new ways of doing business at various stages of service delivery, ensuring value for money.

2. The Project is following a Multiphase Programmatic Approach (MPA). The phase I includes an up-gradation of 286.82 km road length along with building of three new bridges. The bridge over river Umangot near, connecting East Khasi Hills and West Jaintia Hills, is part of Phase I initiatives.

3. The main objective of constructing the bridge over Umngot river is to connect the group of settlements at both sides, East Khasi Hills and West Jaintai Hills, and create a collective region which currently remains distanced from each other. The bridge will connect the following settlements at Jongksha, Kharang, Dienglien, Nongjrong at East Khasi Hills district with villages from NiriangnDemthring- Sohmynting- Lumsharatoh to Wahiajer at West Jaintia Hills district.

4. The bridge will also connect Jowai the headquarters of West Jaintia Hills district to Smit valley at Nongkrem, which is one of the important tourist spots of the State. Also, West Jaintia Hills is world famous for "Lakadong Turmeric", with high curcumin contain. The project will enable its easy distribution to all parts of the State and to the border of India-Bangladesh.

5. The carriage way of the bridge will be of 7.5m wide with RCC crash barrier of 0.5m at both sides. The superstructure will be of RCC and PSC Girder resting on two piers with pile foundation and strip seal expansions at the joints. About 2150sq.m of land at Nongjrong (East Khasi Hills) side and about 1600sq.m of land at Niriang (West Jaintia Hills) side will be acquired. These lands have been assessed to be privately owned and the acquisition needs have been discussed with the owners.The owners of the land have approached the PWD to voluntarily donate the land for the greater cause of the villages that will be benefiting from the bridge connectivity.

6. As per World Bank Operational Policies, the MITP project has a 'High' environmental risk rating. It triggers the World BankOperational Policies (OP) on Environmental Assessment EA policy (OP4.01), Natural Habitats (OP4.04), Forests (OP 4.36) and Physical Cultural Resources (OP 4.11). Thus, a full-assessment of all relevant direct, indirect and cumulative environmental risks and impacts from construction and operation of the bridge has been carried out. This Environmental Impact Assessment Report has been prepared taking in view of a major bridge as theproject (herein referred "Umngot Bridge") is 75m long.

7. The assessment covers all physical, cultural, biological and socio-economic parameters. The field assessmentsand monitoring of various baseline parameters were conducted between the months of January 2020 to September2020 as part of detailed project report. Samples for ambient air quality, ambient noise level, water quality (Ground and surface) and soil quality were collected and analysed from NABL accredited laboratory. The monitoring results are found within the prescribed limits for air, water, soil and noise level at the monitored locations in the project area.

8. ***Corridor of Impact (CoI)***: The area of 500 m on either side of the proposed bridge centreline is considered as the corridor of impact. The RoW i.e., 10m is thus included within the CoI. This area is more vulnerable to the subproject's direct impacts.

9. ***Project Influence Area (PIA):*** In accordance with MoEF&CC's EIA Guideline Manual for Highways and as per guidelines of EIA Notification-2006, the Project Influence Area has been defined as 10kmon either side (aerial distance) from the boundaries of the bridge and its approach roads at both end (for collection of secondary data, including impacts due to ancillary sites like borrow areas, quarry, material storage, disposal areas, etc.

10. Climate of Meghalaya plateau is influenced by elevation and distribution of physical relief. On the basis of weather condition, the Meghalaya plateau has 4 distinct seasons. The subproject is within the West Jaintia Hills and East Khasi Hillsdistricts of Meghalaya. The general topography of West Jaintia Hills and East Khasi Hillsdistricts is hillyand rolling with flood plains. The proposed bridge and its approach roads are located on the boundary of East Khasi Hills and West Jaintia Hills districts, mostly elevation is in range of 600-1000m. Topographically, the bridge will be constructed at a steep terrain having high-flood level at 1010m from the reference datum at site.

11. The proposed subproject falls under the Seismic Zone V, which is susceptible to major earthquakes as per the seismic zone map of India (IS 1893 - Part I: 2002). Considering the seismic zone, thebridge section area and its approaches has been designed as per standards stipulated in the clause under IRC: 6-2014.

12. Land use pattern abutting the subproject is mainly agricultural and open vegetation and there is no built-up area located within 500m radius of the proposed bridge location.

13. There is No reserve forest, and or notified Wildlife Sanctuary/ Eco-sensitive Zone within the 10km radius of the project site.

14. During construction it is apprehended that the aquatic ecology of the river Umngotmay get impacted from piling works and abutment foundation, causing soil erosion and turbidity in downstream of river. There is a risk of direct release of solid and liquid waste into Umngot river during construction of well foundation and piers inside river. Thus, for faster stabilization of boreholes, polymer will be used, which is an eco-friendly material and only 1/25th quantity is required as compared to bentonite. As mitigation measure, the natural courses of river will be maintained at all time. No disposal of construction debris in river course will be allowed.

15. Rightof way (RoW) at both sides is available for widening the approaches and connecting the approach roads. It is estimated that about29 trees are needed to be felled for this project. All cut trees will be compensated at the rate of 1:10 with preference to fast growing local species that are more efficient in absorbing GHG emissions.

16. Approximately 22407cum of excavated soil is expected to be generated from excavation work. The excavated material will used in backfilling in the subproject and balanced quantity will be disposed of at approved designated site.

17. The estimated 1011 cum of granular sub-base, 110 cum of bituminous concrete would be used for the project.

18. The construction activities e.g., earthwork, concreting of structure and labour camps, would require 10kilo litres per day (KLD) of water. For construction activities, the river water will be used as per suitability. For drinking purposecommunity water source will be tapped after taking due approvals from the concerned state and local authorities.

19. Stone quarrying, crushing, sand mining and use of aggregates for construction, will lead to consumption of natural resources and causing indirect pollution as such sites. This considered as indirect impact and outside the control of the project proponent, i.e., PWD of Meghalaya. Thus, to reduce the risk to the extent possible, materials will be acquired only from those sites which has been certified by the State Pollution Control Board.

20. Air and Noise Pollution - During construction air quality may be adversely impacted for short periods due to (i) the exhaust emissions from the operation of construction equipment and machinery; (ii) dust generated from the haulage of materials, exposed soils and material stockpiles, fugitive dust from earth-moving operations (iii) clearing of vegetative cover; (iv) material loading and unloading; etc. Water will be sprinkled at the site to settle-down the fugitive dust and personal protective equipment will be provided to the labourers at site.

21. It is assessed that following occupational health and safety hazards may impact the labourers working at site and most of them can be avoided by taking adequate precautions while working and wearing personal protective equipment:

- Falling from height;
- Head injuries;
- Exposure to high decibel noise;
- Injuries to eyes and face;
- Foot and leg injuries;
- Exposure of hands to harmful substances
- Exposed to COVID-19 infections

22. In addition, to the above points, specific measures to mitigate anticipated adverse impactshave been prepared as under the Environmental Management Plan (EMP) and presented in the following table – Table 1. The EMP has been sorted based in the life-cycle of the project, i.e., pre-construction stage, construction stage and post-construction or operational stage. Environmental impacts against each project component have been identified and subsequently, the relevant mitigation measure(s) have been suggested.

Table 1: Environmental Management Plan

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
Pre-construction stage			
Land Acquisition	Environmental Impact Assessment	Projects involves land acquisition from the private owners, who have agreed to voluntarily donate the land parcels for the greater benefit of the villagers and communities who would be accessing the bridge. The acquisition of land will be carried out in accordance with the RFCTLAR&R Act, 2013 and entitlement framework for the project.	PIU-PWD has to ascertain that any additional environmental impacts resulting from acquisition of land shall be addressed and integrated into the EMP and other relevant documents. Responsibility: PIU-PWD, PMU, Revenue Department, World Bank
Clearing of Vegetation/ Trees	Biodiversity (both flora and fauna), GHG emission, soil erosion, etc.	Loss of top soil, disturbance to landscape, land degradation and visual impacts. Loss of floral and faunal species namely birds (avifauna) as their habitat may get disturbed along with the felling of trees.	• All efforts should be made to preserve trees, especially full-grown trees and locally important trees (endangered species/ religiously important etc.). • Tree cutting is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances. • In the event of design changes, additional assessments including the possibility to save trees shall be made. • Stacking, transport and storage of the wood will be done as per the relevant norms. Systematic corridor level documentation for the trees cut and those saved will be maintained by the PIU-PWD. • The EPC Contractor to budget provisions for following the mandatory afforestation program which requires planting trees at the rate of 1:10 for trees cut and improving vegetation cover in the project area. • EPC contractor to follow Appendix - Guidance Note on Site Clearance to follow the best practices.
Levelling of ground surface	Fugitive emission of dust; Soil erosion; Air pollution from vehicles	Loss of top soil, disturbance to landscape, land degradation and visual impacts.	Sprinkle of water at the site while such activities are carried out; Provide appropriate mask to the labourers working at site;
Setting up of construction camp for	Water and Land contamination; Occupational Safety&	Water and land may get contaminated from sewerage disposal at the camp site.	• Contractor to submit Labour Camp Management Plan and obtain due approval from PIU-PWD before setting up any labour camp; • Labour-camp Management Plan to be prepared while following the

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
labour/worker	Health Aspects	COVID-19 pandemic could lead to health issues among labourers.	guidelines set under – Appendix - Guidelines on Labour Camp Management Planning. • Follow all points mentioned in ESMF of MITP project on Labour Camp Management; • Hire of local labours/workers to the maximum extent possible • Follow mitigation measures mentioned under – "Mitigation of COVID-19 risks in Addition to routine environmental impacts" In addition; • Detailed guidance can be found in the EIA and IFC general Health and Safety Guidelines • Contractor must familiarize themselves with World Banks Good Practice Note on Road Safety: • For labor camp establishment, adherence to World Bank's Worker Accommodation Processes and Standards • Plans should adhere to the Labor Management Plan and COVID-19 Guidelines issued by World Health Organisation (WHO) and GoI.
Operation of Machinery & Equipment	Occupational Safety& Health Aspects Air pollution Noise Pollution	Operation of heavy earth equipment and movement of dumpers pose hazards to workers. GHG and other emissions from use of fuel.	• Vehicle carry raw material should be covered with tarpaulin sheet to prevent dust generation • Sprinkle water to prevent fugitive dust at working sites, haul/access roads • Vehicles / equipment used should have valid PUCcertificate • Provision of temporary noise barrier in working area
Raw materials Transportation and Usage	Air Quality & GHG emissions Siltation due to fine particles and choking of surface channels.	Generation of fugitive dust and exhaust gas emissions from haulage trucks. Loss of precious soil and siltation of surface channels.	Covering the trucks carrying raw materials with tarpaulins during their movement from source to site. Mitigation measures for quarries are: • aggregates will be first sourced from licensed quarry sites (which are in operation) that comply with environmental and other applicable regulations; • quarries must use controlled and environmentally friendly quarrying techniques in order to minimize erosions and landslides as per guidelines for quarry management;

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			• occupational safety procedures/practices for the work force will be adhered to in all quarries; • quarry and crushing units will be provided with adequate dust suppression measures; and • regular monitoring of the quarries by concerned authorities to ensure compliance with environmental management and monitoring measures.
Site establishment	Air pollution; Water pollution; Soil pollution; Noise pollution; Solid waste generation	Setting up of the site and installing various plants and equipment could lead environmental impacts, most of which are temporary in nature, however some could be irreversible and may adversely impact the environment;	The contractor to prepare a site establishment plan in which following points should be taken care of: • Hard surface Areas: Areas within the site where there is a regular movement of vehicles shall have an acceptable hard surface and be kept clear of loose surface material and shall be so indicated on the required site plan. • Waste Disposal and Site Drainage System outlining systems for water and waste products arising on the site to be collected, removed from the site via a suitable and properly designed temporary drainage system, and disposed of at a location and in a manner that will cause neither pollution nor nuisance, • Biodiversity: The site plan shall avoid establishment of labour camps, stockpiling sites and other temporary structures, near to the river. • Temporary Construction Facilities Relative to Watercourses: The site plans shall be devised to ensure that, insofar as possible, all temporary construction facilities are located at least 50 meters away from an existing water course/river. • Other Water-Related Facilities: Site Plans must indicate adequate precautions to ensure that no spoil or debris of any kind is allowed to be pushed, washed down, fallen or be deposited on land or water bodies adjacent to the site. • Hot mix plants and batching plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 500 m away from the nearest village/settlement preferably in the downwind direction. • Arrangements to control dust pollution through provision of wind

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			screens, sprinklers, dust encapsulation must be provided at all such sites. • Specifications of crushers, hot mix plants and batching plants will comply with the requirements of the relevant current emission control legislations and Consent/NOC for all such plants shall be submitted to the SC and PIU. • The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted. • Location of Wheel Washing Facilities: The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the excavation sites. The Contractor shall ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the construction site and entering public areas and ensure that water or debris from such cleaning operations is contained and not deposited into nearby drains and watercourses. The locations of these facilities shall be clearly illustrated by the site plans. • Location of Sand and Aggregate Storage Provisions: The Contractor shall implement dust suppression measures that shall include, but not be limited to the following: • Stockpiles of sand and aggregate greater than 20 cubic meters for use in concrete manufacture shall be enclosed on three sides, with walls extending above the pile and two (2) meters beyond the front of the piles. • Cement and other such fine-grained materials delivered in bulk shall be stored in closed silos • Locations of Liquid and Toxic Material Storage Areas. The site plans shall specify the locations for the storage of liquid materials and toxic materials including the following such conditions to avoid adverse impacts due to improper fuel and chemical storage: • All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse or wetlands. The base and bund walls shall be impermeable and of sufficient capacity to contain 110

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			percent of the volume of tanks. • Filling and refuelling shall be strictly controlled and subject to formal procedures, and will take place within areas surrounded by bunds to contain spills/leaks of potentially contaminating liquids. • The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any drain or watercourses. • Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited. • Should any accidental spills occur, immediate clean-up will be undertaken and all clean-up materials stored in a secure area for disposal to a site authorized for the disposal of hazardous waste.
Diversion of traffic ferrying the river over bamboo bridge	Movement of traffic to another alternative route Construction site traffic	Movement of traffic to other route may lead to traffic congestion in that route. Traffic movements to the site could also cause local disturbance – air pollution, road accidents	EPC Contractor to submit Traffic management plan for alternative route and get it approved by PWD. The TMP needs to clearly define (i) the approved haul routes for all construction traffic; (ii) maximum speed limits (which are often lower than the legal speed limit) at locations on the route (e.g. 40 km/h or 30 km/h when vulnerable users are present, such as during school hours starting 200m before to 200m after a school), and the hours at which vehicles operate and; (iii) Temporary Traffic Management (TTM) in work zones.
Construction Stage			
Stone crushing, handling and storage of aggregates; Concrete batching plant; Mixing of aggregates with bitumen;	Air Pollution; GHG emissions Occupational Health Hazards	Generation of dust causing fugitive emission, which in may lead to breathing discomfort for people working at site; Additional GHG emissions against baseline would lead to cause of climate change; Generation of harmful emissions including SO2, NOx and HC	Regular sprinkling of water at site and at the approach roads or the application of emulsion coats near villages and or apply any other dust suppression methods. For fugitive emissions: • regular check-up and maintenance of construction equipment is required; • idling of engines is strongly discouraged; • vehicles delivering loose and fine materials should be covered to reduce spills; Mixing plants i.e., asphalt, concrete, and bricks, should be operated within

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			the permissible limits of CPCB
Quarrying	Air, Water and Noise pollution; Consumption of natural resources	Adversely impact all environmental components, causing irreversible changes to the landscape and soil conditions.	• Contractor will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials and other logistic arrangements in case the contractor decides to use quarries other than recommended by DPR consultant, then will be selected based on the suitability of the materials. • The contractor will procure necessary permission for procurement of materials and shall submit a copy of the approval and the rehabilitation plan to the PIU-PWD and Environmental Expert of the PMU. • In case of new Quarries, they must have permission from the Department of Mining and Geology and have the necessary clearances from Pollution Control Board and Forest Department and a valid Environmental Clearance from the State Environmental Impact Assessment Authority (SEIAA). • Contractor will also work out haul road network and report to Environmental Expert of the PIU-PWD and SC will inspect and in turn report to PIU before approval. • In case identified source of sand is from a river, the contractor should follow the guidelines on Sustainable Sand Mining.
Borrow Area Muck-Debris generation	Generation of construction and solid wastes	Debris generated from construction work may cause significant impact to the surrounding environment like contamination of waterbody, soil if not managed properly	Preparation of muck disposal plan to assess the quantitative load of wastes to be generated and reusing it during land and level filling operations for foundation preparation. Follow Borrow Area Management Guidelines for identification, maintenance and closure of borrow area(s).
Construction of pier-wells Construction of abutment walls	Generation of muck; River water pollution; River bed and bund erosion; Impact on aquatic habitat	Construction of pier foundations on the river bed and abutment wall at the banks will cause high water turbidity as well as erosion of soil from the river bed. This could have adverse impact on the riparian vegetation at the site of construction as well as adversely impact fish habitat in water; Additionally, adding of polymer and bentonite for stabilization of wells is likely to cause deleterious	• EPC contractor to submit an Erosion and Sediment Control Plan to the satisfaction of the PWD Environment and Social Cell; The plan shall detail appropriate work methods, best practices for working around water, proposed erosion control methods and containment methodology; • River-bank slope stabilities to be monitored all time, if necessary, appropriate bio-engineering/ engineering remedial measures applied throughout the construction period; • Construction work at bridge during rainy season to be minimized to

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
	Disruption to Natural Drainage System	impact on aquatic habitat; Any spillage of excess quantity could lead to damaging impacts on the entire habitat, leading to high mortality of riparian vegetation and fishes; Construction may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.	avoid erosion and sedimentation; • Construction work in the river water to be avoided during fish spawning season; Conduct in-stream work during the dry season/ or when the water is at the lowest level. • Allow no release of sediments into any water body in levels that are deleterious to fish or fish habitat or wildlife habitat or that would alter growing or hydraulic conditions; • The EPC contractor should list all products and materials to be used or brought to the construction site that are considered or defined as hazardous or toxic to the environment, including but not limited to, • sealer, grout, cement, concrete finishing agents and adhesives; • If welding is used, welding solder must be contained locally or a containment system used that is capable of trapping welding solder and preventing it from entering the river. • Monitoring for grout breakout will be undertaken during micro-pile installations and appropriate action will be taken to prevent/contain any breakouts.
Abstraction of Water for construction	Environmental flow of River Umngot	Construction water requirement (avg. 10 KLD and peak 20 KLD) will be met through approved surface water source (Umngot river). Domestic water requirement (5 KLD) for workers will also be met mainly through approved sources only. Water abstraction due to construction work may lead to water scarcity in the nearby area	• Environmental flow of the river to be maintained all the time such that the downstream is not devoid of water; • Appropriate temporary diversions of streams will be made and brought back to their natural course as soon works are completed in that section. No disposal of construction debris in streams and rivers is allowed. • Local permission to be acquired for usage of both river water for construction as well as drinking water tapped from local sources;
Handling of waste	Solid Waste Management	During construction phase there may be generation of both hazardous and non-hazardous waste which needs to be carefully handled to ensure environment safeguard	• Excess quantity if any may be tried to be used in landscaping. • The top soil preserved earlier shall be used in spreading a layer over the landscaped surface and in green belt development. • Segregation of waste (hazardous and non-hazardous) should be properly done at source • Adequate dustbin should be provided in Labour camps and other suitable areas • The hazardous waste should be disposed of through authorized vendor

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures

			only
			• Non-hazardous waste should be disposed of in a designated site or thorough authorized vendor
			• Regular clearing/disposal of organic waste generated from worker camp to be ensured.
			• Equipment and fuel depots will be placed in safe zones away from drinking water sources and riverbanks;
			• To mitigate the impacts of possible fuel spills the following measures to be applied:
			  • secondary containment around fuel tanks and at fuelling stations to be built;
			  • oil and fuel spills, and other runoff from contaminated areas to be controlled; and

Labour management	Occupational Health and Safety accidents and injuries	Following events/ accidents and injuries could happen to people at site during construction - Falling from height; Head injuries; Exposure to high decibel noise; Injuries to eyes and face; Foot and leg injuries; Exposure of hands to harmful substances;
		
		The construction camps are anticipated to house up to 20 people for about 30 months. With the migrated people, the potential for the transmission of diseases and illnesses will increase within the labour camp as well as within the community located nearby. The main health risks during construction phase will arise from:
		• inadequate sanitation facilities in worker camps;
		• introduction of sexually transmitted, and other diseases, by migrant workers;
		• outbreaks of malaria, typhoid, cholera etc. amongst the labour force; and given the current COVID-19 pandemic there is also a risk of
			• Contractor to submit and obtain approval for a health and safety plan prior to the commencement of work;
			• Provision of adequate health care facilities and ensure adequate security is provided to construction staff on site and at worker accommodation;
			• Workers will be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter; and
			• For COVID-19 related health and safety risk, the contractor to prepare and implement a COVID-19 Action Plan as per measures mentioned under Mitigation of COVID-19 risks in addition to routine environmental impacts
			• Contractor will provide:
			  ○ Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete etc.
			  ○ Welder's protective eye-shields to workers who are engaged in welding works
			  ○ Protective goggles and clothing to workers engaged in Factories Act, 1948 stone breaking activities and workers will

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
		construction workers being exposed to the virus and other communicable viral diseases, particularly given construction is directly within the community and the transient nature of the construction workforce.	be seated at sufficiently safe intervals ○ Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. ○ Adequate safety measures for workers during handling of materials at site are taken up. ○ The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. ○ Daily tool box talk will be conducted by safety officer and reported in monthly report by contractor. ○ Contractor will share grievance redress mechanism and details on procedure with labour as part of induction training ○ The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labour Organization (ILO) Convention No. 62 and World Bank's Environment, Health & Safety Guidelines as far as those are applicable to this contract. ○ The contractor will make sure that during the construction work all relevant provisions of the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. ○ The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. ○ The contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. ○ Contractor will provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry is rubbed and scrapped. ○ The Contractor will mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non -compliance of use of PPE with zero tolerance. These will be reflected in the Construction

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			Safety Plan to be prepared by the Contractor during mobilization and will be approved by PMU and PIU-PWD.
All construction activities	Noise pollution	All type of construction activities is likely to cause noise pollution in the surrounding. Labourers are likely to get impacted from the same. However, the settlements are far away thus there is less likely to impact the community;	Noise generating equipment will have acoustic enclosures. Noise generating activities should not be permitted during night.
Chance finds	Impact on Cultural Resources	During earth-works there could be chance finding of any cultural resources that may lead to anxiety within community	Report immediately to the PWD and seize work until permission is granted by PWD
Operational Stage			
Operation of vehicles	Noise and GHG emissions due to vehicle exhaust gases. Road accidents	The community may be exposed to excessive noise while the ambient noise levels in the open yard may rise due to cumulative addition of noise which may extend into the neighbourhoods. GHG emissions from vehicular emission will enhance cause of climate change Unsafe driving could lead to road accidents on bridge	Installation of appropriate road signage informing of speed and noise limit in the give areas All necessary measures for Road Safety of traffic and pedestrians and workers must be taken by PWD. PWD may familiarize themselves with World Banks Good Practice Note on Road Safety http://pubdocs.worldbank.org/en/648681570135612401/Good-Practice-Note-Road-Safety.pdf

23. **Cumulative Impact:** As the bridge will be built across the river Umngot which is one of the major rivers of the State, it triggers the requirement to assess cumulative impacts.

Scope for conducting CIA	Potential VECs	Potential Changes or Impacts to VECs	Other Potential Sources of Contribution	Potential Bridge Sub-Project Contribution	Mitigation Measures
Umngot River (specific to bridge construction site)	Quality of water from affected river	Increased turbidity levels in river / water body adjoining the road sub-project Deterioration in water quality chemical	Currently no activity has been found to be carried in the river water	Run-off of sediment from construction sites Run-off of oil, petrol, etc. from road surface during operation.	Erosion and sedimentation control plan will be prepared by the EPC contractor stating the best practices to be applied to contain erosion and sedimentation during construction period; Emergency spillage plan will also be in place to contain any accidental spillage of chemical and or

		content)			oil; All actions to be taken by the EPC contractor and monitored by PIU-PWD, Environmental Cell.

24. The Contractor's Environmental Engineer and Health Safety Officer would be responsible for the implementation of the environmental safeguards. The roles and responsibilities of each of these officials have also been detailed out in the EMP. Training and capacity building would be required especially for the PMU staff associated with the project as the Environmental Safeguards would be a relatively new areas which staff are required to handle. The training and capacity building would not only be project specific but would target and developing long term capacities in PWD.

25. An Environmental Monitoring Program has been drawn up to essentially monitor the day-to-day activities in order to ensure that the environmental quality is not adversely affected during the implementation. The monitoring programme consists of Performance Indicators and Process Indicators. For the purpose of reporting of environmental performance, a reporting framework has been defined. This includes:

- Daily Monitoring Report: by the contractor to the PMC on the environmental actions which has been implemented.
- Fortnightly and Monthly Monitoring Report: by the PMC to PMU
- Quarterly Auditing by the PMU to the Management
- Annual Audit by an External Agency of the entire process of EMP Implementation and reporting to the PMU for onward reporting to the World Bank

26. The budget for implementation of the mitigation measures and other improvement activities stands as: INR 2,874,200.

1. INTRODUCTION

1.1 Project Background

27. The Government of Meghalaya, with financing and technical support from the World Bank, has conceptualized a project titled "Meghalaya Integrated Transport Project" (MITP). The objective of the project is to provide a well-connected efficient, good quality and safe transport network on long-term basis in a cost-effective manner maximizing economic and social outcomes. This involves taking a whole-of-the-state approach of the entire transport sector and introduce innovations, efficiency, and new ways of doing business at various stages of service delivery, ensuring value for money.

28. The Project isfollowing a Multi-phase Programmatic Approach (MPA). In the first phase (Phase I), an up-gradation of 286.82 km road length along with building of three new bridges have been undertaken. The bridge over river Umangot, connectingEast Khasi Hills and West Jaintia Hills is one of the three bridges proposed under phase I.

29. Villages Jongksha, Kharang, Dienglien, Nongjrong&Niriang, Wahiajer are separated from connecting each other by river Umngot. Hence, in order to connect these villages, a major bridge of 75m length has been proposed over river Umngot, Meghalaya.

30. This area is very rich in agricultural products, forest products and minerals. On completion of this project, it will greatly uplift the economy of the people living in the Area. Moreover, economy of the State will also enhance in the form of royalty, taxes. etc.

31. The road connects many important villages like Jongksha, Kharang, Dienglien,Nongjrong, Niriang, Wahiajer etc. Since there is no bridge over river, the villagers are facing great difficulty especially during monsoon due to the absence of the bridge. With the completion of the bridge the road will cater to around fifteen thousand population, most of them are villagers who will use the road for transportation of daily products and many agricultural and horticultural products.

32. This bridge will connect NH4-4 (km 49) to tourist spot Smit & connects again to NH-44 (km 11). NH-44 connects Eastern part of Assam, Mizoram, Tripura & leads to Bangladesh. It will also act as bypass road for NH-44.

33. The main objective of this project is to connect villages like Jongksha, Kharang,Dienglien, Nongjrong and Niriang, Wahiajer which till date is having the missing linkin-between as bridge over river Umngot. Upon completion of this bridge, it willconnect also NH44 (km 49) to tourist spot Smit & again to NH 44 (km 11). Since; there is no bridge over river, the people in this area are facing great difficulty especially during monsoon due to the absence of the bridge. With the completion of the bridge the road will cater to around four thousand population, most of them are villagers who will use the road for transportation of daily products and many agricultural and horticultural products.

1.2 Purpose of EIA report

34. The main objective of the proposed consultancy assignment is to carry out the detailed Environmental Impact Assessmentfor Construction of major bridge of 75m lengthover river Umngot at Jongksha and Umlong Village, Meghalaya under MITP. The Consultancy service for preparation of Detailed Project Report have been entrusted to M/s. Projects Consulting India Pvt. Ltd., for bridge design length of 75m of bridge and 375m length of approach as details given in below Table-1.

Table 1:The details of subproject

S.No.	Crossing/Side	Section	Length (m)
1	UmngotRiver	Bridge	75
2	JongkshaSide	Approach	160

3	UmlongSide		215
		Total Length	**450**

35. The project bridge and approach shown on google map is shown in **Figure 1.**

36. This EnvironmentalImpact Assessment Report is prepared formajor bridge over river Umngotand approach (herein referred “Umngot Bridge/Subproject”) in order to identify all relevant direct, indirect and cumulative environmental and social risks and impacts for construction and operational phase. Preparation Environment and Social Management Plan for subproject to mitigate the potential impacts on the physical, biological and socio-economic parameters.

37. The environmental assessment study was conducted between the months of October 2019 to September 2020 as part of detailed project report. The team of experts conducted Environmental and Social Impact Assessment for the subproject include: Environmental and Social Experts – Dr.Umashankar Sain and Mr. Rishi; supported by team of field invigilators from Projects Consulting India Pvt. Ltd. New Delhi and NABL accredited laboratory for environmental baseline parameter monitoring from site.

38. This is draft Environmental Impact Assessment (EIA) report prepared to fulfil requirements of the Operational Policy 4.01 for World Bank funded Project.

1.3 Objective and Scope of the EIA Study

39. The objective of the present, EIA study is to identify potential environmental impacts of the proposedUmngot Bridgemeasures and formulate strategies to avoid / mitigate the same. The scope of work to accomplish the above objective, comprise the following.

- Collecting primary and secondary environmental baseline data within the subproject boundaryand surrounding areas;
- Assessing potential adverse environmental impacts that might arise during operation of the project, after reviewing project information and using the environmental baseline studyconducted during the feasibility study;
- Suggesting appropriate mitigation measures to effectively manage potential adverseimpacts; and
- Analyse the alternatives in terms of alternative alignment, technology, design andoperation, including the “with project” and "without project" situationwere carried out to analyse the feasibility
- Consultation with the Public/Stakeholders and incorporate their concerns into the projectdesign;
- Developing an Environmental Management Plan (EMP) to implement suggestedmitigation measures and management plans to minimise adverse impacts through effectivemanagement systems including formulation of monitoring and reporting requirements;
- Conducting additional studies for the enhancement of the benefit to the local communityand the road users;

40. The environmental studies have been confined to the situation around the deemed areas of direct influence caused by constructional and operational facilities ofthe proposed Umngot Bridge over river Umngot at Jongksha and Umlong Villagein the state of Meghalaya. The following sections of the report, discusses the methodology adopted by the consultant in conducting the study and presents the results of the same.

1.4 Approach and Methodology Adopted for EIA Study

41. The Environmental Impact Assessment has been carried out, in accordance with the requirements of the World Bank's Operational Policy 4.01. The Government of India guidelines for Rail/Road/Highway project; EIA notification 2006 and its amendment of MoEFCC and Highway Sector EIA guidance manual 2010 has also been followed in the process of this environmental assessment. The study methodology has been adopted in such a manner to ensure that environmental concerns are given adequate weightage in the selection of alignment and design of proposed road/bridge improvements. The study in subproject employs an iterative approach in which potential environmental issues have been examined at successive levels in detail and specificity, at each step in the process.

42. The Environmental impact assessment is based on the information collected from secondary as well as primary sources on various environmental attributes. Monitoring of air, water, noise and soil quality was also carried out along the bridge and approach section alignment and significant issues were examined during field surveys to determine the magnitude of significant environmental impacts.

43. The major steps in the EIA process for the subproject were as follows:

(i) Screening of subproject

44. As a part of the project feasibility study, Environmental Screening is undertaken in parallel withthe Preliminary Economic and Engineering studies to determine any significant social orenvironmental issues which could require further analysis (including the analysis of alternativealignments, improvement of junctions etc.) to resolve such issues.

45. The environmental screening typically identifies the natural habitats (e.g. national parks, wildlifereserves, sanctuaries, sacred groves, protected areas, forests, water bodies etc.), major rivers andwaterways, notified cultural heritage sites and any other potentially sensitive areas. Theinformation available from secondary sources along with the inputs from the site visits and consultation with local people are used to identify these issues and sensitive receptors which mightbe located along the corridor. The results of this analysis are communicated to the design team toresolve them (including recommendation for exclusion, analysis of alternative alignment and/ormitigation) as a precursor to engineering design and undertaking the required forenvironmental assessment studies.

(ii) Delineation of Project Impact Zone

46. For carrying out further environmental studies and subsequently the assessment it was required todelineate the project influence zone. Depending on the severity of impact the Project influencezone has been classified as:

47. ***Corridor of Impact (CoI)***: The area of 500 m on either side of the proposed bridge centreline is considered as the corridor of impact. TheRoW i.e. 10 mis thus included within the CoI. This area is more vulnerableto the subproject's direct impacts.

48. ***Project Influence Area (PIA):***In accordance with MoEF&CC's EIA Guideline Manual for Highways and as per guidelines ofEIA Notification-2006, the Project Influence Area has been defined as 10 km on either side (Arialdistance) from boundary of subproject alignment for collection of secondary data, including impacts due toancillary sites like borrow areas, quarry, material storage, disposal areas, etc.

(iii) Engineering Surveys

49. With the information available from the screening the design team took the preliminary surveys ofthe subproject site to assess the engineering aspects of the road including the likely environmentalissues associated with the project. The survey carried out as part of the detailed design datacollection also provided valuable information regarding area adjacent to the proposed projectcorridor.

(iv) Collection of Secondary Environmental Data

50. Secondary data was collected from various verifiable sources about different components e.g.climate, physiography, soil type, ecology, etc. The sources from which information is gathered ispresented in Table-2.

Table 2: Source of information collected on environment features in the subproject area

S.No.	Aspects	Parameters	Source of Information
1	Climatic Conditions in theProject Influence Area	Climate, Temperature,Rainfall	Indian Metrological Department
2	Soil & Geology	Soil type and itsstability,Fertility of the soilpotentiality for soil erosion	Geological Survey of India,State MiningDepartment
3	Slopes	Direction of slope,Percentageof slope	Contour Survey,satellite image and Survey ofIndia topographic sheets
4	Drainage/ Flooding	Existing drainage mapandflooding level including itsextent of water spread.Identification ofdrainagechannel and its catchmentsarea around the Project stretch	Satellite Imagery/ Topo sheet/Hydrologystudy/State WaterResource Department.
5	Water Bodies and WaterQuality	Identification ofwater bodies/canal/drainagechannels where the run offsurface water will flow/due toerosion and also due tospillage oil and otherhazardous materials.Status of surface water andground water quality	Topographysheets/field study. Hydrologicaldata fromthe CGWB Reports
6	Forest within Proposed ROWLegal Status – ProtectedAreas, Endangered Plant andAnimal, Ecological SensitiveArea, MigratoryCorridor/Route,	Status of the forests, Conservation of forest area, &endangered plant and animaland any other species	Department of Forest, Govt.of Meghalaya, DFOs, Discussion with local community and localDFOofficers
7	Trees and Vegetation Cover	Identification of existing treespecies in the projectinfluence area	Forest Department, ResearchInstitution, Field Survey.
8	Settlements along the PROW	Settlements & itspopulation along the corridor.Its location & numbers	Population/ District Census Report2011. Topographic survey
9	Cultural / Heritage andAncient Structures	Conservation areas if any,Protected structures, monuments and heritagestructures.	Archaeological Survey ofIndia, State ArchaeologicalDepartment

(v) Collection of Primary Baseline Information

51. For gathering the baseline environmental information on along the subproject corridor baselines studieswere conducted. These baseline studies includes:

- Baseline environmental surveys for assessing the ambient air, water, soil and noise quality
- Enumeration of trees to identify the Location, number, types spread, girth etc. nos. of the trees within the proposed RoW

- Ecological surveys to identify the habitats and the flora and fauna
- Structure enumeration to identify the one likely to be impacted
- Socio-economic surveys to identify the condition of the impacted persons

52. In addition to the above survey interactions are carried out with the populations along the projectcorridor to gather local level information on the following:

- Local practices and traditions with respect to conservation and use of natural resources;
- Farming practices and Cropping pattern
- Perception of the people about the project
- Traffic surveys were used to estimate the present and future traffic
- Engineering surveys to identify the topographical features

53. These above information'swere used to develop the baseline environmental condition in the project area andidentify the environmental sensitivities which might still get affected by the proposed bridge.

(vi) Public consultation

54. At the beginning of the EIA process, an identification of probable stakeholders was carried out. An inventory of actual / potential stakeholders, including local groups and individuals, local institutions like village community which may be directly or indirectly affected by the subproject or with interest in the development activities in the region was made atproject preparation stage. This inventory was arrived through discussions with local PWD official and also in consultation with members of the local community.

55. Consultations with the community are a continual process that was carried out during the EIA study and would also be continued during the construction and operation phases of the subproject. Issues like disturbance during the construction, severance and increased congestion, noise and air pollution, employment opportunities, need for development of basic infrastructure, safe drinking water, sanitation facilities in the villages adjoining to the corridor were discussed during the consultations so that they can be adequately addressed through the environment management plan. The consultations with community and local institution like village headman also helped in understanding of the requirement of people in the area and identification of the enhancement proposals.

(vii) Impact Identification and Evaluation

56. Potential significant impacts were identified on the basis of: analytical review of baseline data; review of environmental conditions at site; analytical review of the underlying physical, biological and socio-economic conditions within the project influence area.

(viii) Environmental Management and Monitoring

57. The final stage in the EIA Process is definition of the management and monitoring measures that are needed to ensure: a) impacts and their associated Project components remain in conformance with applicable regulations and standards; and b) mitigation measures are effectively implemented to reduce the effects to the extent predicted.

58. An Environmental Management Plan, which is a summary of all actions which the Project has committed to execute with respect to environmental/social/health performance for the Project, is also included as part of the Bidding Documents. The Environmental Management Plan includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

1.5 Limitation of EIA Study

59. This report is based on the designs which were prepared in detailed project report by design consultant for the subproject. The site specific design improvement, if any; would be done by the Contractor before the initiation of construction. Even though no major changes are expected in the design the EIA report needs to be verified against the final engineering design. Further, the report has been developed on certain information available at this point of time, scientific principles and professional judgement to certain facts with resultant subjective interpretation. Professional judgement expressed herein is based on the available data and information.

60. The Report only deals with the environment health and safety aspects (both community safety and occupational health and safety) associated with the project during the construction and operations. The social impact and the resettlement and rehabilitation requirement of private and community property have been detailed in the Social Impact Assessment and Resettlement and Rehabilitation Plan. In case of common property structures the report only considers those structures where relocation is required and only enhancement is required either for the aesthetics or safety purpose.

61. In case of minor changes, PWD will review social and environmental impacts, and add the necessary environment management actions to be taken to the ESMP and bid document. In case of any major changes to design, this being a Category A project, the PWD will seek a no objection from the World Bank and process of EIA for the change proposed could apply.

