Asian Development Bank	(CDCL)	Kingdom of Bhutan

Phuentsholing Township Development Project

Project Number: 50165-002

Loan Number: 3668-BHU(COL)

Grant Number: 0573-BHU(SF)

Semi-Annual Environmental Monitoring Report n°4

Period from 1 January to 30 June 2020

egis \ Gyaltshen Consultan	**Phuentsholing Township Development Project** Project Implementation Consultant PIC Site Office, Near NHDCL Housing Colony Amochu, Phuentsholing, Chukha

General information

Author(s)	Megay Penjore (HSE, PIC) & Sonam Deki (Environmentalist, PIC)
Projects Name	Phuentsholing Township Development Project (PTDP) PIC Report Cataloguing N° PTDP 065
Document Name	Semi-Annual Environmental Monitoring Report n°04
Date	Period from 1 January to 30 June 2020 (2020S4)
Reference	Version n°01

Addressee(s)

Sent to:		
Name	**Organisation**	**Sent on (date):**
Kamal Dhakal	Project Manager, PIU, CDCL	22nd July 2020
Edwin Jatnowin	Deputy Team Leader, PIC	22nd July 2020

Copy to:		
Name	**Organisation**	**Sent on (date):**
Dr. Lam Dorji	Independent Environment Monitoring Expert	22nd July 2020
Pemchung	Environmental Manager, PIU	22nd July 2020

History of modifications

Version	**Date**	**Written by**	**Approved by**
Version 01 (Draft)	20/07/2020	Megay Penjore & Sonam Deki	PMU
Version 02 (Draft)	28/07/2020	Megay Penjore & Sonam Deki	PMU
Version 03 (Draft)	30/07/2020	Megay Penjore & Sonam Deki	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS

ADB	**:**	Asian Development Bank
AIDS	**:**	Acquired Immuno Deficiency Syndrome
ALDTP	**:**	Amochhu Land Development and Township Project
CDCL	**:**	Construction Development Corporation Limited
DGPS	**:**	Differential Global Positioning System
DHI	**:**	Druk Holdings and Investment Ltd.
GRM	**:**	Grievance Redress Mechanism
EA	**:**	Executing Agency
EIA	**:**	Environmental Impact Assessment
CEMP	**:**	Contractors Environmental Management Plan
FNCR	**:**	Forest and Nature Conservation Rules
HIV	**:**	Human Immunodeficiency Virus
IA	**:**	Implementing Agency
IEE	**:**	Initial Environmental Examination
IPP	**:**	Indigenous Peoples Plan
IUCN	**:**	International Union for Conservation of Nature
NEC	**:**	National Environment Commission
NLCS	**:**	National land Commission Secretariat
PIC	**:**	Project Implementation Consultant
PIU	**:**	Project Implementation Unit
PMU	**:**	Project Management Unit
PPE	**:**	Personal Protective Equipment
PTDP	**:**	Phuentsholing Township Development Project
RGoB	**:**	Royal Government of Bhutan
SEMR	**:**	Semi-Annual Environmental Monitoring Report
SPS	**:**	Safeguard Policy Statement
STD	**:**	Sexually Transmitted Diseases

Semi-Annual Environmental Monitoring Report

This report presents the status of social and environmental safeguards compliance, for the period from January to June 2020. The report reviews the compliance of social and environmental activities set in CEMP during the period and proposes practices/innovations leading to an improved and sustainable environment in the future.

1. Project Background

1 The Construction Development Corporation Limited (CDCL) has taken up Phuentsholing Township Development Project (PTDP) with financial assistance from Asian Development Bank (ADB) under Loan Agreement No. 3668-BHU.

2 The Government of Bhutan has proposed for Phuentsholing Township Development Project (PTDP) near Phuentsholing City which includes develop 460 hectares of riparian land near Phuentsholing City, provide protection from floods and erosion, and construct smart urban infrastructure to allow phased urban expansion. The City of Phuentsholing is located adjacent to the Amochhu River on Bhutan's southwestern border with India (Jaigoan, Alipurduar district, West Bengal). Phuentsholing is the country's economic capital and main trading gateway with India. The Royal Government of Bhutan's vision is for Phuentsholing to grow into an economically vibrant, ecologically sustainable, and energy-efficient center that supports economic diversification, employment creation, and income generation.

3 The project aims to protect the existing and new towns from floods and riverbank erosion which currently threatens lives and livelihoods and disrupts connectivity with nearby communities. The project was initiated to train the river along both banks of Amochhu and to reclaim the area for the development of the extended Phuentsholing Township. According to PTDP Master Plan, the project will be undertaken in phases and is expected to be completed in 15 years.

4 The PTDP is divided into five zones: Zone A, Zone B, Zone C, Zone D and Zone E. Zone D represents Kaileshwar Hill which is currently not included in the project development. The remaining four Zones will require about 15 kilometres of riverbank protection works with subsequent development of about 464 hectares of Amochhu riparian land. The development comprises of new common urban infrastructures such as roads, bridges, water supply and wastewater system, municipal solid waste system, power and telecommunications to support the habitation of 50,000 people. The implementation of the project is phased with the scale and demand for development. The allocation of land and riverbank protection for the project's development is shown in **Table 1** below:

Table 1: Allocation of Land under PTDP

Zone	Area (ha)	Length of Riverbank (m)
A	66	3,974
B	94	3,046
C	277	4,872
E	27	3,083
Total	**464**	**14,975**

5 PTDP is being implemented in a phased manner to the scale and demand for development. In the first phase, PTDP has been taken up the development of Zone A. In subsequent phases, the remaining zones will be taken up. **Figure 1** and **2** below shows the current project area and progress at the PTDP project site as of 30th June 2020.

Figure 1: Zone A Project Area

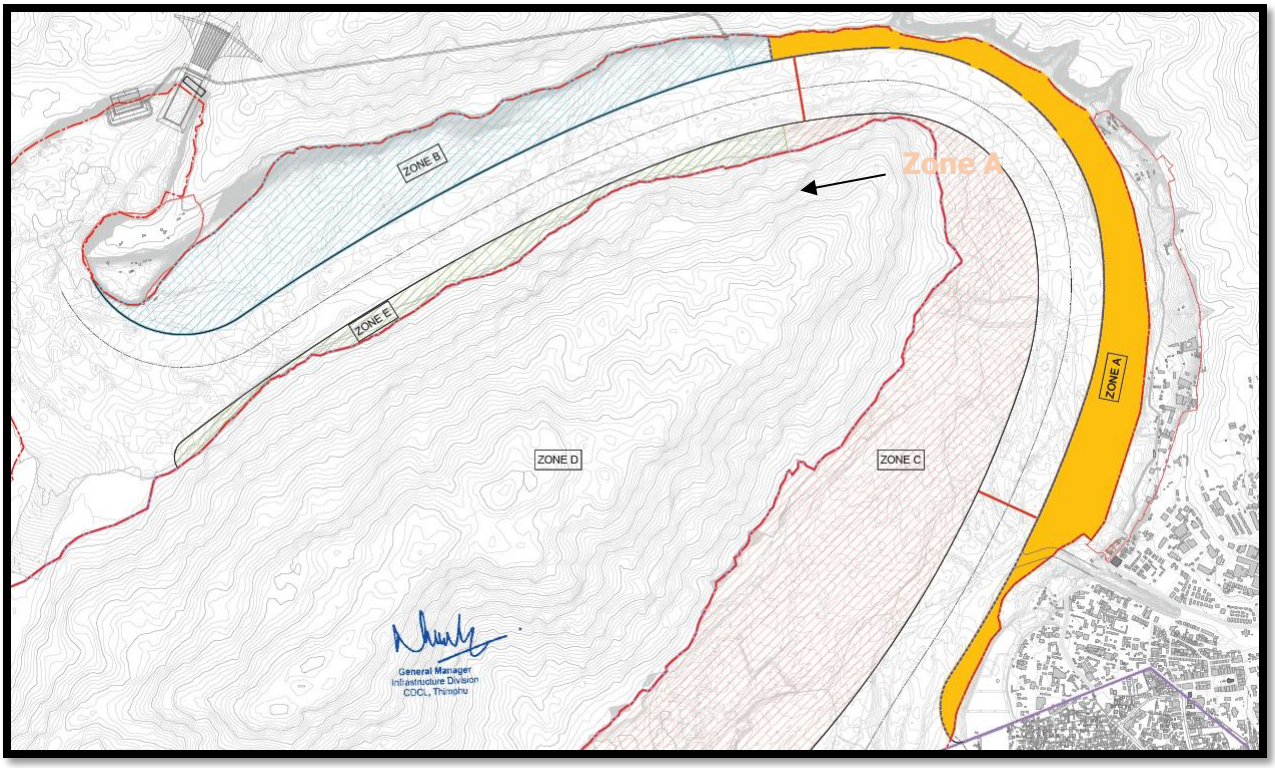


Figure 2:PTDP Master Plan

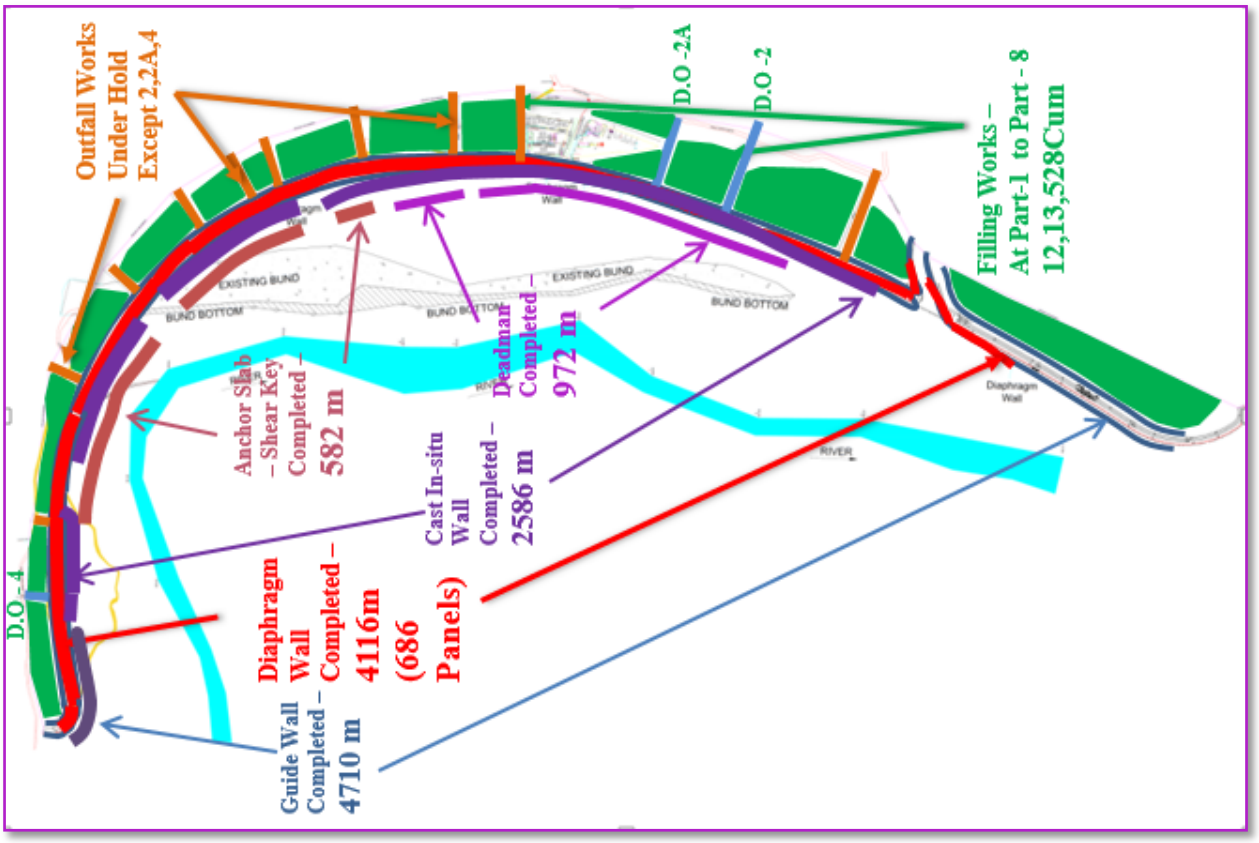


Figure 3: Overall Progress of PTDP Project as of 30th June 2020

6 Phase 1 is financed with support from the Asian Development Bank (ADB) and Druk Holding and Investments (DHI). DHI is the Project Owner and the Executing Agency (EA) and Construction Development Corporation Limited (CDCL), is the Implementing Agency (IA).

7 For the convenience of construction, the development works of Zone-A has been divided into different construction packages. The Package CW-01 includes the construction of approximately 4.5 km of River Training and Embankment works along the Amochhu River in Phuentsholing. The scope of works includes river training (diaphragm wall, Anchor slab), Embankment (retaining walls, outfalls and slope stability), General Earth Filling, Irrigation and Landscape work.

8 The Civil work contract of Package-CW-01 has been awarded to M/s AFCONS Infrastructural Limited, India in September 2018 for 30 months. The CDCL has appointed M/s EGIS International as Project Implementation Consultant (PIC) who acts as Engineer for the project. The Contract of PIC was signed in the month of October 2018.

2. Status of Construction Works:

9 The construction activities at the site are in a preliminary stage. Pre-construction stage is completed and construction activities have commenced. During the reporting period, the following activities were in progress:

- Finalization of the site for the establishment of their camp office, staff quarters, labour camp, batching plant, stockyards, etc. All these facilities are located in the same place.
- The construction works for different amenities at the campsite.
- Re-survey of Differential Global positioning system (DGPS) control points on NLCS points to establish control points for the Project.
- Commencement of excavation for guide wall works in Part-8, chainage 734 R
- Diaphragm wall at part 4, 5, 6 is completed and in progress at part 2, 3 and part 7.
- Cast Insitu first lift completed by 80% in part 3, 4, 5 and 6.

3. The Safeguard category of the projects

10 The PTDP falls under category "A" for environmental safeguards as per ADB categorization criteria based on ADB's Environmental Assessment Guidelines 2003, and Safeguard Policy Statement (SPS) 2009. The EIA report was prepared for all the Four Zones (A, B, C & E) based on which the anticipated environmental impacts; Environmental Management Plan (EMP) was formulated for mitigating, managing and enhancing the efficiency of environmental components wherever it is possible. The recommended EMP was included in the domain of detailed design and bid documents for all the sub-projects. There is a separate budgetary allocation for implementation of EMP and have been included in the contracts.

11 Besides, no involuntary resettlement was carried out, and no indigenous peoples were affected and hence the project has been classified as category "C".

4. Scope of the Present Report

12 The scope of this report is mainly to assess the compliance status on social and environmental safeguards during construction in the construction package CW-01 where works are in progress. In particular, the report concentrates on the CW-01 awarded to and being carried out by M/s AFCONS Infrastructural Limited, India. The assessment of safeguards compliance cover the status of compliance with:

- statutory requirements in each construction packages,
- conditions of EMP stipulated in contract conditions and
- monitoring of environmental attributes at different representative sites

13 The report contains information on environmental conditions in areas adjacent to the project area gathered through periodical monitoring. The report also assesses the performance and effectiveness of the implementation of environmental safeguards as per the contract specification. Information presented in this report is mainly based on a review of the safeguards documents, contract agreement of Contractor and PIC and observations made during field inspections carried out by the PIU, the engineer's representative and the contractor.

14 The report also assesses the compliance status on health and safety during construction in all the construction packages, where works are in progress, the performance and effectiveness of the implementation of Emergency Response Plan, Traffic Management Plan, Occupational Safety and Health Management Plan as per the contract specification. Information presented in this report is

mainly based on a review of the safeguards documents, contractor's monthly reports and observations made during field inspections.

15 This report is a documentation of the environmental, health and safety standards and procedures required by ADB and RGoB, which is executed by the contractor 'Ms. AFCONS' during the implementation of the Phuentsholing Township Development Project. The reporting period is from January to June 2020.

5. Approach and methodology adopted for Safeguard monitoring of the projects

16 The monitoring of compliance of EMP and its performance is carried out through the following tasks:

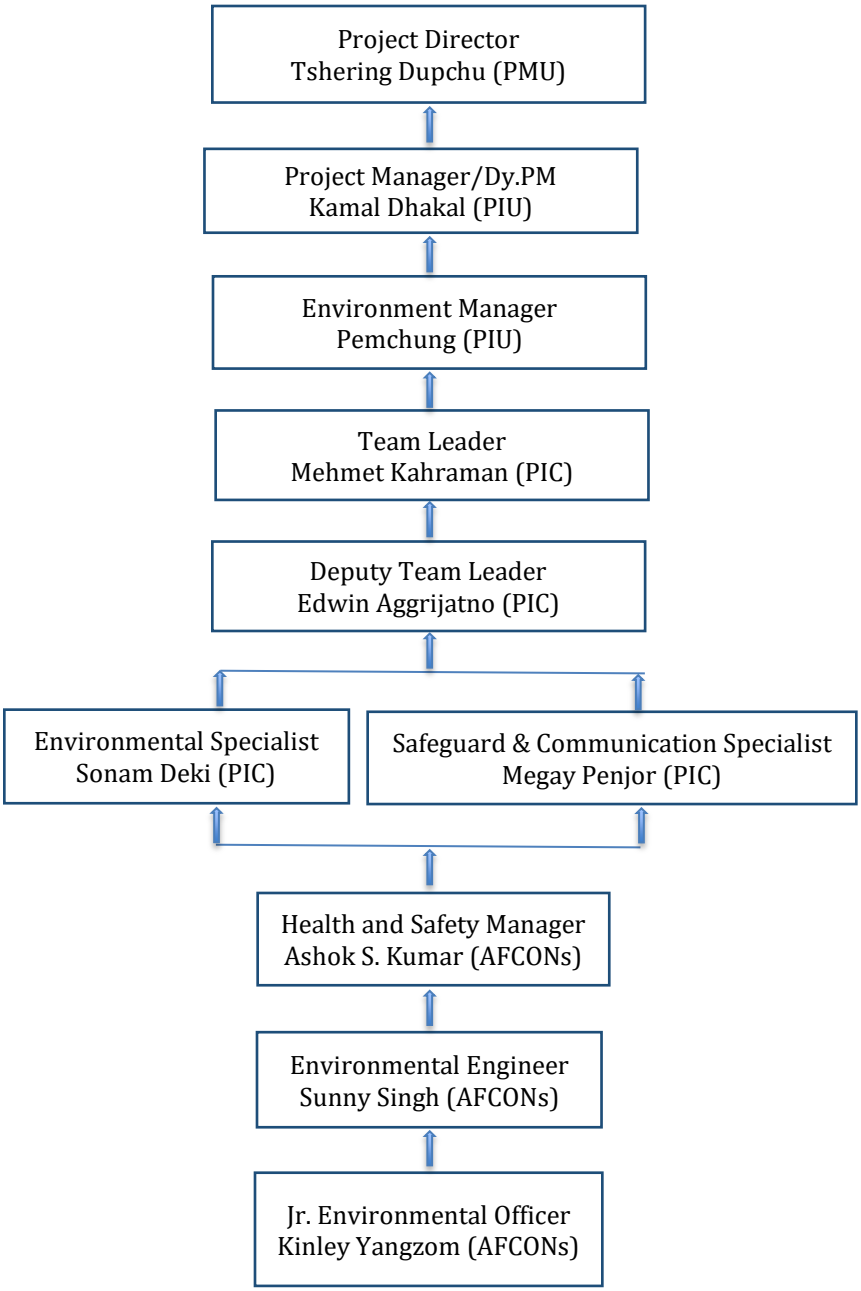
- Site inspections by PIC Environmental Specialist, Social and communication Specialist, local environmental specialist and Environmental Manager of PIU
- Review of Contractor's documents related to the implementation of Environmental safeguards
- Monitoring of selected environmental attributes identified under the Environmental Monitoring Plan

17 Checklist method has been adopted by the PIC for monitoring the safeguards compliance at site. The checklist developed by the PIC was used for compliance monitoring at the site by PIU and PIC environmental staff.

6. Institutional Arrangement for EMP Implementation

For the overall implementation and monitoring of environmental safeguards the entities below are responsible:

18 Organizational Chart of Safeguards Supervision Team


Project Director
Tshering Dupchu (PMU)
Project Manager/Dy.PM
Kamal Dhakal (PIU)
Environment Manager
Pemchung (PIU)
Team Leader
Mehmet Kahraman (PIC)
Deputy Team Leader
Edwin Aggrijatno (PIC)
Environmental Specialist
Sonam Deki (PIC)
Safeguard & Communication Specialist
Megay Penjor (PIC)
Health and Safety Manager
Ashok S. Kumar (AFCONs)
Environmental Engineer
Sunny Singh (AFCONs)
Jr. Environmental Officer
Kinley Yangzom (AFCONs)

19 The contractor is the agency responsible for the direct implementation of environmental mitigation measures at different locations whereas the others are having supervisory/monitoring roles.

20 At each level, there is a provision of environmental personnel for ensuring the effectiveness of implementation and monitoring of environmental mitigation measures. The status of appointment/ nomination of environmental personnel at different levels as on date are as follows:

6.1 CDCL Safeguard Team:

21 There is a provision of an Environmental Manager at PMU who supports the Project Director (PMU) and PIU environmental staff. The role of the Environmental Manager (PMU) is to oversee the implementation of environmental safeguards work under the project. He is responsible for updating of EMP if necessary throughout project implementation per ADB's Safeguards Policy Statement (SPS, 2009) and the Environmental Assessment Act (2000), and submit to ADB for review, final approval, and disclosure before the commencement of works; (ii) before the expiry of the initial EIA after five years, review and revise (if necessary) the EIA and undertake necessary actions as required, to obtain NEC and ADB continued approval; and (iii) liaise with the relevant authorities to obtain all required clearances and environmental permits on time before construction;

22 There is also a provision of Environmental Manager at PIU level. The Environment Officer in the PIU, assisted by the environmental specialist on the PIC team, oversees implementation of environmental safeguards work under the project, including the following activities: (i) facilitate and confirm overall compliance with Government of Bhutan rules, oversee timely preparation and finalization of CEMP by contractors, and assist in obtaining all required clearances and environmental permits on time before construction; (ii) monitor CEMP implementation by the contractors during construction including all mitigation measures and environmental parameters (air and water quality, noise, etc.) and taking corrective actions where necessary; (iii) address and record grievances through the Grievance Redress Mechanism on time, and taking quick corrective actions where necessary; (iv) ensure that all required environmental study (e.g. biodiversity studies on aquatic ecosystem and elephant social behaviour) are professionally and comprehensively carried out; (v) ensure that all environmental quality monitoring required for the project is comprehensively done; and (vi) review monthly environmental monitoring reports submitted to PIU by contractors and consultants, and preparing and submitting semi-annual environmental monitoring reports to ADB on behalf of the PMU.

23 CDCL has appointed Mr. Pemchung in place of Mr. Pushpa Raj Pradhan as Environmental Manager. Mr. Pemchung is in-charge of both PMU and PIU Offices. He is responsible for overseeing his implementation of environmental safeguards, coordination with stakeholders, government officials and regulatory authorities on environmental issues, addressing the public grievances on environmental issues.

24 As part of the project's overall safeguard compliance, Mr. Lam Dorji has been recruited as the Independent Environmental Monitoring Expert for the project to provide technical support to PIU, PIC, PMU and ADB during project implementation and document the progress of the Environmental Management Plan (EMP). The expert's responsibilities are to ensure (i) the implementation of the Contractor Environmental Management Plan (CEMP) and Environmental Monitoring Plan (EMoP) are compliant to Asian Development Bank Safeguard Policy Statement (ADB SPS) of 2009 and Environmental Clearance (EC) from the National Environment Commission and (ii) timely submission of the Environmental Monitoring Report (EMR) of the Project Implementation Unit (PIU), and iii) to assist the Project Implementation Consultant (PIC) and Project Implementation Unit (PIU) and report to the Project Management Unit (PMU) and ADB.

6.2 PIC Environmental Specialist:

25 There is the provision of an International Environmental Specialist in the PIC team, who is responsible for:

- Review of the EIA, SIA and EMP and the conditions of Approval of NEC;
- Liaising and coordination with PIU's environmental manager and NEC personnel to ensure that roles and responsibilities are clear and documented;
- Review of bidding documents prepared for each contractor in Zone A and ensure that all safeguards requirements from the EIA and NEC approval are included;
- Ensuring the appointment of suitably experienced persons of the contractor at key environmental safeguards positions;
- Ensuring that the personnel are mobilized within one month of Contract Award;
- Supervision and approval of Contractor's EMP (CEMP) in Zone A and close coordination with the National Safeguards specialist supervise and approve SSHP of each contractor before any construction work commences;
- Supervision of the implementation of each CEMP and SSHP to ensure that contractors submit a monthly report on the implementation of CEMP and SSHP to the PIU;
- Check and clear contractor's claims for all costs to address environmental Prepare semi-annual reports on the overall implementation of EMP to be submitted to ADB by the EA;
- Prepare a detailed TOR for the proposed baseline study and monitoring BMBMS of flora and fauna ecosystems in Zone C;
- Supervise the implementation of the baseline study in Zone C;
- Ensure that all "critical" and/or "natural habitat" (defined in ADB Safeguards Policy Statement, 2009) are identified and using the results of the study prepare a Zone C Environmental Management Plan and any necessary review of the EIA for further approval by NEC;
- In case unexpected impacts occur during construction time, work closely with other PIU team and contractors to prepare remedial measures to manage those impacts;
- Make recommendations to improve or correct environmental management and monitoring for all other zones and other project components such as management of solid waste;
- Work closely with other PIU team members to ensure that all outputs under point 3 above are delivered.

26 The PIC has appointed Dr. Surjit Singh Deepak as Environmental Specialist-International, who was officially mobilized as part of Gyaltshen Consultancy team from 3rd January 2019. His input at the site is intermittent or upon requirement. He will conduct a periodical site inspection and accordingly review the environmental progress based on the site visit and information provided by the PIC. As required training workshops on Environmental implementation will be conducted for PIU/PMU and the contractors as capacity building measures on effective implementation and monitoring of EMP in the project during construction.

27 PIC has appointed Ms. Sonam Deki as Environmental Specialist-National, who was officially mobilized as part of Gyaltshen Consultancy Team at the PTDP site from 22nd March 2019. She conducts monthly site inspection and prepares the monthly, quarterly and semi-annual progress report.

6.3 PIC Social and Communication Specialist:

28 There is a provision for a national, Safeguard and Communication specialist in the PIC team, which is responsible for:

- Review bidding documents prepared for each contractor and ensure that all safeguards requirements, if any, from SIA, are included;
- Ensure that each contractor has suitably experienced personnel in the key social and gender position;
- Prepare and implement an overall Communications & Consultation Plan (CCP) for Zone A which includes sub plans on community relations, labour and employment and project induced in-migration (PIIM) also referred to as Influx;
- In close consultation with each contractor in Zone A prepare an agreement on social monitoring locations and responsibility for collection and input to the Project GIS;
- Prepare and implement a Social Monitoring Plan for Zone A in close consultation with the contractors and their sub-contractors and ensure all on-going results are documented in the Project GIS;
- Ensure roles and responsibilities for the collection of social monitoring data is agreed between PIU and each contractor and their subcontractors;
- Assist supervise the preparation and implementation of a Security Safety and Health Plan (SSHP) which includes a sub-plan on Construction Camp Management by the main Contractors;
- Monitor, report and advise on social issues, including relevant gender components, HIV/AIDS, human trafficking and core labour standards and equal payment for equal work provisions in the civil works contracts;
- Work closely with an international specialist to assist him/her in undertaking field monitoring on the implementation of CEMP and SSHP and provide inputs on the preparation of the semi-annual report for implementing EMP;
- Prepare semi-annual social and monitoring reports for review and approval by PIU for submission to ADB for disclosure;
- Ensure compliance with social impact mitigation requirements of civil works contracts, and providing information to PIU on those processes in the monthly progress reports;
- Lead the implementation of Grievance Redress Mechanism for the project by developing systematic recording claim, organizing meeting to resolve grievances
- Organize and coordinate gender awareness training for the PIU;
- Coordinate with PIU to conduct awareness programs amongst key stakeholders.

29 The PIC has appointed Mr. Megay Penjore as the Safeguard and communication specialist, who has already been mobilized at the site. During his inputs, he conducts site visits and contributes to the social safeguards the semi-annual report based on the progress.

6.4 Contractor's Environmental Officers:

30 The Contractor has mobilized it's Environmental and Safety Personnel, who are responsible for the following activities on safeguards:

- Implementation of all environmental, health and safety measures as per approved CEMP and contract specification during construction including regular testing and monitoring of environmental parameters outlined
- Coordinating with the PIC during preparation and obtaining approval of the CEMP.

- Ensuring that the contractor engages a suitable expert as a resource person or organization to undertake STIs/ HIV/ AIDS briefings and awareness-raising among the contractor's employees and neighbouring communities with follow-up upon request.
- Coordinating with PIU and PIC in respect of community consultation.
- Participating in monitoring and coordinating with PIC to ensure that environmental management activities are reported as required.
- Coordinate and communicate with the PIC as required, to facilitate consultation with the affected villages, various stakeholders, and ensuring smooth implementation of the subproject.
- address public grievances by taking quick corrective actions and reporting status of grievances and redress to PIU/PMU; (iv) undertake its monitoring of project-related impacts and prepare an environmental section of the monthly report to CDCL environment team and PIC;
- The Contractor has appointed the Occupational Health Safety and Environment (OHSE) Manager supported by one Environmental Engineer and one Safety Manager for effective implementation of environmental and safety measures at the site.

31 The environmental and staff have been mobilized by the Contractor at the site as shown in **Table 2**

Table 2: Environmental and Safety staff mobilized by the contractor

SN	Name	Designation	Job Responsibility
1.	Mr. S Ashok Kumar	OHSE Manager	Responsible for the overall occupational health safety and environmental performance of CEMP. He is directly reporting to the Project Manager. For any issues arising related to the implementation of CEMP provisions, the Environment, Health and Safety (EHS) Manager shall appraise the issue to the Project Manager and the Project Manager will resolve the issue by assigning the task to the person(s) of his choice.
2.	Mr. Sunny	Environment In-charge	To assist OHSE Manager in day to day implementation of Environmental aspect of the CEMP. The Environment Engineer is responsible for the induction of all employees to create awareness on the CEMP.
3	Ms. Kinley Yangzom	Junior Environment Officer	To assist OHSE Manager in day to day implementation of Environmental aspect of the CEMP. The Environment officer is responsible for the preparing Environmental Monthly Report for the project.
3.	Mr. Bijender Kumar Singh	Safety Manager	To assist OHSE Manager in day to day implementation of Safety and social aspect of the CEMP. The manager is responsible for the induction of all employees to create awareness on the CEMP.

32 In addition to the above positions, the contractor has appointed 4 safety stewards, to oversee the safety at different sites of work.

7. Contractor Environmental Management Plan (CEMP)

33 Only a draft CEMP was submitted as part of the 1st SEMR July – December 2018 and clarifications were sought by ADB on the CEMP. After the visit of PIC environmental specialist, the CEMP was re-visited and was jointly approved in February 2019. A matrix was prepared as part of the new submission to ADB in the draft CEMP which was submitted as part of the quarterly progress report (January – March 2019). The approved matrix table showing the changes and the approved CEMP is attached as Appendix I in the 2nd SEMR (January – June 2019).

8. Environmental Compliance Monitoring

34 For effective monitoring of Environmental Compliance, environmental parameters have been identified as indicators which may be qualitatively and quantitatively measured periodically and compared over time to ensure the effectiveness of the safeguard measures during project execution. The parameters selected as performance indicators are as follows:

- Ambient air monitoring
- Ambient noise monitoring
- Surface water quality monitoring
- Groundwater Quality monitoring
- Aquatic and Terrestrial study
- Meteorological monitoring

8.1 Compliance to 3rd SEMR (July – December 2019)

35 The 3rd Semi-Annual Compliance Report (July – December 2019) was submitted on 17th February and was subsequently disclosed at ADB's website for information dissimilation. The report was reviewed by ADB and the comments were discussed and incorporated as shown in **Table 3** below:

Table 3: Comments and compliance with SEMR (July – December 2019)

Sl. No	ADB's comment (July – December 2019)	Remarks
1	On the title page, please use the "Semi-Annual Report" instead of "Health Safety & Environment Semi-Annual Report". The title of "Semi-Annual Report" was used since the first report, thus, please be consistent with the name of the document.	Comments noted and complied
2	Under para 34, the paragraph is incomplete. Author is supposed to mention the parameters as performance indicators, however, nothing followed. Please complete the paragraph.	Comment noted and complied.
3	Please include the solution/s performed to mitigate the bug infestation problem in the campsite's sleeping quarters.	Comments noted and complied.
4	Several Emission Tests Validity of vehicles are nearing expiration. Kindly monitor the renewal of the vehicle emission test certificates of the contractor and sub-contractor.	Comments noted and complied. The valid emission certificates were attached with final SEMR(July-Dec 2019)

8.2 Compliance with state and national statutes & regulations

36 CDCL obtained the Environmental Clearance per the Environmental Assessment Act 2000, Regulation 2002 from National Environmental Commission (NEC), RGoB on 1st September 2017 which includes clearance the entire Zones (including Zone A) and is valid up to August 30, 2022 (5 years). **Table 4** contains the compliance requirements and the status compliance of PTDP.

Table 4: Compliance with the Terms and Conditions of the Environmental Clearance

No.	Compliance Requirement	Status
I.	**GENERAL**	
1	The holder shall comply with provisions of the National Environmental Protection Act 2007, Environmental Assessment Act 2000 and it's Regulation 2016, Waste Preservation and Management Act of Bhutan 2009 and it's Regulation 2016, and the Water Act of Bhutan 2011 and it's Regulation 2014 and Revised Regulation on the Control of Ozone Depleting Substances (ODS) 2008	The PTDP management has put in place the necessary institutional mechanisms and personnel who are regularly monitoring environmental quality, supervising ongoing project activities and reporting compliance. Environmental quality monitoring is carried out by the contractor and its sub-contractor, while the PIC's environment specialist and site supervisors monitor and report on the compliance. The PIU's Environmental Manager oversees the project activities in terms of compliance to environmental safeguards and standards.
2	The holder shall ensure that construction activities are in line with the Initial Environmental Examination report submitted for EC	The CEMP, which is drawn on the requirements of the IEE is being constantly followed through and implemented regularly.
3	The holder shall ensure that local communities, properties, and any religious, cultural, historic and ecologically important sites are not adversely affected by the activities	Initially, there were no communities in 'Zone A' where project activity is focused. In recent times, however, part 3 of Zone A is occupied by temporary housing schemes constructed as COVID 19 Emergency response to house the Bhutanese who used to live in Jaigaon, India. The project activities have no adverse impact on the residents. Instead, the project contributes to the welfare of temporary residents.
4	The holder shall restore the damage of any public or private properties caused by the activities	No damage caused to public or private properties so far.
5	The holder shall inform NECS and any other relevant authorities of any unanticipated or unforeseen chance-find of any precious metals or minerals or articles, that have economic, cultural, religious, archaeological, and/or ecological importance	Such an incident has not yet occurred. If such an incident occurs, NECS and relevant authorities will be informed.
6	The holder shall erect a signboard at the take-off point of the main entrance of the activities stating the name of the activities and contact address	Safety signboards are at strategic locations which necessitate specific warning signs.
II.	**ENVIRONMENTAL STANDARDS**	
7	The holder shall comply with the existing Environmental Standards	Regular monitoring reports reveal environmental parameters are within the set standards. However, other entities are operating in the project site whose compliance to environmental standards are not known and beyond the authority of the project to monitor.
III.	**IMPORT AND USE OF SECONDHAND EQUIPMENT**	
8	The holder shall ensure that import and use of second-hand equipment and machinery are strictly prohibited.	No second-hand equipment was used at the site. All required equipment were purchased new and monitoring is carried out regularly

		to ensure the deployed equipment and machinery are in good condition.
9	The holder shall ensure that import and use ODS are in line with the Revised Regulation on the Control of ODS 2008	Use of ODS in project equipment and machinery are minimal. The PIU/ PIC ensures that purchase of equipment and machinery is in line with the Revised Regulation on the control on ODS 2008.
IV.	**PROTECTION AND MANAGEMENT OF WATER RESOURCES**	
10	The holder shall ensure that activities do not disrupt the water flow and pollute the water bodies	Ongoing project work is concentrated along the Amochhu river bank and does not interfere with the flowing river. Measures are being taken to ensure the water bodies are not impacted or polluted. The employment of Casagrande machinery entails ground excavation of along guide wall. The excavated sludge and bedrocks are disposed of on the surface along the guide wall and do not directly flow into the river.
V.	**WASTE PREVENTION AND MANAGEMENT**	
11	The holder shall manage wastes generated from the activities (activity site, labour camps, offices, etc.) with the application of 4R (Reduce, reuse, recycle, responsibility) principle and other environmentally friendly methods of waste management	Solid wastes from the camp and office are collected in waste bins placed in and around the premises. Larger containers are provided to store the solid waste until collected by the municipal garbage trucks. Organic wastes are collected and disposed of in a separate pit. Tarpaulin is used to cover lightweight materials at the site.
12	The holder shall ensure that import and use of hazardous wastes are strictly prohibited	The project does not require any use or import of hazardous materials. Thus such wastes are not generated.
VI.	**MANAGEMENT OF EXCAVATED MATERIALS AND RUN-OFF**	
13	The holder shall dispose of excess excavated materials at the pre-identified approved dumpsite only	Excavated materials, which are essentially river bed material, are being reused in backfilling, thus not requiring a dumpsite.
14	The holder shall put appropriate measures to avoid erosion and landslides	The PTDP is essentially an intervention to curb erosion and flooding. No erosion/landslide issues occurred at the site. Third Emergency Evacuation Mock drill for the flood was conducted on 28th May 2020.
VII.	**IMPLEMENTATION PLAN**	
15	The holder shall prepare a Detailed Implementation Plan (DIP) focusing on the implementation of terms and conditions of this EC and submit to NECS within three (3) months from the date of issue of this EC	Accomplished and reported in 2nd SEMR See Appendix II of January – June 2019 SEMR.
VIII.	**MONITORING AND REPORTING**	
16	The holder shall ensure that the effective day-to-day monitoring of the EC terms and conditions are carried out by the environmental unit or designated environmental focal person	AFCONS has a Health & Safety Manager who ensures environmental and health safeguards are being observed on a day to day basis. The environmental parameters for air, water and land are monitored

		regularly. The Environmental Specialist of PIC provides oversight of the contractor's compliance with safeguards. Environment Manager of PIU and HSE officer from PIC conduct daily monitoring in rotation. Reports are provided every month by the contractor and verified by the PIC before submission to the Environmental Manager at PIU.
17	The holder shall maintain proper records on wastes generated and its management, stating types of wastes, quantities and characteristic and submit to NECS annually	The contractor has maintained records of waste generated for January – June 2020 and reported in their monthly reports
IX.	**RENEWAL AND MODIFICATION**	
18	The holder shall ensure that renewal of this EC is processed at least three (3) months before its expiry along with a copy EC and a report on the implementation of its terms and conditions	The Management is aware of this requirement and will pursue accordingly when the time for EC renewal approaches
19	The holder shall obtain prior approval from NECS for any modification to the existing proposal/application	There has been no modification in the proposal so far.
X.	**RESERVATION**	
20	The NECS may stop the activity or impose additional terms and conditions, as may be deemed necessary	N/A
21	The EC shall be subject to periodic review and modifications as per Article 25 of the EA Act 2000, without any liability on the part of the Royal Government	No modifications to the EC has been issued by NEC so far.
22	The holder may adopt best practices in executing these terms and conditions to avoid adverse environmental impacts.	The project has put in place the mechanisms, facilities, and human resources to ensure project activities comply with environmental standards and safeguards.

8.3 Compliance with the Environmental Management Plan

37 It is the responsibility of the contractor to implement the stipulated environmental safeguard measures outlined in EMP during construction. The CEMP is contractor's bible when it comes to its obligations to comply with the EMP. The compliances with the safeguards requirements by the contractor during construction are being monitored by PIC and PIU at the site. **Table 5** reflects the Contractor's compliance with the EMP.

