Environmental Impact Assessment (DRAFT)

March 2018

VIE: Northern Mountain Road Connectivity Project

Prepared by the Project Management Unit No. 2 of the Ministry of Transport for the Asian Development Bank.

CURRENCY EQUIVALENTS

(As of March 2018)

Currency Unit	–	dong (VND)
VND1.00	=	$0.000045
$1.00	=	D 22,350

ABBREVIATIONS

AP	-	Affected person
BOD	-	Biochemical oxygen demand
CEMP	-	Construction Environmental management plan
COD	-	Chemical oxygen demand
CR	-	Critically Endangered
CSC	-	Construction supervision consultant
DD	-	Detail Design
DOLISA	-	Provincial Department of Labor, Invalids and Social Assistance
DONRE	-	Provincial Department of Natural Resources and Environment
DPI	-	Provincial department for planning and investment
EIA	-	Environmental impact assessment
EMC	-	External Monitoring Consultant
EMP	-	Environmental management plan
EN	-	Endangered
FS	-	Feasibility study
H&S	-	Health and safety
IFC	-	International Finance Corporation
IOL	-	Inventory of Losses
IRP	-	Income Restoration Program
LARP	-	Land Acquisition and Resettlement Plan
LEP	-	Law on Environmental Protection
LURC	-	Land Use rights certificate
MARD	-	Ministry of Agriculture and Rural Development
MOF	-	Ministry of Finance
MOLISA	-	Ministry of Labor, Invalids and Social Assistance
MONRE	-	Ministry of Natural Resources and Environment
MOST	-	Ministry of Science and Technology
MOT	-	Ministry of Transport
MPI	-	Ministry of Planning and Investment
NGO	-	Non-Government Organization
NO2	-	Nitrogen Dioxide
NTP	-	Notice to Proceed
O&M	-	Operation and Maintenance
OC	-	Oriental Consultants
PAPs	-	Project Affected Peoples
PFS	-	Pre-Feasibility Study
PM10	-	Particulate Matter (less than or equal to 10 micrometer)
PMU2	-	Project Management Unit 2
PPC	-	Provincial People's Committee

PRC	-	People's Republic of China
QCVN	-	Technical Regulation of Viet Nam
REMDP	-	Resettlement and Ethnic Minority Development Plan
ROW	-	Right-of-Way
SAVHs	-	Severely Affected and Vulnerable Households
SO2	-	Sulfur Dioxide
SS	-	Suspended Solids
TA	-	Technical Assistance
TCVN	-	Standard of Viet Nam
TCVN	-	Viet Nam national standards
TOR	-	Term of reference
TSP	-	Total Suspended Particulates
TSS/ SS	-	Total suspended solids
USD	-	United States Dollars
VACNE	-	Viet Nam Association for Conservation and Environment
VAFEIA	-	Viet Nam Association for Environmental Impact Assessment
VND	-	Vietnamese Dong
VOC	-	Volatile Organic Compound
VU	-	Vulnerable
VWU	-	Viet Nam Women's Union
WHO	-	World Health organization

NOTE

In this report, "$" refers to US dollars.

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A. EXECUTIVE SUMMARY

A.1. Project Background

1. The Greater Mekong Subregion (GMS) economic corridor roads have been implemented during previous years in the Socialist Republic of Viet Nam (Viet Nam), partly with support of the Asian Development Bank (ADB). This structuring network is nearing completion and further expansion is planned. In North-western Viet Nam, the Hanoi (Noi Bai) / Lao Cai expressway is part of the GMS Eastern Corridor linking Hai Phong port in Viet Nam to Kunming the capital of the Yunnan Province in the People's Republic of China (PRC).

2. Despite the GMS corridors implementation, due to poor quality of some of the secondary roads, the underdeveloped and remote provinces in parts of Viet Nam do not fully benefit from the corridors economy attractiveness. As a result, the Government of Viet Nam approached ADB to support improvement of these provincial connections.

3. The project aims to address some of the current bottlenecks and enhance the access to the GMS corridors in North-western Regions of Viet Nam. The project will provide access for underdeveloped regions to the GMS Eastern Corridor by improvement works in Lai Chau Province, Lao Cai Province and Yen Bai Province. The project comprises rehabilitation and upgrading National Highways (NH) and a provincial road (PR) to enhance connectivity of provinces in the North-Western Regions. Specifically, the works will improve roads NH279, NH32 and PR175. The project will also support the Department of Roads Viet Nam (DRVN) of Ministry of Transport (MOT) in road asset management. This will result in establishing (i) Lai Chau Province connection to GMS Eastern Corridor; and (ii) Yen Bai Province connection to GMS Eastern Corridor.

4. In principle, road rehabilitation and improvement works will follow existing road alignments. However, some improvement works include realigning of both horizontal or vertical profiles, road widening, re-pavement, raising of embankments and increased drainage facilities and bridge re-construction as part of climate resilience measures.

5. The project will include rehabilitation of 35 bridges, and the construction of 13 new bridges. 187 km of road improvement works (>90%) will be along the existing road alignment, and will involve rehabilitation/upgrade works only. However, the project proposes 3 partial road re-alignments, or by-passes in Duong Quy, Minh Luong and Bang Bo-Dong Pao for a total of 15km. These are necessary to avoid congested village centers and minimize resettlement. The project will also rehabilitate all culverts and drainage ditches.

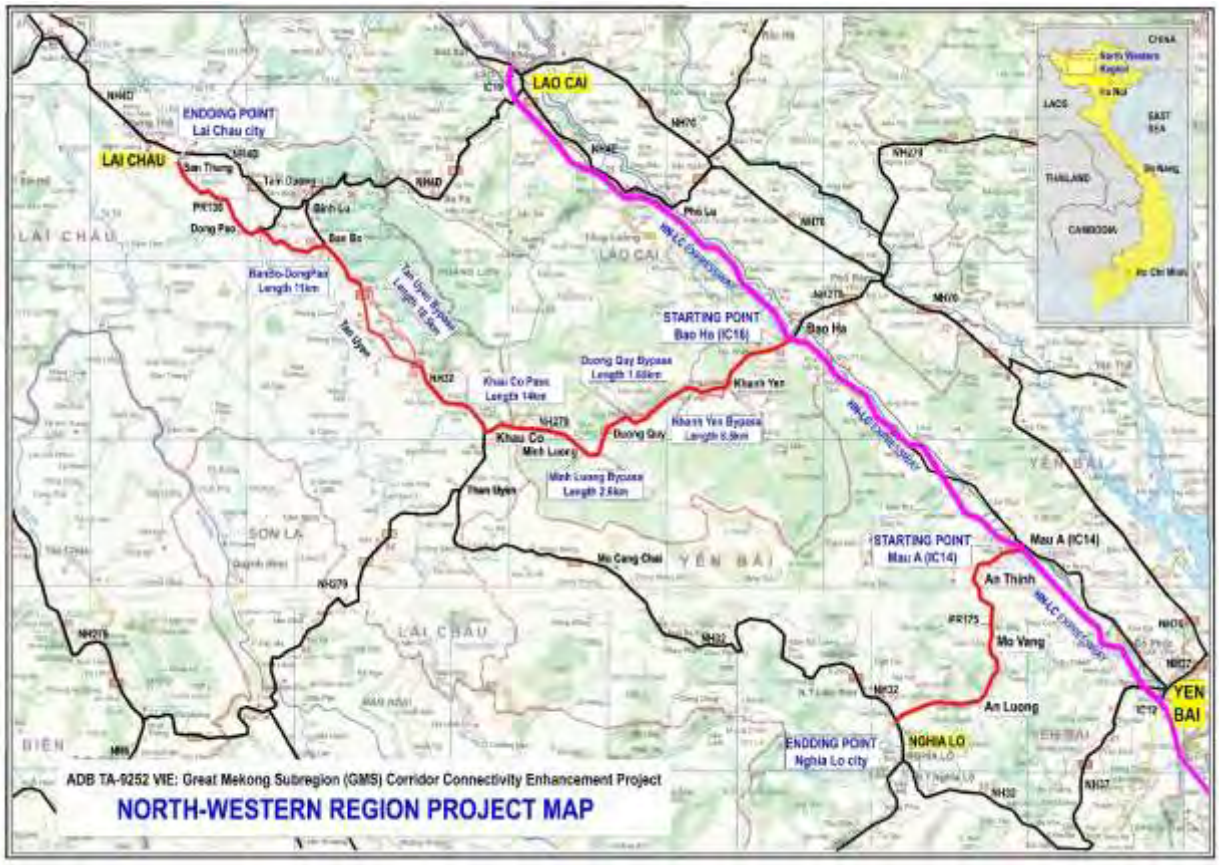


Figure A-1: Alignments of NH279, NH32 and PR175

6. The Ministry of Transport (MOT) will be the Executing Agency. MOT will be responsible for overall project oversight and assist in coordination with other related line ministries, provinces or related government agencies. MOT will delegate project implementation responsibilities to the Project Management Unit No. 2 (PMU2) which is directly under the administration of MOT. PMU2 will be the Implementing Agency in this project and will have overall responsibility for project implementation and formal correspondence with the line ministries, provincial authorities and the ADB. PMU2 will assign Project Implementation Divisions (PID) No.19 and No.25 for day-to-day implementation of the project. PMU2 has sufficient experience in implementing ODA-funded projects and therefore PMU2 is considered capable of implementing this project.

7. Works contractors will have the main responsibility to implement the requirements of the environmental management plan. Environmental monitoring and enforcement will be performed by the construction supervision consultants and external monitoring consultants.

8. Lai Chau Provincial People's Committee, Lao Cai Provincial People's Committee, and Yen Bai Provincial People's Committee will oversee land acquisition and resettlement activities.

9. The project implementation will start with detailed design in Q1 20120, with construction works expected to finish in Q4 2024.

A.2. Safeguard Categorization

10. This project is classified as a Category A project and therefore a full EIA report is needed as per ADB's Safeguard Policy Statement (2009). Additionally, as per the Vietnamese Guideline for EIA, this project belongs to the group of projects needing an EIA report per Law on Environmental Protection (No.55/2014/QH13) dated June 23, 2014 and Decree on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (No. 18/2015/ND-CP) dated February 14, 2015. The Vietnamese EIA is scheduled to be approved by the Ministry of Natural Resource and Environment in May 2018.

11. This EIA report prepared for the Northern Mountain Road Connectivity Project follows Viet Nam legal regulations, ADB's Safeguard Policy Statement (2009) and International Standards such as the IFC's Environment, Health and Safety Guidelines (2007).

12. The Project will be implemented according to the directives set down for use of Official Development Assistance (ODA) by GoV Decree No. 38/2013/ND-CP of April 23rd, 2013 on management and use of Official Development Assistance (ODA) and concessional loans of Donors, and in accordance with the provisions of the Project.

A.3. Description of the Environment (Baseline)

13. The project roads are located within 3 provinces, including Lao Cai, Lai Chau, and Yen Bai, which belong to the North-Western region of Viet Nam. North-western Viet Nam is characterized by rugged terrain with high mountains running from northwest to southeast. Hoang Lien Son Mountain Range, the roof of Viet Nam has a length of 180 km, width of 30 km, with several mounts at the height from 2,800m to 3,000m. The terrain in the project area slopes down from Northwest to Southeast, is mostly mountainous with approximately 70% of the area at an altitude of over 500 meters and about 47% at an altitude of over 1,000m. Soils along the project roads consist primarily of ferralitic soils (ferrosols and lixisols) with small areas of and fluviosols (along the Black River) and alisols (around the Khau Co Pass).

14. Land use in the project area consists primarily of forest (with open and closed canopy), barren/agriculture land, built up areas and shrubland. Land use along the project roads has been established based on remote sensing and site-surveys (covering 200m right and left of the current alignment), and based on maps made available by provincial and district authorities. Land cover directly adjacent to the road consists mainly of agricultural land, shrubland, rivers and residential areas. Since the road follows existing road alignment, vegetation along the road (i.e. within the proposed right-of-way) has been removed and consists primarily of shrubs. Road NH279 runs partly along protection forest and special-use forest (i.e. Van Ban Nature Reserve)[1].

15. Main sub-systems of the Red River system in North-western Viet Nam include the Lo River Basin, the Thao River Basin, the Da River Basin (Black River), the Day River Basin and the Cau River Basin. The project roads are located within the Da River Basin (NH32, part of NH279), and the Thao River Basin (part of NH279, PR175).

16. The project area is located in the main basin of Red River Basin North-western Viet Nam belong to the Northern Indochina Subtropical Forests terrestrial ecoregion, which extends across the northern Myanmar highlands, the southern part of Yunnan, and northern parts of Thailand, the Lao PDR, and Viet Nam.[2] This ecological region is dominated by evergreen and semi-evergreen forests, with sub-types such as lowland evergreen mixed closed and broad leaved humid forests less than 700m; lowland evergreen mixed closed and broad leaved humid forests in the South; low and medium mountainous evergreen mixed closed and broad leaved humid forests 500 – 1,500m. In general, forests in the project region have been strongly impacted by human activities. Primary natural forests do no longer exist, except isolated areas in legally protected areas. There exists only modified secondary natural forest. Forest volume and yield in the region is quite low (on the average: 80- 245m3 /ha). Natural forest is mainly contained within the special use forests delineated by the Vietnamese Government.

17. The existing NH279 runs through the Ecological Restoration Subzone (ERS) of Van Ban Nature Reserve, a provincial nature reserve established in 2007 under Decision No. 399 (2007) of the Lao Cai People's Committee. The reserve is in the Hoang Lien Mountain Range between 210°24' to 210°50' North and 103°57' to 104°00' East. The topography of the nature reserve

[1] Viet Nam classifies forests by use, including: (i) protection forest, i.e. forest used primarily to protect water resources, soil conservation, erosion and desertification reduction, natural disaster mitigation, climate regulation, and environmental protection; (ii) special-use forest, i.e. forest used to preserve natural resources, national important ecosystems, forest genetic resources, contribution to scientific researches, historical protection, and tourism development along with environmental protection; and (iii) production forest, i.e. forest used mainly for the production and trading of woods, non-timber forest products.

[2] BCA, WWF, Stockholm University, 2013. Ecosystems classification mapping in Viet Nam. Ha Noi, Viet Nam

from north to east is characterized by high mountains and hills intermixed with valleys.

18. The protection objectives of the HLVBNR as per the HLVBNR Master Plan 2012 are defined as follows: (i) to protect the valuable and precious gene resources of the wild flora and fauna of Viet Nam including the populations of globally threatened western black crested gibbons *Nomascus concolor*, beautiful nuthatch *Sitta Formosa* and the pine *Taiwania cryptomerioides*; (ii) to protect and maintain the water sources used for local irrigation and agricultural production in the buffer zones and by downstream users; and (iii) to enhance local people's awareness of natural resource and environmental conservation, and enhance local livelihoods of buffer zone residents through implementing programs of forest regeneration, protection and production. The nature reserve is divided in functional subzones, including strictly protected subzones (SPS), ecological reforestation subzones (ERS) and a small service-administration subzone (SAS). The ERS consists mainly of poor secondary natural forest, and young planted forest for ecological restoration. The ERS also includes farmland and paddy fields, residential areas (one village with 14 households), and the NH279 (paved class IV or lower mountainous road).

19. The project owner has coordinated with the Institute of Transport Science and Technology (the domestic EIA institute with a license for monitoring activities) to conduct air quality, noise, vibration, surface water quality, groundwater quality, soil and river sediment quality monitoring in the project's area of influence. The methods of measurement and environmental analysis used are in accordance with MONRE regulations, Vietnamese standards for monitoring methods, analysis of environmental parameters and comparative evaluation.

20. In general, the quality of the micro-climate in the area is typical of tropical monsoon climate. At the time of the survey, temperature varied between 26.0-33.9oC, the moisture from 65.3% -88.3%, the wind speed from 0.2 m/s -6.3 m/s (NE), the atmospheric pressure from 920-1011 mbar. Air quality is generally good in terms of TSP, CO, SO2 and NO2, complying with the national air quality standard QCVN 05: 2013 / BTNMT. Noise levels along the roads are generally compliant with QCVN 26: 2010 / BTNMT and the IFC (2007) standard for commercial areas, but exceeding noise level recommended by IFC (2007) for residential areas during daytime. This is not surprising given the proximity of the residential areas to the roads with partly heavy traffic and frequent use of vehicle horns. Noise levels at night are significantly lower given the almost total absence of traffic on these roads. Surface water quality is rivers and streams that could be affected by project construction is generally good, complying with the national standard QCVN 08-MT: 2015 / BTNMT type B1, with some exceedances observed for TSS. Groundwater quality is generally good, compliance with the national standard comply with QCVN 09-MT: 2015 / BTNMT. Soil quality along project roads complies with QCVN03-MT: 2015 / BTNMT for agricultural land. Soil is not contaminated by heavy metals. The results of sediment samples obtained at the same locations where surface water samples were taken indicate that all parameters are within the limits provided in QCVN 43:2012/BTNMT

A.4. Anticipated Environmental Impacts, Mitigation Measures

21. The EIA identified several potentially significant environmental impacts related to the design, upgrade and operation of the project roads, and proposed mitigation measures. The exact alignment of the project roads will need to be reconfirmed during detailed design. The preliminary design presented in the feasibility study and used as basis for the EIA foresees to use the existing alignment of NH32, NH279 and PR 175 to minimize fragmentation of settlements and minimize impacts on environmentally sensitive areas. 3 bypasses and 2 new alignments are proposed which will remove existing transport bottlenecks, improve traffic safety, minimize resettlement and reduce existing noise and vehicular emission on residential areas. However, because of these bypasses and widening of the existing roads, the project will require the permanent acquisition of 38.2 ha of land, including 32.6 ha of productive land of various types (agricultural, forestry). These impacts are addressed through the provincial land acquisition and resettlement plans (LARP) prepared for the project.

22. The project is also expected to require removal of roadside vegetation to allow the

widening of the project roads. Roadside vegetation is in most areas is of low ecological value as the areas and consists primarily of shrubs, production forest and highly disturbed secondary natural forest. Using a very conservative assessment methodology, the EIA estimates that 23.1 ha of forest could be affected by the project, including 20.2 ha of production forest, 2.0 ha of protection forest, and 1.0 ha of special-use forest. Special-use forest likely to be affected by the project is located exclusively within the boundaries of the Ecological Restoration Subzone (ERS) of the Van Ban Nature Reserve. Protection Forest is located at various sections of NH32, NH279 and PR175, but primarily on the West side of the Khau Co Pass. Forest types affected by the project include secondary natural forest (mainly within Van Ban Nature Reserve) and planted forest. None of the forest areas affected by the project classifies as primary natural forest.

23. The exact impact will be estimated at detailed design stage and will be fully offset through compensation replanting in compliance with Circular 23/2017/TT0-BNNPTNT "Provisions on Replacement Afforestation upon Conversion of Forest Use Purpose to Other Purposes" and the new Forestry Law, to become effective on 1 January 2019. Per the new Forestry Law (Article 21), forest classified as natural forest must be compensated through compensation replanting of an area 3 times the affected area. Compensation replanting will be financed through the project loan, but implemented by provincial forestry authorities. Tree replanting will be conducted exclusively in protection and special-use forest zones, as required per Circular 23/2017/TT0-BNNPTNT.

24. Without mitigation measures, construction impacts have the potential to be significant. The project is expected to generate 6.3 million m^3 of spoil. Suitable spoil disposal sites will be identified by district environmental protection authorities for excavated soil that can't be used for road embankment. These sites will be defined in the bidding documents for works contracts. The project will require the construction of 22 new bridges to cross rivers and streams. Bridge pier construction will avoid the high runoff season to minimize negative impacts on river hydrology, ecology and surface water quality. Other anticipated construction environmental impacts are fugitive dust, noise, disposal of solid waste, temporary traffic disturbance, and occupational and community health and safety at construction sites.

25. NH279 currently passes through the Hoang Lien Van Ban Nature Reserve (HLVBNR). The alignment of NR279 within the VBNR passes between several blocks of forest which are designated Ecological Restoration Subzones (ERS). Several alignments were considered including upgrading the existing road, a tunnel and viaducts. All studied alternatives encroach on the Ecological Restoration Subzone (ERS) of the HLVBNR, and permission was obtained from the HLVBNR Management Authority (through the EIA appraisal process by MONRE). Sustainable development is permitted within the forest blocks. Each block contains several different types of forest and these have been identified. None of these forest types prohibit the rehabilitation of the road, which is defined in the Nature Reserve's master plan.