1.6 Structure of EIA Report

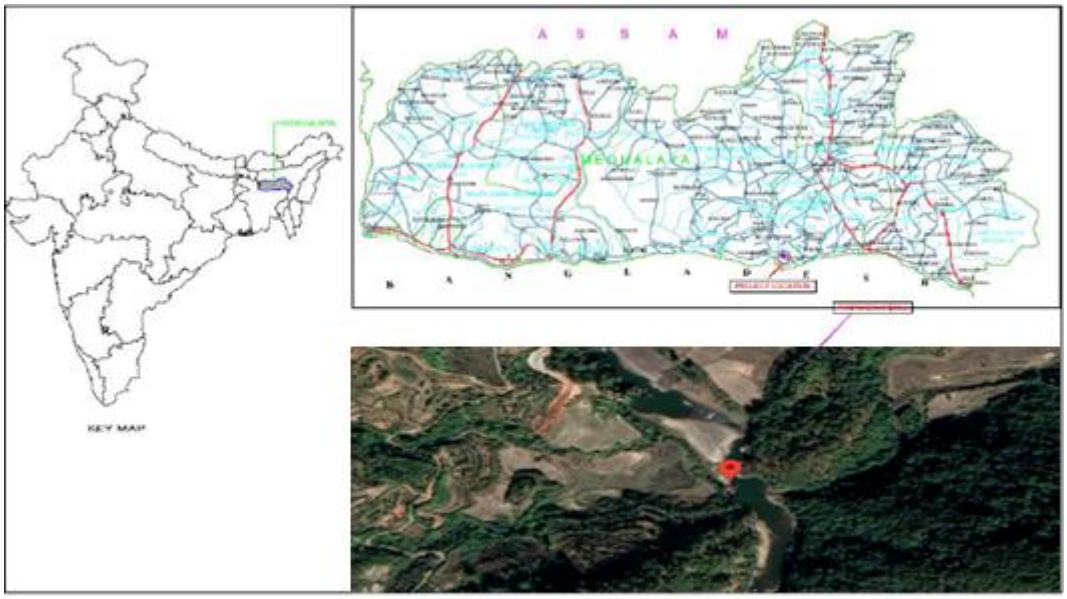
62. This EIA report has been presented as per requirements of the World Bank's Operational Policy 4.01. The report is organised into following ten chapters, a brief of each chapter is described below:

- ***Chapter 1 - Introduction***: This section described the background information about the subproject and EIA study.
- ***Chapter 2 - Project Description***: This section presents the key features andcomponents of the proposed subproject.
- ***Chapter 3 - Policy, Legal, and Administrative Frameworks***: this section summarizing the national and local legal and institutional frameworks that guided the conduct of the assessment.
- ***Chapter 4 - Environmental BaselineStatus***: This section discussing the relevant physical, biological, and socioeconomic features that may be affected by the proposed subproject.
- ***Chapter 5- Analysis of Alternatives***: This section covers analysis of various alternatives considered to minimize the overall impacts of proposed development and suggest most appropriate alternatives based of detailed analysis of impact and risk associated with each alternative.
- ***Chapter 6– Impact Assessment and Mitigation***: This section presents the environmental assessment of likely positive and adverse impacts attributed to the proposed subproject and mitigation measures.
- ***Chapter 7– Public Consultation and Discussion***: This section describing the consultation process undertaken during the environmental examination and its results, their consideration in the project design, and manner of compliance to the Bank's Publication Policy and related national laws.
- ***Chapter 8 - Environmental Management Plan***: This section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate or compensate adverse impacts and reinforces beneficial impacts. This plan is divided into three sub-sections; mitigation, monitoring, and implementation arrangements.

- ***Chapter 9–Implementation Arrangements***: This section brief the institutional set up in the executing & implementation agency and contract for the execution of the subproject along with responsibilities on environmental management.
- ***Chapter 10- Conclusion and Recommendation***:Thedocument summaries the environmental sensitivities in the project. The environmental safeguards, monitoring etc which need to be implemented is also summarised in the Chapter.

63. An Executive Summary is also prepared and presented in the beginning of the report.

Figure 1: Subproject location onGoogle Map



2. PROJECT DESCRIPTION

2.1 Type of Project

64. Villages Jongksha, Kharang, Dienglien, Nongjrong&Niriang, Wahiajer are separated from connecting each other by river Umngot. Hence, in order to connect these villages, a major bridge of 75m length has been proposed over river Umngot, Meghalaya.

65. This area is very rich in agricultural products, forest products and minerals. On completion of this project, it will greatly uplift the economy of the people living in the Area. Moreover, economy of the State will also enhance in the form of royalty, taxes. etc.

66. The road connects many important villages like Jongksha, Kharang, Dienglien,Nongjrong, Niriang, Wahiajer etc. Since there is no bridge over river, the villagers are facing great difficulty especially during monsoon due to the absence of the bridge. With the completion of the bridge the road will cater to around fifteen thousand population, most of them are villagers who will use the road for transportation of daily products and many agricultural and horticultural products.

67. This bridge will connect also NH44 (km 49) to tourist spot Smit & connects again to NH 44 (km 11). NH44 connects Eastern part of Assam, Mizoram, Tripura & leads to Bangladesh. It will also act as bypass road for NH44.

68. The proposed length and length of approaches of this bridge will be 75m and 375m repectively. The main objective of this project is to connect villages like Jongksha, Kharang,Dienglien, Nongjrong and Niriang, Wahiajer which till date is having the missing linkin-between as bridge over river Umngot. Upon completion of this bridge, it willconnect also NH44 (km 49) to tourist spot Smit & again to NH 44 (km 11). Since there is no bridge over river, the people in this area are facing great difficulty especially during monsoon due to the absence of the bridge. With the completion of the bridge the road will cater to around four thousand population, most of them are villagers who will use the road for transportation of daily products and many agricultural and horticultural products.

2.2 Location and Features of the subproject

69. The proposed bridge over river Umngotis located 25°12'N, 90°1'E near Jongksha (Shillong) and Umlong Village in the state of Meghalaya. The total approach length is 375m,towards Jongksha Side is 160m and length towards Umlong side 215m. The existing approach of non-bituminous alignment on both sides. The adopted carriageway width for Bridge is 7.5m and for approach is 7 m with 0.9m hard shoulder and 0.6m crash barrier/Drainfor the connecting/approaches of the bridge.

70. The existing alignment on the Index map is presented in Figure 2.Photos of the start and end point are alsopresented in Figure 3.

Figure 2: Index Map Umngot Bridge subproject on state map

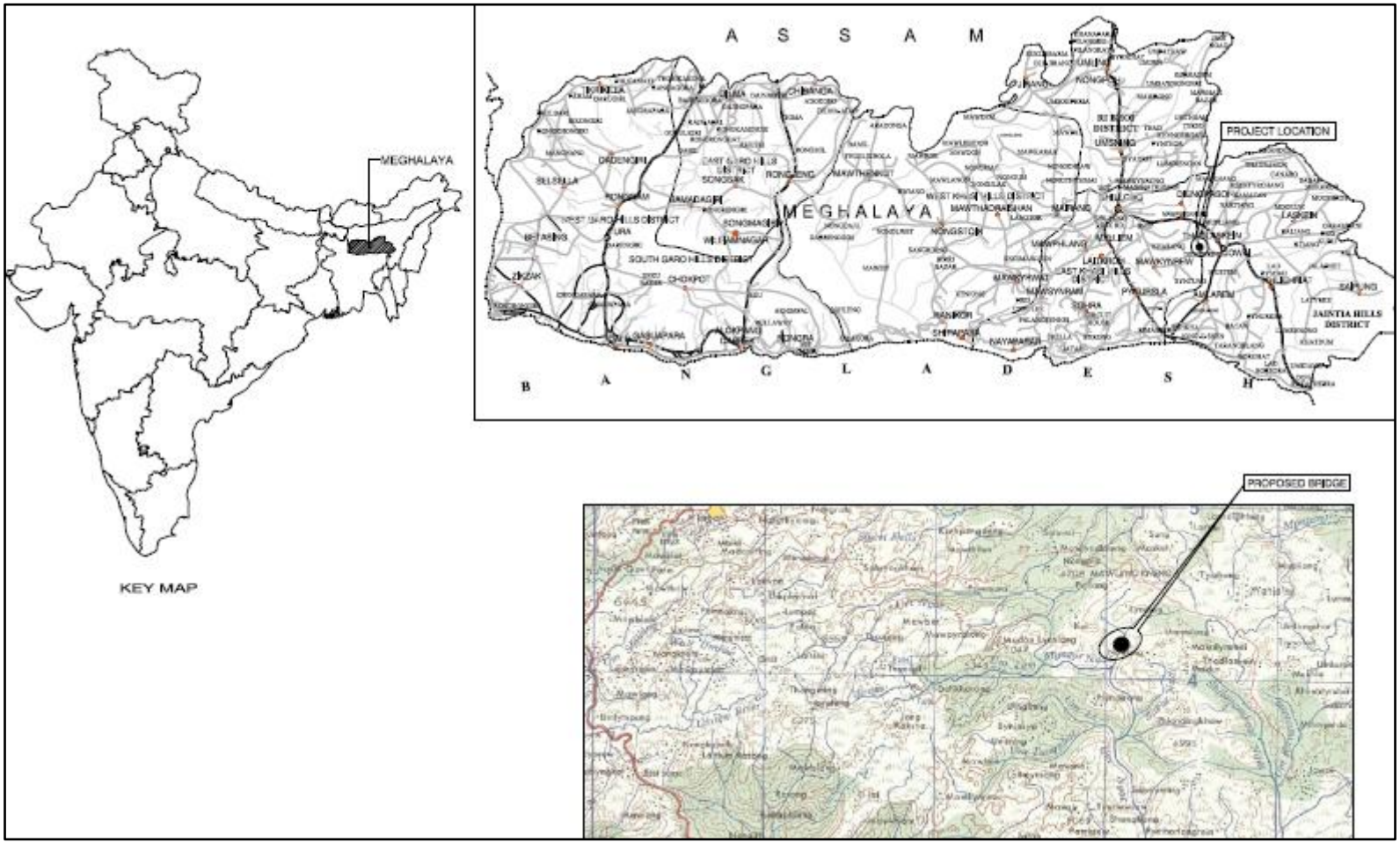


Figure 3: Photo of start and end point of the subproject

Photo: approach to bridge from Jongksha Side

Photo: Proposed Bridge site view

Photo: approach to bridge from Umlong Side

Connecting road to bridge

Photo :Upstream View

Photo: Down Stream View

2.3 Project Features

71. The features of the proposed bridge and the exiting road and are presented in the following section.

2.3.1 Approach

72. The existing approaches for the proposed bridge are unpaved on both side river and non-motorable in raining season.

2.3.2 Bridge Structure

73. There is no bridge over Umngot in the locality, it is required 60 km detouring to cross river by vehicle. The carriageway width in proposed bridge section is 7.5 m with RCC crash barrier of 0.5m width on each side. Thus, total width for the bridge section from out to out is 8.5m is required.

2.3.3 Right of Way

74. The carriageway width in the existing connecting unpaved road section is 3.75m with unpaved shoulders and right of way as was observed varies from 10m to 12m.

2.3.4 Connecting Road

75. **Carriageway:** The detailed inventory on existing carriageway reveals that the approach road stretch comprises of mainlysingle lane carriageway with width of 3.75m configuration. The existing pavement is flexible throughout the road section.

76. **Pavement Conditions:** The existing pavement of approach road is bituminous surface with earthen shoulders of width 0.5m exist predominantly on both sides throughout the stretch. The pavement is flexible type having earthen shoulders. Pavement condition is fair except few locations where it has been badly damaged. The pavement is showing signs of distress at some locations.

2.4 Improvement Proposals

77. As part of subproject for proposed new bridgeand the existing unpaved single-lane road would be converted into doublelane corridor (7.000m carriageway) with 0.9 m wide hard shoulder on both side, Crash Barrier with 0.6m on valley side and drain on hill side. The total width required will be 10.000m.

78. In addition, provisions the following provision for improvement have been made:

- Geometric Improvements
- Pavement – strengthening and reconstruction
- Cross-Drainage Structures
- Safety and
- Road Appurtenances

79. The draft design standards proposed for this bridge are based on IRC: 112-2011, Manual of Standards& Specifications for Intermediate Laning. The design standards are presented below:

(i) Design Life

80. *Geometry:* The geometry of a highway is difficult to improve at frequent intervals because of inherent difficulties in availability of land and inconvenience and hazards to running traffic during improvement works. Thus, a design life of pavement has been taken for 15 years.

81. *Structures:* Structure, like bridges are costly. It is difficult and uneconomical to augment/ widen these structures later. These structures have therefore to be designed for longer life, that is, 75-100 years. Culverts are designed for a design life of 25 years.

(ii) Design Speed

82. It was proposed that the design speeds tabulated in Table be adopted, in general, for the Project Road as recommended by IRC. Wherever it becomes necessary to impose short sections of geometry over which operating speeds will have to be lower than 30 km/h, (R<35 m), these will be adequately marked with appropriate warning road signs.

Road Classification	Design Speed (km/h)			
	Mountainous Terrain		Steep Terrain	
	Ruling	Min.	Ruling	Min.
National/State Highway	50	40	40	30
Major District Roads	40	30	30	20

83. **Traffic Surveys & Projections:** The traffic projections are based on IRC guidelines and assumed growth rate is 5%.

84. **Terrainand Topography**:The connecting road section is in plain& rolling terrain the alignment.This is determined by the general ground slope, and categorised as below:

Ground Slopes for Different Terrain

Terrain	Percent cross slope of the country
Plain	0-10
Rolling	10-25
Hilly	25-60
Mountainous	Greater than 60

85. **Sight Distance:**As per IRC recommendations, the minimum sight distance (Stopping sight distance) is absolutely minimum from safety angle and must be ensured regardless of any other considerations. It would be good practice if this value can be exceeded and visibility corresponding to intermediate sight distance in as much length of road as possible.The following stopping and intermediate sight distance for various design speeds are adopted:

Design Speed (kmph)	Sight Distance (m)	
	Stopping	Intermediate
20	20	40
25	25	50
30	30	60
35	40	80
40	45	90
50	60	120
60	80	160
65	90	180
80	120	240
100	180	360

86. **Soil Characteristics:** The soil characteristics along the alignment are determined in terms of CBR, both under soaked and un-soaked conditions. The design of pavement is based on the traffic load and on the soil characteristics available.

87. **Earth Work Slopes:** The recommended earthwork side slopes are tabulated in Table as shown-

Material	Cut	Fill
Soil	1:1	2:1
Rock	0.25:1	Not Applicable

88. For 'rock' cuttings of height > 6.0 m in occurrences of friable material the consultants have considered the practical issue of inserting horizontal benches into the side slopes to reduce the load on the lower section of the cutting and to intercept occasional falls of soil, rocks fragments, and other debris.

(iii) Design Elements

89. Various design elements, which govern functioning of the project road, are broadly grouped under the following-

- Geometric Design
- Pavement Design

90. Geometric Design:Geometric design will be done using Civil 3D Standard software for Roads.The following activities will constitute the design process:

- Finalizing the final centerline of the existing road with due regard to flattening sharp horizontal curves to the extent possible.
- Finalizing the profile for the existing road duly interfaced with pavement strengthening requirements, after carrying out possible improvements to stretches with unacceptable grades/sight distance.
- Finalising the typical cross-sections as applicable to different road stretches. This will have interfaces with available land, roadside condition (hill, deep valley, major utility lines etc.) environmental impact assessment (presence of reserve forest, big trees, high hills, marshy land, obstruction to waterways etc.), rehabilitation / resettlement impacts (presence of roadside structures including encroachments, agricultural lands etc.)
- Developing the final alignment for the improved facility, showing centerline, carriageway and roadway lines, toe lines, etc.

91. Geometric design features include individual components like Cross-sectionalElements, Sight Distances, Horizontal Alignment and Vertical Alignment. Theseelements are geometrically combined to generate an efficient road layout.

92. Super elevation has been retained to maximum of 7.0%. Curve widening has been done on inner side wherever applicable.The surface cross fall of 2.5% is provided on main carriageway.

93. Components *of Horizontal Alignment:* Horizontal alignment has several components, all inter-dependent on each other. They are super-elevation, side Friction, radius of curvature, length of spiral, and attainment of super elevation. All the above elements are functions of design speed.

94. *Horizontal Curves*: The tangent sections, circular curve and transition curve elements are the major component of Horizontal alignment. A balanced control on the above elements is required to provide safe and continuous flow of vehicles under the general traffic conditions.

95. *Transition* curves in the form of spiral between the tangent sections and circular curve element are designed to satisfy the requirements of allowable rate of change in experiencing centrifugal acceleration by the user and attaining super-elevation on carriageway for the circular curve. The minimum transition lengths suggested in the IRC guideline are indicated in the following sections. However, in unavoidable cases, where transition curves cannot be provided, super-elevation should be achieved by two-third being attained on the straight section before start of circular curve and one-third on the curve. The radii for horizontal curves corresponding to ruling minimum and absolute minimum design speed and the minimum transition lengths suggested in the IRC guideline are indicated in the below Tables.

Minimum Radii of Horizontal Curves for Various Classes of Hill Roads

S. No.	Road Classification	Mountainous Terrain	
		Ruling Min.	Absolute Min.
1	National and State Highways	80	50
2	Major District Roads	50	30
3	Other District Roads	30	20
4	Village Roads	20	14

Minimum Transition Length for Different Speeds & Curve Radii for Mountainous Terrain

Curve Radius (m)	Design Speed (kmph)				
	50	40	30	25	20
15				NA	30
20				35	20
25			NA	25	20
30			30	25	15
40		NA	25	20	15
50		40	20	15	15
55		40	20	15	15
70	NA	30	15	15	15
80	55	25	15	15	NR
90	45	25	15	15	
100	45	20	15	15	
125	35	15	15	NR	
150	30	15	15		
170	25	15	NR		
200	20	15			
300	15	NR			
400	15				
500	NR				

Radius of Curve (m)	Upto 20	21 to 40	41 to 60	61 to 100	101 to 300	Above 300
Extra Width (m)						
Two-Lane	1.5	1.5	1.2	0.9	0.6	Nil
Single-Lane	0.9	0.6	0.6	Nil	Nil	Nil

96. *Horizontal Transition Curves:* Transition curves have not been used due to geometry in this terrain generally does not find sufficient straight lengths in between curves to accommodate spiral lengths for transition.

97. *Broken Back Curves:* It is recommended to adopt a minimum 15-20 m minimum length of straight between curves of the same turning direction within the flat and rolling terrain sections; and in the hilly and mountainous terrain sections make every attempt to avoid the incorporation of short straight elements. In these latter sections each situation is considered individually and, if deemed appropriate, suitable warning signage will be installed.

98. *Curve Widening:* Recommended curve widening for Single lane road as per IRC: SP: 48-1998 are indicated in Table below:

Radius (m)	Widening (m)
< 20	0.9
20-60	0.6
Above 60	No Widening Required

99. *Components of Vertical Profile:* Various components of vertical profile are longitudinal gradient and vertical curves. These elements are functions of design speed.

Longitudinal Gradient

Maximum Gradient:

The maximum grades allowed in steep terrain up-to 3000 m above MSL are

- Ruling gradient – 6.0% (1 in 16.7)
- Limiting gradient – 7.0% (1 in 14.3)

100. However, in *view* of the existing steep hills and necessary economy in the project it has been proposed to limit the gradient to 4%.

101. *Vertical Curve:* The vertical curves are classified into two categories: Summit or Crest Curves and Valley or Sag Curves. Crest curves are designed to provide visibility corresponding to safe stopping sight distance (SSD). Length of sag curves is based on headlight sight distance and comfort criteria.

102. The "K" value, the ratio of length of curve and the algebraic difference between the intersection *tangent* grades, adopted for different speeds are given below.

"K" Values for Vertical Curve

Design Speed (kmph) V	Rate of Vertical Curvature "K" (length (m) per % of grade difference)	
	Crest Curve	***Sag Curve***
30	2	3.5
50	9	8
65	19	16

103. Pavement Design: The existing road is having non-bituminous crust of ~250mm. It has been recommended tomake good the deficient non-bituminous crust to 450mm.

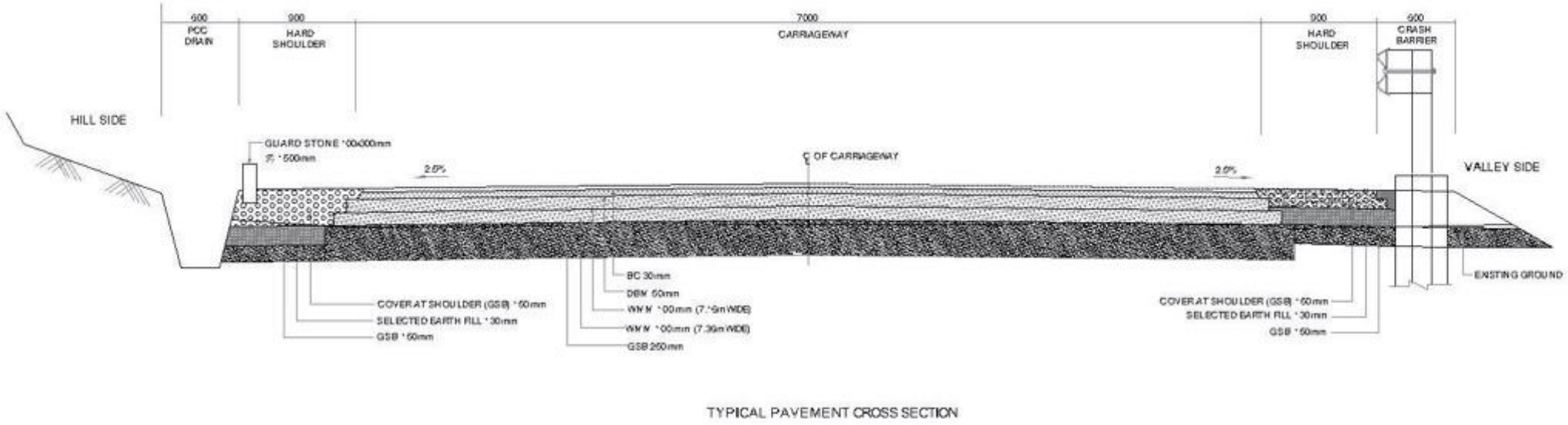
104. For extra widening portion and curves GSB has been proposed below WMM to match the existing crust. Pavement crust thickness is adopted as follows:

Crust	Thickness (mm)
BC	30
DBM	50
WMM	2 X 100
GSB	250

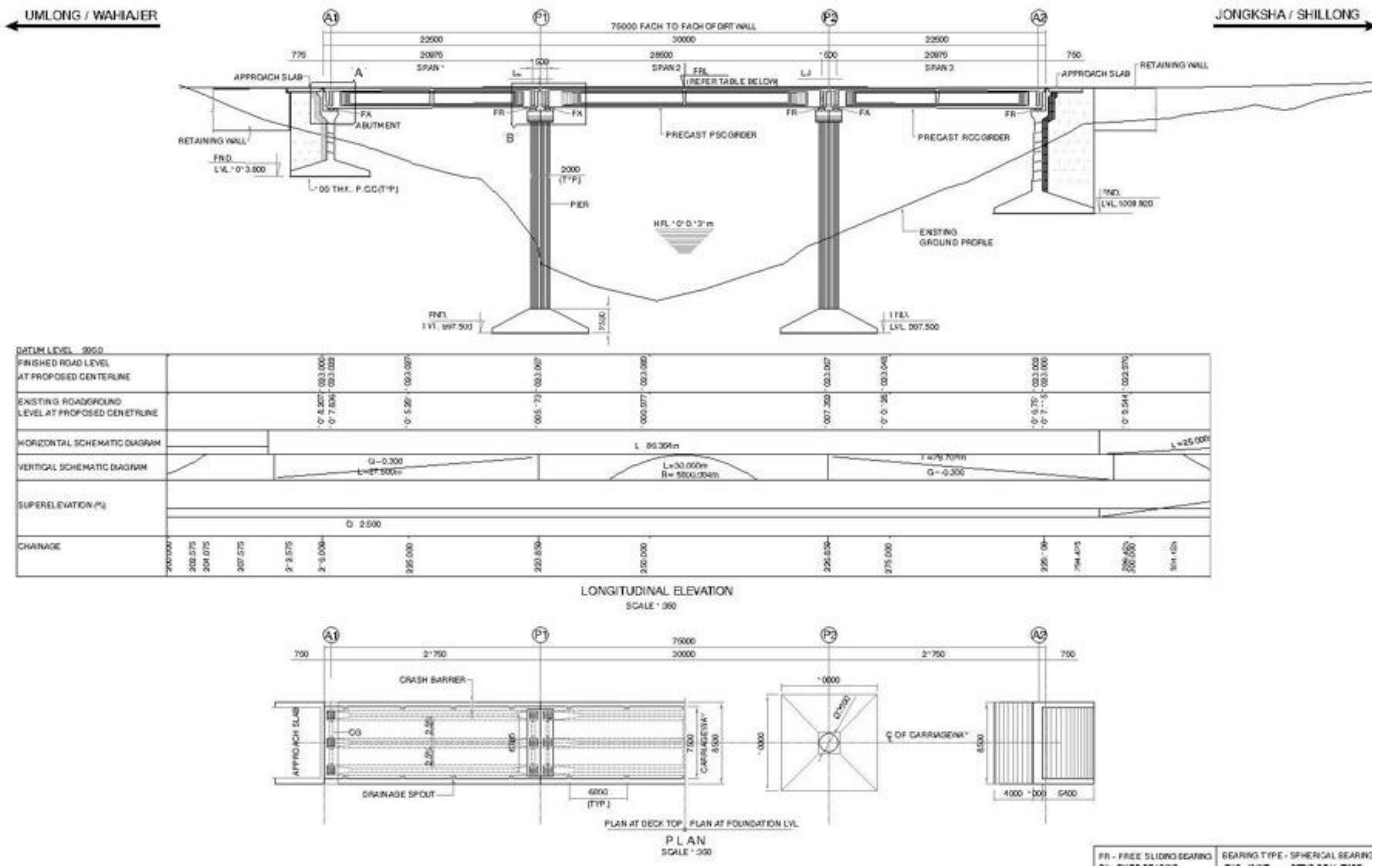
105. Adopted Carriageway width is 7.0m with 0.9m hard shoulder and 0.6m Crash Barrier / Drainin consultation with Meghalaya PWD.

106. Below mentioned Typical Pavement Cross sections proposed components for subproject, are given in Figure-4:

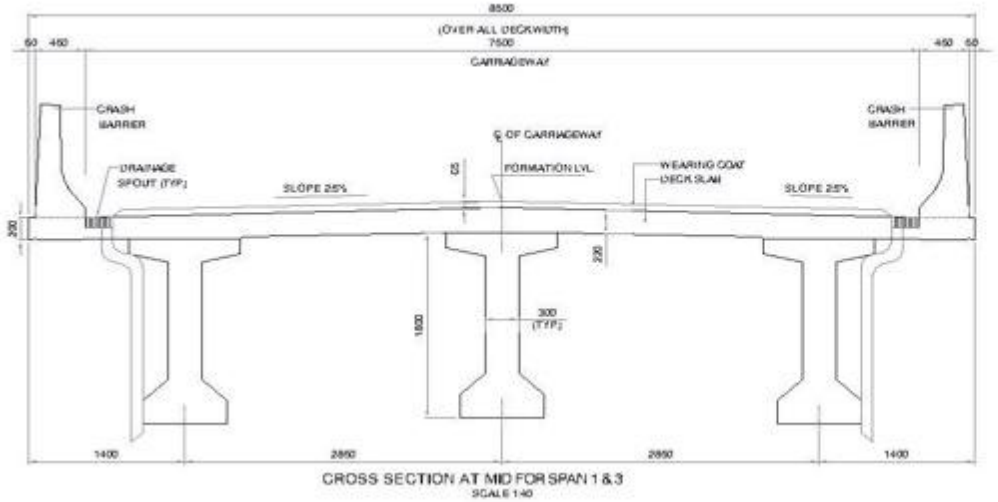
Figure 4: Typical Cross-Section for subproject components

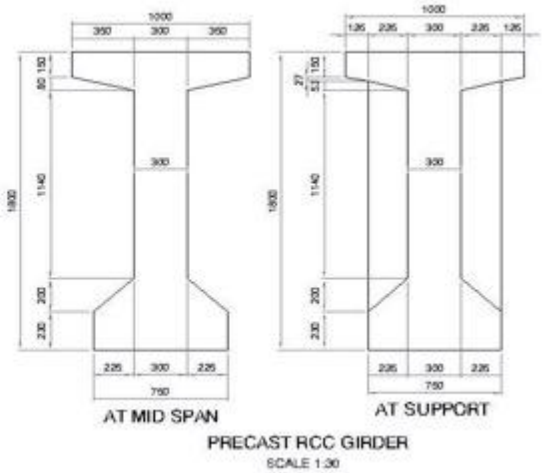


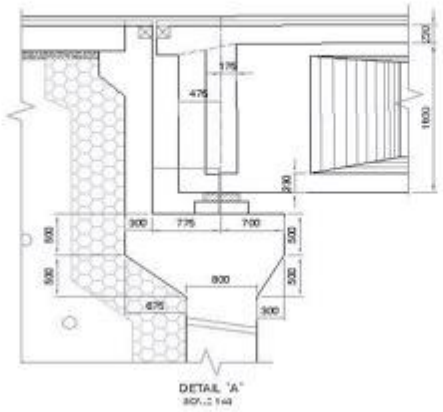
Pavement and Right of way for approach road


UMLONG / WAHIAJER
JONGKSHA / SHILLONG
APPROACH SLAB
RETAINING WALL
ABUTMENT
PIER
PRECAST PSC GIRDER
PRECAST RCC GIRDER
EXISTING GROUND PROFILE
DATUM LEVEL
FINISHED ROAD LEVEL AT PROPOSED CENTERLINE
EXISTING ROAD/GROUND LEVEL AT PROPOSED CENETRLINE
HORIZONTAL SCHEMATIC DIAGRAM
VERTICAL SCHEMATIC DIAGRAM
SUPERELEVATION (%)
CHAINAGE
LONGITUDINAL ELEVATION
CRASH BARRIER
DRAINAGE SPOUT
APPROACH SLAB
PLAN AT DECK TOP
PLAN AT FOUNDATION LVL
PLAN
FR - FREE SLIDING BEARING
BEARING TYPE - SPHERICAL BEARING

Longitudinal Plan of the proposed Bridge







Cross-section of proposed bridge

2.5 Project Environmental Setting

107. The proposed bridge over Umngot River and approaches atJongksha is located in East Khasi Hill District and Umlong villageis located in West Jaintia Hills District.

- The proposed bridge is over River Umngotnear Jongksha&Umlong Village, the river is perennial in nature.
- The road connects villages including Jongksha, Kharang, Dienglien, Nongjrong&Niriang, Wahiajer.

2.6 Components & Activities of The Proposed Project

108. The development of the bridge and approaches would necessarily entail the following three stages. Each of the stages would have several activities and sub-activities. The three stages are

- Detailed design and Pre-Construction Stage
  - Carrying out EIA studies & preparation of EMP
  - Development of Forest Proposal, if forest land is involved
  - Finalization of alignment with incorporation of environmental and community concerns in addition to the design and safety aspects
  - Relocation of utilities and private & community structures
  - Community consultation for land identification for borrow areas, water availability, siting of camps, tree felling permission
  - Identification of sources of material
  - Contractor mobilization
- Construction Stage
  - Site clearing & construction camp sitting
  - Material procurement & transportation
  - Earthwork, hill side cutting, if required, embankment construction, GSB, WBM, operation of equipment, plant and machinery.
  - Structuredemolition& construction work
  - Surfacing and shoulder protection & road furniture
- Post-Construction, Operations & Maintenance Stage
  - Decommissioning of camp, removal of Construction &demolition waste
  - Operation of vehicles and safety of road users

2.7 Infrastructure Requirement for subproject Development

109. During the construction and operations of the subproject components the following infrastructure would be developed and maintained by the Contractor.

110. **Construction Camp:** Even though local labour would be employed to the extent possible number of activities would require specialised skilled labour e.g. operator of the vehicle and machinery, skilled crews for specialised operations e.g. bar-bending and casting. These labours in most cases would be migrant from other parts of Meghalaya or other states. The Contractor would setup a construction camp for the accommodation of the workers.

111. **Hot Mix Plant:** For the manufacturing of the Bituminous material the Contractor would setup a Hot mix Plant. The plant would be setup considering the siting guidelines specified by regulatory authorities.

112. **Batching Plant:** The Concrete batching plant would also be installed for concrete casting of structures i.e.Minor bridges, box and Hume pipe culverts. The Batching plant in addition to cylos for cement,aggregates and sand would also have an area for storage of cement and additives.

113. **Laydown Areas:**The contractor would identify an area for storage of the raw-material required for construction including soil, sand GSB and aggregates. These would be stored as open heaps within the laydown area. The laydown area might also be sued as a maintenance yard for the vehicles and machinery.

114. The excavate material from the pavement and hill side cutting would have to be stored at some places before it can be utilised or disposed of at a permanent approved disposal site.

2.8 Resource Requirements for subproject

115. Soil for the embankment, sub grade and shoulders: The approx. 1245cum of earth would be required for the embankment. This would be sourced from borrow areas which would be identified by the Contractor at the time of construction. The locations of the borrow area would not only satisfy the requirements of MoRTH specifications but also meet the environmental health safety requirement.

116. **Granular material for sub-base:**The estimated 1011cum of granular sub-base would be required. These would be sources from local sources in the proximity to the project location. The facilities which operate with valid environmental clearance would only be selected by the contractor during the Pre- Construction stage.

117. Stone aggregate for use in pavement course and cement concrete: The bridge and road design estimates that 110 cum of bituminous concrete would be used for the project. The aggregate required for these works would be sources from licensed quarriers. The Contractor shall identify these during the pre-construction stage. The location map of identified quarry area is given in Appendix-1.

118. **Power:** Power required at the construction camp would be drawn from the grid where it is available else DG sets would be used to supply the power to the Camp. 1 no. of 250 KVA DG set would be used for the supply of power. 1 DG would be in running condition and 1 on standby. In addition, one no. of 100 KVA DG set would be used for domestic purpose.

119. **Manpower:** The manpower requirement would vary over the construction period depending on the quantum and type of work involved. The peak manpower requirement would be approximately 50 which the average manpower requirement for the subproject would be approximately 30. The skilled manpower, primarily the machine operators and concrete casting crew would be migrant labour and would be housed in the construction camp. On an average the crew in the construction camp is likely to be around 15 persons at any given point of time. The remaining 15 workmen would be local labour who would be working as day labours.

120. **Time Frame:** The construction period would be 30 months.

121. **Water:** The project would require water for both construction activities and domestic purpose during the construction period. The operations period of the project would have no water requirement.

122. For construction of bridge and road section, approx.10KL per day water is likely to be needed for construction purpose depending upon construction activities. Water for construction of the road will be extracted from river water /ground water sources after obtaining necessary permission. The break-up of water tentative requirement is given in Table 3.

Table 3:Break-up of water requirement for subproject construction

S.No.	Purpose	Average Demand (KLD)	Peak Demand (KLD)	Source
1.	Road construction	10	15	Surface/Ground water
3.	Domestic (drinking & washing etc.)	5	5	
Total		**15**	**20**	

2.9 Project Benefits

123. The proposed road sections under the project will have many positive impacts on the region and the people. The various direct impacts of the proposed project and their consequential impacts on the life and livelihood of people are discussed below.

- **ImprovedConnectivity in Area:** The subprojectbridge and approachesare important roads for connecting major habitation in the area, thus construction of the bridge will improvethe connectivity in the area, which will remove a critical bottleneck in the movement of freight and passengers within the area and state.
- **Traffic Congestion** - Traffic movement will improve and congestion will be reduced once the road is widened to 2-lanes. Bottlenecks along the road will be removed. The traffic congestion will ease at all the junctions.
- **Road Safety** - There will be a decrease in the number of road accidents after widening of the highway, as there will be adequate space for plying vehicles to cross and overtake. Also, proper road signage will be provided for safety and convenience of people.
- **Environmental Quality** - The free flow of traffic on new bridge and improved road section will improve the environmental quality as the emissions from the plying vehicles will reduce. The compensatory plantation done will further improve the air quality and aesthetics of the area.
- **Transportation Facilities** –Thesubproject will add in transport convenience of people and to provide better transportation infrastructure to local communities. The travel time will be reduced due to bridge over river and up-gradation of road.
- **Economic Development** - The subproject will provide major connectivity across the river. Economic activities will gradually improve once the road is widened. It will also benefit farmers, as they will be able to sell their agricultural produce in distant markets due to improved transportation. It will also bring other employment opportunities to the region.
- **Development Potential** - There will be higher potential for development in this area due to improvement in access and consequent growth in economic activities. Essential community infrastructures like drainage system, water supply, electricity, transportation etc will come as consequence of proposed development.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS

3.1 Introduction

124. To address environmental risks of the subproject and its associated components and to protect and conserve the environment from any adverse impacts, the regulations, policy and guidelines enacted by the Government of India and Government of Meghalaya which must be followed are presented in the sections below. In addition, the World Bank have their own set of requirements i.e. the Operational Policy to which any project funded by them must also ensure compliance.

125. This Section focuses on the administrative framework under the purview of which the Project will fall and the EIA study will be governed, namely:

- The national and local, legal and institutional framework;
- World Bank Policies and framework; and
- International Safeguard Requirements.

3.2 Government (India) Environmental Legal Framework

126. The national legal framework of India consists of several acts, notifications, rules and regulations to protect environment and wildlife. In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment.

127. The environmental impact assessment requirement in India is based on the Environment (Protection) Act, 1986, the Environmental Impact Assessment Notification, 2006 (amended 2009), all its related circulars, MOEF&CC's Environmental Impact Assessment Guidance Manual for Highways 2010 and IRC Guidelines for Environmental Impacts Assessment (IRC:104-1988) of highway projects. In addition to road widening and rehabilitation including establishment of temporary workshops, construction camps, hotmix plants, and opening of quarries for road construction work require to comply with provisions of The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003): The Wildlife (Protection) Act, 1972 (Amended 1993); The Water (Prevention and Control of Pollution) Act 1972 (Amended 1988) and Rules 1974; The Air (Prevention and Control of Pollution) Act, 1981 (Amended 1987) and Rules 1982; The Noise Pollution (Regulation and Control) Rules, 2000 (Amended 2002) and Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules 2008 (Amended 2009).

128. The Acts and Regulations require project to comply with the following:

a) As per provisions of Environmental Impact Assessment Notification 2006 (amended in 2009, 2011 and 2013), the bridge with connecting approaches does not require environmental clearance from the Ministry of Environment and Forests & climate change. Since; subproject bridge and road section in the study are of category village road, these do not fall under the purview of EIA notification. Therefore; Environmental Clearance from MoEFCC is not required for the subproject.

b) Forest Clearance from Department of Forests is required for diversion of forest land to non-forest purpose. Prior permission is required from Forests Department to carry out any

work within the forest areas and felling of road side trees. Cutting of trees need to be compensated by compensatory afforestation as required by the Forest Department.[1]

c) As per Office Memorandum (OM) issued by MOEFCC on 19 March 2013 the grant of environmental clearance for linear projects including roads has been delinked from the forestry clearance procedure. Hence, after receipt of environmental clearance construction works may commence on sections/parts of a linear project that do not require forestry clearance. Construction works may commence on sections requiring forestry clearance only after receipt of the respective clearance.

d) Placement of hot-mix plants, quarrying and crushers, batch mixing plants, discharge of sewage from construction camps requires No Objection Certificate (Consent to Establish and Consent to Operate) from State Pollution Control Board prior to establishment.

e) Permission from Central Ground Water Authority is required for extracting ground water for construction purposes, from areas declared as critical or semi critical from ground water potential prospective by them.