Table 5: Status of Compliance to the activities proposed in CEMP

Sl. no.	Activity	Mitigation Measures	Compliance attained (Yes, No, Partial)	Location	Remarks
1	**Establishment of workers camp, material storage, work areas and parking areas**	**AIR** ➢ Site barricading before the commencement of construction work. ➢ Proper maintenance of equipment, including DGS set/s. ➢ Vehicles to be covered in case they are carrying construction materials or the like ➢ Vehicles to be well maintained to not release objectionable fumes ➢ Liquid fuels or electricity to be provided to workers by the contractor ➢ No fuel wood burning **WATER** ➢ Construct toilets for workers @ one toilet / 20 workers. ➢ Establish a septic tank with soak pit before the commencement of construction and connect each toilet to the septic system. ➢ Proper pest control, use of nets and regular monitoring **NOISE** ➢ Site barricading before the commencement of construction work ➢ Implementation of no-honking rules (except abnormal conditions) ➢ Vehicles with warning lights ➢ Roads on the construction site to have a median/partition for segregation of incoming and outgoing vehicles. ➢ Ensure proper maintenance and operation of DG set/s **SOIL**	**AIR** ➢ Site Barricading is and has been done at all necessary points and location. ➢ The contractor has been asked to monitor the heavy vehicles carrying construction materials to and from the project site. Private companies functioning from the project site has also been asked to ensure that their trucks carrying boulders or construction materials are all covered. ➢ Emission Test Certificates have been submitted to PIU and PIC. ➢ Electricity is provided by the contractor at the workers camp and the project office. ➢ The sites have no Fuel Woodburning activities **WATER** ➢ Toilets have been provided at the worker and office camps. Portable toilets are installed at the site where work is ongoing. ➢ Established soak pits and septic tank which is cleaned monthly or as and when required. ➢ Pest control is conducted by the Phuentsholing general hospital. Initially, pest control was to take place every six months, but the Phuentsholing hospital only conducts it once a year before or during the monsoon season, as they do not want the mosquitoes to become resistant to the medicine. Mosquito nets and repellent have been provided to the workers residing in the labour camp at the site. Mosquito repellent ointment was also handed out to all individuals who attended the session on Dengue and monsoon diseases.	Zone A	1st fogging and pest control was conducted on 26th July 2019 2nd fogging and pest control was conducted on 20th April 2020

		➢ Follow Construction & Demolition (C & D) Waste Management Plan **RISK/HAZARD** ➢ Follow Occupational Safety and Health Management Plan (OHSMP) ➢ Location of the camps should be at an elevation higher than the High Flood Level (HFL) of the River.	**NOISE** ➢ All the mentioned points have been maintained ➢ Project vehicles are prohibited from honking unnecessarily at the site except during necessary situations. Heavy vehicles are installed with back-up beeper, to alert individuals and vehicles while backing. ➢ Speed limit signage, speed bumps have been created every time the traffic has been diverted. Security guards have also been placed at the entry and exit points of the project. **SOIL** ➢ Construction and Demolition waste is being discarded properly as per waste management plan in the CEMP in their designated area **RISK/HAZARD** ➢ Following the OHSMP plan while ensuring the safety of the workers and the project. ➢ Location of camps is higher than the flood level of the river.		As a part of OHSMP, OHS training such as toolbox talks, and presentations by qualified individuals on various diseases are provided to individuals at the project site.
2	**Establishment of stores, warehouse and parking areas**	**WATER REGIME** ➢ Extract as per the EC issued on the EIA report. **RISK HAZARD** ➢ Pre-project job safety analysis to be done ➢ Worker safety training before commencement of work; use of personal protective equipment (PPE) as required. ➢ Preparation and implementation of OHSMP. ➢ Location of the equipment should be at an elevation higher than the HFL.	**WATER REGIME** ➢ Monitoring the change in waterways are taken at a frequency of twice every week from a designated location. **RISK HAZARD** ➢ Work safety training was provided to all workers and continue to be provided by the contractor every day in the form of toolbox and safety talks. ➢ Workers are provided with PPE and any required replacement of PPE is provided every morning. A safety inspector is at all locations where work is ongoing to ensure the safety of the workers, and the use of PPE.	Zone A	Storeroom, workshop and parking areas have been recognized and allocated at the project site. Contractors are to ensure that spillage from the workshop is contained

			➢ All OHS have been identified and mentioned with the respective management plans in the CEMP		
3	**Installation/establishment of Flood warning system**	**FLOOD RISK HAZARD** ➢ Construction of temporary gabion wall near the camp area and project start point. ➢ Designation of assembly points. ➢ Formulation of evacuation plan and Emergency response team. ➢ Identification of Flood monitoring stations at two locations extending beyond the project area	**FLOOD RISK HAZARD** ➢ An assembly point has been designated in the main worker and project office camp and in the locations where work is ongoing. ➢ Emergency Response Team and Evacuation Plans have been identified and set into place.	Zone A	Emergency siren has been installed at the project site 27th June 2019 Flood mock drill (Emergency evacuation briefing) was conducted on 20th August 2019 Mock drill on earthquake was conducted on 28th May 2020 Emergency Evacuation Mock drill
4	**Preparing roads for access to site and management of traffic**	**AIR** ➢ Ensure that road construction up to the construction site are sprinkled. ➢ Vehicles to be well maintained to not release objectionable fumes; ➢ Preparation and implementation of a Traffic and Safety Management Plan to ensure smooth traffic flow of project-related vehicles as well as other vehicles. **WATER** ➢ Provision of barriers drains to arrest such water runoff **NOISE**	**AIR** ➢ Sprinkling work is done regularly (approx. Once in two hours) or when sprinkling is required due to weather condition. Sprinkler log is also maintained by the drinker, which is attached as **Appendix 6** ➢ Traffic Survey is carried out once a month and is submitted with the monthly report as **Appendix 6** **WATER** ➢ All areas which are prone to runoff has been identified and outfall will be constructed in those areas. A total of 12 outfalls is to be constructed,	Zone A	Traffic Survey is carried out every month and submitted with the contractor's monthly report. Outfall design under process.

		➢ to maintain vehicles as per their maintenance schedule; ➢ limit access road construction working hours to daytime only **ECOLOGY** ➢ Provision of catch Pits/sedimentation tanks ➢ Provision of barriers drains to arrest such water runoff; **RISK/HAZARD** ➢ pre-project job safety analysis to be done ➢ worker safety training before commencement of work ➢ Use of Personal Protective Equipment (PPE) as required. ➢ Preparation and implementation of Occupational Safety and Health Management Plan (OHSMP) ➢ Preparation and implementation of a Traffic and Safety Management Plan to ensure smooth traffic flow of project-related vehicles as well as other vehicles. **FLOOD/BACKWATERS** ➢ Proper planning and development of the outfalls and their connection to the Amochhu or as side-channel	8 open outfall, and 4 closed/ducted outfall. These outfalls will help in guiding the flood or sedimentation into the river and not to the communities causing flooding. **NOISE** ➢ Each driver is responsible for one vehicle, and they are to ensure that the vehicles are well maintained, all documents are up to date and that they inform and update their respective HR. ➢ Project vehicles are to refrain from honking unnecessarily at the project site and all heavy vehicles are installed with back-up beeper, to alert individuals and vehicles while backing. ➢ Speed limit signage, speed bumps have been created every time the traffic has been diverted. Security guards have also been placed at the entry and exit points of the project. **ECOLOGY** ➢ All areas which are prone to runoff has been identified and outfall will be constructed in those areas. A total of 12 outfalls is to be constructed, 8 open outfall, and 4 closed/ducted outfall. These outfalls will help in guiding the flood or sedimentation into the river and not to the communities causing flooding. **RISK/HAZARD** ➢ Work safety training was provided to all workers and continue to be provided by the contractor every day in the form of toolbox and safety talks. ➢ Workers are provided with PPE and any required replacement of PPE is provided every morning. A safety inspector is at all locations where work is ongoing to ensure the safety of the workers, and the use of PPE.		

			➢ All OHS have been identified and mentioned with the respective management plans in the C.E.M.P **FLOOD/BACKWATERS** ➢ There are a total of 12 outfalls, 8 open and 4 closed/ducted in identified locations which are prone to runoff. The design is currently being finalized.		
5	**Solid Waste Management - Generation of Solid Wastes, Construction wastes and scrap**	**LAND** ➢ Ensure closed dust bins/waste containers ➢ Implement provisions of Bhutan's Waste Prevention and Management Regulation 2012, as amended in 2016 **WATER** ➢ Provision of drains with traps ➢ Provision of stormwater drains in the facility ➢ Clean-up of spillages **SOIL/LAND** ➢ Provision of impervious floors in the facility **RISK/HAZARD** ➢ Ensure closed dust bins/waste containers ➢ Implement provisions of Bhutan's Waste Prevention and Management Regulation 2012, as amended in 2016 ➢ Preparation and implementation of OHSMP ➢ Work with the Thromde to ensure proper collection and disposal of Municipal Solid Waste.	**LAND** ➢ Two large bins are installed outside the labour and office camp to dispose of domestic and kitchen waste from the office and labour camps. ➢ A designated location is allocated to dispose of the construction waste. **WATER** ➢ All areas which are prone to runoff has been identified and outfall will be constructed in those areas. A total of 12 outfalls is to be constructed, 8 open outfall, and 4 closed/ducted outfall. These outfalls will help in guiding the flood or sedimentation into the river and not to the communities causing flooding. **SOIL/LAND** ➢ Work or activities that involve the use of oil, which could cause spillage, the contractors are recommended to either cement the ground like at the workshop, use tarpaulin at the sites, and use trays to store the open oil barrels. **RISK/HAZARD** ➢ Two large bins are installed outside the labour and office camp to dispose of domestic and kitchen waste from the office and labour camps. ➢ The garbage bins are collected by the Thromde Municipality every two weeks or as and when requested.	Zone A	Data for solid waste management is submitted in the contractor's monthly report. May 2020 onwards the contractor has started keeping a record of three categories of waste generated from the project: Domestic waste, construction waste and liquid waste

6	**Removal of staff housing, equipment, labour camps and all temporary structures safely from the project site**	**WATER** ➢ Ensure that the decommission procedure clean-up of spillage ➢ Securing of wastes and their sale/disposal to authorised dealers/landfill or suitable disposal site. **NOISE** ➢ Provision of Noise barriers & enclosures ➢ Provision of earplugs ➢ Establish and supervise a waste collection and removal plan ➢ Comply with National Environmental Standards and International Good Practices. **RISK/HAZARDS** ➢ Follow the Occupational Safety and Health Management Plan (OHSMP) Plan	**WATER** ➢ To ensure that there is no spillage in the ground or the water, the contractor has ensured that all chemical liquid is stored properly in a tray, covered in a tarpaulin or stalled on top of a cemented ground. ➢ Waste from construction is reused and the non-reusable materials are **NOISE** ➢ All workers at the site are provided with earplugs to be used while machines which generate a lot of noise are in use or functioning. The operators are also recommended to close the doors of the machines to minimize the noise entering inside the operator's space. **RISK/HAZARDS** ➢ OHSMP is in place and is regularly monitored at the project site.	Zone A	The project is ongoing and removal of housing will only take place once the project is completed

8.4 Monitoring of environmental quality

38 The purpose of the environment quality monitoring is to collect data on air, water and noise quality for the project area during the construction phase, so that future variation could be assessed during or after the project implementation (operation phase). AFCONS has engaged Bhutan Ecolab Services, Phuentsholing for carrying out sampling and testing of these attributes.

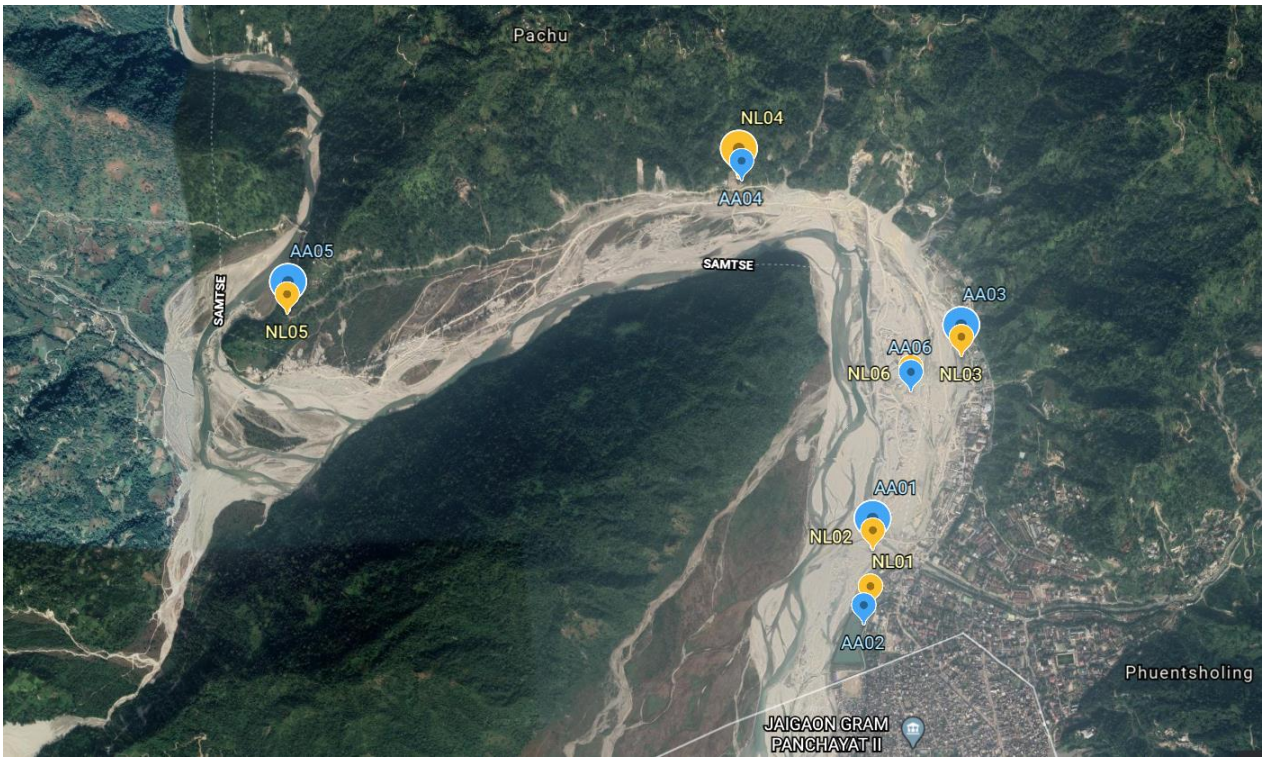


Figure 4:Air (AA01-AA06) and Noise (NL01-NL06) Monitoring Locations

8.4.1 Air Quality Monitoring

39 The PTDP project is monitoring air quality in the project site and adjacent areas. This task is carried out by M/s Bhutan Ecolab Services, a sub-contractor of AFCONS. Air quality is monitored every day for 24 hrs in six locations namely AA01 (Near B-Mobile Tower), AA02 (Near the STP plant), AA03 (NHDCL Colony), AA04 (Chamkuna Village), AA05 (Toorsa Tar Village) and AA06 (Near Rigsar's Batching Plant).

40 To ensure that the project is not causing or contributing towards the rising pollution in the project area, parameters like TSPM, PM 10, PM 2.5, NO_X, SO_2, and CO are being monitored regularly. To ensure the data generated is reliable, the project ensures that the measurement equipment is calibrated. Air and Noise monitoring equipment calibration certificates are provided in **Appendix II**. Depending on the results of the monthly tests, mitigation measures are being strictly implemented. An average of the data for air pollution for the past six months January – June is reflected in **Table 6.**

Table 6: Ambient Air Quality Monitoring data: Average for the period of January – June 2020

Station Code		TSPM (µg/m3)	PM10 (µg/m3)	PM2.5 (µg/m3)	NO_X (µg/m3)	SO_2 (µg/m3)	CO (ppm)
	NEC	**200**	**100**	**-**	**80**	**80**	**2000**

	Standard						
	IFC Standards	**-**	**150**	**75**	**125**	**200**	**160**
AA01 (Near Mobile Tower)	**Maximum**	148.21	67.03	45.38	BDL	BDL	BDL
	Minimum	14.53	8.21	2.93	BDL	BDL	BDL
	Average	58.62	28.42	14.64	BDL	BDL	BDL
AA02 (Near STP)	**Maximum**	70.98	46.06	18.87	BDL	BDL	BDL
	Minimum	12.84	3.03	2.12	BDL	BDL	BDL
	Average	24.26	15.17	8.05	BDL	BDL	BDL
AA03 (NHDCL Colony)	**Maximum**	46.80	22.20	16.09	BDL	BDL	BDL
	Minimum	11.17	5.64	3.88	BDL	BDL	BDL
	Average	25.11	12.92	8.22	BDL	BDL	BDL
AA04 (Near White Building)	**Maximum**	99.77	51.96	30.65	BDL	BDL	BDL
	Minimum	18.07	9.08	4.53	BDL	BDL	BDL
	Average	49.77	26.58	14.07	BDL	BDL	BDL
AA05 (Near the Shop)	**Maximum**	59.90	38.54	14.99	BDL	BDL	BDL
	Minimum	7.56	4.26	2.34	BDL	BDL	BDL
	Average	26.99	14.45	8.33	BDL	BDL	BDL
AA06 (Near Rigsar's Bathing Plant)	**Maximum**	180.93	83.14	54.80	2.08	BDL	BDL
	Minimum	37.43	16.87	8.36	BDL	BDL	BDL
	Average	83.69	43.31	25.26	0.71	BDL	BDL

41 Result and Interpretation of Air Quality Monitoring: The observed measurements for the air quality parameters comply with the National Ambient Air Quality Standards, **Figure 5** below is a graphical representation for TSPM, PM10 and PM2.5. In the average represented in the table above the three parameters: NOx, SO2 and CO were below detectable levels.

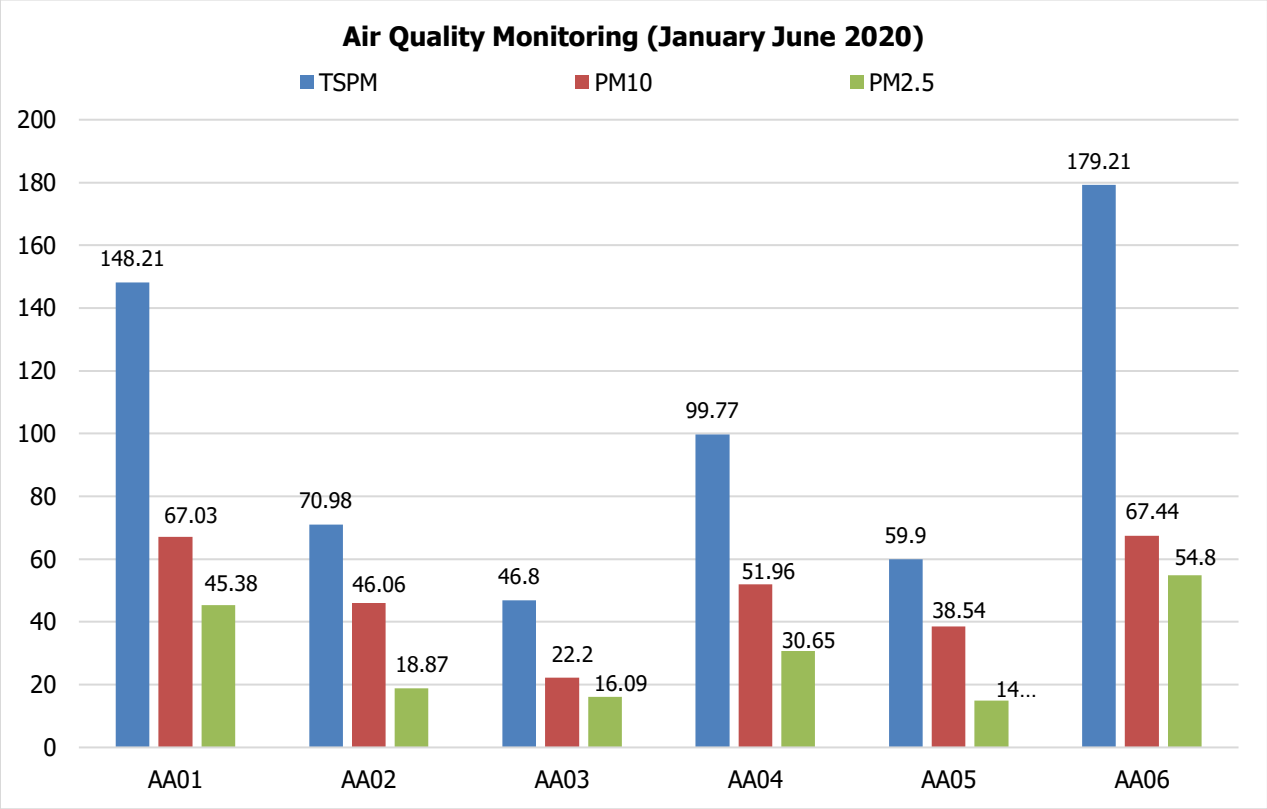


Figure 5: Graphical Representation of the Air quality (January - June 2020)

42 The cumulative air parameters for the past six months for all locations are within the NEC's permissible limits. Although every month, there are locations which indicate a high level of TSPM, PM10 or PM2.5. So far NOx, So2 and CO has either not been detected or is below the permissible limits. Recording of high air parameters is due to the location, the setup of the AQM equipment, activities around the AQM and natural factors. Point 43 provides a general overview of the pollution caused by external factors and activities currently ongoing beyond the project vicinity.

43 Non-compliance in ambient air quality is not only attributed to the project activities but owing to the following reasons:

i. *Ongoing developmental works under Phuentsholing Thromde:* Phuentsholing town is undergoing a major facelift and has multiple constructions going on simultaneously. As a result, dust from construction sites and dust and debris-laden are the primary sources of dust in the air. The increased traffic from recent export of river bed material has resulted in increased disturbance and suspended dust particles in the air along roads. The efforts of the project to suppress the dust through the sprinkling of water in and around the project site are simply not adequate to address the issue. This is particularly true during the dry winter and spring seasons covering January to May. This is further aggravated by from influx of people from colder places adding to the already congested traffic. During the winter, many people from around Bhutan come to Phuentsholing for their holiday due to perks such as warmer weather, for business and school shopping. Due to the increase of vehicular movements, and emission from vehicles increasing Nitrogen Oxide are some of the primary reasons for high pollution during those months. The dust levels from the movement of vehicles are occasionally high enough to obscure vision temporarily. Winds and gusts during the

spring season result in increased suspended particles in the air not only in the city but also in surrounding places.

ii. *Increased traffic from Phuentsholing - Samtse highway*: With the recent opening of Amochhu Bridge, the in-country road link between Phuentsholing and Samtse has led to increased traffic along the bare and unpaved road along the Amochhu. A combination of natural factors such as high temperature during summers, little rainfall during winters, wind and external factors such as unpaved roads, high vehicular movement, emission from the movement of vehicles cause increased suspended particles adding to the already polluted air in the area.

iii. *River bed material (RBM) extraction and Export:* The areas designated for the PTDP is also being used by other contractors who are engaged in extraction, accumulation and export of RBMs. In the last few months, the project has seen an increasing number of trucks parked along the highway, truck plying along the project road carrying construction materials, aggregates, and release of excess emission from the parked trucks along the highway and vehicles moving along PTDP road are all contributing towards a high level of pollution in the project area.

iv. Further, private firms like Rigsar and Yangkhil have not been granted extra time for collecting of RBMs from the Ammochhu River. Until May 2020 the dust pollution from their sites was due to loading and unloading of RBM, and movement of heavy uncovered vehicles. Starting May 2020, they have been moving their materials, and machines to evacuate the PTDP project site which is all a contributing factor towards air pollution especially in location 6. This increased traffic on the unpaved road within the project site contributes to the suspended particulate matters in the air.

v. Also, there are many workshops located along the highway and emissions from vehicles and equipment used from the workshops are another contributor to the high level of pollutants in the vicinity.

44 *Mitigation Measures:* To ensure that the project is not contributing towards the rising pollution in and around the project area, and impacting the communities living along with the township development, the project ensures that sprinkler trucks are being deployed regularly, speed limit signs have been raised in required locations, speed bumps have been formed along the Phuentsholing-Samtse Highway to ensure that vehicles do not speed, and all project vehicles carrying construction materials are covered in tarpaulin.

45 A traffic survey is also conducted every month by the contractors to study the number of times the project vehicles are using the highway in comparison to third-party vehicles. This study is conducted to ensure that project vehicles are not a major contributor to pollution. The detail of the traffic study is discussed in the subsequent **Section 9** of the report.

46 A sprinkler log sheet is also maintained by the contractors to keep track of the number of times the sprinkler trucks are being deployed, to settle the dust. The external parties carrying the RBM materials have also been informed through Phuentsholing Thromde and Department of Road (DoR) that all construction materials at the site should be covered in tarpaulin and a regular sprinkling activity must be carried out.

47 All workers at the site have been informed and encouraged to wear suitable gears and wear their N95 or equivalent mask at all times.

8.4.2 Noise Monitoring

48 Monitoring of noise levels is required to ensure that the noise generated from activities in the project area do not exceed the permissible level and that it does not cause nuisance and disturbance on a regular basis. Monitoring noise levels would allow for appropriate measures to be undertaken by project authority and contractor to take appropriate mitigation measures to maintain the noise levels within acceptable limits. AFCONS has also outsourced the work of noise monitoring to Bhutan Ecolab Services, who has conducted monitoring of sound levels during the day and at night in six locations on a daily basis.

49 The average noise levels monitored from January – June 2020 is reflected in **Table 7** and **Table 8** respectively.

Table 7: - Average Day time Ambient Noise monitoring for the period January – June 2020 (in decibels)

Sampling Code/Month	January	February	March	April	May	June	Average
NL01	50.1	56.1	55.5	62.1	60.1	44.19	54.68
NL02	69.5	79.1	77.9	45.1	69.1	41.54	63.71
NL03	61.5	66.7	68.1	61.7	63.1	53.25	62.39
NL04	54.2	61.1	65.3	61.2	73.2	52.31	61.22
NL05	60.1	69.5	72.4	61.1	65.6	51.4	63.35
NL06	71.2	75.1	78.8	68.5	71.3	58.5	70.57
NEC (Permissible level)	65	65	65	65	65	65	65
IFC (permissible level)	55	55	55	55	55	55	55

Table 8: Average night time Ambient Noise monitoring for the period January – June 2020 (in decibels)

Sampling Code/Month	January	February	March	April	May	June	Average
NL01	44.8	41.8	32.6	42.5	38.5	43.13	40.56
NL02	61.3	65.3	56.4	31.8	42.6	37.72	49.19
NL03	52.3	51.9	47.6	39.9	40.7	50.25	47.11
NL04	41.3	38.7	39.9	38.1	39.6	49.15	41.13
NL05	42.8	55.1	47.1	44.3	42.7	40.9	45.48
NL06	56.1	65.2	42.9	43.8	52.3	44.7	50.83
NEC (Permissible level)	55	55	55	55	55	55	55
IFC (permissible level)	45	45	45	45	45	45	45

50 Result and Interpretation of Noise Monitoring data: As reflected in the tables above and demonstrated in **Figure 6** below, day time noise levels during the period January – June 2020 were much higher in comparison to the night time noise levels. Day time noise levels for NL02, NL03, NL04, NL05 and NL06 surpass the permissible limits for most of the months. NL01 was the only station that was within the permissible limits in all months, and June was the only month where all locations were within the permissible limits as evident in **Table 7** above.

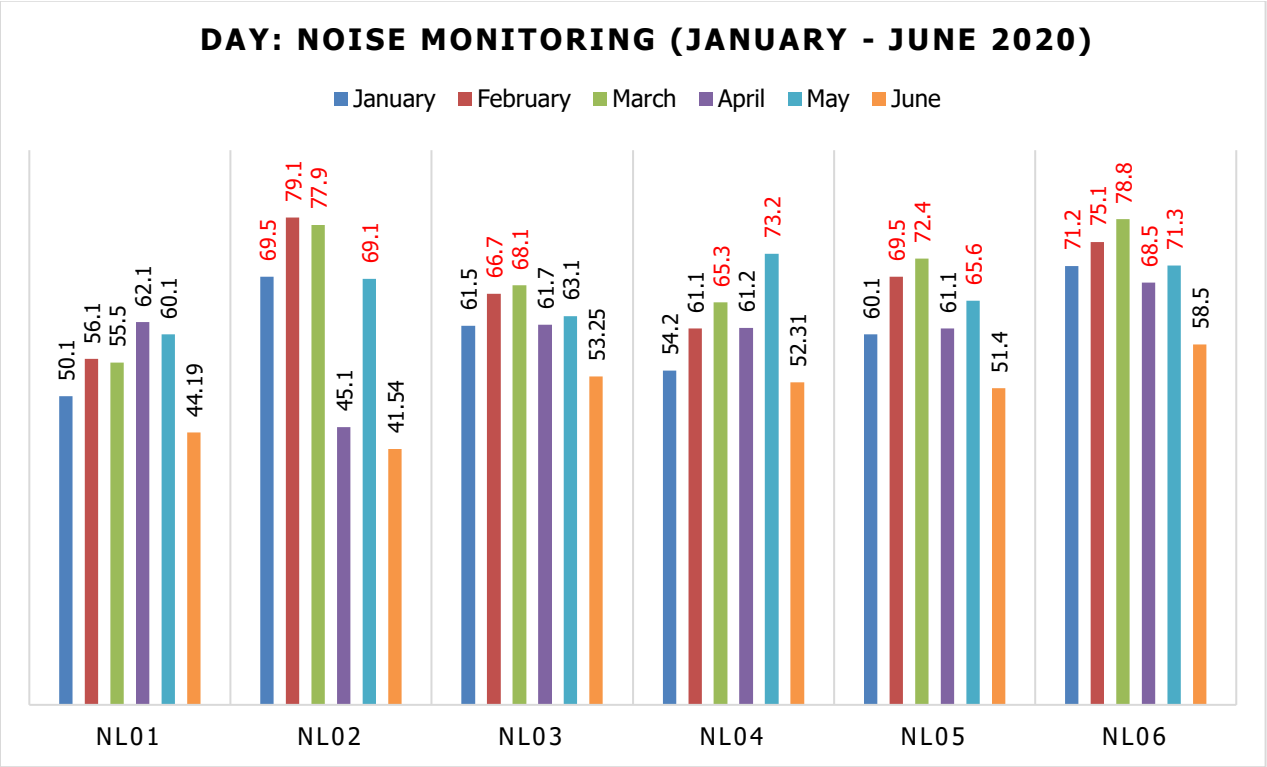


Figure 6: Graphical representation of Ambient Noise Quality during day time (January - June 2020)

51 Night time noise levels were generally within the standards except for NL02 which recorded noise level above the permissible limits in January, February & March, and NL06 which recorded higher noise level in January & February as evident in **Table 8**. Refer to **Figure 6** below for a graphical representation.

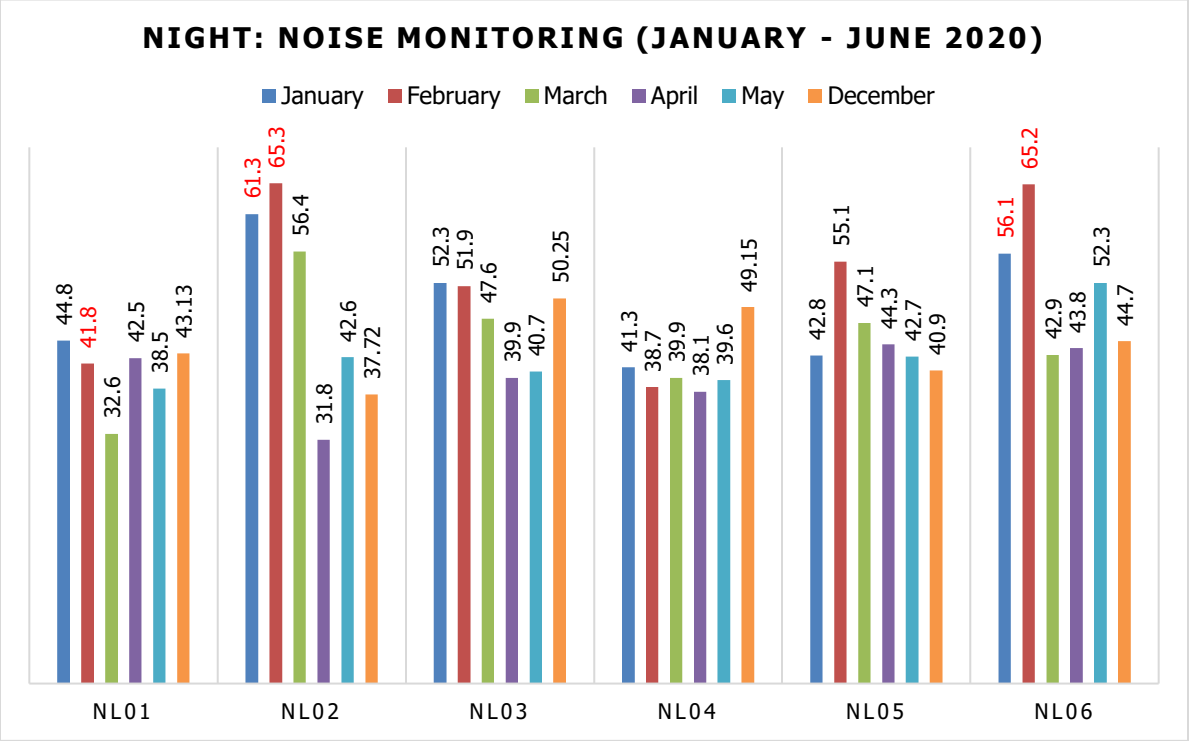


Figure 7:Graphical Representation of Ambient Air quality at night (January – June 2020)

52 Again, this observed non-compliance to national noise level standards cannot only be attributed to the PTDP activities. Locations NL01, NL02 and NL03 are situated away from the main PTDP project site. Monitoring noise levels in these areas enable the project to compare and assess the project's contribution to noise levels in the area. These observations indicated that economic activities in areas adjacent to the project site are also a major contributing factor towards increased noise levels in the area. Much of this increased noise level may be attributed to the hastened engagement of private firms in extraction and accumulation of river bed materials for export to Bangladesh. The associated increase in economic activity include:

i. Increased traffic and constricted road access from several trucks parked along the Phuentsholing-Samtse highway, which run parallel to the project site. In the last three months, the project has seen a growing number of heavy vehicles and economic activities causing air pollution from vehicle emission from, but congestion for daily commuters leading to constant honking, and running engines all contributing towards the rise in noise level in the vicinity.

ii. Increased business establishments and economic activities in areas adjacent to the project site: The areas adjacent to the project site are parts of the expanded Phuentsholing municipality. Over the last few years, the areas along the Amochhu has undergone unplanned development wherein businesses and economic activities have picked up owing the opening of Phuentsholing-Samtse highway, the increased value of land driven by the perceived future benefits of PTDP, and the recent rush for river bed material extraction, accumulation and export. Many shops, vehicle repair workshops and human settlements along the highway and associated economic activities have made the area less tranquil. The use of machinery, equipment, and vehicles are major contributors to the increased noise levels in the vicinity.

iii. In the last three months Phuentsholing has received a lot of heavy rainfall, which was sometimes accompanied by thunderstorm, which are also possible factors contributing towards high level of noise

iv. While the project restricts the use of heavy machinery, equipment and vehicles to regular working hours, the same does not apply to the private firms.

v. The noise generated during the testing are not permanent, and will not have any future impact.

53 Mitigation Measures: Many external factors are contributing to the rise in noise pollution which is beyond the authority of the project management to control, but sounds generated from the PTDP project activities are monitored and controlled. Contractors are constantly advised to restrict use of heavy machinery to normal working hours. Contractors are also required to ensure that all workers living in the camps do not create too much noise which could disturb the neighbouring households. All project drivers are also prohibited from unnecessarily honking in the vicinity.

54 All workers at the site have been informed and encouraged to wear suitable gears and wear their earplugs at all times or while operating noisy heavy machinery.

8.4.3 Surface Water Quality

Figure 8:Surface Water (SW01-SW10), Ground Water (GW01-GW02), Water Regime and Water Level Monitoring Stations

55 The surface water test is conducted to ensure that the project does not pollute and impact the Amochhu River. Of the ten water quality sampling stations (SW01-SW10), monthly tests are conducted in SW04 & SW05 which are points right above and below the project camp area. This is to monitor and ensure that any camp or project activities are not contributing towards any form of pollution along that stretch of the river. Whereas a pre and post-monsoon water quality test encompassing SW01-SW10 are conducted every six months. Surface water quality test for all stations SW01-SW10 was conducted in March 2020.

56 The data for surface water quality monitoring for the past six months are reflected in **Table 9** and **Table 10**. Except for total suspended solids (TSS), all other water quality parameters are well within

the permissible levels. The high content of TSS may be attributed to the monsoon rains and associated soil upstream erosion, which is a normal phenomenon in the monsoon season. Observed test results non-compliant to the standards are flagged with shaded cells.

Table 9: Surface Water monitoring (January – June 2020) for SW04

Parameter	Unit	Ambient Water Quality Standards as per ES 2010			IFC Standard	Months						
		A Very Good	B Good	C Moderate		Jan	Feb	March	April	May	June	Average
pH		6.5-8.5	6-9	6-9	6-9	8.36	7.15	7.64	7.48	7.87	7.87	7.73
Electrical Conductivity	**µs/cm**	800	1000	2000	-	234	10.4	217.6	167.6	168	179	162.77
Total Dissolved Solute (TDS)	**mg/L**	-	-	-	-	117	109	107.4	79	88.9	127	104.72
Temperature		-	-	-	-	13.79	16.5	17.88	18.6	20.16	18.17	17.52
Biochemical Oxygen Demand	**mg/L**	2	5	50	30	5.82	5.91	3.71	6.092	12.904	9.074	7.25
Chemical Oxygen Demand	**mg/L**	-	-	-	125	10.052	11.79	7.95	12.28	37.031	32.105	18.53
TSS	**mg/L**	25	100	-	50	72.3	59.8	76.83	58.104	287.94	327.94	147.15
Salinity	**Hz**	-	-	-	-	0.11	0.23	0.13	0.08	0.085	0.071	0.12
Dissolved Oxygen	**mg/L**	6	4	-	-	9.17	6.87	11.08	10.86	10.23	11.32	9.92
Phenol	**Mg/L**	0.001	0.002	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate	**mg/L**	25	100	-	-	0.651	BDL	1.548	0.326	0.0872	0.0523	0.53
Nitrate	**mg/L**	10	50	-	-	1.973	1.482	7.205	2.031	1.903	2.701	2.88
Fluoride	**mg/L**	1	2	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
SAR	**mg/L**	-	-	26	-	0.37	0.34	1.37	0.28	0.418	0.305	0.51

Ammonical Nitrogen	**mg/L**	-	-	-	-	1.093	1.27	0.018	0.903	0.0065	0.0071	0.55
Magnesium	**mg/L**	-	-	-	-	BDL	BDL	1.726	BDL	0.0718	0.061	0.62
Sodium	**mg/L**	-	-	-	-	4.87	3.891	5.037	3.2	1.985	2.088	3.51
Potassium	**mg/L**	-	-	-	-	1.051	1.207	0.931	1.038	0.069	0.043	0.72
Chloride	**mg/L**	-	-	-	-	2.17	2.61	2.083	1.902	3.081	2.33	2.36
Cyanide	**mg/L**	0.05	0.05	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heavy Metal: Lead	**mg/L**	0.002	0.02	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Total Coliform	**mg/L**	50	5000	10000	400	17	13	13	8	8	13	12.00
Faecal Coliform	**MPN/ 100ml**	20	2000	5000	-	15	19	5	4	3	11	9.50
Odour	**MPN/ 100ml**	unobjectionable	unobjectionable	-	-	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable
Mineral Oil		No Film	No Film	-	-	No Film	No Film	No Film	No Film	No Film	No Film	No Film
Iron*	**mg/l**	No permissible limit but recommended <0.3			-	-	-	-	-	0.058	0.095	0.08
Manganese*	**mg/l**	0.4 maximum permissible limit			-	-	-	-	-	BDL	BDL	BDL
Arsenic*	**mg/l**	Maximum permissible limit 0.01			-	-	-	-	-	BDL	BDL	BDL
Color	**PCU**	5	50	-	-	-	-	-	-	-	0.35	0.35
Turbidity*	**NTU**	Maximum permission limit is 5			-	-	-	-	-	-	35.49	35.49

Table 10: Surface Water Monitoring from January – June 2020 for SW05

Parameter	Unit	Ambient Water Quality Standards as per ES 2010			IFC Standard	Months						
		A Very Good	B Good	C Moderate		Jan	Feb	March	April	May	June	Average
pH		6.5-8.5	6-9	6-9	6-9	8.12	7.14	7.48	7.69	7.95	7.95	7.72
Electrical Conductivity	**µs/cm**	800	1000	2000	-	226	10.3	231.4	143	132.6	174	152.88
Total Dissolved Solute (TDS)	**mg/L**	-	-	-	-	119	113	213.5	65.6	68.7	132	118.63
Temperature		-	-	-	-	14.29	16.7	18.15	18.76	19.87	18.09	17.64
Biochemical Oxygen Demand	**mg/L**	2	5	50	30	4.85	5.94	4.82	3.98	3.061	10.012	5.44
Chemical Oxygen Demand	**mg/L**	-	-	-	125	7.91	11.71	5.039	9.023	10.708	36.022	13.40
TSS	**mg/L**	25	100	-	50	63.8	42.7	128	49.27	68.3	385.61	122.95
Salinity	**Hz**	-	-	-	-	0.11	0.15	0.21	0.06	0.06	0.07	0.11
Dissolved Oxygen	**mg/L**	6	4	-	-	12.14	5.61	9.75	11.85	9.86	10.99	10.03
Phenol	**Mg/L**	0.001	0.002	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate	**mg/L**	25	100	-	-	0.681	BDL	2.708	BDL	0.073	0.049	0.88
Nitrate	**mg/L**	10	50	-	-	2.86	2.095	6.014	2.69	1.965	2.041	2.94
Fluoride	**mg/L**	1	2	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
SAR	**mg/L**	-	-	26	-	0.39	0.28	1.402	0.036	0.058	0.32	0.41
Ammonical Nitrogen	**mg/L**	-	-	-	-	1.314	1.093	0.018	BDL	0.0083	0.0056	0.49

Magnesium	**mg/L**	-	-	-	-	BDL	BDL	2.061	BDL	BDL	0.048	1.05
Sodium	**mg/L**	-	-	-	-	4.81	4.17	8.052	3.005	3.782	1.875	4.28
Potassium	**mg/L**	-	-	-	-	1.062	1.081	1.095	0.861	0.825	0.081	0.83
Chloride	**mg/L**	-	-	-	-	2.921	2.79	7.04	1.872	0.917	2.051	2.93
Cyanide	**mg/L**	0.05	0.05	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heavy Metal: Lead	**mg/L**	0.002	0.02	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Total Coliform	**mg/L**	50	5000	10000	400	15	8	13	6	9	26	12.83
Faecal Coliform	**MPN/ 100ml**	20	2000	5000	-	11	7	6	10	4	17	9.17
Odour	**MPN/ 100ml**	unobjectionable	unobjectionable	-	-	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable	unobjectionable
Mineral Oil		No Film	No Film	-	-	No Film	No Film	No Film	No Film	No Film	No Film	No Film
Iron*	**mg/l**	No permissible limit but recommended <0.3			-	-	-	-	-	0.071	0.043	0.06
Manganese*	**mg/l**	0.4 maximum permissible limit			-	-	-	-	-	BDL	BDL	BDL
Arsenic*	**mg/l**	Maximum permissible limit 0.01			-	-	-	-	-	BDL	BDL	BDL
Color	**PCU**	5	50	-	-	-	-	-	-	-	0.46	0.46
Turbidity*	**NTU**	Maximum permission limit is 5			-	-	-	-	-	-	41.07	41.07

57 The pre-monsoon water quality test was carried out by the contractor in March 2020. The results of the tests carried out for all the monitoring stations are presented in **Table 11** below. Observed test results non-compliant to the standards are flagged with shaded cells.