26. The HLVBNR Management Authority and Lao Cai provincial forest protection department (FPD), the department of natural resources and environment (DONRE) and the department of agriculture and rural development (DARD) have been consulted and support the project. The HLVBNR Management Authority has expressed some concerns over temporary impacts during construction. These concerns are addressed in the EMP. Spoil disposal within the boundary of the reserve will be strictly prohibited. Training will be provided by the CSC, with support of the HLVBNR Management Authority to construction workers, to provide information on the nature reserve's sensitivities, and to instruct them on prohibited activities including collection of non-timber forest products, wildlife poaching and others.

27. The most important species found in the area include the globally threatened western black crested gibbon (*Nomascus concolor)*, the Owston's civet (*Chrotogale owstoni)* and the Vietnamese salamander (*Paramesotriton deloustali).* These and other species classified as critically endangered (CR), endangered (EN) or vulnerable (VU) are mainly threaten from exploitation for traditional medicine, food and for pet trade. Recent research indicate that the black crested gibbon has not been sighted in the ERS of the nature reserve and is reported to occur at elevations of 1,600-2,000 m. This and other primates prefer interior mature and/or heterogeneously structured primary forests. The Owston's civet is hunted for meat and

traditional medicine (including its bones, scent gland, and penis). The Vietnamese salamander is not a migrant, and is collected locally for use in traditional medicines and the domestic pet trade. The globally Vulnerable (VU) beautiful nuthatch (*Sitta Formosa*) occurs primarily in mature broadleaved forests at altitudes from 1,500-2,400 m. Main threats to the species include forest loss, degradation and fragmentation, predominantly because of shifting cultivation. The EIA concludes that the project will not have any significant adverse impact on species classifying as CR and/or VU.

28. The baseline assessment concludes that none of the areas along NH279 located within the ERS of the Van Ban Nature Reserve classifies as critical habitat per ADB's Safeguard Policy Statement (2009). The ERS classifies as modified habitat (i.e. altered natural habitat) formed by the removal of native species during resource harvesting, land use conversion and/or the introduction of alien species of plants and animals. The ERS is not an area with biodiversity that has significant social, cultural or economic importance to local communities, or a habitat required for the survival of critically endangered or endangered species; such areas/habitats are located within the SPS of the reserve. The assessment concludes that (i) the project acts in a manner consistent with the nature reserve master plan (2012); (ii) the project is supported by nature reserve managers, local communities, and provincial authorities (as documented in Section I); and (iii) the proposed upgrade of the NH279 within the ERS is legally permitted.

29. The EIA further concludes that the operation of NH279 is not anticipated to have significant incremental impacts on the nature reserve and its protection objectives. HLVBNR Management Authority confirmed that there are no major wildlife crossings on NH279. Since the project's intervention in the ERS will be limited to minor road rehabilitation works without significant traffic increase, the project is not expected to significantly increase the risk of accidental road kills or reduce wildlife crossing opportunities. HLVBNR Management Authority have checkpoints on NH279 to police illegal activities such as poaching animals and illegal logging. HLVBNR Management Authority committed to install additional guard check posts on the road to discourage and indeed arrest poachers. They have been successful in this in previous years and quoted that several vehicles have been impounded from poachers.

30. NH32 currently passes about 4 km from Hoang Lien National Park. The rehabilitation of the road is not anticipated to have any negative impact on the National Park. This was confirmed by relevant provincial authorities. In fact, the project is anticipated to reduce the current pressure of traffic on the Hoang Lien National Park by diverting some 15% of the existing traffic on NH4D, which partly encroaches on the Hoang Lien National Park. PR175 does not encroach on any protected area.

31. The project will rehabilitate or replace box culverts and pipe culverts to reduce the current risk of waterlogging. A traffic safety appraisal will be conducted in compliance with relevant Vietnamese regulations before the roads are open to traffic. The impact of vehicular emissions on local air quality is not expected to be significant. This will be confirmed through regular air quality monitoring by provincial Departments of Natural Resources and Environment (DONRE) during the operation period of the roads.

32. Noise along project roads is not anticipated to increase significantly (i.e. below 3dB increase) beyond baseline levels as a result of the project. Beyond 10-20m from the centerline, the noise level is not projected to exceed the permissible Viet Nam limit (70dBA) during daytime but will exceed the WHO daytime guideline value for residential areas of 55dB at a distance of 30 m or less from the road centerline. Beyond 20m the noise level is not projected to exceed the permissible Viet Nam limit (70dBA) during daytime so the impact on the communities on both sides of the road will be not be significant. However, the forecast results also show that most households living along the project roads will be affected by noise within 30 meters of the road during the night. The noise level at 100m is projected to be 55dB(A), which meets the Vietnamese night time standard and the IFC daytime standard of 55dB(A) but exceeds the IFC guideline value of 45dB(A) at night.

33. To assess if the second condition of the IFC Guideline is met (i.e. project results in a maximum increase in background levels of 3 dB at the nearest receptor location off-site), noise levels for 2031 and 2041 were projected at the sites where baseline monitoring was conducted.

The assessment concludes that at distances more than 20 metres from the road centerline (or 12.5 metres from the carriageway edge) the ambient will not be increased by more than 3dB. It is however impossible and impractical at this stage of project preparation to identify the exact scope of impact. Therefore, this EIA recommends that a more detailed analysis of the project's impact on noise sensitive receptors be conducted at detail design stage, and that the need for implementation of noise protection measures be included in the BOQ of bidding documents.

34. Absolute CO2eq emissions for the baseline year (2018) were estimated based on actual traffic counts and amount to 41,323 tons per year. These absolute emissions are anticipated to increase to 69,678.5 tons per year (2031) and 104,252.7 tons per year (2041). These figures represent the sum of normal traffic (i.e. traffic that would use the project roads even if no improvements were made); diverted traffic (i.e. traffic that changes from an original route to the project road because of the road improvement); and generated traffic (i.e. traffic that occurs only because of the improvement to the roads, due to the reduction in perceived costs). The sum of diverted plus generated traffic thus represents the relative or net CO2eq emissions, i.e. the net increase in CO2eq emissions generated by the project as compared to "business as usual" or "without project". For the period 2021-2041 (20 years), the cumulative net CO2eq emissions are estimated at -35,400 tons (Table F-22), representing an average annual emission reduction of approximately 2,000 tons as compared with the no-project alternative.

A.5. Climate Risks

35. The project is classified as "High Climate Risk" mainly because of risks associated with flooding, landslide/rockfall, wild fire, temperature increase and precipitation increase. A climate risk and vulnerability assessment (CRVA) was prepared for the project by an independent group of consultants. The full report is available under separate cover on the project website.

36. Under future climate conditions, monthly total and daily maximum rainfall and maximum/minimum daily temperatures are projected to increase across the region by mid-century. The projected increases under RCP8.5 are greater than those under RCP4.5. May/June and Nov/Dec (i.e. pre- and post- the traditional July to October wet season months) are projected to become be wetter. This is true for both RCP4.5 and RCP8.5, with the magnitude of May precipitation increase possibly up to 59-61%, and the magnitude of December precipitation increase possibly up to 173%-208%. Similarly, results show some consensus that January to April will be drier, with projections suggesting monthly precipitation decreases greater than 60% for some months in the January to April period. Results also show consensus for the months just before and just after the traditional wet season (July to October) to experience greater daily precipitation maximums. This is true for both RCP4.5 and RCP8.5, and is especially clear for December where projections consistently suggest daily precipitation maximums greater than 1.5-2 times what is experienced historically.

37. The implications of these projected changes in monthly precipitation totals and daily precipitation maximums for both Nh32/NH279 and PR175 are similar. That is, for the climate-related hazards, there is an increased risk (likelihood and magnitude of impacts) of flooding, landslides and rockfalls in the July to October wet season and an increased risk of wildfire from January to April.

38. The projected increases in temperature are far more certainty than those for rainfall. The CRVA concludes that it is very likely, under both RCP4.5 and RCP8.5, that mean maximum daily temperature will increase across the project area for all months of the year. The range of projected changes in maximum daily temperatures varies from, on average, 0.2-2.7°C for RCP4.5 and 1.1–3.1°C for RCP8.5 ("pessimistic"). The obvious implication of these projected increases in maximum daily temperatures is an increased risk of wildfire in the dry/hot months between December to April.

39. The CRVA team identified a total of 30 "hot spot" sites (see Appendix A for details). Flood and landslides were the most common hazard types. For NH32 and NH279, 11 climate-related vulnerability "hot spots" were identified. Most of this vulnerability is associated with flooding due to the low elevation of the roads and frequent high-water levels experienced in the nearby Nam Chan River. For PR175 there were 19 climate-related vulnerability "hot spots"

identified. The biggest concern is about landslides and floods associated with high water levels in the Ngoi Thia River.

40. Project infrastructure design will need to account for projected increases in precipitation and runoff. Bridge clearances, road drainage and culvert capacity will need to be adjusted to ensure that these are climate-proof. For that purpose, the DD consultant will be required to apply projected climate data (precipitation, peak runoff) rather than historic climate data. Projected climate data (IDF curves) has been generated by the CRVA team and shall be used as basis for the detailed design (Figures D13-D17). The DD consultant shall also review climate-related risks at the hotspots identified by the CRVA team, and consider incorporating adaptation measures for those sites as recommended by the CRVA team (Appendix A). Exact cost estimates of climate-proofing of the project roads is not possible at preliminary design stage, but are estimated to amount to 1% of the total investment costs.

A.6. Information disclosure, consultation and participation

41. Meaningful public consultations were carried out during EIA preparation to inform the project design and environmental assessment process. In total, 1,100 potentially affected people in the project provinces as well as more than 50 representatives from relevant provincial and district authorities (including the People's Committees, the Departments of Agriculture and Rural Development (DARD, the Departments of Natural Resources and Environment (DONRE) and other specialized agencies such as the Van Ban Nature Reserve Management Board) were consulted. The responses are overwhelmingly positive and the project is receiving full support. Issues raised during public consultation relate to land acquisition and resettlement, and fears over poor environment management performance of contractors during construction, which could affect local environment and community health and safety. These concerns have been address through mitigation measures defined in the EMP. Consultation will continue during project implementation in accordance with the consultation plan defined in the EMP.

42. Environmental complaints will be handled through the project safeguards grievance redress mechanism (GRM) described in this EIA, coordinated by PMU2 and the CSC.

A.7. Environmental management plan (EMP)

43. An **environmental management plan** (EMP) has been prepared to address the identified negative impacts. The EMP outlines potential impacts, mitigation and monitoring measures, institutional arrangements, training requirements, and an environment implementation budget that is 1% of the total civil works costs. The works contractors will be required to prepare site-specific construction EMPs (CEMPs) to manage environmental impacts based on the EMP of this EIA.

44. The following **EMP implementation arrangements** will be put in place to implement and supervise the EMP: (i) MOT as the Executing Agency will be responsible for the overall implementation and compliance with loan assurances, this EIA and the EMP; (ii) PMU2 will be responsible, on behalf of MOT, for the day-to-day management of the project. PMU2 will coordinate procurement and consultant recruitment. The PMU2 will have the overall responsibility to supervise the implementation of environment mitigation and monitoring measures, ensure the contractors' compliance with environmental management requirements, and coordinate the Grievance Redress Mechanism (GRM) and report to ADB. The PMU2 will appoint one qualified full-time staff to coordinate and manage EMP implementation; (iii) PMU2 will hire a construction supervision consultant (CSC) to advise and support the PMU2 throughout project implementation, supervise construction works, conduct environmental effect monitoring, provide oversight of contractors' environmental management performance, and provide training on EMP, amongst others. The CSC will include environment specialists, an occupational safety specialist, and a forestry specialist; (iv) each works contractor will develop a site-specific construction EMP (CEMP) and will assign one person responsible for EMP implementation supervision and monitoring, and one qualified person responsible for construction safety. Contractors will conduct noise monitoring at construction site boundaries and nearby sensitive receptors to confirm compliance with relevant Vietnamese ambient quality

standards as well as the IFC (2007) standard for noise.

45. As required by ADB's Safeguard Policy Statement (2009) for category A projects, the implementation of safeguard plans, including the EMP and the LARP, will be verified by an independent **external monitoring consultant** (EMC), to be contracted by the PMU2. All external safeguard monitoring experts, covering environment, resettlement and Indigenous Peoples safeguards, will be recruited under one contract package.

A.8. Conclusion and Recommendations

46. This EIA concludes that the project is feasible from an environmental point of view. Some significant adverse and irreversible impacts are anticipated, justifying the environment Category A classification. Diligent implementation of the EMP by works contractors, to be closely monitored by the CSC and verified by an independent, external environmental monitoring consultant, will mitigate anticipated construction impacts and risks to acceptable levels.

B. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

48. This project is classified as a Category A project and therefore a full EIA report is needed as per ADB's Safeguard Policy Statement (2009). Additionally, as per the Vietnamese Guideline for EIA, this project belongs to the group of projects needing an EIA report per Law on Environmental Protection (No.55/2014/QH13) dated June 23, 2014 and Decree on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (No. 18/2015/ND-CP) dated February 14, 2015. The Vietnamese EIA is scheduled to be approved by the Ministry of Natural Resource and Environment in May 2018.

49. This EIA report prepared for the Northern Mountain Road Connectivity Project follows Viet Nam legal regulations, ADB's Safeguard Policy Statement (2009) and International Standards such as the IFC's Environment, Health and Safety Guidelines (2007).

50. The Project will be implemented according to the directives set down for use of Official Development Assistance (ODA) by GoV Decree No. 38/2013/ND-CP of April 23rd, 2013 on management and use of Official Development Assistance (ODA) and concessional loans of Donors, and in accordance with the provisions of the Project.

51. The following section lists the main laws, regulations and standards that the project adheres to.

B.1. Viet Nam Regulatory Framework for Environmental Assessment

52. Law on Environmental Protection (No.55/2014/QH13) dated June 23, 2014 and Decree on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (No. 18/2015/ND-CP) dated February 14, 2015 are key legal frameworks for environmental management in Viet Nam. The Law on Environmental Protection (LEP) provides statutory provisions on environmental protection activities; measures and resources used for environmental protection; rights, powers, duties and obligations of regulatory bodies, agencies, organizations, households and individuals who are tasked with the environmental protection task. LEP is applicable to regulatory bodies, public agencies, organizations, family households and individuals within the territory of the Socialist Republic of Viet Nam, including mainland, islands, territorial waters and airspace. LEP is on regulating strategic environmental assessment, environmental impact assessment and environmental protection commitment. Furthermore, the law also prescribes consultation on, inspection and approval of the planning for environmental protection (Article 11, chapter II) as well as the list of entities subject to strategic environmental assessment in appendix I and II of the Decree No. 18/2015/ND-CP dated February 14, 2015 of the Government.

53. The Article 13 of the Decree (No. 18/2015/ND-CP) explains the requirement of the pertaining EIA agencies.

a. Clause 1: The project owner or the advisory organization conducting EIA must meet all requirements – (a) there are staff members in charge of EIA meeting requirements prescribed in Clause 2 of this Article; (b) there is specialist staff members related to the project obtaining at least Bachelor‘s degrees; and (c) there are laboratories, inspection and calibration devices eligible for performing measurement, sampling, processing and analysis of environmental samples serving the EIA of the project; if there is not any laboratory with decent equipment for inspection and calibration, it is required to have a contract with a unit capable of carrying out inspection and calibration.

b. Clause 2: The staff members in charge of EIA must obtain at least Bachelor ‘s degrees and Certificate in EIA consultancy.

c. Clause 3: The Ministry of Natural Resources and Environment shall manage the training and issuance of Certificates in consultancy of EIA.

54. Key laws, decrees and circulars of relevance for the environmental impact assessment are listed below.

a. Laws

- Environmental Protection Law No. 55/2014/QH13 ratified by the National Assembly of the Socialist Republic of Viet Nam on June 23, 2014.
- Land Law No. 45/2013/QH13 dated 29 November 2013.
- Investment Law No. 67/2014/QH13 ratified by the National Assembly of the Socialist Republic of Viet Nam on November 26, 2014.
- Construction Law No. 50/2014/ QH13 ratified by the National Assembly of the Socialist Republic of Viet Nam on June 18, 2014.
- Law on Water Resources No. 17/2012/QH13 ratified by the National Assembly of the Socialist Republic of Viet Nam on June 21, 2012.
- Law of Biodiversity No.20/2008/QH12 dated 13th November 2008.
- Law of Cultural Heritage No.28/2001/QH10 dated 29th June 2001.
- Law of Mineral No.46/2005/QH11 dated 14th June 2005.
- Law on Natural Disaster Prevention and Control No. 33/2013/QH13 dated June 19, 2013;
- Law on Occupational Health and Safety No. 84/2015/QH13;
- Law of Forest Protection and Development. No. 29/2004/QH11 dated 3rd December 2004 (to be replaced by the New Forest Protection Law, to become effective 1 January 2019)
- Law of Grievance, Accusation No.58/2005/QH11 dated 29th November 2005.
- Law of Roadway Traffic No.23/2008/QH12 dated 13th November 2008.
- Law on Standards and Technical Regulations No. 68/2006/QH11 ratified by the National Assembly of the Socialist Republic of Viet Nam on June 29, 2006.

b. Decrees and Circulars

- Decree No. 18/2015/ND-CP dated April 1, 2015 of the Government promulgating environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan.
- Decree No. 19/2015/ND-CP dated 14 May 02, 2015 of the Government detailing the implementation of some articles of the Law on Environmental Protection.
- Decree No. 201/2013/ND-CP dated November 27, 2013 of the Government detailing the implementation of some articles of the Law on Water Resources.
- Decree No. 127/2007/ND-CP dated August 1, 2007 of the Government stipulating the implementation of some articles of the Law on Standards and Technical Regulations.
- Decree No. 80/2014/ND-CP dated August 6, 2014 of the Government stipulating drainage and waste water treatment.
- Decree No. 03/2015/ND-CP dated 06 May 2015 of the Government on the environmental damage assessment.
- Decree No. 59/2015/ND-CP dated June 18, 2015 of the Government on construction project management.
- Decree No. 38/2015/ND-CP dated April 24, 2015 of the Government on the management of waste and scrap.
- Decree No. 179/2013/ND-CP dated December 30, 2013 of the Government on sanctioning of administrative violations in the field of environmental protection.
- Decree No. 43/2014/ND-CP dated May 15, 2014 of the Government detailing the implementation of some articles of the Law on Land.
- Decree No. 44/2014/ND-CP dated May 15, 2014 of the Government regulating land prices.
- Decree No. 45/2014/ND-CP dated 05/15/2014 of the Government providing the collection of land use levy.
- Decree No. 46/2014/ND-CP dated 05/15/2014 of the Government providing the collection of land and water surface lease.
- Decree No. 47/2014/ND-CP dated 05/15/2014 of the Government regulating compensation, support and resettlement upon land acquisition by the State.

- Decree No. 84/2013/ND-CP of the Government on management of housing development and resettlement.
- Decree No. 16/2016/ND-CP dated 03/16/2016 of the Government on the management and use of official development assistance (ODA) and preferential loans from donors;
- Circular No. 27/2015/TT-BTNMT dated May 29, 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plan.
- Circular No. 36/2015/TT-BTNMT dated June 30, 2015 of the Ministry of Natural Resources and Environment on hazardous waste management.
- Circular No. 36/2014/TT-BTNMT dated 06/30/2014 of MONRE on land pricing method; compilation of and adjustment to land price lists; determination of specific land prices and consultancy on land pricing.
- Circular No. 37/2014/TT-BTNMT 06/30/2014 MONRE detailing regulations on compensation, support, and resettlement upon land expropriation by the State.

B.1.1.Road Transport Sector Regulatory Framework

55. Table 3-1 summarized key laws and policies governing the road transport sector in Viet Nam that apply to the project. Specific legal directives and required approvals for the Project are summarized in Table 3-2.

Table B-1: Road Transport Legislation and Associated Legal Instruments

Laws and Regulations	Description
A. Laws	
Road Transport Law 23/2008/QH12 dated 13/11/2008.	This Law provides for road traffic rules; road traffic infrastructure; means and participants in road traffic; road transport and state management of road traffic.
B. Decrees	
Decree No. 15/2013 / ND-CP dated 06/02/2013	On quality management of construction works
C. Circulars	
Circular No. 13/2012 / TT-BGTVT amending and supplementing some provisions of Decree No. 09/2010 / TT-BGTVT	Regulation on environmental protection in transport infrastructure development

B.1.2.Land Development and Construction Regulatory Framework

56. Laws and directives for land development and construction that are relevant to the road transport sector are summarized in Table 3-2.