129. Specifically, for the proposed bridge and it's approaches in Meghalaya, the following (Table 4) environmental laws and regulations are applicable:

Table 4: Applicable Environmental National and State Requirements

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
1.	Environmental (Protection) Act, 1986 amended 1991 and associated rules / notifications	The Environment (Protection) Act is an umbrella legislation on control of pollution (the Water Actand the Air Act) by enacting a general legislation for environment Protection.	The Act and the Rulesframedunder the actdefines thestandards foremission anddischarges. All theequipmentmachinerywhich wouldbe usedin the project has to complywiththe emissionand ordischargestandards specified.	MoEFCC	Contractor
2.	Notification on Environment Impact Assessment of Development projects, 2006 as amended in	Sand borrow soil and aggregate used for road construction has been classified as a minor mineral as per	The quarry sites borrow areas and the sand mines would require a prior environmental clearance under	District Level Expert Appraisal Committee/ District Level Impact Assessment	The Contractor has to obtainnecessary clearance before use ofany borrow

[1]For the proposedsubproject, since no forest land is involved in bridge and it's approaches construction, permission would be required for cutting of road side trees from District authorities as subproject do not pass through any forest area.

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
	2009 and 2013, 2016	The Meghalaya Minor Mineral Concession Rules, 2016.	the EIA Notification 2006.	Authority	area and quarry.
3	The Forest Conservation Act 1980 and The Forest Conservation Rules 1981	The central government enactedThe Forest (Conservation) Act in1980 to stop largescale diversion offorestland fornon-forest use.	The proposed alignment does not pass through any forest area hence no clearance is required.	The Forest Department, Government of Meghalaya and MoEF&CC	MPWD
4	Wildlife (Protection) Act, 1972 amended 1993 and Rules 1995; Wildlife (Protection) Amendment Act, 2002	The act was enacted to protect wild animals and birds through the creation of National Parks, Sanctuaries, Conservation Reserve, Tiger Reserve.	The present alignment does notpass through any wild lifesanctuary. Not Applicable	Wildlife Division, Government of Meghalaya/ MoEF&CC	MPWD
5.	Cutting of road side trees	The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003) and Environmental Protection Act of 1986 and as amended Meghalaya Forest Regulation (Application and Amendment) Act, 1973 The Meghalaya Tree (Preservation) Act, 1976	Permit from Autonomous District Councils Garo/Khasi/Jaintia Hills / Forest Department	Autonomous District Councils / State Department of Forests	MPWD
6.	Ancient Monuments & Archaeological Sites and Remains Act, 1958	The act has been enacted to prevent damage to archaeological sites identified by Archaeological Survey of India	The present alignment does not encroach within legally marked boundary of any national and state protected	Archaeological Dept. GOI and GoM	MPWD

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
			heritage sites. Not Applicable		
7.	Construction and Demolition Waste Management Rules, 2016	Rules to manage construction waste resulting from construction, remodeling, repair and demolition of any civil structure.	Construction and demolition waste generated from the project construction shall be managed and disposed as per the rules.	State Pollution Control Board	The Contractor
8.	Municipal Solid Wastes Management Rules, 2016	Rules to manage municipal solid waste generated; provides rules for segregation, storage, collection, processing and disposal.	Solid waste generated during construction stage at construction camp shall be managed and disposed in accordance with the Rules.	State Pollution Control Board	The Contractor
9.	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets and construction vehicles	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Act of 1986 and as amended Central Motor Vehicle Act, 1988 and Central Motor Vehicle Rules,1989	Consent-for-establishment	State Pollution Control Board	The Contractor
10.	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Act of 1986 and as amended	Consent-for-operation	State Pollution Control Board	The Contractor
11.	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor
12.	Storage of fuel oil, lubricants, diesel etc. at	Manufacture storage and Import of Hazardous	Permission for storage of hazardous	State Pollution Control	The Contractor

Sl. No.	Policy/Act/Rule	Project relevance	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance
	construction camp	Chemical Rules 1989 Hazardous and other Wastes (Management and Transboundary Movement) Rules, 2015	chemical	Board or Local Authority (DM/DC)	
13.	Quarry operation	State Minor Mineral Concession Rules, The Mines and Minerals (Regulation and Development) Act (MMRD Act), 1957, The Meghalaya Minor Minerals Concession Rules 2016	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor
14.	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	The Contractor
15.	Use of surface water for construction	-	Permission for use of water for construction purpose	Irrigation Department	The Contractor
16.	Engagement of labour	Labour Act	Labour license	Labour Commissioner	The Contractor

3.3 Social Regulatory Requirements of India and State

130. There are many rules and regulations framed by the Government of India for the protection of workers. Most of these legislations will be applicable to contractors in charge of construction. EA will ensure compliance to these social legislations through contractual obligation and regular checks & penalties. These legislations include Contract Labour (Regulation and Abolition) Act, 1970;The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996, The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979, The Child Labour (Prohibition and Regulation) Act, 1986, Minimum Wages Act, 1948, Workmen Compensation Act, 1923 and Equal Remuneration Act, 1979; Payment of Gratuity Act, 1972; Employee State Insurance Act; Employees P.F. and Miscellaneous Provision Act, 1952; Maternity Benefit Act, 1951etc.

3.4 Operational Policies of World Bank

131. As part of the review of environmental and social risks and impacts of a proposed investment, World Bank as part of IFC uses a process of environmental and social categorization to reflect the magnitude of risks and impacts. The resulting category also specifies IFC's institutional requirements for disclosure in accordance with IFC's Access to Information Policy.

132. The World Bank has 10 safeguard policies. The details and applicability of the safe guard policies to the project road are provided in the Table-5.

Table 5: Applicable World Bank Safeguards Policies for subproject

Safeguard Policy	Subject	Triggered or Not	Gaps between National Policy and OPs of World Bank	Reason for its Applicability	Mitigation Measures	Documentation
OP 4.01	Environmental Assessment	Triggered	In undertaking Environmental Impact Assessment, the project will adhere to World Banks OP 4.01 and the Notification of Environmental Impact Assessment of Development Projects, 2006 and related amendments. As per national law, the subproject is bridge and its approaches construction and does fall under the preview of environmental clearance (EC) requirement.	Umbrella Policy	The Environmental Impact Assessment is based on the suggested content of OP 4.01 for EIA and has been undertaken for the sub-project. The findings of the community consultations and assessment were integrated into the Detailed Project Report (DPR) for the road and an Environmental Management Plan (EMP) to manage and mitigate impacts was prepared.	EIA & EMP required
OP 4.04	Natural Habitats	Not Triggered	The provisions of the laws - Biological Diversity Act, 2002, Wildlife Protection Act 1972 (WLPA) largely meet the requirements of the OP within Protected Areas, Wildlife Sanctuaries and govern the protection of Schedule 1 species.	Subproject is not passing through Protected areas under National regulation notification.	Not Applicable	Not Applicable
OP 4.36	Forestry	Triggered	The Forest (Conservation) Act 1980 (Amended 1988) and Rules 1981 (Amended 2003) and Environmental Protection Act of 1986 and as amended Meghalaya Forest Regulation (Application and Amendment) Act, 1973 and The Meghalaya Tree (Preservation) Act, 1976 are the National and State laws in place governing the diversion of forest land for non-forest purposes and removal of trees and meet the requirements of OP 4.36.	There is community forest along the road section in approaches.	No Forest Land will be diverted for the project. Permissions for Tree cutting along the road section will be taken under the Meghalaya Tree Preservation Act, 1976 and compensatory afforestation undertaken.	Applicable
OP 4.30	Involuntary Resettlement	Not Triggered		The bridge construction and its approaches will not lead to loss of livelihoods and buildings etc	Not Applicable	Social Impact Assessment report is prepared

Safeguard Policy	Subject	Triggered or Not	Gaps between National Policy and OPs of World Bank	Reason for its Applicability	Mitigation Measures	Documentation
OP 4.20	Indigenous People	Not Triggered		No separate Indigenous people development Plan is required for the subproject.	Not Applicable	Social Impact Assessment report with TPPF focusing on inclusion of tribal in the project benefits is prepared
OP4.11	Physical Cultural Resources (PCR)	Not Triggered	Ancient Monuments and Archaeological Sites and Remains Act, 1958 and The Meghalaya Ancient and Historical Monuments and Archaeological Sites and Remains Act, 1976; Provisions form the act meets the ESS requirements.	There is no archaeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance within proposed RoW that require rehabilitation.	Not Applicable	Social Impact Assessment report is prepared
EHS General Guidelines and Guidelines for Construction Materials Extraction, April, 2007, IFC	Occupation Health and Safety, Environmental Protection	Triggered	Several Acts govern EHS including Occupational Health and Safety and Community Health and Safety; While the subproject will comply with all national and state laws and regulations, it will adhere to the EHS guidelines and other best practice documents to maintain the highest EHS standards. The national laws applicable are: Air (Prevention and Control of Pollution) Act, 1981; Water (Prevention and Control of Pollution) Act, 1974, for Pollution-Prevention-and-Management; The Noise Pollution (Regulation And Control) Rules, 2000, Notification for use of fly ash, 2003 and MoEF&CC notification dated 25th March 2015, Municipal		World Bank EHS and Best Practice Guidelines that will be followed are: • IFC General Environmental Health and Safety Guidelines and Guidelines for Construction Materials Extraction: http://documents.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf	

Safeguard Policy	Subject	Triggered or Not	Gaps between National Policy and OPs of World Bank	Reason for its Applicability	Mitigation Measures	Documentation
			Solid Waste (Management & Handling), Rules, 2000 (MSW Rules), Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008, Batteries (Management and Handling) Rules, 2001, Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules 1989, The E-Waste (Management) Rules, 2016, Plastic waste Management Rules, 2016, Construction & Demolition, Waste Management Rules, 2016, The Mines and Minerals (Development and Regulation) Act 1957, State Minor Mineral Concession Rules, The Meghalaya Minor Minerals Concession Rules 2016;		• For labor camp establishment, adherence to World Banks Worker Accommodation Processes and Standards: http://documents.worldbank.org/curated/en/604561468170043490/pdf/602530WP0worke10Box358316B01PUBLIC1.pdf • World Banks Good Practice Note on Road Safety: http://pubdocs.worldbank.org/en/648681570135612401/Good-Practice-Note-Road-Safety.pdf	

3.5 Category of the Project

133. Environmental requirements of World Bank are specified in detail in its Operational Policy (OP) 4.01 and other related OPs. In instances in which the procedural and regulatory requirements differ, the more stringent applies. The World Bank environmental requirements are based on a three-part classification system.

- Category A: project requires a full Environmental Assessment (EA).
- Category B: project requires a lesser level of environmental investigation.
- Category C: project requires no environmental analysis.

134. Internally World Bank (WB) classified the project in to 'Category A' requiring Environmental Assessment. This classification is based on the type, location, sensitivity, and scale/magnitude of the project road. This could be largely due to anticipated impacts on socio-economic & physical and biological environmental attributes. In other words, the World Bank Classification is based on the anticipated cumulative environmental and social impacts due to the construction and operation of the project road sections.

135. The subproject triggers two, out of ten safeguard policies. Therefore, implementation of the project in tune with these triggered safeguard policies is important.

136. The Operational Policy 4.04 governs for presence of Natural Habitats in the subproject area. The bridge and its approaches is located near Umngot River and there is no identified wildlife habitat or animal movement recorded. Hence, for this subproject this policy is not triggered. The Operational Policy 4.36 takes care of forestry in the subproject areas, in this road section there is no forest orcommunity forestlocated along the alignment.Right of way is available for proposed widening of approaches road and no additional land acquisition is proposed. However, tree cutting permission will be required for community areas, hence this policy is triggered.

137. The Banks Operational Policy 4.30 describes policy and procedures for project that involve involuntary resettlement. The policy requires that project minimize the need for involuntary resettlement. Banks policy aims to improve, or at a minimum, sustain the same standard of living of the people who will be displaced because of a development project. Where displacement is unavoidable, resettlement plans should pay particular attention to the vulnerable groups.

4. ENVIRONMENTAL BASELINE STATUS

4.1 Introduction

138. This section describes the existing environmental and social baseline of the study area around the subproject. It includes relevant components of physical, biological and socio-economic environment.

139. The purposes of describing the environmental settings of the study area are:

- To understand the project needs and environmental characteristics of the area; and
- To assess the quality of the existing environment, as well as the environmental impacts of the future developments being studied.

140. The baseline environment for the EIA was studied through primary survey, information collected from secondary sources and discussion with stakeholders.

4.2 Methodology

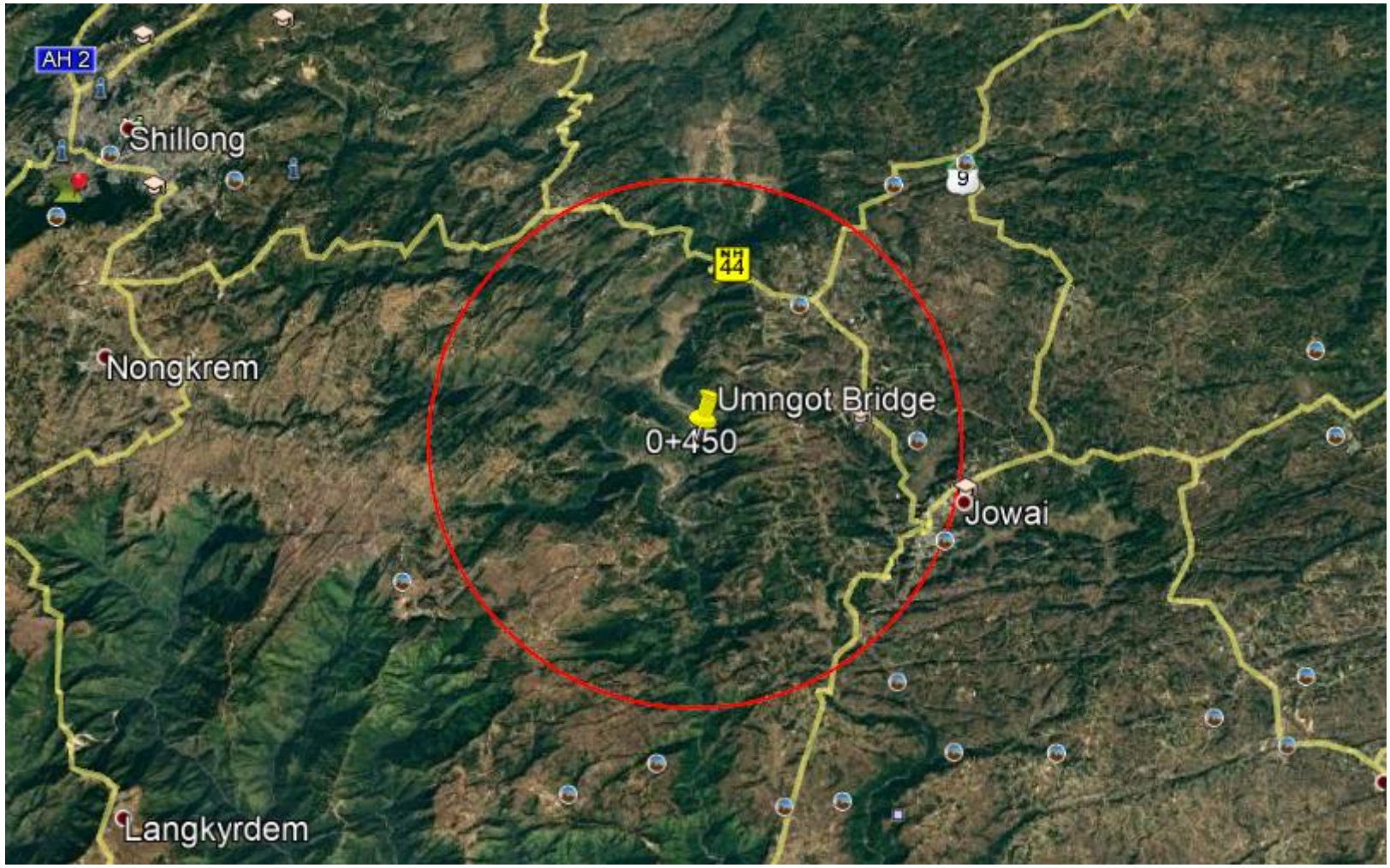
4.2.1 Study Area

141. As discussed in section -1. the study area has been defined as follows:

142. **Corridor of Impact (CoI):** The area of 500m on either side of the proposed bridge and approaches centreline is considered as the corridor of impact. The proposed RoWi.e.10m is thus included within the CoI. This area is more vulnerable to the subproject's direct impacts.

143. **Project Influence Area (PIA):** In accordance with MoEF&CC's EIA Guideline Manual for Highways and as per guidelines of EIA Notification-2006, the Project Influence Area has been defined as 10 km on either side (Arial distance) from boundary of road. Collection of secondary data, including likely impacts due to ancillary sites like borrow areas, quarry, material storage,disposal areas, etc. are done within this influence area. The project influence area is marked on google map is given in Figure-5.

Figure 5:Subproject alignment on google map showing study area



4.2.2 Environmental Surveys and Studies

144. Collection of baseline information on bio-physical, socio-economic aspects of the subproject area is the most important reference for environmental assessment studies. The description of environmental settings includes the characteristic of area in which the activity of bridge construction would occur, and cover area affected by all environmental impacts. Thus, for conducting EIA, existing environmental conditions along the subproject alignment have been obtained by primary data collection, monitoring, sampling and secondary data collection from published source and various government agencies. The primary studies are focused on the Corridor of influence but the sensitivities in the project influence area have been collected through secondary literature review.

145. To assess the baseline environmental status of the Corridor of Impact, monitoring of various environmental attributes was conducted by the consultants during November-December 2019. Primary data for ambient air quality, ambient noise status, water quality (Ground and surface) and soil quality was collected and analysed through NABL accredited laboratory. The detailed results of baseline monitoring are given in Appendix-2.

146. Information of various physical parameters was collected from the Shillong Centre of Indian Meteorological Department, Statistical Department, Gazetteer of Meghalaya, Forest Department, Department of Environment and other concern Government Departments and discussions with the officials from these agencies. The proposed bridge over River Umngot is located in West Jaintia Hillsand East Khasi Hills district, the baseline of project district and subproject area are described below.

4.3 Land Environment

4.3.1 Topography

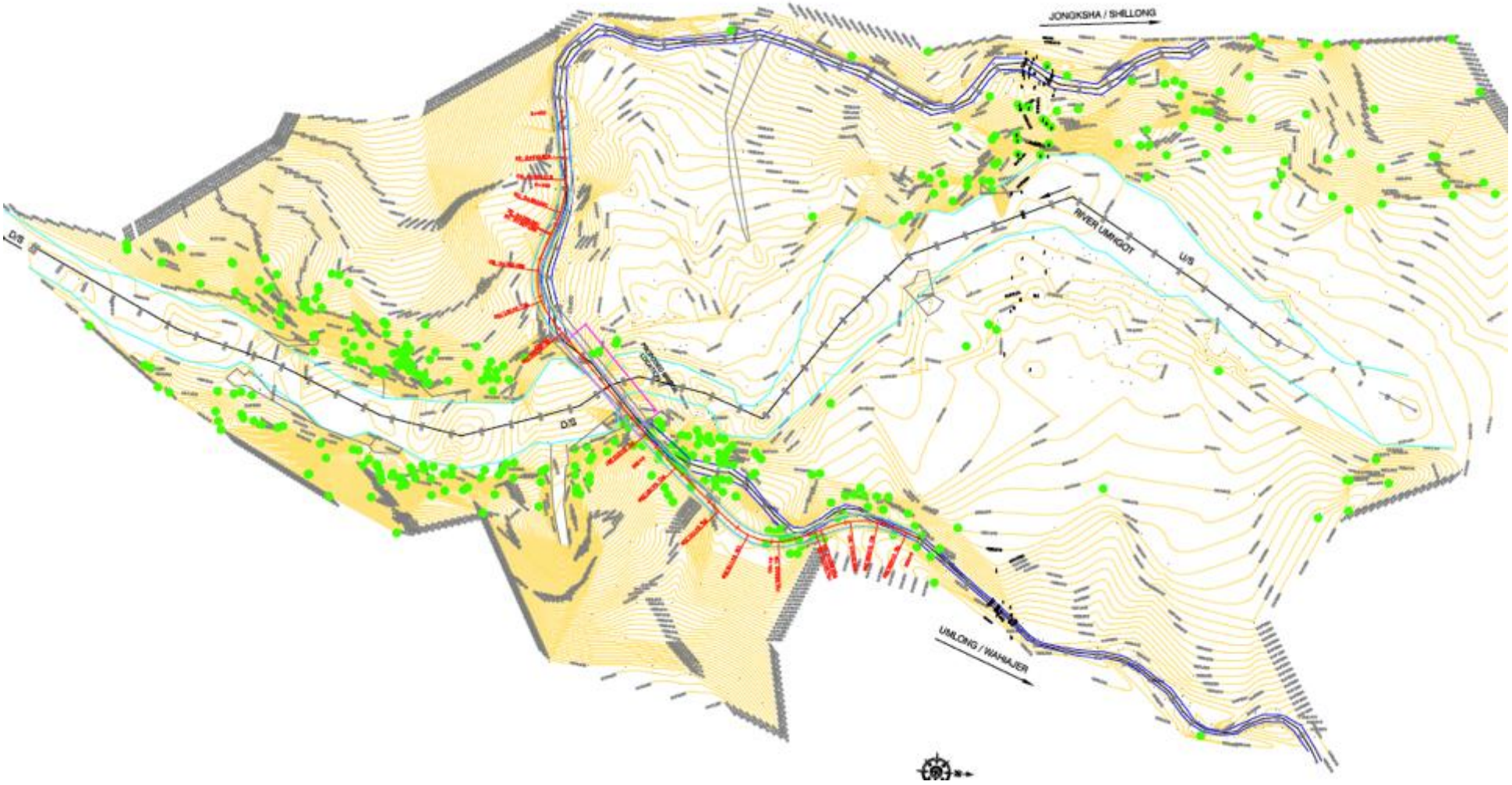
147. Meghalaya state is also known as Meghalaya plateau. The state can, broadly, be divided into three physiographic zones, namely:

- Central Plateau Region comprising the Khasi Hills and has the highest elevations between 900-2000m,
- Sub-montane region in continuation with the Central Plateau below 900m which gradually merges with the plains in the West and North, namely the Jaintia Hills, and
- Border region which stretches south-wards abruptly from the Central Plateau to the plains in Bangladesh, mainly the Garo Hills region, and is nearly plain.

148. The highest point in the state is the Shillong Peak with an altitude of 1961 meters.

149. The topography of subproject area is of undulating low hills and valleys with altitude ranges from 400m to 2000m above mean sea level. Elevation in East Khasi Hills district ranges between a minimum of 900m to a maximum of 2000m above msl and in West Jaintia Hills District the range of elevation is in between 500m to 1500m above msl. The subproject is located in region with elevation in the range of 500m to 1200m, Figure 6 depicts the elevation across thesubprojectlocation.

Figure 6: Topographical Map of the subproject area



Source: DPR study report

4.3.2 Geology

150. Geologically the Meghalaya plateau comprises of rocks from the oldest Precambrian gneissic complex to the Recent alluvium formations. The stratigraphic sequence is as follows.

- Cretaceous –Tertiary sediments
- The Sylhet trap
- Lower Gondwana rocks
- Shillong Group of rocks
- Precambrian gneissic complex (Basement gneiss)

151. The Precambrian gneissic complex comprising para and orthogneisses, migmatites and the Shillong Group of rocks comprising mainly quartzytes are exposed in the central, eastern and northern parts of the Meghalaya plateau. They are intruded by basic and ultrabasic intrusives and late techtonic granite plutons.

152. The lower Gondwana rocks of Permo-Carboniferous age are recognized at the western part of Garo Hills and consists of pebble bed, sandstone, and carbonaceous shale. The Sylhet trap of middle Jurassic age comprising mainly of basalt, rhyolites, acid tuffs, is exposed in a narrow E-W strip along the southern border of Khasi Hills.

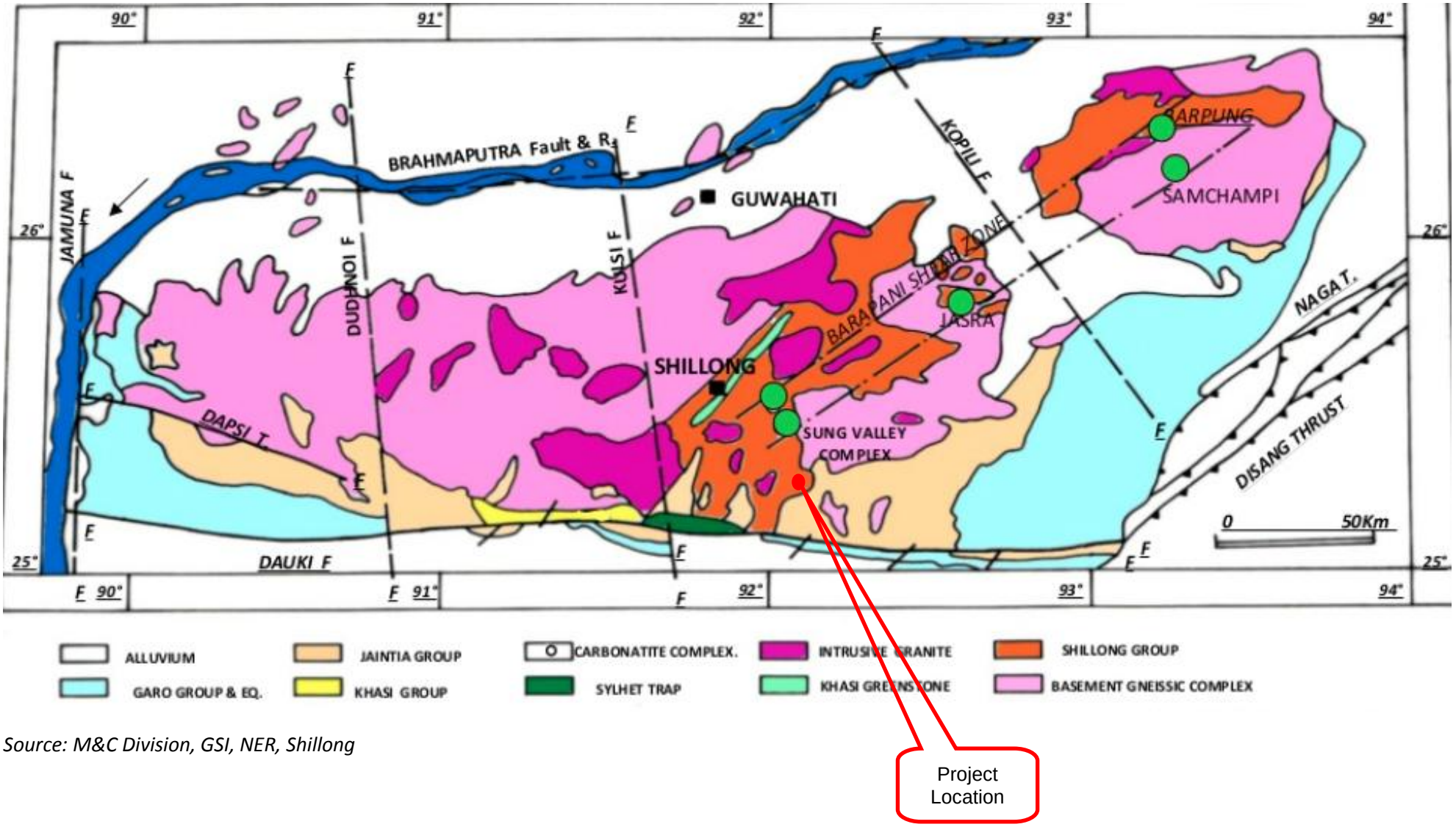
153. The Cretaceous – Tertiary sediments occupying southern part of the Meghalaya plateau comprises of the Khasi Group (arenaceous facies), the Jaintia Group (calcareous facies) and the youngest formation the Garo Group which is represented as Simsang, Bagmara and Chengapara formations.

154. North Garo Hills District is mainly exposed with the rocks of Assam Meghalaya Gneissic Complex (AMGC) of Proterozoic age consists of metamorphic rocks like migmatites, augen-gneiss, biotite gneiss etc. Older Supracrustals rocks like amphibolites, schists, quartzites and calc-granulites of Proterozoic age are present as enclaves within the gneissic country rocks of AMGC. This group of rocks is intruded by grey/pink granite/porphyritic granite (Mylliem/Nongpoh Granite) of Neoproterozoic to early Palaeozoic age. Pegmatites and quartz vein also occur at some places. The basaltic dykes are apparently related to the Sylhet traps of Jurassic to Cretaceous age.

155. The Assam Meghalaya Gneissic Complex is overlain by sedimentary sequence of QuaternarytoLate Holocene age. Sylhettrapis unconformablyoverlainby undifferentiated Quaternary Formation of fluvial sediments, sand, silt and clay. Older Alluvium comprises ofreddish brown to dark brown oxidized sand, silt clay and loamy sand of Chapar and Sorbhog formation.

156. The subproject area falls mainly within the Shillong or Meghalaya Plateau which is constituted mainly of Precambrian rocks of gneissic composition in which granites, schists, amphibolits, calcsilicate rocks occur as inclusions of various dimensions. The gneisses form the Basement Complex for the overlying Shillong Group of rocks and is separated from the later by an unconformity indicated at places by the occurrence of a conglomerate bed. The presence of primary structures like current bedding, ripple marksetc indicated that quartzite's of the Shillong Group are of sedimentary derivative later metamorphosed to quartzites. These occur mostly as thick layers. Grainite Plutons occur as isolated patches in the district, intruding the Basement Gneissic complex and Shillong Group of rocks. The Granites occur as intrusive body in the Basement Gneissic complex. Both Porphyritic and fine-grained pink granite occur in the area. The Shella Formation of Jaintia Group consists of alteration of sandstone and limestone occurs in the south-central and south-western part of the district. The subproject location on geological map of State is shown in Figure 7.

Figure 7:Geological Map of Meghalaya state and subproject location

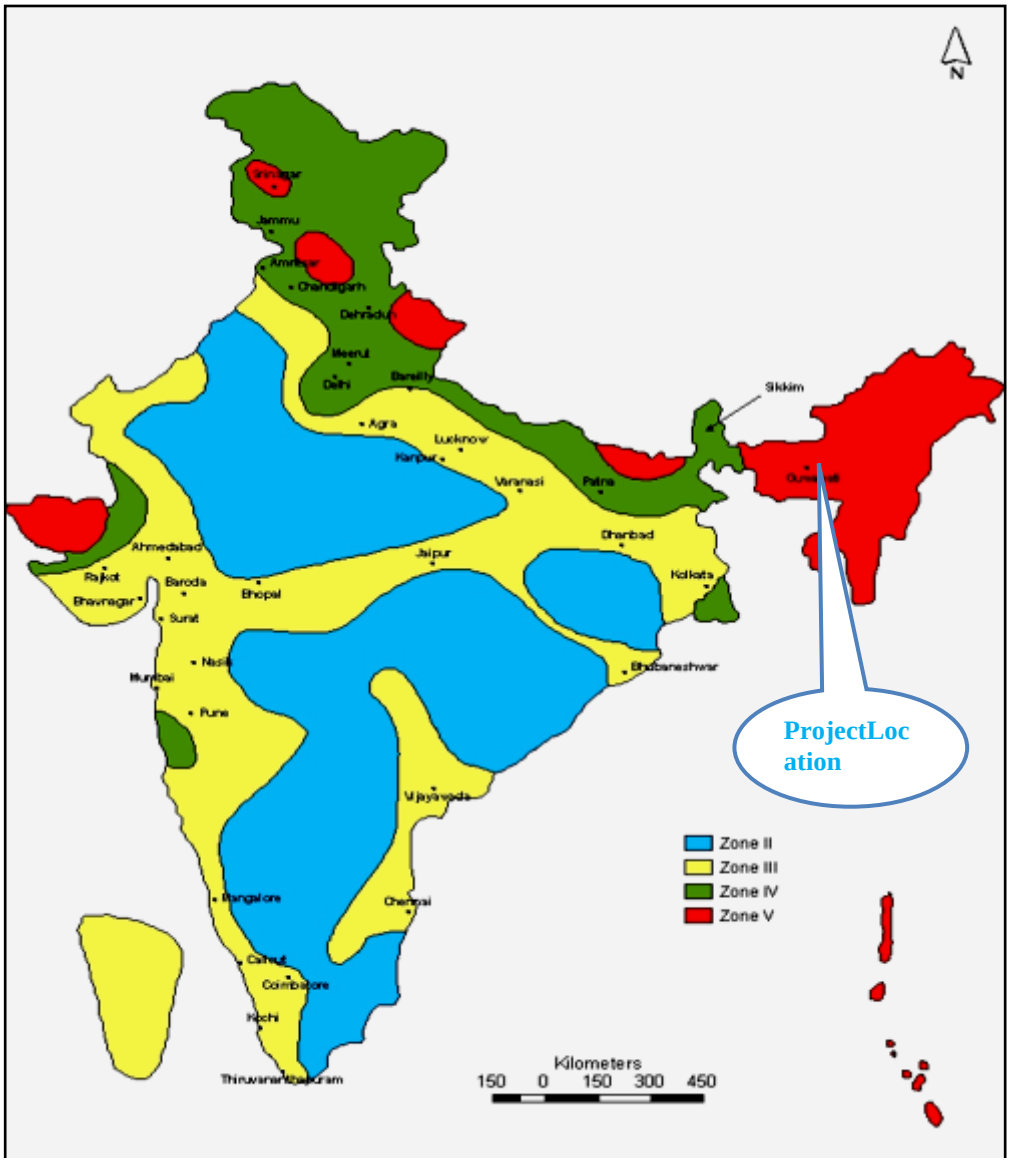


Source: M&C Division, GSI, NER, Shillong

4.3.3 Seismicity

157. The Bureau of Indian Standards[2] has categorized the entire country in various zones depending upon the degree of proneness to earthquakes. The Zone I signify lesser degree while Zone V signifies highest order. The proposed project road falls under the Seismic Zone V, which is susceptible to major earthquakes as per the seismic zone map of India (IS 1893 - Part I: 2002), shown below in Figure 8.

Figure 8: Seismic Zoning Map of India showing Project Location

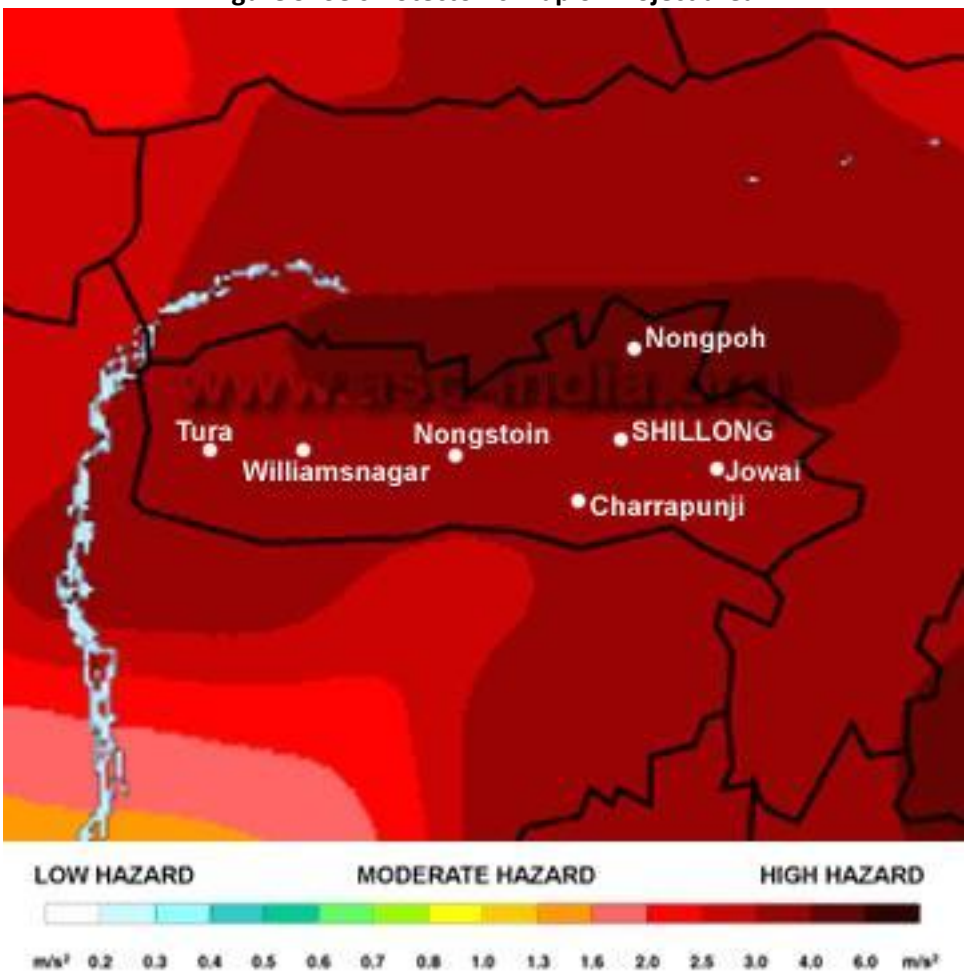


*(**Source:**Envis, Government of Meghalaya)*

158. According to GSHAP data, the state of Meghalaya falls in a region of high to very high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, this state also falls in Zone V. Historically; parts of this state have experienced seismic activity greater than **M**6.0 including an **M**8.1 in 1897. Figure-9 shows the seismotectonic map of Project location.

[2] Bureau of Indian Standards (BIS), a Government of India body has prepared the seismic zoning map for the entire India and established criteria for earth quake resistant design of structures. Zone I indicate the lesser proneness of the region to earthquakes and Zone V indicates higher degree of proneness of earthquakes.

Figure 9: Seismotectonic Map of Project area



(Source: ASC, Pune)

159. Nearly all of the state of Meghalaya, lies on the "Shillong Massif". This is a block-like structure that has not undergone much folding or faulting compared to the surrounding areas. The main threats to the state come from faults bounding the massif with the surrounding areas. The northern part of the massif has several faults, among the newly identified Oldham Fault that is believed responsible for the 1897 earthquake.

160. Moderate earthquakeshave occurred in the state but the most significant of all was the Great Assam earthquake of 1897. Centred across the state border in Assam, much of Meghalaya was severely jolted especially Shillong.

161. Considering high hazard seismic zone of the subproject area, design standards for structures stipulated in the clause under IRC: 6-2014 has been taken into account.

4.3.4 Soil Type and Quality

162. The project district has two type of soils(a) Sandy clay soil which occupies small pockets of South-eastparts; and (b) Clay loam-gravelly clay occupying major part of the district.The soil depth varies from deep to moderately deep and permeable and highly prone to erosion. These are soil generally acidic in nature with pH ranges from 4.9 to 5.6.

163. Soil samples were collected from project influenced area and analysed to find physio-chemical properties. The soil sample locations are given in below Table-6.

Table 6: Soil sample collection location in the project area

S. No.	Location Code	Chainage	Location Name	Source
1	SS_1	0+100	Umlongside	From Agriculture field
2	SS_2	0+320	Jongksha side	From Agriculture field

164. The summary of soil quality results for the project stretch is presented in Table-7.

Table 7: Results of soil quality in the project area

S. No.	Parameter(S)	Unit	Test Result	
			SS_1	SS_2
1	Soil Texture	-	Silty Clay Soil	Silty Clay Soil
2	Soil Colour		Greyish Brown	Greyish Brown
3	pH Value at 25°C	-	8.44	7.84
4	Conductivity at 25°C	µS/cm	714	684
5	Moisture	% by mass	8.5	7.4
6	Bulk Density	gm/cc	1.21	1.27
7	Water Holding Capacity	Inches/foot	1.36	1.18
8	Nitrogen as N	mg/Kg	21.4	24.1
9	Phosphorus	mg/Kg	3.84	3.54
10	Potassium (as K)	mg/Kg	71.2	60.4
11	Calcium as Ca	mg/Kg	58	51
12	Nitrate as NO_3	mg/Kg	109	114
13	Sulphate as SO_4	mg/Kg	10.5	11.2
14	Chloride	mg/Kg	6.7	5.6
15	Organic Carbon	% by mass	5.4	4.9
16	Organic Matter	% by mass	6.7	5.4
17	Total Soluble Solids	mg/Kg	12.4	11.4
18	Soil Texture			
A	Sand	% by mass	18.1	24.1
B	Silt	% by mass	41.2	36.8
C	Clay	% by mass	40.7	39.1

165. The results show soil texture of clay loam in thesubproject area. There is higher value of organic matter and nitrate can be observed from the chemical analysis of the soil samples. The soils from agriculture fields is not acidic in nature; may be due cropping pattern and proper drainage.