Table 11: Surface Water Monitoring for March (SW01-SW10)

Parameter	Unit	Ambient Water Quality Standards as per ES 2010			IFC Standard	Monitoring Stations									
		A Very Good	B Good	C Moderate		SW01	SW02	SW03	SW04	SW05	SW06	SW07	SW08	SW09	SW10
pH		6.5-8.5	6-9	6-9	6-9	7.64	7.97	7.85	7.64	7.48	8.37	8.37	7.96	8.32	8.87
Electrical Conductivity	**µs/cm**	800	1000	2000	-	601	206	221	217.6	231.4	236.7	204	1053	224	589.6
Total Dissolved Solute (TDS)	**mg/L**	-	-	-	-	298	104	111	107.4	213.5	113.6	103	524.6	113	299
Temperature		-	-	-	-	20.5	17.92	18.78	17.88	18.15	18.22	16.92	20.93	18.2	21.66
Biochemical Oxygen Demand	**mg/L**	2	5	50	30	5.072	3.89	3.281	3.71	4.82	13.08	3.061	3.021	6.093	9.08
Chemical Oxygen Demand	**mg/L**	-	-	-	125	7.021	7.541	5.093	7.95	5.039	23.07	5.807	4.809	13.78	18.76
TSS	**mg/L**	25	100	-	50	26.12	125.8	98.65	76.83	128	107.04	87.5	46.7	67.92	98.35
Salinity	**Hz**	-	-	-	-	0.05	0.23	0.34	0.41	0.53	0.52	0.3	0.03	0.43	0.41
Dissolved Oxygen	**mg/L**	6	4	-	-	9.83	11.83	9.85	11.08	9.75	8.97	12.08	10.89	8.97	8.32
Phenol	**Mg/L**	0.001	0.002	-	-	0.046	0.1	0.12	0.13	0.21	0.11	0.1	0.52	0.13	0.29
Sulphate	**mg/L**	25	100	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Nitrate	**mg/L**	10	50	-	-	0.871	1.872	1.942	1.548	2.708	3.072	0.896	0.056	2.809	2.031

Fluoride	**mg/L**	1	2	-	-	4.719	7.31	7.025	7.205	6.014	6.083	7.106	4.033	4.066	3.063
SAR	**mg/L**	-	-	26	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ammonical Nitrogen	**mg/L**	-	-	-	-	1.83	1.052	2.004	1.37	1.402	2.23	2.032	1.092	2.105	0.964
Magnesium	**mg/L**	-	-	-	-	0.527	0.471	0.371	0.018	0.018	0.047	0.078	BDL	0.307	0.32
Sodium	**mg/L**	-	-	-	-	0.92	2.613	1.864	1.726	2.061	2.373	2.495	3.081	2.017	2.803
Potassium	**mg/L**	-	-	-	-	2.685	5.081	2.803	5.037	8.052	5.077	1.893	3.27	5.22	3.504
Chloride	**mg/L**	-	-	-	-	1.973	1.64	1.53	0.931	1.095	2.21	0.839	0.063	1.974	0.097
Cyanide	**mg/L**	0.05	0.05	-	-	0.872	3.016	3.081	2.083	7.04	5.026	2.045	10.4	6.081	9.509
Heavy Metal: Lead	**mg/L**	0.002	0.02	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Total Coliform	**mg/L**	50	5000	10000	400	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Faecal Coliform	**MPN/100ml**	20	2000	5000	-	5	7	7	13	13	14	5	BDL	9	13
Odour	**MPN/100ml**	unobjectionable	unobjectionable	-	-	3	4	3	5	6	7	2	BDL	4	8
Mineral Oil		No Film	No Film	-	-	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No Film	No Film

58 Interpretation of water quality monitoring results: The water quality monitoring results reveal the water quality in the project area has been primarily in good condition during the reporting period. The results for SW04 and SW05 for the period from January – June 2020 reflects that all parameters are within the permissible limits except high TSS in the monsoon months. For the pre-monsoon monitoring carried out in March for the ten locations SW01 to SW10 also revealed that the quality of water has been good except for high TSS and DO in most of the locations, which may be attributed to upstream disturbance and developmental activities.

59 One of the main causes of high TSS could be due to the heavy rainfall, which increases the river turbidity, thus increasing siltation and sedimentation in the river. Other factors such as disposal of materials from construction sites along the Omchhu, and industrial waste (from Karma steel) and settlements along the Omchhu are all factors contributing towards high TSS.

60 The data for surface water for all tests recorded high Dissolved Oxygen concentration, which is not necessarily considered bad, but instead high DO is considered to be good especially for the aquatic life. But too high (No permissible limit) or below the permissible limit could be harmful to the aquatic life. DO in a freshwater system like the Omchhu and Amochhu River will vary depending on the season, location and water depth. Due to Phuentsholing town's geographical location at a lower altitude, the rivers can hold more dissolved oxygen in comparison to a higher altitude. In addition to the change in climate, heavy rainfall causing an influx of stormwater, which leads to an increase in the water level and decrease in the water temperature are all contributors towards a higher DO

61 Mitigation Measures: There is a limited option for the project to address the high TSS in the water bodies in and around the project site considering that the sources of suspended solids are in the upper watershed areas. However, PTDP will need to continue with its efforts to ensure that the project is not contributing to the turbidity and pollution of the river. The project needs to ensure that the following activities are undertaken:

- Properly collecting and disposing of all waste
- No dumping of construction materials along the riverbed or in the river
- Ensure that all construction materials are well covered
- Ensure that all restrooms in the project and campsites are well maintained so that workers are discouraged from defecating around the project vicinity or near the river
- Making sure the septic system at the project site and camps are functional and well maintained
- Landscaping and greening the office premises and camps with native plants

8.4.4 Ground Water Quality Monitoring

62 Groundwater testing is done every six months at two tube wells which are used for drinking and domestic use in the stockyard and the campsite to prevent any form of contamination due to oil and grease spillage.

63 For May, monitoring of groundwater contamination was conducted at two points GW01 (Camp area) and GW02 which was previously in the Office area, has now been shifted to Rigsar's campsite. This change in location was arranged during the ADB missions visit to the Rigsar campsite on November 1st. During the visit observations of spillage of grease and oil from the workshops was noted, and noticed

a high chance of it seeping into the Amochhu River and the water being used by the workers. Keeping the risk factors to the workers and the aquatic life in the Amochhu in mind, the change in location was decided.

64 As shown in **Tables 12**, all groundwater parameters are within the permissible limits stipulated by the NEC, except for Dissolved Oxygen and Iron in both locations.

Table 12: Ground Water Quality Monitoring for May

SL. No.	Parameter	Unit	Ambient Water Quality Standards as per NEC			IFC standards	GW01	GW02
			A (Very Good)	B (Good)	C (Moderate)			
1	**pH**			6-9	6-9	6-9	7.28	7.43
2	**Electrical Conductivity**	**µs/cm**	800	1000	2000	-	127	181.3
3	**Total Dissolved Solute (TDS)**	**mg/l**	-	-	-	-	92	104
4	**Temperature**	**˚C**	-	-	-	30	20.62	20.14
5	**Biochemical Oxygen Demand**	**mg/l**	2	5	50	30	0.097	0.085
6	**Chemical Oxygen Demand**	**mg/l**	-	-	-	125	0.209	0.503
7	**TSS**	**mg/l**	25	100	-	50	3.815	2.105
8	**Salinity**	**PSU**	-	-	-	-	0.02	0.04
9	**Dissolved Oxygen**	**mg/l**	6	4	-	-	10.97	9.62
10	**Phenol**	**mg/l**	0.001	0.002	-	-	BDL	BDL
11	**Sulphate**	**mg/l**	25	100	-	-	BDL	BDL
12	**Nitrate**	**mg/l**	10	50	-	-	0.017	0.031
13	**Fluoride**	**mg/l**	1.0	2.0	-	-	BDL	BDL
14	**SAR**	**mg/l**	-	-	26	-	0.045	0.037
15	**Ammonical Nitrogen**	**mg/l**	-	-	-	-	BDL	BDL
16	**Magnesium**	**mg/l**	-	-	-	-	BDL	BDL
17	**Sodium**	**mg/l**	-	-	-	-	1.073	1.401
18	**Potassium**	**mg/l**	-	-	-	-	0.058	0.073
19	**Chloride**	**mg/l**				-	BDL	BDL

SL. No.	Parameter	Unit	Ambient Water Quality Standards as per NEC			IFC standards	GW01	GW02
			A (Very Good)	B (Good)	C (Moderate)			
20	**Cyanide**	**mg/l**	0.05	0.05	-	-	BDL	BDL
21	**Heavy Metal: Lead**	**mg/l**	0.002	0.02	-	-	BDL	BDL
22	**Total Coliform**	**MPN/ 100ml**	50	5000	10000	400	3	BDL
23	**Faecal Coliform**	**MPN/ 100ml**	20	2000	5000	-	BDL	BDL
24	**Iron***	**mg/l**	No permissible limit but recommended <0.3			-	0.709	0.924
25	**Manganese***	**mg/l**	0.4 maximum permissible limit			-	BDL	BDL
26	**Arsenic***	**mg/l**	Maximum permissible limit 0.01			-	BDL	BDL

65 Interpretation of water quality monitoring results: The only parameters detected above the permissible limits was the Dissolved Oxygen (DO) for both GW01 and GW02.
High Dissolved Oxygen in both locations could be high because the samples were bottled from a booster pump pipeline, and oxygen from the air-water interface might have added to the oxygen level. Another factor is cooler water has a greater oxygen dissolving capacity, and given the current situation of change in climate and the constant rainfall, explains the higher oxygen level for May.
Iron is commonly found in water and are essential elements required in small amounts by all living organisms. The concentration of iron in groundwater can fluctuate seasonally and vary with the depth and location and the geology of an area. The most common sources of iron in groundwater are naturally occurring, for example from weathering of iron. Water with a high concentration of iron may cause the staining of plumbing fixtures. Since the level of Iron detected during the Groundwater test is not alarmingly high it should not be of much concern. But it needs to continuously be monitored and ensured that it does not further increase.

66 Mitigation Measures: The cause of high Iron is due to external and natural factors, the PTDP can only ensure that our project and camp activities are not contributing towards the pollution. This can be achieved by ensuring that camp or project sites are:

- Properly collecting and disposing of all waste
- All canisters containing oil and grease are well stored and covered
- Ensure that all construction materials are well covered
- Ensure that all restrooms in the project and campsites are well maintained so that workers are discouraged from defecating around the project vicinity or near the river
- Making sure to service the septic system at the project site and camps
- Landscaping the project office and camps with native plants
- Pitcher-type carbon filtration units can remove some forms of iron

- Water treatment with chlorine, ozone or by adding chemicals that cause the metals to form a solid that will settle or be filtered out
- Water treatment methods such as ion exchange, oxidizing filters, and reverse osmosis can also be used but these have variable effectiveness and may be expensive for small water systems or households.

8.4.5 Water Level Monitoring

67 The first water level monitoring was conducted on 4th May 2019. This monitoring is being conducted twice every week (Mondays and Saturdays) between part 5 & 6, where construction activities are currently ongoing. This monitoring is conducted to monitor the increase and decrease in the Amochhu water level. This monitoring is also another way to foresee any warning signs of flooding in the project area.

68 For January an average water level change of 0.142m was noted since the initial measurement which was conducted on the 4th and the last test on the 27th of January 2020. For February an average water level change of – 0.113 m was noted since the initial measurement which was conducted on the 1st and the last test on the 29th of February 2020. For March water level change of – 0.774 m was noted since the initial measurement which was conducted on the 2nd and the last test on the 30th March 2020. Due to the dry season with hardly much rainfall, the river was flowing at its narrow original state with the decreased water level.

69 For April, Water level change of 0.092m was noted since the initial measurement which was conducted on the 4th April and the last test on the 30th April 2020. For May, an average water level change of 0.262 m was noted since the initial measurement which was conducted on the 2nd and the last test conducted on 30th May 2020. For June, water level change of 0.529 m was noted since the initial measurement which was conducted on the 1st and the last test conducted on 29th June 2020. With the onset of the monsoon season and heavy rainfall the river level has risen, the river level has increased, is wider and getting closer to the river banks.

8.4.6 Water Regime Monitoring

70 The first water regime monitoring was conducted on 7th March 2019. Pictures of the river will be taken by the contractors twice every week. This monitoring is being conducted, so that the project can record the change in waterways and water level, and examine and analyse the information to ensure that the project will not be impacted.

71 **Figure 8** reflects the images of the changes in waterways for the period of January – June 2020. Due to the heavy rainfall experienced during the monsoon season (March – June), the waterways have changed and water levels have increased. The river has diverted its course and has become wider and has come closer to the river banks. Whereas in comparison for the months from January - February the change in waterways was very minimal. This was due to the dry season, where Phuentsholing hardly received any rainfall, the river was diverted back to its original course. Due to the decrease in water level, the current reduced and the water had moved away from the river bed to its natural course.

Figure 9:Images of Water Regime from January – June 2020


Time: 13:50
26/04/2020


Time: 11:35
30/05/2020


Time: 12:45
20/06/2020

8.4.7 Ground Contamination

72 To ensure that the contractor puts in place the mechanisms to prevent ground contamination from the use of oil and grease for the machinery. While the contractors have been using trays to collect used oil in addition to the already cemented floor in the workshop, evidence of oil and grease leakages were observed in many spots around the project sites. This could be from private vehicles plying through the project site as well as from spillage during movement of barrels or from overflowing of the tray containers.

73 Several strategies for remediation are:
- The encapsulation process to ensure that contaminants do not spread any further.
- Thermal soil process is by baking the contaminated soil so contaminants evaporate and then disposing of the soil.
- Excavate soil and take it to a disposal site away from ready pathways for human or sensitive ecosystem contact.
- Containment of the soil contaminants such as capping or paving over in place.
- Contractor to record oil and grease contamination from private vehicles and inform project management to take action or report to the concerned authority.

8.4.8 Waste Management

74 Although waste was being segregated and collected by the contractors, details of how much waste was produced each month were only generated from March, after PIU and PIC recommended to incorporate the details. This information is required to help the contractor and project authority to prevent the generation of excess solid and liquid wastes and to ensure that wastes generated are properly disposed of. The measures put in place by the contractor include i) segregation of biodegradable and degradable wastes, ii) provision of dust bins in office and camp premises and iii) installation of large coloured bins for collection and storage of waste.

75 Upon recommendation from PIU and PIC, the contractor started submitting a data log of all the various waste generated at the project site starting May 2020. **Table 13** reflects the three categories of waste generated from the project: Domestic, construction and liquid waste. The domestic & liquid wastes are disposed of monthly or upon requirement and accordingly request the municipal garbage & sewage collection services for which the project pays a nominal service fee, and construction waste are either reused or discarded in an already identified location.

76 *Domestic Waste*: Domestic waste is the everyday trash generated from the office and labour camp spaces and the kitchen. Domestic waste is segregated into Degradable waste i.e. food waste and other relative biodegradable waste and non-degradable waste

77 Degradable Waste: Waste that decomposes naturally in the environment and is considered beneficial if discarded in a compost pit. Degradable/organic waste consists of vegetables, fruit peels, plants etc. waste.

78 Non-biodegradable/Recyclable Waste: These are waste that cannot be broken down by natural organisms and cannot be decomposed by natural agents. They consist of waste like paper, plastic, cardboard and other miscellaneous office and camp waste.

79 *Construction Waste:* These are the heterogeneous building waste materials which are produced from the PTDP construction activities. The three listed materials: Bentonite, cement waste and bags, and scarps, are the most commonly used materials and waste generated at the project site.

80 *Liquid Waste:* Liquid Waste refers to Greywater from the kitchens and toilets. The respective Grey Water sources have proper drainage lines. The drainage line for the toilet block connects to the septic tank followed by a soak pit. The sludge from the septic tank is cleaned as per requirement.

81 Colour-coded bins have been installed in the project and campsites. Blue for degradable and Green for biodegradable waste. The Phuentsholing Thromde Municipality makes a bi-weekly or monthly trip to collect waste from the project site. A monthly record is maintained by the contractors to understand the amount of waste generated

Table 13: Waste generated from January - June 2020

Type of Waste Generated	Months						Management Procedure
	January	February	March	April	May	June	
Domestic Waste							
Degradable	1.45 MT	1.86 MT	1.45 MT	1.67 MT	1.7 MT	1.5 MT	Collectively dumped in the Green colour bins; when the bin is full, it is then taken by Phuentsholing Thromde and emptied in a designated landfill site.
Non-degradable	1 MT	1.4 MT	1 MT	1.3 MT	1.4 MT	1.3 MT	Collectively dumped in the Blue colour bins; when the bin is full, it is then taken by Phuentsholing Thromde and emptied in a designated landfill site.
Construction Waste							
Bentonite	-	-	-	-	0 MT	0 MT	Bentonite ($Al_2H_2Na_2O_{13}Si_4$) from the Diaphragm wall is used/ reused for maximum number of times (approx. 4-5 panels).
Cement waste and cement bags	-	-	-	-	1.23 MT	0.73 MT	Concrete waste is being dumped in designated pits strategically located at outfall 1, 2A, 4 and 7. If the concrete waste is in a large quantity then it is used in other construction actives. Cement bags are used as stop end supports in Diaphragm Wall
Scraps	-	-	-	-	0.75 MT	1.2 MT	Steel and Metal waste generated is being collected in respective scrap yards.
Liquid Waste							
Waste Water plus sludge	-	-	-	-	0.91 MG	0.52 MG	The septic tanks are cleared in coordination with Phuentsholing Thromde as per requirement

MT: Metric Tonne
MG: Million Gallons

8.4.9 Ecological Study

82 The PTDP is required to constantly monitor the aquatic and terrestrial ecology of the areas in and around the project site. The requirement is placed on the contractor, which has outsourced the job to Bhutan Ecolab consultants.

83 The ecological study comprises of two components: Aquatic and Terrestrial survey. The study was proposed to be carried out every quarterly as per the CEMP. However, after the ADB mission visit in May 2019, the study was agreed to be carried out bi-annually with each study covering all 4 seasons.

84 The study is being conducted to comprehend the diversity of species (both aquatic and terrestrial) in the PTDP project area. On May 14th 2020, the third aquatic report was submitted and the fourth terrestrial report was submitted on 29th June 2020.

85 **Aquatic Survey:** The objective of the survey is to assess and determine the diversity of fish species in the Amochhu basin. The third Aquatic survey (Second Pre-monsoon survey) (Please refer to **Appendix III** for the complete Aquatic Report) was conducted from 26th – 27th March 2020 for which approval was sought from the Department of Forest and Park Service. The details are as follows:

- The catch and release approach was adopted at all the sampling points. Electrofishing method was used to conduct this survey. Using Electro-Fisher device (DC 3 KW electro shocker. ELT 62-II D, Grassl, Germany) by pulsing (12 V) DC for about 2 to 3 second into the water, which temporarily immobilized the fish. Dip net was used to catch the fishes. Fishes were placed in transparent photarium and photographed, and measured before releasing back into the river.
- Ten sites were located to conduct the fish sampling
- During the study, a total of 27 species of fishes were found which are reflected in tables 14, 15 & 16. The status of these species as per the Forest and Nature Conservation Regulations of Bhutan (FNCR) and the International Union for Conservation of Nature (IUCN) were identified in the EIA report as given below:

Table 14: List of fish species belonging to order Cypriniformis

Family Cyprinidae	IUCN Red List Status	Last Assessed as per IUCN
1. Barilius barna	Least Concern	19/03/2011
2. Barilius bendelisis	Least Concern	22/01/2010
3. Barilius vagra	Least Concern	22/01/2010
4. Crossocheilus latius	Least Concern	09/10/2009
5. Garra annandalei	Least Concern	09/10/2009
6. Garra gotyla	Least Concern	07/10/2009
7. Neolissochilus hexagonolepis	Near threaten	09/10/2009
8. Neolissochilus dukai	Data deficient	01/03/2010
9. Pethia ticto	Least Concern	22/03/2010
10. Schizothorax progastus	Least Concern	11/05/2010
11. Schizothorax richardsonii	Vulnerable	14/06/2010
12. Tor putitora	Endangered	
II). **Family Psilorhynchidae**		

13. Psilorhynchusbalitora	Least Concern (LC)	23/02/2010
III). **Family Balitoridae**		
14. Aborichthys sp.	Least Concern (LC)	Species not determined
IV). **Family Amblycipitidae**		
15. Amblyceps apangi	Least Concern	16/12/2009
16. Amblyceps cerinum	Least Concern	Not Assessed
V). **Family Sisoridae**		
17. Glyptothorax sp.	Least Concern (LC)	Species not determined
18. Glyptothorax panda	Least Concern (LC)	09/04/2010
VI). **Family Conitidae**		
19. *Lepidocephalichthys guntea*	Least Concern (LC)	Species not determined
VII). **Family Nemacheilidae**		
20. *Schistu rabeavani*	Least Concern (LC)	Species not determined
21. *Paracanthoscobitisab utwebi*	Least Concern	Not Assessed
22. *Schistu rareticulo fasciata*	Least Concern	Not Assessed

Table 15: List of fish species belonging to order *Perciformes* under respective to their Family

Name of the species	IUCN Red List Status	Last Assessed
VIII)Family *Channidae*		
23. *Channa punctatus*	Least Concern	Not Assessed
24. *Channa gachua*	Least Concern	Not Assessed
IX)Family *Badidae*		
25. *Badis badis*	Least Concern	10/03/2010

Table 16: List of fish species belonging to Order *Siluriformes*

Name of the species	IUCN Red List Status	Last Assessed
X)Family *Bagridae*		
26. *Olyralongicaudata*	Least Concern	Not Assessed
XI)Family *Sisoridae*		
27. *Pseudochenesis*	Least Concern	Not Assessed

Note: For the above tabulation (Table 14, 15 & 16) the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred.

86 **Terrestrial Study:** The objective of this study is to evaluate the diversity of terrestrial ecological components in the project area and the impacts. At the least, the purpose of the study is to assess the presence of species known to have existed before the project.

On 16th January 2020, the fifth Terrestrial walkthrough was conducted by Ecolab with a representative from PIU, PIC and AFCONs.

On 16th February 2020, the sixth Terrestrial walkthrough was conducted by Ecolab with attendance from PIU, PIC and AFCONs. The Terrestrial survey report was submitted in March 2020.

On 18th March 2020, the seventh Terrestrial walkthrough was conducted by Ecolab with attendance from PIU, PIC and AFCONs. The Terrestrial survey report was submitted in March 2020.

On 16 & 17 April 2020, the 8th Terrestrial walkthrough survey was conducted by Ecolab in presence of officials from PIU, PIC and AFCONs.

On 16th May 2020, the 9th Terrestrial walkthrough was conducted by Ecolab with attendance from PIU, PIC and AFCONs.

On 17th June 2020, the 10th Terrestrial walkthrough was conducted by Ecolab with attendance from PIU, PIC and AFCONs.

87 A total of 24 floral (Tree) species which was also recorded in the past three reports. During the fourth survey, there was one new tree species *Ziziphus jujube (*jujube tree) was found.

88 A total of 36 Floral (Herbs and Shrubs) species were recorded in all the four terrestrial surveys. During the fourth survey, only three new Floral (Herbs and Shrubs) plants were recorded *Amaranthus retroflexus* (Red-wood pigweed), *Cryptolepsisi buchanani* (Wax leaved climber) and *Woodfordia fruticosa* (Fire flame bush).

89 A total of 7 species of climbers, creepers, vines and grass was recorded during all four surveys.

90 The detailed report is attached as **Appendix IV.** Please refer to the report for detailed information.

91 However, all species (Flora and Fauna) were recorded based on the survey questionnaires and the available secondary data, and no actual species were found during the survey.

9. Occupational Health and Safety Monitoring

9.1 General Parameters for Compliance

A. Overall Construction Sites:

- Equipment/Machines in proper condition and safe
- First Aid and medicinal facilities
- Any community/Social concerns
- Encroachment into farm land/settlement

B. Work Environment

- Stockpiles & materials stocked & maintained in safe place and condition
- Adequate lighting at work site
- Segregated work areas and signage adequate (direction, warnings)

C. Hazardous and dangerous goods and substances

- Fuel storage tanks within sealed area and bunded
- Hazardous substances sealed and properly labeled
- Safe disposal of containers of hazardous materials

D. Dust and smoke

- No burning of wastes of any nature
- No visible dust clouds from excavation

E. Toilets and kitchen

- Maintenance of office toilets and washrooms
- Use of proper septic tanks and its cleaning regularly
- Placement of garbage bins and proper places including kitchen and emptying them regularly
- Garbage disposal through the Thromde garbage disposal system
- Maintenance of kitchen hygiene
- Adequate water supply to the toilets, washrooms and kitchen
- Provision of dust bins

F. Employees accommodation

- Proper rooms with no seepages
- Information board for employees
- Provisions of toilets and washrooms, their maintenance for cleanliness
- Safe power supply
- Adequate lighting
- Provision of dust bins

G. Mess facility

- Provision of hygienic food to workers
- Provision of bust bins

H. Fire prevention facility

- Provision of sufficient number of fire points with suitable equipment available

I. Transport, security and housekeeping facilities

- Company transport facility and vehicle condition
- Appropriate functional security system
- Cleanliness of the camp area

J. Fire Safety

- Fire extinguishers in place and appropriate locations
- Staff and workers trained on how to use the fire extinguisher

K. Safe Driving

- Safe driving norms followed

L. PPE awareness

- Provisions of PPE
- Provisions of PPE with regard to COVID - 19

M. Lifting and rigging safety workshop

- Proper understanding and awareness of one's surrounding
- Having to put on one's respective PPEs at all times
- Personal experiences

N. Lock Out Tag Out Safety (LOTO)

- Proper understanding and awareness of the work status before logging in or logging out of work
- Having to put one's respective PPEs at all times
- Personal experiences

O. Working at Heights

- Importance of maintaining PPEs while working
- Importance of checking the assurance of all PPEs
- Proper managing and buckling of safety hooks
- Personal experience

P. Hot work permit

- Importance of maintaining PPEs while working
- Personal experiences

Q. Mock drill

- Emergency alert route
- Gathering at the assembly point
- Briefing
- Safe evacuation from the site

9.2 Both contractors comply with HSE work safety protocols and core labour norms

92 AFCONS as well as the sub-contractor are following the health and safety guides as well as core labour norms as per MOLRH guidelines.

9.3 Preparedness and protocol to contain the COVID -19 Pandemic

- Hand sanitization
- Hand washing
- Use of face mask
- Maintaining social distancing
- Avoiding crowded areas

9.4 COVID – 19 Relief Sheds/Housing

93 The COVID – 19 relief housing which is located within the project is built basically to house the families who were living in neghbouring Indian town of Jaigoan, West Bengal prior to the onset of the COVID – 19 pandemic,. With the onset of the pandemic it was felt right from the highest level of the government to bring in the Bhutanese living across the border to be housed within Bhutan. With Phuentsholing facing housing crunch ever since its development, had no space to house these families. A small portion of the PTDP area was chosen for construction of temporary houses for these families. Now the temporary houses have been completed and nearly 1000 families are housed in these structures which is managed by the Phuentsholing Thromde/Phuentsholing Dungkhag.

9.5 Health and safety briefings and awareness

94 The following are some of the main parameters where talks, briefings and awareness programmes were carried out on health and safety issues to the project employees. Health professionals from the Phuentsholing General Hospital were called in to deliver talks on dengue/malaria, HIV/AIDS, COVID – 19 and menstrual health whereas the general safety talks were delivered by the health and safety in-charge of the contractor.

Table 17: General topics on Health and Safety

Sl. No	Topics
1.	Reverse Driving
2.	Waste segregation/Management
3.	Lifting/wielding and Rigging Safety
4.	Lock Out Tag Out
5.	PPE
6.	COVID-19 Emergency Response Plan
7.	Flood Emergency Response Plan
8.	Crane Safety
9.	Excavation Safety
10.	Backfilling Safety
11.	Personal Hygiene
12.	HIRA (Hazard Identification and Risk Assessment)
13.	Dengue preventive measures
14.	Hot work Permit
15.	Corona virus awareness
16.	Housekeeping
17.	Material Handling
18.	Electrical Safety
19.	Menstrual health
20.	Working at height
21.	Briefing on the use of Life jacket, Life Buoy and life boat
22.	Fire safety

Table 18: General compliance

Sl. No.	Activity	Detail task	Status & Action taken as per monthly report
1	General health and safety	- Workers equipped with PPE	Complied through the project period till date
		- First aid boxes available at work site	Present at site
		- Maintenance of first aid register	Followed and maintained
		- Availability of radio communication during times of emergencies	Use of mobile phones as reported as well as radio communication
		- Visible and legible Safety signage	Visible at site

Sl. No.	Activity	Detail task	Status & Action taken as per monthly report
		- Working condition equipment with proper registration documents such as emission and fitness certificates from the concerned authorities	It is mandatory by motor vehicle act to up-date all vehicle fitness documents periodically
		- Proper markings and fencings at critical areas such as deep excavations, concreting etc.	Markings are present but fencing get damaged from time to time and are being replaced
		- Vehicle operation safety such as reversing siren, air-horn whistle, etc.	Followed both by the principal contractor and by the sub-contractors as well
		- Flag men for passing vehicles from & through the project area	Security personals follow it throughout the working hours.
		- Proper traffic management plan	Traffic management plan in place and followed by all project vehicles. However, non-project vehicles are often difficult to track and make them follow
		- HIV/AIDS awareness training	How it is spread, Signs and symptoms, Preventive measures
		- Dengue and malaria and safety awareness	Sixth health briefing was conducted on 31st March 2020 by Phuentsholing General Hospital
		- COVID – 19 awareness and safety protocol	Thermal screening, Hand washing demonstration, General COVID - 19 information, RGoB protocol on COVID – 19, social distancing
		- Proper employee register segregated by gender, nationality and skill	Properly maintained for all the 12 months
2	Work environment	- Stockpiles & materials stocked & maintained in safe place and condition	Safe practice has been continued from the start of the project
		- Traffic management at site and adequate parking provision	Traffic management is being carried out all through the project period in locations where work is under full progress. Traffic survey was also carried out in July, August and September 2019.
		- Adequate lighting at work site	Lighting provision and DGs are installed and kept on standby right from the beginning of the project
		- Work areas segregated and adequate signage such as direction, warnings, etc.	Proper signages are in place and provided wherever required as per requirement and the progress of the project.
		- Work safety	Safe electrical equipment handling and proper electrical installation was discussed with the workers in July 2019.
3	Hazardous & dangerous goods & substances	- Fuel storage tanks within sealed area & bunded	Fuel storage place secure and located at safe locations
		- Hazardous substances sealed & properly labeled	Physically verified and found to be at safe locations
		- Hazardous materials safe disposal of containers	The contractor and the sub-contractor are following hazardous materials safety precautions as per requirement.
		- No burning of wastes of any nature	Not seen within the project area.
4	Dust & smoke	- No visible dust clouds from excavation	Water sprinkling carried out on a daily basis during dry months
5	Toilets & kitchen	- Maintenance of office toilets and washrooms	Proper and periodic cleaning of office toilets and washrooms carried out
		- Use of proper septic tanks & its cleaning regularly	Provision of septic tanks for all toilets
		- Placement of garbage bins and proper places including kitchen and emptying them regularly	Garbage from kitchen, toilet and office space disposed off to the main larger disposal bins regularly
		- Garbage disposal through the Thromde garbage disposal system	Segregation of Garbage disposal is practice and disposed through the Phuentsholing Thromde garbage collection trucks. It has been followed ever since the arrangement has been made with the Phuentsholing Thromde.
		- Maintenance of kitchen hygiene	Kitchens are kept clean as reported

Sl. No.	Activity	Detail task	Status & Action taken as per monthly report
		- Adequate water-supply to toilets, washrooms & kitchen	Underground water is pumped to supply water for all needs
6	Employees accommodation	- Proper rooms with no seepages	Accommodation rooms are of good standard & are continued to be maintained well
		- Information board for employees	Information displayed at the entrance
		- Provisions of toilets and washrooms & their maintenance for cleanliness	Continued to be maintained well
		- Safe power supply	Regular power supply in place
		- Adequate lighting	Lighting facilities in the office, workers camp and at work sites are adequately managed
		- Accommodation	Adequate accommodation for workers, of AFCONS, Rigsar and CDCL staff
7	Mess facility	- Provision of hygienic food to workers	Food preparation continues to be well maintained
8	Fire prevention facility	- Provision of sufficient number of fire points with suitable equipment available	Fire extinguishers placed at proper locations and extended wherever needed.
9	Transport, security & house-keeping facilities	- Company transport facility and vehicle condition	Bus service for workers in place including for overtime/night shift workers
		- Appropriate functional security system	Security personals deployed at different locations as per the need
		- Cleanliness of the camp area	Camp area continued to be kept clean and maintained well. Briefing on cleanliness in January
10	Fire briefing	Fire safety aspects was also briefed to the workers on - How to use fire extinguisher - Things to keep in mind during fire hazards - How to approach fire (for extinguishing)	These aspects were briefed in July 2019 and was reiterated this time so that workers do not forget the fire safety tips.
11	Safe Driving	- Dos and don'ts while driving	Safe driving tips were reiterated to what was briefed in the last training in Sept. 2019
		- Checking side ways	
		- Use of signals	
		- Maintenance of vehicles	
12	PPE awareness	- Why is it important	Briefing on PPE has been continued to be carried out from time to time. Briefing given to workers towards the end of each month except for March and April Briefing on PPE has been continued to be carried out from time to time
		- What are PPEs	
		- Experiences sharing regarding use of PPE	
		- What are PPEs	
		- Face masks, hand sanitizer	
13	Lifting and rigging safety workshop	- Proper understanding & awareness of one's surrounding	Safety tips reminded every time workers are engaged in lifting and rigging and at the end of each month short trainings are conducted but the months of March and April was skipped.
		- Need to put on one's respective PPEs at all times	
		- Personal experiences	
		- Importance of maintaining PPEs while working	
14	Hot work permit	- Dos & don'ts while doing hot work - Importance of PPE - Safety in and around hot work site for flammable materials	Spot briefing was conducted on the 11th of January 2020, at the worksite on the safety aspects while and after hot work. (16 participants)
17	Mock drill	- Emergency alert route	Mock drill on emergency evacuation was conducted on the 28th of May in two separate sessions. (Together there were a total 0f 41 participants)
		- Gathering at the assembly point	
		- Briefing	
		- Safe evacuation from the site	
18.	Day of events	- Safety awards	AFCONS awarded the International Safety Award Merit for 2020 by the British Safety Council (annex. 4)

Note: Reported for January to June, 2020

Table 19: Health awareness sessions

Topics	Jan (28th, 29th)	Feb (7th)	Mar (17th & 31st)	Apr (9th)	May (28th)	Jun (27th)
Topics covered						
COVID _ 19	- Corona Virus and how it is spread	- COVID - 19 awareness	- Origin of COVID – 19	No sessions	- News update on COVID - 19	- History and current situation
	- Its Prevention	- Thermal screening	- World scenario		- Signs and symptoms	- How it is spread
	- Importance of face mask and handwashing	- Hand washing demonstration	- RGoB protocol on COVID - 19		- Preventive measures	- Signs and symptoms
	8 participants ***Conducted by AFCONS Safety officer***	- General COVID - 19 information	- COVID - 19 spread and symptoms - Preventive measures/PPE - Maintaining proper/kitchen hygiene - In case of common symptoms reporting to concerned authorities - **No. of Participants (41)**		**Conducted by AFCONS** **No. of Participants (22)**	- Preventive measures **All sessions conducted by Phuentsholing General Hospital**
HIV/AIDS	No sessions	No sessions	- How it is spread - Signs and symptoms - Preventive measures	No sessions	No sessions	- How it is spread - Signs and symptoms - Preventive measures
Dengue	No sessions	No sessions	No sessions	- How it is spread and what causes Dengue - Signs and symptoms - Preventive measures **Conducted by AFCONS** **No. of Participants (28)**	No sessions	- How it is spread - Signs and symptoms - Preventive measures
Feminine Health	No sessions	No sessions	- Menstrual health - Tips during menstrual cycle **Conducted by Phuentsholing General Hospital** **No. of Participants (24)**	No sessions	No sessions	Menstrual health Tips during menstrual cycle **Conducted by Phuentsholing General Hospital** **No. of participants (30)**

Table 20: Health awareness sessions on personal hygiene/PPE

Jan (25th)	Feb (23rd)	Mar	Apr	May (28th)	Jun (27th)
Topics					
- Clean surrounding	- Lifting safety protocol			- Rigging and lifting SOP	- Importance of PPE
- Personal hygiene	- Rigging			- Importance of PPE	- Personal hygiene
- Importance of PPE i.e. gloves face mask, boots	- Use and importance of PPE			- SOP at work site	- SOP at work site
	Proper use of PPE				- Rigging and lifting SOP
No. of Participants (25)	***No. of participants (19)***			***No. of Participants (22)***	***No. of participants (28)***
Conducted by Health and Safety Officer, AFCONS					

Table 21: Electrical Safety

Jan	Feb	Mar	Apr	May	Jun (27th)	Conducted by
Topics						
					What is electrical safety	Health and Safety Officer, AFCONS No. of participants (22)
					Why is it important	
					Dos and Don'ts at work site	

9.5 List of some of the signs / labels/tags on site for public awareness

95 Posters, signage and awareness materials are displayed at the project site at appropriate locations. Some of these materials are for public awareness, some are for traffic and pedestrian direction and some are cautionary signs. These materials are put up at appropriate locations where and when necessary so that workers, public and all concerned are aware of what one should do while entering the work place or the office premises.