Table B-2: Applicable land development and construction law and policy

Laws	Description
A. Laws	
Land Law No 45/2013/QH13 dated November 29, 2013	This Law prescribes the regime of land ownership, powers and responsibilities of the State in representing the entire-people, owner of land and uniformly managing land, the regime of land management and use, and the rights and obligations of land users.

B. Decrees	
Decree No. 44/2014/ND-CP dated May 15, 2014	This Decree regulates methods for land pricing, adjustment to land price brackets and land price lists, specific land pricing and provision of consultancy on land pricing.
Decree No. 37/2014/ND-CP dated May 15, 2014	The Decree details some articles of the Law on Land concerning compensation, support, and resettlement upon land expropriation by the State.
C. Circulars	
Circular No. 36/2014 / TT-BTNMT dated June 30, 2014	Specifying detailed methods of valuation of land prices, construction, adjustment of land prices; specific land prices valuation and land prices valuation consulting service.
Circular No. 37/2014/TT-BTNMT dated June 30, 2014,	Providing detailed regulation on compensation, assistance, and resettlement when the State acquires land.
Document of Prime Minister No. 1665/TTg-CN, dated October 17, 2006	Regarding management of clearance of site, mine and explosive ordnance for construction

B.1.3.Forestry Resources/Biodiversity Regulatory Framework

57. Laws and decrees related to biodiversity conservation and forest management that are relevant to this project are summarized in **Table B-3**.

Table B-3: Relevant biodiversity and forestry resources laws and decrees

Laws	**Description**
A. Laws	
Biodiversity Law No.20/2008/QH12 dated 13th November 2008	Provides for the biodiversity conservation and sustainable development; rights and obligations of organization, households and individuals in the biodiversity conservation and sustainable development.
Law of Forest Protection and Development. No. 29/2004/QH11 dated 3rd December 2004.	Prescribes the management, protection, development and use of forests; rights and obligations of forest owners. To be replaced by new Forestry Law (2018), to become effective 1 January 2019.
B. Decrees	
Decree No. 32/2006/ND-CP	Regulating management of endangered, precious and rare forest plants and animals.
Decree No. 23/2006/ND-CP dated March 03, 2006	Providing detailed regulations on the implementation of the law on forest protection and development.
Decree No. 99/2010/ND-CP dated September 24, 2010	Defines policy on payment for forest environment services.
Decree No. 117/2010/ND-CP dated December 24, 2010	Regulates management responsibilities and requirements of the Government for special use forest system
C. Circulars	
Circular 23/2017/TT0-BNNPTNT “Provisions on	Regulates replacement afforestation upon conversion of forest use purpose to other purposes.

Replacement Afforestation upon Conversion of Forest Use Purpose to Other Purposes"	
Circular No. 78/2011/TT-BNNPTNT dated November 11, 2011	Provides detailed guidance on the implementation of Decree No. 117/2010/ND-CP on the Government organization and management of special use forest system
Directive 13-CT/TW dated 12 January 2017 (by Central Committee)	The Directive aims to increase the Party's leadership in forest management, protection and development, while mobilizing government agencies, businesses and civil society at all levels to improve the effectiveness and efficiency of forest protection and development in Viet Nam.
Decision No: 419/QD -TTg dated 5 April 2017	Decision of the National Action Programme on reduction of greenhouse gas emissions through efforts to reduce deforestation and forest degradation, sustainable management of forest resources, conservation and enhancement of forest carbon stocks (REDD+ Programme) for the period up to 2030.

B.1.4. Applicable National Environmental Standards

58. Applicable national standards and regulations are presented below:

- QCVN 03:2008/BTNMT - National technical regulations on permissible limits of heavy metals in the soil.
- QCVN 05:2013/BTNMT: National Technical Regulation on Ambient Air Quality.
- QCVN 06:2009/BTNMT: National technical regulation on hazardous substances in ambient air;
- QCVN 08-MT:2015/BTNMT - National technical regulation on surface water quality.
- QCVN 09-MT:2015/BTNMT - National technical regulation on ground water quality.
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater.
- QCVN 26:2010/BTNMT: National technical regulation on noise.
- QCVN 27:2010/BTNMT: National technical regulation on vibration.
- QCVN 50:2013/BTNMT: National Technical Regulation on Hazardous Thresholds for Sludge from Water Treatment Process.
- QCVN 21: 2016/BYT - National Technical Regulation on high frequency electromagnetic fields in working places.
- Viet Nam Building Code QCXDVN 01:2008/BXD compiled by Viet Nam Institute for Urban and Rural Planning, approved by Science and Technology Department, issued under Decision No. 04/2008/QD-BXD dated 3 April 2008 by the Ministry of Construction.

B.2. ADB Safeguard Policy

59. All ADB financed projects are required to undergo environmental assessment to ensure the environmental soundness and sustainability of the projects. It also aims to support the integration of the environmental considerations in the decision-making process.

60. The ADB's Safeguard Policy Statement, June 2009 (SPS) clarifies the rationale, scope and content an environmental assessment. The initial screening of the project to determine its environmental category was carried out using the Rapid Environmental Assessment (REA) Checklist as attached to the SPS. Accordingly, the proposed project was categorised as a Category "A" project which requires an EIA.

61. The SPS emphasizes the need for effective implementation of the environmental safeguards which are to:

- Avoid possible impacts of projects on the environment and affected people, where possible
- minimize, mitigate and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

62. The SPS contains several operational principles that includes the requirement to ensure that the measures identified during the impact assessment are included in the EMP and are implemented in agreement with the borrower. The borrower/client is required to monitor the progress of implementation of the EMP, document the monitoring results, identify necessary corrective actions and reflect them in a corrective action plan. Periodic monitoring reports on implementation of the EMP are submitted to the ADB on a semi-annual basis during construction of projects with significant adverse environmental impacts and quarterly for highly complex and sensitive projects. During operation, reporting to the ADB for projects with significant adverse impacts is required on an annual basis.

B.3. International Environmental Management Conventions

63. Viet Nam is signatory to the following relevant **international conventions**:

- Stockholm Convention on Persistent Organic Pollutants (2002)
- Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, Copenhagen (1992)
- United Nations Framework Convention on Climate Change (1992)
- Convention on Biological Diversity (1992)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973

64. The project does not involve wetlands, neither does it relate to emission of persistent organic pollutants. Therefore, relevant international environmental agreements to which Viet Nam is a party do not apply.

65. **International Guidelines.** Per ADB's Safeguard Policy Statement (2009), the project is required to adhere to international pollution prevention and abatement standards whenever these are more stringent than national standards or where national standards are missing. The following standards are considered in this EIA:

- IFC/World Bank Group, 2007. Environmental Health and Safety Guidelines. General Guidelines. Wash. DC.
- IFC/World Bank Group, 2007. Environmental Health and Safety Guidelines. Industry Sector Guidelines, Infrastructure (Water and Sanitation), Wash. DC.

C. PROJECT DESCRIPTION

C.1. Project Rationale

66. The Government of the Socialist Republic of Viet Nam has approached the Asian Development Bank (ADB) for support to international and national transport connectivity of underdeveloped provinces of Viet Nam by improving their accessibility to GMS corridors.

67. In the recent past, ADB interventions in the Transport sector in Viet Nam mainly focused on supporting the government to build the key GMS expressway infrastructure. This network expansion is either nearing completion or under way and further expressway expansion is increasingly being considered under public–private partnership/build-operate-transfer (PPP/BOT) modality.

Figure C-1: GMS corridors (source ADB)

68. In North-western Viet Nam, the GMS Eastern Corridor links Hai Phong port in Viet Nam to Kunming the capital of the Yunnan Province in the People's Republic of China (PRC). This network includes the Noi Bai to Lao Cai expressway of which further expansion is planned. The next-tier road network connecting to these GMS corridors is still underdeveloped. Provinces in the corridors' proximity have not fully benefitted from the improved GMS corridors and have generally developed at a slower pace than the rest of the country. The current transport network status in the project area is presented in **Table C-1**.

Table C-1: Current Transport Network Status

No.	Province	Current transport Network status				Provincial Natural Area (Km^2)	Traffic Density ($Km/100Km^2$)
		NH (Km)	PR (Km)	Other Road (Km)	Total (Km)		
1	Lai Chau	318.57	438.00	1861.10	2617.67	9059.00	28.90
2	Lao Cai	540.75	600.70	1000.00	2141.45	6384.00	33.54
3	Ha Giang	471.00	363.00	1881.00	2715.00	7946.00	34.17
4	Yen Bai	454.50	440.00	1541.81	2436.31	6900.00	35.31
5	Tuyen Quang	450.12	372.20	1193.97	2016.29	5867.00	34.37
6	Phu Tho	262.00	723.00	998.00	1983.00	3528.00	56.21
Total		2,496.94	2,936.90	8,475.88	13,909.72	39,684.00	35.05

69. Based on the assessment of the status of roads in the northern mountainous areas, only Hanoi - Lao Cai expressway has the scale and specifications of a high standard road, all other roads are at low standard including national highways. Road sections are usually of class V-IV mountainous road standards, and in difficult topography positions, class VI mountainous road standards. Therefore, traffic circulation between northern mountainous provinces with plain areas and vice versa is difficult which reduces possibility of socio-economic and tourism development of the northern mountainous provinces.

70. The project aims to address some of the current bottlenecks and enhance the access to the GMS corridors in North-western Regions of Viet Nam. The project will provide access for underdeveloped regions to the GMS Eastern Corridor by improvement works in Lai Chau Province, Lao Cai Province and Yen Bai Province. The project comprises rehabilitation and upgrading National Highways (NH) to enhance connectivity of provinces in the North-Western Regions. Specifically, the works will improve roads NR279, NR32 and PR175. The project will also support the Department of Roads Viet Nam (DRVN) of Ministry of Transport (MOT) in road asset management.

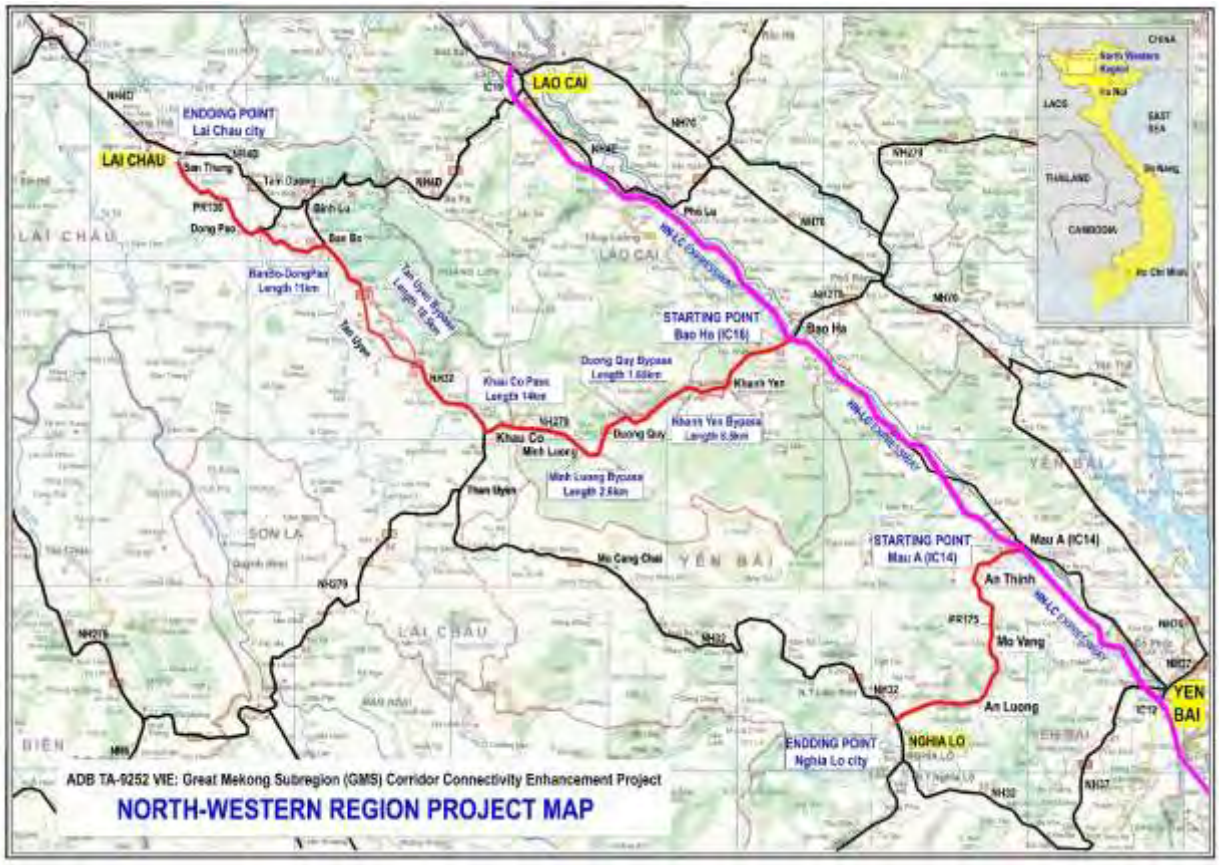


Figure C-2: Project Roads NH32, NH279 and PR175

71. **Link to development master plans.** The project is consistent with related master plans, including:

- Adjustment on Master Plan for road transport development of Viet Nam until 2020 and orientations toward 2030 approved by the Prime Minister in Decision No. 356/QD-TTg dated 25/02/2013
- The overall planning of socio-economic development for midlands and northern mountains until 2020 approved by the Prime Minister in Decision No.1064/ QD-TTg dated 08/7/2013
- Planning of industrial, economic zones, related projects within project area in provinces of Lai Chau, Lao Cai, Ha Giang, and Yen Bai

C.2. Project outcome, outputs

72. The Project **Outcome** is to expand the benefits of Greater Mekong Subregion (GMS) corridors to adjacent provinces with high poverty incidence. The project comprises upgrading National Highways (NH) to enhance connectivity of provinces in the North-western Region and supporting Department of Roads Viet Nam (DRVN) of Ministry of Transport (MOT) in road asset management.

73. The project will have four outputs, as described below:

a. **Output 1: Improvement of Safety and Climate Resilience for the Project Roads.** This output will upgrade the design class, ensure standard is consistent over the entire length by improving the geometry of the project roads to Class III-IV Mountainous roads, integrating climate resiliency features such as sound slope protection measures in areas of land and rock slides, raising/reconstructing of highway embankments and bridges along road sections prone to dangerous flooding, increasing cross drainage capacity, and installing cost-effective road safety devices and pavement markings. Specifically, works under this output will improve roads NR279, NR32 and PR175.

b. **Output 2: Road fund revenue collection process optimized for the Project.**

This component will focus on reviewing the current vehicle registration tax collection process and improving the operational process to increase road fund revenue.

c. **Output 3: Protection of the Project Roads against Overloaded Vehicles.** This component will consist in reviewing the program for controlling vehicle overloading, and piloting new approaches in Departments of Transport (DOTs) of the project provinces in controlling axle load.

d. **Output 4:** Improvement of Road Safety for Local Communities along the Project Roads. This component will support road safety awareness programs in project communes to explain the traffic regulations and rules, the use of traffic safety devices installed on the project roads, and the dangers of reckless driving.

74. Under Output 1, the project will rehabilitate and upgrade NH32 (including some sections of PR136 and NH4D), NH279 and PR175. A description of these roads is provided below, and presented in **Figure C-4**. Most road sections are in difficult terrain, crossing high mountains or rivers with lower class technical standards that do not meet the increasing transport demands. Also, some sections do not provide all-year accessibility.

75. The **NH 32** is 415km long, starting from Ha Noi, Son Tay, Phu Tho, running through the districts of Van Chan, Nghia Lo, Mu Cang Chai (Yen Bai Province) and Than Uyen, Tan Uyen, Tam Tuong (Lai Chau Province). The role of this route is to meet demand for transportation and trading activities of neighboring provinces and the North-Western Region as well as the whole country. Currently, heavy trucks, container trucks and buses with passengers cannot operate on the section in Yen Bai province. The road is steep and winding and of Class IV mountainous standard in the project area.

76. The **NH 279** is 760km long, and is Class V and VI mountainous standard in the project area. The road starts from the intersection with NH 18 in Ha Long City (Quang Ninh Province) and runs through 10 Northern mountainous provinces including, Quang Ninh, Bac Giang, Lang Son, Bac Kan, Tuyen Quang, Ha Giang, Lao Cai, Lai Chau, Son La and Dien Bien. This is a vital route, being Ring Road 2 in the Northern Midland and Mountainous Region, connecting 10 mountainous provinces in the Northern Region. It plays an important role in ensuring trade and economic development activities in the North-Western Region, such as Son La, Dien Bien provinces, particularly in the rainy season, when other NHs are affected by landslides, blocked with traffic jams, interruptions etc. In flood season, landslides frequently occur on road sections in the project area.

77. The section from Lao Cai to Dien Bien is seriously degraded. The section starts from Hanoi-Lao Cai Expressway at IC-16 to the point connecting with NH 279 with a length of about 4km. Its pavement is exposed with many potholes and big holes. Roads and culverts are damaged by postponed repairs and upgrading works, storms and large traffic volume of heavy trucks. The road condition has not been improved due to lack of funds. The remaining road length is in fair condition, narrow, with some steep and winding sections. The road connects Van Ban mountainous district (Lao Cai) with Ha Noi - Lao Cai Expressway. However, due to very poor condition of the road, local people in Van Ban still have difficulty in accessing the expressway. The section from Km 108 + 700 to Km 110 + 400 is within the Khanh Yen Town Planning area (Lao Cai).

78. The **PR 175** is 61km long. The existing PR175 road is earth of low road standard. From the starting point it cuts NH32 at Km209+500, then runs along the road coinciding with the Van Chan hydropower plant, passing along the right side of Ngoi Thia to Khe Cam commune. At An Luong it passes Ngoi Thia then runs parallel with the left side of Ngoi Thia to IC.14 of Ha Noi-Lao Cai expressway at Mau A. The road is not passable in all 4 seasons and is blocked in the rainy season. On this road, there is an underwater crossing (submerged ford). It is usually inundated during flood causing traffic jams. The road connects two vital National Highways in the Region, i.e.: NH 32 and NH 70. The road meets the criteria for becoming a National Highway. Therefore, Yen Bai PPC proposed to MOT for upgrading PR 175 to become a national highway. The PR 175, after upgrading, will strengthen the connectivity with the Ha Noi – Lao Cai expressway and help in flexible traffic management in the Region and promote the

development of industry, tourism and services of Mu Cang Chai district (Yen Bai province). There are intersections where it intersects with NH32 (Km209+500-NH32) at the starting point, and with the Ha Noi- Lao Cai expressway at IC14. Currently, the section from Nghia Lo to Mau A is subject to flooding and encounters severe water crossings. It is basically an aggregate soil road, of width about 3-4m, in difficult terrain.