4.3.5 Land Use

166. Meghalaya lies between 24^0 58' North to 26^0 07' North latitudes and 89^0 48' East to 92^0 51' East longitudes. It covers an area of 22,429 sq. km. of which about 70% is endowed with dense forests and rivers cascading down undulating terrain. The State has most of its land covered by hills interspersed with gorges and small valleys.

167. Most of the land is under rural areas, with Shillong being predominately the main urban settlement. Only 12.74% is net sown area. The principal crop grown in the state is rice covering at least 80% of the cultivated land, followed by maize and wheat. About 17.4% of the land is under wasteland category, (comprising of scrubland, jhum, abandoned jhum lands and degraded scrub forest, with the highest proportion in the west Khasi hills and Jaintia hills.

168. The state of Meghalaya is a resource rich state. There are a variety of landholdings, water resources and forests under different classifications. The table-8 below provides district wise data on land use and forest cover:

Table 8: District-wise Land Use Classification, (2015 – 2016, Area in Ha)

District	Area under forest	Land not available for cultivation	Other un-cultivated land excluding Fallow land	Fallow Land	Net Sown Area	Total	Area Sown More than Once	Gross Cropped Area
East Khasi Hills	106964	53731	65508	10720	37866	**274789**	11127	48993
Ri - Bhoi	87141	33277	86290	15036	22751	**244495**	2983	25734
West Khasi Hills	156012	50284	110241	47802	20260	**384599**	4724	24984
South West Khasi Hills	50508	24818	34889	18865	11010	**140090**	2122	13132
East Jaintia Hills	84077	15565	78288	14642	25169	**203643**	48	11119
West Jaintia Hills	69886	17290	52797	12618	11071	**177760**	388	25557
North Garo Hills	55455	5063	35892	11445	17778	**115981**	2576	20354
East Garo Hills	69122	6364	26240	13596	19311	**144285**	2677	21988
West Garo Hills	126265	15809	29997	13596	73241	**281090**	18668	91909
South West Garo Hills	38526	6592	8900	10162	22406	**86586**	6699	29105
South Garo Hills	102292	11167	25382	24381	25462	**188684**	5264	30726
Total	**946248**	**239960**	**554424**	**215045**	**286325**	**2242902**	57276	343601

Source: Directorate of Economics & Statistics, Meghalaya (Statistical Abstract 2018)

169. The land utilization in subprojectdistrict of West Jaintia Hill and East Khasi Hills varies in many respects. Forest cover for West Jaintia Hills and East Khasi Hills district which constitutes106964 ha. & 69886 ha. respectively,of the total geographical area of the districts and is higher compared to other category of land use. Cultivable waste land and groves of these districts is about 65508 ha. & 52797ha.hindcasting there is high degradation of land resulting from faulty agricultural practice and due to large-scale deforestation.The net sown area of these districts constitutes 37866 ha.& 11071 ha.of the total area see Table-8.

170. Land use pattern abutting the subproject alignment of connecting road section is mainly agriculture fields and vegetation. The land use within the project influence area and along the project corridor is presented in Table-9.

Table 9: Landuse details along the project alignment

Chainage (Km)		Length (m)	Landuse	Remark
From	To			

0+000	0+210	0+210	AG/VG	Agriculture fields &Vegetation
0+210	0+300	0+900	Water body	Umngot river
0+300	0+450	0+150	AG/ VG	Agriculture fields& vegetation

Source: Environmental features survey along the project alignment October-December 2019

4.4 Air Environment

4.4.1 Climate & Meteorology

171. Climate of Meghalaya plateau is influenced by elevation and distribution of physical relief. On the basis of weather condition, the Meghalaya plateau has 4 distinct seasons. The seasons are:

(a) The rainy season from May to early October.
(b) The cool season from early October to November.
(c) The cold season from December to February.
(d) The warm season or hot season from March to April.

172. The salient climatic features of the state are as fallow:

- Average Annual Rainfall - 2000-4000 mm
- Concentration of precipitation - May to October
- Humidity - 67 to 94%
- Cloudiness - Heavily clouded
- Wind - Generally light except rainy season
- Temperature - Summer 23°C to 25°C
  Winter 7°C to 11°C

173. The Khasi and Jaintia hills experience a moderate climate because of higher elevation. Warm and humid conditions are prevalent in the foothill region in the south and sub-montane region in the north and central uplands. The plateau experiences a temperature of 24°C throughout the year. The southern parts of the plateau have the Cherrapunji -Mawsynram region which receives the heaviest rainfall, an annual average of 12670mm which is the highest amount of rainfall in the world. The Khasi and Jaintia hills receive an average of 7700mm of rainfall and lies in the rain shadow area.

Table 10: District wise rainfall in the State (2004-2012)

District/Centres	2004	2005	2006	2007	2008	2009	2010	2011	2012
East Khasi Hills (a)Mawsynram	14026	10072	8082	13302	10722	8952	11069	8927	12327
(b)Sohra	NA	NA	NA	12647	11415	9000	13472	8732	13350
West Khasi Hills (a)Nongstoin	4036	3097	2366	4778	NA	*3507	3316	2982	NA
Jaintia Hills (a)Jowai	5374	3042	2898	5379	3094	3025	3404	2964	4254
East Garo Hills (a)Willliamnagar	3837	3612	2098	3899	3317	3252	3183	NA	3109
West Garo Hills (a)Tura	4107	4652	2528	4265	3632	3355	3278	4003	3580
Ribhoi (a)Nongpoh	1147	1792	1274	3086	3853	3354	1156	6278	NA

South Garo Hills (a)Baghmara	1811	2347	1405	2589	2392	1532	1161	2147	1841

*Source: District Agriculture office, Meghalaya, District and local Research Station and laboratories, West Garo Hills, Tura, S.D.O, PWD, Mawsynram, Sub-Divisional Agriculture Officer – Sohra (*February to December)*

174. Subproject site has a mild subtropical highland climate, with monsoonal influences typical ofIndia. The city's annual rainfall average stands at 11,777 millimetres (463.7 in). This figure for total rainfall places it behind only nearby Mawsynram, Meghalaya, whose average is 11,873millimetres (467.4 in). Sohra receives both the southwest and northeast monsoonal winds,giving it a single monsoon season. It lies on the windward side of the Khasi Hills, so theresulting orographic lift enhances precipitation. In the winter months it receives thenortheast monsoon showers that travel down the Brahmaputra valley. The driest monthsare November, December, January and February.

175. In the subproject district rainfall recorded from month January to December during year 2016. The month wise rainfall in North Garo Hills district is mentioned in Table -11 below.

Table 11: Average monthly rainfall of East Khasi Hill & West Jaintia Hills District

S.No.	Month	Average Rainfall (mm)	
		East Khasi Hills	West Jaintia Hills
1	January	49.4	28
2	February	60.5	9.6
3	March	284.14	46.2
4	April	4142.8	94.4
5	May	3115.1	320.9
6	June	2949.2	353.6
7	July	9866.5	7889.6
8	August	715.52	87.2
9	September	943.8	272
10	October	0	0
11	November	0	0
12	December	0	0

Source: GoM, Department of Agriculture and Farmer's Welfare

176. Temperatures average of the subproject area 11.5 °C in January and 20.6 °C in August, and the annual mean is17.3 °C.

Table 12: Average Seasonal Temperature of the State

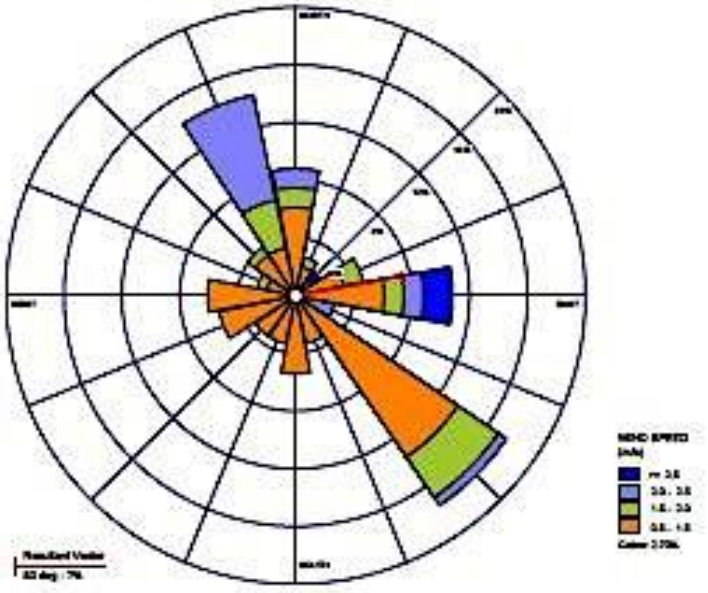
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temp. (°C)	10.4	12.3	16.4	18.9	19.6	20.8	21.2	21.1	20.5	18.1	14.4	11.4
Min Temp (°C)	4.9	7.3	11.2	14.4	15.9	17.9	18.5	18.2	17.3	14.1	9.3	5.9
Max Temp (°C)	15.9	17.4	21.6	23.5	23.4	23.7	23.9	24.1	23.7	22.2	19.5	16.9

Source: https://en.climate-data.org/asia/india/meghalaya/shillong-24618/

177. The below (Figure -10) wind-rose diagram indicates the distribution of wind direction and its speed over the monitoring period at Shillong. From the diagram it is shown that around 17% wind direction is from South-East with a wind speed of 0.1 to 1.5 m/s. Similarly, around 14% wind direction has been observed from North/North-West with 2-0-2.5 m/s wind speed. From the diagram the resultant vector has been obtained at 80 degree. The predominant wind direction was observed to be from East-North-East with an average wind speed value of 1.08 m/s. The highest

wind speed frequency was generally observed in the range of 0.5-1.5 m/s with calm frequency being recorded at 2.70%.

Figure 10: Wind-rose diagram of the state capital (Shillong)



4.4.2 Ambient Air Quality

178. Two ambient air-sampling locations has been selected for assessment of the existing status of air environment within the study zone, details are in Table -13. The selection of monitoring locations has been done to get representative baseline of any variation in land use as well as the baseline at Sensitive Receptors along the subproject. The heights of the sampling locations were kept between 1.0 to 1.5 m in all the locations. The monitoring of the Ambient Air Quality (AAQ) for the residential land use along the connecting road was carried out at selected location as per guidelines of Central Pollution Control Board (CPCB) and the requirements of MoEF&CC.

Table 13: Ambient air quality locations along the subproject

S.No.	Location Code	Location Name	Category as per AAQ standards	Distance from project road	Environmental Setting
1	AAQM-I	Jongksha Village	Rural	4.8 Km	Residential
2	AAQM-II	Umlong Village	Rural	4.2 Km	Residential

179. The summary of ambient air quality results for the project stretch is presented in Table-14.

Table 14: Results of ambient air quality monitoring

S.No.	Location	PM10 (µg/m3)	PM2.5 (µg/m3)	Sox (µg/m3)	NOx (µg/m3)	CO (µg/m3)
1	Jongksha Village	64	36	6.5	9.7	BDL
2	Umlong Village	62	34	5.2	9.9	BDL
NAAQS Limits		**100**	**60**	**80**	**80**	**04**

180. All the pollutant levels along the subproject are within the permissible limits. In case of gaseous pollutant, the however the measured levels are lower than standards.Overall the air quality of the project area is not a problem.

4.4.3 Ambient Noise Quality

181. Noise is an important environmental attribute in road and bridge projects because vehicular traffic is a source of noise pollution. Two monitoring sites were identified for noise monitoring to characterise the baseline noise levels in the project area. Locations for noise monitoring along the alignment are identified based on the criteria same as those used for air monitoring. The description of environmental settings of noise given in Table -15.

Table 15: Noise level monitoring locations along the subproject

S.No.	Location Code	Location Name	Category as per AAQ standards	Distance from project road	Environmental Setting
1	NQ-I	Jongksha Village	Rural	4.8 Km	Habitation (residential)
2	NQ-II	Umlong Village	Rural	4.2 Km	Commercial & residential

182. The main objective of noise monitoring in the study area is to establish the baseline noise levels, which was used to assess the impact of the total noise generated by the proposed subproject activities. Noise level monitoring was carried out continuously for 24 - hours with one-hour interval at each location using Sound level meter (HTC made in Taiwan Model No. SL-1350) capable of measuring the Sound Pressure Level (SPL) in dB (A). Hourly Leq values were computed by the noise integrating sound level meter and statistical analysis was done for measured noise levels at 2locations in the study area. The Leq day, and Leq night calculated for various locations in the area are presented below which are compared with the standards prescribed by CPCB for various zones. The Noise quality results presented in Table 16 show Leq Day time is in the range of 50.2 to 52.1 dB(A) and Leq Night time is in between 34.2 to 36.1dB(A).

Table 16: Result of noise level monitoring

S.No.	Monitoring Location	Leq dB(A) day	Leq dB(A) night	Limits in Leq dB(A)	
				Day	Night
1	Jongksha Village	50.2	36.1	55	45
2	Umlong Village	52.1	34.2	55	45

183. The noise levels are within the standards are almost comparable to the standards.

4.5 Water Environment

4.5.1 Hydrogeology

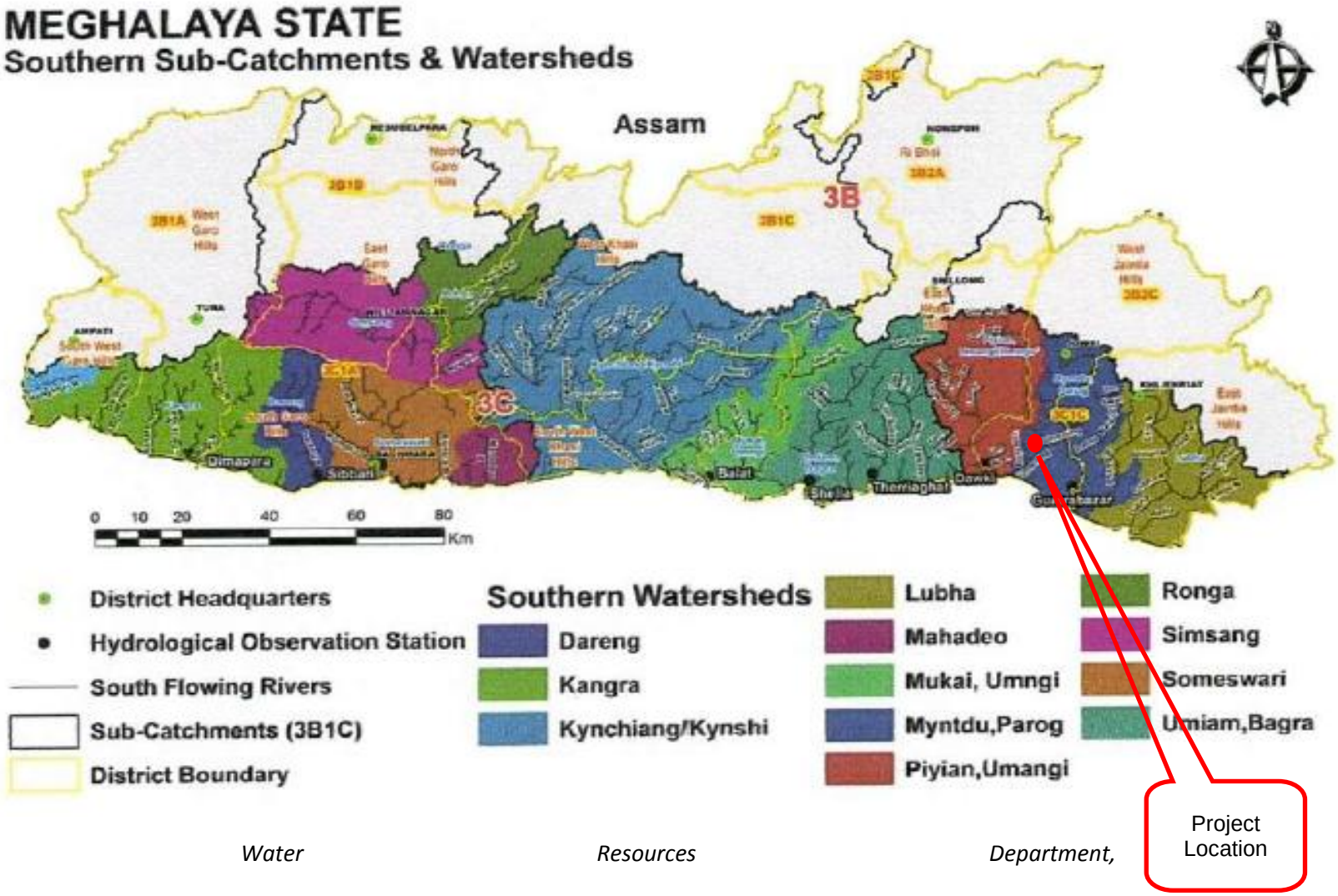
184. One of the world's wettest regions is found in Meghalaya. Mawsynram and Cherrapunji (Sohra) in the East Khasi Hills district are geographically considered as the rainiest places in the World, with Cherrapunjee, receiving close to 12000 mm of annual rainfall and Mawsynram, a village directly west of Cherrapunji, where rainfall of around 17,800 mm (700 inches) per year. These areas receive rainfall on an average for 160 days in a year, spread over six to eight months between March to October. Paradoxically, even then the state of Meghalaya is water stressed in some regions during summer months. This is mainly due to topographical and geomorphological conditions apart from alterations of the natural land surface by way of development, mining and urbanization. Moreover, the characteristic hilly and steep sloping terrain condition in the area with localized small valleys results in very high surface run-off during the monsoon.

185. The rivers of the State are rainfed and therefore their discharge dwindles during summer. Important rivers in East Khasi Hills region areUmiamkhwan, Umkhem, UmiamUmiew, Umngot, Tharia, Wahkasimara, Umngi, Wahkhuri, Wah Umliew and Bhowal. The surface water resource is tapped in a number of places by constructing dams across the rivers. The reservoirs, like the Umiam and Kopili, so developed are not only used for irrigation and drinking water but also for generating electricity.

186. The surface water available in Meghalaya on annual basis is roughly estimated at 63.204 billion cubic metres (BCM) and the estimated replenishable ground water resources estimated as 1.15BCM. According to the Central Ground Water Board (CGWB) 1.04BCM of ground water is potentially available for utilization.

187. The southern part of the state (subproject area) has many sub-catchments and watersheds which covers and crosses through major part of the subproject area. Figure-11shows catchment areaand drainage system of Southern Part of the State.

Figure 11: Sub-catchment & Watersheds of Southern Part of the State

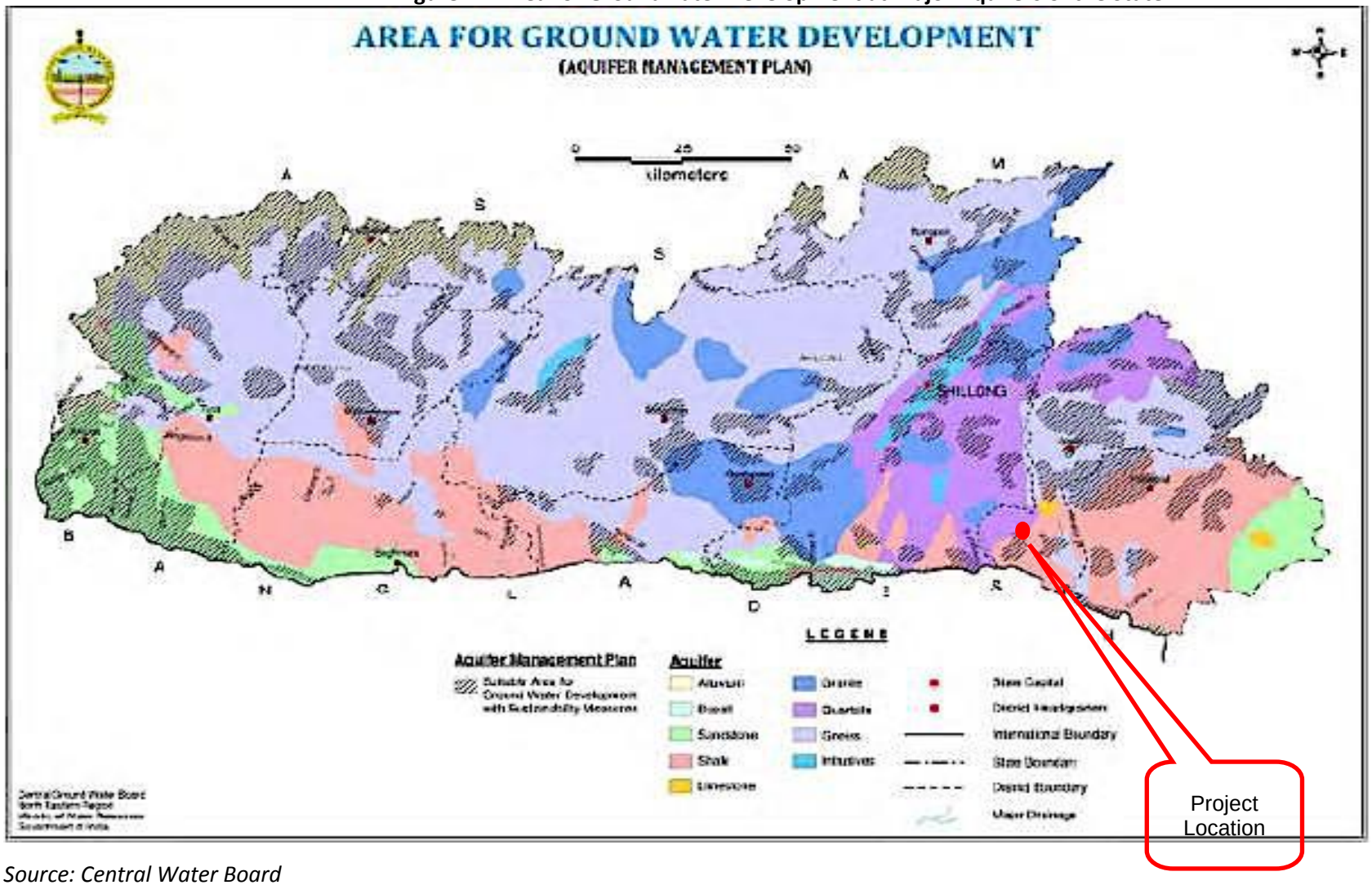


Source: Water Resources Department, GOM

188. In Meghalaya, groundwater is generally extracted through dugwells and springs (or seepage wells in valley areas/topographic depressions) and bore wells. Dugwells are generally shallow in depth. The level of ground water development in the state is 0.15%. The annual gross dynamic ground water recharge of Meghalaya has been estimated as 1.234BCM. Annual allocation for domestic & industrial water requirement upto year 2025 is estimated as 0.096 BCM as per census 2001. 1.014 BCM of ground water potential may be utilized for irrigation. The importance and contribution of groundwater is felt in the recent years, particularly to meet the drinking water needs.

189. Meghalaya's economy is primarily agricultural engaging around 80 per cent of its total work force. Thus, major part of water consumption in the state is under irrigation followed by utilization of water in household and industrial needs. The State is mostly dependent on rain and surface water resources for irrigation purposes. Surface water is abundant but limited during non-rainy season. According to the CGWB, 18% of the available groundwater is currently utilized and there is ample potential for further increase in ground water exploitation.

Figure 12: Area for Groundwater Development at Major Aquifers of the State



Source: Central Water Board

190. The district of East Khasi Hills is covered mainly by crystalline rocks with Tertiary sedimentary rocks. The secondary porosity in consolidated formation e.g. fractures; joints, etc developed due to major, minor tectonic movements, prolonged physicochemical weathering, form the conduits as well as reservoirs of ground water. The weathered mantle varies from 10 to 30 m bgl. Ground water occurs under water table condition in the top weathered quartzite and in semi-confined condition in the fractured and jointed rocks. At hydrogeologically feasible locations, well drilled down to the depth of about 80 -150 m below ground level may yield a moderate discharge of 5-15 m3/hr in Archaean and Pre-Cambrian Group of rocks. Depth to water level is found to occur between 2 and 15 m bgl. The valley areas are found to be favourable for the construction of dug wells and bore wells in other steep areas.

191. Ground water development in the district is mainly through dug /open well tapping the water in the weathered zone and bore wells are constructed to tap ground water from the fractures/joints in the hard rocks. In the shallow aquifer, the depth to water level ranges from less than 2 m bgl to 6 m bgl.

192. Springs play a major role to cater water requirement of the people throughout the year. Most of the springs are gravity springs. It is observed that discharge of most of the springs lie within the range of 5000-25000 lpd in pre- & post monsoon period.

193. In the project district, the ground water occurs under unconfined conditions and under semi-confined conditions in the interconnected secondary structural weak zones / features like joints, fractures, etc., of consolidated formation. The thickness of the overburden/ weathered zone is expected to be 20 – 30 m in topographical depression but it is less in the hilly areas. The depth to water level ranges from 1 to 5 m and the ground water potentials of these rocks depend upon topographic setup and a moderate yield prospect from 5 m 3 /hr to 15 m 3 /hr.

194. The net ground water availability in the project district is 7316 ham, currently in use for domestic and industrial is 1042 ham and balance available for future irrigation purposes. Thus, the ground water resource potential available in the project district and fall in the safe category.

4.5.2 Groundwater Quality

195. As reported by CGWB; the chemical constituents present in the ground water of the district are within the permissible limits set by BIS and WHO. The chemical quality of ground water indicates that groundwater in the area is good for domestic, irrigation and industrial uses.However, sporadic occurrence of higher concentration of Iron is detected from some localities in the district.

4.5.3 Hydrological Flow & Drainage

196. The hydrogeological framework of the district is essentially controlled by geological setting, distribution of rainfall and movement of ground water through inter-connect weak planes due to joints, fissures and faults, primary and secondary porosities of the Geological formation. Hydro-geologically, the district can be divided into three units, namely consolidated, semi-consolidated and unconsolidated formations.

197. The important rivers of the District are Umngot, the Manda, Didram, and Ildek river which are northbound flowing rivers joining the Brahmaputra. All these rivers emerge from the catchment and hills of the district having an average height of 600m above mean sea level as first order river, navigates down the undulating land with gentle to moderate slopes.

198. The subproject components are located on Umngot river. The river Umngot drain approx. 7% area of East Khasi Hill District which is about 187 sq.km. The total length of the river in east khasihill district is 42km after origin near Mawkynrew and near Laityngkot at an altitude in the range of 1100m to 1700m above msl.

4.5.4 Surface water quality

199. Total three water samples(twosurface water and one groundwater) were collected from the subproject influenced area to monitor the water quality. The sample details are given in below table-17.

Table 17: Water quality sampling location along subproject area

S. No.	Location Code	Chainage	Location Name	Source
1	SW1	Upstream	Proposed bridge location	Umngot River
2	SW2	Downstream		
3	GW1	-	Jongksha Village	Handpump

200. The water was analysed in a laboratory as per the methods prescribed in "Standard Methods for the Examination of Water and Wastewater (American Public Health Association)" and the result was compared against IS 10,500: 2012 for drinking water standards. The results are presented in Table-18.

Table 18: Surface and Ground water Characteristics in the subproject area

Sl. No.	Parameter	Prescribed Limit as per IS:10500 & IS:2296	Monitored Value		
			Water Sample		
			SW1	SW2	GW1
1	Colour, Hazen units	5 Max	< 1	< 1	<1
2	Odour		Agreeable	Agreeable	Agreeable
3	Turbidity, NTU	1 Max	<1	<1	<1
4	Electrical Conductivity at 25°C	-	240	273	312
5	pH Value at 25°C	6.5 - 8.5	7.62	7.42	7.51
6	Total Dissolve Solids, mg/l	500 Max	156	177	203
7	Total Alkalinity (as $CaCO_3$) ,mg/l	200 Max	106	121	132
8	Total Hardness (as $HCaCO_3$) ,mg/l	200 Max	96	112	127
9	Calcium (as Ca),mg/l	75 Max	20.1	24.2	27.4
10	Magnesium (as Mg) , mg/l	30 Max	11.2	12.5	14.2
11	Sodium (as Na) ,mg/l	-	8.4	9.2	10.2
12	Potassium (as K) ,mg/l	-	2.1	3.1	4.1
13	Bicarbonate (as HCO_3),mg/l	200 Max	104	123	141
14	Sulphate (as SO_4) ,mg/l	200 Max	16.2	18.2	19.2
15	Chloride (as Cl),mg/l	250 Max	9.2	10.1	11.2
16	Nitrate (as NO_3) ,mg/l	45 Max	1.9	2.2	3.6
17	Fluoride (as F),mg/l	1 Max	0.04	0.05	0.03
18	Phenolic Compound (as C_6H_5OH) ,mg/l	0.001 Max	BDL	BDL	BDL
19	Cyanide, mg/l	0..05	BDL	BDL	BDL
20	Aluminum, mg/l	0.03	BDL	BDL	BDL
21	Arsenic, mg/l	0.05	BDL	BDL	BDL
22	Cadmium (as Cd) , mg/l	0.003 Max	BDL	BDL	BDL
23	Chromium as Cr,mg/l	0.05	BDL	BDL	BDL

24	Iron (as Fe),mg/l	0.3 Max	0.01	0.01	0.07
25	Copper (as Cu),mg/l	0.05 Max	BDL	BDL	BDL
26	Lead (as Pb) , mg/l	0.01 Max	BDL	BDL	BDL
27	Manganese (as Mn) , mg/l	0.1 Max	BDL	BDL	BDL
28	Zinc (as Zn) , mg/l	5 Max	BDL	BDL	BDL
29	Mercury as Hg,mg/l	0.001	BDL	BDL	BDL
30	Dissolve Oxygen, mg/l	-	6.5	6.4	-
31	Biochemical Oxygen Demand, mg/l	-	4	4	-
32	Chemical Oxygen Demand, mg/l	-	10	14	-
33	Oil &Grease, mg/l	-	BDL	BDL	-

201. Analysing the tests result of water samples analysis it was observed that the nitrates are high in water in the subproject area. The other parameters are all within the desired limits.

4.6 Biological Environment

4.6.1 Forest

202. As per the Forest Survey of India report, Meghalaya rank seventh amongst the Indian states in respect of percentage of geographical area under forest cover. The forests of Meghalaya are rich in biodiversity and endowed with rare species of orchids and medicinal plants. The forest types in Meghalya are Subtropical Pine, Subtropical Broadleaf, Tropical Wet Evergreen, Tropical Semi-Evergreen, and Tropical Moist Deciduous Forests. Scared groves mostly located in the Khasi and the Jainita Hills represent the climax vegetation of the area. According to Haridasaan and Rao (1985), the forest vegetation of Meghalaya consists of Tropical Evergreen Forest in the low-lying areas with high rainfall; Tropical Semi-Evergreen Forest up to the elevation of about 1,200 m with annual rainfall between 1,500 to 2,000 mm; Tropical Moist Deciduous Forest in the areas with less than 1,500 mm rainfall; Grassland on the tops of Khasi, the Jaintia and the Garo Hills; isolated patches of Temperate Forest along the southern slopes of the Khasi and Jainita Hills; and Subtropical Pine Forest with pure stands of Pinus kesiya confined to the Higher reaches of the Shillong Plateau. Bamboo and canes are found in undisturbed forests. Meghalaya has many endemic plant species, the most famous being the carnivore pitcher plant Nepenthes khasiana.

203. The Forest and Tree cover in the State is 79.37 % covering 17,803 Sq.km. Out of total forest area of 17,146 sq km (76.44% of the state's geographical area) only 1145.19 sq km of Forest areas (5.10 % of geographical area) comes directly under the control of the State Forest Department in the form of reserved forest, protected forest, national parks, wildlife sanctuaries and parks & gardens. The rest of the forest areas belong to communities, clan and private people and District Councils. There are three Autonomous District Councils (ADCs) i.e., Khasi Hills Autonomous District Councils, Jaintia Hills Autonomous District Councils and Garo Hills Autonomous District Councils, which have been set up under the provisions of the Sixth Schedule to the Constitution of India. These ADCs have the power to make laws with respect to, among others, the management of any forest not being a reserved forest.

Table 19: Forest Cover of the State

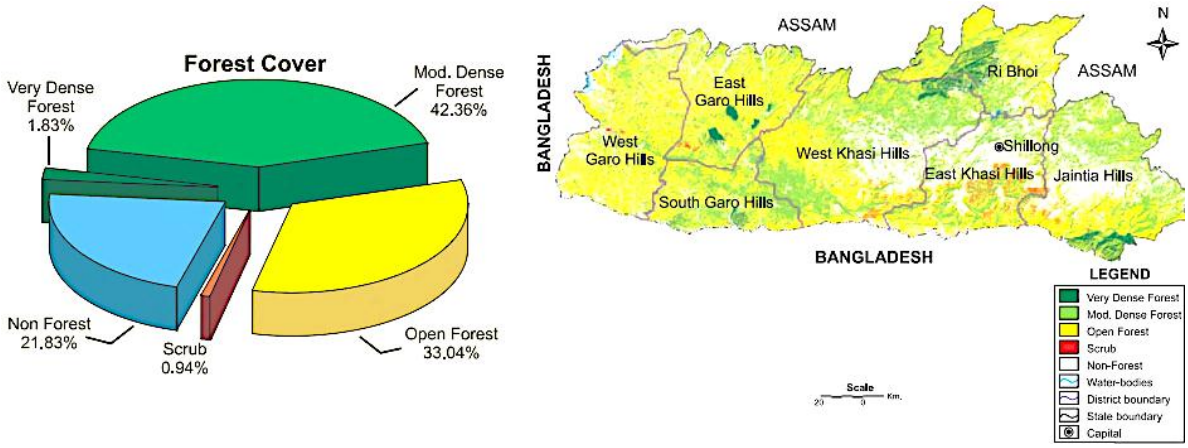
Class of Forests	Area (sq. km.)
Reserved Forests	626.55
Protected Forests	12.39
National Parks (including proposed)	399.48
Wildlife Sanctuary (including proposed)	100.74
Parks and Gardens	295.39

Non-Forest Land transferred to the Department and Exchanged lands	3.08
Sub-total	**1145.19**
Unclassified	1600.81
Total	**17146**

Source: Department of Forest, GoM

204. The Khasi Hills Autonomous District Council, Garo Hills Autonomous District Council and the Jaintia Hills Autonomous District Council. Under the Sixth Schedule of the Constitution, these District Councils have been vested with legislative, executive and judicial functions in many subjects. In terms of canopy density classes, the total forest area is classified under Very dense forests (VDF), moderately dense forests (MDF), open forests (OF) and scrub land.

Figure 13: Forest cover type in Meghalaya



Source: GoM, Department of Forest and Environment

205. In addition to providing an economic and cultural backdrop for the lives of people, forests in Meghalaya deliver an array of essential local and global environmental services, including water storage and filtration, soil stabilisation and carbon sequestration, prevention and reduction of floods, provide food, fodder, fuel, medicines, and materials for construction.

4.6.2 Forest type and density

206. The forests of Meghalaya can broadly be grouped under the tropical type and the temperate type, mainly based on the altitude, rainfall and dominant species composition.

- Tropical Forests: These forests are met within areas upto an elevation of 1200m and with an average rainfall of about 100-250cm. There are numerous subtypes within this category such as evergreen, semi-evergreen, moist and dry deciduous forest, etc.
- Tropical evergreen forests: These forests usually occur in high rainfall areas as well as near catchment areas. They seldom form continuous belts due to various exogenous factors. But still, they harbour very rich species diversity, where nature is at its extravaganza forming a closed evergreen canopy. The trees exhibit clear zonation with dense and impenetrable herbaceous undergrowth.
- Tropical semi-evergreen forests: This category of forests occupies the north-eastern and northern slopes of the State, typically upto elevations of 1200m, where annual rainfall is 150-200cm with a comparatively cooler winter. The numbers of species here are fewer than the evergreen zone. There are also a few species in these forests which are deciduous in nature, such as Careya arborea, Dilleniapentagyna and Callicarpa arborea. Again, there is a clear stratification of the trees in these forests.

- Tropical moist and dry deciduous forests: This type of forests occurs where annual rainfall is below 150cm and at comparatively low elevations. Typical natural deciduous forests do not occur anywhere in Meghalaya but are only subclimax or man-made forests. These forests are characterised by seasonal leaf shedding and profuse flowering of the trees. Recurrent forest fires are a common phenomenon here. Deciduous forests are much more extensive in their distribution in the State and include a host of economically important trees like Shorearobusta, Tectona grandis, Terminalia myriocarpa, Sterculia villosa, Logerstroemiaflos-reginae, L. Porviflora, Moruslaevigatus, Artocarpus chaplasha, and Gmelina arborea both as natural and as plantations. Schimawallichii, Artocarpus gameziana, Tetramelesmudiflora, Lanneacoromandelica, Salmaliamalabarica Erythrina stricta, Premnamilliflora, Vitex peduncularis, Albizia lebbeck. Lucida, Terminalia bellirica etc is also in abundance. These trees of the deciduous canopy are always lofty and straight bowl and with spreading crown.
- Grass and Savannas: Grasslands of Meghalaya are also not a climax type but are only as a result of removal of original forest cover. The rolling grasslands covering large areas can be seen throughout the Shillong plateau, around Riangdo, Ranikor, Weiloi, Mawphlang, Mawsynram, Cherrapunji, Shillong, Jowai, Jarain, and Sutnga in Khasi and Jaintia Hills and major parts of west Garo Hills.
- Temperate Forests: The temperate forests occupy the higher elevations about 1000m, mostly along the southern slope of Khasi and Jaintia Hills. The rainfall here is very high 200-500cm with a severe winter during November to March. Ground frost is also common during December to January.
- Sacred Groves: The scared groves of Meghalaya largely fall under the temperate type and are the relic type evolved through millions of years. These are rich storehouse of vegetation wealth incomparable to any other type of forests in the State. These isolated pockets are untouched due to the religious beliefs and myths attributed to them. Many of the endangered species of the State are presently confined to these pockets only. Fagacaea members dominate over others in these sacred forests. Epiphytic flora is quite abundant and again dominated over by ferns and orchids.

Table 20: Details of district wise forest cover in Meghalaya State

District	Geo graphical area (In Sq.Km)	Area In Sq.Km				Percent of GA
		Very dense forest	Mod, Dense forest	Open forest	Total	
East Garo Hills	2603	62.73	1185.89	1139.34	2287.96	87.90
East Khasi Hills	2748	19.39	969.24	723.56	1712.19	62.31
Jaintia Hills	3819	103.31	1448.69	985.89	2537.89	66.45
Ri Bhoi	2448	127.36	1097.30	912.68	2137.34	87.31
South Garo Hills	1887	65.39	990.45	646.36	1702.20	90.21
West Garo Hills	3677	0	1260.41	1599.81	2860.22	77.79
West Khasi Hills	5247	110.80	2415.31	1354.88	3880.99	73.97
Total	**22429**	**488.98**	**9267.29**	**7362.52**	**17118.79**	**76.32**

Source:*FSI,State Forest Report, Meghalaya, 2018-19*

207. Thesubproject connecting road sectionis passing through plain/rolling terrain with land use being agriculture and community vegetation area. There is no forest area located along the alignment of the road section, only patches of open vegetation ofindividual/community forest isalong the road section.