Table 22: List of signage/posters on display

Sl. No.	Posters/Signs/labels on display	Sl. No.	Posters/Signs/labels on display
1	PPE awareness	23	Speed limit
2	Electrical safety	24	Speed bumps
3	Environment Safety Posters	25	Waste management
4	Lifting and rigging	26	Crane and rigging safety
5	DG Safety Poster	27	Barricade Zone
6	Fire extinguishers (PASS)	28	Harness Safety
7	Reverse handling/driving	29	Helmet Safety
8	Cement bund/aggregate bund	30	Safety Signs and their meanings
9	"Family waiting for you" sign	31	Human machine interface
10	Hand Safety	32	Safety shoes

11	Material handling	33	Assembly Points
12	Equipment handling	34	Fire exits
13	Road based Signs (i.e. Diversion, road conditions etc.)	35	No car washing
14	Cylinder storage and safety	36	No honking
15	No smoking	37	Cautionary signs
16	Fire bucket	38	Workshop based signs
17	Office, Mess, Washroom, Kitchen, toilets etc. (labels)	39	Office vehicle stickers
18	Deep excavation	40	Barricades
19	Men and women at work	41	Contacts points
20	Mandatory PPE	42	HSE contact personals
21	Monthly HSE Summary	43	Body De-hydration signs
22	Place tag	44	Location signs

9.7 Labour Employment

96 As per the labour deployment record, the detals of labours hired as of now by the contractors is as per table 5 presented below. It is shown that the Bhutanese labourers constitute over 31% for May and over 28% for June of the overall labour force engaged in the project and females constitute between 6% to *% of the during the reporting period.

Table 23: Labour employment

Sl. No.	Category of workers	2020					
		Jan	Feb	Mar	Apr	May	Jun
1	Bhutanese Day Labourers (Female)	15	16	18	18	19	19
2	Non-Bhutanese Day Labourers (Female)	0	0	0	0	0	0
3	Bhutanese Day Labourers (Male)	38	35	37	3	36	27
4	Bhutanese Resident Labourers (Male)	0	0	0	0	33	18
5	Non-Bhutanese Day Labourers (Male)	25	25	25	0	0	0
6	Non-Bhutanese Resident Labourers (Male)	168	166	166	188	202	159
	Total labourers per month	**246**	**242**	**246**	**209**	**290**	**223**

9.8 Incidents of Health and Safety Issues

97 The contractor is mandated to maintain records of the incidents of health and safety issues. Table 10 below shows the frequency of the medical cases occurred during the reporting period. There were just 2 accidents/incidents, 1 in Feb. and one in June. These were minor cases which were treated at the contractor's first aid centre.

Table 24: Cases of accidents and incidents at work sites

Incidents of health and issues	2020					
	Number of cases					
	Jan	Feb	Mar	Apr	May	Jun
Near miss	0	0	0	0	0	0
Accidents/incident	0	1	0	0	0	1
First aid cases	0	0	0	0	0	0
Safe Man Hours	206,400	16,150	130,950	230,290	330,430	3,290
Cumulative man hours	1,270,790	1,405,920	1,520,720	1,620,060	1,720,200	1,816,850

Report of the case attached as annex. 3

9.9 Traffic Survey

98 To access the number of vehicles plying in the project area, monthly traffic counts are carried out by the contractor to know the number of vehicles by type. Table 11 below gives the traffic results, which shows that the road used by the project vehicles is between 15% to 27% only in comparison to third party vehicles during the six months reporting period.

Table 25: Traffic counts from January – June 2020

Month, Date & time	Jan		Feb		Mar		Apr		May		Jun	
	9th	10th	25th Feb.		27th March		18th April		11th	16th	26th	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Project LV	285	24	318	30	212	57	130	13	146	18	199	11
Project HV	285	3	75	0	70	0	101	13	60		14	7
Project Trailer	8	0	6	0	5	0	12	0	8	0	0	0
Total of PTDP	578	27	399	30	287	57	243	26	214	25	213	18
Others LV	1,312	379	800	308	625	272	378	153	235	244	1,061	217
Others HV	1,104	211	586	269	552	298	933	207	338	251	494	86
Trailer Others	55	6	0	6	-	2	3	2	0	0	0	0
Total of others	***2,471***	***596***	***1,386***	***583***	***1,177***	***572***	***1,314***	***362***	***573***	***495***	***1,555***	***303***
Total of all Vehicles	**3,049**	**623**	**1,785**	**613**	**1,464**	**629**	**1,557**	**388**	**787**	**520**	**1,768**	**321**
% of total Project Vehicles	18.96	4.33	22.35	4.89	19.60	9.06	15.61	6.70	27.19	4.81	12.05	5.61
% of total Other Vehicles	81.04	95.67	77.65	95.11	80.40	90.94	84.39	93.30	72.81	95.19	87.95	94.39

LV = Light Vehicle, HV = Heavy vehicle

Result

- The day survey is conducted from 8:00 AM – 5:00 PM with a lunch gap of one hour
- The night survey is conducted from 8:00 PM – 8:00 AM

The traffic flow has slightly decreased from March onwards as there was slight decrease in the project activities due to COVID – 19, Similarly with the non-project vehicles also there was a decrease in the traffic flow. However, provisions for traffic diversion and, signage was not compromised for the safety of all vehicles plying through the project area during the six months reporting period.

9.10 PTDP site and road sprinkling activity

99 Water sprinkling activity continues for the dry months. The sprinkling areas not only covered the project areas but also the adjacent areas from where a lot of dust is being generated. Simultaneously the PCR Project also carries out water sprinkling activity which is located adjacent to the PTDP project site. However, there was less of sprinkling activities from end of April till June due to the onset of early monsoon.

9.11 Health Awareness Sessions / events

100 AFCONS and taken part in the International British Safety Awards for the 2019-year session and won the International Safety Award Merit for 2019.

9.12 Safety from Monsoon Hazards

101 Till date there is no major threats from flooding or any other monsoon hazards. However, there is full preparedness for any event of hazards and flooding caused by river swelling. Workers have been briefed of any such eventualities. Emergency Evacuation Mock Drill was conducted on 28th of May by AFCONS management. It was conducted to prepare employees to respond quickly, calmly and safely in case of flood It was attended by 41 participants. (***Emergency Evacuation Plan for flood is attached as Appendix V)***

9.13 Grievance Redressal Mechanism

102 The Grievance Redressal Mechanism formulated at the beginning of the project commencement is in place but. As of now, no grievances have been registered and grievance reporting format has also been uploaded on the CDCL website (www.cdcl.bt/ptdp/).

Figure 10:GRM Structure

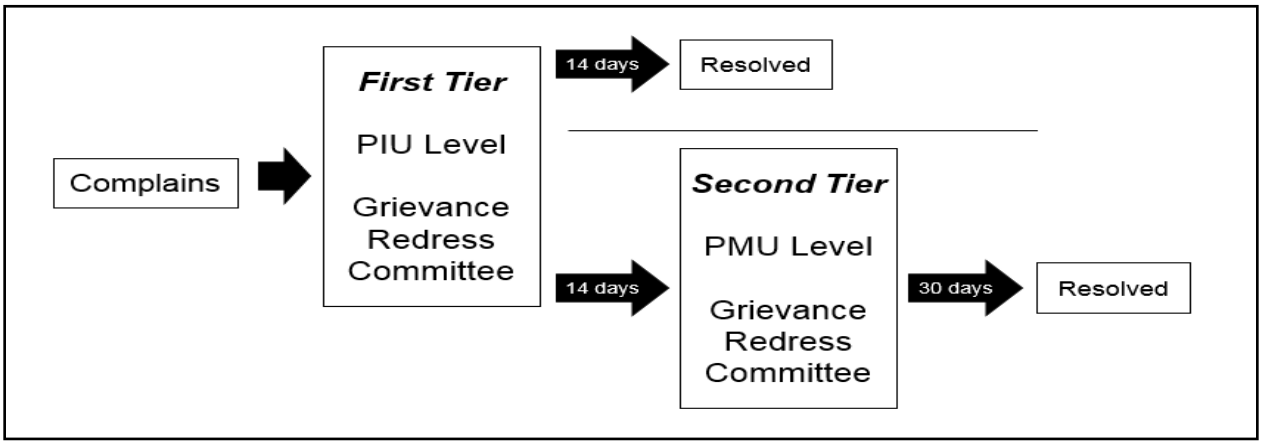


Table 26: Members of the First Tier

Positions	Names	Remark
PIU Project Manager	Mr. Kamal Dhakal	Chairman
PIU Deputy Project Manager	Mr. Lhendup Dorji	Member
PIU Environment Manager	Mr. Pem Chung	Member
PIC Team Leader/Dy. Team leader	Mr. Robert / Mr. Edwin	Member
PIC Safeguard and communications specialist	Mr. Megay Penjore	Secretary
Representative of local leader	Mr. Nar Bahadur Rai	Thomde Constituency Representative (Member)
Representative from District office	Mr. Sonam Tenzin	Phuentsholing Thromde (Member)
Representative from reputable community-based organization	Ms. Dechen	RENEW (Member)
Contractor	Mr. Ravi, Project Manager	AFCONS (Member)
Members on call basis based on the nature of grievance representing relevant section of office	-	

Table 27: Member of the Second Tier

Positions	Names	Remark
PMU Head	Mr. Tshering Dupchu	Chairman
PMU Urban Planner	Ms. Kamala Thapa	Member
PIU Head	Mr. Kamal Dhakal	Member
Environment Officer of PIU	Mr. Pem Chung	GRC Secretary
Central Government Department		DoFPS (Member)
Reputable community-based organization		RENEW (Member)

9.14 Communication Strategy Plan

103 The communication Strategy Plan was framed and is in place since the start of the project. However, its updating has been not required during this reporting period and its reporting requirements have been carried out and included in the periodic reports.

Table 28: Communication Strategy Plan Matrix

Project information to be communicated	Means of communication	Responsible Agency	Audience(s)	Frequency
Report and Recommendation of the President	ADB Website (linked documents)	ADB	ADB, DHI, CSOs, beneficiaries and RGoB	Once at Project inception
Procurement and bidding documents	Invitations for bids published on the DHI and CDCL websites and in the newspapers. Information for pre-bid meetings to be published likewise	PMU	Contractors and local suppliers of goods and services ADB, DHI, CDCL	During the procurement period. 1. For ADB, DHI, CDCL Reported Quarterly in Project Quarterly Report 2. For interested bidders, As per the procurement plan
Construction	The selected construction company(s) will ensure that the construction areas will have signage boards with their contact information	PIU	ADB, DHI, CDCL, Stakeholders	During the construction period. Reported Monthly in Monthly Progress Report
Progress status during construction works and construction issues	Signage boards on site (updated periodically)	PIU	ADB, DHI, CDCL General Public	During the construction period. 1. For ADB, DHI, CDCL 2. Reported Monthly in Monthly Progress Report 3. For general public. Within Specific Public event (once a year)
Project performance reports	ADB and DHI Websites	ADB and DHI	Beneficiaries, stakeholders and RGoB	Either Semi-annually or annually once PPMES (project performance

				management evaluation system) is set-up.
Safeguard monitoring (Environment and Social monitoring reports)	ADB websites	ADB and CDCL	ADB, DHI, CSOs, beneficiaries and RGoB	Semi-annually
Project completion Report	ADB Websites	ADB and CDCL	ADB, DHI	At Project closure

10. Conclusion and Recommendation

Some environment-related issues had been observed as part of the monitoring at the project site. The major issues have been highlighted and observation/action taken has been duly reflected as follows:

104 23rd January 2020: Terrestrial walkthrough was conducted by Eco lab along with PIU environment manager, Dr. Lam, PIC representative and AFCONs team.

105 For the month of January 199 MT of Sodium Bentonite was used.

106 16th February 2020: Sixth terrestrial walkthrough was conducted by Eco lab along with PIU environment manager, PIC representative and AFCONs team.

107 28th March 2020: Eco Lab was requested to conduct a three-day consecutive test on groundwater and borehole upon ADBs request. This is to ensure that the water being used for drinking is safe and no extra filtration is required. The test was conducted from 23-25th March 2020, and the test results were submitted to PIU and PIC on 28th March 2020.

108 For March 381 MT of Sodium Bentonite was used.

109 While supervising the project site, the toilet stall between part 4 & 5 location has an overflown septic tank, which is releasing foul odour, attracting flies and is not sanitary to be left idle. AFCONs has been informed verbally by the PIU environmentalist on March 25th, with a follow up on April 7th and the PIC environmentalist on April 9th 2020. The issue was also raised during the PIC & CW01 meeting number 55 (April 10th 2020) to immediately rectify the problem and to remove any toilet stalls, not in use by the project. For now, they have stuck "CLOSED" sticker and have informed the municipal to send the vehicle for immediate unclogging and cleaning of the location. AFCONs has been given a few days to rectify the problem.

110 AFCONs has been informed to barricade the backfilled locations, as private vehicles are speeding generating dusty, and poses a threat to the project workers.

111 Trespassers are entering into the project site and dumping their waste in the outfall. AFCONs has informed the guards to ensure that other than project vehicles and individuals, to not allow access to other individuals. A list of vehicles mobilized with the project and private vehicles of experts have all been handed over to the guards to ensure only project vehicles are plying on the road.

112 It was noticed that the project site has become very dusty, due to multiple external factors such as kilometres of unpaved roads, multiple ongoing projects and activities, and the weather conditions, but AFCONs is ensuring that daily sprinkling is ongoing in the projects and a sprinkling log sheet is submitted with the monthly report. To reduce the dust, the contractor has also created speed bumps and erected speed limit signs.

113 4th April 2020: Submission of EMR by AFCONs to PIU & PIC

114 8th April 2020: AFCONs submitted noise monitoring location schedules to PIC and PIU for monitoring purpose.

115 16th April 2020: 8th terrestrial walkthrough was conducted by Eco lab along with PIU environment manager, PIC representative and AFCONs team.

116 20th April 2020: Surface water sampling of SW04 & SW05.

117 21st April 2020: PIU, PIC, CW01 and Ecolab meet to discuss the dysfunction of air monitoring equipment's

118 22nd April 2020: Submission of Third Terrestrial Report for the period of December 2019 to February 2020

119 28th April 2020: Contractor's Submission for Engineer's approval of the substitution of Air monitoring equipment. Please elaborate that the other equipment was not functioning and that a request to use the manual machine, for the time being, was requested.

120 30th April 2020: Contractor submission for Engineer approval of the substitution of lab equipment

121 111 MT of Sodium Bentonite was used for April.

122 April 2020: Water level change of 0.092m was noted since the initial measurement which was conducted on the 4th April and the last test on the 30th April 2020.

123 14th May 2020: Submission of Third Aquatic Report

124 16th May 2020: 9th terrestrial walkthrough was conducted by Eco lab along with PIU environment manager, PIC representative and AFCONs team.

125 19th May 2020: Surface water sampling for locations SW04 & SW05 & Groundwater quality testing at zone A was conducted

126 23rd May 2020: Changed Filter for Air Monitoring Device (PIU, PIC, CW01 & Eco Lab)

127 Approximately 1.7 metric ton of degradable waste and 1.4 metric tons of Non-biodegradable waste was generated from the PTDP project in May 2020.

128 May 2020: An average water level change of 0.262 m was noted since the initial measurement which was conducted on the 2nd and the last test conducted on 30th May 2020.

129 2nd June 2020: Social Forestry Day was celebrated by conducting a mass cleaning campaign at the PTDP project site and tree planation at PIU camp

130 17th June 2020: 10th terrestrial walkthrough was conducted by Eco lab along with PIU environment manager, PIC representative and AFCONs team.

131 20th June 2020: Surface water sampling for SW04 & SW05 was conducted

132 29th June 2020: Submission of Fourth Terrestrial report

133 June 2020: Water level change of 0.529 m was noted since the initial measurement which was conducted on the 1st and the last test conducted on 29th June 2020.

134 The Health Safety aspects at the PTDP project site has been followed as per the requirement. However, the contractor needs to follow-up and continue the implementation of the PPE norms on a constant basis. The induction programmes, onsite talks on health issues and health & safety, the involvement of the health professionals from the Phuentsholing General Hospital and bringing them on board is playing a positive role in creating awareness about possible diseases out breaks at the project sites. Because of all these activities carried out by the contractor and the other entities of the project, there has been no major disease outbreaks within the project area.

135 The COVID – 19 protocols are strictly being implemented at the project. There are provisions for hand washing facilities at all appropriate locations. Face mask regulations are also being adhered to by the contractor by providing face masks to all the workers. Daily thermal scans of all employees, including those of the PIU and PIC are checked and recorded. Social distancing is also adhered to wherever possible.

136 Health related activities have also taken on board the female workers by way of health sessions being conducted on Menstrual Health, HIV/AIDS and hygiene.

137 Traffic management has been regularly followed up so as not to hinder the ferrying of public transport from adjacent to the project area and even in the monsoon season all efforts are made to keep the traffic open. There has been constant co-ordination meeting conducted with the PCR which a road project running parallel to the PTDP project. These co-ordination meetings have helped the two projects in synchronization of the outfalls, addressing the social issues such as dust suppression activities and streamlining of traffic flow through the two project areas.

138 PTDP has also rendered support COVID – 19 relief housing complex by allowing the construction workers occupy the project area till the completion of the construction, by providing moveable toilets at the initial phase of the relief house construction and stream lining traffic to minimize hindrance to their activities. The sub-contractor is also obliged to follow the health and safety regulations at all times. Though there is a shortage of manpower and some restrictions protocol delays on the import of materials from across the border, yet the work progress has not really been hampered to such a great magnitude.

139 Few photographic Clips indicating the environment and safety compliance is presented in environment photo log

140 All aspects on health and safety is to be followed on a daily basis so that no one's life is put at risk due to the implementation of the PTDP project. It should be in the minds of all the parties involved in the project that health and safety is every one's responsibility. The induction programmes, onsite talks on health issues and health and safety, the involvement of the health professionals from the Phuentsholing General Hospital needs to continue especially in the wake of the COVID – 19 pandemic. It will also ensure that no new workers are left out and are aware of the health and safety aspects of the project. As the activities continue, traffic flow for the public should not be compromised. Vehicle parking in the project area, which is often a problem, needs to be coordinated with the concerned authorities on a continuous basis.

141 The COVID – 19 prevention activities have to be strictly adhered to since community transmission of the virus is not yet there in the country, any lapses on the part of the project would be a disaster. All outsiders visiting the project area need to be well screened as is the current practice. The COVID-19 Workplace Safeguard Protocol which has been developed needs to followed strictly.

142 The COVID – 19 relief housing constructed within the project area has almost 1000 housing units catering to an equal number of families, vacated from the Indian town of Jaigaon. It lies between the Omchhu River outfall number 1 and 2. As it is within the project area, any out-break of diseases or any other mishaps in the area could impact the project. However, since the housing colony is not under the jurisdiction of the project but the land area is, it is suggested that the land area also be handed over to the Phuentsholing Thromde/Phuentsholing Dungkhag (who are responsible for the management of the houses and occupants) till such time that the houses are cleared off and the project can take over the land area again. This can be coordinated between the Phuentsholing Thromde/Phuentsholing Dungkhag and the PTDP at the earliest.

Environment Photo Log

Environment

Terrestrial walkthrough at Zone B

Terrestrial walkthrough at Zone C

Terrestrial walkthrough at Zone B on 18-03-2020

Terrestrial walkthrough at Zone B

Surface water testing

Surface water testing and Sampling

Surface water testing

Air monitoring devices

Instructed CW01 to sprinkle

Dusty road nearby the project vicinity

Waste dumped at project area

Air monitoring and Noise monitoring devices






Aquatic Survey June 2020

SOCIAL, HEALTH AND SAFEGUARD PHOTO LOG

View of the project area as of June, 2020

PTDP project HSE Statistics details updated till June, 2020

Talk on HIV/AIDS, Dengue and Feminine Hygiene by professionals from Phuentsholing General Hospital (June, 2020)

Awarness briefing on COVID 19 by the health professionals from the Phuentsholing General Hospital

COVID-19 prevention, hand washing demonstration by the Health professionals

Markings in the workers' mess for social distancing Prevention of spread of COVID-19, April 2020)

Provision for Hand washing placed in front of the office entrance

Briefing on COVID to the workers' mess cooks (17th March 2020)

Thermal scanning of workers being done every day before start of work

On site Safety tool talk (Feb. 2020)

On site Health briefing sessions conducted by HSE team.

25/07/2020

List of vehicles on hire by CW01 with respect to the Emission Test Validity dates

Sl. No	Name/Type of Vehicle	Vehicle Number	Validity Date
1.	Bus	BP-2-A0062	13/09/2020
2.	Bus	BP-2-A0059	23/01/2021
3.	Transit Mixer	MH-40BG-8313	05/09/2020
4.	Transit Mixer	MH-40BG-8154	05/08/2020
5.	Transit Mixer	MH-40BG-7840	5/09/2020
6.	Transit Mixer	MH-46BB-2905	5/09/2020
7.	Transit Mixer	MH-40BL-4193	22/10/2020
8.	Transit Mixer	MH-40BL-2784	17/01/2021
9.	Camper	BP-2-B8531	17/01/2021
10.	Camper	BP-2-B8334	21/01/2021
11.	Ambulance	BP-1-3049	8/1/2021
12.	Scorpio	BP-2-B9820	28/10/2020
13.	Dumper	BP-2-A8653	17/09/2020

Bus – 01

13210

Govt. Approved Agent

YANGKI AUTOMOBILES

P. O. Box 384, Thimphu

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2008/8538

Emission REF :			
Vehicle No. :	BP-2-A 0062	Tested Date :	[illegible]
Make :	[illegible]	Registration Date :	[illegible]
Frame No :		Type :	Bus
		Engine # :	
		Fuel :	Diesel

Test Type	Test Value	Average Spread	RESULT	[illegible]	
CO	29.8 29.9 30.1	29.6	PASS	19/09/23	

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

For queries contact @ 00975-2-321184 (O), 17177177, 17666333

E-mail : yangkiauto@gmail.com

7/23/2020

Bus #2.

YANGKI AUTO EMISSION CENTER

Government Approved Agency

YANGKI AUTOMOBILES

P.O. Box 384

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan Vide letter No. RSTA/RS-12/2016/2231-36

EMISSION REF #	258043		Tested Date		23/07/2020
icle #	BP-2-A0059		Registration Date		11/12/2018
Make	Eicher		Type		Heavy Bus
Chassis #	MC2A5HRTOHF376049		Engine #		E414CDHF150304
			Fuel		Diesel
Test Type	Test Value	Average/Spread	Result	Validity	Remarks
T1	45.6	46.666666666666664	PASS	23/01/2021	
T2	48.5				
T3	47.9				
				Amount (Nu)	200.00

Maximum permissible HSU level = 75% for < 2005 Model & 70% for 2005 > Model

For queries contact @ 17666333 / 17177177, Email : yangkiauto@hotmail.com

Govt. Authorized Agent
YANGKI EMISSION CENTER
Authorized Signatory

TRANSIT MIXER-01

YANGKI AUTO EMISSION CENTER

Govt. Approved Agent

YANGKI AUTOMOBILES

13199 P. O. Box 384, Thimphu

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2006/6568

Emission REF :		Tested Date :	5/3/2020
Vehicle No. :	MH 40 AG 8313	Registration Date :	
Make :	heavy.	Type :	heavy.
Frame No :		Engine # :	
		Fuel :	Diesel

Test Type	Test Value	Average Spread	RESULT	Validity	REMARKS
CO	39.1 39.1	38.1	Pass	5/9/2020	YANGKI EMISSION CENTER

200

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

Light Vehicle Nu. 150/- ☐

Taxi Nu. 100/- ☐

Retest Fee Nu. 75/- ☐

For queries contact @ 00975-2-321184 (O), 17177177, 17666333

E-mail : yangkiauto@gmail.com

TRANSIT MIXER -2.

YANGKI AUTO EMISSION CENTER

Govt. Approved Agent

13196

YANGKI AUTOMOBILES

P. O. Box 384, Thimphu

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2006/6568

Emission REF :		Tested Date :	5/3/20
Vehicle No. :	MH - 40 - BG. 3154	Registration Date :	
Make :	heavy	Type :	heavy
Frame No :		Engine # :	
		Fuel :	Diesel

Test Type	Test Value	Average Spread	RESULT	Validity	REMARKS
CO	39.4 39.6	34.5	Pass	5/05/2020	GOVT. APPROVED AGENT YANGKI EMISSION PHUENTSHOLING

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

200

Light Vehicle Nu. 150/- ☐

Taxi Nu. 100/- ☐

Retest Fee Nu. 75/- ☐

For queries contact @ 00975-2-321184 (O), 17177177, 17666333
E-mail : yangkiauto@gmail.com

TRANSIT MIXER – 3

YANGKI AUTO EMISSION CENTER

Govt. Approved Agent

13198

YANGKI AUTOMOBILES

P. O. Box 384, Thimphu

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2006/6568

Emission REF :		Tested Date :	5/3/20
Vehicle No. :	MH-40BG-7840	Registration Date :	
Make :	hemyo	Type :	hemy.
Frame No :		Engine # :	
		Fuel :	Dusel

Test Type	Test Value	Average Spread	RESULT	Validity	REMARKS
CO	40.1 4321	43.5	Pass	5/9/2020	YANGKI EMISSION CENTER PHUENTSHOLING

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

200.-

Light Vehicle Nu. 150/- ☐

Taxi Nu. 100/- ☐

Retest Fee Nu. 75/- ☐

For queries contact @ 00975-2-321184 (O), 17177177, 17666333
E-mail : yangkiauto@gmail.com

TRANSIT MIXER-04.

Govt. Approved Agent
YANGKI AUTOMOBILES
P. O. Box 384, Thimphu

13197

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2006/6568

Emission REF :		Tested Date :	5/9/20
Vehicle No. :		Registration Date :	
Make :	heavy.	Type :	heavy.
Frame No :		Engine # :	
		Fuel :	Diesel.

Test Type	Test Value	Average Spread	RESULT	Validity	REMARKS
CO	38.4	425.	Pass	5/9/2010.	

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

200.

Light Vehicle Nu. 150/- ☐
Taxi Nu. 100/- ☐
Retest Fee Nu. 75/- ☐

For queries contact @ 00975-2-321184 (O), 17177177, 17666333
E-mail : yangkiauto@gmail.com

TRANSIT MIXER-5

YANGKI AUTO EMISSION CENTER

Govt. Approved Agent

YANGKI AUTOMOBILES

P. O. Box 384, Thimphu

13245

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2006/6568

Emission REF :		Tested Date :	22/04/2020
Vehicle No. :	MH-40-BL-4193	Registration Date :	—
Make :		Type :	—
Frame No :	MB1AZWC2RSE7045	Engine # :	SBH695686
		Fuel :	Diesel.

Test Type	Test Value	Average Spread	RESULT	Validity	G.R.E. Authorized Agent
CO	39.4 39.4	34.0.	Pass	22/10/2020	YANGKI EMISSION CENTRE PHUENTSHOLING

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

200

Light Vehicle Nu. 150/- ☐

Taxi Nu. 100/- ☐

Retest Fee Nu. 75/- ☐

For queries contact @ 00975-2-321184 (O), 17177177, 17666333

E-mail : yangkiauto@gmail.com

TRANSIT MIXER-6

YANGKI AUTO EMISSION CENTER

Govt. Approved Agent

13330 YANGKI AUTOMOBILES

P. O. Box 384, Thimphu

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan vide letter No. RSTA/TM-12/2006/6568

Emission REF :		Tested Date :	17/07/2020
Vehicle No. :	MH-40 BL-2784	Registration Date :	
Make :	Transit mixer	Type :	heavy.
Frame No :	–	Engine # :	
		Fuel :	Diesel "

Test Type	Test Value	Average Spread	RESULT	Validity	REMARKS
CO	39.4	40.5.	Pass	17/01/21	Govt. Authorized Agent YANGKI EMISSION CENTER PHUENTSHOLING

* Maximum permissible CO level = 4.5 < 2005 Model & 4.00 for 2005 > Model

200/-

Light Vehicle Nu. 150/-

Taxi Nu. 100/-

Retest Fee Nu. 75/-

For queries contact @ 00975-2-321184 (O), 17177177, 17666333

E-mail : yangkiauto@gmail.com

1/17/2020

CAMPER-01

YANGKI AUTO EMISSION CENTER

Government Approved Agency

YANGKI AUTOMOBILES

P.O. Box 384

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan Vide letter No. RSTA/RS-12/2016/2231-36

EMISSION REF #	243033	Tested Date	17/01/2020
Vehicle #	BP-2-B853	Registration Date	06/10/2017
Make	Mahindra	Type	Light Vehicle
Chassis #	MA1RU4GHKH3B90909	Engine #	GHH4B60205
		Fuel	Diesel

Test Type	Test Value	Average/Spread	Result	Validity	Remarks
T1	97.7				
T2	35.3	56	PASS	17/01/2021	
T3	36.3				
				Amount (Nu)	150.00

Maximum permissible HSU level = 75% for < 2005 Model & 70% for 2005 > Model

For queries contact @ 17666333 / 17177177, Email : yangkiauto@hotmail.com

Authorized Signatory

Camper – 02

YANGKI AUTO EMISSION CENTER

Government Approved Agency

YANGKI AUTOMOBILES

P.O. Box 384

VEHICLE EMISSION CERTIFICATE

ized by Royal Government of Bhutan Vide letter No. RSTA/RS-12/2016/2231-36

	BP-2-B8334	Tested Date	21/01/2020
	Mahindra	Registration Date	28/07/2017
	MA1RU4GHKG3G99050	Type	Light Vehicle
		Engine #	GHG4G57075
		Fuel	Diesel

Test Type	Test Value	Average/Spread	Result	Validity	Remarks
T1	27.1				
T2	15.9	18.666666666666668	PASS	21/01/2021	
T3	14.9				

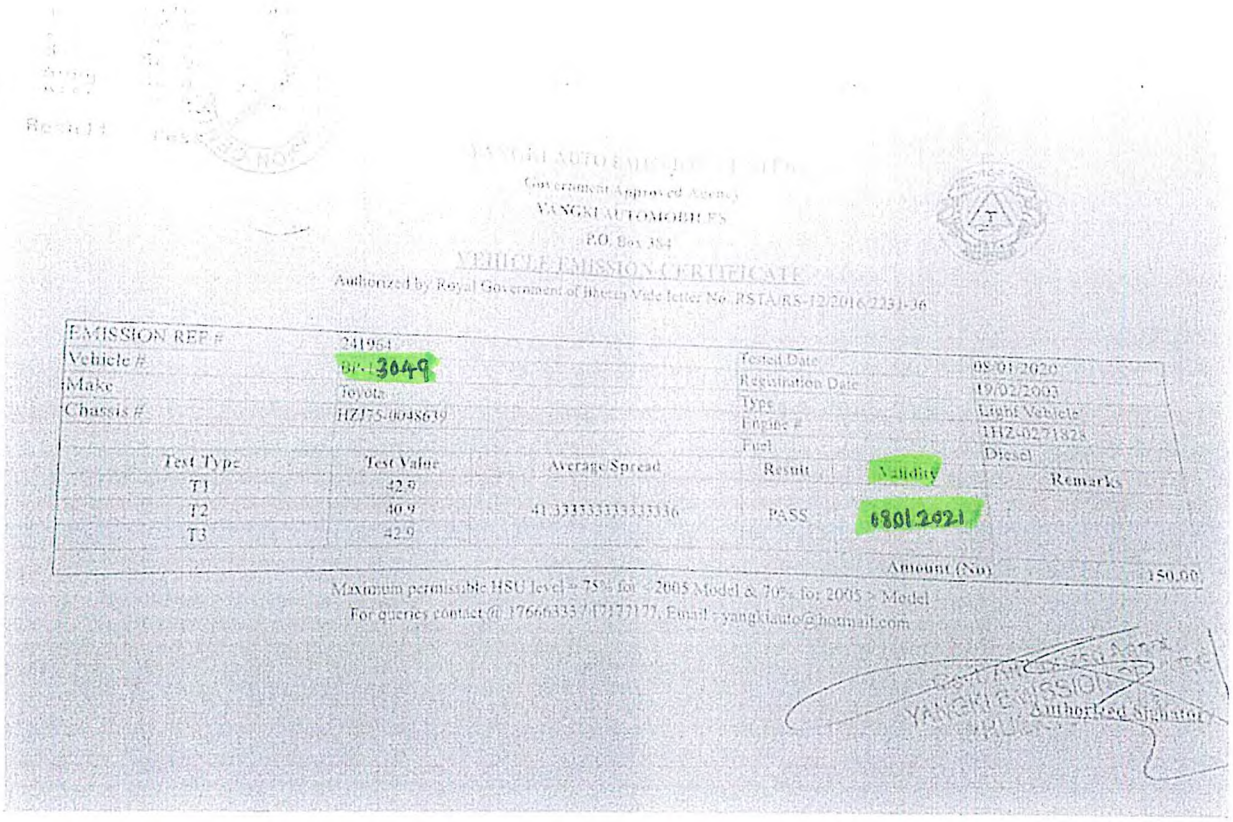
Amount (Nu): 150.00

Maximum permissible HSU level = 75% for < 2005 Model & 70% for 2005 > Model

For queries contact @ 17666333 / 17177177, Email : yangkiauto@hotmail.com

Govt. Authorized Agent
YANGKI EMISSION CENTRE
PHUENTSHOLING

Authorized Signatory



Government Approved Agency

YANGKI AUTOMOBILES

P.O. Box 384

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Tuvalu Vide letter No. PSTA/RS-12/2016/2231-36

EMISSION REF #	241964	Tested Date	09/01/2020
Vehicle #	Br- 3049	Registration Date	19/02/2003
Make	Toyota	Type	Light Vehicle
Chassis #	HZJ75-0048639	Engine #	1HZ-0271823
		Fuel	Diesel

Test Type	Test Value	Average Spread	Result	Validity	Remarks
T1	42.9				
T2	40.9	41.333333333333336	PASS	08/01/2021	
T3	42.9				

Amount (Ngn) 150.00

Maximum permissible HSU level = 75% for < 2005 Model & 70% for 2005 > Model

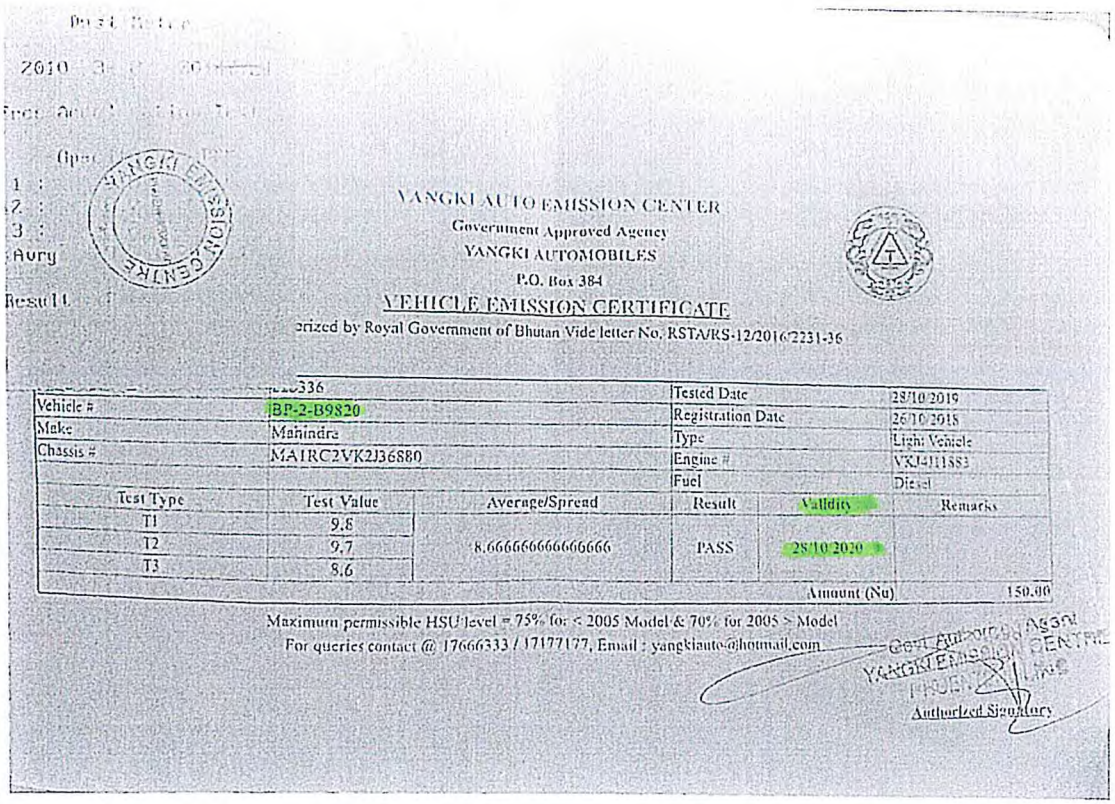
For queries contact @ 17666333 / 17177177, Email - yangklaute@hotmail.com

YANGKI AUTOMOBILES

Authorized Signature

Arm balance

Scorpio



YANGKI AUTO EMISSION CENTER

Government Approved Agency

YANGKI AUTOMOBILES

P.O. Box 384

VEHICLE EMISSION CERTIFICATE

orized by Royal Government of Bhutan Vide letter No. RSTA/RS-12/2016/2231-36

	336	Tested Date	28/10/2019
Vehicle #	BP-2-B9820	Registration Date	26/10/2015
Make	Mahindra	Type	Light Vehicle
Chassis #	MA1RC2VK2J36880	Engine #	VKJ4J11583
		Fuel	Diesel

Test Type	Test Value	Average/Spread	Result	Validity	Remarks
T1	9.8				
T2	9.7	8.666666666666666	PASS	28/10/2020	
T3	8.6				

Amount (Nu) 150.00

Maximum permissible HSU level = 75% for < 2005 Model & 70% for 2005 > Model

For queries contact @ 17666333 / 17177177, Email : yangkiauto@hotmail.com

YANGKI EMISSION CENTRE

Authorized Signatory

3/17/2020

Dumper - 01

YANGKI AUTO EMISSION CENTER

Government Approved Agency

YANGKI AUTOMOBILES

P.O. Box 384

VEHICLE EMISSION CERTIFICATE

Authorized by Royal Government of Bhutan Vide letter No. RSTA/RS-12/2016/2231-36

EMISSION REF #	250388		Tested Date		17/03/2020
Vehicle #	BP-2-A8653		Registration Date		25/02/2016
Make	Man Force Pvt. Ltd		Type		Heavy Vehicle
Chassis #	MBKMC5AR1GN016065		Engine #		6DGA21769
			Fuel		Diesel
Test Type	Test Value	Average/Spread	Result	Validity	Remarks
T1	32.6				
T2	25.8	26.333333333333332	PASS	17/09/2020	
T3	22.0				
			Amount (Nu)		200.00

Maximum permissible HSU level = 75% for < 2005 Model & 70% for 2005 > Model

For queries contact @ 17666333 / 17177177, Email : yangkiauto@hotmail.com

Authorized Signatory

INSTRUMEX

An ISO 9001-2015 Certified Company

CALIBRATION CERTIFICATE FOR MULTIGAS DETECTOR

Certificate No: GD-102/19-20/641

Name of the Client	Calibrated on:	Calibration Due on:	Environmental Details:
M/s. Bhutan Ecolab	28.02.2020	27.02.2021	Temperature : (25 ± 2)°C Relative Humidity : (68±10) %

Details of Device Under Calibration [DUT]:	Details of Standard Instrument used for calibration [STD]:
Description : Multi Gas Detector Model No. : GD-102 Range : CO: 0 to 500ppm SO2 : 0 to 500ppm NO2: 0 to 500ppm Serial No. : 01/2019H/061	Description : Reference Gases of CO, SO2 and NO2 : Gas Flow meter

Calibration Results:

Sr. #	Sample Gas	Standard Value (ppm)	Value on Device Under Test (ppm)	% Error	Remarks
1	CO	5	5.3	13	Acceptable
		20	23	13	Acceptable
		50	48	04	Acceptable
		100	96	04	Acceptable
		200	206	02	Acceptable
		500	493	01	Acceptable
2	SO_2	5	4.8	04	Acceptable
		20	18	11	Acceptable
		50	45	10	Acceptable
		100	106	06	Acceptable
		200	190	05	Acceptable
		500	491	02	Acceptable
3	NO_2	5	4.7	06	Acceptable
		20	21	05	Acceptable
		50	55	10	Acceptable
		100	108	08	Acceptable
		200	212	06	Acceptable
		500	513	02	Acceptable

Remarks:

- Calibration Method : Passing Standard Gas mixture over the instrument and standard device.
- The average percentage error was found to be within the acceptable limits.
- Results reported are valid at the time of and under the stated conditions of measurement

Calibrated by:	
Naem K.	
Certificate Prepared by:	
Rishabh K.	
Certificate Checked by:	
Radheshyam K.	

Factory Certificate Stamp

Envirotech Instruments Pvt. Ltd.

ISO 9001:2015 certified company

Manufacturers of Air Quality Monitoring Instruments

Regd. Office & Works: A-271, Okhla Industrial Area, Phase-I, New Delhi-110020, India Tel: 26814139 / 26813887
Fax: 91 11 26811833 E-mail : sales@envirotechindia.com Website : www.envirotechindia.com CIN: U74899DL1983PTC016927

M/s Bhutan Eco –Lab Services
Pekarzhing (Toribari) Phuentssholing, Chhukha
Bhutan

Certificate No.: EIPL/SLM/2019-20/86

Date of calibration: 08/12/2019

CALIBRATION CERTIFICATE

This is to certify that Sound Level Meter Envirotech SLM -100 (Sl. No. 347-DTA-2017) have been calibrated by EIPL. Details of Reference Equipment used for calibration.