Figure C-3: Existing conditions of PR175 sections

79. A more detailed description of the project roads (NH32, NH279 and PR175) is presented in **Appendix A**.

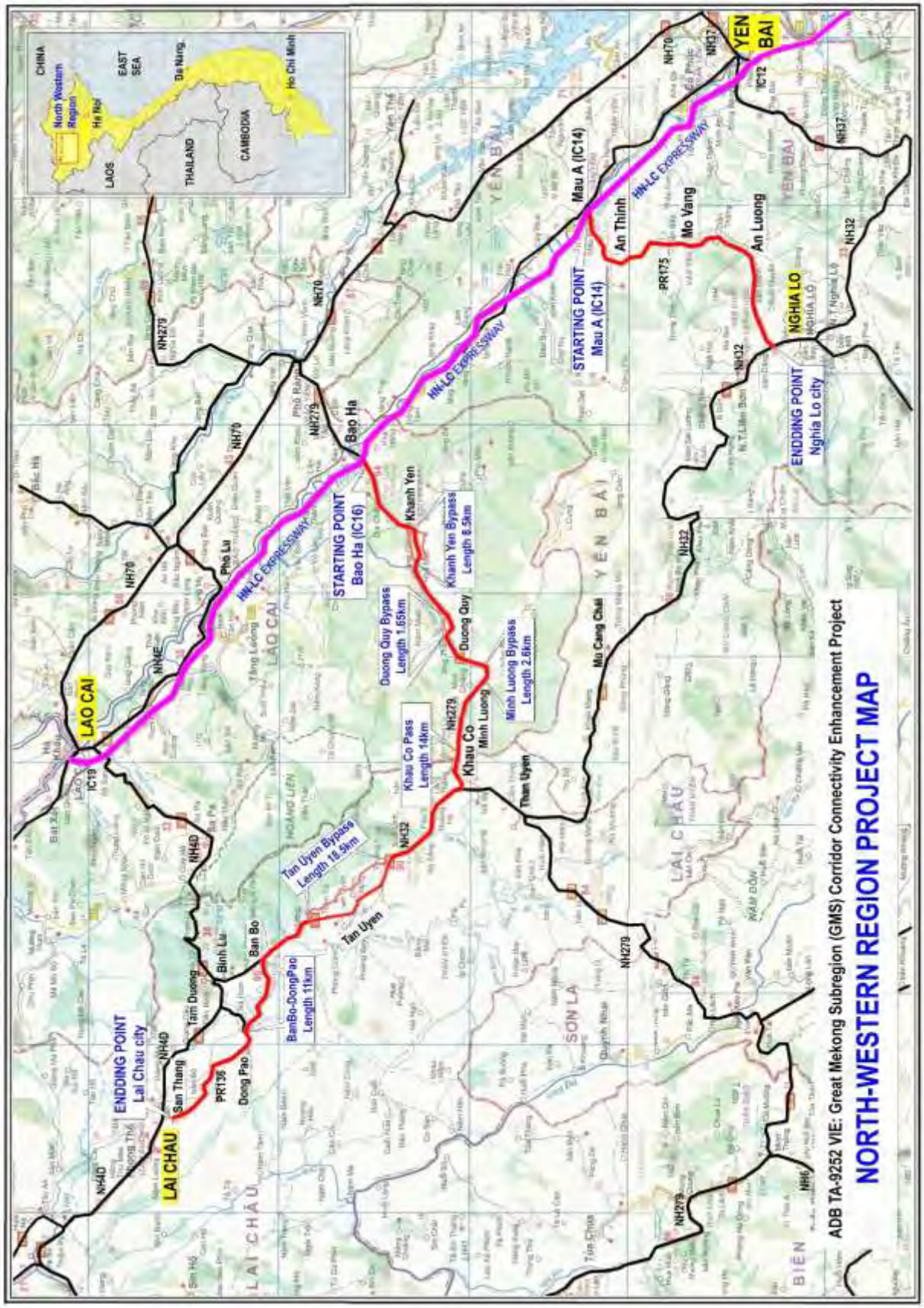


Figure C-4: Project Roads NH279, NH32 and PR175

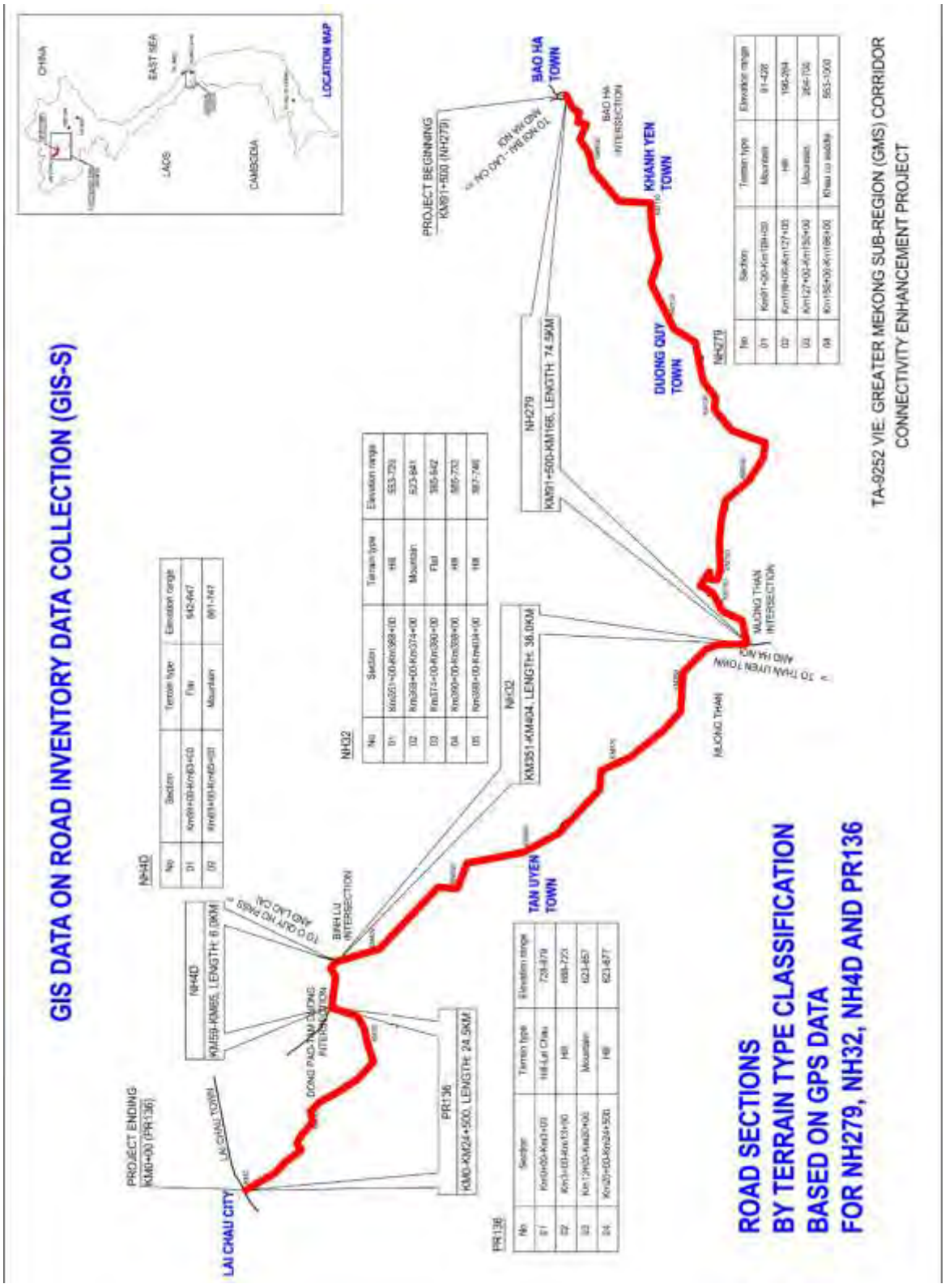


Figure C-5: Alignment NH279 and NH32 (including PR136 and NH4D)

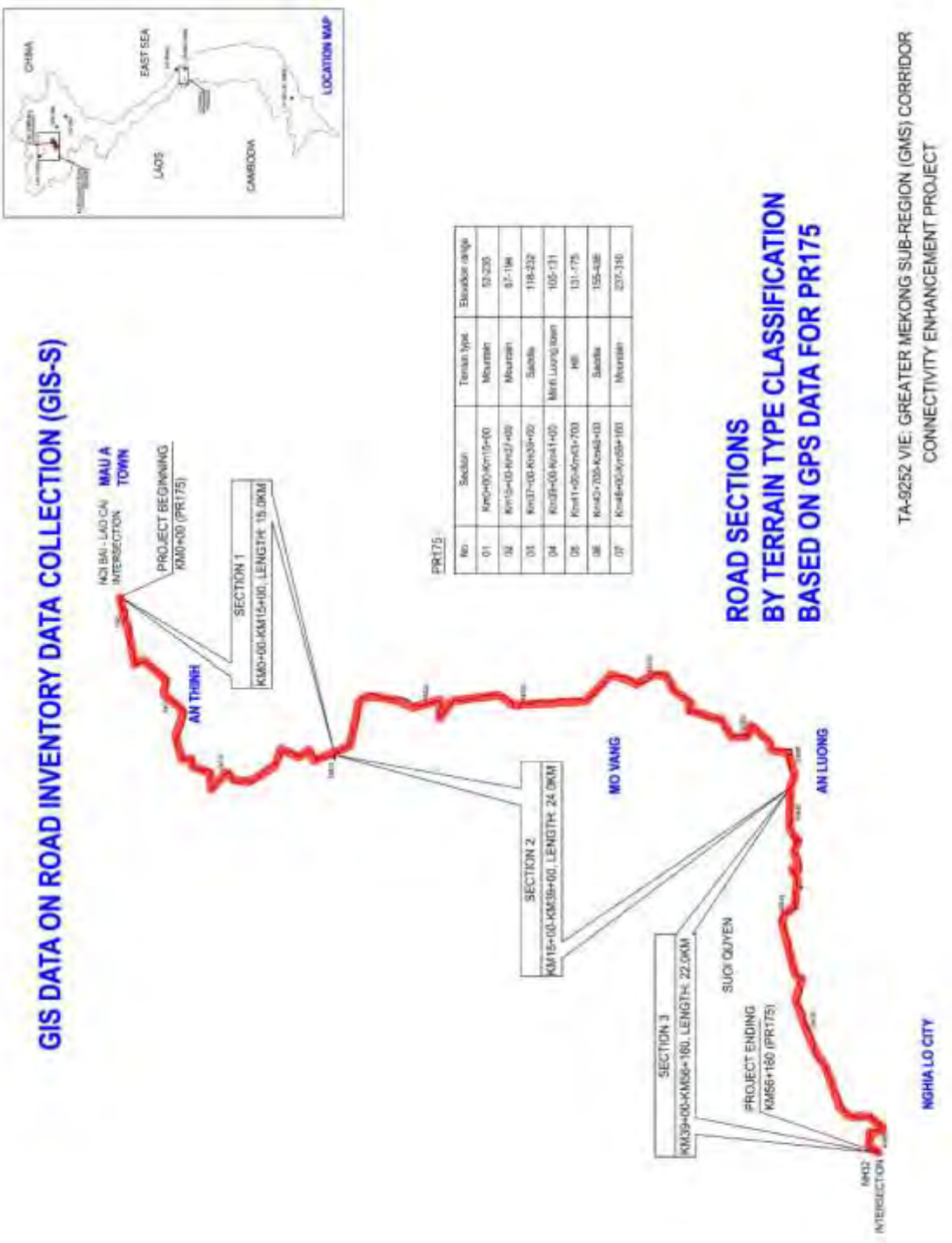


Figure C-6: Alignment connecting Ha Noi - Lao Cai with Nghia Lo - Yen Bai (PR175)

C.3. Geometric Design

80. The horizontal and vertical alignments of the roads was defined to ensure compatibility with the existing situation in terms of existing alignment, topography, geotechnical, social, environmental, safety, hydraulic and drainage patterns. The design of major structures such major bridges act as key points in the road design.

81. In principle, road rehabilitation and improvement works will follow existing road alignments. However, some improvement works include realigning of both horizontal or vertical profiles, road widening, re-pavement, raising of embankments and increased drainage facilities and bridge re-construction as part of climate resilience measures. Road alignments have been proposed by local consultants in the pre-FS stage. All alignment alternatives have been presented, discussed and approved by local authorities (see Alternative Analysis, Chapter E).

82. The roads will be improved to highway class III and IV per TCVN 4054:2005. The table below presents major technical elements for the geometric design.

Table C-2: Main criteria for Highway Class III and IV (Mountainous)

Elements	Highway Class	
	III	IV
Design Speed (Km/h)	60	40
Cross section width (m)	9.0	7.5
Design lane width (m)	3.0	2.75
Number of lanes	2	2
Maximum super elevation, %	7	8
Minimum curve radius (corresponding to the super elevation of 6%), m	125	60
Normal minimum curve radius (corresponding to the super elevation of 4%), m	250	125
Curve radius without super elevation, m	1500	600
Maximum longitudinal grades, %	7	8
Minimum radius of crest vertical curve, m	2500	700
Minimum radius of sag vertical curve, m	1000	450

Source: Standard TCVN 4054-2005)

83. The project roads have been divided in homogenous sections. Within these sections, road treatment was identified in terms of levels of improvement (road alignment, width extension, raising of the embankment, increased drainage facilities, pavement rehabilitation, etc). The different sections of the road improvement works are presented in **Table C-3**.

Table C-3: Homogeneous Sections, NH279, NH32

No	Project Chainage			Homo-genous Segs.	Design Class	Segments		Road
	From	To	Length (Km)			From	To	
1	Km0+000	Km16+700	16.70	#1; M; R	III (M)	Km91+500	Km109+00	NH279
2	Km16+700	Km18+700	2.00	#1; H; U	III (M)	Km109+000	Km111+00	
3	Km18+700	Km31+000	12.30	#2; H; R	III (M)	Km111+00	Km124+00	
4	Km31+000	Km32+000	1.00	#2; H; U	III (M)	Km124+00	Km125+00	
5	Km32+000	Km45+100	13.10	#2; M; R	III (M)	Km125+00	Km138+00	
6	Km45+100	Km47+100	2.00	#2; M; U	III (M)	Km138+00	Km140+00	
7	Km47+100	Km65+070	17.97	#2; M; R	III (M)	Km140+00	Km356+00	NH32
8	Km65+070	Km77+200	12.13	#3; H; R	III (M)	Km356+00	Km368+00	
9	Km77+200	Km82+300	5.10	#3; M; R	III (M)	Km368+00	Km374+00	
10	Km82+300	Km88+200	5.90	#3; F; R	III (F)	Km374+00	Km380+00	
11	Km88+200	Km93+200	5.00	#3; F; U	III (F)	Km380+00	Km385+00	
12	Km93+200	Km98+000	4.80	#3; F; R	III (F)	Km385+00	Km390+00	
13	Km98+000	Km105+649	7.65	#3; H; R	III (M)	Km390+00	Km398+00	
14	Km105+649	Km116+400	10.75		III (M)	Km398+00	Km20+00	
15	Km116+400	Km122+700	6.30	#3; M; R	III (M)	Km20+00	Km13+00	LAI CHAU – DONG PAO ROAD
16	Km122+700	Km132+550	9.85	#3; H; R	III (M)	Km13+00	Km3+00	
17	Km132+550	Km135+550	3.00	#3; H; U	III (M)	Km3+00	Km0+00	

Notes:

- Terrain Classification: F as Flat Terrain, M as Mountainous Terrain, H: Hill Terrain;
- #1/#2/#3: Traffic Volume Categories, #1: 5,517 vehicles per day, #2: 5,999 vehicles per day, #3: 12,836 vehicles per day;
- R/ U as Rural/Urban Sections.

Table C-4: Homogeneous Sections, PR175

No	Project Chainage			Homo-genous Segs.	Design Class	Segments		Road
	From	To	Length (Km)			From	To	
1	Km0+00	Km7+300	7	#1; M; U	IV (M)	Km0-300	Km7+00	PR175
2	Km7+300	Km34+550	27.55	#1; M; R	IV (M)	Km7+00	Km39+00	PR175
3	Km34+550	Km36+700	2.15	#1; H; U	IV (M)	Km39+00	Km41+00	PR175
4	Km36+700	Km38+700	2	#1; H; R	IV (M)	Km41+00	Km43+700	PR175
5	Km38+700	Km50+130	11.43	#1; M; R	IV (M)	Km43+700	Km56+160	PR175

Notes:

- Terrain Classification: F as Flat Terrain, M as Mountainous Terrain, H: Hill Terrain;
- #1: 3,757 vehicles per day;
- R/U as Rural/Town areas.

84. **Typical cross-sections** have been selected as per TCVB 4054-2005 and TCXDVN 104-2007. Typical cross-sections of the project roads are presented in **Figure C-7** and **Figure C-8**.

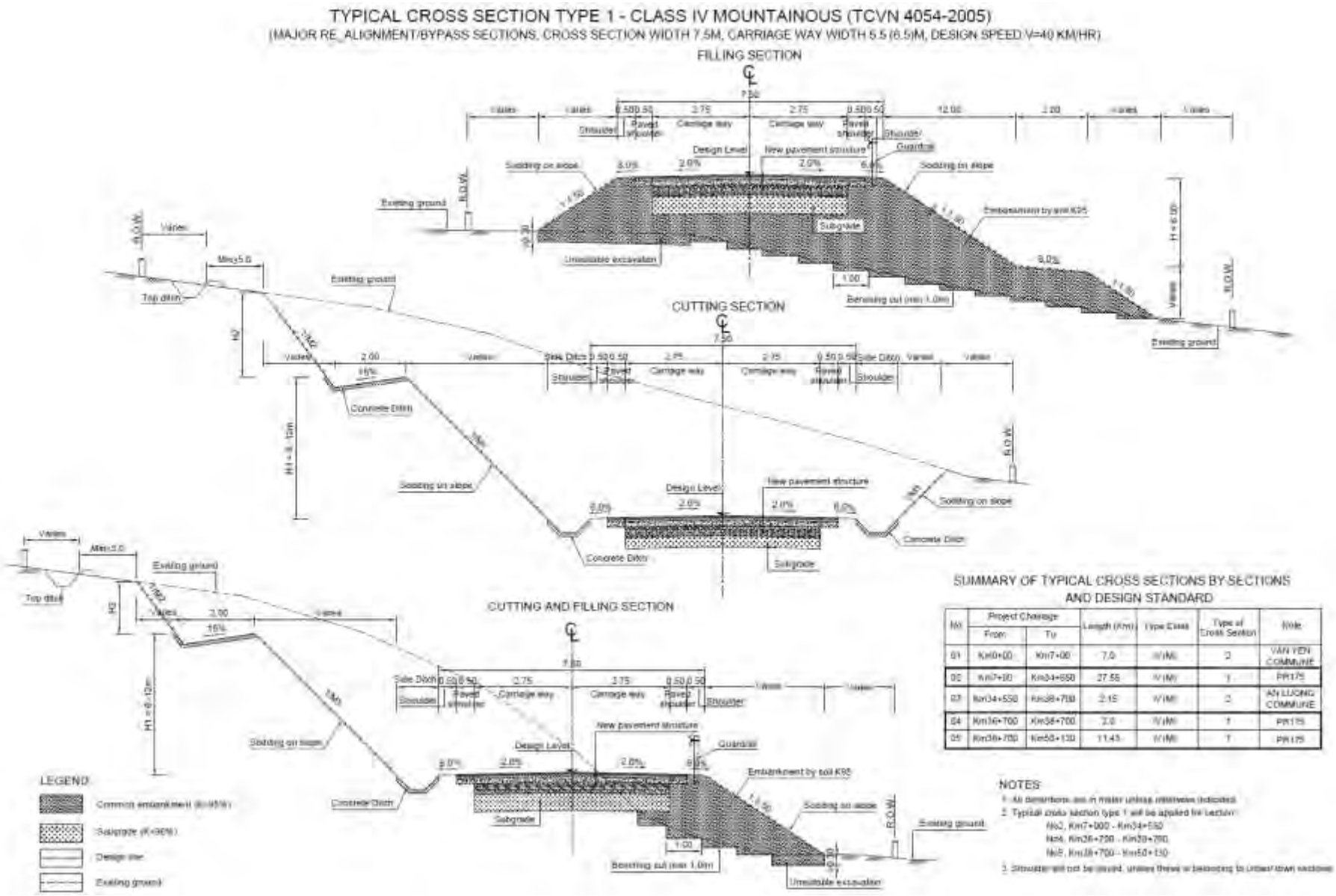


Figure C-7: Typical cross-sections Type 1

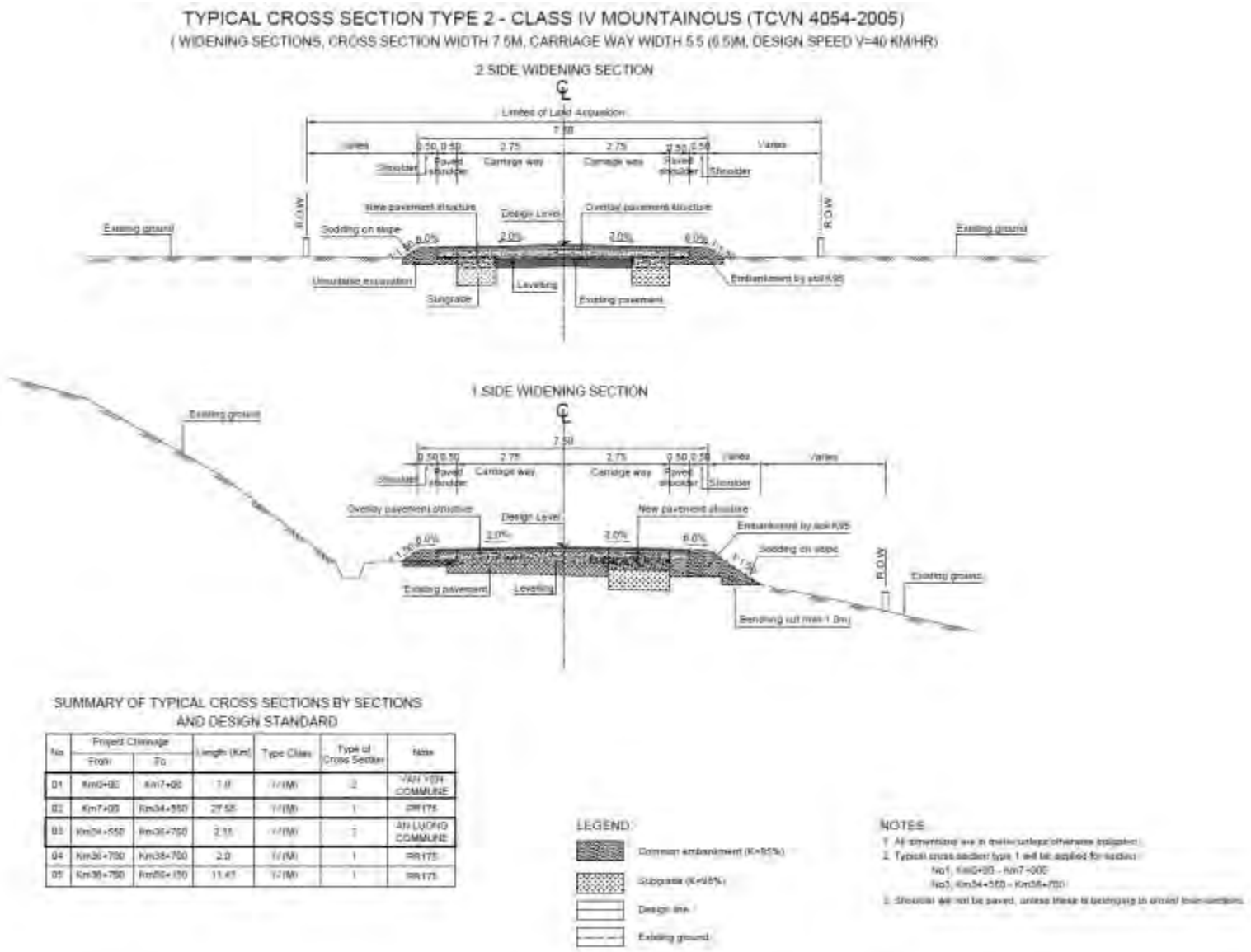


Figure C-8: Typical cross-sections Type 2

85. **Bypasses.** 137 km of road improvement works (90%) along NH32 and NH279 and 50 km along PR175 (100%) will be along the existing road alignment, and will involve rehabilitation/upgrade works only. However, the project proposes 3 partial road re-alignments, or by-passes in Duong Quy, Minh Luong and Bang Bo-Dong Pao for a total of 15km (10%). These are necessary to avoid congested village centers to improve traffic safety and minimize resettlement. These are further discussed below. A more detailed discussion on bypass alternatives is presented in the Alternative Analysis (Chapter E).