4.6.3 Flora

208. According to state forest report the main forest types found in East Khasi Hills district are Sub tropical pine forest, Tropical semi- evergreen, Tropical moist and dry deciduous, Tropical dry deciduous and bamboo mix. The prevailing and pre-dominant floral species observed in the direct area of influence and in the study areas of the project road[3]are Pinus kesiya generally at an elevation of 1500m and above, Careya arborea, Dilleniapentagyna and Callicarpa arborea in semi-evergreen forests typically up to elevations of 1200m msl and Dendrocalamushamiltonii, D. giganteus, Bambusabambos, Cephalostychumlatifolium, Melocannabambusoides are common bamboo species in the state.None of these species are vulnerable or endangered as per the IUCN Red List.

209. The trees to be cut in corridor of impact of road section are along the existing alignment of connecting road and on river bank are thinly distributed. Trees being next to existing road, these are less preferred for habitat or shelter by birds and animals due to human activities.

210. Field survey has been carried out to identify the number and type of trees to be affected by the proposed improvement work of road alignment. It is envisaged that about 29number of trees are likely to be cut for the implementation subproject.

4.6.4 Fauna

211. Meghalaya is a part of Indo-Burma biodiversity hot spot and identified as key area for biodiversity conservation due to high species diversity and high level of endemism. It has attracted the attention of wildlife enthusiasts and research scholars from all over the country.

212. During the winterseason, Bio rich rivers and forest areas attracts more migratory and local birds and it isalso known as bird watching season. Some of the species recorded around the subproject district and surrounding area are listed below.

213. Aian Pied Starling (Gracupica contra), Ashy Drongo (Dicruruleucophaeus), Ashyminivet (Pericrocotusdivaricatus), Ashy Wood Swallow (Aratamusfuscus), Asian PalmSwift (Cypsiurusbalasiensis), Black crested bulbul (Pycnonotusflaviventris), BlackDrongo (Dicrurusmacrocercus), Black Hooded Oriole (Oriolusxanthornus), Black Kite(Milvus migrans), Black rumpedFlameback (Dinopiumbenghalense), black winged kite(Elanus caeruleus), Blue tailed Bee eater (Meropsphilippinus), Blue Throated Barbet(Psilopogon Asiaticus), Bronzed Drongo (Dicrurus aeneus), Brown Shrike (Laniuscristatus), Cattle Egret (Bubulcus ibis), Chestnut Tailed Starling (Sturniamalabarica),Cinereous Tit (Parus major), Common Hawk Cuckoo (Hierococcyxvarius), CommonHoopoe (Upupa epops), Common Iora (Aegithinatiphia), Common Kingfisher (Alcedoatthis), Common Myna (Acridotheristristis), Common Stonechat (Saxicola torquatus),Common Tailor Bird (Orthothomussutorius), Coppersmith barbet (Psilopogonhaemacephalus), Crested serpant eagle (Spilornischeela), Dusky Warbler (Phylloscopusfuscatus), Emerald Dove (Chalcophaps indica), Eurasian Tree Sparrow (Passermontanus), Fulvous breasted Woodpecker (Dedrocopsmacei), Great barbet (Psilopogonvirens), Great Egret (Aedea alba), Greater Coucal (Centropussinesis), Greater Racquettailed Drongo (Dicrurusparadiseus), Greaternecklacedlaughingtrush (Garrulaxpectoralis), Green Bee eater (Merosorientalis), Green bee eater (Meropsorientalis), GreyBacked Shirke (Laniustephronotus), Grey wagtail (Motacilla cinerea), Hooded pitta(Pitta sordida), House Crow (Corpus splendens), House Sparrow (Passer domesticus),House swift (Apus nipalensis), Indian Pond Heron (Ardeolagrayii), Indian Rollar(Coracias benghalensis), Jungle Babler (Turduides striata), Jungle Crow (Corvusmacrorhynchos), Jungle myna (Acridothersfuscus), Jungle owlet (Glaucidium

[3] List of tree species in the project area based on consultation with local community during field survey.

radiatum),Large billed crow (Corvus macrorhynchos), Large cuckooshrike (Coracinadobsoni),lesser adjutant (Leptoptilosjavanicus), lesser coucal (Centropus bengalensis), lesserracquet tailed drongo (Dicrurusremifer), Lessernecklacedlaughingtrush (Garrulaxmonileger), Liniated Barbet (MegalaimaLiniata), Little Cormorant (Microcarbaniger),Longtail Shrike (Leniusschach), Median egret (Ardea intermedia), Orange belliedleafbird (Chloropsishardwickii), Oriental Honeybuzzard (Pernis ptilorhynchus), OrientalMagpai Robin (Copsychussaularis), Oriental White Eye (Zostropspalpebrosus), Paddyfield pipit (Anthusrufulus), Purple Sunbird (Cinnyris asiaticus), Red Breasted Parakeet(Psitacullaalexandri), Red Collared Dove (Streptopeliasemitorquata), Red headed tragon(Herpactes erythrocephalus), Red Vented Bulbul (Pycnonotuscafer), Red WatledLapwing (Vanellus indicus), Rose Ringed Parakeet (Psitacullakrameri), Rufous Treepie(Dendrocitavagabunda), Rufous woodpecker (Micropternusbrachyurus), Scally BreastedMunia (Lonchurapunctulata), Spotted Dove (Spilopelia chinensis), Spotted Owlet(Athene brama), Sprangled Drongo (Dicrurushottentottus), Stork billed kingfisher(Pelargopsis capensis), Thick billed green pigeon (Treroncurvirostra), white rumpedmunia (Lonchura striata), White Wagtail (Motacilla alba), White-throated Kingfisher(Halcyon smyrnensis), Yellow wagtail (Motacilla flava), Hair Crested Drongo (Dicrurushottentottus), Barn Owl (Tyto alba).

214. Data collected from field clearly shows the subproject area is free of fauna. The wildlife does not offer a wide spectrum of mammalian species in the subproject area. Some of the identified animal's species are-Golden Jackal (Canius aureus), Hoary bellied squirell (Callosciuruspygerythus), Jungle cat (Felis chaus), House Rat (Rattus rattus), Rhesus macaque (Macaca mulatta), Indian Mongoose (Herpestesjavanicus).

215. The reptiles and amphibian species found in the project area are as follows:Checkered keelback (Xenochropispiscatar), Common garden lizard (Calotesversicolar),Bronze skink (Eutropismacularia), Red Necked keelbak (Rhabdophissubminiatus),Spotted forest skink (Sphenomorphus maculates), Common Skink (Lampropholisguichenoti), Banded krait (Bungarus fasciatus), Common Tree Frog (Polypepdatesleucomystax), Common Indian Toad (Duttaphrynusmelanostictus), White spotted suppleskink (Lygosomaalbapunctata), Tokay Gecko (Gekkogekko), Common House gecko(Hemidactylus frenatus), Rat Snake (Ptyas mucosa), Rainbow water snake (Enhydrisenhydris), Common Wolf Snake (Lycodonaulicus).

216. As per the study in the lower stretch of Umngot River in West Jaintia Hills District of Meghalaya Was studied in 2014-15. There aretotal 24 fish species recorded belong to 19 genera, 9 families and 6 orders from the study area of the river. Major percentage fish species belongs to order Cypriniformes (67%) with 16 spp., followed by Siluriformes (13%) with 3 species, Channiformes (8%) with 2 spp., Perciformes (4%) 1 sp, clupeiformes (4%) 1 sp, Mastacembeliformes (4%) 1 sp.

217. The fishes recorded from Umngot river as informed by the State Fisheries departmentare given in Table-21.

Table 21: Fish species recorded from River Umngot in corridor of impact of Bridge

Statement showing the types of fish species present at Umngot river Niriang connecting Nongjrong village.

Sl no	**Name of Species**
1.	**Cat Fish species**
a.	*Glypthorax striatus*
b.	*Heteropnuestus fossilis (Kha singhi)*
c.	*Mystus bleekeri* (Tung Shynrang)
d.	*Hemibagrus menoda* (Khatyndong)
e.	*Mystus cavasius* (Khakulai)
f.	*Glypthorax trilineatus* (Kha briang)
2.	**Channa Species**
a.	*Channa gachua* (Dwarf snake head)
b.	*Channa stewartii* (Golden snakehead)
3.	**Garra species**
a.	*Garra lissorhynchus* (Sher)
b.	*Garra gotyla gotyla* (Kew)
4.	**Labeo species**
a.	*Labeo gonius* (Kha ski)
b.	*Labeo calbasu* (Kha iong)
c.	*Labeo rohita* (Kha bah)
5.	**Danios species**
a.	*Danio dangila* (Shalynnai)
b.	*Devario aequipinnatus* (Giant danio, Shalynnai)
	Other Species
6.	Neolissochilus hexagonolipis (Kha saw)
7.	*Chanda nama* (Tung snad)
8.	*Parambassis ranga* (Tung snad)
9.	*Pethia conchonius* (Rosy barb)
10.	*Systomus sarana* (Olive barb)
11.	*Balitora brucei* (Gray stonr loach)
12.	*Schistura multifasciata* (Kha syngkai)
13.	*Trichogaster fasciata* (Tungsniang)
14.	*Xenentodon cancila* (Tungbniar)
15.	*Cyprinus carpio* (Kha pyllun)
16.	*Puntius chola(Kha roin)*

Superintendent of Fisheries
East Khasi Hills District, Shillong.

4.6.5 Protected Area Network

218. The protected area network in Meghalaya occupies 512.61 Sq.km area The Protected Area Network includes two National Parks, four Wildlife Sanctuaries and one Biosphere Reserve playing an important role in in-situ conservation of biodiversity. The Protected Area Network still support viable population of one of the two closely related Apes found in India, the endangered Western Hoolock Gibbon (*Hoolock hoolock*), and the Bengal Slow Loris (*Nycticebus bengalensis*). Other primates including Stumped-tailed Macaque (*Macaca arctoides*), Assamese Macaque (*Macaca assamensis*), Northern Pig-tailed Macaque (*Macaca leonina*), Rhesus Macaque (*Macaca mulatta*), Capped Langur (*Trachypithecuspileatus*) are also found in these areas. Among the carnivores, the

Bengal Tiger (*Panthera tigris*) and the Clouded Leopard (*Neofelisnebulosa*) have become extremely rare while the adaptable Common Leopard (*Panthera pardus*) is still widely distributed. Bears including Sun Bear (*Helarctosmalayanus*), Asiatic Black Bear (*Ursus thibetanus*) and the Sloth Bear (*Melursus ursinus*) are found as well. Smaller cats like the Jungle Cat (*Felis chaus*), Marbled Cat (*Pardofelis marmorata*) and Leopard Cat (*Prionailurus bengalensis*) are still found in these protected areas. Smaller carnivores are also abounding, among them mongoose, badger, binturong, dhole, jackal, weasel, otter, fox and marten.

219. The details of sites are given in Table 22. Figure 14 shows the protected area map of Meghalaya. The total area under the protected area network is 5.06 percent of total geographical area of state.

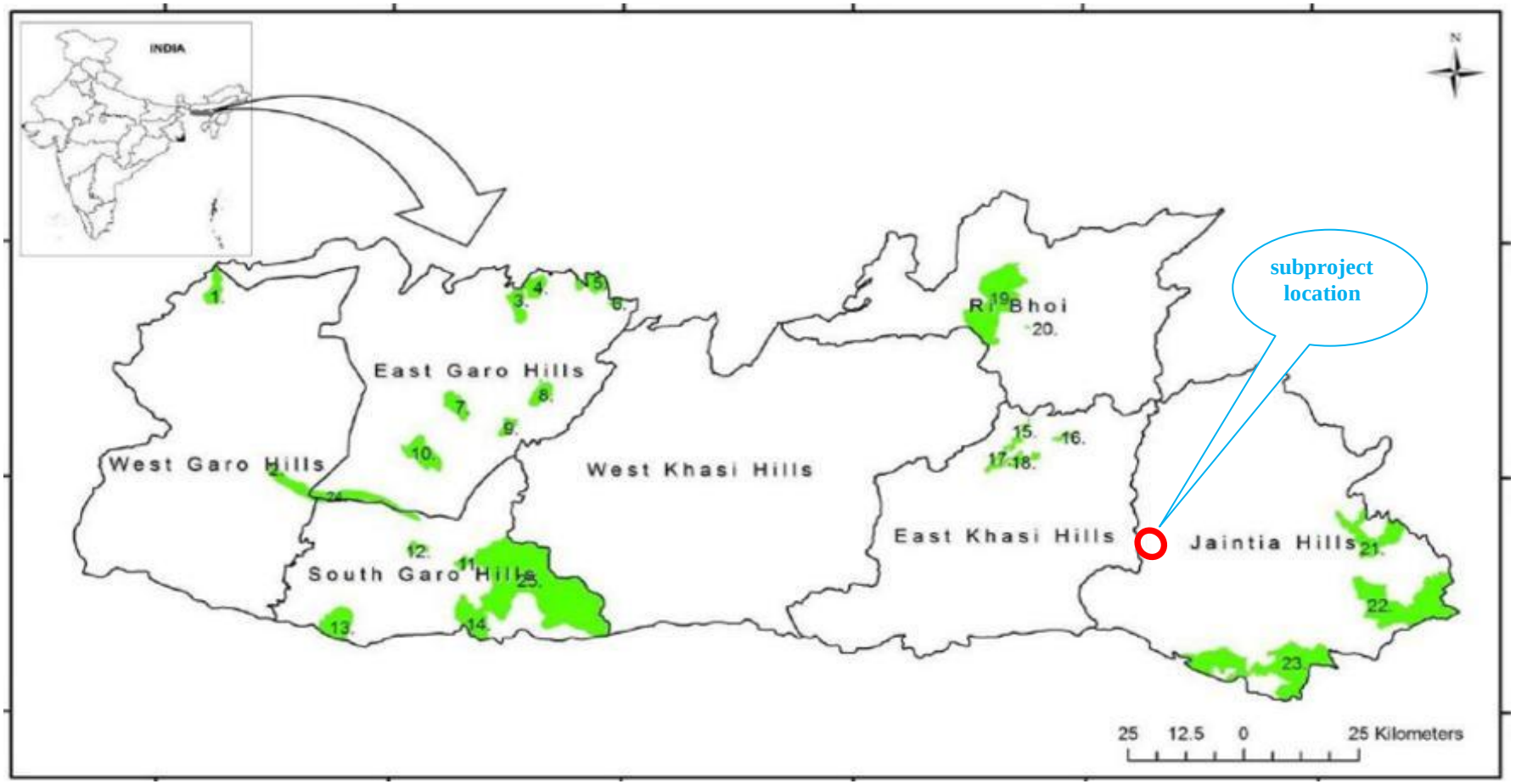
Table 22: Protected Area Network in the State of Meghalaya

Sl.	Protected Area	Location (District)	Area in sq.km
1	Siju Wildlife Sanctuary	South Garo Hills	5.81
2	Nongkhyllem Wildlife Sanctuary	Ri-Bhoi District	29
3	Baghmara Pitcher Plant Sanctuary	South Garo Hills	0.02
4	Balpakram National Park	South Garo Hills	220
5	Nokrek Ridge National Park	East Garo Hills	47.78
6.	Nokrek Biosphere Reserve	East, West and South Garo Hills	820
7.	Narpuh Wildlife Sanctuary	East Jaintia Hills	59.90

Source: *Meghalaya Biodiversity Board*

220. Informal interviews were held with the local villagers, livestock herders to gather information on the presence of wildlife and their habitats along the project road. Officials from local forest department were also consulted. Local communities and local forest officials informed thatthere is no National Parks or Wildlife Sanctuary within 10 km of theproposed alignment. It can be seen from the map (Figure 15) of the protected (notified) areas in State of Meghalaya.

Figure 14: Protected Area Map of Meghalaya State showing subproject location



1. Dribruhills RF, 2. Tura peak RF, 3. ChimaBangshi RF, 4. Dhima RF, 5. Rajasimla RF, 6. Iidek RF, 7. Songsak RF, 8. Darugiri RF, 9. DambuRF, 10. RongrengiriRF, 11. Siju WLS/RF, 12. Emanggiri RF, 13. Angratoli RF, 14. Baghmara WLS/RF, 15. RaitKhawn RF, 16. Shyrwat RF, 17. Upper Shillong RF, 18. Rait Laban RF, 19. Nongkhyllem WLS/ RF, 20. Umsaw RF, 21. Saipung RF, 22. Saipung RF, 23. Narphu RF, 24. Nokrek NP, and 25. Balphakram NP.

Source: GoM, Department of Forest &Environment

221. According to 'Right of Passage: Elephant Corridors of India (2017)', five active elephant corridors have been identified in the State of Meghalaya. The details of five elephant corridors are given in Table -23:

Table 23: Elephant Corridor in the State

Corridor Name	Forest type	Habitation	Corridor Usage
Ranggira – Nokrek	Tropical evergreen and moist deciduous with *jhum* patches	Chasingre, Phagugre, Chibragre, GanolSangma, 2nd Police Battalion campus and Boldorenggre	Rare
Nokrek – Imangre	Tropical evergreen and moist deciduous patches	RongmaRekmangre, Dobagre, Gopgre, EnanRompagre and Papa Asakgre	Regular
Rewak – Imangre	Tropical evergreen forest	Jadegindam	Throughout the year
Siju – Rewak	Tropical evergreen forest with plantation	SijuAretika	Throughout the year
Baghmara – Balpakram	Forest, plantation and agriculture (*jhum*)	Settlements	Regular

222. There is no identified elephant corridor within the project influence area of this subproject. Further there is no Sacred Groves of Meghalaya are located within the subproject influenced area.

4.7 Socioeconomic Environment

4.7.1 Demographic Profile

223. The demographic feature of north-eastern states is unique in that there are more than 29 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and traditional knowledge systems. The major minority groups in the state namely Khasi, Jaintia, Bhoi, War collectively known as the Hynniewtrep people predominantly inhabit the districts of East Meghalaya. The Garo Hills is predominantly inhabited by the Garos, belonging to the Bodo family of the Tibeto-Burman race, said to have migrated from Tibet. Table 24 presents the demographic features of the state and the North eastern region.

Table 24: Demographic Features of project districtas per 2011 census

State/District	Area (sq. km)	Population			Density	Sex Ratio
		Rural	Urban	Total		
East Khasi Hills	2748	459441	366481	825922	301	1011
Ri-Bhoi	2448	233587	25253	258840	106	953
Jaintia Hills	3819	366694	28430	395124	103	1013
Meghalaya	22429	2371439	595450	2966889	132	989
NE Region	262179	45533982	5809395	39041167	173	936
All India	3287263	833087662	377105760	1210193422	382	933

Source: 1) Census of India, 2011, 2) Statistical Abstract of State Governments, Directorate of Economics and Statistics, Meghalaya 2017

224. The subproject is located in East Khasi Hill and West Jaintia Hill. As per census 2011,Total population of East Khasi Hill district recorded overall total population is found to be 8,25,922 out of which the male population comprises of 4,10,749 and the female population of 4,15,173. About 55.63% (228,409 males and 231,032 females) population live in villages. In rural areas of the gender ratio is 1011 females per 1000 males, which is higher than district figures of 976 females per 1000 males.

225. Literacy rate in rural areas of East Khasi Hills district is 77.73 % as per census data 2011. Gender wise, male and female literacy stood at 76.73 and 78.70 percent respectively.

226. The district has mostly the Schedule Tribe (ST) population as reported in the district census report. In the state population, 99.00 % of the population belongs to ST category.

4.7.2 Economy

(i) Agriculture and Forestry

227. The main occupation in the state is agriculture and allied activities as the industrial sector in Meghalaya is still under-developed. It employs 70% of the population in Meghalaya and contributes 22% to the State GDP. Agriculture is heavily dependent on monsoon with irrigation potential being under-utilised. Primitive agricultural practices like shifting cultivation (*Jhum*) are indigenous to the region especially in the Khasi Hills.

(ii) Livestock*, Fisheries and other related activities*

228. The other economic sectors that add to the livelihood source of the people are livestock and poultry, pesciculture, apiculture, forestry, sericulture and weaving. There has been a steady increase in the production of milk and egg in the state, with a growth rate of 1.16 % on milk production and 0.63 % on egg. While, the production of meat has decreased by 0.44% over 2014-2015. Fisheries and aquaculture isan important source of revenue, food, employment and social security for the rural poor.

229. Data on *Fish Seed Distribution* clearly indicates that engagement of population in fisheries and aquaculture in East Khasi Hills, West Khasi Hills and South Garo Hills districts is higher in comparison to other districts. Climatic conditions are a big obstacle in the development of fisheries in the State with heavy rains and resulting flash floods and run-away water which causes siltation of fish ponds and washes away the fish feed.

(iii) Sericulture and weaving

230. Sericulture and weaving sector in Meghalaya are the two most important cottage based, eco-friendly industries in the rural areas. These twin industries portray the cultural ethos and rich heritage of the people of the State. There are 1812 sericulture villages as per 2011-2012 statistics and involve 28923 families engaged in sericulture.

231. With limited infrastructure and fragile environment not suitable for setting up of heavy industries in Meghalaya, it is the small-scale industries sector that contributes to the state's economy. From the table -24 below it can be seen that there are 641 small scale industries at present in the state which employ 3057 people. Industries like tailoring and embroidery, betelnut preservation, cane and bamboo works, weaving and handloom, bee keeping, and honey processing have shown great potential in this sector.

232. Apart from this, educated individuals have taken up teaching, government jobs and private services as their profession. It is only in the recent times that individuals have been seen to take up

various other entrepreneurial steps and come out of the socalled conservative occupations and hence depend on business of varying natures and sizes.

233. The subproject area mainly depended in agriculture based economy. Weaving is one of themost important vocations in the economic life of the Khasi &Jantia. The district produces ShortStaple Cotton and the weavers are known for their exquisite skill in weaving various typesof fabrics.

(iv) Aesthetic and Tourism

234. The entire northeast region States has immense scope for promotion of tourism. It has a salubrious climate, exotic greenery and rich flora and fauna besides the rich culture. Various wildlife protected areas and natural.

235. There are about 101 tourist destinations in Meghalaya with majority of them existing in East Khasi Hills followed by West Garo Hills. This may be concentrated in the Khasi Hills due to the accessibility and promotion of these sites. The number of tourists visiting Meghalaya has also considerably increased from 271720 in 2002 to 685567 in 2012.

Table 25: Tourists Visiting Meghalaya

Year	Indian	Foreign	Total
2002	268529	3191	271720
2003	371953	6304	378257
2004	433495	12407	445902
2005	375911	5099	381010
2006	400287	4259	404546
2007	457685	5267	462592
2008	549954	4919	554873
2009	591398	4522	595920
2010	NA	NA	NA
2011	667504	4803	672307
2012	680254	5313	685567

Source: Directorate of Tourism, Government of Meghalaya

(v) Cultural Resources

236. Meghalaya states have great cultural value. Festivals and cultural activities are being celebrated throughout the year in the area. The department of arts and cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments. The region has great cultural value Christian. To promote and preserve the rich cultural heritage of the state, the department has been organising a number of programmes annually.

237. During the environmental and social screening survey, it is noted that there is no sensitive receptors such as school, temple etc. are located within next to existing RoW.

(i) Archaeological and Historical Monuments

238. This is a list of Monuments of National Importance as officially recognized by Archaeological Survey of India is listed below in Table 26, there are also state protected monuments, archaeological sites that have been recognized by the ASI in Meghalaya, in the West Garo Hills, these include excavated temples, Buddhist Stupa and a Fortress.

Table 26: Protected Archaeological and Historic Sites

Sl. No	Name of monuments/ sites	Location	District
1.	Megalithic Bridge between Jaraem and Syndai	Um-Nyakaneth	Jaintia Hills
2.	Megalithic Bridge known as Thulum-wi between Jowai and Jarain	Maput	Jaintia Hills
3.	Megalithic Bridge on the Um-Kumbeh	Um-Kumbeh	Jaintia Hills
4.	Stone memorial of U.Mawthaw - dur-briew	Nartiang	Jaintia Hills
5.	Tank, Syndai	Syndai	Jaintia Hills
6.	Stone memorial of U-Mawthoh-dur, Bhoi	Bhoi	East Khasi Hills
7.	Scott's Memorials	Cherrapunji	East Khasi Hills
8.	Manipur Memorial	Shillong	East Khasi Hills
9.	Monolithic Garden	Jowai	Jaintia Hills

239. There is no archaeological and historical monument is located along subprojectroad alignment.

5. ANALYSIS OF ALTERNATIVES

240. This chapter presents a comparative analysis of various alternatives considered to avoid or minimize impacts that would be inevitable if technically (based on location, design and geometrics) best-fit option is followed. Cross-sections adopted for the construction of bridge and its approach as presented in Chapter -2 (project description) are flexible in design to avoid most of the impacts within RoW. The proposed subproject involves the construction of bridge over river Umngot to connect habitation/settlements on both the side. Hence, location of the bridge and approaches is to align with existing road sections to minimize additional land acquisition. An analysis of various alternatives is attempted to arrive at the technically and environmentally & socially best-fit alternative.

241. For finalization of the bridge location, the status of underground/overhead utilities is verified and taken into consideration. The bridge is proposed in a way which helps in improving the longitudinal gradient and planprofile of the approaches of the bridge. The preliminary survey, subsoil investigation and hydraulic survey were undertaken for the selected location to finalise the structure options for the proposed bridge structure. Four structure options were studied as part of alternate analysis. Option 1: Semi through Steel Arch of one span @94m, Option 2: RCC T-Beam of 28.5m+38.0m + 28.5m, Option 3: Composite Steel Girder: 22.5 m + 30 m + 22.5 m and Option 4: PSC Girder 3@31.67 m. Out of these option 3 with slightly modification has been recommended for the subproject.

242. The subproject approaches and connecting roadshave number of geometric deficient locations and efforts has been made to improve these locations by providing alignment improvement where it is feasible and workable within available RoW.

5.1 Design Considerations

243. The proposed formation width and requirement of right of way all options were reviewed to minimize the land acquisition and R&R impacts. The final alternate design option selected for the road section with no additional land acquisition and nil R&R impacts.

5.2 With or Without Project Scenario

5.2.1 With Project' Scenario

244. The 'with project' scenario includes the construction of bridge and approaches of carriageway width of single lane road section in Meghalaya. The 'with project' scenario has been assessed to be economically viable and will alleviate the existing conditions. It would thereby, contribute to the development goals envisaged by the Government of Meghalaya, and enhance the growth potential of the regional and the state.

245. To avoid the large-scale acquisition of land and properties, the project envisages the construction of single laneapproach road following the existing alignment to minimize the loss of properties and livelihood of the PAPs.

5.2.2 Without Project' Scenario

246. In the case of 'without project' scenario the existing condition without bridge over Umngot river and narrow carriageway width of connecting roads will be considered as it is. Considering the community requirement and potential for growth in near future, the non-availability of paved road and bridge over river is insufficient for handling expected population demand for all weather connectivity and calls in for immediate construction of bridge.

247. The existing bamboo footpath bridge over river does not have strength to take load of vehicles. Further unpaved approaches and poor connecting road is seriously impacting and deteriorating the traffic movement in the subproject area. This is further compounded by the water lagging and disrupting the movement for long hours particularly in monsoon season. The existing unsafe conditions and the adverse environmental consequences, in terms of the environmental quality along the connecting road, would continue to worsen in the absence of the proposed improvements.

248. Therefore, the no-action alternative is neither a reasonable nor a prudent course of action for the proposed subproject, as it would amount to failure to initiate any further improvements and impede economic development. Keeping in view the site conditions and the scope of development of the area, the 'With' and 'Without' project scenarios have been compared as shown in Table 27.

249. By looking at the table it can be concluded that "With" project scenario with positive/beneficial impacts will vastly improve the environment and enhance social and economic development of the region compared to the "Without" project scenario, which will further deteriorate the present environmental setup and quality of life. Hence the "With" project scenario with minor reversible impacts is an acceptable option than the "Without" project scenario. The implementation of the project therefore will be definitely advantageous to achieve the all – round development of the economy and progress of the State.

Table 27:Comparison of 'With' and 'Without' project scenarios as alternative analysis

With Project		Without Project	
Impacts		**Impacts**	
+ve	**-ve**	**+ve**	**-ve**
• With the improvement of road surface and embankment protection measures, the traffic congestion due to obstructed movement of vehicles will be minimized and thus wastage of fuel emissions from the vehicles will be reduced. • Tourism will flourish. • Better access to other part of the region as the subproject bridge will be as a lifeline of interior region. • Providing better level of service in terms of improved riding quality and smooth traffic flow. • Will reduce accident rate.	• Minor change in topography is expected due to construction of embankments. • Minor changes in land use pattern.	Nil	• Increase in travel time. • Increase case of soil erosion. • Increase in fuel consumptions. • Increase in dust pollution and vehicular emission. • Increase in accident rate. • Overall economy of the State will be affected.
• All weather access reliability to across the river.	• Removal of vegetative cover along the connecting road section at selected locations and loss of trees. • Impacts of flora and fauna. • Removal of trees from river bank and along the road section.	Nil	• Increase in accidents.
• Reduced transportation costs.	• Increase in air pollution due to vehicular traffic. • Short term increase in dust due to earth work during construction at micro-level.	Nil	• Subproject unpaved alignment will further deteriorate.

With Project		Without Project	
Impacts		Impacts	
+ve	-ve	+ve	-ve
• Increased access to markets.	• Increase in noise pollution due to vehicular traffic during construction work.	Nil	• Increased vehicle operation cost.
• Access to new employment centers.	Nil	Nil	• Reduced employment/ economic opportunities.
• Employment to local workers during the execution of the project.	Nil	Nil	• Arrest of possible significant enhancement and economic development of the region.
• Better access to health care centers and other social services. • Improved quality of life.	Nil	Nil	• Land degradation, dust pollution and damage to pastureland, contamination in water bodies due to vehicles travelling along multiple tracks on the open ground. • Deep impact to human health in case of emergency.
• Strengthening of local economies.	Nil	Nil	• In absence of the project, it is extremely difficult to generate funds for such a massive improvement of the road infrastructure from its own resources.
• Reduction in travel time and development of the important places of in the district of North Garo Hillsand East Garo Hillsof Meghalaya State.	Increase in speed may lead to accidents in congested areas.	Nil	• Affect the development of the area.
• Reduction in erosion and landslides from multi tracking and stone pitching of elevated embankments.	Nil	Nil	• Increase in dust pollution and creation of sedimentation problems in water bodies.
• The widened and paved road will reduce impacts due to multiple tracking on soil and vegetation along the connecting road.	Nil	Nil	• Increased adverse impacts on soil and vegetation.

5.3 Location and Alignment Alternatives

250. The proposed subproject isconstruction of bridge and approaches along with connecting road having strategic importance to connect rural areas across river Umngot. Government of Meghalaya has planned to implement the subproject to connect with important rural economy and district centres for community development and market accessibility. Therefore; no alternate location were considered for the subproject.

251. The proposed subproject construction of bridge near Thapa Bazar to be the best possible alignment due to existing connecting roads and requirement of local community to cross the river. This alignments has following advantages over any other alternate alignment option:

- The location of proposed bridge is suitable due to geotechnical stability of strata on river banks and shorter length of bridge span
- It follows existing alignment for connecting road section.
- Land take from forest and private parties is nil and improvement work within existing RoW can meet the traffic demand. No additional land will be required the subproject component.
- Existing unpaved track alignment is geologically more stable and will require less or less volume of excavation and filling,
- The existing right of way is available to accommodate improvement proposal in the connecting road section passing along agriculture fields; hence no forest Clarence is required in this section,
- Cost of construction is lower for improvement proposal on existing connecting road alignment.

6. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 Impact Assessment and Mitigation Measures

252. This chapter presents key environmental issues associated with various aspects of the proposed project and the mitigation measures to avoid and reduce the adverse impacts. The impacts were assessed on the basis of nature, extent and magnitude of likely changes that may occur during construction and or operation stage of the project. Beneficial impacts are mostly long-term and permanent whereas adverse impacts are localized and temporary in nature and are likely to occur mostly during construction stage.

252. The methodology of assessing environmental impacts from the project entailed clearly identifying the environmental components (i.e., physical, biological, cultural and health hazards) that will be impacted, type of impacts, i.e., positive or adverse, direct or indirect, significance of the impact and description of the impact including temporary or permanent, reversible or irreversible, and any cumulative and/or transboundary in nature.

253. **Areaof impact assessment.** The area covered for assessing direct impacts include:

a) The right of way of subproject is taken 30m corridor. This includes 10m on either side studied for direct impacts.
b) In addition, a 10 km buffer was studied for indirect impacts. Other indirect impact area covers location of quarries; borrow areas, storage area of construction material etc.

6.2 Positive Impacts

254. The positive impacts note against the proposed project are:

- The subproject bridge will connect the two districts and reduce the travel time to the capital of the State from West Jaintia Hills;
- Trading activities will increase between the districts giving a larger reach to the producer of the domestic markets;
- With the completion of the bridge the long connecting road will cater to around fifteen thousand of rural population.

6.3 Anticipated Adverse Impacts

255. Table belowlist out the anticipated impacts from the project activities during pre, post and during construction stage as well as during operation stage of the bridge.

256. The subsequent table delineates the mitigation measures against each anticipated adverse impact identified

Table – Listing the anticipated adverse impacts that may occur at pre, during and post construction period:

Project Component	Environmental Components	Description of the Environmental Impacts	Direct (D) or Indirect (ID)	Reversible (R)/ Irreversible (IR)	Intensity (L-Low, M-Moderate, H-High)	Area of Impact (Local, State, Regional)
Pre-construction stage						
Clearing of Vegetation/ Trees	Biodiversity (both flora and fauna), GHG emission, soil erosion, etc.	Loss of top soil, disturbance to landscape, land degradation and visual impacts. Loss of floral and faunal species namely birds (avifauna) as their habitat may get disturbed along with the felling of trees.	D	R	L	Local
Levelling of ground surface	Fugitive emission of dust; Soil erosion; Air pollution from vehicles	Loss of top soil, disturbance to landscape, land degradation and visual impacts.	D	R	L	Local
Setting up of construction camp for labour/worker	Water and Land contamination; Occupational Safety & Health Aspects	Water and land may get contaminated from sewerage disposal at the camp site. COVID-19 pandemic could lead to health issues among labourers.	D	R	High due to COVID – 19 pandemic	Local
Operation of Machinery & Equipment	Occupational Safety & Health Aspects Air pollution Noise Pollution	Operation of heavy earth equipment and movement of dumpers pose hazards to workers. Vehicular emission from use of diesel.	D	IR	L	Local
Raw materials Transportation	Air Quality & GHG emissions Siltation due to fine particles and choking of surface channels.	Generation of fugitive dust and exhaust gas emissions from haulage trucks. Loss of precious soil and siltation of surface channels.	D	IR	L	Local
Diversion of traffic ferrying the river over bamboo bridge	Movement of traffic to other alternative route	Movement of traffic to other route may lead to traffic congestion in that route.	D	R	L	Local
Construction Stage						
Stone crushing,	Air Pollution;	Generation of dust causing fugitive emission, which in may lead to	D	IR	M	Local

Project Component	Environmental Components	Description of the Environmental Impacts	Direct (D) or Indirect (ID)	Reversible (R)/ Irreversible (IR)	Intensity (L-Low, M-Moderate, H-High)	Area of Impact (Local, State, Regional)
handling and storage of aggregates; Concretebatchingplant; Mixing of aggregates with bitumen;	GHG emissions Occupational Health Hazards	breathing discomfort for people working at site; Additional GHG emissions against baseline would lead to cause of climate change; Generation of harmfulemissions including SO2,NOx and HC				
Muck-Debris generation during construction activities	Generation of construction and solid wastes	Debris generated from construction work may cause significant impact to the surrounding environment like contamination of waterbody, soil if not managed properly	D	IR	M	Local
Construction of pier-wells Construction of abutment walls	Generation of river muck; River water pollution; River bed and bund erosion; Impact on aquatic habitat Disruption to Natural Drainage System	Construction of pier foundations on the river bed and abutment wall at the banks will cause high water turbidity as well as erosion of soil from the river bed. This could have adverse impact on the riparian vegetation at the site of construction as well as adversely impact fish habitat in water; Additionally, adding of polymer and bentonite for stabilization of wells is likely to cause deleterious impact on aquatic habitat; Any spillage of excess quantity could lead to damaging impacts on the entire habitat, leading to high mortality of riparian vegetation and fishes; Construction may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.	D	R	M	Local
Abstraction of Water for construction	Environmental flow of River Umngot	Construction water requirement (avg. 10 KLD and peak 20 KLD) will be met through approved surface water source (Umngot river). Domestic water requirement (5 KLD) for workers will also be met mainly through approved sources only. Water abstraction due toconstruction work maylead to water scarcity inthe nearby area	D	IR	L	Local
Handling of waste	Solid Waste Management	During construction phase there may be generation of both hazardous and nonhazardous waste which needs to be carefully handled to ensureenvironment safeguard	D	R	L	Local
Labour management	Occupational Health and Safety	Following events/ accidents and injuries could happen to people at site during construction - Falling from height; Head	D (labours)	IR	M	Local

Project Component	Environmental Components	Description of the Environmental Impacts	Direct (D) or Indirect (ID)	Reversible (R)/ Irreversible (IR)	Intensity (L-Low, M-Moderate, H-High)	Area of Impact (Local, State, Regional)
	accidents and injuries	injuries;Exposure to high decibel noise; Injuries to eyes and face; Foot and leg injuries; Exposure of hands to harmful substances; The construction camps are anticipated to house up to 20 people for about 30 months. With the migrated people, the potential for the transmission of diseases and illnesses will increase within the labour camp as well as within the community located nearby. The main health risks during construction phase will arise from: • inadequate sanitation facilities in worker camps; • introduction of sexually transmitted, and other diseases, by migrant workers; • outbreaks of malaria, typhoid, cholera etc. amongst the labour force; and given the current COVID-19 pandemic there is also a risk of construction workers being exposed to the virus and other communicable viral diseases, particularly given construction is directly within the community and the transient nature of the construction workforce.	ID (community form migrant labourers)			
All construction activities	Noise pollution	All type of construction activities is likely to cause noise pollution in the surrounding. Labourers are likely to get impacted from the same. However, the settlements are far away thus there is less likely to impact the community;	D	IR	L (community) M (labourers)	Local
Chance finds	Impact on Cultural Resources	During earth-works there could be chance finding of any cultural resources that may lead to anxiety within community	ID	R	L	Local
Operation Phase						
Operation of vehicles	Noise and GHG emissions due to vehicle exhaust gases. Road accidents	The community may be exposed to excessive noise while the ambient noise levels in the open yard may rise due to cumulative addition of noise which may extend into the neighborhoods. GHG emissions from vehicular emission will enhance cause of climate change Unsafe driving could lead to road accidents on bridge	D	IR	M	Local

Table: Listing of appropriate mitigation measures against the identified anticipated adverse impacts:

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
Pre-construction stage			
Land Acquisition	Environmental Impact Assessment	Projects involves land acquisition from the private owners, who have agreed to voluntarily donate the land parcels for the greater benefit of the villagers and communities who would be accessing the bridge. The acquisition of land will be carried out in accordance with the RFCTLAR&R Act, 2013 and entitlement framework for the project.	PIU-PWD has to ascertain that any additional environmental impacts resulting from acquisition of land shall be addressed and integrated into the EMP and other relevant documents. Responsibility: PIU-PWD, PMU, Revenue Department, World Bank
Clearing of Vegetation/ Trees	Biodiversity (both flora and fauna), GHG emission, soil erosion, etc.	Loss of top soil, disturbance to landscape, land degradation and visual impacts. Loss of floral and faunal species namely birds (avifauna) as their habitat may get disturbed along with the felling of trees.	• All efforts should be made to preserve trees, especially full-grown trees and locally important trees (endangered species/ religiously important etc.). • Tree cutting is to proceed only after all the legal requirements including attaining of In-principle and Formal Clearances. • In the event of design changes, additional assessments including the possibility to save trees shall be made. • Stacking, transport and storage of the wood will be done as per the relevant norms. Systematic corridor level documentation for the trees cut and those saved will be maintained by the PIU-PWD. • The EPC Contractor to budget provisions for following the mandatory afforestation program which requires planting trees at the rate of 1:10 for trees cut and improving vegetation cover in the project area. • EPC contractor to follow Appendix - Guidance Note on Site Clearance to follow the best practices.
Levelling of ground surface	Fugitive emission of dust; Soil erosion; Air pollution from vehicles	Loss of top soil, disturbance to landscape, land degradation and visual impacts.	Sprinkle of water at the site while such activities are carried out; Provide appropriate mask to the labourers working at site;
Setting up of construction camp for labour/worker	Water and Land contamination; Occupational Safety& Health Aspects	Water and land may get contaminated from sewerage disposal at the camp site. COVID-19 pandemic could lead to health issues	• Contractor to submit Labour Camp Management Plan and obtain due approval from PIU-PWD before setting up any labour camp; • Labour-camp Management Plan to be prepared while following the guidelines set under – Appendix - Guidelines on Labour Camp

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
		among labourers.	Management Planning. • Follow all points mentioned in ESMF of MITP project on Labour Camp Management; • Hire of local labours/workers to the maximum extent possible • Follow mitigation measures mentioned under – "Mitigation of COVID-19 risks in Addition to routine environmental impacts" In addition; • Detailed guidance can be found in the EIA and IFC general Health and Safety Guidelines • Contractor must familiarize themselves with World Banks Good Practice Note on Road Safety: • For labor camp establishment, adherence to World Bank's Worker Accommodation Processes and Standards • Plans should adhere to the Labor Management Plan and COVID-19 Guidelines issued by World Health Organisation (WHO) and GoI.
Operation of Machinery & Equipment	Occupational Safety& Health Aspects Air pollution Noise Pollution	Operation of heavy earth equipment and movement of dumpers pose hazards to workers. GHG and other emissions from use of fuel.	• Vehicle carry raw material should be covered with tarpaulin sheet to prevent dust generation • Sprinkle water to prevent fugitive dust at working sites, haul/access roads • Vehicles / equipment used should have valid PUC certificate • Provision of temporary noise barrier in working area
Raw materials Transportation and Usage	Air Quality & GHG emissions Siltation due to fine particles and choking of surface channels.	Generation of fugitive dust and exhaust gas emissions from haulage trucks. Loss of precious soil and siltation of surface channels.	Covering the trucks carrying raw materials with tarpaulins during their movement from source to site. Mitigation measures for quarries are: • aggregates will be first sourced from licensed quarry sites (which are in operation) that comply with environmental and other applicable regulations; • quarries must use controlled and environmentally friendly quarrying techniques in order to minimize erosions and landslides as per guidelines for quarry management; • occupational safety procedures/practices for the work force will be

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			adhered to in all quarries; • quarry and crushing units will be provided with adequate dust suppression measures; and • regular monitoring of the quarries by concerned authorities to ensure compliance with environmental management and monitoring measures.
Site establishment	Air pollution; Water pollution; Soil pollution; Noise pollution; Solid waste generation	Setting up of the site and installing various plants and equipment could lead environmental impacts, most of which are temporary in nature, however some could be irreversible and may adversely impact the environment;	The contractor to prepare a site establishment plan in which following points should be taken care of: • Hard surface Areas: Areas within the site where there is a regular movement of vehicles shall have an acceptable hard surface and be kept clear of loose surface material and shall be so indicated on the required site plan. • Waste Disposal and Site Drainage System outlining systems for water and waste products arising on the site to be collected, removed from the site via a suitable and properly designed temporary drainage system, and disposed of at a location and in a manner that will cause neither pollution nor nuisance, • Biodiversity: The site plan shall avoid establishment of labour camps, stockpiling sites and other temporary structures, near to the river. • Temporary Construction Facilities Relative to Watercourses: The site plans shall be devised to ensure that, insofar as possible, all temporary construction facilities are located at least 50 meters away from an existing water course/river. • Other Water-Related Facilities: Site Plans must indicate adequate precautions to ensure that no spoil or debris of any kind is allowed to be pushed, washed down, fallen or be deposited on land or water bodies adjacent to the site. • Hot mix plants and batching plants will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 500 m away from the nearest village/settlement preferably in the downwind direction. • Arrangements to control dust pollution through provision of wind screens, sprinklers, dust encapsulation must be provided at all such

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			sites. • Specifications of crushers, hot mix plants and batching plants will comply with the requirements of the relevant current emission control legislations and Consent/NOC for all such plants shall be submitted to the SC and PIU. • The Contractor shall not initiate plant/s operation till the required legal clearances are obtained and submitted. • Location of Wheel Washing Facilities: The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the excavation sites. The Contractor shall ensure that all vehicles are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the construction site and entering public areas and ensure that water or debris from such cleaning operations is contained and not deposited into nearby drains and watercourses. The locations of these facilities shall be clearly illustrated by the site plans. • Location of Sand and Aggregate Storage Provisions: The Contractor shall implement dust suppression measures that shall include, but not be limited to the following: • Stockpiles of sand and aggregate greater than 20 cubic meters for use in concrete manufacture shall be enclosed on three sides, with walls extending above the pile and two (2) meters beyond the front of the piles. • Cement and other such fine-grained materials delivered in bulk shall be stored in closed silos • Locations of Liquid and Toxic Material Storage Areas. The site plans shall specify the locations for the storage of liquid materials and toxic materials including the following such conditions to avoid adverse impacts due to improper fuel and chemical storage: • All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse or wetlands. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 percent of the volume of tanks.

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
			• Filling and refuelling shall be strictly controlled and subject to formal procedures, and will take place within areas surrounded by bunds to contain spills/leaks of potentially contaminating liquids. • The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any drain or watercourses. • Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited. • Should any accidental spills occur, immediate clean-up will be undertaken and all clean-up materials stored in a secure area for disposal to a site authorized for the disposal of hazardous waste.
Diversion of traffic ferrying the river over bamboo bridge	Movement of traffic to another alternative route Construction site traffic	Movement of traffic to other route may lead to traffic congestion in that route. Traffic movements to the site could also cause local disturbance – air pollution, road accidents	EPC Contractor to submit Traffic management plan for alternative route and get it approved by PWD. The TMP needs to clearly define (i) the approved haul routes for all construction traffic; (ii) maximum speed limits (which are often lower than the legal speed limit) at locations on the route (e.g. 40 km/h or 30 km/h when vulnerable users are present, such as during school hours starting 200m before to 200m after a school), and the hours at which vehicles operate and; (iii) Temporary Traffic Management (TTM) in work zones.
Construction Stage			
Stone crushing, handling and storage of aggregates; Concrete batching plant; Mixing of aggregates with bitumen;	Air Pollution; GHG emissions Occupational Health Hazards	Generation of dust causing fugitive emission, which in may lead to breathing discomfort for people working at site; Additional GHG emissions against baseline would lead to cause of climate change; Generation of harmful emissions including SO2, NOx and HC	Regular sprinkling of water at site and at the approach roads or the application of emulsion coats near villages and or apply any other dust suppression methods. For fugitive emissions: • regular check-up and maintenance of construction equipment is required; • idling of engines is strongly discouraged; • vehicles delivering loose and fine materials should be covered to reduce spills; Mixing plants i.e., asphalt, concrete, and bricks, should be operated within the permissible limits of CPCB

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
Quarrying	Air, Water and Noise pollution; Consumption of natural resources	Adversely impact all environmental components, causing irreversible changes to the landscape and soil conditions.	• Contractor will finalize the quarry for procurement of construction materials after assessment of the availability of sufficient materials and other logistic arrangements in case the contractor decides to use quarries other than recommended by DPR consultant, then will be selected based on the suitability of the materials. • The contractor will procure necessary permission for procurement of materials and shall submit a copy of the approval and the rehabilitation plan to the PIU-PWD and Environmental Expert of the PMU. • In case of new Quarries, they must have permission from the Department of Mining and Geology and have the necessary clearances from Pollution Control Board and Forest Department and a valid Environmental Clearance from the State Environmental Impact Assessment Authority (SEIAA). • Contractor will also work out haul road network and report to Environmental Expert of the PIU-PWD and SC will inspect and in turn report to PIU before approval. • In case identified source of sand is from a river, the contractor should follow the guidelines on Sustainable Sand Mining.
Borrow Area Muck-Debris generation	Generation of construction and solid wastes	Debris generated from construction work may cause significant impact to the surrounding environment like contamination of waterbody, soil if not managed properly	Preparation of muck disposal plan to assess the quantitative load of wastes to be generated and reusing it during land and level filling operations for foundation preparation. Follow Borrow Area Management Guidelines for identification, maintenance and closure of borrow area(s).
Construction of pier-wells Construction of abutment walls	Generation of muck; River water pollution; River bed and bund erosion; Impact on aquatic habitat Disruption to Natural	Construction of pier foundations on the river bed and abutment wall at the banks will cause high water turbidity as well as erosion of soil from the river bed. This could have adverse impact on the riparian vegetation at the site of construction as well as adversely impact fish habitat in water; Additionally, adding of polymer and bentonite for stabilization of wells is likely to cause deleterious impact on aquatic habitat;	• EPC contractor to submit an Erosion and Sediment Control Plan to the satisfaction of the PWD Environment and Social Cell; The plan shall detail appropriate work methods, best practices for working around water, proposed erosion control methods and containment methodology; • River-bank slope stabilities to be monitored all time, if necessary, appropriate bioengineering/ engineering remedial measures applied throughout the construction period; • Construction work at bridge during rainy season to be minimized to avoid erosion and sedimentation; • Construction work in the river water to be avoided during fish

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
	Drainage System	Any spillage of excess quantity could lead to damaging impacts on the entire habitat, leading to high mortality of riparian vegetation and fishes; Construction may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.	spawning season; Conduct in-stream work during the dry season/ or when the water is at the lowest level. • Allow no release of sediments into any water body in levels that are deleterious to fish or fish habitat or wildlife habitat or that would alter growing or hydraulic conditions; • The EPC contractor should list all products and materials to be used or brought to the construction site that are considered or defined as hazardous or toxic to the environment, including but not limited to, • sealer, grout, cement, concrete finishing agents and adhesives; • If welding is used, welding solder must be contained locally or a containment system used that is capable of trapping welding solder and preventing it from entering the river. • Monitoring for grout breakout will be undertaken during micro-pile installations and appropriate action will be taken to prevent/contain any breakouts.
Abstraction of Water for construction	Environmental flow of River Umngot	Construction water requirement (avg. 10 KLD and peak 20 KLD) will be met through approved surface water source (Umngot river). Domestic water requirement (5 KLD) for workers will also be met mainly through approved sources only. Water abstraction due to construction work may lead to water scarcity in the nearby area	• Environmental flow of the river to be maintained all the time such that the downstream is not devoid of water; • Appropriate temporary diversions of streams will be made and brought back to their natural course as soon works are completed in that section. No disposal of construction debris in streams and rivers is allowed. • Local permission to be acquired for usage of both river water for construction as well as drinking water tapped from local sources;
Handling of waste	Solid Waste Management	During construction phase there may be generation of both hazardous and non-hazardous waste which needs to be carefully handled to ensure environment safeguard	• Excess quantity if any may be tried to be used in landscaping. • The top soil preserved earlier shall be used in spreading a layer over the landscaped surface and in green belt development. • Segregation of waste (hazardous and non-hazardous) should be properly done at source • Adequate dustbin should be provided in Labour camps and other suitable areas • The hazardous waste should be disposed of through authorized vendor only • Non-hazardous waste should be disposed of in a designated site or

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures

			thorough authorized vendor
			• Regular clearing/disposal of organic waste generated from worker camp to be ensured.
			• Equipment and fuel depots will be placed in safe zones away from drinking water sources and riverbanks;
			• To mitigate the impacts of possible fuel spills the following measures to be applied:
			  • secondary containment around fuel tanks and at fuelling stations to be built;
			  • oil and fuel spills, and other runoff from contaminated areas to be controlled; and

Labour management	Occupational Health and Safety accidents and injuries	Following events/ accidents and injuries could happen to people at site during construction - Falling from height; Head injuries; Exposure to high decibel noise; Injuries to eyes and face; Foot and leg injuries; Exposure of hands to harmful substances;
		
		The construction camps are anticipated to house up to 20 people for about 30 months. With the migrated people, the potential for the transmission of diseases and illnesses will increase within the labour camp as well as within the community located nearby. The main health risks during construction phase will arise from:
		• inadequate sanitation facilities in worker camps;
		• introduction of sexually transmitted, and other diseases, by migrant workers;
		• outbreaks of malaria, typhoid, cholera etc. amongst the labour force; and given the current COVID-19 pandemic there is also a risk of construction workers being exposed to the virus and other communicable viral diseases, particularly given
			• Contractor to submit and obtain approval for a health and safety plan prior to the commencement of work;
			• Provision of adequate health care facilities and ensure adequate security is provided to construction staff on site and at worker accommodation;
			• Workers will be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter; and
			• For COVID-19 related health and safety risk, the contractor to prepare and implement a COVID-19 Action Plan as per measures mentioned under Mitigation of COVID-19 risks in addition to routine environmental impacts
			• Contractor will provide:
			  ○ Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete etc.
			  ○ Welder's protective eye-shields to workers who are engaged in welding works
			  ○ Protective goggles and clothing to workers engaged in Factories Act, 1948 stone breaking activities and workers will be seated at sufficiently safe intervals
			  ○ Earplugs to workers exposed to loud noise, and workers

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
		construction is directly within the community and the transient nature of the construction workforce.	working in crushing, compaction, or concrete mixing operation. o Adequate safety measures for workers during handling of materials at site are taken up. o The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress. o Daily tool box talk will be conducted by safety officer and reported in monthly report by contractor. o Contractor will share grievance redress mechanism and details on procedure with labour as part of induction training o The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labour Organization (ILO) Convention No. 62 and World Bank's Environment, Health & Safety Guidelines as far as those are applicable to this contract. o The contractor will make sure that during the construction work all relevant provisions of the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. o The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. o The contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. o Contractor will provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry is rubbed and scrapped. o The Contractor will mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non -compliance of use of PPE with zero tolerance. These will be reflected in the Construction Safety Plan to be prepared by the Contractor during mobilization and will be approved by PMU and PIU-PWD.

Project Component	Environmental Components	Description of the Environmental Impacts	Mitigation Measures
All construction activities	Noise pollution	All type of construction activities is likely to cause noise pollution in the surrounding. Labourers are likely to get impacted from the same. However, the settlements are far away thus there is less likely to impact the community;	Noise generating equipment will have acoustic enclosures. Noise generating activities should not be permitted during night.
Chance finds	Impact on Cultural Resources	During earth-works there could be chance finding of any cultural resources that may lead to anxiety within community	Report immediately to the PWD and seize work until permission is granted by PWD
Operational Stage			
Operation of vehicles	Noise and GHG emissions due to vehicle exhaust gases. Road accidents	The community may be exposed to excessive noise while the ambient noise levels in the open yard may rise due to cumulative addition of noise which may extend into the neighbourhoods. GHG emissions from vehicular emission will enhance cause of climate change Unsafe driving could lead to road accidents on bridge	Installation of appropriate road signage informing of speed and noise limit in the give areas All necessary measures for Road Safety of traffic and pedestrians and workers must be taken by PWD. PWD may familiarize themselves with World Banks Good Practice Note on Road Safety http://pubdocs.worldbank.org/en/648681570135612401/Good-Practice-Note-Road-Safety.pdf

Cumulative Impact: As the bridge will be built across the river Umngot which is one of the major rivers of the State, it triggers the requirement to assess cumulative impacts.

Scope for conducting CIA	Potential VECs	Potential Changes or Impacts to VECs	Other Potential Sources of Contribution to Cumulative Impacts on Potential VECs	Potential Bridge Sub-Project Contribution to Cumulative Impacts on Potential VECs	Mitigation Measures

Scope for conducting CIA	Potential VECs	Potential Changes or Impacts to VECs	Other Potential Sources of Contribution to Cumulative Impacts on Potential VECs	Potential Bridge Sub-Project Contribution to Cumulative Impacts on Potential VECs	Mitigation Measures
Umngot River (specific to bridge construction site)	Quality of water from affected river	Increased turbidity levels in river / water body adjoining the road sub-project Deterioration in water quality chemical content)	Currently there is no usage of river water at the nearest upstream or downstream of the river	Run-off of sediment from construction sites Run-off of oil, petrol, etc. from road surface during operation.	Erosion and sedimentation control plan will be prepared by the EPC contractor stating the best practices to be applied to contain erosion and sedimentation during construction period; Emergency spillage plan will also be in place to contain any accidental spillage of chemical and or oil; All actions to be taken by the EPC contractor and monitored by PIU-PWD, Environmental Cell.

Mitigation of COVID-19 risks in Addition to routine environmental impacts:

257. It is assumed that the threat due the pandemic infection of Covid-19 shall remain until the construction stage of the bridge. In view of this, it is of utmost importance to follow the Ministry of Health & Family Welfare Directorate General of Health Services Guidelines on preventive measures against the spread of COVID-19 infections in the workplace settings.

258. Clauses for inclusion in Civil Works Contracts adaptted from approved project by Ministry of Health and Family Welfare (MoFHW), GoI are as follow:

- Clauses already part of contract/bidding documents being used need not be duplicated.
- The primary/main contractor will be responsible for ensuring these, even if one or more sub-contractors are used for completing the civil works.
- The contractor to put in place measures to avoid or minimize the spread of the transmission of COVID-19 and/or any communicable diseases that may be associated with the influx of temporary or permanent contract-related labour.
- Any suspect case of COVID19 should be tested as per the national/state guidelines issued by the Health and Family Welfare Ministry/Departments and precautions/protocol to be followed for the infected worker and his/her co-workers.
- General Obligations of the Contractor
    - To take all necessary precautions to maintain the health and safety of the Contractor's Personnel.
    - To depute a health and safety officer at site, who will have the authority to issue directives for the purpose of maintaining the health and safety of all personnel authorized to enter and or work on the site and to take protective measures to prevent accidents, including spread of COVID19.
    - To ensure, in collaboration with local health authorities, access to medical help, first aid and ambulance services are available for workers/labors, as and when needed.
    - Provide health and safety training/orientation on COVID19 to all workers and staff and other employees of the sub-contractor (tips on cough etiquette, hand hygiene and social distancing).
    - Prepare a detailed profile of the project work force, key work activities, schedule for carrying out such activities, different durations of contract and rotations, confirmed addresses of the labor and any underlying health conditions that increases the risk of severe infection, to facilitate tracking of workers in case of COVID-19 exposure.
    - All laborers to be provided with photo ID cards for accessing the construction site.
    - All laborers engaged at construction site to be provided with the required Personal Protection Equipment (PPE) – safety helmet and shoes, secured harness when working at heights, electrical gloves, eye protection for welding etc., without which entry to the construction site shall not be allowed.
    - In relation to COVID19, masks, adequate hand washing/ sanitization, clean drinking water and sanitation facilities to be provided at construction site.
    - All workers/labor to be regularly checked for symptoms before allowing entry to the work site.
    - Paid leave to be mandatorily given if labor contacts COVID-19 and/or any other contagious disease while working at the construction site or in the labor camp.
- For Labour Camp
    - Contractor to provide hygienic living conditions and safe drinking water.
    - Separate toilets for male and females and adequate hand washing/sanitization facilities.
    - Monthly/weekly health check up to be organized at the camp for all labors/family.
    - Organize awareness campaign for social distancing and general health and hygiene.

- Construction Management in Upgrading of Existing Facilities
    - Maintain a roster of workers/staff at work site indicating their health condition and symptoms and ensure screening procedures (non-physical temperature measurement) at work sites.
    - Depute and assign monitoring and reporting responsibilities on environmental management, health and personnel safety.
    - Preventing a worker from an affected area or who has been in contact with an infected person from returning to the site for 14 days or (if that is not possible) isolating such worker for 14 days.
    - Place posters and signages at/around the site, with images and text in local languages relating to personal safety, hygiene and on COVID-19 symptoms and guidelines.
    - Ensuring handwashing facilities supplied with soap, disposable paper towels and closed waste bins exist at key places throughout site, including at entrances/exits to work areas; where there is a toilet, canteen or food distribution, or provision of drinking water; in worker accommodation; at waste stations; at stores; and in common spaces.
    - Segregate lunch hours at worksite of workers to maintain social distancing.
    - Securing the construction site with entry only for authorized personnel and disinfecting of the worksite to be undertaken at close of work every day or as may be required.
    - Any medical waste produced during the care of ill workers should be collected safely in designated containers or bags and treated and disposed of following relevant requirements (e.g., Biomedical Waste Rules-2018, WHO).

Table 28: Precautions to be taken during Operation of Facilities

DO's	DON'T's
To maintain personal hygiene and physical distancing.	Shake hands
To practice frequent hand washing. Wash hands with soap and water or use alcohol-based hand rub. Wash hands even if they are visibly clean.	Have a close contact with anyone, if you're experiencing cough and fever.
To cover your nose and mouth with handkerchief/tissue while sneezing and coughing.	Touch your eyes, nose and mouth.
To throw used tissues into closed bins immediately after use.	Sneeze or cough into palms of your hands.
To maintain a safe distance from persons during interaction, especially with those having flu-like symptoms.	Spit in Public.
To sneeze in the inner side of your elbow and not to cough into the palms of your hands.	Participate in large gatherings, including sitting in groups at canteens.
To take their temperature regularly and check for respiratory symptoms.	
To see a doctor if you feel unwell (fever, difficulty in breathing and coughing). While visiting doctor, wear a mask/cloth to cover your mouth	
For any fever/flu-like signs/symptoms, please call State helpline number.	
Self-monitoring of health by all and reporting any illness at the earliest	

Table 29: Guidelines for cleaning toilets for use of Staff and Workers

Areas	Agents / Toilet cleaner	Procedure

Toilet pot/ commode	Sodium hypochlorite 1% (equivalent to 10,000 ppm)/ detergent Soap powder / long handle angular brush	• Inside of toilet pot/commode: • Scrub with the recommended agents and the long handle angular brush. • Outside: clean with recommended agents; use a scrubber.
Lid/ commode	Nylon scrubber and soap powder/detergent 1% Sodium Hypochlorite	• Wet and scrub with soap powder and the nylon scrubber inside and outside. • Wipe with 1% Sodium Hypochlorite
Toilet floor	Soap powder /detergent and scrubbing brush/ nylon broom 1% Sodium Hypochlorite	• Scrub floor with soap powder and the scrubbing brush • Wash with water • Use sodium hypochlorite1% dilution
Sink	Soap powder / detergent and nylon scrubber 1% Sodium Hypochlorite	• Scrub with the nylon scrubber. • Wipe with 1% sodium hypochlorite
Showers area / Taps and fittings	Warm water Detergent powder Nylon Scrubber 1% Sodium Hypochlorite/ 70% alcohol	• Thoroughly scrub the floors/tiles with warm water and detergent • Wipe over taps and fittings with a damp cloth and detergent. • Care should be taken to clean the underside of taps and fittings. • Wipe with 1% sodium hypochlorite/ 70% alcohol
Soap dispensers	Detergent and water	• Should be cleaned daily with detergent and water and dried.

6.4 Climate ResilientMeasures as perDPR

259. There are design measures also considered in detailed project report to minimize impacts on environmental conditions and social setup along subproject alignment due to proposed bridge construction works. The followingclimate resilientmeasures have been taken:

- Geo-technical assessment for load capacity of the soil strata in the subproject area.
- Recycle/reuse of excavated soil from road side and BT &Non-BT material scarified from existing carriage.
- Hydrological data analysis to design bridge over river with peak waterflow and rainfall in the subproject area
- Design of cross-drainage structures based on rainfall data of the subproject area.
- Accommodation of improvement proposal within existing right of way, to avoid impacts on trees, land and existing structures.
- Tree plantation on and application of Bio-engineering and bio-technology for embankment protection.
- Dumping areas for muck disposal has been identified and consent processed at DPR stage
- Provision of protection work at required river bank at proposed bridge location
- Provision of side drains to minimize soil erosion and water pollution.
- Involvement of community in maintenance works and plantation schemes along subproject alignment.

7. PUBLICCONSULTATIONS AND DISCLOSURE

260. Stakeholder consultation is a two-way process which involves the interaction of various stakeholders and the project proponent. It is highly desirable for all key stakeholders to arrive at a consensus on sensitive features, issues, impacts and remedial actions. It is useful for gathering and making them understand the project alternatives and mitigation and enhancement measures and last but not the least the compensation packages arrived for the affected population. The consultations were held with the communities currently using the river passage for commuting either over the bamboo bridge and or ferry services run only during rainy season, population residing and shop owners along thesubproject alignment. The consultations were to know the views of public on proposed bridge construction, to know the locations of problem faced by community in absence of proper arrangement to cross river, and to identify environmental issues due to subproject development.

261. The stakeholders identified are potential affected community, Field offices of the project Road and Building Department of Government of Meghalaya State, Forest Department, State Pollution Control Board, People residing along the project road, State Irrigation Department, State Electricity Department, State Transport Department and the State Tourism Department.

262. During the process efforts were made to ascertain the views and preferences of the people. The aims of community consultation were:

- To understand views of the people affected w.r.t to the impacts of the subproject
- To identify and assess all major economic and sociological characteristics of the village to enable effective planning and implementation and;
- To resolve the issues relating to the impacts on community property if any.

7.1 Local Level Consultation

263. Local level consultations were carried out at both ends of the proposed bridgesite and all the comments received have been incorporated in the document. Efforts were made to select all habitations along the subproject alignment in order to get representation of all the segments of affected population. Prior intimation about consultation meeting was given to Village office /Community Leader/Villagers, so that the villagers were aware of date and location of meeting before hand for active participation. Details of stakeholder consultation in given in the Annex to this report.

7.1.1 Key findings of the local level consultations

264. The key findings of the local level consultations are as follows:

- The size of participants in each consultation is mentioned in the Table-34.
- The participants were aware of the fact that new bridge is proposed and connecting road will be widened.
- Women also participated during the consultation and there were no negative issues raised.
- The participants, in general, were in favour of bridge construction and connecting road widening and improvement; however, they had apprehensions regarding safety.

Table 30: Summery of public consultation for project road sections in East Meghalaya

Venue / Place	Date	Participants	Issues/Suggestions	Concerns included in project
Village: Jongkhsa and Umlong	28January 2020	20Participants from village community including village head, housewife, business owners, labours, farmers and students	• Proposed new bridge over river Umngot and its approaches will provide better level of services in terms of improved traffic flow in all weather. • All the villagers were in favour of the new bridge construction and widening of the connecting road. • The villagers raised their concern about the increased risk of accidents specially of children during construction. It was thus suggested that proper safety measures will be taken. Like diversion of traffic during construction and safety designs should be incorporated in subproject design wherever it is necessary. • Community has also raised the importance of both-side footpath and adequate street lighting along the proposed bridge and connecting road passing through residential cum commercial area. • Development assistance in public utilities along the subproject like public toilets, lay-off areas and market sheds was also requested during consultation. • Noise disturbance at night time due to construction and air pollution in the form of	• Design within existing RoW of alignment for connecting roads for smooth traffic flow. • Speed limits and traffic control measures as per IRC included in detailed project report for improved road section. • During construction stage implementation of World Bank's Environmental Health and Safety Guidelines to minimise the risk of accidents. • Provision of health safety officer and training to workers/drivers for safe driving for Bridge construction. • Drain and footpath included in bridge design • Provision of budget for development assistance in public utilities in Market Area (Thapa Bazar) • No construction activities during night by restriction of working hours. • Construction supervision by implementation agency and Project Management Consultant • Grievance redress mechanism to address complaints

Venue / Place	Date	Participants	Issues/Suggestions	Concerns included in project
			dust are the health concerns raised by the community. Asthma patients would be seriously affected due to this. It was thus assured that construction work will be done only during daytime in the habitation areas. • To reduce pollution the consultant suggested the remedial measures like dust suppression and screens will be used to confine the pollution within the work zone. Water will be sprinkled twice a day for dust suppression. • Similar to there was a demand for drains along the bridge and connecting roads to be constructed. The consultant shared that provision has been given for road side drains and these are integral part of Road design in habitation areas along the road section.	

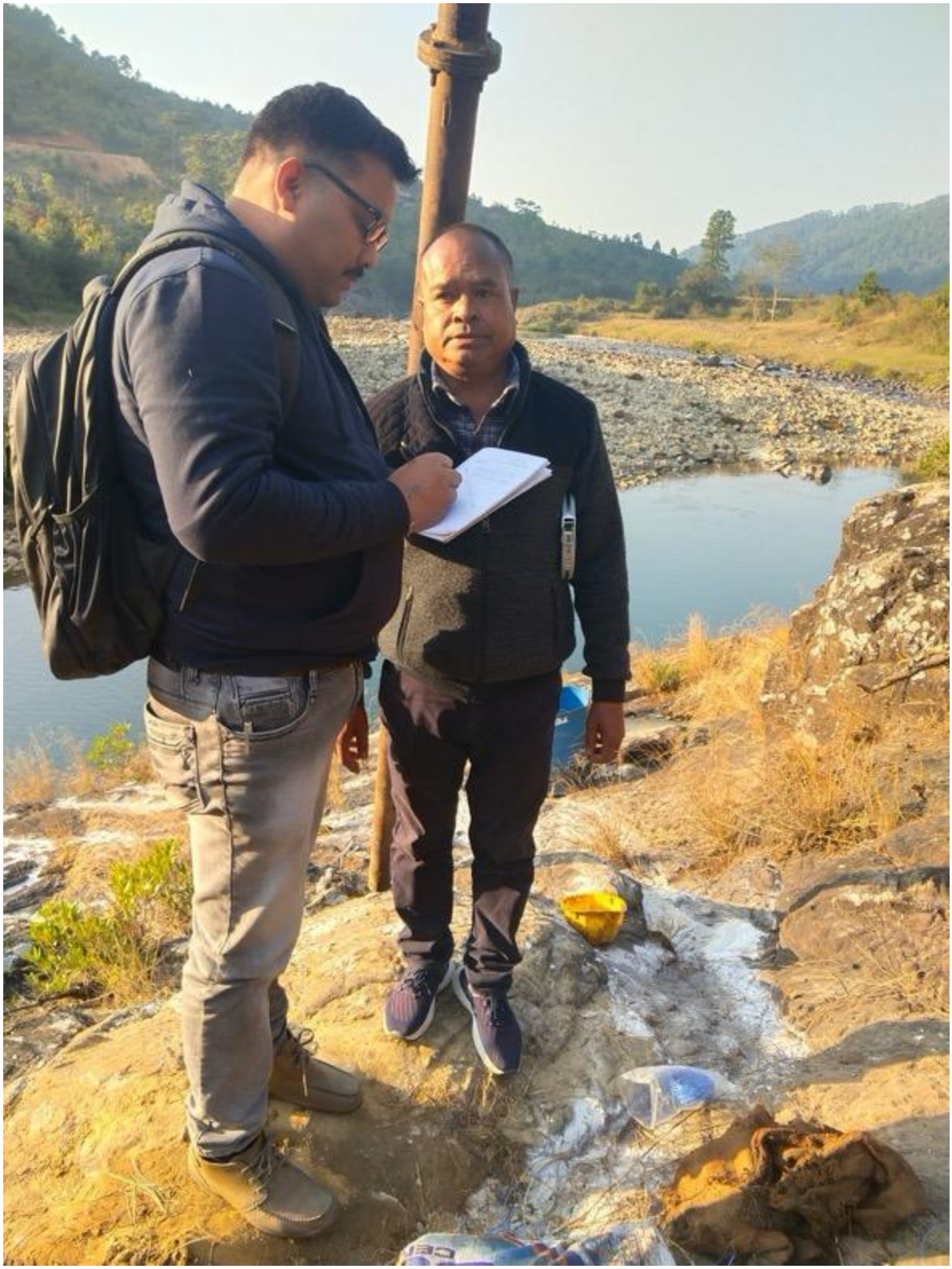


Photo-Public consultation

7.2 Conclusion of Stakeholder Consultations

265. All the stakeholder's suggestions and comments were conveyed to the design team for consideration and incorporation in the project design. It can be concluded that all the concerns of stakeholders have been taken into account in the project planning and design issues.

7.3 Information Disclosure

266. The draft and final versions of the EIA will be disclosed for public knowledge through the website of the Executing Agency (EA) and the World Bank. The full document and executive summary (in local language) shall be disclosed by uploading at respective websites of EA. The copy of document will be made available at the offices of PMU, district level offices of line departments, State and District Libraries, Local municipal and ADCs and VECs offices for public reference.

8. ENVIRONMENT MANAGEMENT PLAN

8.1 Introduction

267. This Environmental Management Plan has been drawn based on the understanding of the interactions between the environmental setting and the subproject components and the assessment of the likely impacts. Mitigation measures described earlier in the report has been further elaborated as specific actions which would have to be implemented during the subproject implementation. The EMP would help the MPWD implement the project in an environmentally sustainable manner and where all contractors, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage such risk.

8.2 Environment Management Plan

268. Considering the nature of the works and environmental setup along the subproject alignment in the state of Meghalaya, anEMP (Appendix-6) have been developed. Prior to start of construction work Environmental Expert of PMC in coordination with Contractor will update the EMP to make it subproject specific construction EMP. The construction EMP for this subproject prepared by contractor should include health and safety plan as per World Bank's EHS guidelines.

269. The Environment Management Plan would be included as part of the Bidding document and shall at a later date used by the Contractor for developing the Contractor's EMP. The contractor's environment management plan should be in accordance with the EIA presented in the Environment Assessment Report.

8.3 Environmental Monitoring Program

270. The Environmental Monitoring Program is aimed at essentially monitoring the day to day activitiesin order to ensure that the environmental quality is not adversely affected during theimplementation. The monitoring programme consists of Performance Indicators and ProcessIndicators. The monitoring plan for the subproject is given in Table -36.

8.3.1 Monitoring Indicators

271. Monitoring indicators have been identified to objectively identify and assess a particularenvironmental component which is expected to be affected due toparticular activities at a particular time of the subproject lifecycle. These indicators would be a mix of both objective as well as subjective. The performanceindicators shall be evaluated under three heads as;

- Environmental condition indicators to determine efficacy of environmental management with respect to air, noise, water and soil pollution.
- Environmental management indicators to determine compliance with the suggested environmental management measures
- Operational performance indicators have also been devised to determine efficacy and utility of the proposed mitigation measures

272. The performance indicators include the components which have to be identified and reportedduring the different stages of the implementation. These wouldhelp identify the level ofenvironmental performance of the project. In addition, there would be Process Indicators whichwould help in assessing theeffectiveness of the system which has been instituted.

273. The processand performance indicators for different stages are presented in Table-35.

Table 31: Details of process and performance indicators

S.No.	Indicator	Description	Type of Indicator
Pre-construction			
1	Sourcing of Water	Has the Contractor applied for permit for groundwater abstraction or local community permission for use of stream water	Performance Indicator
2	Rainwater Harvesting	Has the Contractor initiated the process of rainwater harvesting in storm channels and at camp site	Performance Indicator
3	Siting of Contractors Camp	Have the EA/IA intimated the Contractor the guidelines for siting of the Camp	Process indicator
4	Facilities in Contractors Camp	Has the IA/EA verified the design /Plan of the Contractor's Camp for adequacy of the Facility	Process indicator
5	Adequacy of cross drainage structures	The adequacy of cross drainage structure should be checked not only from the hydraulic perspective but also whether the location and number of culverts for efficiency in removing waterfrom the different micro-catchment along the alignment so that the embankment does not impede on the movement of water or there is no back flow.	Performance Indicator
6	Impact Water HarvestingStructure	The alignment should not encroach upon any water harvesting structure or its catchment. The runofffrom the pavement should also not drain into the catchment of such areas	Performance Indicator
7	Number of Trees which could be saved	Possibility of preventing felling of trees especially mature trees by modification of design. TheFeasibility of transplantation of trees should also be worked out	Performance Indicator
8	Schools, Hospitals and community sensitive receptors	The design should include mitigation measures for noise and safety of children in front of the school. The design should traffic calming measures and also measure for ensuring noise attenuation	Performance Indicator
9	Review of Design for landslide locations	Has the design been reviewed and observations sent for improvement of works for such locations	Process indicator
Construction Phase			
10	Dust Suppression	Dust suppression activities carried out by the Contractor using the dust suppressant	Process indicator
		Air Quality Monitoring carried out by the Contractor	Process indicator
		Effectiveness of the dust suppression carried out by the Contractor	Performance Indicator
11	Nuisance due to Noise	Complaints received from local people	Performance Indicator
		Noise monitoring carried out by the Contractor	Process indicator
12	Usage of Water for Construction	Quantity and source of extraction of water	Performance Indicator
13	Safety of the workers	No. of cases where the non- conformance has been reported to the Health and Safety Plan	Process indicator

S.No.	Indicator	Description	Type of Indicator
		No of cases of injuries or fatalities reported	Performance Indicator
14	Community Health safety	Non-conformance on Community health safety pointes in the audit	Process indicator
15	Prevention of pollution	No of cases of non-conformance pointed out from discharges from labour camps and equipment(concrete wash water)and emission from machinery	Performance Indicator

Table 32: Environmental Monitoring Plan

Sl. No.	Attributes	Stage	Parameters to be Monitored	Location	Frequency	Responsibility	Cost estimates INR
1	Integration of local people's environmentalconcerns	Pre construction	Implementation of measures as suggested in the EMP	On-site/Off-Site	During the study and design process and prior to approval	DPR consultant	Part of project report
2	Incorporation of mitigation measures and environmental codes of conductinto designs	Pre Construction	Implementation of measures as suggested in the EMP	On-Site	During Project Approval	DPR consultant	Part of project report
3	Preparation of all documents as mentioned in EMP before start of work	Pre Construction	Implementation of measures as suggested in EMP	On-Site	Before start of construction work	Contractor and Environmental Management Specialist (Project Management Consultant)	As part of Contractor Team costs
Construction Phase							
4	Implementation of construction phase impact mitigation measures	Construction	Implementation of measures as suggested in the EMP	On-site	Weekly-one	Environmental Management Specialist (Project Management Consultant) / Environmental Officer (PMU)	As part of Consultant Team costs
5	Construction and location of drainage facilities	Construction	Drains	Site inspections at places where such drains are required	During construction	Contractor	Part of project cost
6	Care and safe storage of top soil for later use	Construction	Loose soil	Site clearance activities	Weekly	Contractor	Part of project cost

7	Care of vegetation in the immediate vicinity	Construction	vegetation	Site clearance activities	Weekly	Contractor	Part of project cost
8	Safeguarding of community infrastructures	Construction	Public toilets, bus stops etc.	Site observation	During and immediately after construction	Contractor	Part of project cost
9	Safe disposal of excavated materials and other construction wastes	Construction	Soil, debris etc	At excavation sites	Weekly	Contractor	Part of project cost
10	Impacts on agricultural land due to spoil, soil erosion, water logging etc.	Construction	Topography	Respective locations	Weekly	Contractor	Part of project cost
11	Information Sign Boards	Construction	Information about work	Construction sites	Before starting, in between constructio n	Contractor	To be included in BOQ. Part of project cost
12	Air Quality	Construction	PM10, and PM2.5, SOx, NOx, CO	2 locations (near habitations), Monitoring near hot mix plant locations approved by the PMC as per NAAQS, 2009 CPCB	Quarterly - including once priorto start ofwork	Contractor	Cost included in EMP budget.
13	Noise	Construction	Equivalent Day & Night Time Noise Levels	At two locations, especially around sensitive receptors and settlements including camp & construction yard if any.	Quarterly - including once priorto start ofwork	Contractor	Cost included in EMP budget.
14	Water quality and environmental flow	Construction	River water quality – General parameters and Oil and grease, And E-flow to maintain aquatic life and other activities carried out in the river	At River Umngot; (at 2 points each upstream and downstrea m of the bridge location)	Monthly - including once prior to start of work	Contractor	Cost included in EMP budget.