Traceability Statement:	All the following Reference Equipments used to calibrate Sampler, are traceable to National Standards.		
Calibrator Name	**Make**	**Model & S.No.**	**Certificate Report No.**
Sound Level Calibrator Calibrated at FCRI, Palakkad, Kerala	Metravi	SC-05 150610293	FCRI/EQL/18-19/675 Dt. 12/12/2018

Recalibration is due on 07/12/2020 or after a major repair/overhaul.

For Envirotech Instruments Pvt. Ltd

(Authorized Signatory)

Envirotech Instruments Pvt. Ltd.,

M/s Bhutan Eco –Lab Services
Pekarzhing (Toribari) Phuentsholing, Chhukha
Bhutan

Page : 2 of 2
Certificate No.: EIPL/SLM/2019-20/86
Date of calibration: 08/12/2019

CLIBRATION RESULTS

CALIBRATION DATA GENETRATED FOR SOUND LEVEL METER Envirotech SLM -100 (Sl. NO. 347-DTA-2017)

Table 1

S. No.	Test Instrument		Reference Meter		Calibration Factor	Expanded Uncertainty
	Test Unit Reading (dB)	Avg. Test Unit Reading (dB)	Reference Meter Reading (dB)	Avg. Reference Meter Reading (dB)		
1	93.0	93.1	94.0	94.0	1.010	1.71 dB
2	93.1		94.0			
3	93.0		94.0			
4	93.1		94.0			
5	93.0		94.0			
6	93.1		94.0			
7	112.8	112.8	114.0	114.0	1.011	1.71 dB
8	112.7		114.0			
9	112.7		114.0			
10	112.7		114.0			
11	112.8		114.0			
12	112.8		114.0			

Calibrated By: Checked by: Certified By:

INSTRUMEX
An ISO 9001-2015 Certified Company

CALIBRATION CERTIFICATE FOR MICRO DUSTEC - 5003

Report No: IPM-5003/2019-20/10013-02

Name of the Client	Calibrated on:	Calibration Due on:	Environmental Details:
M/s. Bhutan Ecolab	27.01.2020	26.01.2021	Temperature : (25 ± 2)°C Relative Humidity : (68±10) %

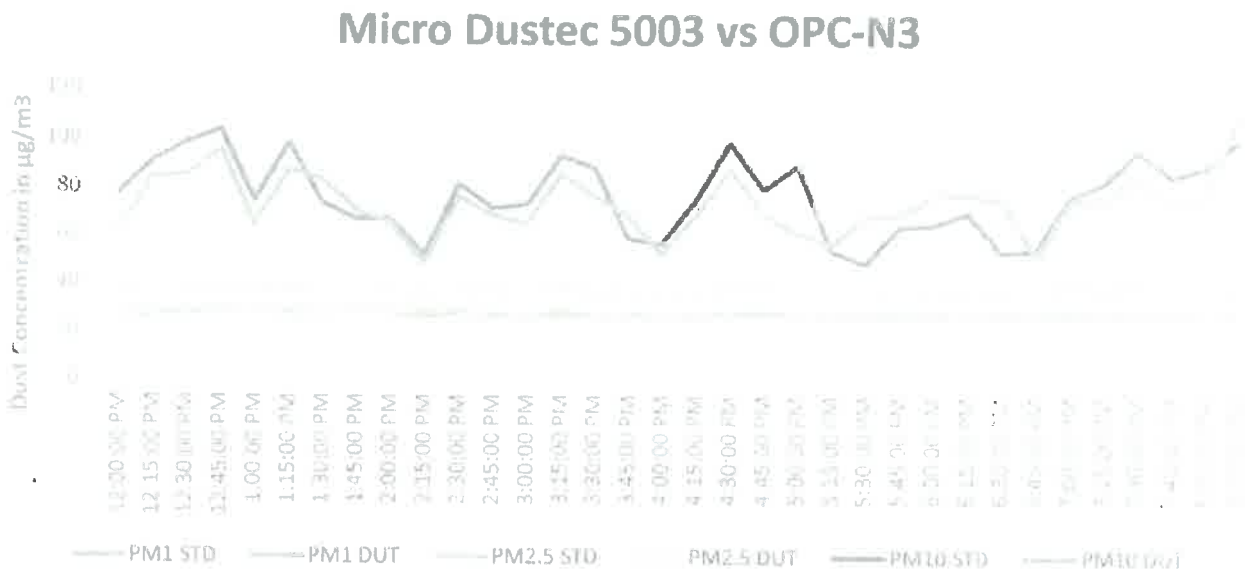
Details of Device Under Calibration [DUT]:	Details of Standard Instrument used for calibration [STD]:
Description : Instrumex Micro Dustec Real Time Dust Monitor Model No. : 5003 Range : Particulates – 0 to 2,000 µg/m3 Temperature – 0 to 60°C Humidity – 0 to 99.9% Serial No. : 11519	Description : 1) Alphasense Dust monitor & 2) Temperature Humidity Sensor Model No. : 1) OPC-N3 2) MHB-382SD Range : Particulates – 0 to 2,000 µg/m3 Temperature – 0 to 60°C Humidity – 0 to 99.9% Serial No. : 17696423 & Q20192034

Calibration Results:

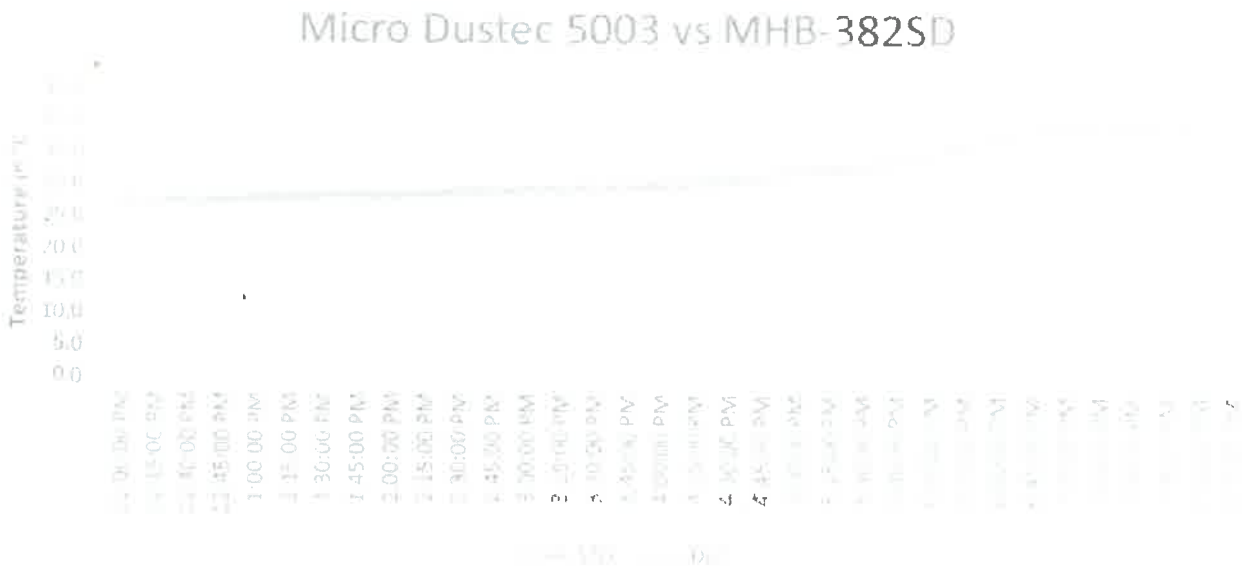
	PM1.0			PM2.5			PM10			Temperature			Humidity		
Time	STD	DUT	% ERR	STD	DUT	% ERR	STD	DUT	% ERR	STD	DUT	% ERR	STD	DUT	% ERR
12:00:00 PM	29.27	31.23	4.90	40.93	37.58	1.64521	102.48	93.79	10.0438	27.4	27.2	0.72993	44.5	43.6	[illegible]
12:15:00 PM	27.71	30.1	-8.63	37.68	30.21	-6.87247	187.43	175.42	-3.52838	27.6	27.3	1.08696	44.1	43.8	[illegible]
12:30:00 PM	15.09	16.22	0.16	20.43	21.07	0.66854	68.6	56.45	0.68224	27.8	27.5	1.07914	45.1	[illegible]	[illegible]
12:45:00 PM	16.82	16.58	1.72	23.93	21.19	10.0642	89.95	84.83	5.69091	27.9	28	0.35842	[illegible]	[illegible]	[illegible]
1:00:00 PM	18.77	15.93	14.90	24.7	21.08	-9.91242	59.27	61.5	[illegible]	28.1	28.1	[illegible]	44.8	[illegible]	[illegible]
1:15:00 PM	16.69	14.62	11.34	22.6	18.96	-6.742	61	88.53	2.90007	28.9	29.2	1.03806	45.5	[illegible]	[illegible]
1:30:00 PM	15.93	15.61	2.13	20.83	19.74	0.11632	48.23	61.6	1.11584	29.5	29.8	1.01695	45.9	43.6	[illegible]
1:45:00 PM	13.82	15.22	3.16	20.85	19.56	-3.35889	68.03	49.18	2.09565	29.8	30.1	-1.00671	46	43.6	[illegible]
2:00:00 PM	14.9	15.24	-2.28	15.54	19.77	-4.8381	42.37	58.64	2.48125	30.0	30.4	[illegible]	46	43.6	5.21739
2:15:00 PM	16.22	15.52	4.26	21.81	22.75	12.463	57.74	41.94	2.80197	30.7	30.4	[illegible]	45.4	[illegible]	[illegible]
2:30:00 PM	15.65	15.68	0.19	20.99	[illegible]	1.18592	72.20	84.28	[illegible]	31.6	31.5	[illegible]	[illegible]	[illegible]	[illegible]
2:45:00 PM	16.93	[illegible]	11.75	21.91	21.7	[illegible]	60.72	78.51	[illegible]	32.0	31.8	[illegible]	[illegible]	[illegible]	[illegible]
3:00:00 PM	15.49	14.9	9.64	22.04	20.61	8.71515	70.22	56.33	5.63575	32.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3:15:00 PM	15.23	16.08	3.89	21.88	21.76	[illegible]	125.42	145.50	0.11381	32.4	32	[illegible]	[illegible]	[illegible]	[illegible]
3:30:00 PM	15.76	15.94	7.28	21.81	20.44	3.08576	80.73	98.42	[illegible]	32.1	31.8	0.93458	45	[illegible]	[illegible]
3:45:00 PM	15.02	14.79	7.68	21.3	19.3	6.96398	98.33	109.27	[illegible]	31.8	32	0.62893	[illegible]	[illegible]	[illegible]
4:00:00 PM	16.02	14.75	11.20	21.67	19.01	4.91743	52.66	69.71	5.85391	32.1	31.5	1.28617	44.8	41.2	[illegible]
4:15:00 PM	16.74	15.52	7.29	22.72	20.27	-4.61538	67.49	82.94	6.58132	32.6	31.9	0.94937	44.6	[illegible]	3 [illegible]
4:30:00 PM	16.56	14.25	13.95	22.21	18.29	4.18278	150.15	167.89	2.07589	30.4	30.8	1.31579	44.4	43	3 [illegible]
4:45:00 PM	15.03	15.41	2.53	20.04	19.8	9.1133	136.88	149.85	4.17237	30.7	31	[illegible]	44.3	41.8	[illegible]
5:00:00 PM	16.11	14.78	8.26	22.32	18.57	-7.47384	165.88	178.49	-7.30634	31.2	31.5	0.96154	44.3	42.8	3.386
5:15:00 PM	16.29	15.31	6.02	21.37	19.37	-10.4901	59.54	57.66	-5.01081	31.6	32	-1.26582	44.3	42.8	3.386
5:30:00 PM	16.57	16.01	3.26	22.44	21.02	5.6568	70.90	79.26	2.85866	32.3	32.9	1.85759	44.2	42.8	3.15742
5:45:00 PM	16.04	15.46	3.62	21.41	20.02	-4.92104	80.00	74.28	-3.21112	32.3	[illegible]	[illegible]	44.2	42.6	[illegible]
6:00:00 PM	16.52	15.40	6.23	22.35	19.22	-9.34	96.39	110.48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	16.77	15.39	[illegible]	22.14	19.67	[illegible]	[illegible]	118.19	10.7161	[illegible]	33.9	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	16.87	[illegible]	9.07	22.05	21.24	5.23861	[illegible]	63.21	[illegible]	[illegible]	34	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17.76	15.47	12.89	22.74	[illegible]	-9.74688	[illegible]	85.63	5.24109	[illegible]	34.1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	15.95	15.47	2.77	20.81	21.26	7.30782	61.9	48.17	[illegible]	[illegible]	33.8	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	16.42	15.56	5.24	21.23	20.95	2.01751	50.29	68.51	1.86368	[illegible]	34	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	15.75	15.75	0.00	20.33	21.34	7.42202	[illegible]	70.34	[illegible]	[illegible]	34.5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	16.03	[illegible]	20.74	21.18	9.01789	[illegible]	[illegible]	[illegible]	[illegible]	34.8	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	16.50	14.88	10.14	25.11	19.89	6.47741	[illegible]	155.32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	15.55	4.54	25.35	20.13	5.23438	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AVERAGE	17.06	16.31	4.67	22.94	21.24	-2.29	86.28	91.85	-1.99	31.46	31.69	-0.67	44.67	43.04	3.63

Registered Office 106 Ashish Udyog Bhavan, [illegible] SNDT College Liberty Garden Malad (W), Mumbai 400 064 India
Tel +91 22 28443997 / 67427738 | M. 9322235241 / 9702284343 | Email info@instrumex.co.in | Web www.instrumexindia.com
Branch Office # [illegible] 15th Main 4th T Block Jayanagar Bangalore 560 041 India | Email info@instrumex.net

Calibration Curve for Particulates:

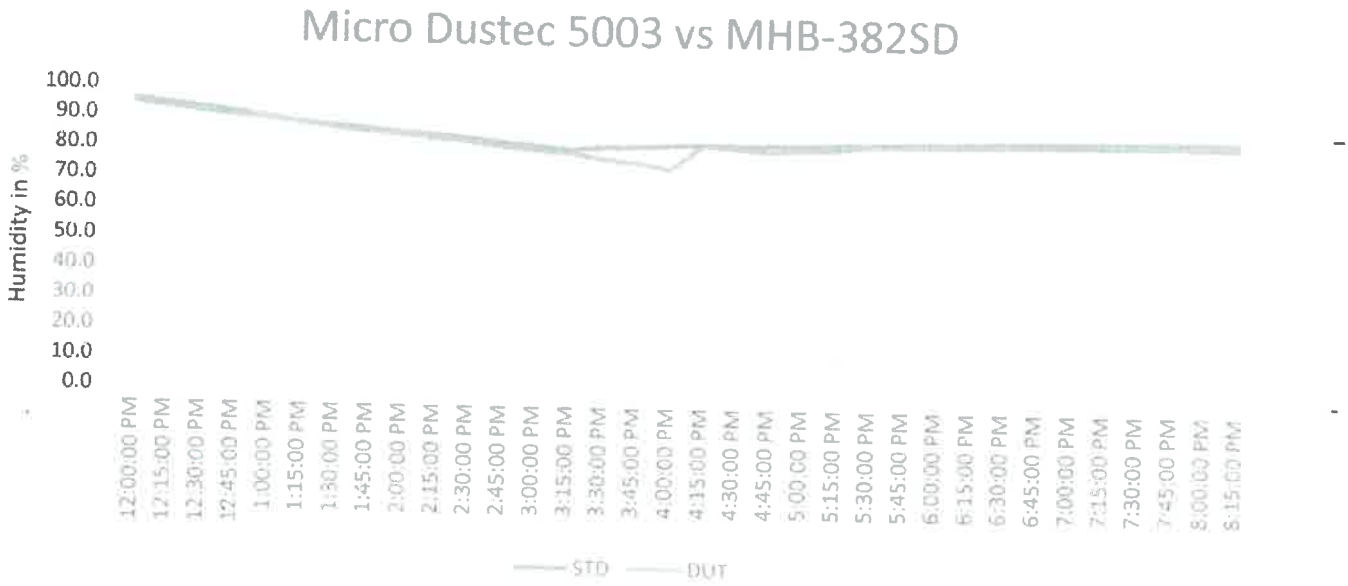


Calibration Curve for Temperature:



Registered Office 10o Ashish Udyog Bhavan, Opp SNDT College, Liberty Garden Malad (W), Mumbai 400 064, India
Tel +91 22 28443997 / 67427738 | M. 9322235281 / 9702284343 | Email info@instrumex.co.in | Web. www.instrumexind.com
Branch Office # 208, 15th Main 4th T Block, Jayanagar, Bangalore 560 041 India | Email info@instrumex.net

Calibration Curve for Humidity:



Remarks:

- Calibration Method : Comparison with standard device
- 8 hour test was performed on the Device Under Test (DUT) and the Standard Device (STD)
- The average percentage error of 8 hour run was within the acceptable limits.
- Results reported are valid at the time of and under the stated conditions of measurement

Calibrated by:
Naeem K.
Certificate Prepared by:
Rishabh K.
Certificate Checked by:
Radheshyam K.

Factory Certificate Stamp

Registered Office 106 Ashish Udyog Bhavan Opp SNDT College, Liberty Garden, Malad (W) Mumbai 400 064 India
Tel. +91 22 28443997 / 67427738 | M. 9322235281 / 9702284343 | Email info@instrumex.co.in | Web www.instrumexindia.com
Branch Office # 208, 15th Main, 4th T Block, Jayanagar, Bangalore 560 041, India | Email info@instrumex.net

CALIBRATION CERTIFICATE FOR MICRO DUSTEC - 5003

Report No: IPM-5003/2019-20/11600-01

Name of the Client	Calibrated on:	Calibration Due on:	Environmental Details:
M/s. Bhutan Ecolab	27.01.2020	26.01.2021	Temperature : (27 ± 1)°C Relative Humidity : (85 ±10) %

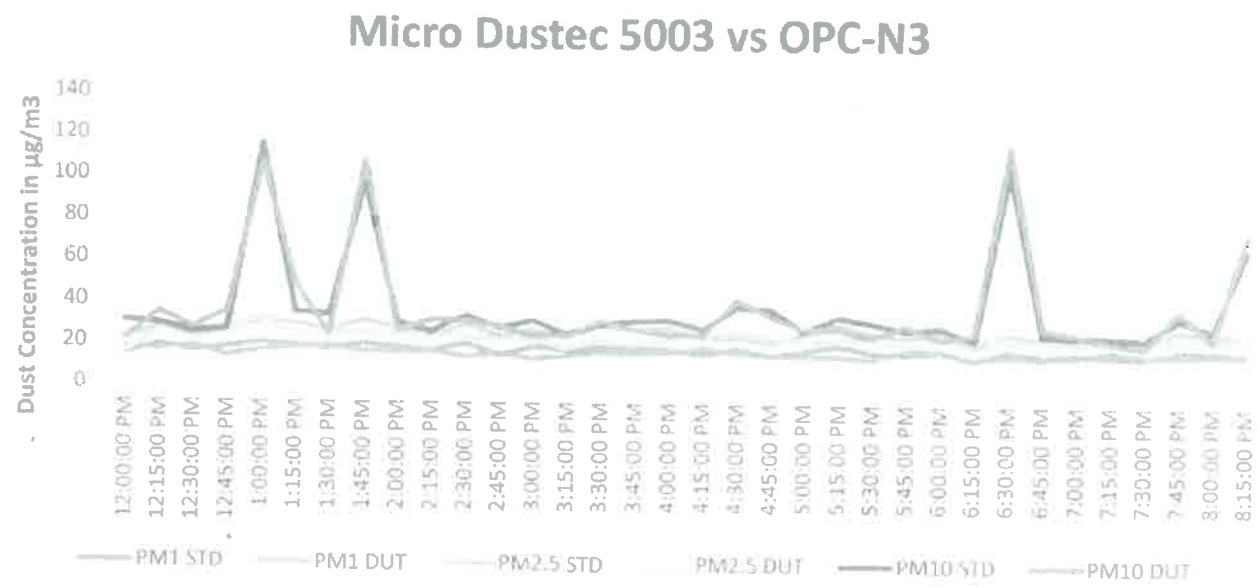
Details of Device Under Calibration [DUT]:	Details of Standard Instrument used for calibration [STD]:
Description : Instrumex Micro Dustec Real Time Dust Monitor Model No. : 5003 Range : Particulates – 0 to 10,000 µg/m3 Temperature – 0 to 60°C Humidity – 0 to 99.9% Serial No. : 11600	Description : 1) Alphasense Dust monitor & 2) Temperature Humidity Sensor Model No. : 1) OPC-N3 2) MHB-382SD Range : Particulates – 0 to 10,000 µg/m3 Temperature – 0 to 60°C Humidity – 0 to 99.9% Serial No. : 17688032 & Q20180132

Calibration Results:

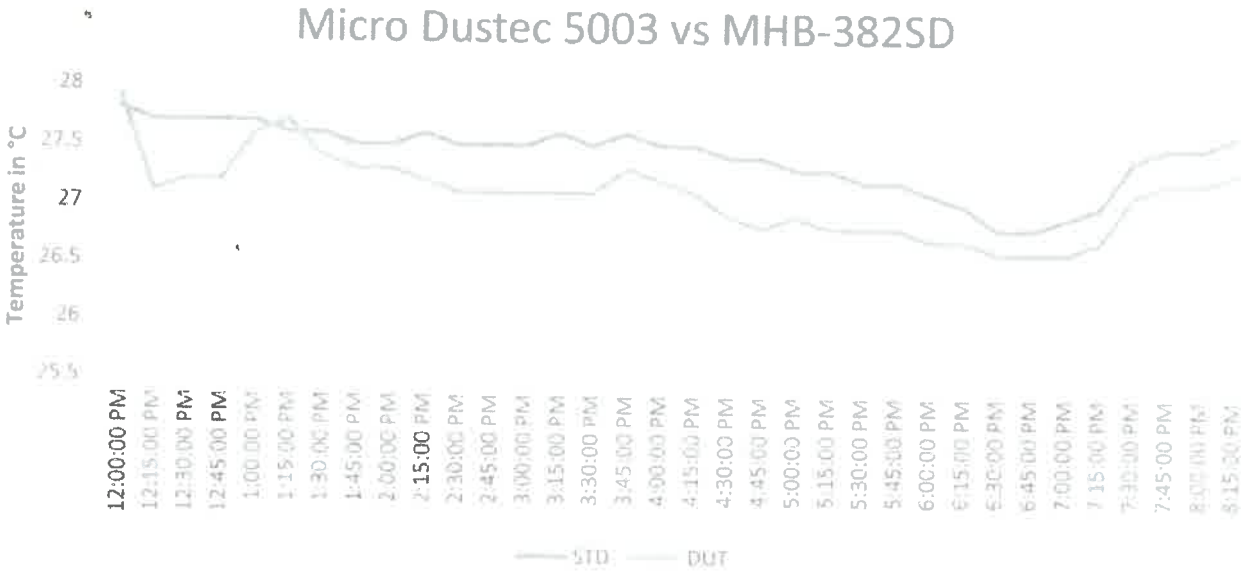
	PM1.0			PM2.5			PM10			Temperature			Humidity		
Time	STD	DUT	% ERR	STD	DUT	% ERR	STD	DUT	% ERR	STD	DUT	% ERR	STD	DUT	% ERR
12:00:00 PM	14.22	17.08	-20.07	21.98	14.76	32.85	30.14	21.34	29.20	27.8	27.9	-0.36	95.1	94.1	1.10
12:15:00 PM	18.53	16.44	11.26	26.74	25.78	3.61	28.98	34.68	-19.66	27.7	27.1	2.17	94.1	92.8	1.35
12:30:00 PM	15.94	18.24	-14.42	22.70	26.34	-16.02	25.04	27.08	-8.13	27.7	27.2	1.81	92.8	91.3	1.57
12:45:00 PM	17.57	13.46	23.37	25.12	25.29	-0.67	26.52	35.18	-32.64	27.7	27.2	1.81	91.4	90.1	1.37
1:00:00 PM	19.83	16.42	17.20	30.42	32.54	-6.95	115.67	107.19	7.32	27.7	27.6	0.36	89.7	89.4	0.30
1:15:00 PM	18.74	17.75	5.29	29.31	23.06	21.35	34.95	48.84	-39.74	27.6	27.7	-0.36	88.1	87.9	0.21
1:30:00 PM	17.26	18.65	-8.03	25.90	25.18	2.80	33.94	24.38	28.18	27.6	27.4	0.72	87.2	86.4	0.96
1:45:00 PM	19.66	16.02	18.53	30.99	25.22	18.63	97.42	108.23	-11.10	27.5	27.3	0.73	86.3	85.5	0.94
2:00:00 PM	18.37	15.86	13.66	27.85	23.89	14.21	30.39	26.35	13.30	27.5	27.3	0.73	85.1	84.4	0.77
2:15:00 PM	16.68	16.22	2.79	23.27	23.92	-2.79	25.91	31.43	-21.33	27.6	27.2	1.45	84.6	83.5	1.30
2:30:00 PM	20.12	14.02	30.32	29.52	23.62	19.98	33.72	31.43	6.78	27.5	27.1	1.45	83.5	82.4	1.37
2:45:00 PM	14.76	15.55	-5.36	24.14	22.05	8.69	28.00	28.78	2.77	27.5	27.1	1.45	82.3	81	1.55
3:00:00 PM	18.84	13.24	29.71	27.39	22.81	16.73	31.49	24.25	23.01	27.5	27.1	1.45	81.3	79.8	1.85
3:15:00 PM	17.50	14.60	16.58	23.49	18.65	20.62	25.22	24.34	3.48	27.6	27.1	1.81	80.3	79	1.66
3:30:00 PM	19.03	16.12	15.28	28.84	22.30	22.68	29.90	31.32	-4.76	27.5	27.1	1.45	81.4	77.2	5.16
3:45:00 PM	18.03	15.54	13.81	27.47	20.32	26.03	31.45	27.29	13.21	27.6	27.1	1.09	81.5	75.9	6.87
4:00:00 PM	18.04	16.61	7.90	28.46	23.13	18.74	32.05	25.08	21.75	27.5	27.2	1.09	82.0	74	9.76
4:15:00 PM	15.68	18.45	-17.62	23.71	25.06	-5.70	27.78	25.10	9.63	27.5	27.1	1.45	82.4	82.3	0.15
4:30:00 PM	18.45	16.63	9.85	24.01	26.32	-9.65	38.81	42.43	-9.31	27.4	26.9	1.82	82.3	81.3	1.21
4:45:00 PM	15.34	15.23	0.70	21.54	24.82	-15.22	37.83	34.39	9.10	27.4	26.8	2.19	82.6	80.3	2.74
5:00:00 PM	17.77	15.37	13.51	25.70	21.20	17.49	27.27	28.35	-3.97	27.3	26.9	1.47	82.8	81.4	1.69
5:15:00 PM	20.38	15.35	24.70	30.74	23.27	24.31	34.12	28.44	16.67	27.3	26.8	1.83	83.2	81.5	2.04
5:30:00 PM	17.34	14.01	19.20	26.52	24.20	8.75	31.29	24.47	21.80	27.2	26.8	1.47	83.5	83.0	0.60
5:45:00 PM	16.59	18.47	-11.32	24.51	20.38	16.84	27.91	30.46	-9.13	27.2	26.8	1.47	83.9	83.2	0.83
6:00:00 PM	18.07	17.97	0.53	27.20	24.28	10.74	29.57	23.51	20.49	27.1	26.7	1.48	84.0	83.1	1.07
6:15:00 PM	13.96	14.38	-3.02	20.28	25.06	-23.57	23.38	26.59	-13.73	27	26.7	1.11	84.3	83.2	1.30
6:30:00 PM	18.06	15.90	11.95	26.79	22.74	15.11	105.12	116.04	-10.38	26.8	26.6	0.75	84.7	83.6	1.30
6:45:00 PM	16.10	14.91	7.36	24.60	24.13	1.92	25.93	29.25	-12.80	26.8	26.6	0.75	84.8	84	0.94
7:00:00 PM	16.89	16.30	3.53	24.01	21.67	9.74	25.88	26.30	-1.62	26.9	26.6	1.12	85.0	84	1.18
7:15:00 PM	16.12	18.57	-15.19	23.06	24.16	-4.79	25.34	22.98	9.34	27	26.7	1.11	85.2	84	1.42
7:30:00 PM	15.69	16.37	-4.30	22.36	28.09	25.63	24.34	20.14	17.25	27.4	27.1	1.09	85.4	84.1	1.52
7:45:00 PM	18.76	16.47	12.21	28.80	23.03	20.05	34.23	38.38	-12.14	27.5	27.2	1.09	85.7	84.2	1.75
8:00.00 PM	18.46	17.22	6.73	26.88	23.51	12.54	29.03	24.24	16.50	27.5	27.2	1.09	85.9	84.1	2.10
8:15:00 PM	17.72	16.63	6.14	26.76	25.13	6.10	67.23	74.62	-10.99	27.6	27.3	1.09	85.6	84	1.87
AVERAGE	**17.49**	**16.18**	6.55	**25.91**	**23.70**	7.65	**37.52**	**37.44**	1.26	**27.41**	**27.08**	1.21	**85.23**	**83.71**	1.82

Registered Office : 106, Ashish [illegible] Bhavan, Opp. SNDT College, Liberty Garden, Malad (W), Mumbai - 400 064, India
Tel: +91 22 28443497 / 67427738 | M: 9322235281 / 9702284343 | Email: info@instrumex.co.in | Web: www.instrumexindia.com
Branch Office : [illegible] 15th Main, 4th T Block, Jayanagar, Bangalore - 560 041, India | Email: info@instrumex.net

Calibration Curve for Particulates:

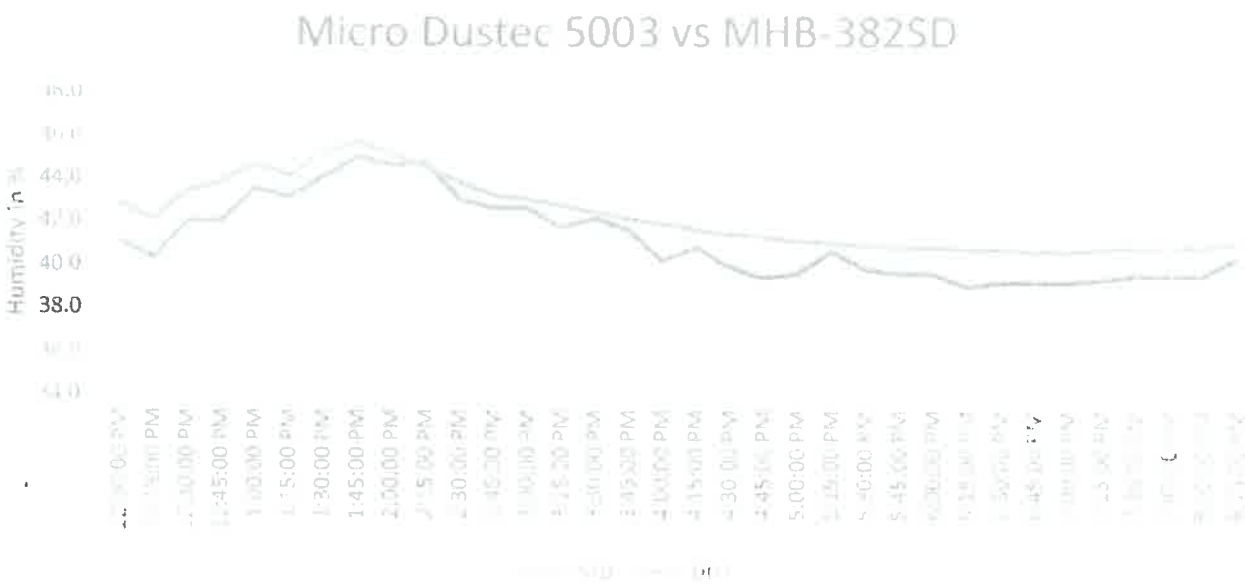


Calibration Curve for Temperature:



Registered Office 10b, Ashish Udyog Bhawan Opp. SNDT College Liberty Garden Malad (W), Mumbai - 400 064 India
Tel: +91 22 2884 [illegible] / 67427738 | M: [illegible] / 9702284341 | Email: info@instrumexindia.com | Web: www.instrumexindia.com

Calibration Curve for Humidity:



Remarks:

- Calibration Method : Comparison with standard device
- 8 hour test was performed on the Device Under Test (DUT) and the Standard Device (STD)
- The average percentage error of 8 hour run was within the acceptable limits.
- Results reported are valid at the time of and under the stated conditions of measurement

Calibrated by:	
Naeem K.	
Certificate Prepared by:	
Rishabh K.	
Certificate Checked by:	
Radheshyam K.	

Factory Certificate Stamp

Manufacturers of Air Quality Monitoring Instruments

Regd. Office & Works: A-271, Okhla Industrial Area, Phase-I, New Delhi-110020, India Tel: 26814139 / 26813887
91 11 26811833 E-mail : sales@envirotechindia.com Website : www.envirotechindia.com CIN: U74899DL1983PTC016927

Certificate No.: EIPL/RDS/2019-20/380

Date of calibration: 08/12/2019

M/s Bhutan Eco –Lab Services
Pekarzhing (Toribari) Phuentssholing, Chhukha
Bhutan

CALIBRATION CERTIFICATE

This is to certify that Respirable Dust Sampler, Make Envirotech, Model APM 460 NL (Sl. No. 1400-DTL-2016) and Gaseous Sampling Attachment, Make Envirotech, Model APM 411TE (S. No. 1806-DTG-2016) have been calibrated by EIPL. Details of Reference Equipment used for calibration.

Traceability Statement:	All the following Reference Equipments used to calibrate Sampler, are traceable to National Standards.		
Calibrator Name	**Make**	**Model & S.No.**	**Certificate Report No.**
Top Loading Calibrator Calibrated at ECL, New Delhi	Envirotech	APM421 85	**ECL/ECL/2018-19/FLOW/3548** Dt. 02/01/2019
Differential Pressure Meter Calibrated at ECL New Delhi	Testo	510 43401225/301	**ECL/ECL/2018-19/MECH/4504** Dt. 25/02/2019
Diaphragm Gas Meter Calibrated at ECL, New Delhi	Itron	Gallus 2016 160540333	**ECL/ECL/2019-20/FLOW/1749** Dt. 24/07/2019
Stop Watch Calibrated at ECL, New Delhi	Racer	396	**ECL/ECL/2019-20/ET/1603** Dt. 11/07/2019

Recalibration is due on 07/12/2020 or after a major repair/overhaul.

For Envirotech Instruments Pvt. Ltd

(Authorized Signatory)

Envirotech Instruments Pvt. Ltd.,

M/s Bhutan Eco –Lab Services
Pekarzhing (Toribari) Phuentssholing, Chhukha
Bhutan

Certificate No.: EIPL/RDS/2019-20/380

Date of calibration: 08/12/2019

CALIBRATION RESULTS

1. CALIBRATION DATA GENETRATED FOR RESPIRABLE DUST SAMPLER Make Envirotech, Model APM 460 NL (Sl. NO- 1400-DTL-2016)

Manometer

S. No.	Test Piece Measured Flow Rate (m^3/min)	Reference Flow Rate (m^3/min)	Calibration Factor	Expanded Uncertainty (K=2)
1	0.840	0.848	1.009	±1.10%
2	0.950	0.937	0.986	±1.10%
3	1.040	1.052	1.011	±1.10%
4	1.140	1.151	1.010	±1.10%
5	1.200	1.203	1.003	±1.10%

Time Totalizer

S. No.	Time Totalizer Reading (Hrs)		Test Piece Measured Time (Min)	Reference True Time(min)	Calibration Factor	Expanded Uncertainty
	I.Reading	F.Reading				
1	349.30	349.80	30	30	1.000	±0.13 min
2	349.80	350.30	30	30	1.000	±0.13 min
3	350.30	350.80	30	30	1.000	±0.13 min

2. CALIBRATION DATA GENETRATED FOR GASEOUS SAMPLING ATTACHMENT Make Envirotech, Model APM 411 TE (Sl. No. 1806-DTG-2016)

Rotameter (0-3)lpm (Sl. No. 16/0930)

S. No.	Test Piece Measured Flow Rate (lpm)	Reference Flow Rate (lpm)	Calibration Factor	Expanded Uncertainty
1	0.5	0.510	1.020	±2 36%
2	1.0	1.010	1.010	±2.36%
3	1.5	1.510	1.007	±2.36%
4	2.0	2.020	1.010	±2.36%
5	2.5	2.475	0.990	±2.36%
6	3.0	2.998	0.999	±2.36%

Calibrated by

Checked by

Certified by

QF992502

PURCHASE ORDER

Draft Copy

Afcons- Bhutan Project
Bhutan Bhutan
Tel.No.
Fax.No.

Supplier : 113789
Instrumex
106, Ashish Udhyog Bhavan, Opp SNDT Malad West,
Mumbai - 400064 mumbai mumbai 400064 Maharashtra India

Tel No : 9322235281
Fax No : N/A
Email No : sales@instrumex.net
Contact : Vidya S. / 9322235281
Supplier GSTN: 27AFNPK8304B1ZL

Purchase Order No : 4500378854 **Date :** 01.07.2020
Project : 6462 Construction of River Training & Ebarkment works for
Payment Terms : 100% advance against Proforma Invoice
Incoterms: -
Billed To : AFCONS INFRASTRUCTURE LTD. Constriction of river training & Ebarkment Work, Phuentsholing Township Development Project, Bhutan, Post Box No, 247,
Shipped To: AFCONS INFRASTRUCTURE LTD. Constriction of river training & Ebarkment Work, Phuentsholing Township Development Project, Bhutan, Post Box No, 247,

Contact :
Billed to GSTN :

Sr No.	Item Description	Quantity	UOM	Delivery Date	Base Rate(INR)	Discount	Net Rate	Tax%	HSN/SAC	Total Amount (INR)
1	FA02184 - Air Pollution Monitoring System Real Time Dust Monitor,DUSTEC-5003, with Battery **Asset Description** Air Pollution Monitoring System-Instrumex--6462	1.000	NOS	30.07.2020						

Taxes applicable are as following ;

1. D0 - Zero Tax Code

Remarks

1. Reference: This has reference as Per Price Qtn. I/2020-21/LQ-29

2. General: Progress of our PTDP site, entirely depends upon timely supplies made by you. Hence, please note that timely supplies of material confirming to specifications indicated in the order is essence of this contract.

If you fail to make supplies as per delivery schedule given in the order / by site, we reserve our right to make alternative arrangement for procurement from other sources at your risk and cost.

Kindly send us your acceptance within 3 days otherwise it will be taken as acceptance by you.

Please mention our order reference in all the delivery challan & invoice has to be submitted accounts department at our main office. Drawing reference whenever applicable must be mentioned in the delivery challan/invoice

Purchase order value is inclusive of all taxes and duties.

Checked By

For Afcons- Bhutan Project

Note : Acceptance of this order constitute an acceptance of the terms and conditions on face reverse thereof
Indent Ref : ,2000253620Dtd.01.07.2020

Second Pre-Monsoon Aquatic Study Report

On Aquatic Survey along Amochhu River Basin Phuentsholing-Chukha

26th March-27th March 2020
Bhutan Ecolab Services
Phuentsholing

BHUTAN ECOLAB SERVICES

BHUTAN ECOLAB SERVICES ★ PHUENTSHOLING ★

AFCONS INFRASTRUCTURE LTD. BHUTAN

Table of Contents

BHUTAN ECOLAB SERVICES PHUENTSHOLING

AFCONS INFRASTRUCTURE LTD. BHUTAN

List of Figures

List of Tables

List of Appendices

AFCONS INFRASTRUCTURE LTD. BHUTAN

BHUTAN ECOLAB SERVICES PHUENTSHOLING

GLOSSARY

C

1) **Critically Endangered (CN):** A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
2) **Cypriniformis:** Is an order of ray finned fish which possess weberian apparatus. They possess only a dorsal fin in its back unlike other order.

D

3) **Data Deficient (DD):** A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

E

4) **Electro-Fishing Efficiency:** How effective the use of electro-fishing is.
5) **Endangered (EN):** A taxon is endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

G

6) **Galvan taxis:** Response of fish to the electric current.

L

7) **Least Concern (LC):** A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

N

8) **Not Assessed:** A taxon is Not Evaluated or Not Assessed when it is has not yet been evaluated against the criteria.
9) **Near Threatened (NT):** A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

O

10) **Osteichthyes:** Popularly referred as bony fish, is a diverse taxonomic group of fish that have skeletons primary composed of bone tissue as opposed to cartilage.