a. **Duong Quy Bypass.** The populated area of Duong Quy commune is in section Km122+700 - Km123+700 along NH279 for 1.0km in length. The road is currently class V mountainous road standard. The bypass will run on the left side of the existing road alignment and avoid the densely populated center of Duong Quy commune.

b. **Minh Luong Bypass.** Minh Luong commune is at Km135+00 - Km137+600 along NH279. A new road section will be construction (2.6km in length) to bypass the densely populated area of Minh Luong commune.

c. **Dong Pap to Ban Bo new road section.** Currently the section from Dong Pao to Ban Ba is a rough trail across difficult terrain. A new road section (11km in length) will be constructed on the western side of the existing road.

Figure C-9: Existing condition of Dong Pao - Ban Bo sections

C.4. Pavement Design

86. The existing roads pavement structure include Asphalt Concrete, DBST (Double Bituminous Surface Treatment), SBST (Single Bitumen Surface Treatment), and Portland Cement Concrete Pavement (PCCP) in some short sections over one or two layers of crushed stone/untreated aggregate base and subbase.

87. Based on traffic forecast, expected traffic loads, availability of local materials, and maintenance considerations, the project proposed to apply the following pavements for the project roads:

a. Bituminous pavement with the following layers (Pavement type 1):
i. Surface course
1. Wearing course: Dense Asphalt Concrete 12.5 mm;
2. Binder course: Dense Asphalt Concrete 19 mm.
ii. Base course: Crushed aggregate;
iii. Sub-base (If necessary): Crushed aggregate.

b. Bituminous pavement with following the layers (Pavement type 2):
i. Surfacing course
1. Wearing course: Dense Asphalt Concrete 12.5 mm;

2. Binder course: Dense Asphalt Concrete 19 mm.
ii. Base course: Crushed aggregate improved by cement (low compressive strength 2 MPa at 28 days age);
iii. Sub-base (If necessary): Crushed aggregate.

C.5. Bridges

88. The project will include 48 bridges, as defined in **Table C-6**. An assessment conducted by bridge specialists has confirmed that 35 existing bridges were structurally sound and could be used, with minor rehabilitation works. These bridges were built in several campaigns starting from 2000 up to 2009. 13 new bridges will be required, mainly at re-alignment and bypass sections.

89. The bridges use single span structures, precast concrete girders that are commonly used in the country. Deck slab is a reinforcement concrete deck slab. Short bridges (9-15m) will be pre-tensioned pre-cast girder plate bridges. Medium-size bridges (<33m) will apply pre-stressed I girder. Large bridges (33-40m) will apply Super T girder or hollow slap girder on scaffolding (**Table C-5**).

90. For bridges with navigation clearance requirement, bridge design follows the inland waterway standard. For bridges without clearance requirement, the height from design water level have been designed corresponding to the frequency of 1% to the span structure bottom ensuring minimum of 1.0m clearance. All bridge clearances will be designed to account for increased runoff projected from climate change (2050 projections). Some typical cross sections of bridge are presented in **Table C-5**.

Table C-5: Scope of span structure application

	Reinforced Concrete slab girder	Pre-stressed I shape girder	Pre-stressed Super-T girder
Section			
Description	- Reinforcement concrete slab girder and pre-stressed concrete girder are 9-18m length, width of each girder is 1m (B=1.0m); - Reinforcement concrete deck slab is 10-15cm thickness;	- Pre-stressed concrete I girder is 25-33m length - Reinforcement concrete deck slab is 20cm thickness;	- Pre-stressed concrete Super T girder is 40 m length.
Girder length (L) and girder height (h)	+ L=18m, h=0.75m; + L=15m, h=0.55m; + L=12m, h=0.52m; + L=9m, h=0.40m;	+ L=33m, h=1.65m; + L=25m, h=1.45m;	+ L=40m, h=1.75m;
Characteristics	- Low structural, pre-cast girders, short installation time, future widening possibilities; - Can be applied on the casting yard at site or in the factory.	- Girders are precast; installation time is short, convenient for future bridge widening. - Constructed at site casting yard.	- Girder of box-thin walls structure; be good for twisting resistance; saving materials. - Constructed at site casting yard. - Fast erection, convenient for future bridge widening; - Highly economic. - Maximum length L = 40m.

Table C-6: Project Bridges

Section	Existing bridges	Bridges to be reused	New bridges	Total
NH179	8	8	4	12

NH32	30	24	6	30
PR175	3	3	3	6
Total	41	35	18	48

Table C-7: New Bridges to be constructed

No	Chainage	Bridge name	Bridge width (m)	Apertures	Type of structure	Bridge length (m)
1. NH32, NH279						
1	Km 31+683.50	Nậm Chồ	9.0	1x33m	I-girder	43.10
2	Km 38+000.00	-	9	1x5m	Slap girder	
3	Km 56+650.00	Ta Náng 1	9.0	1x12m	I-girder	21.1
4	Km 57+350.00	Ta Náng 2	9.0	1x12m	I-girder	21.1
5	Km 61+350.00	Cầu cạn	9.0	3x33m	T-girder	109.3
6	Km 63+345.00	Nậm Sắp 2	9.0	2x24m	T-girder	60.15
7	Km 107+020.00	Nậm Lăm	9.0	1x18m	I-girder	28.1
8	Km 109+600.00	Nậm Mu	9.0	4x33m	T-girder	142.35
9	Km 117+450.00	Nậm Đích	9.0	2x33m	T-girder	76.15
10	Km 123+750.00	Nậm Hon	9.0	1x24m	I-girder	34.1
2. PR175						
11	Km 0+085.00	Dần Xây	9.0	3x33m	T-girder	110.2
12	Km 15+275.00	Đập Tràn	9.0	3x33m	T-girder	110.2
13	Km 30+728.00	Thác Cá	9.0	3x20m	T-girder	72.2

91. **Bridge foundation.** Foundation works will be subject to geological conditions and the load forcing from the upper structure. The following types of foundation will be used:

a. Shallow foundation: this foundation is applied when good soil or rock layer is close to the natural ground and meeting technical requirements.

b. Square pile foundation: Use of 30cmx30cm, 35x35cm, 40x40cm, 45x45cm, or pre-stressed concrete spun piles; this type of foundation is applied at appropriate geological conditions, load-bearing layers ≤50m; and located in non-residential areas.

c. Bored pile foundation: 1.0m, 1.2m and 1.5m diameter are used. This type of foundation will be applied in cases where the good soil layer is deep or when the precast reinforced concrete square piles cannot be used. Culverts, drainage

C.6. Culverts, drainage ditches

92. Many existing cross culverts, longitudinal culverts and drainage ditches on the project itineraries are in failed situation, especially along provincial road PR175. In many cases, the existing cross culverts lack of head-walls, wing-walls, strengthened yard and foundation.

Generally, they are often filled up by soil agglomeration and lack of maintenance activities. Consequently, the drainage capacity of the existing culverts is reduced significantly and their inlets/outlets are mostly eroded by the flow of surface water. Some culverts do not have enough drainage apertures, causing overflowing situation and serious failure for the pavement of the road section involved. Besides, most of longitudinal culverts through the residential areas are being impacted adversely by soil agglomeration due to lack of maintenance activities. This is the main cause for overflowing situation and serious failure for the road pavement in residential areas.

93. The Project will rehabilitate all existing culverts. The location and type of drainage culverts are presented in **Table C-8** and **Table C-9**.

Table C-8: Drainage ditches and culverts to be rehabilitated/replaced, NH279/NH32

No.	Section	Length (Km)	Culvert (Nos.)	Soil Ditch (m)	Concrete Ditch (m)	Box Culvert (m)
NH279						
1	KM91+500 - Km109	18.5	69	1354	10931	656
2	Km109- Km121	12.0	32	0	2786	4234
3	Km121 - Km123	2.0	10	0	587	0
4	Km123 - Km127	4.0	12	0	1888	1058
5	Km127 - Km150	23.0	92	0	15828	2685
6	Km150 - Km166	16.0	33	0	11513	0
NH32						
1	Km351 - Km368	17.0	51	0	11641	243
2	Km368 - Km374	6.0	19	0	4913	0
3	Km374 - Km390	16.0	42	0	7168	9167
4	Km390 – Km404	14.0	42	0	8928	1517
5 (NH4D)	Km60 – Km63	3.0	1	0	30	5960
6 (NH4D)	Km63 – Km65	2.0	1	0	1013	0

Table C-9: Drainage ditches and culverts to be rehabilitated/replaced, PR175

No.	Section Name	Length (Km)	Culvert (Nos.)	Soil Ditch (l.m)	Masonry Ditch (l.m)	Concrete Ditch (l.m)	Box Culvert (l.m)
1	Km0 - Km15	15.0	1	11600	800	0	1000
2	Km15- Km37	22.0	3	16400	400	400	0
3	Km37 – Km39	2.0	0	2600	0	700	0
4	Km39 – Km41	2.0	0	3000	0	0	0
5	Km41 – Km43+700	2.7	0	0	0	0	0
6	Km43+700 – Km48	4.3	0	3600	0	0	0
7	Km48-Km56+100	8.16	0	8600	600	0	0

C.7. Equipment List, Worker Camps, Quarries

94. The list of major machinery and equipment intended for use in road, bridge and tunnel construction is shown in the table below.

Table C-10: Expected number of machines and equipment used

TT	Device	Amount	TT	Device	Amount
1	1.5KW cage dressing	14	22	Coil beam	12
2	Drill ED, KH, Soilmec	12	23	5KW iron cutting machine	14
3	Vertical drilling machine 4.5KW	14	24	Hammer compressed air	14
4	Diezen compressor 240m3 / h	14	25	Diezen compressor 360m3 / h	14
5	Truck crane 10T	14	26	80L mortar mixer	14
6	23KW welding machine	4	27	Mortar pump 9m3	14
7	Click 250T	14	28	16T crane	14
8	Water pump 20KW	14	29	Self-propelled concrete pump 50m3 / h	14
9	Diesel compressor 600m3 / h	14	30	Dump Truck 10T	50
10	Click 500T	12	31	Cars watering 5m3	10
11	3T pulley	4	32	Wheel Loader	20
12	Crawler crane 25T	12	33	Bulldozer	20
13	5T electric winch	12	34	Motorcycle	10
14	Drilling machine TRC-15	1	35	Wheel loader 1.6 m3	10
15	10kW cable cutter	12	36	Wheel loader	10
16	15kW cable	12	37	Grader	5
17	Edge dressing machine	14	38	Beams castings	36
18	2.8KW	30	39	Carpet BTN	10
19	Jumbo three-wheel hydraulic drilling machine	2	40	Tire rollers	15
20	Ice breaker 1,300kg	5	41	Mixing Station	14
21	Concrete mixers	20	42	BENTONITER BENTONITE 100m3 / h	12

95. It is expected that the peak construction period, some 630 workers will be working on the various construction sites. However, with the prioritization of local labor involved in the construction process of the project, the actual number of workers mobilized from elsewhere is anticipated to amount to about 360. The construction contractors will arrange shelters for 360 workers at the camps, while local workers will return home after each shift. Expected worker camp locations are presented in **Table C-11**.

Table C-11: Expected worker camp locations

Location	Characteristics	Location	Characteristics
1. **Route connecting Nghia Lo town**			
Km3+00	Vacant land left	Km22+600	Vacant land on the right side
Km12+300	Vacant land left	Km37+800	Vacant land left
2. **Route connecting Lai Chau**			
Km91+800 (NH279)	Vacant land on the right side	Km367+450 (NH32)	Vacant land on the right side
Km102+100 (NH279)	Vacant land left	Km379+200 (NH32)	Vacant land left
Km112+500 (NH279)	Vacant land on the right side	Km389+800 (NH32)	Vacant land left
Km123+200 (NH279)	Vacant land on the right side	Km 109+600	The empty land of Nam Mu bridge
Km138+800 (NH279)	Vacant land left	Km 117+450	The drum head of Nam Diem bridge
Km149+800 (NH279)	Vacant land on the right side	Km126+00	The empty land at Dong Pao crossroad - Ban Hon village
The intersection of the end of Muong Than	Vacant land on the right side	Km136+00	Vacant land on the right side

1.4.5. Raw materials, materials and disposal sites

96. **Construction materials.** Raw materials provided to the Project will be purchased from local and available sources. Location of licensed quarries in the project area is shown in **Table C-12**.

97. Two of these quarries (along Bao Hà – Khau Co section along NH279) were visited. These quarries exploit quartzite outcrops to produce sand and concrete aggregates. Quartzite generally presents excellent abrasion resistance. This allows every kind of use for construction purpose including wearing courses, base courses, concrete aggregates.

Table C-12: List of proposed quarries to be used for the project

No.	Source
Quarry 1	- Name of supplier: HB Dai Hung Joint Stock Company - Mine address: Dai Phac commune, Van Yen district, Yen Bai province
Quarry 2	Name of Supplier: Trung Anh One Member Limited Liability Company - Mine address: Ngoi Stream, Ta Thang Village, Gia Phu Commune, Bao Thang District
Quarry 3	- Name of suppliers: Thuong La Limestone Exploitation and Processing Cooperative - Mine address: Tham village, Thuong Bang La commune, Van Chan district, Yen Bai province
Quarry 4	- Name of supplier: Trung Anh One Member Limited Liability Company - Mine address: Lang Vinh Village - Vo Lao Commune - Van Ban District - Lao Cai Province

Quarry 5	- Name of Supplier: Xuan Thanh Cooperative - Mine address: Vung Ú stone spot, Noong Do village, Khanh Yen commune, Van Ban district, Lao Cai province.
Quarry 6	- Name of supplier: Huy Ngoc Joint Stock Company - Mine address: Muong Cang stone mine - Muong Cang commune - Than Uyen district - Lai Chau province
Quarry 7	- Name of supplier: Quynh Trang Co., Ltd - Mine Address: Tam Dan Stone Mine-Muong Village-Than Than Commune-Tan Uyen District-Lai Chau Province
Quarry 8	- Name of supplier: Muong Lu mechanical service cooperative - Mine address: Hua Po village, Binh Lu commune, Tam Duong district, Lai Chau province

98. These building materials will be transported by the Carrier to the facility by trucks. In addition, other construction materials such as iron, steel, cement, bitumen and other materials will be purchased by the construction contractor from local suppliers and transported to the sites. Hot asphalt is available at local sources. Cement concrete will mainly be purchased from existing batching plants in the project area. In addition, the project will install some batching plants of 80m3 / h at some bridges.

99. **Electricity and water supply.** Based on the existing grid system in the locality, the contractor will purchase power from the local electricity management unit. Water used for production and daily living is made available of the available resources in the project area from the local water supply system or local wells. The remaining water used for tire washing, car wash and watering to reduce dirt in the construction area of the project and in the site, will be taken at surface water (rivers, lakes) near the project area.

100. **Waste disposal site and location**. Non-reusable solid waste produced during construction will be disposed of at approved local disposal sites. Specific discharge sites will be clarified at the detailed design stage of the project.

101. **Wastewater** will be pre-treated onsite through sedimentation tanks and septic tanks and will be discharged into the general drainage system of the area. Specific emissions targets are as follows. Discharge points are described in **Table C-13**.

Table C-13: Expected wastewater discharge locations

No	Site	Discharge point
1	Camp at Km3+00	Drainage area
2	Camp at Km12+300	Drainage area
3	Camp at Km22+600	Drainage area
4	Camp at Km37+800	Drainage area
5	Bridge construction Dan Xay (Km 0+085)	Thia Stream
6	Bridge construction Dap Tràn (Km 15+275)	Thia Stream
7	Bridge construction Thac Ca (Km 30+728)	Thia Stream
8	Camp at Km91+800 (QL279)	Drainage area
9	Camp at Km102+100 (QL279)	Drainage area
10	Camp at Km112+500 (QL279)	Drainage area
11	Camp at Km123+200 (QL279)	Drainage area
12	Camp at Km138+800 (QL279)	Drainage area

13	Camp at Km149+800 (QL279)	Drainage area
14	Camp at Nút giao cuối tuyến tranh Mường Than	Drainage area
15	Camp at Km367+450 (QL32)	Drainage area
16	Camp at Km379+200 (QL32)	Drainage area
17	Camp at Km389+800 (QL32)	Drainage area
18	Camp at Km 109+600	Drainage area
19	Camp at Km 117+450	Drainage area
20	Camp at Km126+00	Drainage area
21	Camp at Km136+00	Drainage area
22	Bridge construction Ta Nang 1 (Km56+650)	Ta Nang Stream 1
23	Bridge construction Ta Nang 2 (Km57+250)	Ta Nang Stream 2
24	Bridge construction Nam Sap 2 (Km63+345)	Nam Jam Stream
25	Bridge construction Nam Lam (Km107+020)	Nam Lam Stream
26	Bridge construction Nam Mu (Km109+600)	Nam Mu River
27	Bridge construction Nam Dích (Km117+450)	Nam Doi Stream
28	Bridge construction Nam Hon (Km123+750)	Nam Hon

C.8. Institutional arrangements of the Project

102. The Ministry of Transport (MOT) will be the Executing Agency. MOT will be responsible for overall project oversight and assist in coordination with other related line ministries, provinces or related government agencies.