15	Soil Quality	Construction	Soil quality parameters-for contamination check	At location of workshops and bitumen storage area	Quarterly - including once prior to start of work	Contractor	Cost included in EMP budget.
16	Slope conditions	Construction	Slope conditions of the river embankments	at 2 points each upstream and downstream of the bridge location	Quarterly - including once prior to start of work	Contractor	Cost included in EMP budget.

9. IMPLEMENTATION ARRANGEMENT

9.1 Project Implementation Arrangement

274. Theproject activities will be implemented by agencies: Public Works Department (PWD). The department, will depute a Project Director (PD) preferably at the level of a Chief Engineer/Superintending Engineer along with the required supporting staff with the overall responsibility for project implementation with the involvement of the various field divisions and other units at the head-quarters (HQ – Shillong).

275. Additionally, a project management unit (PMU) will be mobilized under MIDFC to support the implementing agencies during project preparation and subsequent implementation.

9.2 Project Management Unit (PMU)

276. The Project Management Unit (PMU) will engage a consulting firm, as Project Management Consultant (PMC) for providing technical support on safeguard implementation.The PMU shall have one environmental expert and one social and gender expert for implementation of ESMF and E&SMPs.

277. **Environmental Expert:**The environment expert will look after environmental aspects. She / he will guide the project team on environmental aspects and support in building environmental parameters to be built in the bids. She / he will also guide the contracts and monitor their works from time to time. In case of requirement, she/he will prepare a detail environment management plan for different activities to be executed by the project. The expert will be guided by the MIDFC Project Director and reporting to the Project Director directly.

278. The actual responsibility of implementation of the EMP would be with the Contractor. An Environmental Engineer and Health Safety Officer would be responsible for the implementation of the environmental safeguards.

9.2.1 Roles and Responsibilities

279. The roles and responsibilities of the different officers and professionals involved in the implementation ofthe environmental safeguards are presented in Table-37.

Table 33: Roles and Responsibilities for implementation of Environmental Safeguards

S.No.	Position	Responsibilities
1	Chief Engineer (PMU)	• Overview of the project's compliance to Bank's and national laws and regulations • Oversight of the EHS requirements to be integrated in the Project formulation, implementation and formulation e.g. design, bid documents and contract • Ensure that sufficient funds are available for implementation of all agreed Environmental safeguards measures. • Review of environment monitoring and audit findings, grievance associated with environment during each of the project review • Submit annual safeguards monitoring reports to the Bank and closure of the observations made by the Bank. • Review of the annual environmental audit and approve of the mitigation of the EMP if any new or unanticipated environmental

S.No.	Position	Responsibilities
		impacts occur during project implementation due to design change or other reasons • In case of significant new or unforeseen impacts, immediately inform Bank to make a decision on the same besides updating relevant project reports.
2	Environmental Officer (PMU)	• Ensure that project meets the statutory requirement and Bank's requirement; • Recommend for approval to PMU all document and ensure that design and documents includeall relevant EHS Safeguards • Recommend for approval to PMU theContractor's Environmental Management Planafter approval of the Environmental Engineer ofthe PMC; • Review the environmental performance of theproject through Monthly Reports and Monthly • Environmental Audits reports submitted by thePProject Management Consultants and report tothe Management; • Carry out quarterly environmental audits andreport back to the management • Review Corrective Action Plan for closure of theEnvironmental Audit Findings • Overall coordination and management throughPIU supported by PMC and Authority Engineerfor implementation of Environment Safeguards. • Review and action on all grievance related toenvironment through the Grievance RedressMechanism. • Prepare the Annual Safeguards Monitoring &closure Reports to the Management for reviewand onwards submission to the Bank and itsclosure; • Review of all the finding in the monitoring andauditing report and ensuring corrective actionare implemented so that it does not reoccur; • Updating of the EMP if any new or unanticipated environmental impacts occur during project implementation due to design change or other reasons • Organise training for Capacity building of thePMU and the PIU for effective implementation ofsafeguard requirements
3	Environmental Engineer (PMC)	• Ensure that Contractor is in compliance with allthe statutory requirement and the Safeguardrequirement mentioned in the EMP. • Review and approve the Contractor's EMPImplementation Plan; • Ensure that the weekly environmental reportsare compiled by Contractor, reviewed andsubmitted to PMC; • Carry out any specialized designs which would berequired for the environmental safeguards; • Facilitating the Contractor to obtain necessary permissions/ approvals and its submission toPMC • Directly interact with aggrieved persons andrecord their views and grievances in theGrievance Management System. • Work with the contractor to ensure grievances ifany at field level is resolved • Review and approve the package specific EMP'sand make necessary modifications if required.

S.No.	Position	Responsibilities
		• Ensure that all mitigation measures as given inthe EMP are implemented properly by theContractor during the study. • Conduct weekly environmental monitoring of allproject during pre-construction, constructionand operation phases. • Ensure monthly, quarterly and annualenvironmental monitoring reports are preparedand submitted to PMC. • Work with the Contractor and PMC forpreparation of the environmental correctiveactions on audit observations
4	Environmental Engineer (Contractor)	• Responsible for integration of the mitigationmeasures proposed in the EnvironmentalManagement Plans (EMP) associated with theconstruction activities into the constructionprocesses. • Responsible for daily monitoring of theenvironmental compliance and submission of theinformation to the Authority Engineer. • Preparation of Contract Specific managementand submission of the same to the AuthorityEngineer for approval. • Ensure that adequate budget provisions aremade for implementing all mitigation measuresspecified in the Contract specific EMP. • Participate in induction training on EMPprovisions and requirements delivered by thePMU and carry out the same for all contractstaff. • Carry out liasoning with the regulatory agenciesfor necessary environmental license(s), permitsetc. • Assist the PIU with support required forobtaining necessary environmental permits • Participate in resolving issues as a member of theGrievance Redressal Cell. • Respond promptly to grievances raised by thelocal community or and implement correctiveactions.
5	Health and Safety Office (Contractor)	• Responsible for ensuring integration of thehealth and safety aspects in the work processesassociated with the construction activities. • Responsible for day -to day monitoring of theoccupational health and safety performance and submission of the information to the AuthorityEngineer. • Preparation of a Safety Plan and submission ofthe same to the Authority Engineer for approval. • Participate in induction training on EMPprovisions and requirements delivered by thePMU and carry out the same for all contractstaff. • Carry out Construction safety Audits and reportit to the Team Leader of the Contractor. • Assist the PMC with the health safety performanceof the project • Respond promptly to grievances raised by thelocal community for the safety and implementcorrective actions.

9.2.2 Training and Capacity Building

280. Training and capacity building would be required especially for the PMU staff associated with the project as the Environmental Safeguards would bea relatively new area which the staff are required to handle. The training and capacity building would not only be project specific but would also target and develop long term capacities in the PWD Division. The training program would include:

- Sensitisation Training: primarily aimed at introducing the EHS safeguards to the officers and also make them aware of the responsibilities.

- Orientation Training: Introducing the Environmental safeguards to the PMU staff and making them aware of the key principles of environmental safeguards
- Detailed Training: aimed at the PMU staff to make them aware of the detailed activities which needs to be implemented and enforced during the EMP Implementations
- Refresher Training: this would be a need-based training organized to rectify the shortcomings identified during the Monitoring.

9.3 Monitoring Plan

281. Reporting system for the suggested monitoring plan, operating at two levels are as follows:

- Reporting for environmental management (EM) indicators to assess the progress of the EMP Implementations
- Review of the Environmental management implementation to assess the effectiveness of the implementation

282. The monitoring responsibilities and their reporting authority over the period of one year is presented in Table-38. This cycle would be replicated over the tenure of the project.

Table 34: Reporting requirement details of the project

Reports	Responsibility	Reporting authority
Daily	Contractor-Summery of all environmental issues and activities	Authority Engineer-review of reports and corrective action
Monthly	PMC- Monitoring of all projects and compilation and review of all corrective actions	PMU- review the action taken repeat and develop new strategies
Quarterly	PMU- review of project progress and auditing of the process of implementation	Management- review of progress and process of implementation, Approve of the Corrective ActionPlan
Annual External Audit	External Agency- review of progress EMP of implementation	Management/World Bank- Review of findings and approve of the corrective Action Plan; Report to the World Bank

9.3.1 Monitoring

283. Periodic Monitoring of the EMP is required for assessing the progress of the implementation of the EMP. The monitoring would include regular activities related to the activities proposed in the EMP.The following Monitoring reports would be submitted as per the protocol described earlier:

- Daily Monitoring Report: by the Contractor to the PMC on the environmental actions which has been implemented on site on a daily basis. The complains received from the community, observations at site for EHS issues, daily site audit, unsafe acts etc. would alsorecord;
- Monthly Monitoring: by the PMC for reporting to the PMU, would include a monitoring of all the packages and report the observations. The Completed Action would also be assessed for its effectiveness and sustainability.
- QuarterlyMonitoring: by the PMU for reporting to the World Bank, would include a monitoring of all observations and Completed Action would also be assessed for its effectiveness and sustainability.

9.3.2 Periodic Evaluation

284. An external evaluation of the safeguard implementation prepared for sub projects will also be undertaken twice during the implementation of the project – midterm and at the end of the implementation. During implementation, meetings will be organized by PMU inviting all PIUs for providing information on the progress of the project work.

- **Mid-term Assessment Study** – this would be undertaken mid-way through the project to ascertain the progress achieved and any mid-course corrections which need to be introduced. It would include indicators to measure progress towards log frame goals and objectives.
- **End-Term Assessment Study** – this will be undertaken at the end of the project period (around the time of project completion) and will assess the achievement of the project during the tenure.

285. All monitoring and evaluation records would be transmitted and maintained electronically. No hardcopies of the documents would be used for circulation. Each of the documents would be uniquelynumbered by the Package, Project Corridor Nomenclature of the Report and Date. The records ofthe project would be stored in a Central repository at the PMU.

9.3.3 Review and Corrective Action

286. An annual review shall be conducted by Project Advisory Committee at the time of the ProjectReviewmeeting and after the completion of the Quarterly and Annual audit. The Project Directors and theAssistant Engineer of the respective projects shall deliberate on the findings andrecommendationof Environment Audit and agree on a Corrective Action Plan including budgetary support ifrequired. The Corrective Action Plan shall be implemented in a time bound manner and reportedback to the PMU. The PMU would prepare a closure report which would form a part of the AnnualReport submitted to the Bank.

9.4 Environment Management Budget

287. The budget for implementing the Environmental management Plan for the road section is presented in Table-39. Thisbudget would not be part of the Contract and would be used by the PMU to implement theEnvironmental Safeguards. The budget should not form a part of the Bid Document.

Table 35: EMP budget estimation for the subproject

Sr. No.	Description of Items			Unit	Qty	Rate (Rs)	Cost (Rs)
1	***Environmental Management Items***						
1.01	**Vegetated bamboo crib wall :** Construction of Vegetated bamboo crib wall width 1.2m & height 1.5m including providing and supplying bamboo, binding wire, cutting, plantation of vegetation / grass, & backfilling.			Rm	200	1000	2,00,000
1.02	**Turfing with Sods**						
	Furnishing and laying of the live sods of perennial turf forming grass on embankment slope, verges or other locations shown on the drawing or as directed by the engineer including preparation of ground, fetching of sods and watering complete as per MORT&H technical specifications 307.			sqm	600	82	49,200
						Sub-Total (A)	**249,200**
1.03	**(A) Mitigation / Enhancement**						
	Component	**Stage**	**Item**				
a)	**Air**	Construction	Sprinkling of water in the settlement and working area as per Instruction of SC	Month	30	10000	3,00,000
b)	**Water**	Pre-construction	Tanks	No.	1	30000	30,000
c)	**Flora**	Construction	Compensatory afforestation, in accordance with Forest. Conservation Act (1980) as per guide line provided in EMP	No.	35	1250	43,750
			Additional tree plantation along valley slopes as per guideline provided in EMP	No.	125	1250	1,56,250
			Maintenance Grant to local SHGs (Self Help Groups) under councils for ensuring survival as per guideline provided in EMP.	No.	24	10000	2,40,000
			Provision of bamboo tree guards for the trees 600m on either side of village as per guideline provided in EMP.	m	160	1000	160,000

d)	**Conservation of Biodiversity**	Construction	Pre-construction fish species survey in river stream.	No.	1	200000	2,00,000
			Provision of protection net for fish species to stop coming in bridge construction zone	rm	200	2000	4,00,000
e)	**Stability of Slopes**		Bioengineering measures for protection of embankment slopes	sq.m	1000	150	150,000
f)	**Development of water source structures**	Construction	Concrete drain along the approach	Nos.	1	250000	2,50,000
						Sub-Total (B)	**19,30,000**
1.04	**(B) Mitigation / Enhancement Costs**						
	Monitoring						
	Component	**Stage**	**Item**				
a)	**Air**	Construction	Monitoring near hot mix plant location approved by the Engineer as per NAAQS, 2009 CPCB	No. of Samples	8	10000	80,000
			Monitoring construction sites in tandem with construction Engineer as per NAAQS, 2009 CPCB	No. of Samples	16	10000	160,000
b)	**Water Quality**	Construction	At locations specified in the monitoring plan as per IS10,500 and IS2296	No. of Samples	20	6500	130,000
		Operation	At two locations specified in the Monitoring Plan as per IS 10,500 and IS 2296	No. of Samples	10	6500	65,000
c)	**Noise**	Construction	At equipment yards as directed by the Engineer as per CPCB guideline 1989	No. of Samples	8	2500	20,000

		Operation	At locations of compensatory plantation, All along the corridor as per CPCB guideline 1989	No. of Years	16	2500	40,000
d)	**Monitoring Measures**	Construction	Monitoring tree survival	No. of Visits of Monitoring team	2	50000	1,00,000
		Operation	Monitoring effectiveness	No. of Visits of Monitoring team	2	50000	1,00,000
						Sub-Total (C)	6,95,000
						Total	**2,874,200**

APPENDICES

Appendix 1: Stakeholder Consultation

Stakeholder Consultation at Niriang Village

District: West Jaintia Hills Village: Niriang Village
Date: 28/11 /2020 Time :12.00 PM
Venue: Niriang Village Duration :2 (Two)hours
1. Project Description: Construction of Major Bridge over river Umngot river connecting Nongjrong Village and Niriang Village.
2. The Official and Members of the Community present during the Consultation:
i. Shri. L. Kharmawlong, Superintending Engineer P.W.D. (Roads), Jowai Circle
ii. Shri.M. Tang, Executive Engineer, PWD (Roads), Jowai Central Division, Jowai.
iii. Shri. H. Pakyntein, Assistant Executive Engineer, PWD (Roads),
iv. Shri. C. Shullai, Assistant Engineer, PWD (Roads)
v. Shri. W. Challam. Sectional Assistant (P.W.D) Roads
vi. Shri. Rain Suting . Headman of Niriang.
vii. Shri. P. Muruh, Secretary (Rangbah Dong), Niriang and
iii. Villagers (List as per Attendance Sheet).

3. Issues raised by the community and responses provided Issues: The Executive Engineer informed the Community about the Project bridge and then on the Environment and Social Safeguards as per World Bank's requirement. During the meeting, the Executive Engineer thanked all the members present during consultation and has opened the discussions. The points which have been raised by some villagers are as follows: -
a. Land Donation: - The Land Owner has expressed his willingness to donate the land free of cost since he felt that the project is meant for the development of the area and some has expressed that this project will ultimately benefit their children in future.
b. Sanction and Commencement of the Project: Elderly persons has expressed gratitude to the Government who has considered sanctioning this Construction of the Bridge as he felt that this has been a long pending aspiration of the villagers as they had already been facing immense hardship with regards to commuting across the river by boats. To his query, the Executive Engineer has informed that the project will soon be sanctioned.
c. Co-ordination with PWD: - The consultation process was very productive as all the people were very happy with the upcoming project and they were all eager to see that the construction really materialized.
4.Key issues: There are no negative issues raised during the meeting. What the people wanted, as expressed by every villager is the early approval of the Project.
5.Conclusion by PWD representatives: At the end of the meeting, the Executive Engineer has expressed gratitude to all the villagers present during the meeting. He also reiterated that he will take up the matter with the higher authority for early approval of the project. He also thanked the President, Secretaries, the land owner and the villagers in general who have spared their precious time to make the Community Consultation a Success.

Dated, Niriang Village, 28th November 2020.
Note: The Attendance Sheet enclosed.

Shri. M. Tang
Executive Engineer, PWD (Roads)
Jowai Central Division, Jowai.

Official and Members of the Community Present at Nongjrong

1. Shri. M. Tang, E.E. PWD (Rds).
2. Shri. H. Pakyntein AEE PWD (Rds)
3. Shri. C. Shullai AE PWD (Rds)
4. Shri W. Challam SA PWD (Rds)
5 Shri P. Syiejri Headman
6 Shri. K. Rangbsy Rangbah dong
7. Shri. H. Kharkongor Synjat shnong
8 Shri. M. Nongspung Kpa Iaing (Trai Jaka) M Nongspung
9. Shri M. Kharlukhi Khon Iaing (Trai Jaka) MK
10 Shri. Richan Suiam Member.

27/10/2020

Stakeholder Consultation at Norgjrong Village, East Khasi Hills

Date: 27/11 /2020 Time :12.00 PM
Venue: Nongjrong Village Duration :2 (Two)hours

1. Project Description: Construction of Major Bridge over river Umngot river connecting Nongjrong Village and andNiriang Village.

2. The Official and Members of the Community present during the Consultation:
i. Shri.M. Tang, Executive Engineer, PWD (Roads), Jowai Central Division, Jowai.
ii. Shri. H. Pakyntein, Assistant Executive Engineer, PWD (Roads),
iii. Shri. C. Shullai, Assistant Engineer, PWD (Roads)
iv. Shri. W. Challam. Sectional Assistant (P.W.D) Roads
v. Shri. P. Synjri. Headman of Nongjrong.
vi. Shri. K. Rangteng, Secretary (Rangbah Dong), Nongjrong
vii. Shri. H. Kharkongor, Assistant Secretary (SngotShnong), Nongjrong.
viii. Shri. M. Nongspung, Land Owner
ix. Land owner and villagers (List as per Attendance Sheet).

3. Issues raised by the community and responses provided Issues: The Executive Engineer informed on the objective of the project to the community and the need for Environment and Social Safeguards to be assessed prior to construction of the proposed Bridge over Umgot river. During the meeting, the Executive Engineer has thanked all the members present during

consultation and has opened the discussions. The points which have been raised by some villagers are as follows: -

a. Land Donation: - The Land Owner has expressed his willingness to donate the land free of cost since he felt that the project is meant for the development of the area and some has expressed that this project will ultimately benefit their children in future.

b. Sanction and Commencement of the Project: Elderly persons has expressed gratitude to the Government who has considered sanctioning this Construction of the Bridge as he felt that this has been a long pending aspiration of the villagers as they had already been facing immense hardship with regards to commuting across the river by boats. To his query, the Executive Engineer has informed that the project will soon be sanctioned.

c. Co-ordination with PWD:- The consultation process was very productive as all the people were very happy with the upcoming project and they were all eager to see that the construction really materialized.

4.Key issues: There are no negative issues raised during the meeting. What the people wanted, as expressed by every villager is the early approval of the Project.

5.Conclusion by PWD representatives: At the end of the meeting, the Executive Engineer has expressed gratitude to all the villagers present during the meeting. He also reiterated that he will take up the matter with the higher authority for early approval of the project. He also thanked the President, Secretaries, the land owner and the villagers in general who have spared their precious time to make the Community Consultation a Success.

Dated, Nongjrong Village The 27th November 2020.

Shri. M. Tang

Executive Engineer, PWD (Roads)

Jowai Central Division, Jowai.

1. Shri. L. Kharmawlong SE PWD(Roads), Jowai Circle.

2. Shri. M. Tang E.E. PWD (Roads), Jowai Central Division

3. Shri. H. Pakyntein A.E.E. PWD (Roads), NH Sub-Division Jowai.

4. Shri. C. Shullai A.E. PWD (Roads), NH Sub-Division, Jowai

5. Shri. W. Shallam S/A PWD (Roads) Jowai Central.

6. Rain Suting Headman Niriang

7. Shri Praising Mynrih Secretary Shnong

8. Shri Bok Sohliem

9. Shri Plomen Khriam

10. Shri Embait War

11. Shri Jemen Dkhar

12. Shri Toi Laloo

13. Shri Taiar Passah

14. Shri Moon Shullai

15. Shri Ronis Passah

16. Shri Matar Passah

17. Smt Nomai Syngkon

17. Smt Helina Dkhar

18. Shri Richan Suiam

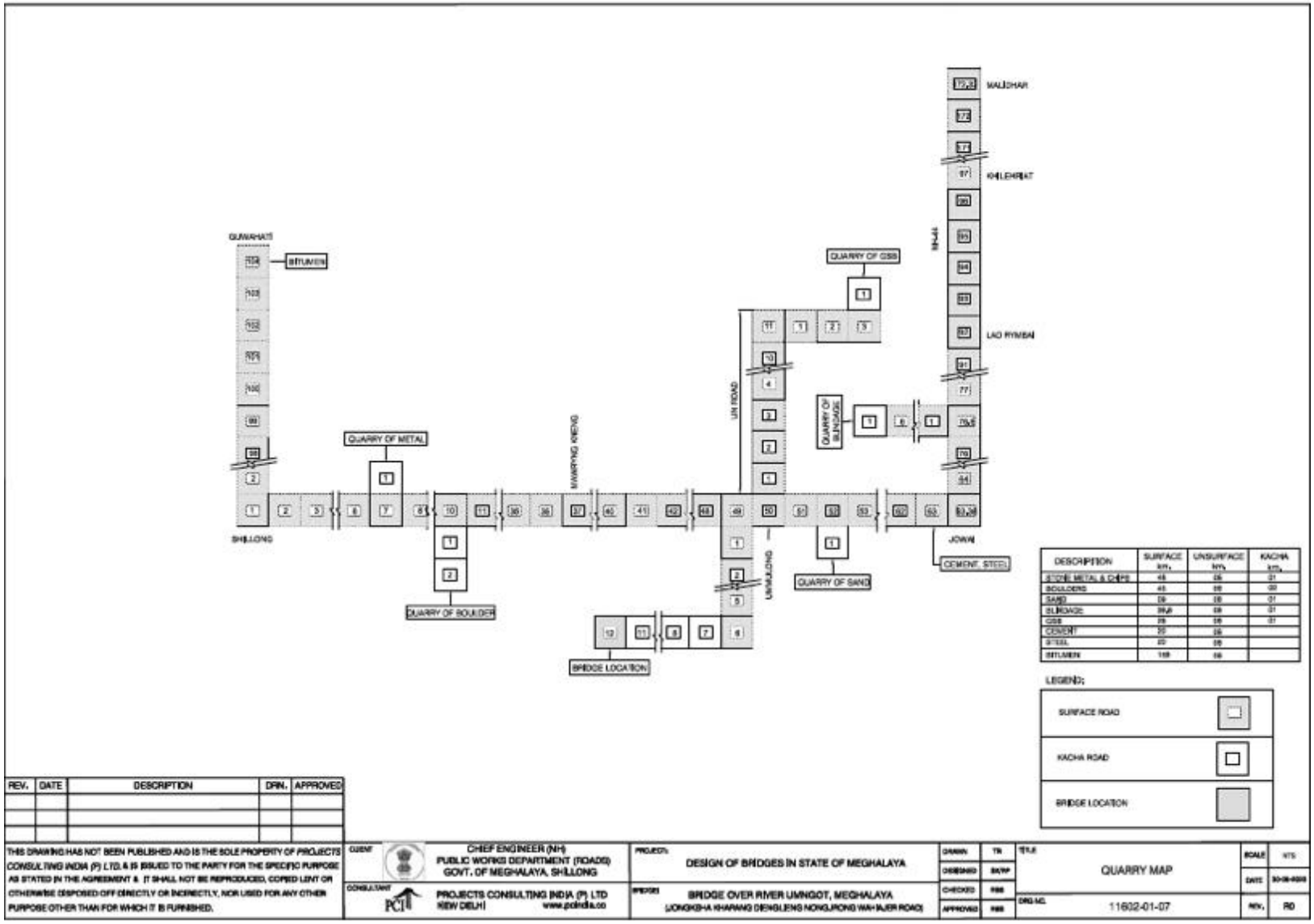
Secretary
Shnong Niriang

Shri. Praising Mynrih.
Secretary Niriang.

Waheh Shnong
Niriang Village
West Jaintia Hills Dist.

Shri. Rain Suting.
Headman Niriang

Appendix-1: Site map for Quarry Area



Appendix-2: Baseline parameter monitoring results

ISO 9001 2015

Industrial Testing Laboratory & Consulting House

(A Govt. Approved Laboratory)

Analysis Report

AMBIENT AIR QUALITY ANALYSIS REPORT
Test Report No. : ITL/ED/01
Dispatch Date : 04.02.2020

1.	Laboratory Sample No.		ITL/01-20/PR/02/01	
2.	Issued to		**M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070**	
3.	Contact person from Industry		**Mr. R.B. Singh**	
4.	Name of the Sample Collecting Officer		By Lab. Representative	
5.	Type of Sample		Ambient Air Quality Monitoring	
6.	Location of Sample Collection		**Jongksha Village**	
7.	Sampling Method		IS 5182 (Part -14)	
8.	Date of Sample Collection		22/01/2020 to 23/01/2020	
9.	Duration of Sample Collection		24 hrs. Except CO (8 hr)	
10.	Date of Sample Receipt		26/01/2020	
11.	Sampling Site		**Project bridge on Umangot River**	
Date of analysis Commencement		26/01/2020	Date of analysis completion	01/02/2020

Test Results

S. No.	Test Parameter	Method of Test	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I
1	Particulate Matter, $PM_{2.5}$ (µg/m3)	* CPCB method	µg/m3	36	60
2	Particulate Matter, PM_{10} (µg/m3)	IS 5182 Part 23:2006	µg/m3	64	100
3	Sulphur dioxide (SO2)	IS 5182 Part 2:2001	µg/m3	6.5	80
4	Nitrogen dioxide (NO2)	IS 5182 Part 6:2006	µg/m3	9.7	80
5	Carbon monoxide (CO)	* CPCB method	mg /m3	BDL	4

* NAAQS Monitoring & Analysis Guidelines Volume-1, 2011 CPCB

----------End of the report--------

ISO 9001 2015

Industrial Testing Laboratory & Consulting House

(A Govt. Approved Laboratory)

Analysis Report

NOISE QUALITY ANALYSIS REPORT
Test Report No. : ITL/ED/03
Dispatch Date : 04.02.2020

1.	Laboratory Sample No.	ITL/01-20/PR/02/03
2.	Issued to	**M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070**
3.	Contact person from company	**Mr. R.B. Singh**
4.	Name of the Sample Collecting Officer	By Lab. Representative
5.	Type of Sample	Noise Quality Monitoring
6.	Location of Sample Collection	**Jongksha Village**
7.	Sampling Method	ITL/SOP/NQ/01
8.	Date of Sample Collection	22/01/2020 to 23/01/2020
9.	Duration of Sample Collection	24 hrs
10.	Date of Sample Receipt	-
11.	Sampling Site	**Project bridge on Umangot River**
Date of analysis Commencement	-	Date of analysis completion -

Test Results

S. No.	Test Parameter	Method of Test	Unit	Results	Regulatory Standards (EPA, 1986)
1	Leq dB(A) day (6AM to 10PM)	IS 9989 -1981 RA- 2001	dBA	50.2	55
2	Leq dB(A) night (10PM to 6AM)	IS 9989 -1981 RA- 2001	dBA	36.1	45

----------End of the report--------

Industrial Testing Laboratory & Consulting House

(A Govt. Approved Laboratory)

ISO 9001 : 2015

Analysis Report

SOIL SAMPLE ANALYSIS REPORT

Test Report No. : ITL/ED/08
Dispatch Date : 04.02.2020

1.	Laboratory Sample No.		ITL/01-20/PR/02/08		
2.	Issued to		M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070		
3.	Contact person from Industry		Mr. R.B. Singh		
4.	Name of the Sample Collecting Officer		By Lab. Representative		
5.	Type of Sample		Soil Sample		
6.	Description of Sample		SS1, Soil Sample		
7.	Location of Sample Collection		SS1- Umlong Village, SS2 -Jongksha Village		
8.	Sampling Method		IS 3025 (Part -1)		
9.	Date of Sample Collection		23/01/2020		
10.	Date of Sample Receipt		26/01/2020		
11.	Sampling Site		Project bridge on Umangot River		
Date of analysis Commencement		26/01/2020	Date of analysis completion		04/02/2020

Test Results

S. No.	Parameter(S)	Unit	Test Result	
			SS_1	SS_2
1	Soil Texture	-	Silty Clay Soil	Silty Clay Soil
2	Soil Colour	-	Greyish Brown	Greyish Brown
3	pH Value at 25°C	-	8.44	7.84
4	Conductivity at 25°C	µS/cm	714	684
5	Moisture	% by mass	8.5	7.4
6	Bulk Density	gm/cc	1.21	1.27
7	Water Holding Capacity	Inches/foot	1.36	1.18
8	Nitrogen as N	mg/Kg	21.4	24.1
9	Phosphorus as PO_4	mg/Kg	3.84	3.54
10	Potassium (as K)	mg/Kg	71.2	60.4
11	Calcium as Ca	mg/Kg	58	51
12	Nitrate as NO_3	mg/Kg	109	114
13	Sulphate as SO_4	mg/Kg	10.5	11.2
14	Chloride	mg/Kg	6.7	5.6
15	Organic Carbon	% by mass	5.4	4.9
16	Organic Matter	% by mass	6.7	5.4
17	Total Soluble Solids	mg/Kg	12.4	11.4
18	Soil Texture			
a	Sand	% by mass	18.1	24.1
b	Silt	% by mass	41.2	36.8
c	Clay	% by mass	40.7	39.1

----------End of the report--------

Industrial Testing Laboratory & Consulting House

(A Govt. Approved Laboratory)

ISO 9001 : 2015

Analysis Report

WATER QUALITY ANALYSIS REPORT

Test Report No. : ITL/ED/05
Dispatch Date : 04.02.2020

1.	Laboratory Sample No.	ITL/01-20/PR/02/05-07	
2.	Issued to	M/S PROJECTS CONSULTING INDIA (P) LTD 6110/2, SECTOR-6, VASANTKUNJ, NEW DELHI 110070	
3.	Contact person from Industry	Mr. R.B. Singh	
4.	Name of the Sample Collecting Officer	By Lab. Representative	
5.	Type of Sample	Water Sample	
6.	Description of Sample	Surface Water Sample, Ground Water Sample	
7.	Location of Sample Collection	SW1- Upstream Umangot River, SW2 Downstream, GW1- Jongkaha Village	
8.	Sampling Method	IS 3025 (Part -1)	
9.	Date of Sample Collection	23/01/2020	
10.	Date of Sample Receipt	26/01/2020	
11.	Sampling Site	Project bridge on Umangot River	
Date of analysis Commencement	26/01/2020	Date of analysis completion	04/02/2020

Test Results

S. No.	Parameter	Prescribed Limit as per IS:10500 & IS:2296	Results		
			SW1	SW2	GW1
1	Colour, Hazen units	5 Max	< 1	< 1	<1
2	Odour	-	Agreeable	Agreeable	Agreeable
3	Turbidity, NTU	1 Max	<1	<1	<1
4	Electrical Conductivity at 25°C	-	240	273	312
5	pH Value at 25°C	6.5 - 8.5	7.62	7.42	7.51
6	Total Dissolve Solids, mg/l	500 Max	156	177	203
7	Total Alkalinity (as CaCO3) ,mg/l	200 Max	106	121	132
8	Total Hardness (as HCaCO3) ,mg/l	200 Max	96	112	127
9	Calcium (as Ca),mg/l	75 Max	20.1	24.2	27.4
10	Magnesium (as Mg) , mg/l	30 Max	11.2	12.5	14.2
11	Sodium (as Na) ,mg/l	-	8.4	9.2	10.2
12	Potassium (as K) ,mg/l	-	2.1	3.1	4.1
13	Bicarbonate (as HCO3),mg/l	200 Max	104	123	141
14	Sulphate (as SO4) ,mg/l	200 Max	16.2	18.2	19.2
15	Chloride (as Cl),mg/l	250 Max	9.2	10.1	11.2
16	Nitrate (as NO3) ,mg/l	45 Max	1.9	2.2	3.6
17	Fluoride (as F),mg/l	1 Max	0.04	0.05	0.03
18	Phenolic Compound (as C6H5OH) ,mg/l	0.001 Max	BDL	BDL	BDL
19	Cyanide, mg/l	0..05	BDL	BDL	BDL
20	Aluminium, mg/l	0.03	BDL	BDL	BDL
21	Arsenic, mg/l	0.05	BDL	BDL	BDL
22	Cadmium (as Cd) , mg/l	0.003 Max	BDL	BDL	BDL
23	Chromium as Cr,mg/l	0.05	BDL	BDL	BDL
24	Iron (as Fe),mg/l	0.3 Max	0.01	0.01	0.07
25	Copper (as Cu),mg/l	0.05 Max	BDL	BDL	BDL
26	Lead (as Pb) , mg/l	0.01 Max	BDL	BDL	BDL
27	Manganese (as Mn) , mg/l	0.1 Max	BDL	BDL	BDL
28	Zinc (as Zn) , mg/l	5 Max	BDL	BDL	BDL
29	Mercury as Hg,mg/l	0.001	BDL	BDL	BDL
30	Dissolve Oxygen, mg/l	-	6.5	6.4	-
31	Biochemical Oxygen Demand, mg/l	-	4	4	-
32	Chemical Oxygen Demand, mg/l	-	10	14	-
33	Oil &Grease, mg/l	-	BDL	BDL	-

End of the report

Appendix-3: Borrow area management guidelines

Borrow Area Management

Preconstruction Stage

The contractor shall identify the borrow area locations in consultation with the individual owners in case of private lands and the concerned department in case of government lands, after assessing suitability of material. The contractor shall submit an application to the District Level Environmental Assessment Committee for Environmental Clearance with the required details. The Environmental clearance shall be submitted to the Employer before the borrowing operations can begin.

Borrowing are to be avoided in the following areas:

- Lands close to toe line of the existing or proposed road.
- Irrigated agricultural lands shall be avoided. (In case of necessity for borrowing from agricultural land, the topsoil shall be preserved in stockpiles. The subsequent Guidelines detail the conservation of topsoil.
- Grazing land or any community property e.g. Orans, Gochars etc.
- Lands within 0.8km of settlements.
- Environmental sensitive areas such as Reserve Forests, Protected Forests, Sanctuary, wetlands. distance of 1000 m should be maintained from such areas.
- Eco-sensitive areas around Mount Abu and Eco-Sensitive Zones of the Wild Life Sanctuaries
- Unstable side-hills.
- Water-bodies.
- Streams and seepage areas.
- Areas supporting rare plant/ animal species;

The Employer/PMC will have the right to stop work at any borrow location even after the required environmental clearance is received if it violates any of the above.
The Contractor shall ensure soft rock is not prominent within the proposed depth of excavation as it will render rehabilitation difficult. The compliance to with MoRTH, clause 305.2.2.2 for redevelopment of Borrow area must be considered.

The rehabilitation measures for the borrow areas shall be dependent on the following factors:

- Land use objectives and agreed post-borrowing activities with the owner of the land as per the agreement;
  - Physical aspects (landform stability, erosion, re-establishment of drainage, geological profile);
  - Biological aspects (species richness, plant density,) for areas of native re vegetation;
  - Water quality and soil standards; and
  - Public safety issues.

The method statement which can be adopted for different options is presented below in as Options for Rehabilitation of Borrow areas to the Guidance Notes Operation of the Borrow Areas during the Construction Period.

The Contractor will work out statutory requirement for borrowing with the land from the Department of Mining and Geology, Govt. of Meghalaya. The Contractor must also obtain the necessary environmental clearance as per the EIA Notification 2006.

The Contractor shall also work out an agreement for the borrowing of soil with the concerned land owner. The arrangements will include:

- commitment not to use the topsoil;
- redevelopment after completion of borrowing;

- Commercial terms and conditions as may be agreed between the two parties;

The contractor shall submit to the Employer/Engineer the following before beginning work on the borrow areas.

- Environmental Clearance Certificate of the borrow area
- Written No-objection certificate of the owner;
- Estimate extent of earth requires;
- Extent of land required and duration of the agreement;
- Photograph of the site in original condition; and
- Site redevelopment plan after completion.

The arrangements (except for the commercial terms and conditions) will be verified by the Employer/Engineer to enable redressal of grievances at a later stage of the project. The Employer/Engineer shall approve the borrow area with or without inspection of the site to verify the reclamation plan and its suitability with the contractor and landowner. The contractor shall commence borrowing soil only after the approval by the Employer/Engineer.

The depth of excavation should be decided based on natural ground level of the land and its surroundings, as well as based on the rehabilitation plan. In case of highland larger depths may be allowed but the final level of the borrowed land shall in no case be lower than the adjoining plots so that it gets water logged. In case higher depth of excavation is agreed by backfilling using unsuitable excavated soil (from roadway), in those cases filling should be adequately compacted except for topsoil, which must be spread on the top most layer (for at least 20m thick).

In case the borrow pit is on agricultural land, the depth of borrow pits shall not exceed 45 cm and may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside. In case of stripping and stockpiling of topsoil, provisions of Topsoil Salvage, Storage and Replacement need to be followed.

The guidelines for location, depth, size and shape of the borrow areas are available in the following:

- Clause 305.2.2.2 of MoRTH specification for roads and bridge works of IRC;
- Guidelines for environmental impact assessment of highway projects, Indian Roads Congress, 1989: IRC: 104-1988);
- IRC: 10-1961-Recommended practice for borrow pits for road embankments constructed by manual operations, as revised in 1989;
- Highways Sector EIA manual of MoEFCC, 2010 (http://envfor.nic.in/sites/default/files/highways-10_may_0.pdf);

During the excavation the contractor must ensure that following database must be documented for each identified borrow areas that provide the basis of the redevelopment plan.

- Chainage along with offset distance;
- Area of the plot (Sq.);
- Geo-tagged Photograph of the borrow pit from all sides;
- Type of access/width/kutcha/pucca etc from the carriageway;
- Soil type;
- Slope/drainage characteristics;
- Water table of the area or identify from the nearest well, etc;
- Existing landuse, for example barren/agricultural/grazing land;
- Location/name/population of the nearest settlement from borrow area;
- Present usage of borrow area; and
- Community facility near borrow pit.