P

11) **Perciformes:** Fish in this order have the dorsal and anal fins divided into anterior spiny and posterior soft rayed which may be partially or completely separated.

S

12) **Synbranchiformes:** Often called swamp eels are an order of ray finned fishes that are like eel but have spiny rays.

13) **Species not determined:** A taxon is Species not determined when it has been evaluated against the criteria and does not qualify under any recognized species.

V

14) **Vulnerable (VU):** A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

ABBREVIATION

1)	**CDCL**	:	Construction Development Corporation Limited
2)	**CEMP**	:	Contractors Environmental Management Plan
3)	**DC**	:	Direct Current
4)	**EIA**	:	Environmental Impact Assessment
5)	**FNCR**	:	Forest and Nature Conservation Regulation
6)	**IUCN**	:	International Union for Conservation of Nature
7)	**NRCR&LF**	:	National Research Centre for Riverine & Lake Fisheries
8)	**ADB**	:	Asian Development Bank
9)	**BES**	:	Bhutan Ecolab Services
10)	**PTDP**	:	Phuentsholing Township Development Project

BHUTAN ECOLAB SERVICES PHUENTSHOLING

AFCONS INFRASTRUCTURE LTD. BHUTAN

1. Introduction:

Phuentsholing is located adjacent to the Bhutan and the Indian border and so, is tagged as the "economic capital" (Amochhu EIA Report, 2017) for Bhutan. In the recent years, Phuentsholing has face the problem of increasing population with limited area (Amochhu EIA Report, 2017); adding to this, the Amochhu River threatens to flood, erode and cause loss of valuable land resulting in sedimentation at lower ends of the river. Hence so, Phuentsholing Township Development Project, contracted to AFCONS Infrastructure Limited by CDCL with their consultant as Egis International is working on the Construction of River Training and Embankment Work along the Amochhu River. In the course of the construction works, it is crucial to monitor and maintain the ecological health i.e. Terrestrial and Aquatic environment within and the areas adjacent to the project site.

The Aquatic Survey Reports study the fish composition and observe the diversity variability during different seasons and the mobility behavior of critically endangered fish like Golden Mahseer (Ammo Chhu River is the migratory Route for the Golden Mahseer). This report i.e. the Third Aquatic Study (and the Second Pre-monsoon study) will be comparative to the last Pre-monsoon and Post monsoon Aquatic studies (First & Second Aquatic survey respectively) conducted.

According to the information shared by residents, the natural river flow and water ways are under continuous disturbance due to dredging, surface boulders/sand collection and operation of stone crushing Plants by non PTDP relative private parties in the study area. However, during the Third Aquatic Study, the surface boulder and sand collections activity were absent along the river but two crushing Plants were observed in Zone A site.

The Second Pre-monsoon Aquatic Survey (i.e. Third Aquatic Survey conducted) was carried out on 26th and 27thMarch 2020. The study was conducted with the assistance of a team of fishery experts from the NRCR&LF, Haa (**Appendix 2**) under the Department of Livestock, Ministry of Agriculture and Forests. An approval from the Department of Forest for the study is attached as **Appendix 3**. With respect to the objectives listed in **section 3** of this report, our primary focus remains to noted the presence and absence of the protected fish species Golden Mahseer which is marked as endangered in the IUCN Red list

Therefore, this report provides fish species diversity in different seasons along the Ammo Chhu basin falling within the Phuntsholing Township Development Project executed by M/s Afcons Infrastructure Ltd. The data thus recorded will serve as baseline data for future studies and development of conservation program to minimize major impacts on Ammo Chhu aquatic ecosystem from project activity.

BHUTAN ECOLAB SERVICES * PHUENTSH

AFCONS INFRASTRUCTURE LTD. BHUTAN

CONTACT NO: +975-17449115; EMAIL: tenzin85yeshi@gmail.com

1.2 Golden Mahseer

Among the fish species that are being studied, the Himalayan Golden Mahseer (*Tor putitora*) is an endangered species having their migrant habitat in the Ammochhu River. Generally, Golden Mahseer inhabits both rivers and lakes, with most species found in fast-flowing rivers/streams with rocky bottoms for breeding. Morphologically, its caudal, pelvic and anal fins show a tint of reddish-golden colour. While the body above its lateral lines is generally golden in color adulthood, the gold colour might be absent in juvenile. They are omnivorous and so prey on algae species, crustaceans, insects, frogs, other smaller fishes and also fruits that fall from overhead.

Tor putitora is the largest member of its group and is one of the largest cyprinids that grow to 2.75 meters and 54 kilograms in weight. The juveniles are mostly found near the large and small boulders, where water is free-flowing and well oxygenated. Among the golden Mahseer, Himalayan Mahseer, *Tor putitora,* is an endangered species of cyprinid fish that is found in rapid streams, Riverine pools and lakes in the Himalayan region and southern Asia.

The species is threatened mainly due to habitat loss, habitat degradation and overfishing. According to research, its population has been declined drastically to more than 50 % as of today.

CONTACT NO. +975-17449115; EMAIL: tenzin85yeshi@gmail.com

2. Objective

1. To study and assess the fish species composition (diversity) along the Amochhu River basin that fall under the Phuentsholing Township Development Project (PTDP);
2. Establish baseline data for fish composition
3. Assess presence of protected fish species primarily focusing on Golden Mahseer i.e. marked as endangered in the IUCN Red list.
4. To study, compare and analyze the data collected thus far.

3. Study Area Description:

Study sites were based on the EIA report for Phuentsholing Township Development Project in accordance with the CEMP. The sampling stations allow for the even distribution of the sampling areas to obtain unbiased samples. Sampling stations were divided as follows:

i The main **Amochhu:** With six sampling stations, which starts from Indo-Bhutan border till the Purbay Bridge (Phuentsholing - Samtse High Way Bridge);

ii The **Omchhu:** Commonly known as Dortikhola with two stations, starts from Amochhu - Omchhu Confluence till Crocodile farm;

iii The **Lawrichhu:** Falls under Samtse Dzongkhag, is also covered as one of the fish sampling station

iv The **Hawri khola:** Two stations starting from Ammochhu-Hawri khola confluence and upstream. However, the sampling from the location could not be taken as the river bed had completely dried up during the survey **(Figure 2).**

CONTACT NO: +975 17449115; EMAIL: tenzin85yeshi@gmail.com

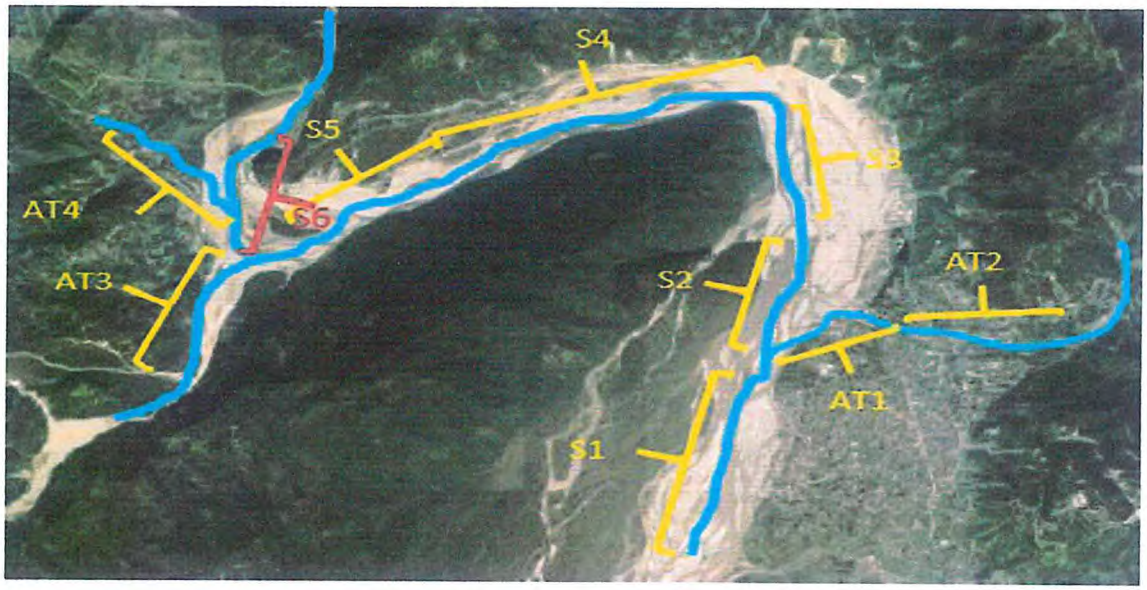


Figure 1: Geographical outlay of survey sites.

Figure 2: Dried up River bed of Hawri khola (AT3)

CONTACT NO. +975-17[illegible]15; EMAIL: tenzin85yeshi@gmail.com

The GPS coordinates of all sampling sites is shown in **Table 1.**

Table 1: Details of Sample station with GPS Coordinates

Station	Location	Coordinates		Altitude (m)	Remarks
		Start Points	End Points		
S1	Amochhu- Below Amochhu-Omchhu confluence	N26.86323 E089.36226	N26.86805 E089.37244	182	Indo-Bhutan Border
S2	Amochhu- Above Omchhu-Amochhu confluence	N26.86805 E089.37244	N26.87709 E089.37215	189	Development
S3	Amochhu-Main Construction Site	N26.87709 E089.37215	N26.88541 E089.37103	199	Main Office Area
S4	Amochhu- Above Wangchunye (Shiv Mandir)	N26.88541 E089.37103	N26.88544 E089.36548	200	Development Site
S5	Amochhu-Below Lawrichhu-Amochhu Confluence	N26.87501 E089.97103	N26.88544 E089.33882	245	Development Site
S6	Amochhu-Below Confluence	N26.87501, E089.33882	N26.88629 E89.33504	257	Development Site
AT1	Amochhu-Omchhu Confluence	N26.86805 E089.3724	N26.86719 E089.77475	183	Below Samtse Highway Bridge
AT2	Omchhu-Crocodile Farm to new high way bridge	N26.86719 E089.77475	N26.86381 E89.39029	217	Dortikhola
AT3	Howrai khola	Tributary had dried up			
AT4	Loawrichhu-Amochhu confluence to below Tanding gup Office Samtse	N26.87501 E089.33882	N26.87808 E089.32619	222	Tanding gewog, Samtse

CONTACT NO. +975-17449115, EMAIL: tenzin85yeshi@gmail.com

4. Methods & Methodology:

The catch and release approach was adopted at all the sampling points. The fishes were caught using Electro-Fisher device (12 volt battery operated electro-shocker) by pulsing DC current into the water; this temporarily immobilizes the fish & dip net is used to catch the fish. Generally, 12 Volts of electric current is pulsed into the water for approximately 1 to 3 seconds at various points along the sampling sites. Each fish caught is placed inside the transparent Photarium and photographed using high DSLR camera before releasing back into the river. **Figure 3** is representative of the field survey conducted.

4.1 How Electro-fishing Works

An Electro-fisher was used during the survey for sampling the fish species. The backpacked electro-fisher (Electro-Shocker) powered by petrol generator, equipped with positive and negative probe extended electrodes (Anode & Cathode) were used to pulse DC into the water.

DC is more effective & less traumatic on the fishes (Lamarque, 1990) and so, was preferred and recommended for the study. The use of the Electro-Shocker interrupts the neurological pathways of the fish (galvano taxis), causing the fish to move towards the anode. The operator walks with the electro fisher unit, holding a pole-mounted anode and trailing a cathode to shock the fishes. Following the operator is a netter with dip net to capture the immobilized fishes. That is, the density of electric field increases as the fish swims towards the anode which then leaves them temporarily immobilized (Lamarque, 1990&Lamarque et al., 1971) thus making the sampling possible.

Survey with Electro-Shocker is feasible in habitats where the operators can safely walk in the river. However, the wading becomes dangerous at depths greater than 0.5 m, as it increases the chances of operator getting shocked as the operators have to use the pole under water at greater depth (Hickley, 1990).

Electro-Fishing efficiency is lower in larger streams as the fishes can avoid the electric current (Paller, 1995) and so, surveying in smaller stream is advised. However, fishes can be captured in wider streams by using multiple electro-fishing units or multiple anodes (Bayley et al., 1989). Turbidity of the water also affects the catch rate of the fishes. Catch rates are highest in intermediate turbidities because when the turbidity is low, fishes notice the operator sooner and can thus flee, while at high turbidity netters cannot see the immobilized fishes(Reynolds, 1983).

CONTACT NO. +975-17449176, EMAIL: tenzin85yeshi@gmail.com

Figure 3: Fish sampling using battery operated electro-shocker

4.2 List of Materials used during survey:

1. 12 volt battery operated electro-shocker fitted with positive and negative probe to pulse the current into the water.
2. Portable dip net
3. Polyester open bags to store fish safely
4. DSLR Camera
5. Garmin GPS
6. Photarium
7. Portable handheld multi-parameter water quality testing device
8. Cloth pieces
9. Pens & pencils
10. Field data sheets.

CONTACT NO. +975-17449115, EMAIL: tenzin85yeshi@gmail.com

5. Findings:

During the study, the basic water quality parameters such as the concentration of dissolved oxygen, temperature, & pH were subsequently measured to detect the quality of water, thermal variability and adaptability of fishes in each sampling station. Detail of the basic water parameter is given in **Table 2.**

Table 2: Basic Water Parameters Data for each sampling Location

Stations	Location Name	Temperature (°C)	pH	Dissolved Oxygen (mg/L)
S1	Amochhu –below Amochhu –Amochhu confluence	18.2	7.7	9.83
S2	Amochhu- Above Omchhu – Amochhu confluence	20.5	7.9	10.7
S3	Amochhu-Main Construction site	18.8	7.7	9.97
S4	Amochhu-Above Wangchhunye (Shiv Mandir)	17.9	7.7	9.37
S5	Amochhu-above Wangchhunye (Shiv Mandir)	18.9	7.6	10.9
S6	Amochhu-Below Loawrichhu-Amochhu Confluence	16.9	7.9	10.7
AT1	Amochhu-Amochhu confluence to crocodile farm	20.7	-	-
AT2	Omchhu-crocodile farm to new high way bridge	20	7.9	9.12
AT3	Howrai khola	Tributary had Dried Up		
AT4	Lawrichhu-Amochhu confluence to below Tanding gup office Samtse	16.9	7.6	12.8

5.1 Phytoplankton:

These are the microscopic algae that float and inhabit the upper layer of most freshwater and marine environment. The concentration/ presence of Phytoplankton are reflective on the color and clarity of lakes, wetlands, rivers, streams and estuaries. They are the primary producers in aquatic ecosystems as they are the food sources for higher order organisms such as zooplankton and small fishes. During the survey, phytoplankton species were found on the beds of the river at a very scare and infrequent habitations; this may be the case due to the recurrent erosion and sedimentation along the river banks.

5.2 Zooplanktons:

Zooplanktons are heterotrophic (detrivores) microscopic organisms found both in freshwater and marine ecosystem. They also serve as food source for fishes. However, respective to the fish survey technique used the identification of zooplanktons was not noted; this however does not mean the absence of zooplanktons in the Amochhu River.

5.3 Benthos:

Are the organism that thrive on, in or near the seabed, riverbed or at the bottom of lakes i.e. mostly in the sedimentary environment of a water body. During the survey, benthic species were not caught as the mesh of the nets may have been too large to catch benthic organism; this however, does not conclude the presence or the absence of benthic organism in the Amochhu River or its tributaries and therefore recommend for an explicit study to be conducted.

5.4 Fishes

During the survey, a total of 27 osteichthyic fishes belonging to three orders, eleven families and twenty genera were found. The status of the fish species caught during the survey has been referred from IUCN and is represented in the table below (**Table 3, 4 & 5**).

CONTACT NO. +975-17449115; EMAIL: tenzin85yeshi@gmail.com

5.4.1 Classification of Fish Species found in Second Pre-Monsoon Aquatic Survey based on their Order with IUCN Status

Note: For the tabulations (**Table 3, 4 & 5**) the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred.

Table3: List of Fish Species belonging to Order *Cypriniformis* respective to their Family

Name of the species	IUCN Red List Status	Last Assessed by IUCN
I). Family *Cyprinidae*		
1. *Bariliusbarna*	Least Concern	19/03/2011
2. *Bariliusbendelisis*	Least Concern	22/01/2010
3. *Bariliusvagra*	Least Concern	22/01/2010
4. *Crossocheiluslatius*	Least Concern	09/10/2009
5. *Garra annandalei*	Least Concern	09/10/2009
6. *Garra gotyla*	Least Concern	07/10/2009
7. *Neolissochilus hexagonolepis*	Near threaten	09/10/2009
8. *Neolissochilus dukai*	Data deficient	01/03/2010
9. *Pethia ticto*	Least Concern	22/03/2010
10. *Schizothorax progastus*	Least Concern	11/05/2010
11. *Schizothorax richardsonii*	Vulnerable	14/06/2010
12. *Tor putitora*	Endangered	10/09/2019
II). Family *Psilorhynchidae*		
13. *Psilorhynchus balitora*	Least Concern	23/02/2010
III). Family *Balitoridae*		
14. *Aborichthys sp.*	Least Concern	Species not determined
IV). Family *Amblycipitidae*		
15. *Amblyceps apangi*	Least Concern	16/12/2009
16. *Amblyceps cerinum*	Least Concern	Not Assessed
V). Family *Sisoridae*		
17. *Glyptothorax sp.*	Least Concern	Species notdetermined
18. *Glyptothorax panda*	Least Concern	09/04/2010
VI). Family Cobitidae		
19. *Lepidocephalichthys guntea*	Least Concern	Species not determined
VII). Family Nemacheilidae		
20. *Schistura beavani*	Least Concern	Species not determined
21. *Paracanthoscobitisab utwebi*	Least Concern	Not Assessed
22. *Schistura reticulo fasciata*	Least Concern	Not Assessed

CONTACT NO. 1975-1744911; EMAIL: tenzin85yeshi@gmail.com

Table 4: List of Fish Species belonging to Order *Perciformes* under respective to their Family

Name of the species	IUCN Red List Status	Last Assessed by IUCN
VIII)Family *Channidae*		
23. *Channa punctatus*	Least Concern	Not Assessed
24. *Channa gachua*	Least Concern	Not Assessed
IX)Family *Badidae*		
25. *Badis badis*	Least Concern	10/03/2010

Table 5: List of Fish Species belonging to Order *Siluriformes* respective to Family

Name of the species	IUCN Red List Status	Last Assessed by IUCN
X)Family *Bagridae*		
26. Olyra longicaudata	Least Concern	Not Assessed
XI)Family *Sisoridae*		
27. Pseudo chenesis	Least Concern	Not Assessed

CONTACT NO. +975-17449115; EMAIL: tenzin85yeshi@gmail.com

5.4.2 Fishes caught at each Sampling Sites during the Second Pre-monsoon Aquatic Survey

Table 6: Stations with Fish Species Distribution

Station	Location	*Fish Species*
S1	Amochhu – below Amochhu – Amochhu confluence	*Barilius barna, Barilius bendelisis, Bariliusvagra, Crossocheiluslatiu Garra annandalei, Garra gotyla, Neolissochilus hexagonolepis, Schizothorax progastus, Schizothorax richardsonii, Psilorhynchus balitora, Aborichthy ssp. Amblycepsapangi, Glyptothorax sp. Glyptothorax panda, Schisturasp. Channa gachua, Channa punctatus, Badis Badis, Schisturadevdevi, Schistura reticulo fasciata*
S2	Amochhu- Above Omchhu – Amochhu confluence	*Barilius barna, Barilius bendelisis, Crossocheiluslatius, Garra annandalei, Garra gotyla, Neolissochilus hexagonolepis, Schizothorax progastus, Psilorhynchusbalitora, Aborichthys sp. Amblycepscerinum, Glyptothorax sp.Glyptothorax panda, Schisturasp.BadisBadis, Lepidocephalichthysguntea, Schisturadevdevi, Schisturareticulofasciata*
S3	Amochhu-Main Construction site	*Bariliusbarna,Bariliusbendelisis, Bariliusvagra, Garraannandalei, Garragotyla, Neolissochilushexagonolepis,Neolissochilusdukai, Pethiaticto, Schizothoraxprogastus, Schizothoraxrichardsonii, Psilorhynchusbalitora, Aborichthys sp. Glyptothoraxsp.Glyptothorax panda, Schisturasp.Channagachua, Channa ,punctatus,BadisBadis, Olyralongicaudata, Lepidocephalichthysguntea, Schisturadevdevi, Schisturareticulofasciata.*
S4	Amochhu-Above Wangchunye (Shiv Mandir)	*Barilius barna,Barilius bendelisis, Bariliusvagra, Crossocheiluslatius, Garra annandalei, Garragotyla, Neolissochilus hexagonolepis , Pethiaticto, Schizothorax progastus, Schizothoraxrichardsonii, Psilorhynchusbalitora, Aborichthyssp.Amblycepsapangi, Amblycepscerinum, Schisturadevdevi, Schistura reticulo fasciata, Glyptothorax sp.Glyptothorax panda, Schisturasp.Channagachua, Channapunctatus,BadisBadis, Olyralongicaudata ,Lepidocephalichthysguntea. Paracanthocobitisabutwebi ,*
S5	Amochhu-above Wangchunye (Shiv Mandir)	*Bariliusbendelisis, Bariliusvagra, Garraannandalei, Garragotyla, Neolissochilus hexagonolepis, Schizothorax progastus, Schizothoraxrichardsonii, Schisturadevdevi, Schisturareticulofasciata,Psilorhynchusbalitora, Aborichthyssp.Amblycepsapangi, Amblycepscerinum, Glyptothoraxsp.Glyptothorax panda,.Channagachua, Channapunctatus,BadisBadis, Olyralongicaudata, Lepidocephalichthysguntea, Pseudochenesissulcatus*
S6	Amochhu Below Loawrichhu-Amochhu Confluence	*Bariliusbarna,Bariliusbendelisis, Bariliusvagra, Garraannandalei, Garragotyla, Neolissochilushexagonolepis, Schizothoraxprogastus, Aborichthyssp., BadisBadis, Lepidocephalichthysguntea, Schisturadevdevi, Schisturareticulofasciata*
AT1	Amochhu-Omchhu confluence to below highway bridge.	Not able to access the fish sampling site due to water training activities
AT2	Omchhu-Crocodile farm to new high way bridge	*Bariliusbarna, Garra annandalei, Garra gotyla, Neolissochilus hexagonolepis, Neolissochi lusdukai, Psilorhynchusbalitora, Aborichthyssp. Lepidocephalichthysguntea, Paracanthocobitisabutwebi, Schisturadevdevi, Schisturareticulofasciata*
AT4	Loawrichhu	*Bariliusbarna, Bariliusvagra, Garraannandalei, Garragotyla, Neolissochilushexagonolepis, Schizothoraxprogastus, Aborichthyssp.Lepidocephalichthysguntea, Schisturadevdevi, Schisturareticulofasciata*

CONTACT NO. +975-17749115; EMAIL: tenzin85yeshi@gmail.com

5.4.3 Presence of Fish Species during First Pre-Monsoon, Post Monsoon and Second Pre-monsoon Aquatic Surveys

The following table is a comparative representation of the fishes that was found in all the three Aquatic Surveys conducted till date. The presence is noted as (✔) while the species that were not caught is left blank.

Table 7: Fish Species caught during Different Sampling Seasons

SL. No	Species Name	Pre-monsoon	Post-Monsoon	2nd Pre-Monsoon
1	*Aborichthys sp.*	✔	✔	✔
2	*Amblyceps apangi*		✔	✔
3	*Amblyceps arunchalensis*	✔		
4	*Amblyceps cerinum*			✔
5	*Apisdoperia sp.*		✔	
6	*Badis Badis*	✔	✔	✔
7	*Barilius barna*	✔	✔	✔
8	*Barilius bendelisis*	✔	✔	✔
9	*Barilius vagra*	✔	✔	✔
10	*Chaguniuschagunio*	✔	✔	
11	*Channa punctatus*			✔
12	*Channa gachua*	✔	✔	✔
13	*Channa melanostigma*	✔	✔	
14	*Crossocheilus latius*	✔	✔	✔
15	*Danio rerio*	✔	✔	
16	*Davario aequipinnatus*	✔		
17	*Garra gotyla*	✔	✔	✔
18	*Garra annandalei*	✔	✔	✔
19	*Glyptothorax panda*	✔	✔	✔
20	*Glyptothorax sp.*	✔	✔	✔
21	*Labeo dyocheilus*		✔	
22	*Lepidocephalicthysguntea*	✔		✔
23	*Mastacembelus armatus*	✔	✔	
24	*Neolissochilus dukai*		✔	✔
25	*Neolissochilus hexagonolepis*	✔	✔	✔
26	*Olyra longicaudata*			✔
27	*Olyra sp.*		✔	
28	*Oreichtyscrenucliodes*	✔		
29	*Paracanthocobitisab utwebi*			✔
30	*Pethia spp*	✔		
31	*Pethia ticto*	✔	✔	✔
32	*Pseudo chenesis sulcatus*			✔
33	*Psilorhynchus balitora*	✔	✔	✔
34	*Pterocryptis sp.*		✔	
35	*Schistura reticulo fasciata*			✔
36	*Schistura beavani*	✔	✔	✔
37	*Schizothorax progastus*	✔	✔	✔
38	*Schizothorax richardsonii*		✔	✔
39	*Semiplotus semiplotus*	✔	✔	
40	*Tor Putitora*	✔		✔

Note: The blue highlight is representative of the new fish species caught during the Second Pre-monsoon Aquatic Survey

*CONTACT NO. +975-17449715; EMAIL: tenzin85yeshi@gmail.com

5.4.4 Photographs of Fish Species caught during the Second Pre-Monsoon Aquatic Survey

The following mentioned fishes were caught and released immediately into the river after taking photograph.

(1) **Scientific Name:** *Barilius barna*
Local Name: Barna Bari

(2) **Scientific Name:** *Barilius bendelisis*
Local Name: Hemiiton's barila

(3) **Scientific Name:** *Barilius vagra*
Local Name: Barilus Vagra

CONTACT NO: +975-17449115; EMAIL: tenzin85yeshi@gmail.com

(4) Scientific Name: *Crossocheilus latius*
Local Name: *Stone Roller/Gangnetic Latia*

(5) Scientific Name: *Garra annandalei*
Local Name: Aannandale Gara

(6) Scientific Name: *Garra gotyla*
Local Name: Cyprinus Gotyla

CONTACT NO: +975-17649115; EMAIL: tenzin85yeshi@gmail.com

(7) **Scientific Name:** *Neolissochilus hexagonolepis*
Local Name: Copper Mahseer

(8) **Scientific Name:** *Neolissochilus dukai*
Local Name: Neolissochilus dukai

(9) **Scientific Name:** *Pethia ticto*
Local Name: Ticto Barb

CONTACT NO. +975-17449115; EMAIL: tenzin85yeshi@gmail.com

(10) Scientific Name: *Schizothorax progastus*
Local Name: Dinnawah Snowtrout

(11) **Scientific Name:** *Schizothorax richardsonii*
Local name: Asla

(12) **Scientific Name:** *Tor putitora*
Local Name: Golden Mahseer

CONTACT NO. +975-17449115; EMAIL: tenzin85yeshi@gmail.com

(13) **Scientific Name:** *Psilorhynchus balitora*
Local Name: Balitora Minnow

(14) **Scientific Name:** *Aborichthys sp.*
Local Name: Not Found

(15) **Scientific Name:** *Lepidocephalichthys guntea*
Local Name: Not Found

(16) **Scientific Name:** *Amblyceps apangi*
Local Name: Not Found

CONTACT NO. +975-17449105, EMAIL: tenzin85yeshi@gmail.com

(17) **Scientific Name:** *Amblyceps cerinum*
Local Name: Not Found

(18) **Scientific Name:** *Glyptothorax sp.*
Local Name: Not Found

(19) **Scientific Name:** *Glyptothorax panda*
Local Name: Not Found

CONTACT NO: +975-17449116; EMAIL: tenzin85yeshi@gmail.com

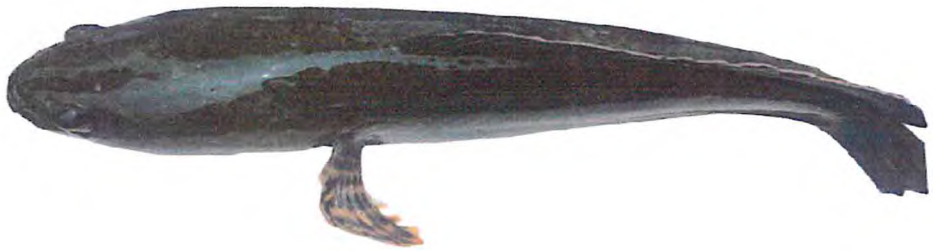
(20) **Scientific Name:** *Schistura beavani*
Local Name: Not found

(21) **Scientific Name:** *Schistura reticulo fasciata*
Local Name: Not found

(22) **Scientific Name:** *Channa punctatus*
Local Name: Not Found

CONTACT NO. +975-17449116, EMAIL: tenzin85yeshi@gmail.com

(23) **Scientific Name:** *Channa gachua*
Local Name: Snake Head



(24) **Scientific Name:** *Badis badis*
Local Name: Blue perch or Blue Badies

(25) **Scientific Name:** *Olyra longicaudata*
Local Name: Not Found

CONTACT NO.: +975-17449[illegible] EMAIL: tenzin85yeshi@gmail.com

(26) **Scientific Name:** *Paracanthocobitisab utwebi*
Local Name: Not Found

(27) **Scientific Name:** *Pseudo chenesissu lcatus*
Local Name: Not Found

CONTACT NO: +975-17449152, EMAIL: tenzin85yeshi@gmail.com

6. Conclusion

For the Second Pre-monsoon Aquatic Survey conducted on the 26th to 27th of May, 2020, a total of 27 species of fish were recorded (including *Tor putitora* /Golden Mahseer). Six new fish species that were not recorded during the First and Second Aquatic surveys were caught during the Third i.e. the Second Pre-monsoon Aquatic Survey.

A total of six new species of fish i.e. *Paracanthocobitisab utwebi, Amblyceps cerinum, Olyra longicaudate, Pseudo chenesissu lcatus, Schistura reticulo fasciata and Channa punctatus* were caught during Third Aquatic Survey. Five fish species i.e. *Schizothorax richardsonii, Semiplotus semiplotus, Mastacembelus armatus, Danio rerio and Chagunius chagunio* that were caught during the First and Second Aquatic Survey were found to be absent/ were not caught during Third Aquatic Survey. These absence and presence of fishes from the three seasons are mainly due to the migration and spawning pattern of the fishes. For instance, *Tor Putitora* is one type of fish that swim towards the south i.e. near the Indian border during the winter season (Kuensel, dec 7, 2018) and swim up to the rocky water beds for breeding during flood and spawn over rocky and gravel substrates (WWF India). Accordingly, two endangered species namely *Tor putitora* (Golden Mahseer) and *Amblyceps arunchalensis* were recorded during the First Pre-monsoon Survey while *Amblyceps arunchalensis* was not caught during the Second Pre-monsoon Study. For the Post-monsoon Study (Second Aquatic Study) both of these endangered fish species were not caught (a total of 28 species were recorded).

Among the fish species, *Barilius barna, Barilius bendelisis, Barilius vagra, Garra gotyla & Badis Badis* were common catches in most of the sites as these fish species are less likely to migrate and can thrive in shallower river unlike the above mentioned fishes. Fish species like *Paracanthocobitisab utwebi, Amblyceps cerinum, Olyral ongicaudate, Pseudo chenesissu lcatus, Labeo spp., Olyra spp. & Mastacembelus sp.* were not frequently caught. According to the experts, those species prefer deep river and thrive at greater depth where the electro fisher operator could not reach during the survey

S3, S4 & S5 were found to have the highest number of species as the disturbance (sand & surface boulder collection) in these sites remained fairly absent therefore the presence of fishes were more likely.

Till date, there were 27 fish species recorded during each of the First and the Second Pre-monsoon Aquatic Studies respectively. For the Post-monsoon Aquatic Survey, 28 fish species were caught. Cumulatively, a total of 40 fish species have been noted from the Three Aquatic Surveys conducted till date i.e. for spring, autumn season (2019) and winter (2019-2020).

CONTACT NO. +975-17449116, EMAIL: tenzin85yeshi@gmail.com

7. REFERENCES:

Bayley, P., R.W.Larimore& D.C. Dowling (1989). *Electric Seine as a fish Sampling Gear in streams.* Trans. Amer. Fish. Soc. 118: 447-453.

Construction Development Cooperation Development Limited, Royal Government of Bhutan for the Asian Development Bank (2017). Bhutan; *EIAAmmochu Land Development and Township Project.* Project no. 50165-002

Hickley, P (1990). *Electric fishing in practice.* Pp. 176-187 *in* I.G. Cowx and P. Lamarque [Eds.] Fishing with Electricity. Fishing News Books, Oxford, England.

IUCN (2019). *The IUCN Red List of Threatened Species.* Version 2019-2. https://www.iucnredlist.orgISSN 2307-8235

IUCN Standards and Petitions Subcommitee (2014).Guidelines for Using the IUCN Red List Categories and Criteria.Version 11.Prepared by Standards and Petitions Subcommitee. Download from http://www.iucnredlist.org/documents/RedlistGuidelins.pdf

Kuensel (dec 7) 2018, *Conserving the Golden Masheer.*retrieved on 29th Oct, 2019.from http://www.bbs.bt/news/?p=107933

Lamarque, P (1990). *Electrophysiology of fish in electric fields.*Pp 4-33 *in* I.G. Cowx& P. Lamarque[Eds.] Fishing with Electricity. Fishing News Books, Oxford, England.

Lamarque, P., J. Etzensperger and N. Charlton (1971). *Etude électro-physiologique des réactions de la grenouille au courant élecriquecontinu.*Annalesd'Hydrobiologi.

Reynolds, J.B(1983). *Electrofishing.*Pages 147-164 in L.A. Nielson and D.L. Johnson, Editors, Fisheries Techniques.American Fisheries Society, Bethesda, Maryland.

World Wildlife Fund India, *Priority species*, retrieved on 31th oct, 2019. From https://www.wwfindia.org/about_wwf/priority_species/threatened_species/golden_mahseer/

Appendix 1: List of Persons Involved

SN	Names	Designation	Organization
1	Mr. Pemchung	Environment Manager	Construction Development Corporation Limited
2	Ms. Sonam Deki	Environmentalist	Gyaltshen Consultancy
3	Mr. Ashok Kumar	HSE-In charge	AFCONS Infrastructure Limited
4	Mr. Sunny	Env. Engineer	AFCONS Infrastructure Limited
5	Ms. Kinley Yangzom	Jr. Environmental Officer	AFCONS Infrastructure Limited
6	Mr. Yeshey Tenzin	Quality Manager	Bhutan Ecolab Services
7	Mr. Anand Bhandari	Environmental Officer	Bhutan Ecolab Services
8	Mr. Sangay Norbu	Senior ES (III)	National Research Centre for Riverine & Lake Fisheries
9	Mr. Kellay Wangdi	Staff	Bhutan Ecolab Services
10	Mr. Tek Bdr Ghallay	Staff	Bhutan Ecolab Services
11	Mr. Ngawang Pelden	Staff	Bhutan Ecolab Services

Appendix 2: Letter to National Center for Riverine & Lake Fisheries

05/03/2020

To
The Director General,
Department of Livestock,
MoAF, Thimphu.

Subject: Seeking an Assistance to carryout Fish sampling (26/03/2020 to 28/03/2020) at Ammochu (Phuntsholing Township Development Project).

Respected Dasho,

We would like to seek Dasho's kind approval for getting assistance from National Research Centre for Riverines and Lake Fisheries (NRCRLF) to carryout aquatic survey (Fish Sampling). Our aim of the study is to assess the fish diversity and presence of Golden Mahseer (critically endangered fish) for conservation recommendation during and after the Phuntsoling Township Development Project.
Since, we have got study approval from Department of forest and parks services to carry out the study, we would be highly grateful if Department of livestocks could kindly assist us with technical and manpower support from the NRCRLF,Haa.
We have contacted with technical person at NRCRLF and advised us to get an approval from Department of Livestock.
We anticipate your kind support and extend our gratitude for helping in our first aquatic survey held in March, 2019.

Thanking you,
Yours faithfully,

Yeshi Tenzin
(Lab Manager)
17449115

BHUTAN ECOLAB SERVICES
Quality Manager

BHUTAN ★ PHUENTSHOLING ★

AFCONS INFRASTRUCTURE LTD. BHUTAN

CONTACT NO. +975-17449115, EMAIL: tenzin85yeshi@gmail.com

Appendix 3: Clearance letter for the Aquatic Survey

Royal Government of Bhutan
Ministry of Agriculture & Forests
Department of Forests & Park Service
NATURE CONSERVATION DIVISION
Managing Bhutan's Natural Heritage"

NCD/SCMS-02/2019-20/ 229 — 2nd March 2020

The Project Manager.
PIU, PTDP, CDCL.
Thimphu

Subject: Approval for Aquatic Survey on the Amochhu for Phuentsholing Township Development Project

Sir,

The Nature Conservation Division, Department of Forests and Park Services, acknowledges the receipt of the report on Post Monsoon Aquatic Survey conducted on the Amochhu from 21st October to 23rd October 2019.

Based on the subsequent request for approval as per letter No. CDCL/PTDP/PIU/2020/09/431 dated 29th February 2020 for the same survey, we would like to convey the approval to conduct aquatic survey in three specified micro-habitats one each at the project site, upstream, and downstream as described in the proposal. However, please note that approval is only valid for survey sites within our national jurisdiction during this season. Fish survey should strictly deploy the catch and release method using electroshocker (3kw) only or improvised nets.

We would like to request you to kindly liaise with the concerned forest offices for awareness and monitoring during the field survey.

Once the survey is completed, kindly share a copy of the report/information generated from this study to this office for our record and reference.

Thanking you.

Yours sincerely,

(Sonam Wangdi)
Chief Forestry Officer

cc.
- Director, Department of Forests and Park Services for kind information
- Chief Forestry Officer, Gedu Forest Division for kind information and necessary action

Telephone # : +975 02 325042/324131 Fax # : +975 02 335806 Post box #: 130

BHUTAN ECOLAB SERVICES PHUENTSHOLING

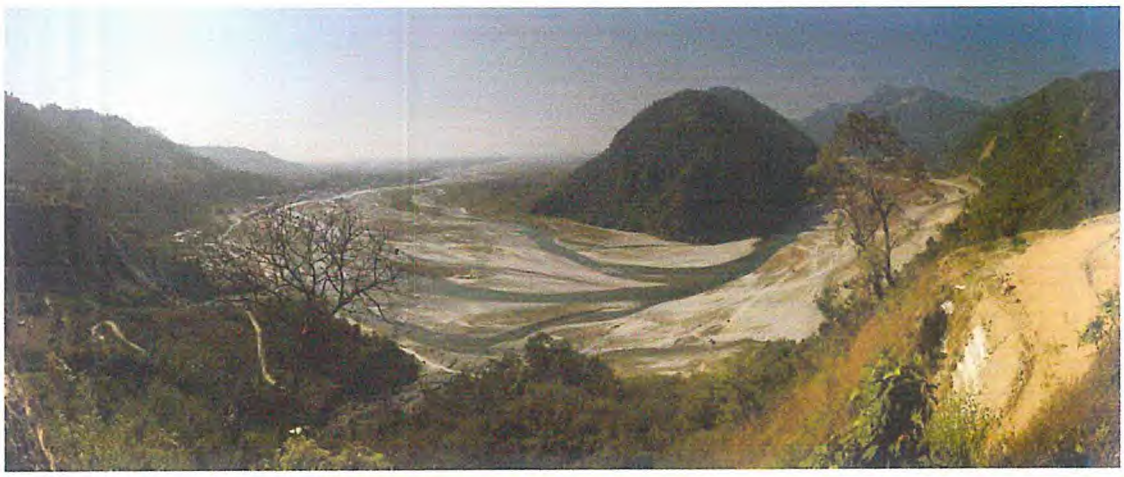
AFCONS INFRASTRUCTURE LTD. BHUTAN

Fourth Terrestrial Survey Report:
Terrestrial Survey along the Phuentsholing Township Development Project

(Zone A and Zone B)

March – May, 2020

Phuentsholing, Chhukha Dzongkhag



Bhutan Ecolab Services

Phuntsholing

BHUTAN

Table of Contents

BHUTAN ECOLAB SERVICES * PHUENTSHOLING *

ACONS INFRASTRUCTURE LTD.

LIST OF FIGURES

LIST OF TABLES

BHUTAN ECOLAB SERVICES PHUENTSHOLING

AFCONS INFRASTRUCTURE LTD.

GLOSSARY

A

ANNUAL PLANTS: Plants that complete their life cycle in one growing season.
AVIFAUNA: The birds, or all kinds of birds, inhabiting a region.

B

BIENNIAL PLANTS: Plants that requires two years to complete their life cycle.