103. MOT will delegate project implementation responsibilities to the Project Management Unit No.2 (PMU2) which is directly under the administration of MOT. PMU2 will be the Implementing Agency in this project and will have overall responsibility for project implementation and formal correspondence with the line ministries, provincial authorities and the ADB. The major tasks of PMU2 are regarding planning, financing and administration, implementing the project including technical and procurement matters, monitoring and evaluation, resettlement and safeguard compliance. The responsibilities of PMU2 consist of: (i) preparation of procurement plans, work plans, and annual budget plans; (ii) carrying out procurement and recruitment activities; (iii) responsibility for signing contracts with consultants and contractors; (iv) monitoring and evaluation of contract performance and payment; (v) ensuring quality control for works; (vi) ensuring the implementation of community road/work safety and HIV programs, the completion of Environmental Management Plan and Gender Action Plan; (vii) providing operation support to the relevant PPCs (Lai Chau, Lao Cai and Yen Bai) in implementing land acquisition and resettlement activities; (viii) preparing disbursement schedules and withdrawal applications; (ix) disbursement of counterpart funds; and (x) focal point for inter-agency coordination with ADB and relevant agencies of the Borrower.

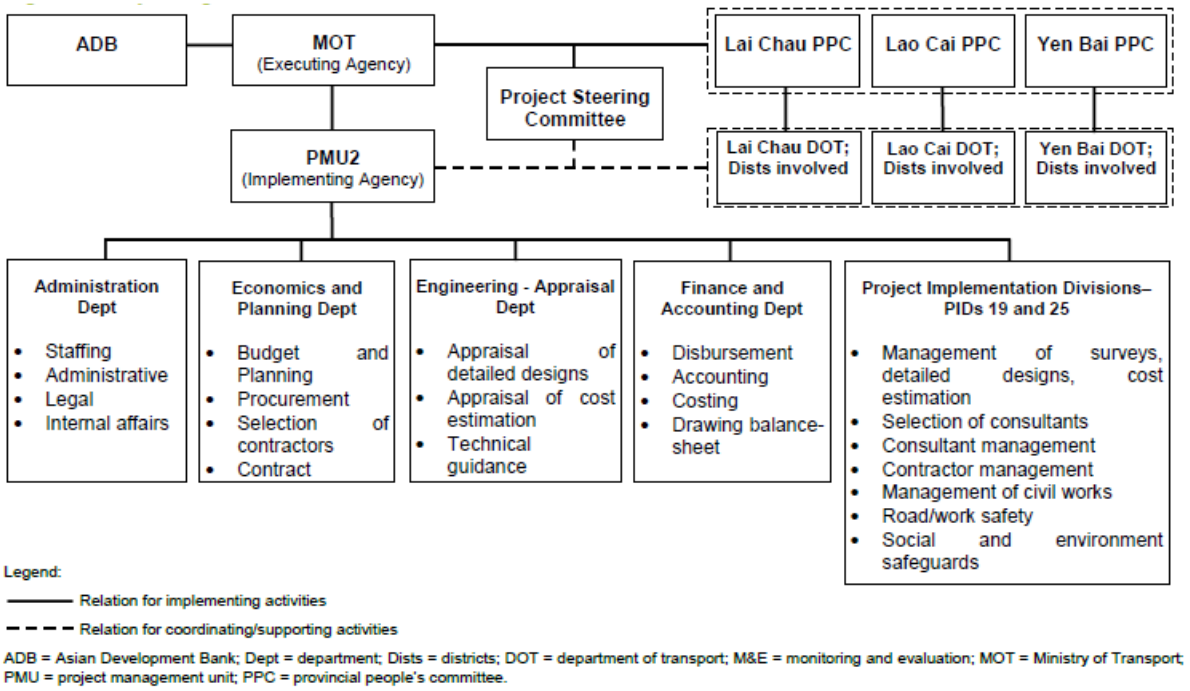
104. PMU2 will assign Project Implementation Divisions (PID) No.19 and No.25 for day-to-day implementation of the project. PMU2 has sufficient experience in implementing ODA-funded projects and therefore PMU2 is capable of implementing this project.

105. EMP and GAP requirements will be incorporated into the construction documents. Works contractors will have the main responsibility to implement the requirements of the environmental management plan. Environmental monitoring and enforcement will be

performed by the construction supervision consultants and external monitoring consultants.

106. Lai Chau Provincial People's Committee, Lao Cai Provincial People's Committee, and Yen Bai Provincial People's Committee will oversee land acquisition and resettlement activities. Their roles and responsibilities include: (i) implementation of land acquisition and resettlement related activities; (ii) implementation of the Indigenous People Development Plan; (iii) disbursement of payments for land acquisition and resettlement related expenses; and (iv) procurement of civil works for public utility relocation.

107. **Figure C-10** provides an overview of the project's institutional arrangements.



ADB = Asian Development Bank; Dept = department; Dists = districts; DOT = department of transport; M&E = monitoring and evaluation; MOT = Ministry of Transport; PMU = project management unit; PPC = provincial people's committee.

Figure C-10: Institutional arrangement for the Project

C.9. Project Implementation Schedule

108. The project implementation will start with detailed design in Q1 2020, with construction works expected to finish in Q4 2024.

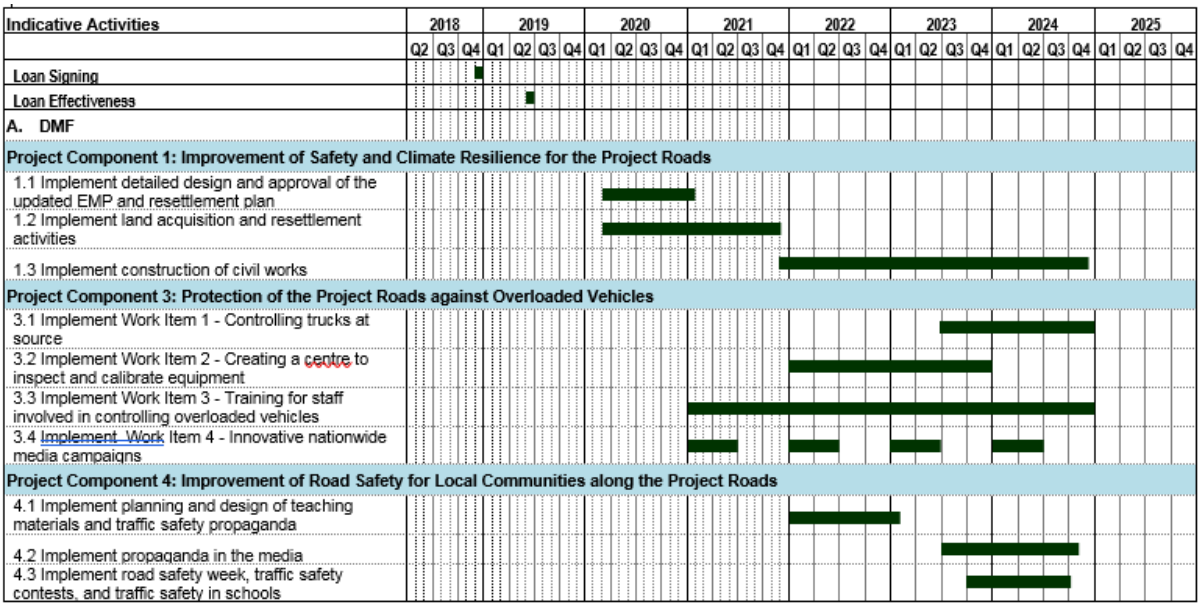
109. In the project implementation stage, there will be many activities involved, including detailed design, procurement of works packages and recruitment of construction supervision consultants, land acquisition and resettlement, unexploded ordnance (UXO) clearance, and civil work. The main time points for these activities are provided as the followings:

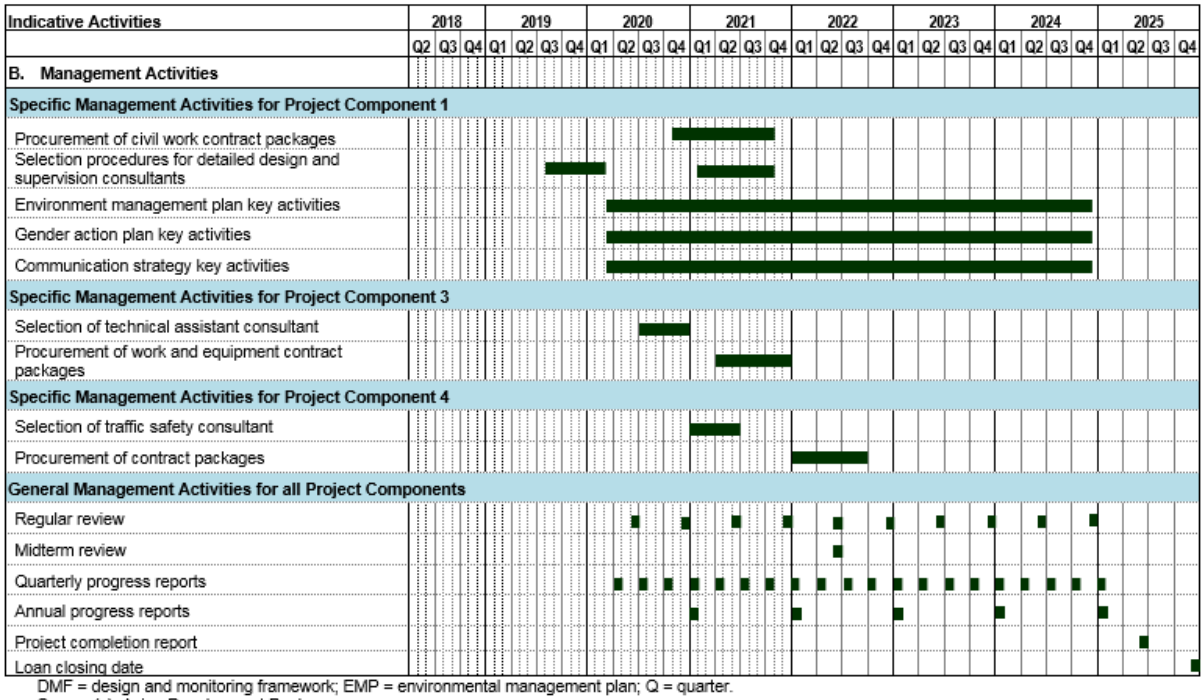
a. Detailed design is planned from Q1 2020 to Q1 2021;

b. Land acquisition and resettlement activities are planned from Q1 2020 to Q4 2024;

c. The activities related to civil works are planned to begin in Q4 2021 and finish in Q4 2024.

110. During the construction of civil works, internal and external resettlement monitoring and environmental monitoring will be performed with a frequency of six months. **Figure C-11** presents the detailed implementation schedule of the project.





DMF = design and monitoring framework; EMP = environmental management plan; Q = quarter.
Source (s): Asian Development Bank.

Figure C-11: Project Implementation Schedule

D. ENVIRONMENTAL BASELINE

D.1. Project Location, Physical environment

D.1.1.Project Provinces

111. The project roads are located within 3 provinces, including Lao Cai, Lai Chau, and Yen Bai, which belong to the North-Western region of Viet Nam.

112. **Lao Cai** is a border highland province, located in the middle of the Northeast and Northwest of Viet Nam, 296km far from Hanoi by railway and 345km by road. Eastern side is adjacent to Ha Giang province, Southern side is adjacent to Yen Bai province, western side is adjacent to Lai Chau province, northern side is adjacent to Yunnan province of the PRC with 203km of border route.

113. **Lai Chau** province is a high mountainous region in the North West of Viet Nam, north of the Da River. Its neighbors are Yunnan (PCR) to the north, Lao PDR to the west, Lao Cai Province on the north-east, and Dien Bien and Son La provinces to the south. The natural area of the province is 16,919Km^2 accounting 5.14% of total natural area of the whole country.

114. **Yen Bai** is in the North-Western region. North-eastern side is adjacent to Tuyen Quang and Ha Giang provinces, southeastern side is adjacent to Phu Tho province, southwestern side is adjacent to Son La Province, Northwestern side is adjacent to Lai Chau and Lao Cai provinces. Yen Bai has a natural area of 6,882.9 km², accounting for 2% the national natural area and 10.4% the natural area of Northeast, ranking the 8th among 11 northern mountainous provinces in the land size.

D.1.2.Topography

115. Northwestern Viet Nam is characterized by rugged terrain with high mountains running from northwest to southeast. Hoang Lien Son Mountain Range, the roof of Viet Nam has a length of 180 km, width of 30 km, with many mounts at the height from 2800m to 3000m. The terrain in the project area slopes down from Northwest to Southeast, is mostly mountainous with approximately 70% of the area at an altitude of over 500 meters and about 47% at an altitude of over 1,000m.

116. The topography along the project roads is presented below.

117. **NH32, NH279.** The topography along NH32 and NH279 (from Bao Ha Toll Gate (IC16) to Lai Chau city) consists of high mountains, hills and plains. The altitude (WGS84 datum) is increasing from Bao Ha (76m), to Lai Chau (881m). From East to West, the terrain is separated by the Hoang Lien Son mountain range (top peak 3,143 m). The road includes two main passes, including O Quy Ho Pass (altitude 2011m) and Khau Co Pass (1058m). The entire route can be divided into 3 sections:

a. **Eastern of Khau Co pass (NH279):** Elevations vary from Khau Co Pass (highest point of 1058m) to the lowest point (76m) at IC16 Bao Ha Toll Gate. The region is mostly mountainous with an average elevation range of 200-550m.

b. **Western of Khau Co Pass, Section from Muong Than to Binh Lu (NH32):** Elevations increase from the junction between NH279 and NH32 (about 560m), to Binh Lu junction (between NH32 and NH4D) at elevation of 750m. The topography includes mountainous areas and plateaus, with an average elevation of 560-750m.

c. **Section from Tam Duong to Lai Chau City:** Elevations increase from KM20 Bridge (Height 617m), to Point KM0 (Elevation of 881m). The region is mountainous, intermingled with flat hills with an average elevation of 700m.

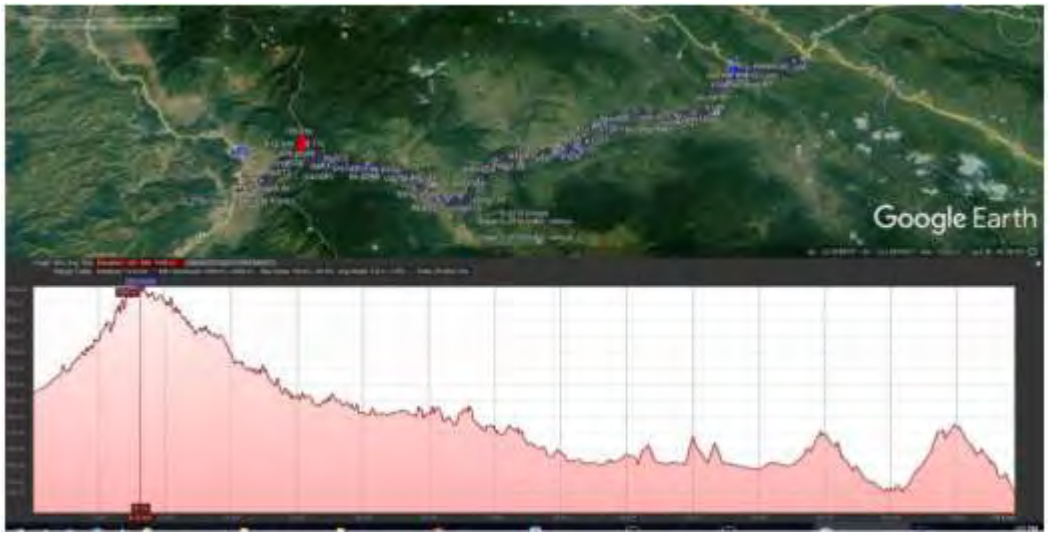


Figure D-1: Eastern of Khau Co pass (NH279)

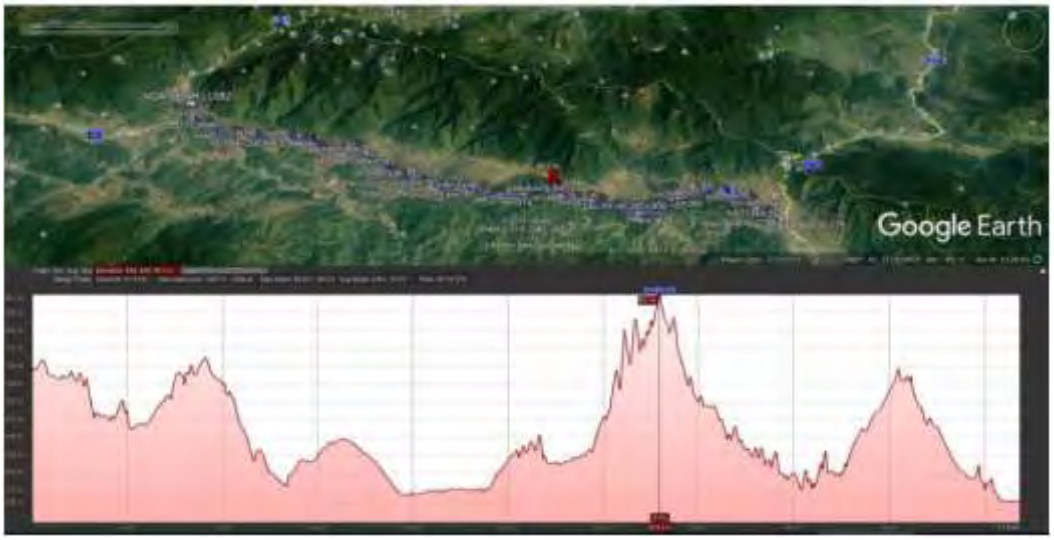


Figure D-2: Western of Khau Co Pass, Section from Muong Than to Binh Lu (NH32)

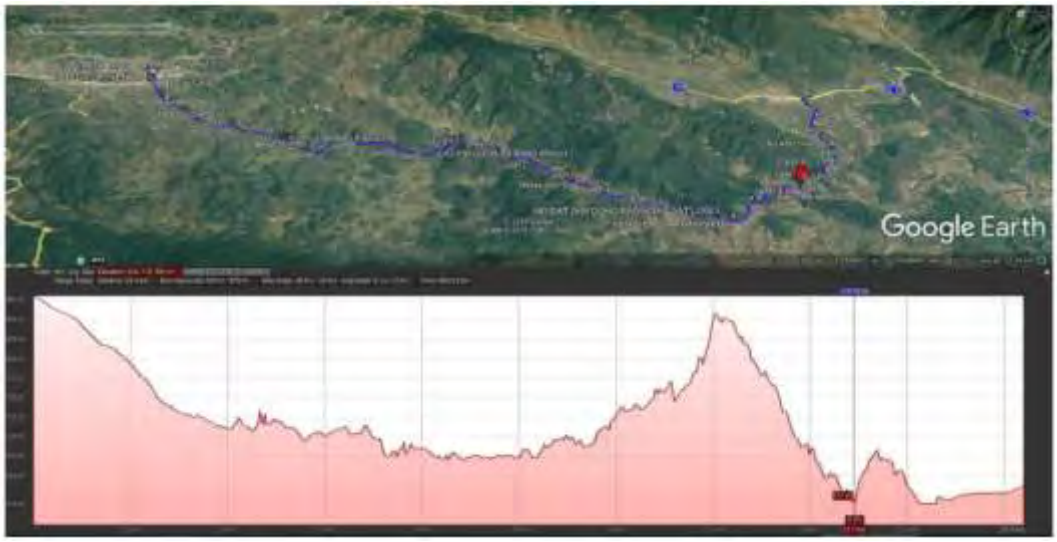


Figure D-3: Section from Tam Duong to Lai Chau City (NH32, PR136):

118. **PR175.** The topography from Mau A (IC14) to Nghia Lo City is mainly mountainous terrain. The difference in elevations between Mau A (50m) and Nghia Lo (250m) is relatively small. However, along the Thia river and the steep slopes of Quyen Mountain, the terrain is difficult. It can be divided into two regions:

a. **Eastern of An Luong Causeway:** Elevations increase from Toll Gate IC14 junction (50m elevation) to the An Luong causeway (elevation 107m). The section is mountainous.

b. **Western of the An Luong Causeway:** Elevations increase from An Luong (107m) to the junction between PR175 and NH32 (at elevation of 250m). The section is mountainous, with two ranges of 107-175m, and 235-275m.