Appendix-4: GUIDELINES FOR STORAGE, HANDLING AND DISPOSAL OF HAZARDOUS WASTE, MUNICIPAL SOLID WASTE AND CONSTRUCTION AND DEMOLITION WASTE

Hazardous Waste

- For storing of hazardous waste (Used oil and waste oil, Empty barrels/containers of oil, lubricant and grease, Contaminated cotton rags or other cleaning materials), the Contractor shall follow the guidelines while planning and designing the hazardous waste storage areas:
  - The storage area should be provided with concrete floor;
  - The storage area floor should be provided with secondary containment;
  - Proper slopes as well as collection pit to be provided in the storage area to collect wash water and the leakages/spills etc.;
  - Storage area should be provided with the flameproof electrical fittings;
  - Automatic smoke, heat detection system should be provided in the sheds;
  - Adequate firefighting systems (ABC type fire extinguisher) should be provided for the storage area; and
  - The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.

Municipal Solid Waste

- The Contractor shall segregate and store bio-degradable and non-biodegradable municipal solid waste in two separate bins (primary collection point). The storage area should be provided with concrete floor;
- The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.
- The storage area shall be enclosed, or the storage containers shall be covered to prevent vermis and scavengers from littering

Construction and Demolition Waste

- The Contractor shall keep the construction and demolition waste within the premise or at a designated place for the collection of the C&D waste. The designated place shall be decided in consultation with the local body. The agreement with the local body shall essentially mention the end-use of the designated location. The designated site shall be away from:
  - Located at least 1000 m away from sensitive locations;
  - do not contaminate any water sources, rivers etc; and
  - Lotal site has adequate capacity equal to the amount of debris generated;
  - Public perception about the location of debris disposal site has to be obtained before
  - finalizing the location;
  - Productive lands are avoided; and available waste lands shall be given preference;
  - Forest land shall be avoided.

- During the site clearance and disposal of debris, the contractor will take full care to ensure that the public or private properties are not damaged/affected and that the traffic is not interrupted.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the PMC .
- The contractor will at all times ensure that the existing water bodies and drains within and adjacent to the site are kept safe and free from any debris.
- In case the dumping operations are carried out in dry and windy condition Contractor will regulate the dumping operations so that the dust generation is minimised, or preferably carry out the operations in

early morning when the environment is moist. The contractor may utilize effective water sprays during the delivery and handling of materials.

- Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and with the permission of PMC .
- During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- While disposing debris / waste material, the contractor will take into account the wind direction and location of settlements to ensure against any dust problems. The contractor can also consider the use of dust screens to prevent dust pollution.

EMERGENCY SPILL CONTROL PROCEDURE

Should a spill occur, either though spillage or equipment failure, the applicable emergency spill procedure outlined below must followed.

Spill Procedure: In the case of a spill, overflow or release fluid into the stream waterway (whether water is flowing during the spill or not), any actions that is practical and safely possible to control the situation, shall be implemented.

- Stop the flow
  - Stop the release into the stream waterway
  - Shutdown equipment
  - Close valves and pumps
  - Plug hoses
- Remove Ignition Sources
  - Shut off vehicles and other engines
- Do not allow torches, mobile phone, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible).
- Contact the environmental Officer and initiate Emergency Response
- Notify the site supervisor and the Contractor's Environmental Engineer and Health and Safety Officer as soon as possible
- The Environmental Engineer of the Contractor will review the situation and decide if Emergency Services like Fire Brigade are required
- Appropriate parties to be notified of the spill are The contractor's Project Manager, The
- PMC through his designated Environmental Officer, The PIU, Regulatory Agencies like Pollution Control Board, Municipal Authorities, as applicable,

Clean up and Disposal

- Identify nature and type of chemical/fuel spilled through information available onsite or from first responder.
- Refer to the MSDS for any special instruction
- Wear personal protective equipment (PPEs) viz. chemical resistant gloves, safety boots, safety glasses etc. Reach for the spill kit placed at the Contractor Camp.
- In case of spill on land create a dyke on the spill and use readily available sand, saw dust to contain the spill. Use absorbent pads, to clean up the spill. In case of spill in a water channel which is dry use the above method.

- In case the spill occurs within a waterbody stop any agitation to the waterbody and place absorbent material to remove the spill.
- Recover the spill contaminated absorbent materials and use pads and store the same in "Hazardous Waste" containers and store it in the waste storage area for disposal.
- For spill on unpaved areas such as soil, remove the upper layer of soil in the contaminated area with a shovel and transfer it to the hazardous waste containers using a bucket.
- If any of your PPEs have been exposed to spill material dispose it off safely in hazardous waste containers

Reporting

- The Contractor's Environmental Officer will document the event and submit reports to the PMC . The PMC would send a report of the incident immediately with its observations to the PIU, PMC and Environmental Officer at the PMU.
- If required the Client would direct the Contractor to imitate the process of reporting to the regulatory agencies. like the Pollution Control Board.

Procedure Review

- The Environmental Office will review the report, determine if changes are required to procedures and recommend implementation of all required changes. He would also intimate the management of such incident.

GUIDANCE NOTE ON SITE CLEARANCE

Vegetation Clearance

- Vegetation clearance shall comprise uprooting of vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth up to 30 cm. measured at a height of one meter above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately. The procedure/ steps involved for uprooting, skating and felling trees are described below.

Uprooting of Vegetation

- The roots of trees and saplings shall be removed to a depth of 60 cm. below ground level or 30 cm. below formation level or 15 cm below sub grade level, whichever is lower.
- All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled.
- Trees, shrubs, poles, fences, signs, monuments, pipe lines, cables etc. within or adjacent to the area, which are not required to be disturbed during vegetation clearance shall be properly protected by the contractor at his own cost.

Staking and Disposal

- All useful materials obtained from clearing and grubbing operation shall be staked in the manner as directed by the Consultant.
- Trunks and branches of trees shall be cleared of limbs and tops stacked properly at the places indicated by the Consultant. These materials shall be the property of the Government.
- All unserviceable materials are disposed off in such a manner that there is no livelihood of getting mixed up with the materials meant for construction.

Felling Trees

- Marking of tress: Trees, above 30 cm girth (measured at a height of one meter above ground level) to be cut, shall be approved by the Consultant and then marked at the site.

- Felling of trees: Felling of trees shall include taking out roots up to 60 cm. below ground level or 30 cm. below formation level or 15 cm. below sub-grade level, whichever is lower.
- Filling: All excavations below general ground level arising out of removal of trees, stumps etc. shall be filled with suitable material in 20 cm. layers and compacted thoroughly so that the surface at these points conform to the surrounding area.
- Sizing: The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Consultant.
- Staking: The serviceable materials shall be staked in the manner as directed by the Environmental specialist of Supervision Consultant.

Disposal: The material, which cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Consultant. Unsuitable waste materials should not get mixed with construction material during disposal

Appendix-4: Construction camp management

1. Campsite of a contractor represents the single potentially most polluting location during implementation of any road project. Air pollution may be caused by emissions from Crushers, Hot-Mix, and Concrete Batching Plants. Water pollution may be caused by discharge of sediment, oil & grease, and organics laden run-off from these plants and their ancillary facilities as well as workshops, residential quarters for the labor. Land may be polluted due to indiscriminate disposal of domestic waste or (accidental) release of hazardous solids from storage areas.

2. While the installation and operation of Crushers and Hot-Mix Plants are regulated by the respective Pollution Control Boards, the other sources described above usually do not appear to be causes of significant concern. Items to be considered for labor camps are mentioned briefly in Clause 105.2 (as part of 105: Scope of Work) of the Ministry of Road Transport and Highways (MoRTH) publication: Specifications for Road and Bridge Works. Some specific requirements for labor accommodation and facilities are to be met by the Contractor in line with Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Currently, there is no one-point guidance regarding the environmental management aspects of the Contractor's campsite. This guideline on Campsites is designed to fill this gap.

A. Scope

3. This guideline covers the Contractors' camp sites – whether used by in-house crew or by any sub-contractors' crew. It covers siting, operation, maintenance, repair and dismantling procedures for facilities for labor employed on project (and ancillary) activities as well as equipment and vehicles.

1. Siting, Establishing, Operation and Closure of Construction Camp

a. Potential Environmental Impacts

4. Construction camps require large areas for siting facilities like major plants, storage areas for material, residential accommodation for construction labor and supervisors, and offices. Removal of topsoil and vegetation from the land to be utilized for camps is the first direct impact of any such establishment. In addition, local drainage may be impaired if proper drainage is not effected by grading. Other impacts may include damage to ecologically important flora and fauna, if campsites are located close to such areas. Water pollution because of discharge of sediment, fuel and chemicals is also a possibility. Pollution of land due to indiscriminate disposal of construction wastes including scarified pavement, concrete and even substantial quantities of domestic wastes from residential areas can also be potentially disastrous, especially if the site is reverted to its original use after the project (mostly agriculture).

b. Mitigation Measures

2. Siting of Construction Camps

5. The following guidelines will assist the Contractor to avoid any environmental issues while siting construction camps:

- Maintain a distance of at least 1 km from boundaries of designated Reserved Forests, Sanctuary or National Park area for locating any temporary or permanent camps.
- Maintain a distance of 500m from river, stream, lake and ponds
- Maintain a distance of 200 m from the boundary of state and national highways
- Locate facilities in areas not affected by flooding and clear of any natural or storm water courses.
- Locate campsites in the (most prevalent) downwind direction of nearest village(s). The boundary of the campsite should be at least 500 m from the nearest habitation so that the incoming labor does not stress the existing local civic facilities.
- The ground should have gentle slope to allow free drainage of the site.
- Recorded consultations should be held with residents of the nearest settlement and/or their representatives to understand and incorporate where possible, what they would like to see within their locality.

3. Establishment, Operation, and Closure of Camps

- The facilities within the camp site should be laid out so that the separation distances suggested in other guidelines are maintained. A notional lay-out of the facilities except the major plants is included in this guideline.
- Topsoil from the area of the plant shall be stored separately for the duration of the operation of the camp and protected from being washed away, unless agreed otherwise in writing with the owner. If stored, it will be returned on to its original location at the time of closure of the site.
- The Contractor shall prepare, make widely available (specially to staff responsible for water and material management), and implement a Storm water Management Plan (SWMP) for (all) the site(s) following approval of the same by the Engineer.
- The Contractor shall prepare an Emergency and Spill Response Plan as per the requirements of Appendix 1 to Clause 501 of Specifications for Road and Bridge Works to cover the spillage of bitumen and/or chemicals like retarders, curing compounds, etc.
- The Contractor shall prepare a Waste Management Plan describing the types and quantities that are likely to be generated from within the camp site, with the period and duration during the construction schedule; methods to be adopted to minimize these; methods of removal, treatment and (on-site or off-site) disposal for each type; as well as location of final disposal site, if any.
- The Contractor shall provide safe ingress and egress for vehicles from the site and public roads and shall not impact existing through traffic.

- Water tankers with sprayers must be available at the camp site at all times to prevent dust generation.
- In case of stockpiles of stored material rising higher than wind-breaking perimeter fencing provided, sprinklers shall be available on site to prevent dusting from the piles during windy days.
- On completion of works, the Contractor shall restore the site to the condition it was in before the establishment of the campsite, unless agreed otherwise in writing with the owner(s) of the site(s). If such a written agreement has been made, the Contractor shall hand over the site to the owner(s) in accordance with such an agreement.
- Construction waste disposal should be disposed only at landfill facilities which are selected, designed, constructed and operated to ensure environmentally safe disposal, and these facilities have to be approved by the regulators.

4. Equipment and Vehicle-related issues

a. Potential Environmental Impacts

6. The maintenance and repair of equipment and vehicles in Contractor's camp are activities that can have significant adverse impacts if not carried out properly. The concern mainly arises from discharge of wash water contaminated with oil and grease, whether from washing of vehicles or degreasing of equipment and vehicle parts. Vehicle washing, especially dirt from tires, also gives rise to sediment-laden run-off. No such discharges should be directly allowed into surface water bodies since they can be harmful to aquatic species.

b. Mitigation Measures

i. Vehicles

- All vehicles used by the Contractor must have copies of currently valid Pollution Under Control Certificates displayed as per the requirement of the Motor Vehicles Department for the duration of the Contract.
- All vehicles and equipment will be fitted with silencers and/or mufflers which will be serviced regularly to maintain them in good working condition and conforming to the standard of 75dB (A) at 1m from surface of enclosure.

ii. Workshop and Maintenance areas

- These areas must have impervious flooring to prevent seepage of any leaked oil & grease into the ground. The area should be covered with a roof to prevent the entry of rainwater.
- The flooring shall be sloped to from both directions to one corner where an oil-and-grease trap with sufficient capacity should be installed. All discharges from the workshop area must pass through the trap to remove

the floating oil and grease before entering the drainage system of the site. The trap should be designed to provide a hydraulic residence time of about 20 minutes for the peak hourly discharge anticipated from the area (as per following figure).

- Alternatively, degreasing can also be carried out using mechanical spray type degreaser, with complete recycle using an enclosure with nozzles and two sieves, coarse above and fine below, may be used as shown in the adjacent photograph. This arrangement will require some initial investment and running cost for the pump, but the payback period, in terms of the use of diesel, under Indian conditions, has been reported to be less than 1 year.

1.
2.
3.
4.

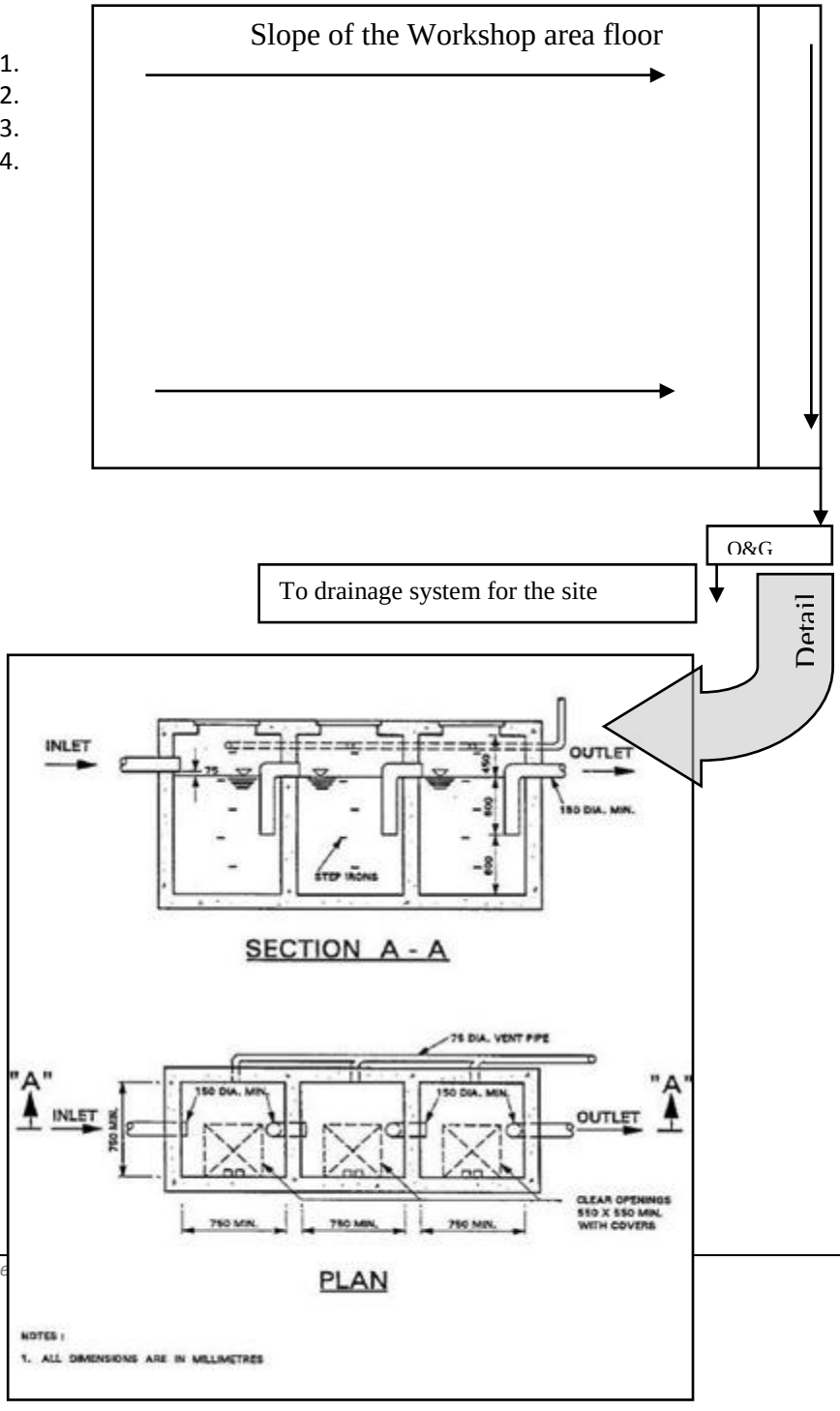
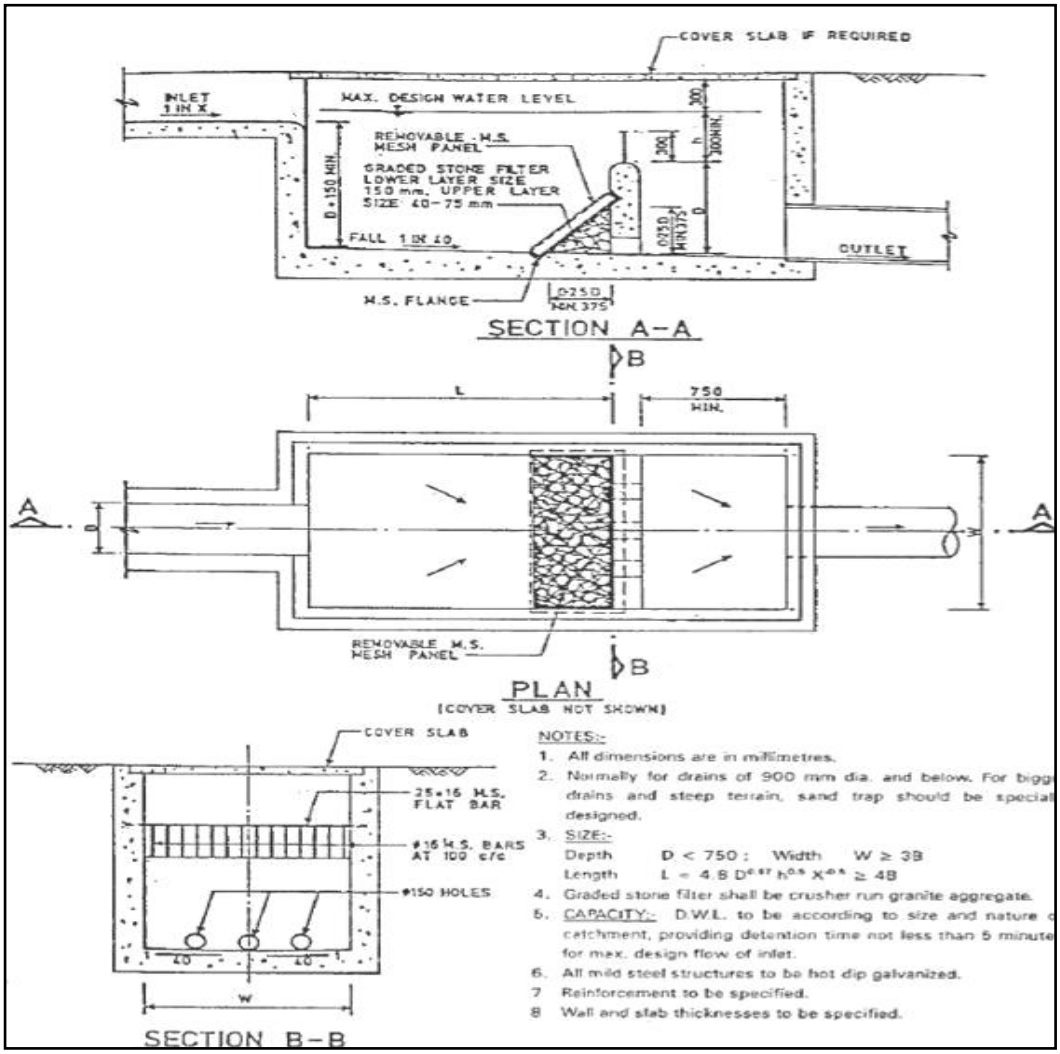


Figure 1: Workshop Area Pollution Control

- All the waste oil collected, from skimming of the oil trap as well as from the drip pans, or the mechanical degreaser shall be stored in accordance with the Environment Protection (Storage and Disposal of Hazardous Wastes) Rules, 1989. For this purpose, metallic drums should be used. These should be stored separately in sheds, preferably bunded. The advantage of this arrangement is that it allows for accurate accounting in case the waste material is sold to oil waste recyclers or other users like brick-kiln owners who can burn such inferior fuel.
- A separate vehicle washing ramp shall be constructed adjacent to the workshop for washing vehicles, including truck mounted concrete mixers, if any, after each day's construction is over, or as required. This ramp should have an impervious bottom and it should be sloped so that it drains into a separate chamber to remove the sediment from the wash water before discharge. The chamber should allow for a hydraulic residence time of about 10 minutes for discharge associated with the washing of each truck. Following figure 2 shows an outline sketch for a sedimentation chamber.

Figure 2: Sedimentation Chamber for vehicle washing ramp discharge


COVER SLAB IF REQUIRED
INLET
MAX. DESIGN WATER LEVEL
REMOVABLE M.S. MESH PANEL
GRADED STONE FILTER LOWER LAYER SIZE 150 mm, UPPER LAYER SIZE 40-75 mm
FALL 1 IN 10
OUTLET
M.S. FLANGE
SECTION A-A
PLAN
(COVER SLAB NOT SHOWN)
COVER SLAB
25x16 M.S. FLAT BAR
ϕ16 M.S. BARS AT 100 c/c
ϕ150 HOLES
SECTION B-B
NOTES:-
1. All dimensions are in millimetres.
2. Normally for drains of 900 mm dia. and below. For bigg drains and steep terrain, sand trap should be special designed.
3. SIZE:-
Depth D < 750 ; Width W ≥ 3B
Length L = 4.8 D^0.67 h^0.5 X^-0.4 ≥ 4B
4. Graded stone filter shall be crusher run granite aggregate.
5. CAPACITY:- D.W.L. to be according to size and nature catchment, providing detention time not less than 5 minute for max. design flow of inlet.
6. All mild steel structures to be hot dip galvanized.
7 Reinforcement to be specified.
8 Wall and slab thicknesses to be specified.

5. Facilities for Labour

a. Potential Environmental Impacts

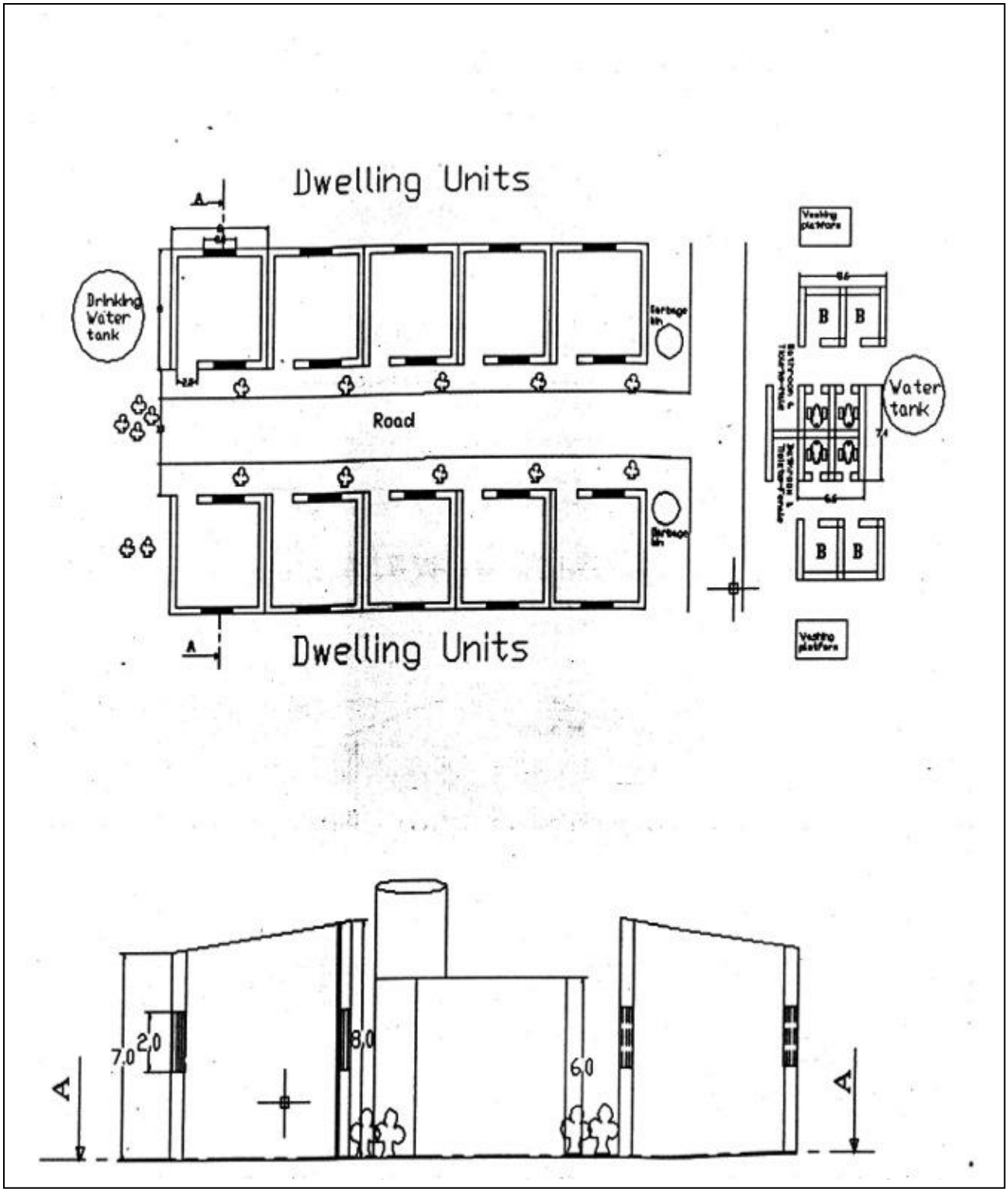
7. The sudden arrival and relatively longer duration of stay of construction crew can cause substantial strain on the existing infrastructure facilities like water supply, sanitation and medical care, especially in rural areas. Pollution from domestic wastes can affect local sources of water supply and may harm the crew themselves as well as local residents. Improper sanitation and inadequate health care also potential bottlenecks that the Contractor can eliminate with relatively little effort.

b. Mitigation Measures

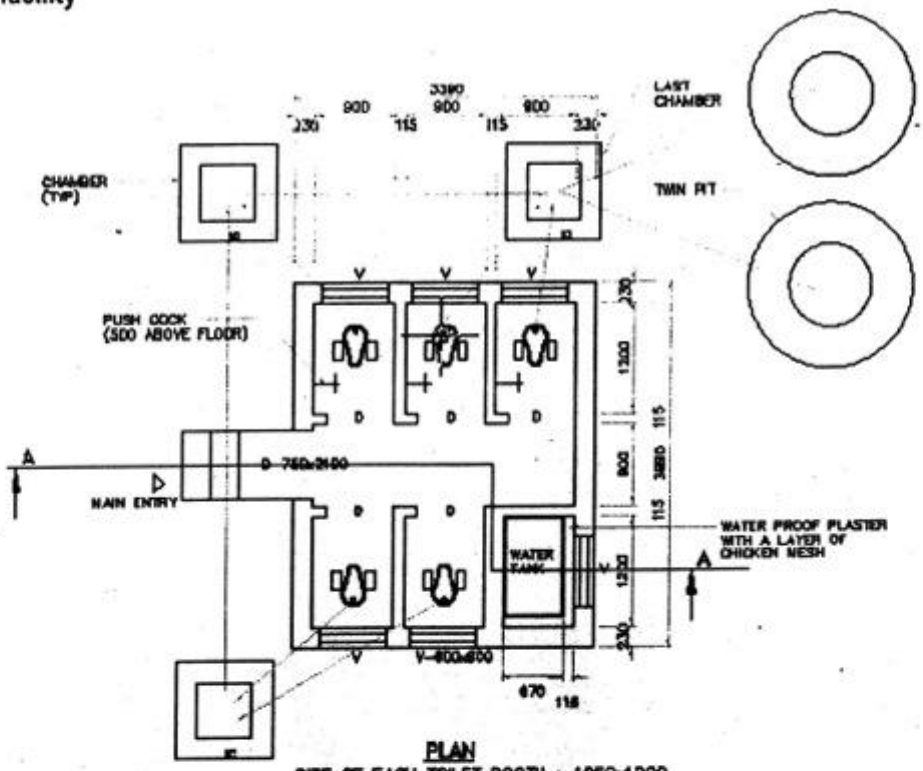
8. It should be emphasized that the Indian Law requires that the Contractor provide several facilities to for the workers as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Some of the provisions described herein are more stringent to act as benchmark for improved environmental performance of road projects:

- The contractor shall provide free-of-charge temporary accommodation to all the labour employed for the project. The accommodation includes separate cooking place, bathing, washing and lavatory facilities. At least, one toilet will be provided for every 35 people and one urinal will be provided for every 20 persons. More toilets and/or urinals may have to be provided if the Engineer decides that these numbers are insufficient. In case female labourers are employed, separate toilet and urinals will be provided in locations clearly marked "Ladies Toilets" in a language understood by most labourers.
- The contractor shall ensure the supply of wholesome water for all the labour, including those employed by any other agency working for the contractor. These locations will be marked "Drinking Water" in the language most commonly understood among the labour. In hot season, the contractor shall make efforts to ensure supply of cool water. No water point shall be located within 15 m of any washing place, urinal, or latrine.
- The contractor shall ensure that adequate cooking fuel, preferably kerosene or LPG, is available on-site. The contractor will ensure that wood/ coal are not used as fuel on the site. Workers need to be made aware of this restriction. In cases where more than 250 labours are employed, canteen facility should be provided by the Contractor.
- A crèche must be provided in each campsite where more than 50 female labourers are employed, whether directly or indirectly, for the project or its ancillary activities.
- Contractor must provide adequate facilities for first-aid treatment at the campsite. A doctor / ambulance should be available on call for the duration of project implementation.
- The contractor shall obtain the approval of the Engineer for these facilities within 30 days of mobilization.

TYPICAL DRAWING OF WORKERS' CAMP SANITARY FACILITY

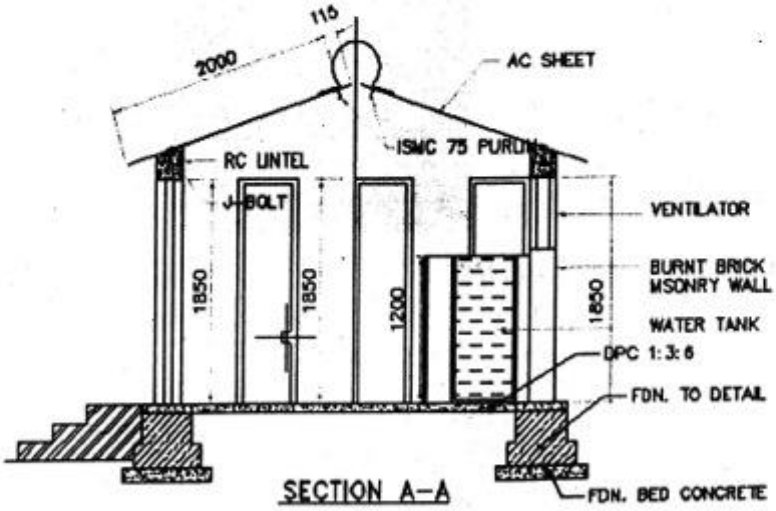


Sanitary facility



PLAN

SIZE OF EACH TOILET BOOTH : 1050x1200
(TYPICAL WITH 8 WC ENCLOSURE FOR SCHOOLS, SHOPPING AREAS)

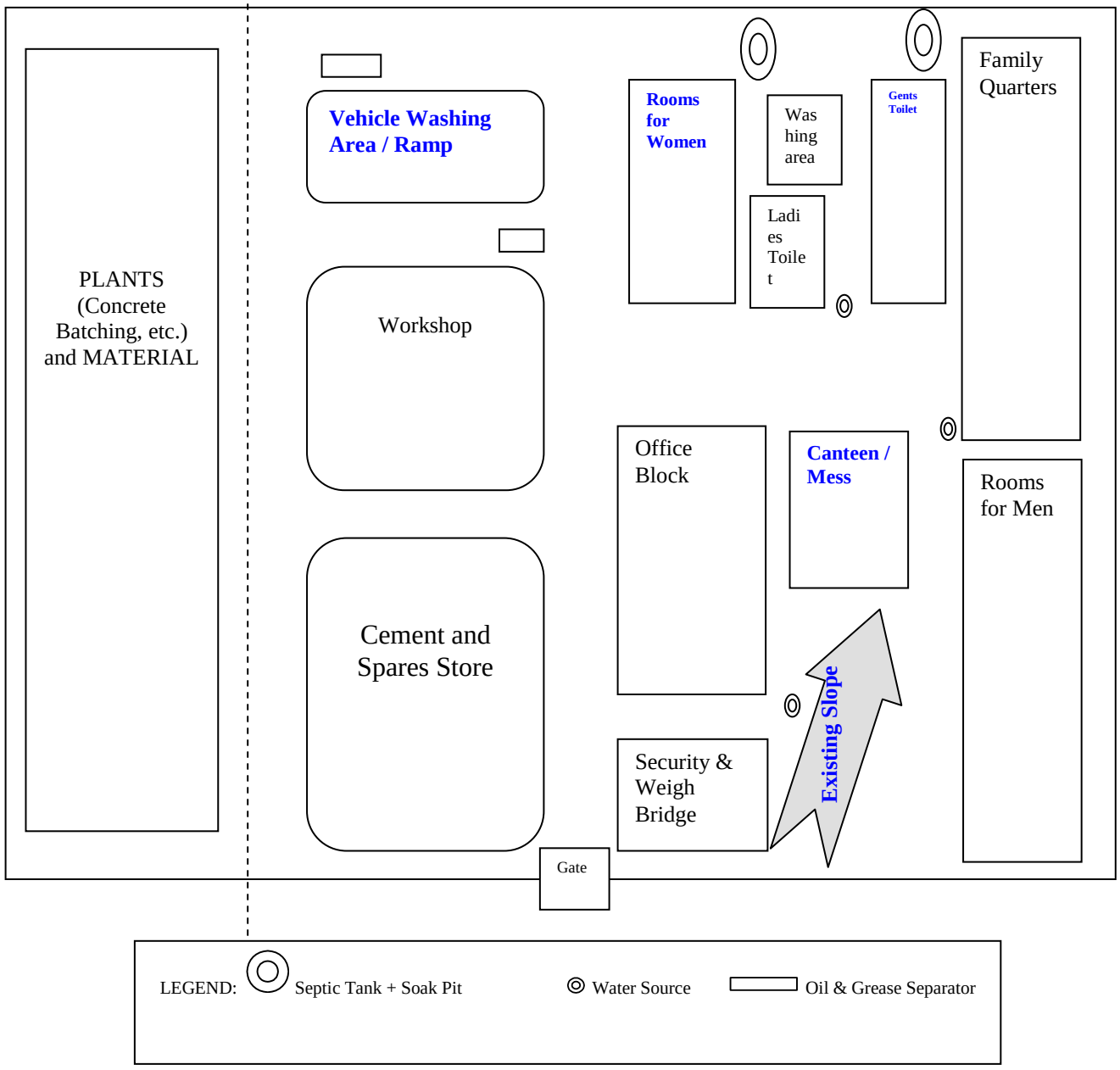


SECTION A–A

NOTES:

1. INSPECTION CHAMBER (IC) 600x600x600 DEEP WITH AIRTIGHT MH COVER
2. SEPTIC TANK & SOAK PIT AS PER SITE CONDITIONS

Layout of a Construction camp



Appendix-5:

Stakeholder Consultation

Stakeholder Consultation at Niriang Village

District: West Jaintia Hills Village: Niriang Village
Date: 28/11 /2020 Time :12.00 PM
Venue: Niriang Village Duration :2 (Two)hours
1. Project Description: Construction of Major Bridge over river Umngot river connecting Nongjrong Village and Niriang Village.
2. The Official and Members of the Community present during the Consultation:
i. Shri. L. Kharmawlong, Superintending Engineer P.W.D. (Roads), Jowai Circle
ii. Shri.M. Tang, Executive Engineer, PWD (Roads), Jowai Central Division, Jowai.
iii. Shri. H. Pakyntein, Assistant Executive Engineer, PWD (Roads),
iv. Shri. C. Shullai, Assistant Engineer, PWD (Roads)
v. Shri. W. Challam. Sectional Assistant (P.W.D) Roads
vi. Shri. Rain Suting . Headman of Niriang.
vii. Shri. P. Muruh, Secretary (Rangbah Dong), Niriang and
iii. Villagers (List as per Attendance Sheet).

3. Issues raised by the community and responses provided Issues: The Executive Engineer informed the Community about the Project bridge and then on the Environment and Social Safeguards as per World Bank's requirement. During the meeting, the Executive Engineer thanked all the members present during consultation and has opened the discussions. The points which have been raised by some villagers are as follows: -
a. Land Donation: - The Land Owner has expressed his willingness to donate the land free of cost since he felt that the project is meant for the development of the area and some has expressed that this project will ultimately benefit their children in future.
b. Sanction and Commencement of the Project: Elderly persons has expressed gratitude to the Government who has considered sanctioning this Construction of the Bridge as he felt that this has been a long pending aspiration of the villagers as they had already been facing immense hardship with regards to commuting across the river by boats. To his query, the Executive Engineer has informed that the project will soon be sanctioned.
c. Co-ordination with PWD: - The consultation process was very productive as all the people were very happy with the upcoming project and they were all eager to see that the construction really materialized.
4.Key issues: There are no negative issues raised during the meeting. What the people wanted, as expressed by every villager is the early approval of the Project.
5.Conclusion by PWD representatives: At the end of the meeting, the Executive Engineer has expressed gratitude to all the villagers present during the meeting. He also reiterated that he will take up the matter with the higher authority for early approval of the project. He also thanked the President, Secretaries, the land owner and the villagers in general who have spared their precious time to make the Community Consultation a Success.

Dated, Niriang Village, 28th November 2020.
Note: The Attendance Sheet enclosed.

Shri. M. Tang
Executive Engineer, PWD
(Roads)
Jowai Central Division, Jowai.

Official and Members of the Community Present at Nongjrong

1. Shri. M. Tang , E.E. PWD (Rds). — [signature]
2. Shri. H. Pakyntein AEE PWD (Rds) — [signature]
3. Shri. C. Shullai AE PWD (Rds) [signature]
4. Shri W. Challam SA PWD (Rds) [signature]
5 Shri P. Syiemi Headman [signature]
6 Shri. R. Rangbry Rangbah dong. [signature]
7. Shri. H. Kharkongor Syngot shnong. HUK
8 Shri. M. Nongspung. Kpa Haiing. (Tiwi Jaka) M Nongspung
9. Shri M. Kharkhlni Khan kaiing (Tiwi Jaka) MK
10 Shri. Richan Suiam Member. [signature]

[signature] 27/10/2020
Sordar Nongjrong, Raid Mawshai, ... Syiemship