C

CRITICALLY ENDANGERED(CN): A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
CREEPER: Any plant that grows along the ground, around another plant through extending stems or branches.

D

DATA DEFICIENT (DD): A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable time has elapsed since the last record of the taxon, threatened status may well be justified.
DECIDUOUS PLANTS: Trees and shrubs that seasonally shed their leaves usually in autumn or the cold winters.
DZONGKHA: Is official and the national language of the kingdom of Bhutan.

E

ENDANGERED (EN): A taxon is endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

F

FAUNA: Animals considered a group, especially those of a particular country, region, time, etc.
FLORA: Plants considered a group, especially those of a particular country, region, time, etc.

G

GRASS: Vegetation consisting of typically short plants with long, narrow leaves, growing wild or cultivated on lawns and pasture, and as a fodder crop.

H

HERBACEOUS PERENNIAL PLANT: Shoot of this type of plant die to the ground in winter, but the root system survives the winter and the new shoot grows back in the spring.
HERBACEOUS: Any seed-bearing plant which does not have a woody stem and dies down to the ground after flowering.

L

LEAST CONCERN (LC): A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
LEAVE ABSCISSION: The natural detachment of leaves a plant/tree depending on their shedding seasons

M

MONOCARPIC PLANT: These plant flowers only once in their lifetime which can be either annual or biennial and the plant die after flowering and fruiting.

N

NEAR THREATENED (NT): A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category soon.

NOT EVALUATED (NE): A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

P

PERENNIAL PLANTS: Plants that have life cycle that goes beyond two years.

POLYCARPIC PLANT: These plant flowers every year and are a perennial plant which does not die after flowering and fruiting.

PRIMARY DATA: Data that is collected by a research from first-hand sources, using methods like surveys, interviews, or experiments.

R

RIPARIAN BUFFER/ BUFFER ZONE: Is an area of vegetation around the body of water that gives benefits to the ecosystem (Distance of 15 ft. from the river bank).

S

SECONDARY DATA: Data that is collected from studies, surveys, or experiments that have been done by other people or for other research.

SHRUB: A woody plant which is smaller than a tree and has several main stems arising at or near the ground.

V

VINE: A dimbing or trailing woody-stemmed plant.

VULNERABLE (VU): A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

W

WOODY PERENNIAL PLANT: Top of these plants persist through winter. In spring shoot growth resumes from the adventitious buds.

ABBREVIATION

CDCL	:	Construction Development Corporation Limited
EIA	:	Environmental Impact Assessment
FNCR	:	Forest and Nature Conservation Regulation
IUCN	:	International Union for Conservation of Nature and Natural Resources
ADB	:	Asian Developmental Bank
BES	:	Bhutan Ecolab Services
PTDP	:	Phuentsholing Township Development Project

SYNONYMOUS

Flora	:	Plants
Fauna	:	Animals
Avifauna	:	Birds
Official	:	Officials from the Forest Range Office, Phuentsholing, under department of Forest and Park Services
Project	:	Phuentsholing Township Development Project focused on Zone A and B
EIA report	:	Amochhu EIA Report, 2017.

1. INTRODUCTION

Phuentsholing falls under Chhukha Dzongkhag and it is located adjacent to Bhutan and the Indian border with a geographical area of 139.8sq.km. In the recent years, Phuentsholing is facing problems of increasing population with a limited area (Amochhu EIA report, 2017); adding to this, the Amochhu River threatens to flood, erode and cause loss of valuable land resulting in sedimentation downstream. Hence, Phuentsholing Township Development Project, contracted to AFCONS Infrastructure Limited by CDCL with their main consultant as Egis International and Gyeltshan consultancy as the sub-consultant, are working on the Construction of River Training and Embankment Work along the Amochhu River. In the course of the construction works, it is crucial to monitor and maintain the ecological health i.e. Terrestrial and Aquatic environment within and the areas adjacent to the project sites. Accordingly, this report is comparative of findings of the studies conducted for the Fourth Terrestrial Survey (dates of the surveys mentioned in **Table 1**) to the findings of the First, Second and Third Terrestrial Surveys that were previously conducted in Zone A, Zone B and its buffer areas of the project. It is to be noted that the First Terrestrial Survey was focused on the density of species for the flora assessment and diversity of species for the avifauna and fauna assessment and so comparisons were made with the species listed in the report. However, as the focused of the first terrestrial report was more on density than diversity of species, it should be noted that the less count of species during the summer terrestrial report does not completely define the diversity of flora species during the season.

On the recommendation of the forest officials, mobile/android applications (specifications mentioned in **appendix 2**) were used to identify the plant species; the mobile application identified plants were later checked and verified (**appendix 3**) by Forest BEAT In-charge, Samtse and the Phuentsholing Range Office. The fauna and avifauna species were recorded through sightseeing and by survey questionnaires with the locals. The secondary data were collected through available literature or publications.

Below are dates of when the Walkthrough and the Questionnaire Survey for the Fourth Terrestrial Survey was conducted:

Table 1: Dates for the Fourth Terrestrial Survey

Month	Date
March	18-03-2020
April	16-04-2020 to 17-04-2020
May	16-05-2020

PHUENTSHOLING

AFCONS INFRASTRUCTURE

2. SCOPE

Relative to the last terrestrial surveys conducted, the Fourth Terrestrial Assessment is focused on the diversity of the terrestrial resources i.e. flora, fauna and avifauna within the Phuentsholing Township Development Project specifically in zone A and zone B (and also along with each zone's buffer points). The Fourth report is comparative of findings from the First, Second and the Third Terrestrial Survey.

This report is a compilation of findings for the studies carried out once every month (dates specified in the introduction **Table 1**) for three months (March-May 2020). Primary and secondary data were collected for this report. Primary data collection involved field studies conducted using mobile applications recommended by the Forest Office and through survey questionnaires (photographs attached as **appendix 6**) designed for locals. As the data from the survey questionnaire falls under the primary data source, pictures of some of the primary findings may not be available. Secondary data involves the reference of books and other resources.

For the flora diversity assessment, focuses on the trees, herbaceous and shrubs, climbers, creepers and vines and on grass species. Here, grass species only covers the species of bamboo and other big grass species. Orchids are not covered for this study. The field study was done by the use of android applications for identifying the flora species in addition to taking of samples of any new species detected to the Phuentsholing Forest Office for confirmation and identification, respectively. Pictures of the Flora species found during the Fourth Terrestrial Survey are attached as **appendix 5.**

For the fauna and avifauna diversity assessment, field study and questionnaires surveys were conducted. However, as the field study was conducted during the day time, finding fauna and avifauna species were difficult to note, especially the nocturnal species. Hence, most of the findings for fauna and avifauna species are from the survey questionnaire, thus no photographs have been attached. It is recommended that for better identification, advance measures such as camera traps could be used. It is to be noted that the study, based on Fauna species only covers mammals, skipping the reptiles, amphibians and insects.

3. AIMS & OBJECTIVES

Aim of Study : Assess Terrestrial Ecological Diversity within the Phuentsholing Township Development Project i.e. PTDP (zone A, B and their respective buffer zone).

Objectives:

- Assess and record flora diversity in project Zone A, B and along its respective buffer zones concerning the changing season.
- Assess and record the diversity of fauna, avifauna and presence of national and IUCN red listed species within the project area.
- Assess and the record presence and absence of flora, fauna and avifauna species by comparing it to the findings of the last Terrestrial Studies.

4. METHODS & METHODOLOGY

4.1. Description of study area:

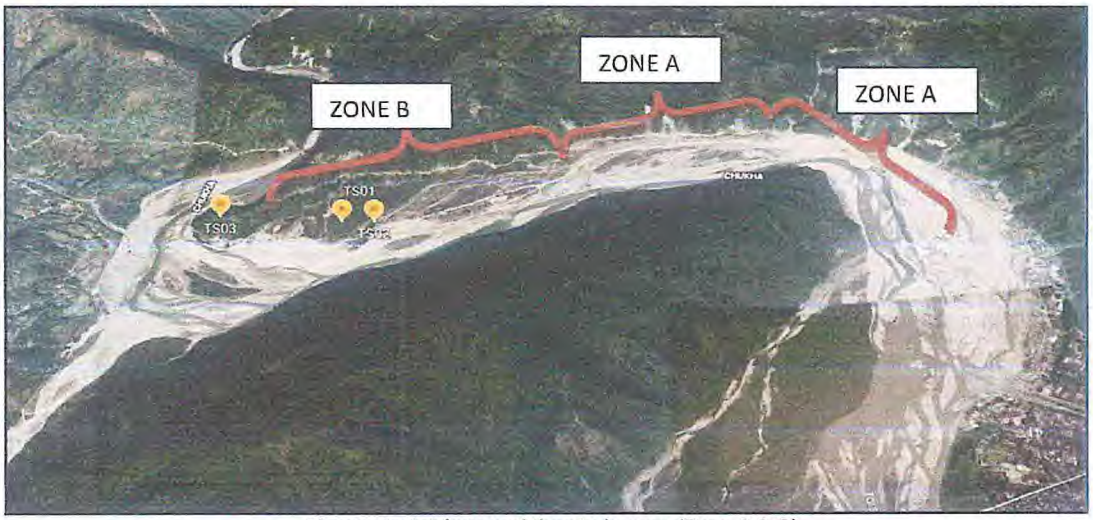


Figure 1: Arial view of the study area (Zone A & B).

The study was focused within the Project zone A & B of the Phuentsholing Township Development Project. The vegetation cover along the river banks was sparse and in patches in the Zone A while zone B is comparatively denser.

Table 2: Coordinates for the Study Area

Study Area	Coordinates	
	Start Point	End Point
Zone A	E187432.017 N2072188.422	E186562.867 N2975305.634
Zone B	E186562.867 N2975305.634	E183458.422 N2974315.442
Buffer Points	Points along zone A and B with vegetative growth below the Phuentsholing Samtse road.	

4.2. Materials required during the survey

- DSLR Camera
- Data collection form
- Pens and pencils
- GPS Device.

4.3. Methods and methodology

Similar to the last Terrestrial Assessment, primary data and secondary data were collected for the Fourth Terrestrial Assessment i.e. focusing on the diversity. Primary data collection was conducted in project Zone A, B and within its respective buffer area where diversity of flora, fauna and avifauna species were recorded. The primary recording methods include:

- Taking photographs, sightseeing and identification of species through mobile applications under the recommendation of the Forest Range office.

- Through survey questionnaires designed for locals residing near the study area (Questionnaire attached as **appendix 4**).

The secondary data on Terrestrial diversity of the Project area were gathered through national publications and reference from the Forest Range Office.

Aforementioned method was adopted for the study as the size of the project area is small, accessible and the vegetation coverage is not dense. Systematic sampling method can be applied if the diversity of species changes with altitude, temperature, pressure and humidity (micro-climate). However, micro- climatic factors of Zone A and B do not vary, and thus, a random sampling method was preferred.

A survey route was to be followed for the primary data collection for field study. However, a more random approach was taken (like in the previous Terrestrial Assessment) to cover all vegetative grounds. The Random Method makes it feasible to identify any growth of flora species in any distribution of vegetation in zone A and B.

4.3.1. Flora Diversity

Flora species diversity was assessed in Zone A, B and its buffer area by directly identifying the species with the help of plant identifying android applications (Leaf Spot & Plantifier) as recommended by the Forest Range Office and each identified plant was later verified with the help of foresters from the Forest Range office, Phuentsholing. Samples such as leaves, twigs, fruits, seeds, flowers, and photos were taken for further confirmation of its genus and species.

4.3.2. Fauna (mammal) Diversity

The diversity of fauna was assessed through a questionnaire survey and sightseeing. Additional information was collected from the Phuentsholing Forest Range Office, National Publications, Journals, etc.

4.3.3. Avifauna Diversity

The Avifauna species diversity was assessed through sightseeing and questionnaire survey. Additional information was collected from the Phuentsholing Forest Range Office, National Publications, Journals, etc.

5. FINDINGS

The collective findings from primary and secondary data are tabulated under its respective heading. All the findings are verified and corrected by Gedu Forest Division and the verification document is attached as **appendix 3** for reference. For flora diversity, the different types of plants are categorized and mentioned as: -

- Trees
- Shrubs and herbaceous
- Climber, creeper & vine, and Grasses.

5.1. Flora Diversity

The following table (**Table 3**) shows the total flora **(Trees)** species recorded during the Fourth Terrestrial Survey, which were also identified during the First, Second and the Third Terrestrial Survey. **Table 4** is representative of the additional flora species which were identified during the Fourth Terrestrial Survey. All the species highlighted are findings from the field study and not from the survey questionnaire and vice versa. The species are classified alphabetically based on their scientific name. The Local Name of each species is derivative to the *commonly known* basis, with preference given to the species name in Dzongkha (if available). The pictures of flora diversity recorded during the field study are attached as **Appendix 5**. Pictures are not available for all the findings from the questionnaire survey.

Table 3: Flora (Trees) species recorded during the Terrestrial Survey

Flora (Trees) diversity assessment of Zone A & B of PTDP (First, Second, Third & Fourth Terrestrial Survey)					
SN	**Scientific Name**	**English Name**	**Local Name**	**Lifecycle**	**IUCN Status**
1	*Acacia catechu*	Khair	Jaseng	Deciduous	Least Concern
2	*Albezia lebbeck*	Siris	Siris	Deciduous	Least Concern
3	*Albizzia Spp*	Flea tree	Siris	Deciduous	Least Concern
4	*Allaeanthus grandies*	Not-found	Gokul	Deciduous, Evergreen	Least Concern
5	*Bauhinia purpurea*	Orchid tree	Taki	Deciduous	Least Concern
6	*Bombax ceiba*	Cotton tree	Simal	Deciduous in winter	Least Concern
7	*Brassiopsis hispida*	Phutta	Phutta	Deciduous	Least Concern
8	*Carica papaya*	Papaya tree	Maywa	Evergreen	Least Concern
9	*Coriaria myrtifolia*	Redoul	Not found	Deciduous	Least Concern
10	*Delonix regia*	Gul mohur tree	Siris	Deciduous	Least Concern
11	*Duabonnga grandiflora*	Hummingbird tree	Lampatey	Deciduous	Least Concern
12	*Ficus auriculata*	Elephant ear fig	Nibaro	Semi-deciduous	Least Concern
13	*Ficus roxburgii*	Not-found	Nibaro	Semi-deciduous	Least Concern
14	*Ficus virens*	White fig	Nibaro	Deciduous	Least Concern
15	*Gmelina arborea*	Beech-wood/ gamhar	Gamari	Deciduous	Least Concern
16	*Garuga pinnata*	Garuga	Not-found	Deciduous	Least Concern
17	*Moringa oleifera*	Drumstick tree	Sajana	Deciduous	Least Concern
18	*Murraya koenigii*	Curry leaf tree	Burigondaey	Evergreen	Least Concern
19	*Premna latifolia*	Arani	Genari	Deciduous	Least Concern
20	*Senegalia catechu*	Black catachu	Not found	Deciduous	Least Concern
21	*Stereospermum tetragonum*	Snake tree	Hatipailey	Deciduous	Least Concern
22	*Terminalia microcarpa*	Damson Plum	Panisasz	Semi-deciduous	Least Concern
23	*Tetrameles nudiflora*	False hemp tree	Myana	Deciduous	Least Concern

Flora (Trees) diversity assessment of Zone A & B of PTDP (First, Second, Third & Fourth Terrestrial Survey)					
SN	**Scientific Name**	**English Name**	**Local Name**	**Lifecycle**	**IUCN Status**
24	*Ziziphus jujube*	jujube tree	Boyar	Deciduous, Evergreen	Least Concern

Table 4: New Flora (Tree) Species Recorded during the Fourth Terrestrial Survey

Flora (Herbaceous and shrubs) diversity assessment of Zone A & B of PTDP (Fourth Terrestrial Survey)					
SN	**Scientific Name**	**English Name**	**Local Name**	**Types**	**IUCN Status**
1	*Wrightia arborea*	Woolly Dying Rosebay	Not Found	Deciduous	Least Concern

Note: For the previous tabulations (**Table 3** and **4**) the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred

Table 5 shows the total flora **(Herbaceous and shrubs)** species recorded during the Fourth Terrestrial Survey, which were also identified during the First, Second and the Third Terrestrial Survey. **Table 6** is representative of the additional flora species i.e. Herbaceous and Shrubs which were identified during the Fourth Terrestrial Survey All the species highlighted are findings from the field study and not from the survey questionnaire and vice versa. The species are classified alphabetically based on their scientific name. The Local Name of each species is derivative to the *commonly known* basis, with preference given to the species name in Dzongkha (if available). The pictures of flora diversity recorded during the field study are attached as **appendix 5**. Pictures are not available for all the findings from the questionnaire survey.

Table 5: Flora (Herbaceous and shrubs) species recorded during the Terrestrial Survey

Flora (Herbaceous and shrubs) diversity assessment of Zone A & B of PTDP (First, Second, Third & Fourth Terrestrial Survey)						
SN	**Scientific Name**	**English Name**	**Local Name**	**Types**	**Lifecycle**	**IUCN Status**
1	*Acmella uliginosa*	Marsh papa cress	Not-found	Herbaceous	Herbaceous perennials	Least Concern
2	*Agerantum conyzoids*	Billygoat-weeds	Illamey	Herbaceous	Annuals	Least Concern
	Alternanthera sessillis	Sessiljoyweed	Not found	Herbaceous	Perennial	Least Concern
3	*Alysicarphus vaginalis*	White moneywort	Not-found	Herbaceous	Herbaceous perennials / Annuals	Least Concern
4	*Arthemisia vulgaris*	Mugwort	Patii	Herbaceous	Herbaceous perennials	Least Concern
5	*Ballota nigra*	Black horehound	Not-found	Shrubs	Herbaceous perennials	Least Concern
6	*Bidens pilosa*	Beggar-ticks	Kuro	Herbaceous	Annuals	Least Concern
7	*Chromolaena odorata*	Devil weed	Not-found	Shrubs	Herbaceous perennials	Least Concern
8	*Cinopodium vulgare*	Wild basil	Not-found	Herbaceous	Perennials	Least Concern
9	*Colocasia esculenta*	Taro	Doothmanay	Herbaceous	Perennials	Least Concern
11	*Coffea benghalensis*	Bengal coffea	Not found	Herbaceous	Perennial	Least Concern
12	*Colebrookea oppositifolia*	Indian squirrel Tail	Not found	Herbaceous	Perennial	Least Concern
13	*Crassocephalum crepidioides*	Redflower ragleaf	Not-found	Shrubs	Annuals	Least Concern
14	*Crotalaria spectabilis*	Snowy rattlepod	Not-found	Herbaceous	Biennials	Least Concern
15	*Erigeron bonariensis*	Flax- leaved fleabane	Not-found	Herbaceous	Herbaceous perennials	Least Concern

Flora (Herbaceous and shrubs) diversity assessment of Zone A & B of PTDP (First, Second, Third & Fourth Terrestrial Survey)						
SN	**Scientific Name**	**English Name**	**Local Name**	**Types**	**Lifecycle**	**IUCN Status**
16	*Erythrina aborescens*	Coral tree	Phaulaedo	Herbaceous	Perennial	Least Concern
17	*Eupatorium odorantum*	Siam weed	Banmara	Herbaceous	Herbaceous perennials	Least Concern
18	*Ipomoea nil*	Morning glory	Not-found	Herbaceous	Annuals	Least Concern
19	*Lamium album*	White dead-nettle	Not-found	Herbaceous	Herbaceous perennials	Least Concern
20	*Lantana camara*	West Indian lantana	Not-found	Shrubs	Herbaceous perennials	Least Concern
21	*Macrothelypteris torresiana*	Sword fern	Gaudich	Herbaceous	Perennial	Least Concern
22	*Mikania micrantha*	Climbing hempvine	Not-found	Herbaceous	Herbaceous perennials	Least Concern
23	*Mimosa pudica*	Touch-me-not	Not-found	Herbaceous	Annuals / Biennials	Least Concern
24	*Musa Spp.*	Banana tree	Kela	Herbaceous	Herbaceous perennials	Least Concern
25	*Parthenium hysterophorus*	Santa-maria feverfew	Not-found	Herbaceous	Annuals	Least Concern
26	*Plectrathus abboinicus*	Indian borage	khushila	Herbaceous	Perennial	Least Concern
27	*Pteridium spp.*	Fern	Uoniou	Herbaceous	Annuals	Least Concern
28	*Ricinus communis*	Castro bean plant	Not-found	Shrubs	Annuals	Least Concern
29	*Senecio vulgaria*	groundsel	Not found	Herbaceous	Annual	Least Concern
30	*Senna occcidentalis*	Coffee senna	Not found	Shrubs	Perennial	Least Concern
31	*Sida acuta*	Common wire-weed	Jaaru	Shrubs	Herbaceous perennials	Least Concern
31	*Solanum nigrum*	Black nightshade	Not-found	Herbaceous	Annuals / Biennials	Least Concern
33	*Solanum torvum*	Turkey berry	Khalanggi	Shrubs	Herbaceous perennials	Least Concern
34	*Solanum viarum*	Topical soda apple	Not-found	Herbaceous	Perennials	Least Concern
35	*Stellaria media*	Chickweed	Not-found	Herbaceous	Annuals / Herbaceous perennials	Least Concern
36	*Viburnum lantana*	Wayfarer	Not found	Herbaceous	Perennial	Least Concern

Table 6: New Flora (Herbs & Shrubs) Species recorded during the Fourth Terrestrial Survey

Flora (Herbs & Shrubs) diversity assessment of Zone A & B of PTDP (Fourth Terrestrial Survey))						
SN	**Scientific Name**	**English Name**	**Local Name**	**Types**	**Lifecycle**	**IUCN Status**
1	*Amaranthus retroflexus*	Red-root pigweed	Not found	shrubs	Annual	Least concern
2	*Cryptolepsisi buchanani*	Wax leaved climber	Langchu Rubjee	shrubs	Perennial	Least concern
3	*Woodfordia fruticosa*	Fire flame bush	Not found	shrubs	Evergreen shrubs	Least concern

Note : For the previous tabulations (**Table 5** and **Table 6**) the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred

Table 7 shows the total flora **(climbers, creepers, vine, and grass)** species recorded during the Second, Third and Fourth Terrestrial Survey. All the species highlighted are findings from the field study and not from the survey questionnaire and vice versa. The species are classified alphabetically based on their scientific name. The Local Name of each species is derivative to the *commonly known* basis, with preference given to the species name in Dzongkha (if available). The pictures of flora diversity recorded during the field study are attached as **appendix 5.** Pictures are not available for all the findings from the questionnaire survey.

Table 7: Flora (climbers, creepers, vine, and grass) species recorded during the Terrestrial Survey

Flora (climbers, creepers, vine, and grass) diversity assessment of Zone A & B of PTDP (First, Second, Third & Fourth Terrestrial Survey)						
SN	**Scientific Name**	**English Name**	**Local Name**	**Types**	**Lifecycle**	**IUCN Status**
1	*Bambuseae spp*	Bamboo	Basx	Grass	Perennial	Least Concern
2	*Cuscuta spp.*	Dodder	Not-Found	Creepers	Annual	Least Concern
3	*Luffa operculata*	Sponge Cucumber	Jaalo	Climbers	Annual	Least Concern
4	*Thysonolaena maxima*	Tiger Grass	Kucho	Grass	Perennial	Least Concern

Note: For the above tabulation (**Table 7**) the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred

5.2. Fauna Diversity

Table 8 shows the fauna species (Wild) recorded during the First, Second, Third and Fourth Terrestrial Surveys conducted. The species are classified alphabetically based on their scientific name. The Local Name of each species is derivative to the *commonly known* basis, with preference given to the species name in Dzongkha (if available), following by their native name. As fauna diversity was recorded based on survey questionnaires, only the names are available. It is also to be understood (as mentioned in the **Scope** of the report) that the fauna species listed below does not limit to or completely verify the present and absence of the species in Zone A and B. However, consultations with the Forest Range Office have been made for each of the findings listed below.

Table 8: Fauna species recorded during the Terrestrial Survey

Fauna diversity assessment of Zone A & B of PTDP				
SN	**Scientific name**	**Local Name**	**English name**	**IUCN Status**
1	*Bos gaurus*	Mithun	Indian Gaur*	Vulnerable
2	*Hystrix indica*	Jithur/Dumshi	Indian crested porcupine	Least concern
3	*Macaca mulatta*	Chea/Bandar	Common monkey	Least concern
4	*Muntiacusmuntjak*	Kasha/Goral	Barking Deer	Least concern
5	*Procyon lotor*	Not-Found	Raccoon	Least concern
6	*Sciurus niger*	Tortola/Lothorkay	Fox Squirrel	Least concern
7	*Sus Scrofa*	Repha/Boudel	Wild boar	Least concern

Note : The ones marked with (*) are migratory.
: For the above tabulation the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred

From the questionnaire survey conducted for the Fourth Terrestrial Survey, there were no mentions of any sightings of *Elephas maximus* i.e. the Asian Elephant. After confirming with the Forest Range Office, Asian Elephants have not been sighted at the project location for many years.

Table 9 shows the primary findings of domesticated species recorded during the First, Second, Third and the Fourth Terrestrial Survey. The species are classified alphabetically based on their scientific name. The Local Name of each species is derivative to the *commonly known* basis, with preference given to the species name in Dzongkha (if available) and followed by the native name. The following data was collected through field study and questionnaire survey. The pictures of following species are not attached as they are universally recognized and currently not endangered.

Table 9: Total domesticated species recorded

Domesticated animal diversity assessment of Zone A & B of PTDP			
SN	**Scientific Name**	**English Name**	**Local Name**
1	*Bos spp.*	Cattle	No / Guye
2	*Capra aegagrus*	Goat	Ra / Khashia
3	*Sus scrofadomesticus*	Pig	Phap / Sungur
4	*Gallus gallusdomesticus*	Chicken	Japay/Jaem /Kukhara
5	*Anas platyrhynchos domesticus*	Duck	Dhamja / Haas
7	*Felisdomesticus*	Cat	Gelee / Biralo
8	*Canislupasfamiliaries*	Dog	Rochee / Kukur
9	*Equus caballus*	Horse	Ta / Gora

Note: *Gallus gallusdomesticus* (Chicken) falls under Avifauna species but it is commonly raised as the domesticated animals; hence it has been included under 'domestic' and not under 'avifauna'

5.3. Avifauna Diversity

Table 10 shows the primary findings of Avifauna species recorded during the First, Second, Third and the Fourth Terrestrial Survey. The species are classified alphabetically based on their scientific name. The Local Name of each species is derivative to the *commonly known* basis, with preference given to the species name in Dzongkha (if available), following by the native name. Similar to the Fauna findings, it is to be understood (as mentioned in the **Scope** of the report) that the avifauna species listed below does not limit to or completely verify the presence or absence of the species in Zone A and B as the avifauna diversity as the data mentioned was recorded based on survey questionnaires (and so, no pictures are available). However, consultation with the Forest Range Office has been made for each of the findings listed below.

As the survey respondents were the same local households from the last survey conducted (Second Terrestrial Survey) the presence of the same Avifauna was listed.

Table 10: Avifauna species recorded during the Terrestrial Survey

Avifauna diversity assessment of Zone A & B of PTDP				
SN	**Scientific name**	**English name**	**Local names**	**IUCN status**
1	*Copsychussaularies*	Orientals Magpie Robin	Robin	Least concern
2	*Aceros nipalensis*	Ruffous-Necked Hornbill *	Jagobo	Vulnerable
3	*Acridotheresfuscus*	Jungle Myna	Teapjanap / Rupi	Least concern
4	*Alcedoatthis*	Common Kingfisher	Chuja	Least concern
5	*Aquila nipalensis*	Steppe Eagle*	Chhagay /Chil	Critically Endangered
6	*Athene brama*	Spotted Owlet	Wokthu / Kokolay	Least concern
7	*Bubulcus ibis*	Cattle Egret	Bakula	Least concern
8	*Columba livia*	Oriental Pigeon	Phutwo / Paraywa	Least concern
9	*Corvussplendens*	House Crow	Ola / Kaag	Least concern
10	*Haliaeetus leucoryphus*	Pallas's Fish Eagle	Chil	Endangered
11	*Hierococcyxvarius*	Common Hawk Cuckoo	Ja-a-khu	Least concern
12	*Hypsipetesleucocephalus*	Black Bulbul	Not-Found	Least concern
13	*Leiopicusauriceps*	Brown Fronted Woodpecker	Shingja	Least concern
14	*Myophonuscaeruleus*	Blue Whistling Thrush	Not-Found	Least concern
15	*Oxyurajamaicensis*	Reddy Duck	Dhamja / Haas	Least concern
16	*Passer cinnamomes*	Russet Sparrow	Nelzem	Least concern
17	*Pavocristatus*	Indian Peafowl *	Mujur	Least concern
18	*Phylloscopusxanthoschistos*	Grey-Hooded Warbler	Not-Found	Least concern
19	*Polyplectron*	Gray Peacock Pheasant *	Majapho	Least concern
20	*Psittaculacyanocephala*	Plum Headed Parakeet *	Not-Found	Least concern
21	*Spilopeliachinensis*	Spotted Dove	Thiligame/Dukur	Least concern
22	*Upupa epops*	Common Hoopoe	Daytokzem	Least concern

Note : The ones marked with (*) are migratory.
: For the above tabulation the Forest and Nature Conservation Act and Regulation 1995 and 2017 have been referred
: It is to be noted that the avifauna species that are protected domestically and internationally are all migratory.

6. Inference from the Study Findings

Table 12, 13 and 14 is representative of the inferences drawn from the four Terrestrial Surveys conducted till date. The Summary of the Terrestrial Survey conducted is mentioned in **Table 11.**

Table 11: Summary of the Terrestrials Surveys conducted till date

SN	Terrestrial Survey	Study Focused on	Study period	Season
1.	First Terrestrial Survey	Density of species for the flora assessment and diversity of species for the avifauna and fauna	June – August 2019	Summer
2.	Second Terrestrial Survey	Diversity of species	September – November 2019	Autumn
3.	Third Terrestrial Survey	Diversity of species	December 2019 – January 2020	Winter
4.	Fourth Terrestrial Survey	Diversity of species	March – May 2020	Spring

6.1. Flora Species

6.1.1. Diversity of Trees during different seasons at Zone A & B and their buffer Zones

Table 12 is the representative of Tree species (noted during the four Terrestrial Surveys conducted till date) based on the presence and absence in the corresponding seasons. However, as the focused of the first terrestrial report was more on density than on diversity of species, it should be noted that the less count of species during the summer terrestrial report does not completely define the diversity of flora species during the season.

75% (21 tree species) of the Trees noted were Deciduous, 11% (3 tree species) semi-deciduous and 14% (4 tree species) were Evergreen species noted; these trees under goes through the process of leave abscission in a certain seasons. Therefore, **Table 12** is comparative of the leave abscission process of the following trees during the respective seasons.

Table 12: Seasonal changes (presence and absence) in Tree Species found in Zone A and B and their respective Buffer Zones

SN	Species	English Name	Seasons on which the Terrestrial Survey was conducted			
			SUMMER	AUTUMN	WINTER	SPRING
1	*Acacia catechu*	Khair	✓	✓	✓	✓
2	*Wrightia arborea*	Woolly Dying Rosebay				✓
3	*Albezia lebbeck*	Siris		✓	✓	✓
4	*Albizzia spp*	Flea tree		✓	✓	✓
5	*Alnus nepalensis*	Nepalese alder	✓			
6	*Allaeanthus grandies*	Not-found		✓	✓	✓
7	*Bauhinia purpurea*	Orchid tree		✓	✓	✓
8	*Brassiopsis hispida*	Phutta			✓	✓
9	*Bombax ceiba*	Cotton tree		✓	✓	✓
10	*Coriaria myrtifolia*	Redoul			✓	✓
11	*Carica papaya*	Papaya tree		✓	✓	✓
12	*Delonix elata*	White Gul mohur tree		✓	✓	✓
13	*Duabonnga grandiflora*	Hummingbird tree		✓	✓	✓
14	*Ficus auriculata*	Elephant ear fig		✓	✓	✓
15	*Ficus roxburgii*	Not-found		✓	✓	✓

16	*Ficus virens*	White fig		✓	✓	✓
17	*Gmelina aborea*	Beech-wood		✓	✓	✓
18	*Guruga pinnata*	Guruga		✓	✓	✓
19	*Moringa oleifere*	Drumstick tree		✓	✓	✓
20	*Morus microura*	King white mulberry	✓			
21	*Murraya koenigii*	Curry leaf tree		✓	✓	✓
22	*Premna latifolia*	Arani		✓	✓	✓
23	*Senegalia catechu*	Black catechu		✓	✓	✓
24	*Stereospermum tetragonum*	Snake tree		✓	✓	✓
25	*Steruculia sp.*	Not found	✓			
26	*Terminalia mycrocarpa*	Damson Plum	✓	✓	✓	✓
27	*Tetrameles nudiflora*	False hemp tree		✓	✓	✓
28	*Ziziphus jujube*	Jujube tree	✓	✓	✓	✓

Note : The one marked with tick (✓) shows the presence while the ones left blank represent the absence of the tree species.
: The highlighted one denotes the evergreen trees.

The presence of tree species were recorded high during the autumn, winter and spring while very few were noted in summer. It is to be understood (as mentioned in the **Scope** of the report) that the species listed above does not limit to or completely verify the presence or absence of the species in Zone A and B especially for the summer study as the species density was focused on rather than the diversity. Accordingly, the evergreen trees like *Albezia lebbeck* (Siris) and few more species highlighted in the **Table 12** were also not recorded during the summer due to above mentioned reasons.

6.1.2. Diversity of Herbs and Shrubs of Trees during different seasons at Zone A & B and their buffer Zones

Table 13 & 14 shows the occurrence of shrubs & herbs and creepers, grasses and climbers during the respective seasons. However, as the focused of the first terrestrial report was more on density than diversity of species, it should be noted that the less count of species during the summer terrestrial report does not completely define the diversity of flora species during the season.

The species mentioned, usually grows only in a particular growing season while during *off seasons*, species either die or remain in dormant phase; which could be one of the reason for the non-identification of some species.

Table 13: Occurrence of Herbs and Shrubs species in corresponding season in Zone A & B and its respective buffer zones

SN	Species	English Name	Types	Seasons on which the Terrestrial Survey was conducted			
				SUMMER	AUTUMN	WINTER	SPRING
1	*Acmella uliginosa*	Marsh papa cress	Herbaceous		✓	✓	✓
2	*Agerantum conyzoids*	Billygoat-weeds	Herbaceous		✓	✓	✓
3	*Alternanthera sessillis*	Sessiljoyweed	Herbaceous			✓	✓
4	*Amaranthus retroflexus*	Red-root pigweed	shrubs				✓
5	*Alysicarphus vaginalis*	White moneywort	Herbaceous		✓	✓	✓
6	*Arthemisia vulgaris*	Mugwort	Herbaceous		✓	✓	✓
7	*Ballota nigra*	Black horehound	Shrubs		✓	✓	✓
8	*Bidens pilosa*	Beggar-ticks	Herbaceous			✓	✓
9	*Chromolaena odorata*	Devil weed	Shrubs		✓	✓	✓
10	*Cinopodium vulgare*	Wild basil	Herbaceous		✓	✓	✓
11	*Coffea benghalensis*	Bengal coffea	Herbaceous			✓	
12	*Colebrookea*	Indian squirrel Tail	Herbaceous			✓	

SN	Species	English Name	Types	Seasons on which the Terrestrial Survey was conducted			
				SUMMER	AUTUMN	WINTER	SPRING
	oppositifolia						
13	*Colocasia esculenta*	Taro	Herbaceous		✓	✓	✓
14	*Crassocephalum crepidioides*	Redflower ragleaf	Shrubs		✓	✓	✓
15	*Crotalaria spectabilis*	Snowy rattlepod	Herbaceous		✓	✓	✓
16	*Cryptolepsis buchanani*	Wax leaved climber	shrubs				✓
17	*Erigeron bonariensis*	Flax leaved fleabane	Herbaceous		✓	✓	✓
18	*Erythrina aborescens*	Coral tree	Herbaceous			✓	
19	*Eupatorium odorantum*	Siam weed	Herbaceous		✓	✓	
20	*Grewia selurata*	Not found	shrubs	✓			
21	*Ipomoea nil*	Morning glory	Herbaceous		✓	✓	✓
22	*Lamium album*	White dead-nettle	Herbaceous		✓	✓	✓
23	*Lantana camara*	West Indian lantana	Shrubs	✓		✓	✓
24	*Macrothelypteris torresiana*	Sword fern	Herbaceous			✓	✓
25	*Mikania micrantha*	Climbing hempvine	Herbaceous	✓	✓	✓	✓
26	*Mimosa pudica*	Touch-me-not	Herbaceous		✓	✓	✓
27	*Musa Spp.*	Banana tree	Herbaceous		✓	✓	✓
28	*Parthenium hysterophorus*	Santa-maria feverfew	Herbaceous		✓	✓	✓
29	*Plectrathus abboinicus*	Indian borage	Herbaceous			✓	
30	*Pteridium spp.*	Fern	Herbaceous		✓	✓	✓
31	*Ricinus communis*	Castro bean plant	Shrubs		✓	✓	✓
32	*Senecio vulgaria*	Groundsel	Herbaceous			✓	✓
33	*Senna occcidentalis*	Coffee senna	Shrubs			✓	✓
34	*Sida acuta*	wire-weed	Shrubs		✓	✓	✓
35	*Solanum erianthum*	Mullein nightshade	Shrubs	✓			
36	*Solanum nigrum*	Black nightshade	Herbaceous		✓	✓	✓
37	*Solanum torvum*	Turkey berry	Shrubs		✓	✓	✓
38	*Solanum viarum*	Topical soda apple	Herbaceous		✓	✓	✓
39	*Stellaria media*	Chickweed	Herbaceous		✓	✓	✓
40	*Viburnum lantana*	Wayfarer	Herbaceous			✓	✓
41	*Woodfordia fruticosa*	Fire flame bush	shrubs				✓

Note: The one marked with tick (✓) shows the presence of species whiles the one left blank denotes the absence of species in a particular season.

Most Herbs and Shrubs found are a Perennial i.e. which grow and die in two consecutive season (spring and summer). Of the total 41 Shrubs and Herbs found in the study area, 36 species are found during winter (highest species count) and only 4 species were found during the summer season (lowest species count). However, the low count could be due to the study methodology adopted during the first terrestrial survey (summer), where the focused was only on density of species (Transect and Quadrant method).

6.1.3. Diversity of climbers, creepers and grasses during different seasons at Zone A & B and their buffer Zones

Table 14: Occurrence of Creeper, Grasses and Climbers in the corresponding season in Zone A & B and its respective buffer zones

SN	Species	English Name	Types	Life Cycle	Seasons on which the Terrestrial Survey was conducted			
					SUMMER	AUTUMN	WINTER	SPRING
1	*Bambuseae spp*	Bamboo	Grass	Perennial	✓	✓	✓	✓
2	*Cuscuta spp.*	Dodder	Creepers	Annual		✓	✓	✓
3	*Luffa operculata*	Sponge Cucumber	Climbers	Annual		✓	✓	✓
4	*Thysonolaena maxima*	Tiger Grass	Grass	Perennial		✓	✓	✓

Note : The one marked with tick (✓) shows the presence of species while one left blank denotes the absence of species in a given season.

6.2. Faunal diversity in different season in Zone A & B and their respective Buffer Zones

As there are no significant changes in the presence (or) absence of domestic faunal species i.e. the availability of these species are dependent on their herder or their *owner* and not on their migratory nature; therefore, the inference of diversity of domestic Fauna species is not discussed.

6.2.1. Diversity of fauna (wild mammal) in different season

Table 15 is representative of the findings from all the four terrestrial surveys conducted till date. Since some species changes their habitat with the change in seasons, the followings comparisons were noted:

Table 15: Faunal (mammals) species during the respective season

SN	Scientific Name	English Name	Seasons on which the Terrestrial Survey was conducted			
			SUMMER	AUTUMN	WINTER	SPRING
1	*Bos gaurus*	Indian Gaur*		✓	✓	✓
2	*Hystrixindica*	Indian crested porcupine		✓	✓	✓
3	*Macaca mulatta*	Common monkey		✓	✓	✓
4	*Muntiacus muntjak*	Barking Deer	✓	✓	✓	✓
5	*Procyon lotor*	Raccoon		✓	✓	✓
6	*Sciurus niger*	Fox Squirrel		✓	✓	✓
7	*Sus Scrofa*	Wild boar	✓	✓	✓	✓

Note : The one with tick (✓) represents the presence of faunal species while the one left blank represents the absence in a given season.
: The ones marked with (*) are migratory.

Almost all the fauna (wild mammals) were found in the three consecutive seasons (i.e. autumn, winter & spring) but there were only two species noted during the summer; this may be due to the lack of resources during the First Report.