Figure D-4: Eastern of An Luong Causeway

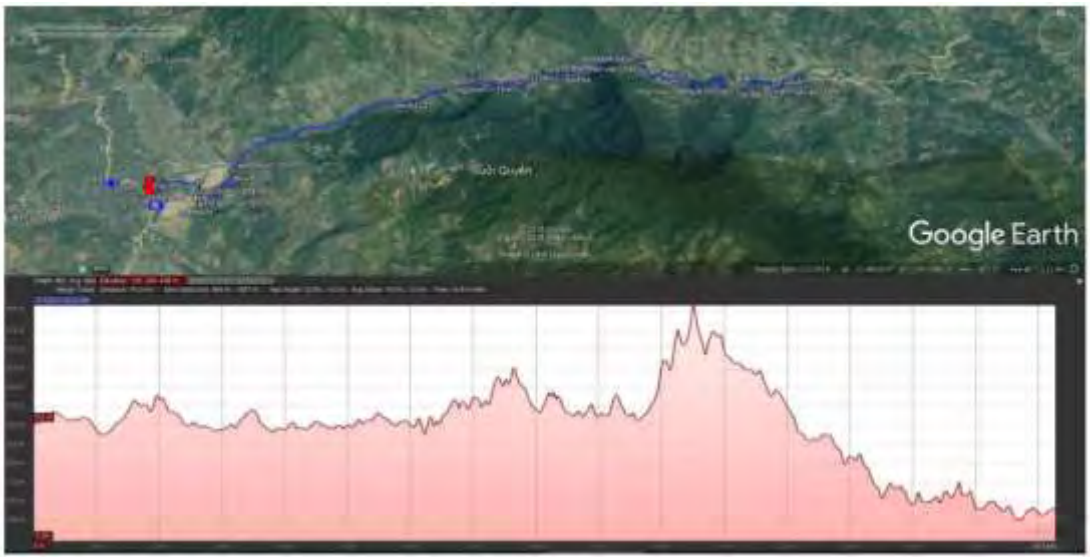


Figure D-5: Western of the An Luong Causeway

D.1.3.Geology and Soils

119. **NH279.** Based on geological map of the Atlas of Geology and Minerals of Viet Nam, Bac Quang F – 48 – XV of scale 1/200000, the Bào Hà – Muong Than the geology in the region may be described as follows (from Bào Hà toward Muong Than): The section starts in microcline and leucocratic granites and granosyenite formations. The rocks in that section

seem to be in an altered state. The section then crosses Cambrian schists just before Khanh Yen village. The section then follows quaternary deposits of Nam Chân river up to Duong Quy. After Duong Quy, the section crosses altered Cretaceous granites formations, Jurassic sandstones and tuffs before crossing Cretaceous rhyodacite and rhyolite formations before National road NH32.

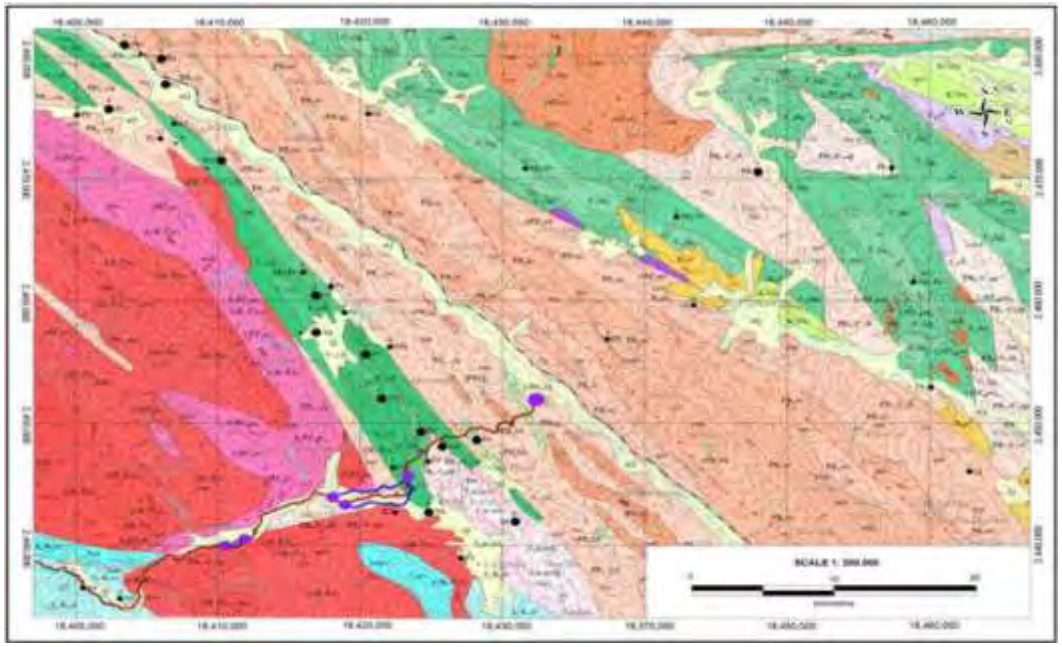


Figure D-6: Geology along NH279

120. **NH32 (Section Nuong Than – Ban Bo).** Based on geological map of the Atlas of Geology and Minerals of Viet Nam, Kim Binh – Lao Cai: F – 48 – VIII & F – 48 - XIV of scale 1/200000, the Muong Than – Ban Bo, the alignment of the Muong Than – Ban Bo section develops mainly the upper sub formations of Triassic sedimentary formations made of sandstones, siltstones and black – grey clay shales. At places, the alignment crosses quaternary deposits made of pebble, granule and clayey sands.

121. **NH32 (Ban Bo – Dong Pao).** The geology of the Ban Bo – Lai Chau section is presented in **Figure D-7** which is an extract of the geological map of the Atlas of Geology and Minerals of Viet Nam, Kim Binh – Lao Cai: F – 48 – VIII & F – 48 - XIV of scale 1/200000. The Ban Bo – Dong Pao new road is mainly located along the foot of gentle hills composed by Triassic clay shales, sandstones and siltstones. It may encounter some marls limestone from KM115+300 to KM117+500. The Dong Pau – Lai Chau section starts in Triassic sandstones, siltstones and marl limestone but is mainly developed in thin bedded limestone and clay shales. Between KM126+500 and KM132+000, it turns around and crosses steep hills of Paleogene igneous rocks as monzogabbro, syenite, and alkaline granite.

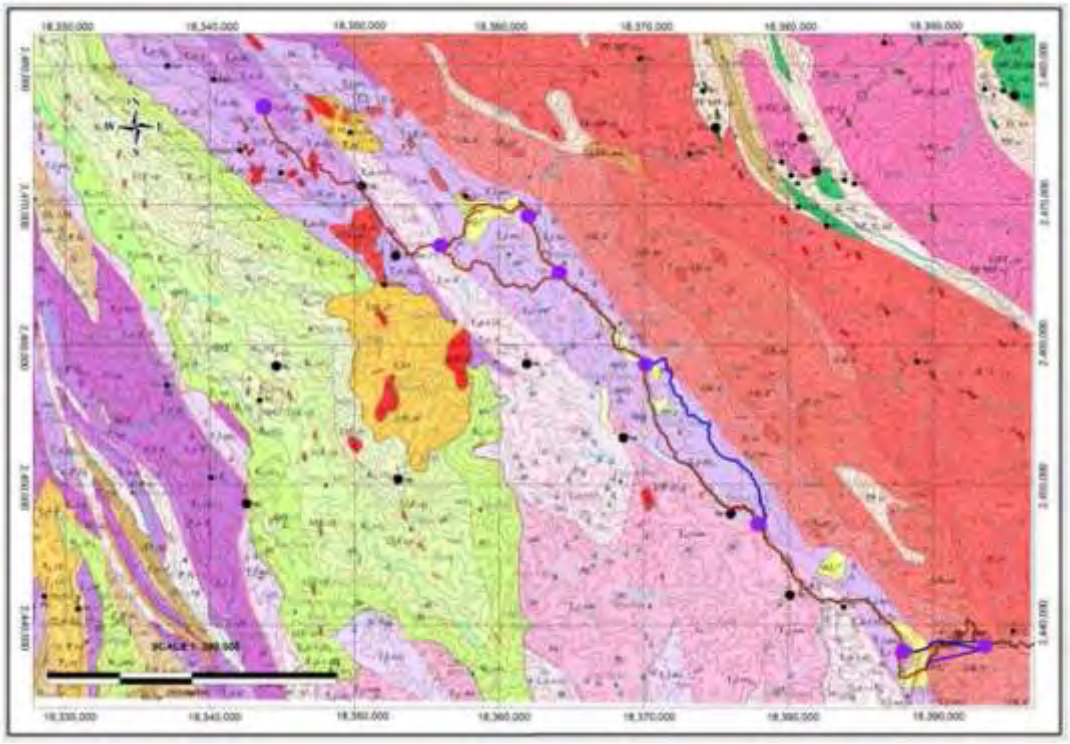


Figure D-7: Geology along NH32

122. **PR175.** Based on geological map of the Atlas of Geology and Minerals of Viet Nam, Yen Bai: F – 48 – XXI of scale 1/200000, the Nghia Lô – Mâu A section starts in quaternary alluvial deposits made of pebble, granule and clayey sands before crossing alternatively gneiss, schists, quartzite and granite formations. These rocks of the Cambrian age present various states of alteration from massive / fractured to fully spoil.

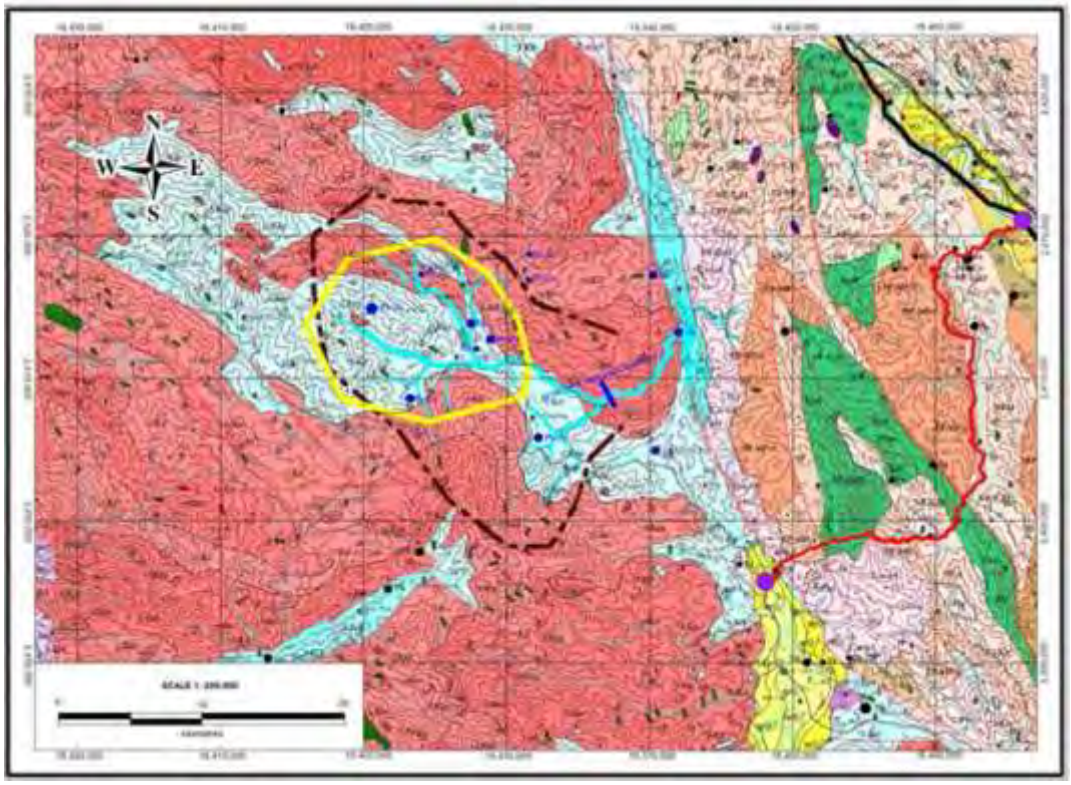


Figure D-8: Geology along PR175

123. Soils along the project roads consist primarily of ferralitic soils (ferrosols and lixisols) with small areas of and fluviosols (along the Black River) and alisols (around the Khau Co Pass). Lixisols are soils with subsurface accumulation of low activity clays and high base saturation. They develop under intensive tropical weathering conditions. Their age and mineralogy have led to low levels of plant nutrients and a high erodibility, making agriculture possible only with frequent fertilizer applications.

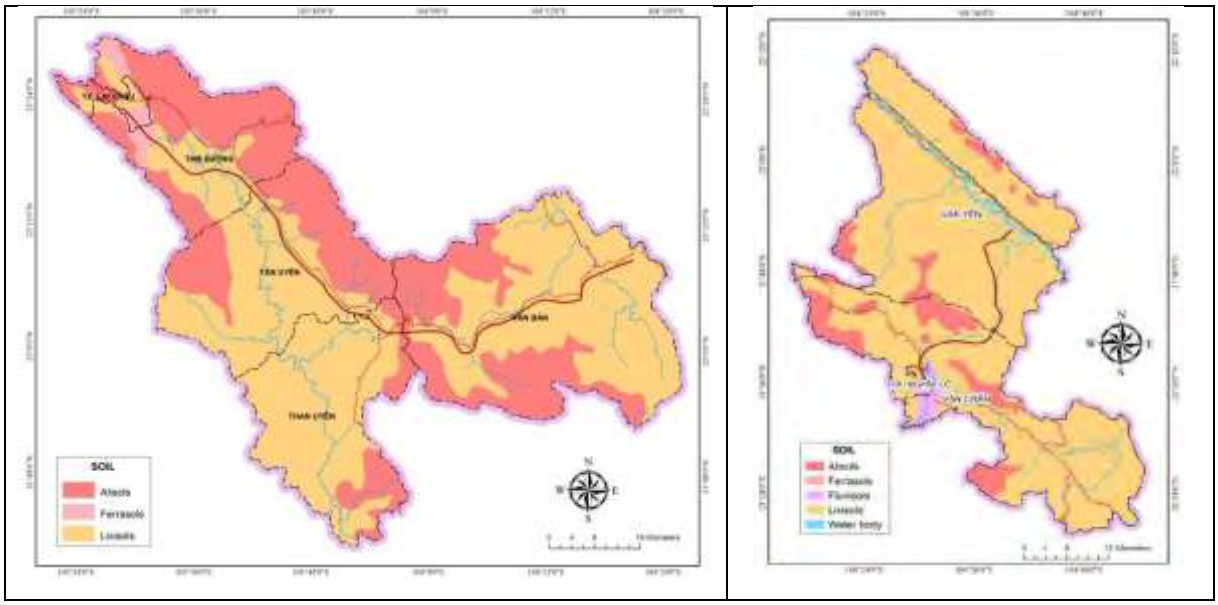


Figure D-9: Soil types in the project area.

Source: Project CRVA, March 2018

D.1.1.Land Use, Land Cover

124. Land use in the project area consists primarily of production and secondary natural forest (with open and closed canopy), barren/agriculture land, built up areas and shrubland. Land use along the project roads has been established based on remote sensing and site-surveys (covering 200m right and left of the current alignment), and based on official land use maps made available by provincial and district authorities. Land cover directly adjacent to the road consists mainly of agricultural land, production forest and secondary natural forest, shrubland, rivers and residential areas. Since the road follows existing road alignment, vegetation along the road (i.e. within the proposed right-of-way) has been removed and consists primarily of shrubs. Land use status within the 200m corridor is described in **Table D-1**. **Figure D-10** and **Figure D-11** illustrate land cover along the existing roads. Official land use maps are provided in **Figure D-21** to **Figure D-23**. A more detailed description of forestry resources along the project roads is presented in Section D.3.1.

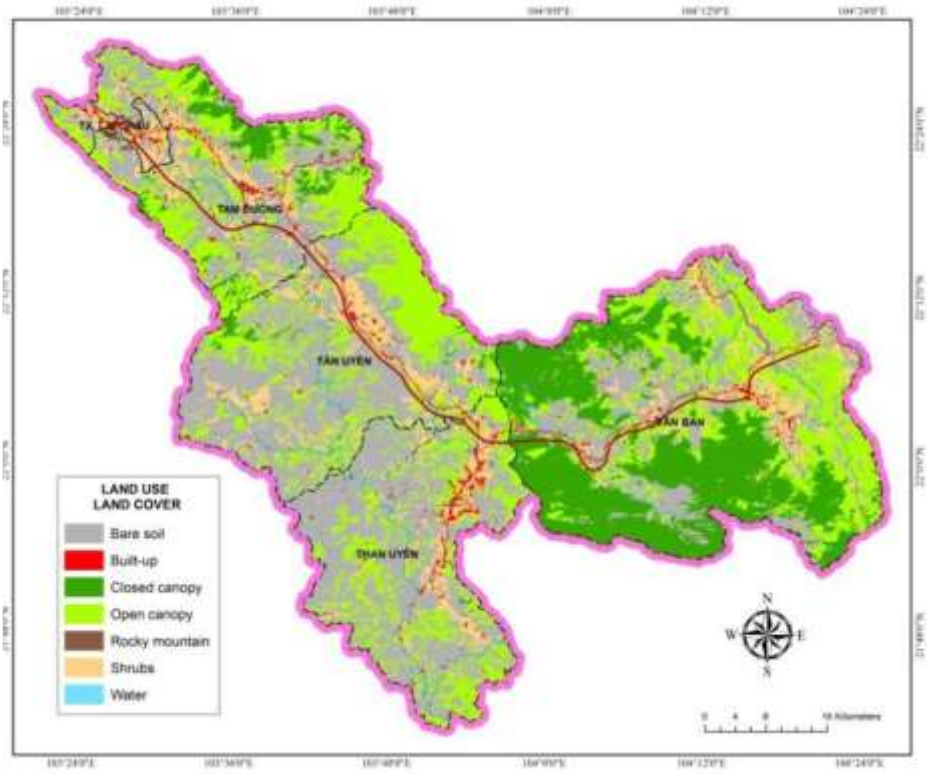


Figure D-10: Land Cover in the project area (NH32, NH179)

Source: Project CRVA, March 2018

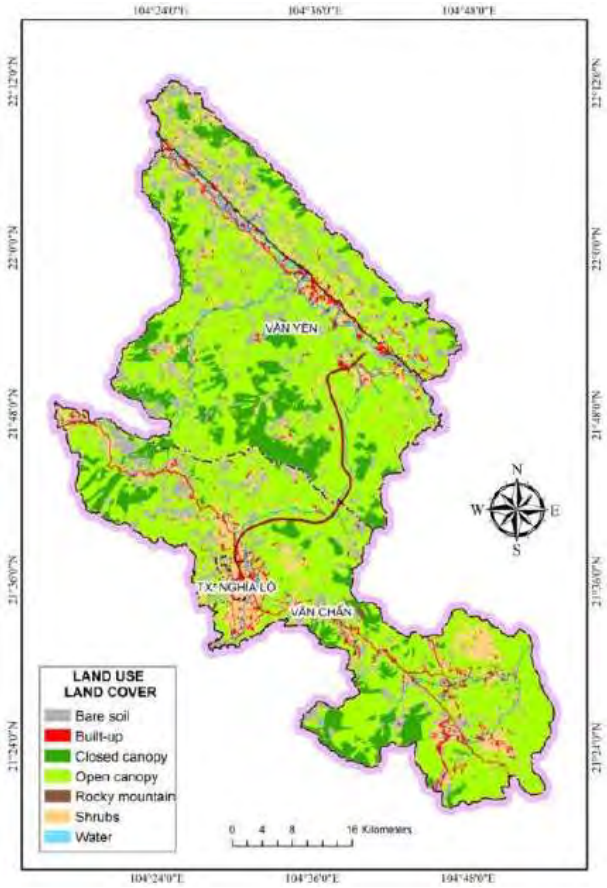


Figure D-11: Land Cover in the project area (PR175)

Source: Project CRVA, March 2018

Table D-1: Land use along project roads (based on site survey)