As per the forest BEAT In-charge of Samtse, *Bosgaurus* (Indian Gaur) is migratory during winter season however as there were mentions of the mammal during the primary data collection (questionnaires from the locality), the fauna species was noted as present.

6.3. Diversity of Avifaunal species in different season in Zone A & B and their respective Buffer Zones

Table 16 is representative of the findings from all the four terrestrial surveys conducted till date. Since some species changes their habitat with the change in seasons, the followings comparisons were noted:

Table16: Avifaunal species during the respective Seasons

SN	Scientific Name	English Name	Seasons on which the Terrestrial Survey was conducted			
			SUMMER	AUTUMN	WINTER	SPRING
1	*Copsychussaularies*	Orientals Magpie Robin		✓	✓	✓
2	*Aceros nipalensis*	Ruffous-Necked Hornbill*		✓	✓	✓
3	*Acridotheresfuscus*	Jungle Myna		✓	✓	✓
4	*Ardea sp.*	Heron	✓			
5	*Ardea modesta*	Great heron	✓			
6	*Alcedoatthis*	Common Kingfisher		✓	✓	✓
7	*Aquila nipalensis*	Steppe Eagle*		✓	✓	
8	*Athene brama*	Spotted Owlet		✓	✓	✓
9	*Bubulcus ibis*	Cattle Egret	✓	✓	✓	✓
10	*Columba livia*	Oriental Pigeon	✓	✓	✓	✓
11	*Corvussplendens*	House Crow	✓	✓	✓	✓
12	*Haliaeetus leucoryphus*	Pallas's Fish Eagle		✓	✓	✓
13	*Hierococcyxvarius*	Common Hawk Cuckoo		✓	✓	✓
14	*Hypsipetesleucocephalus*	Black Bulbul		✓	✓	✓
15	*Leiopicusauriceps*	Brown Fronted Woodpecker		✓	✓	✓
16	*Myophonuscaeruleus*	Blue Whistling Thrush		✓	✓	✓
17	*Oxyurajamaicensis*	Reddy Duck		✓	✓	✓
18	*Passer cinnamomes*	Russet Sparrow	✓	✓	✓	✓
19	*Pavocristatus*	Indian Peafowl *		✓	✓	✓
20	*Phylloscopusxanthoschistos*	Grey-Hooded Warbler		✓	✓	✓
21	*Polyplectron*	Gray Peacock Pheasant *		✓	✓	✓
22	*Psittaculacyanocephala*	Plum Headed Parakeet *		✓	✓	
23	*Spilopeliachinensis*	Spotted Dove		✓	✓	✓
24	*Upupa epops*	Common Hoopoe		✓	✓	✓

Note : The one marked with tick (✓) denotes the presence of species while the one left blank shows the absence of a species in a given year. Since all the domesticated animals are presence throughout the seasons, they are tabulated here.
: The ones marked with (*) are migratory.

4 avifauna species were noted in the sampling site i.e. Zone A and B (inclusive of all buffer point along A and B) for the last four terrestrial surveys conducted.

Avifauna species like Cattle Egret, Pallas's Fish Eagle, Common Hawk Cuckoo and Grey-Hooded Warbler were marked as migratory in the last survey report (i.e. Second and the Third Terrestrial Survey). However, on reconfirming the migratory birds list with the Phuentsholing Range Office for the Fourth Terrestrial survey, these species were noted to be native and not migratory, therefore justifying our findings for the terrestrial surveys. Species inclusive of Cattle Egret, Pallas's Fish Eagle, Common Hawk Cuckoo and Russet Sparrow are all native to Phuentsholing; accordingly, these bird species are marked as present in all the Terrestrial Report conducted till date.

Species like the Ruffous-necked Hornbill, Indian Peafowl and Gray Peacock Pheasant are avifauna species that migrate during the winter as per the Phuentsholing Range Office however as per the questionnaire survey conducted there were mentions of the species and so are noted present in **Table 16.**

Plum Headed Parakeet and Steppe Eagle were two bird species that were noted to be absent during the Fourth Terrestrial Survey i.e. these bird species are migratory during the spring season as confirmed by the Phuentsholing Range Office.

7. Abundance of Species during different Seasons

Table 17 is representative of the respective species abundance recorded during the Four Terrestrial Surveys conducted still date.

Table 17: Showing the number of individual species in corresponding season

Type	Species	Seasons on which the Terrestrial Survey was conducted			
		Summer	Autumn	Winter	Spring
Flora	Trees	5	22	24	25
	Shrubs and Herbs	4	26	36	39
	Climber, creepers and grasses	1	4	4	4
Fauna	Wild mammals	4	7	7	8
	Domestic animals	4	8	8	8
Avifauna		6	22	22	22

It is found that there is a Seasonal variation in the abundance of flora, fauna and avifauna in the sampling site, zone A and B (also along the buffer point of each zone). Maximum abundance of species (inclusive of Flora, Fauna and Avifauna) was noted to be during spring and winter and so, species richness is recorded high in spring followed by winter. Such species abundance could be due to the moderate and cool climatic condition during these seasons which therefore, provide a favorable habitat of many species. Less number of species were recorded in summer however as the first terrestrial report (summer season) focused s on density of species one cannot give much confidence on the diversity listed during the Summer Study.

The dominant species found throughout the season are shrubs and herbs. Shrubs and Herbs species are found in high numbers in all season while climbers, creepers and grasses are found less dominance throughout the season. A total of 68 flora species, 16 fauna species (adding both domestic and wild species) and 22 Avifauna species were noted during the four consecutive terrestrial surveys carried out from the month of June 2019 to May 2020. As mentioned in the scope, the species abundance in Zone A and B (and along their respective Buffer Zones) are not limited to the ones noted in the series of Terrestrial Survey conducted till date; there may be additional species that may have been present but have not been noted due to physical, technical and samplers error.

8. CONCLUSION

The Fourth Terrestrial Survey Report is a collective of Terrestrial Survey data conducted from March 2020 – May 2020. Additionally, this report is comparative to the findings from the First, Second and Third Terrestrial Survey. The study records the diversity of flora, fauna and avifauna species. Primary and Secondary data were collected for the study. For primary data, survey questionnaire and site surveys were conducted. Field surveys were done by using android applications on the recommendation from the Forest Range Office, Phuentsholing. The survey questionnaires were asked to the local households for additional information on flora, fauna and avifauna diversity. For secondary data, information from publications, international web sites and the EIA for Amochhu 2017 were referred.

During the Fourth Survey conducted, a new tree species i.e. *Wrightia arborea* commonly known as Woolly Dying Rosebay was noted. Woolly Dying Rosebay is a deciduous tree and shed their leaves annually; the non-identification of the species during the previous Terrestrial Surveys could be due to the examiner/ surveyor error.

Additionally, three new shrubs species were also identified during the Fourth Terrestrial Survey. Shrub species like *Cryptolepsisi buchanani* and *Amaranthus retroflexus* shed annually and perennially (respectively) and so, the previous non-identification of these species could be due to their shedding. *Woodfordia fruticosa* is an evergreen shrub, therefore the non –identification of the plant could be due to the examiner/ surveyor error while sampling.

Ruffous-Necked Hornbill (*Acerosnipalensis sp)* is also marked as "protected" as per FNCR 1995. However, the protected Avifauna species are migratory which why they do not have its habitat at the Ammochhu for an extended period. Similar findings were noted from the last Terrestrial Surveys Questionnaires as there are only a limited number of local households in zone A and B which results in the survey of the same group of people each season.

In brief, during the survey four additional flora species which were not identified during the first, Second and Third Terrestrial Survey was noted. None of these new flora species recorded are threatened as per IUCN red list or the FNCR 1995 and 2017. Similar to the last Terrestrial Survey findings, the dominant species remain to be Khair (*Acacia catechu*), devil weed (*Chromolaena odorata*) West Indian lantana (*Lantana camara*) and common wire-weed (*Sida acuta*) within the site (relative to their shedding cycle). No new species of Fauna or Avifauna were noted. Many of the species identified were recorded from Zone B due to denser vegetation cover in comparison to Zone A. The above recorded species are not disturbed or threatened by the current township development project.

9. REFERENCES: *

Construction Development Corporation Limited, Royal Government of Bhutan for the Asian Development Bank (2017). Bhutan; *EIA Amochhu Land Development and Township Project*. Project no. 50165-002

Dalgleish, H.J., Koons, D.N. & Adler, P.B. (2010*). Can life-historytraits predict the response of forb populations to changes inclimate variability?* J. Ecol., 98, 209–217.

Forest and Nature Conservation Act of Bhutan (2017). Royal Government of Bhutan, Thimphu.

Forest and Nature Conservation Rules and Regulation of Bhutan (2017). Royal Government of Bhutan. Ministry of Agriculture and Forests. Department of Forest and Park Services, Thimphu.

Garciia, M.B., Pico, F.X. &Ehrle, J. (2008). *Life span correlateswith population dynamics inperennial herbaceous plants*. Am.J. Bot., 95, 258–262.

Harper, J.L. (1977). *Population Biology of Plants*. London, New York, San Francisco, Academic Press. 892 pp.

IUCN (2019). *The IUCN Red List of Threatened Species*. Version 2019-2.ISSN 2307-8235Retrieved from:http://www.iucnredlist.org

IUCN Standards and Petition Subcommittee (2014). *Guidelines for Using the IUCN Red list Categories and Criteria*. Version 11. Prepared by Standards and Petitions Subcommittee. Download from http://www.iucnredlist.org/documents/RedlistGuidelins.pdf

Molisch, H. (1929). Die Lebensdauer der Pflanze. Jena, Gustav Fischer. 168 pp. Molisch H. (1938). *The Longevity of Plants*. Lancaster, PA, Science Press. 226 pp.

Nooden, L.D.&PENNEY, J.P. (2001). *Correlative controls of senescence and plant death in Arabidopsis thaliana (Brassicaceae)*. J. Exp. Bot. 52: 2151–2159.

Nooden, L.D. (1984). *Integration of soybean pod development and monocarpic senescence*. Physiol. Plant. 62: 273–284.

Nooden, L.V. (1988). *The phenomena of senescence and ageing.* In: NOODÉN, L.D.; LEOPOLD, A.C. (eds) Senescence and Aging in Plants. San Diego, CA, Academic Press. 1–50.

Spierenburg, P. (2005) *Birds in Bhutan: Status and Distribution*.Oriental Bird Club. ISBN 0952954516, 9780954514.

*Note: APA reference style is followed.

APPENDIX 1: List of Persons involved

Table 11: List of people involved during the Fourth terrestrial survey.

SN	Names	Designation	Organization
1	Mr. Pemchung	Environmental Manager	Construction Development Corporation Limited
2	Ms. Sonam Deki	Environmentalist	Gyeltshan Consultancy
3	Mr. Ashok Kumar	HSE-In Charge	AFCONS Infrastructure Limited
4	Mr. Sunny	Environmental Engineer	AFCONS Infrastructure Limited
5	Ms. Kinley Yangzom	Jr. Environmental Officer	AFCONS Infrastructure Limited
6	Mr. Yeshi Tenzin	Quality Manager	Bhutan Ecolab Services
7	Ms. Tendey Pema	Environmental Officer	Bhutan Ecolab Services
8	Ms. Tshering Zangmo	Staff	Bhutan Ecolab Services
9	Mr. Tek Bdr Ghallay	Staff	Bhutan Ecolab Services
10	Mr. Rinzin Tempa	Staff (Dip. Forestry)	Bhutan Ecolab Services

APPENDIX 2: The mobile/android application used during the survey

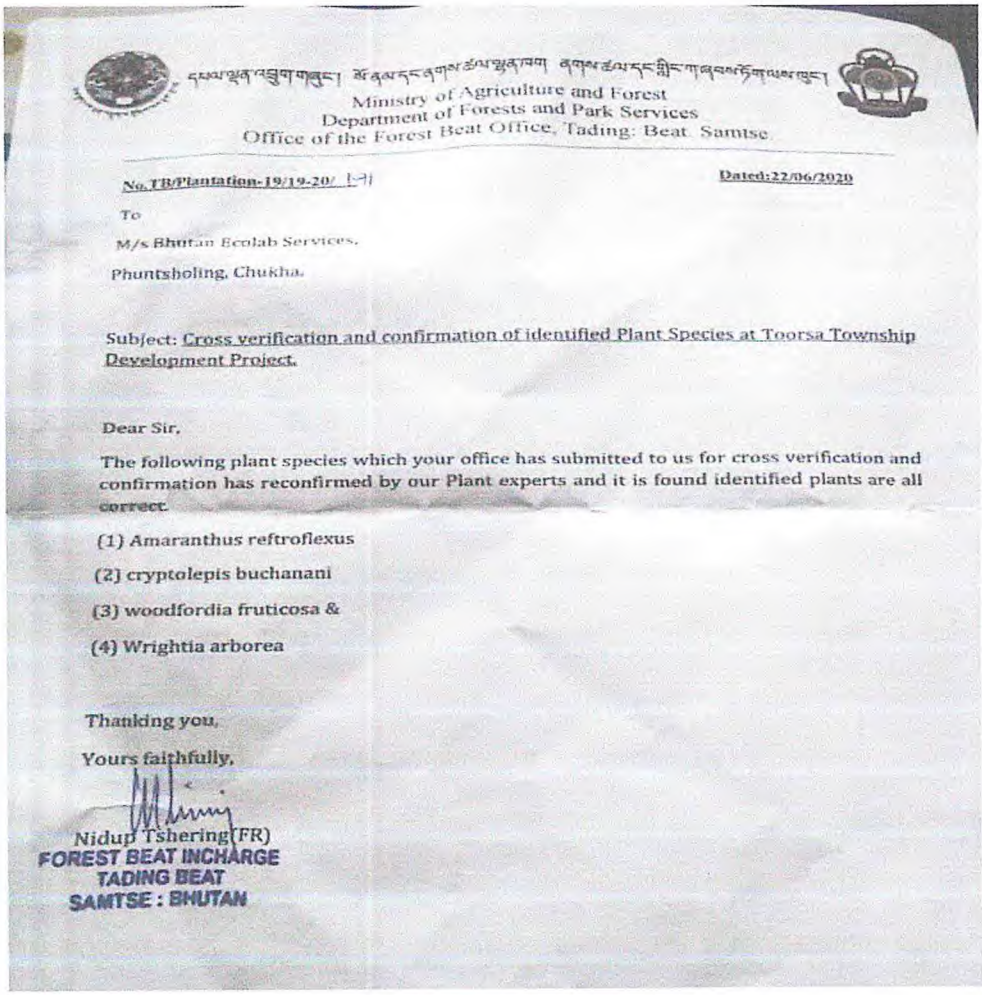
An android application used during the field survey for the identification of flora species as recommended by the Forest Officials from Forest Range Office, Phuentsholing.

Name :Leafspot-plant identification
Version : 1.0
Updated on: January 2, 2019
Offered by :Mobiwhiz

Name : Plantifier
Version : 2.4.2
Updated on: October 29, 2018
Offered by : Gekiere.com

APPENDIX 3: Letter of Verification for the New Flora Species found

Following attachment shows the cross-checked and verified Terrestrial species by the Gedu Forest Division.



Ministry of Agriculture and Forest
Department of Forests and Park Services
Office of the Forest Beat Office, Tading: Beat. Samtse

No.TB/Plantation-19/19-20/ 171 Dated:22/06/2020

To

M/s Bhutan Ecolab Services,

Phuntsholing, Chukha.

Subject: Cross verification and confirmation of identified Plant Species at Toorsa Township Development Project.

Dear Sir,

The following plant species which your office has submitted to us for cross verification and confirmation has reconfirmed by our Plant experts and it is found identified plants are all correct.

(1) Amaranthus reftroflexus

(2) cryptolepis buchanani

(3) woodfordia fruticosa &

(4) Wrightia arborea

Thanking you,

Yours faithfully,

Nidup Tshering(FR)
FOREST BEAT INCHARGE
TADING BEAT
SAMTSE : BHUTAN

APPENDIX 4: Questionnaires for locals and forest officials

Questionnaires for the locals: Assessment of Diversity of Plants, Animals and Birds at Phuentsholing Township Development Project.

A. Survey form for assessment of flora diversity

1) What plant species are found at your locality?
2) Do you know that some plants are protected by laws internationally and in Bhutan?
   a) Yes
   b) No
3) If yes, what are the local names for those plants?
4) Do you take measures to protect those plants?
   a) Yes
   b) No
5) If yes, what measures did you take to protect those species of plants?

Survey form for assessment of Mammals and Birds diversity

1) What mammals and birds are seen in your locality?
2) Do you find some mammals and birds at certain season only?
   a) Yes
   b) No
3) If yes, can you please tell us how long do you see them and at which season?
4) Did you know that some mammals and birds are protected by law internationally and by the Royal Government of Bhutan?
   a) Yes
   b) No
5) If yes, do you recognize those protected mammals and birds?
   a) Yes
   b) No
6) If yes, what are the local name for those mammals and birds?
7) Do you take measures to protect those mammals and birds?
   a) Yes
   b) No
8) If yes, what measures did you take to protect those species of mammals and birds?

Questionnaires for Forest Officials: Assessment of diversity of Plants, Animals and Birds at Phuentsholing Township Development Project.

1. Did the Forest Department document the species of plants, animals and birds along the Toorsa River?
    a. Yes
    b. No
2. If yes, what were the species of plants, animals and birds documented?
3. Do you find any species of plants, animals and birds which are of concern along the Toorsa River?
    a. Yes
    b. No
4. If yes, what are the species of plants, animals and birds which are of concern that you find along the Toorsa River?

APPENDIX 5: PLANT SPECIES RECORDED DURING THE SECOND AND THE FOURTH TERRESTRIAL SURVEY.

1.Trees:

Scientific Name: *Acacia Catachu*
Common Name: Khair

Scientific Name: Albizzia lebbeck
Common Name: Siris

Scientific Name: *Albizzia spp*
Common Name: Flea tree

Scientific Name: *Allaeanthus grandies*
Common Name: Not found

Scientific Name: *Bauhinia purpurea*
Common Name: Cotton tree

Scientific Name: *Bombax ceiba*
Common Name: Orchid tree

Scientific Name: *Carica papaya*
Common Name: Papaya tree

Scientific Name: *Delonix elata*
Common Name: Gul mohur tree

Scientific Name: Duabonnga grandiflora
Common Name: Hummingbird tree

Scientific Name: *Ficus auriculata*
Common Name: Elephant ear fig

Scientific Name: *Ficus virens*
Common Name: White fig

Scientific Name: *Gmelina arborea*
Common Name: Beech wood/gamhar

Scientific Name: *Murraya koenigii*
Common Name: Curry leaf tree

Scientific Name: *Moringa oleifere*
Common Name: Drumstick tree

Scientific Name: *Premna latifolla*
Common Name: Arani

Scientific Name: *Senegalia catechu*
Common Name: Black catechu

scientific Name: Stereospermum tetragonum
Common Name: Snake tree

Scientific Name: Terminalia microcarpa
Common Name: Damson plum

Scientific Name: *Tetrameles nudiflora*
Common Name: False hemp tree

Scientific Name: *Ziziphus jujube*
Common Name: jujube tree

2. Herbaceous and Shrubs

Scientific Name: *Acmella uliginosa*
Common Name: Marsh para cress

Scientific Name: *Ageratum Conyzoids*
Common Name: Billygoat-weed

Scientific Name: Alysicarphus vaginalis
Common Name: White moneywort

Scientific Name: Arthemisia vulgaris
Common Name: Mugwort

Scientific Name: Ballota nigra
Common Name: Black horehound

Scientific Name: Bidens pilosa
Common Name: Beggar-ticks

Scientific Name: *Chromolaena odorata*
Common Name: Devil weed

Scientific Name: *Cinopodium vulgare*
Common Name: wild basil

Scientific Name: *Colocasia esculenta*
Common Name: Taro

Scientific Name: *Crassocephalum crepidioides*
Common Name: Redflower ragleaf/ fireweed

Scientific Name: *Crotalaria Spectabilis*
Common Name: Snowy rattlepod

Scientific Name: *Erigeron bonariensis*
Common Name: Flax leaved fleabane

Scientific Name: *Ipomoea nil*
Common Name: Morning glory

Scientific Name: *Lamium album*
Common Name: White dead-nettle

Scientific Name: *Lantana camara*
Common Name: West Indian Lantana

Scientific Name: *Mikania micrantha*
Common Name: Climbing hempvine

Scientific Name: *Mimosa pudica*
Common Name: Touch-me-not

Scientific Name: *Musa spp*
Common Name: Banana

Scientific Name: Parthenium Hysterophorus
Common Name: Santa-maria feverfew

Scientific Name: Ricinus communis
Common Name: Castro bean plant

Scientific Name: *Sida acuta*
Common Name: Common Wire-weed

Scientific Name: *Solanum nigrum*
Common Name: Black nightshade

Scientific Name: *Solanum torvum*
Common Name: Turkey berry

Scientific Name: *Solanum viarum*
Common Name: Topical soda apple

Scientific Name: *Stellaria media*
Common Name: Chickweed

3. Climbers, creepers and grasses

Scientific Name: *Bambuseae spp*
Common Name: Bamboo

Scientific Name: *Cuscuta spp*
Common Name: Dodder

Scientific Name: *luffa operculata*
Common Name: Sponge cucumber

Scientific Name: *Thysonolaena*
Common Name: Tiger grass

4. Additional species found during the Fourth Terrestrial Survey

Scientific Name: Amaranthus retroflexus
Common Name: Red-root pigweed

Scientific Name: *Cryptolepsis buchanani*
Common Name: Wax leaved climber

Scientific Name: *woodfordia fruticosa*
English Name: Fire flame bush bay

Scientific Name: *Wrightia arborea*
English Name: Woolly Dying Rose

APPENDIX 6: Photographs taken during the Terrestrial Survey Questionnaire

Incident Report

AFCONS	INCIDENT REPORT FORM	Doc No.:03 HSEF/6462/03-B

Project Site :PTDP Bhutan **Job No** : 6462 **Incident Report No** : 05

Location : Part -2(D-Wall) **Department** : Execution/CPE
Name of In-charge : Mr.Prabhakaran

Date of Incident : 29/06/2020 **Time** : 11.30PM

Type of Incident :
Lost Time Injury

Details of Victim :

Name of the Victim : Mr.Harjit Singh Male / Female: Male Address: AFCONS Worker Camp	Employee Code: 20029 Employment Date:24.12.2018 Age:35 Date of Birth: 12/06/1985	Job Function : Rigger Experience: 6 years Subcontractor : (if subcontractor's employee)

Part of the body injured : Left Leg

First aid given : At Phuentsholing Hospital as per the medical report

Details of Further medical treatment in hospital: On proper examination in the hospital and the fractured Left Leg was operated and plate fixed. The victim is in good condition and Discharged from hospital on 04/07/2020

Description Of Incident: While shifting bentonite bags from the part 2 stock yard last night around 11.30 PM bags fall down on Mr.Harjit Singh. His left leg got injured and he was sent to Phuentsholing General hospital for farther examination.

Immediate Corrective Actions: Stopped all the activities and the victim was taken immediately to Phuentsholing General Hospital for farther medical examination.

Root Causes: Due to Monsoon period and frequent rain bentonite bags in slippery condition and not following the safety Precautions

General Observations :

Preventive Actions: take necessary precautions and follow the safety guidelines and before stating of the work tool box talk is to be given.

List of eye-witnesses : Mr. Sukhdev Singh (Rigger)

Photographs (enclosed if any) : 3 Sheets

Remarks if any :

Signature of Safety In-charge :
Date : 09/07/2020

Signature of Project Manager :
Date : 09/07/2020

PHUENTSHOLING HOSPITAL
OPD CARD

DATE 30.6.20

CID No.

NAME	AGE/SEX	ADDRESS
Harjit Singh	37/M	

REG NO	DISEASE CODE	CHAMBER No
CL-2500		

H/o hit by Cement bag while unloading

BP- 110/76

P- 92/min

X-ray (Lt) leg → AP No open wound

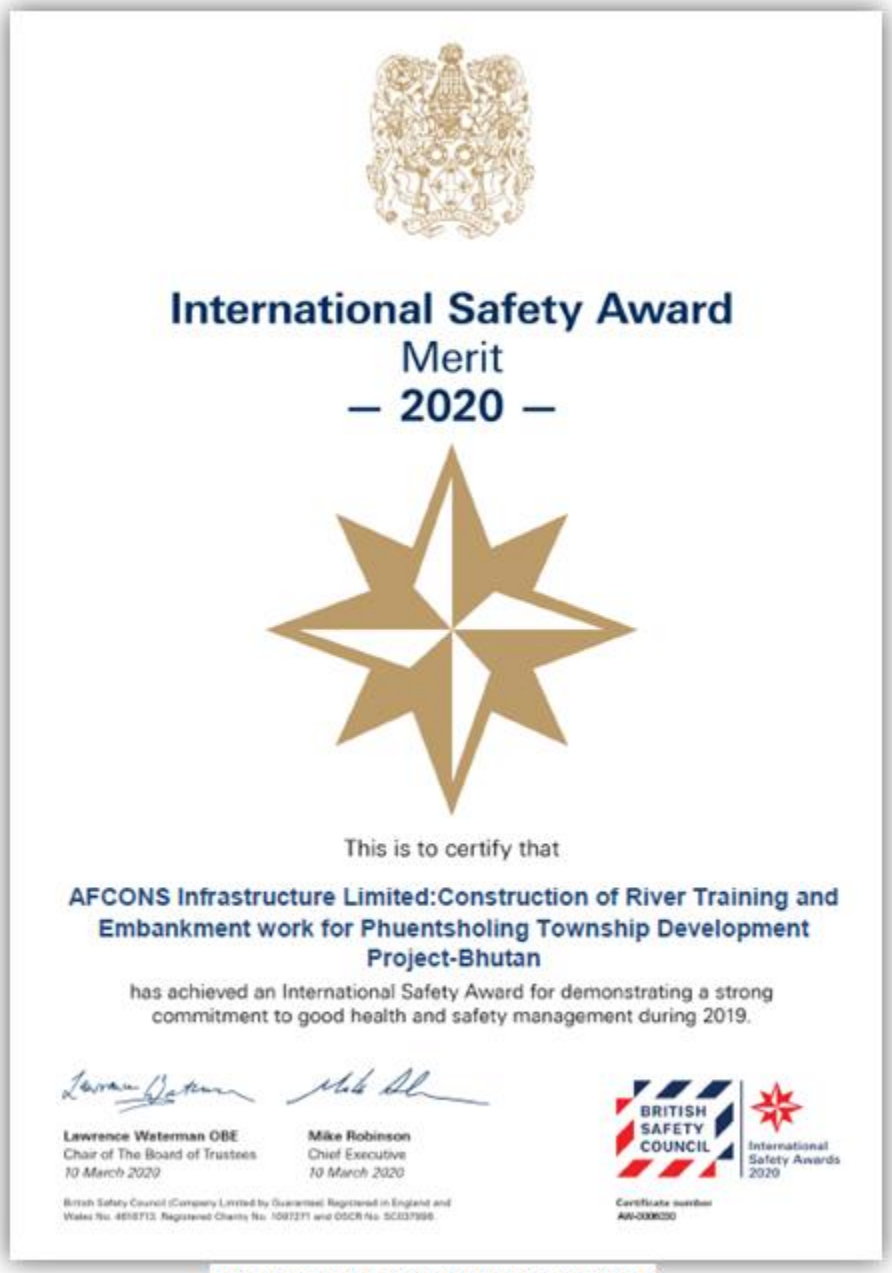
Ankle joint

Phuentsholing General Hospital
Karma Tenzin

Rx

Ag MO for [illegible]

Merit Award



International Safety Award
Merit
— 2020 —

This is to certify that

AFCONS Infrastructure Limited:Construction of River Training and Embankment work for Phuentsholing Township Development Project-Bhutan

has achieved an International Safety Award for demonstrating a strong commitment to good health and safety management during 2019.

Lawrence Waterman OBE
Chair of The Board of Trustees
10 March 2020

Mike Robinson
Chief Executive
10 March 2020

British Safety Council (Company Limited by Guarantee) Registered in England and Wales No. 4616713. Registered Charity No. 1097271 and OSCR No. SC037999.

BRITISH SAFETY COUNCIL
International Safety Awards 2020

Certificate number
AW-0008250

International Safety Award for AFCONS

COVID-19 Workplace Safeguard Protocol

Compliance Report No.1

Phuentsholing Township Development Project
JUNE-2020

Table of Contents

About the Project

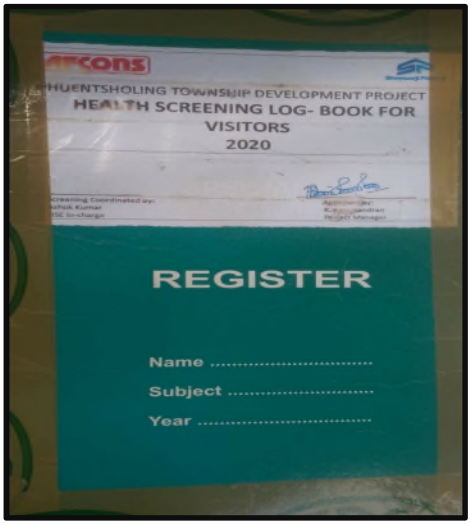
Phuentsholing is located adjacent to the Amochhu River on Bhutan's southwestern border with India (Jaigoan, Alipurduar district, West Bengal). It is the country's economic capital and main trading gateway with India. Phuentsholing Township Development Project (PTDP) is currently developing 464 hectares of riparian land near Phuentsholing City by training the river along both banks of Amochhu. The area reclaimed after river training will be used for the development of township construction. The project aims to protect the existing and new towns from floods and riverbank erosion which currently threatens lives/livelihoods and disrupts connectivity with nearby communities.

With the detection of the first confirmed case of COVID-19 in the country on the 5th of March 2020, the PTDP Health Safety and Environment team had established a Workplace Safeguard Protocol to as a means of mitigating risk and to prevent the spread of the virus in the project area. This report is a compilation of the till date compliance to the PTDP Workplace Safeguard Protocol by the project.

Compliances in the Office Area

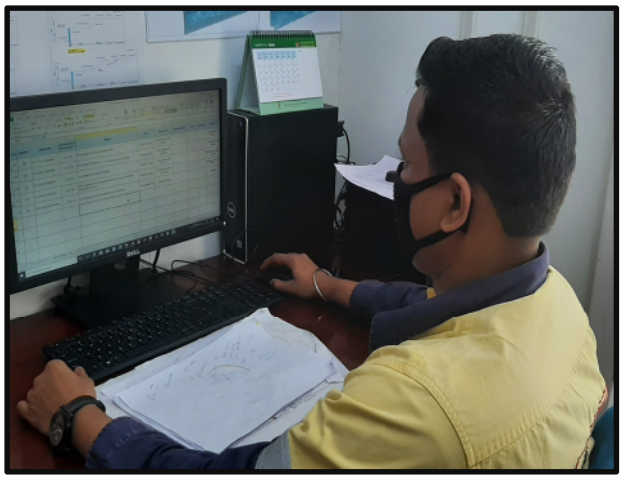
1. Before Entering the Offices (Employee and Visitors inclusive)

All employees are required to download the Druk Trace mobile application and to scan the Quick Response Code whenever they are travelling. Both visitors and employees are required to water their hands (with soap and water), scan the PTDP QR code and get a thermal scan before entering the office area. Additionally, visitors are to register in the visitors log with details of their residence, where they are coming from, their thermal scan reading, their contact number etc. Apart from advocating handing of hands regularly, hand Sanitizer are also made available before enter the offices. Additionally, a daily and weekly report of total thermals scans conducted is also sent to the Drungkhag office, Phuentsholing via the Project Implementing Unit.



2. Inside the Offices

Frequent washing of hands is advised. Physical meetings/ any activity that require gathering of three or more people are avoided; however, in case of necessary meetings social distancing is maintained during any meetings. All employees are required to wear mask at all times in the office.



Thermal scans are also done inside the offices to ensure that all the employees are scanned once a day by the Health Safety & Environment Team personnel of the Project.

Compliances in the Camps Area

1. Camps

Hand washing stations are placed at the entrance point of the camp. Workers and officials entering the camp area are to wash their hands. Anyone entering or exiting the camp (during the morning hours i.e. wok shift change) are scanned for higher than normal temperature HSE personnel and external agency engaged by the office before commencement of work.

A focal person from each camp has been identified that are responsible for the following roles as per the workplace safeguard policy:

- ✓ Ensure that all employee and family members within their respective camps follow a good sanitary habit as advice by the Ministry of Health (MOH, Bhutan) on COVID-19
- ✓ Logs (Name, Travel history, contact details) of any visitors entering the camp is to be noted
- ✓ Logs of workers or officials going out of Phuentsholing are to be maintained
- ✓ Maintain a record of all employees and family members in each camp
- ✓ record movements of people (checking in and out of the camps including family members)

Table 1 is representative of the list of Focal Person from each camp in Phuentsholing Township Development.

Table 1: List of Focal Persons from each Camp

Sl. No	Name	Contact Number	Focal person of
1.	Mr. Ashok Kumar	(+975) 17325971	AFCONS COVID-19 Focal Person
2.	Mr. Kamlesh Mamgain	(+975) 17327152	
3.	Mr. Biswanath Mandal	(+975) 17912769	AFCONS Engineer's Camp
4.	Mr. Ram Bahadur Singh	(+975) 17327398	AFCONS Supervisors and PRW camp
5.	Mr. Pemchung	(+975) 17867955	PIU COVID-19 Focal Person
6.	Ms. Tshering Pelden	(+975) 17824382	
7.	Mr. Namgay Wangchuk	(+975) 1736885	PIU Camp Focal Person
8.	Ms. Kinley Dema	(+975) 17292530	
9.	Mr. Phuentsho Namgay	(+975) 17828484	PIC COVID-19 Focal Person
10.	Ms. Sonam Deki	(+975) 77893929	

2. COVID-19 Duty Vehicles

Two vehicles and their respective drivers have been identified and will be used as "On Covid-19 duty" in case of Covid-19 emergency. The drivers and vehicle will be issued the cards (refer **Figure X ad Figure X)** ONLY during emergency.

Authorization Card to be pasted on the Vehicle

Authorization Card to be issued to the Driver

3. Engineer and Supervisor Dining Halls

Social distancing is maintained in Engineer as well as the Supervisor's dining hall. To ensure that at least a certain distance is maintained, the dinning queue is marked.

Compliances in the Site

1. Active Work Sites

All workers are to be equipped with Personal Protective Equipments and social distancing (as much as possible) is maintained.

To encourage washing of hands regularly, hand washing stations have been installed at each active work site in the project area. Additionally, to advocate the significance of frequent washing of hands during the pandemic, PTDP has installed hand washing stations in the neighboring locations of the project.

2. Material Loading and Uploading

The PTDP Logistics and HSE team ensures that all construction material loading and unloading procedure is as per the rules and regulations of the Royal Government of Bhutan and the Department of Revenue and Customs under the Ministry of Finance. That is, the vehicle will be led by either a security personnel or by the concerned department employee till their destination. After parking the vehicles for unloading of the materials, the vehicle is then barricaded.

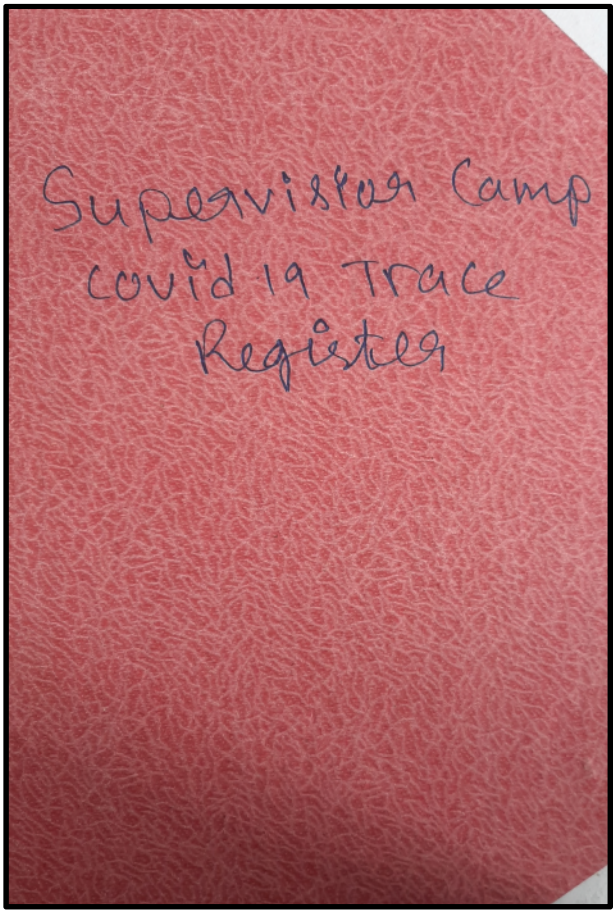
Thermal screening is done for the driver then moved to the sheds specifically meant for the drivers. Designated toilet is allocated for the driver and is then disinfected after use. Additionally, while providing food or tea to drivers, disposable plates and disposable glass are used.

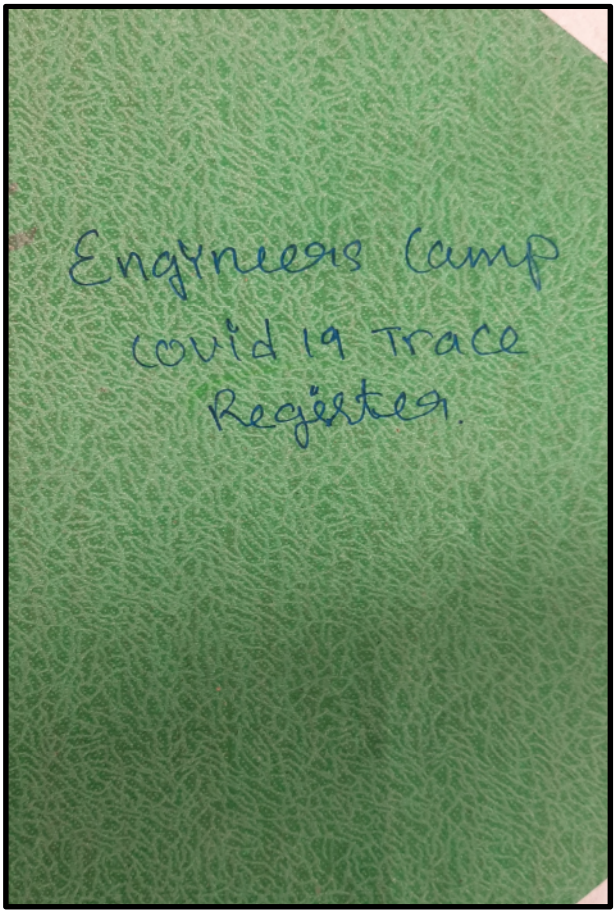
3. Buses

Hand sanitizers are made available inside the bus to encourage regular sanitization of hands. All individuals are instructed on the wear their nose mask and maintain social distancing inside the bus (if possible). To further, minimize the risk of any infection the entry of non-project individuals is prohibited.

Compliances with the Travel Records

The administrative department ensures that the office employees are updated on the latest COVID-19 news in Bhutan and Globally. Accordingly, the department assesses the benefits/risks related to the upcoming travel plans. That is, the office avoids sending employees who may be at higher risk of serious illness (e.g. older employees and those with medical conditions such as diabetes, heart and lung disease) to areas where COVID-19 is spreading. The travel report of all employees is noted by the respective camp supervisors/ covid-19 focal person.





If an individual develops a mild cough or low-grade fever (i.e. a temperature of 37.3 C or more) then he/she is advised to not come for work and inform the Human Resource officer.

Corona Virus Awareness at Site

1. First Covid-19 Awareness

On the 7th of February, 2020 Phuentsholing Township Development Project had two of the doctors from Phuentsholing General Hospital visiting the project site to inform and aware the project personal on the corona virus outbreak. The information session was attained by the Project Manager and the Environmental Manager from PIU, Team Leader &Deputy Team Leader from PIC and the HSE Team of AFCONS.

The session covered general briefings on the virus i.e. how it is/can be transmitted, signs and symptoms and some preventive measures. Accordingly, the doctors also gave a demonstration on how one should wash their hands (so as to minimize infection) and the procedure to proper use and disposal of the mask.

2. Second Covid-19 Awareness Training

On the 27th of June, 2020 Phuentsholing Township Development Project had four of the doctors from Phuentsholing General Hospital visiting the project site to inform and aware the project personal on the corona virus outbreak. The information session was attained by individuals who missed the last COVID-19 session; the session was mainly meant for the workers and supervisors of PTDP.

The session covered general briefings on the virus i.e. how it is/can be transmitted, signs and symptoms and some preventive measures. Accordingly, the doctors also gave a demonstration on how one should wash their hands.

3. Covid-19 Awareness at Site

Health briefing sessions involving Covid-19 as well as Dengue are being conducted at site on a timely basis by the HSE team.