Chainage		Information about current state of land use
NH279		
Chainage of road project	**Chainage of Route**	
	Km91+500-Km91+800	Ngam Thin village – Tan Thuong commune
	Km91+800-Km93+700	Two sides on the road are agricultural land planting cassava and bead tree
	Km93+700-Km96+00	Production forests on two sides of the road
	Km96+00-Km97+00	Protection forests and production forests on two sides of the road
	Km97+00-Km98+700	Production forests are interspersed with agricultural land
	Km98+700-Km100+700	Protection forest is interspersed with agricultural land and residential houses
	Km100+700-Km100+900	On the right side of the road is residential area of Khe Phan Village-Son Thuy commune; one the left is stream.
	Km100+900-Km101+100	On the right side of the road is production forest; one the left side of the road is stream
	Km101+100-Km102+100	Residential area of Khe Lech village-Son Thuy commune
	Km102+100-Km103+700	Agricultural land is interspersed with production forest
	Km103+700-Km105+00	Agricultural land on two sides of the road
	Km105+00-Km106+200	Forestry land is interspersed with production forests and residential houses on two sides of the road
	Km106+200- Km107+200	Production forests on two sides of the road
	Km107+200-Km108+700	Residential area is interspersed with agricultural land
	Km108+700-Km112+00	Khanh Yen town
	Km112+00-Km112+700	Residential area of Ho Phai village-Lang Giang commune
	Km112+700-Km113+100	Agricultural land on two sides of the road
	Km113+100-Km113+700	Residential area of Ho Phai village
	Km113+700-Km114+200	Agricultural land for planting corn and cassava, alternating with residential houses
	Km114+200-Km115+100	Agricultural land for planting corn and rice on two sides of the road
	Km115+100-Km116+00	On the left side of the road is agricultural land, on the right side of the road is Thai Hoa residential area-Hoa Mac commune
	Km116+00-Km116+200	Agricultural land for planting corn on two sides of the road
	Km116+200-Km116+650	Residential area of 5 hamlet –Hoa Mac commune

	Km116+650-Km117+150	On the left side of the road is production forest land; on the right side of the road is stream
	Km117+150-Km118+300	Agricultural land for planting rice and production forest land on two sides of the road are interspersed with resident's houses
	Km118+300-Km120+300	On the left side of the road is production forestry land; on the right side of the road is stream
	Km120+300-Km121+00	Agricultural land on two sides of the road
	Km121+00-Km123+00	On the right side of the road is stream; on the left side of the road is agricultural land
	Km123+00-Km123+300	On the right side of the road is paddy fields; on the left side of the road is residential area of hamlet number 13-Duong Quy commune
	Km123+300-Km123+800	Residential area of hamlet number 13-Duong Quy commune
	Km123+800-Km124+100	Paddy fields on two sides of the road
	Km124+100- Km124+900	Residential area of hamlet number 9-Duong Quy commune
	Km124+900-Km126+400	Agricultural land on two sides of the road is interspersed with residential area of hamlet number 8 and 15-Duong Quy commune
	Km126+400-Km128+00	Agricultural land on two sides of the road is interspersed with resident's houses
	Km128+00-Km128+600	Residential area of Tham village-Tham Duong commune
	Km128+600-Km130+500	Agricultural land on two sides of the road is interspersed with residents' houses
	Km130+500-Km131+200	Paddy fields on two sides of the road; on the right side of the road is hydroelectric plant
	Km131+200-Km134+200	On the left side of the road is protection forest; on the right side of the road is stream
	Km134+200-Km135+00	Agricultural land on two sides of the road
	Km135+00-Km135+400	Residential area of Pom Khen village-Minh Luong commune
	Km135+400-Km137+600	Agricultural land on two sides of the road
	Km137+600-Km140+00	Residential area of hamlet number 3 and 1-Minh Luong commune
	Km140+00-Km141+100	Residential area of hamlet number 2-Minh Luong commune
	Km141+100-Km142+500	On the right side of the road is paddy fields; on the left side of the road is production forest
	Km142+500-Km143+100	Residential area of Tu Ha town-Nam Xe commune
	Km143+100-Km145+450	Agricultural land and empty land on two sides of the road

	Km145+450-Km151+450	Hoang Lien-Van Ban Nature Reserve (consisting of unused natural land, special-use forest and protection forest)
NH 32		
Chainage of road project	**Chainage of Route**	
Km63+950-Km65+00	Km354+650-Km355+700	Agricultural land for planting rice on two sides of the road is interspersed with resident's houses
Km65+00-Km65+200	Km355+700-Km355+900	Residential area of Phuc Than commune on two sides of the road
Km65+200-Km65+600	Km355+900-Km356+300	Agricultural land for planting rice and tea on two sides of the road
Km65+600-Km66+100	Km356+300-Km356+800	Residential area of Long Thang village-Phuc Than commune
Km66+100-Km66+700	Km356+800-Km357+400	On the right side of the road is irrigation lake; on the left side of the road is agricultural land
Km66+700-Km67+900	Km357+400-Km358+600	Residential area of Thanh Son village commune-Pac Ta commune
Km67+900-Km68+400	Km358+600-Km359+100	Agricultural land for planting rice on two sides of the road
Km68+400-Km69+500	Km359+100-Km360+200	Residential area of Hoang Ha village-Pac Ta commune
Km69+500-Km72+00	Km360+200-Km362+700	Agricultural land and production forest on the two sides of the road
Km72+00-Km72+900	Km362+700-Km363+600	Residential area of Pac Ta village
Km72+900-Km74+300	Km363+600-Km365+00	Agricultural land is interspersed with production forest on the two sides of the road
Km74+300-Km74+500	Km365+00-Km365+200	Agricultural land for planting rice on two sides of the road
Km75+500-Km75+00	Km365+200-Km365+700	Agricultural land is interspersed with resident's houses on two side of the road
Km75+00-Km75+300	Km365+700-Km366+00	Production forest on two sides of the road
Km75+300-Km75+800	Km366+00-Km366+500	Residential area of Bo Dun 2 village-Pac Ta commune
Km75+800-Km76+900	Km366+500-Km367+600	Agricultural land for planting corn and production forest on two sides of the road
Km76+900-Km79+700	Km367+600-Km370+400	On the left side of the road is paddy fields; on the right side of the road is paddy fields and production forest which is far away from the road
Km79+700-Km79+900	Km370+400- Km370+600	On the left side of the road is residential area; on the right side of the road is agricultural land
Km79+900-Km82+00	Km370+600-Km372+700	On the right side of the road is agricultural land; on the left side of the road is production forest interspersed with agricultural land
Km82+00-Km82+900	Km372+700-Km373+600	Production forest on two sides of the road
Km82+900-Km84+500	Km373+600-Km375+200	Residential area of Phieng Phat village-Trung Dong commune

Km84+500-Km85+200	Km375+200-Km375+900	Agricultural land on two sides of the road is interspersed with resident's houses
Km85+200-Km86+900	Km375+900-Km377+600	Agricultural land for planting tea on two sides of the road is interspersed with paddy fields
Km86+900-Km87+400	Km377+600-Km378+100	Production forest on two sides of the road
Km87+400-Km88+00	Km378+100-Km378+700	Residential area of Na Bao village-Than Thuoc commune
Km88+00-Km89+300	Km378+700-Km380+00	Residential area of Chom Chang village-Than Thuoc commune
Km89+300-Km93+300	Km380+00-Km384+00	Residential area of Tan Uyen central town
Km93+300-Km96+200	Km384+00-Km384+300	Agricultural land for planting rice on two sides of the road
Km96+200-Km96+600	Km384+300-Km384+700	Residential area of Cham Ca Village-Tan Uyen town
Km96+600-Km96+800	Km384+700-Km384+900	Agricultural land for planting tea on two sides of the road
Km96+800-Km97+200	Km384+900-Km387+300	Agricultural land for planting tea, herbs and fruit tree
Km97+200-Km98+400	Km387+300-Km388+500	Agricultural land for planting rice and tea on two sides of the road is interspersed with resident's houses
Km98+400-Km98+600	Km388+500-Km388+700	Residential area of Na Khoang village-Phuc Khoa commune
Km98+600-Km101+700	Km388+700-Km388+800	Agricultural land for planting rice and tea on two sides of the road
Km101+700-Km104+100	Km388+800-Km391+200	Residential area of Na La village-Phuc Khoa commune
Km104+100-Km104+500	Km391+200-Km391+600	Agricultural land for planting tea on two sides of the road; on the left side of the road is a stream
Km104+500-Km105+00	Km391+600-Km393+100	Residential area of Nam Ban 1-Phuc Khoa commune
Km105+00-Km106+400	Km393+100-Km395+00	Agricultural land for planting tea, rice and cassava on two sides of the road
	Km395+00-Km397+00	Agricultural land for planting tea and rice on two sides of the road is interspersed with resident's houses
	Km397+00-Km397+500	Resident's houses of Hung Phong village-Ban Po commune
	Km397+500- Km398+100	Agricultural land for planting rice and tea on two sides of the road
PR175		
Chainage of road project	**Chainage of Route**	
Km107+00-Km108+400		Residential area of Hung Phong and Na Ni villages-Ban Bo commune
Km108+400-Km115+600		Agricultural land on two sides of the road
Km115+600-Km116+800		On the right side of the road is natural forest; on the right side of the road is agricultural land

Km116+800-Km117+600		Residential area of Na Hum-Binh Lu commune
Km117+600-Km118+400		Natural forested land on two sides of the road is interspersed with agricultural land on the right side of the road
Km118+400-Km120+00		Agricultural land for planting tea, corn and banana
Km120+00-Km120+800		On the right side of the road is production forest; on the left side of the road is agricultural land for planting tea and corn.
Km120+800-Km121+700		Production forest on two sides of the road
Km121+700-Km122+00		Residential area of Dong Pao village-Ban Hon commune
Km122+00-Km123+750		Agricultural land for planting corn and orange on two sides of the road
Km123+750-Km124+700		Agricultural land for planting tea and cassava on two sides of the road
Km124+700-Km125+00		Residential area of Nam Khum village on two sides of the road is interspersed with agricultural land
Km125+00-Km125+200		Agricultural land for planting rice and cassava on two sides of the road
Km125+200-Km125+600		Residential area of Nam Khum village-Ban Hon commune
Km125+600-Km126+200		Agricultural land for planting rice and corn on two sides of the road
Km126+200-Km127+00		Residential area of Ban Hon-Ban Hon commune
Km127+00-Km127+500		Mountainous area for planting forestry trees on two sides of the road
Km127+500-Km129+00		Agricultural land for planting tea, corn and resident's houses on two sides of the road
Km129+00-Km129+500		Land for planting tea on two sides of the road
Km129+500-Km130+500		Resident's houses of Na Bo village-Ban Giang commune on two sides of the road
Km130+500-Km131+00		Land for planting tea on two sides of the road is interspersed with some resident's houses.
Km131+600-Km131+00		Agricultural land for planting tea and corn on two sides of the road is interspersed with some resident's houses
Km131+600-Km132+100		One side of the road is agricultural land and another side is resident's houses
Km132+100-Km132+300		Residential area of Na Bo village-Ban Giang commune
Km132+300-Km132+500		Land for planting tea on two sides of the road

Km132+500-Km132+800		Residential area of Coc Oa village-Ban Giang commune
Km132+800-Km133+300		Agricultural land for planting rice, wheat on two side of the road is interspersed with resident's houses
Km133+300-Km134+450		Agricultural land for planting rice, crops is interspersed with resident's houses
Km134+450-Km135+435		Agricultural land for planting rice, crops is interspersed with resident's houses
K135+195-Km136+795		Residential area of street number 24 and 25-Dong Phong precinct

125. **Appendix A** includes pictures illustrating land use along the project roads.

D.2. Climate

D.2.1.Temperature, Precipitation

126. The northwestern region of Viet Nam has a monsoonal tropical climate, with humidity averaging 84% throughout the year. However, because of the marked variety of topographical relief, the climate tends to vary considerably from place to place. During the winter or dry season, extending roughly from October to March, the monsoon winds usually blow from the northeast along the Chinese coast and across the Gulf of Tonkin, picking up considerable moisture. During the southwesterly summer monsoon, occurring from April to September, the heated air of the Gobi Desert rises, far to the north, inducing moist air to flow inland from the sea and deposit heavy rainfall.

127. **Lao Cai Province** experiences a dry cold climate from October to March, while the tropical monsoon brings the rainy season which lasts from April to September. The annual average temperature is 23 C. The temperature generally ranges between18 C and 28 C in the mountainous region, with the lowland areas showing a temperature variation of between 20 C and 22 C. At higher altitudes, temperature can drop to less than 0 C with snowing conditions. Fog and frost are a common phenomenon in the province. The average annual rainfall recorded in the period 2010-2015 is about 1,600-1,900 mm. The rainy season is typically from April to October. The rainfall level in this period ranges from 232mm (in June) to 326mm (August). The driest period is from November to March. Fog often occurs across the province. In the freezing phase, in the high mountains and sheltered valleys there are also hoar frost, each session lasts 2-3 days.

128. The climate in **Lai Chau** is warm and temperate. The summers are much rainier than the winters and the temperature averages 20°C. With an average of 24.0 °C, July is the warmest month. The lowest average temperatures in the year occur in January, when it is around 13.9 °C. The variation in temperatures throughout the year is 10.1 °C. As it belongs to the tropical monsoon zone, the climate of Lai Chau is divided into two seasons: rain season and dry season. The driest month is December when there is only 9 mm of precipitation. The largest amount of precipitation occurs in July, with an average of 364 mm. The precipitation varies 355 mm between the driest month and the wettest month. Annual precipitation averages 2,200-2,700 mm.

129. **Yen Bai Province** has monsoonal tropical climate, with hot and humid summers and dry and cold winters. The average temperature is 22 - 23°C, the average rainfall ranges from 1500 - 2200mm/ year; the average humidity is 83 - 87%. Yen Bai is divided into 5 small climatic sub-regions which are determined by the terrain: (i) Mu Cang Chai sub-region has the average altitude of 900m and the average temperature of 18^0C - 20^0C, sometimes under 0^0C in winter; (ii) Van Chan Subregion - the south of Van Chan has the altitude of 800m and the average temperature of 18^0C - 20^0C; the north has most rainfall and the south has the least rainfall of the province; (iii) Van Chan – Tu Le Subregion has the average altitude of 200m – 400m, the

average temperature of 21^0C- 32^0C; (iv) the south of Tran Yen - Van Yen - Yen Bai city - Ba Khe region, with the average altitude of 70m, the average temperature of 23^0C- 24^0C, has the most drizzling rain of the province; and (v) Luc Yen - Yen Binh region with the average altitude of under 300 m, the average temperature of 20^0C- 23^0C. Annual rainfall is about 1800-2000 mm. Precipitation has an increasing trend from low- to highland, and rainfall distribution is unevenly distributed over the year. The rainy season occurs from May to September (with average monthly precipitation of 114.8 to 429.4 mm). The driest months are from December to March.

Table D-2: Key meteorological parameters for the project provinces

Station	Month												Year Avg
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
The annually and monthly average air temperature (°C)													
Lai Chau	17.0	18.7	21.9	24.8	26.4	26.6	26.5	26.6	25.9	23.9	20.4	17.2	23.0
Lao Cai	15.7	17.0	20.7	24.2	27.0	27.9	27.9	27.5	26.3	24.0	20.2	17.0	23.0
Yen Bai	15.7	16.8	19.7	23.5	26.7	28.0	28.1	27.8	26.6	24.1	20.6	17.3	22.9
The annually and monthly average highest air temperature (°C)													
Lai Chau	23.4	25.9	29.9	32.4	32.7	31.7	31.3	32.0	31.9	29.9	26.5	23.5	29.3
Lao Cai	20.1	21.3	25.3	28.8	32.1	32.7	32.7	32.4	31.3	28.7	25.1	21.9	27.7
Yen Bai	19.2	19.9	23.0	27.0	31.2	32.5	32.6	32.5	31.5	28.6	25.2	21.7	27.1
The annually and monthly average lowest air temperature (°C)													
Lai Chau	13.6	14.5	16.7	20.0	22.5	23.9	23.8	23.7	22.6	20.5	17.1	13.9	19.4
Lao Cai	13.3	14.5	17.9	21.1	23.6	24.7	24.9	24.4	23.3	21.2	17.5	14.3	20.0
Yen Bai	13.6	14.8	17.8	21.1	23.7	25.0	25.2	24.8	23.6	21.3	17.8	14.5	20.3
Largest daily rainfall (mm)													
Lai Chau	48	47	96	141	171	313	243	235	102	161	132	66	313
Lao Cai	47	45	91	101	148	136	174	178	191	118	79	59	191
Yen Bai	35	86	67	122	349	199	220	212	250	166	101	77	349
The average number of days with thunderstorms, monthly and annually (day)													
Lai Chau	0.9	2.4	5.8	11.6	12.8	11.4	9.2	8.3	4.4	2.2	0.7	0.3	70.0
Lao Cai	0.4	1.1	4.1	9.5	6.8	6.5	6.5	8.1	4.8	1.7	0.5	0.2	50.3
Yen Bai	0.2	1.1	3.1	8.6	9.7	11.5	11.9	12.2	7.2	3.1	0.3	0.2	69.3

Source: Pre-FS (January 2018)

Table D-3: Annual and monthly precipitation in the project provinces

	Yen Bai			Lao Cai			Lai Chau		
Year / Month	2010	2013	2016	2010	2013	2015	2012	2013	2016
Total of year	1,988.3	1,492.9	1,805.0	1,786.11	1,660.05	1,660.15	2,618.7	2,656.6	2,186.4
1	85.4	36.3	70.2	33.60	50.55	80.65	99.7	55.7	74
2	7.2	50.6	17.6	16.25	25.05	27.45	5.5	41.2	24.9
3	35.1	27.9	66	24.42	27.75	36.83	31.9	23.9	66.9
4	113.7	124.5	155	157.25	149.43	113.70	142.9	312.9	197.8
5	250.1	118.9	355.0	262.82	268.05.	172	282.9	381	308.3
6	183.4	91	86.7	235.10	192.08	145.20	481.8	478.7	446.3
7	497.2	414.3	404.7	219.35	390.60	243.63	668.3	470.1	422.7
8	358.1	262.4	353.7	393.15	406.23	315.63	165.8	458.9	236.3
9	242.2	181.7	78.5	216.70	162.73	220.58	323	171.2	281.6
10	126.1	97.7	78.8	105.55	75.80	140.90	243.2	44.6	45.6
11	24.9	7.9	83.1	31.85	15.28	64.93	146.5	19.1	81.6
12	64.9	79.7	55.7	90.07	164.55	98.65	27.2	199.3	0.4

Source: Provincial Statistical Yearbooks, 2016

130. Rainfall data has also been obtained from MONRE for 5 stations which cover the roads alignments. These are: (i) Ngoi Nhu (designated #2); (ii) Duong Quy (designated #5); (iii) Mau A (designated #6); (iv) Binh Lu (designated #7); and (v) Than Uyen (designated #8).

131. Their locations are shown in the figure below. The data gives daily rainfall values for 30 years. This has been analyzed to give Depth Duration Frequency (DDF) graphs as shown below. The data shows that for a 1 in 100-year event the daily rainfall is typically more than 200mm per day. It is generally accepted that rainfall more than 200mm is considered "extreme".

132. The DDF curves were used to develop daily Intensity Duration Frequency (IDF) curves for historic data as well as for projected climate conditions under RCP 4.5 and RCP 8.5 scenarios. Method for adjusting IDFs for CC impacts is as per Bates et al. (2015): Bates, B.C., McLuckie, D., Westra, S., Johnson, F., Green, J., Mummery, J. and Abbs, D. (2015): Australian Rainfall and Runoff – the interim climate change guideline. Proc. 36th Hydrology and Water Resources Symposium, Hobart, Australia, 7-10 December 2015.

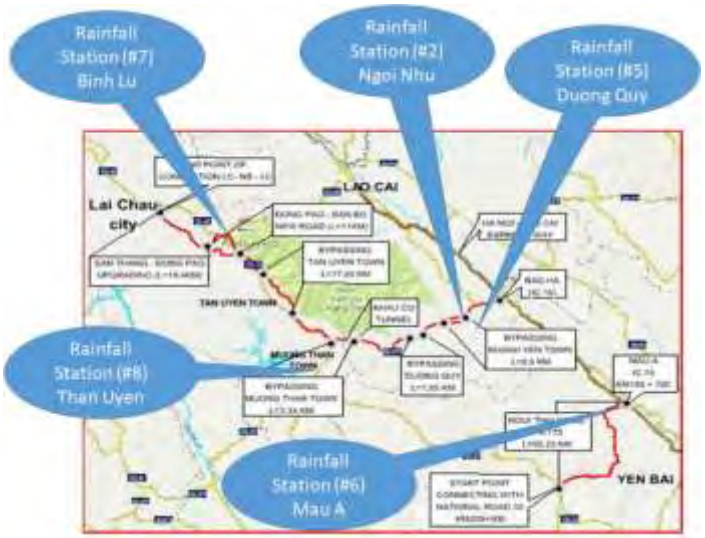


Figure D-12: Location of Rainfall Monitoring Stations

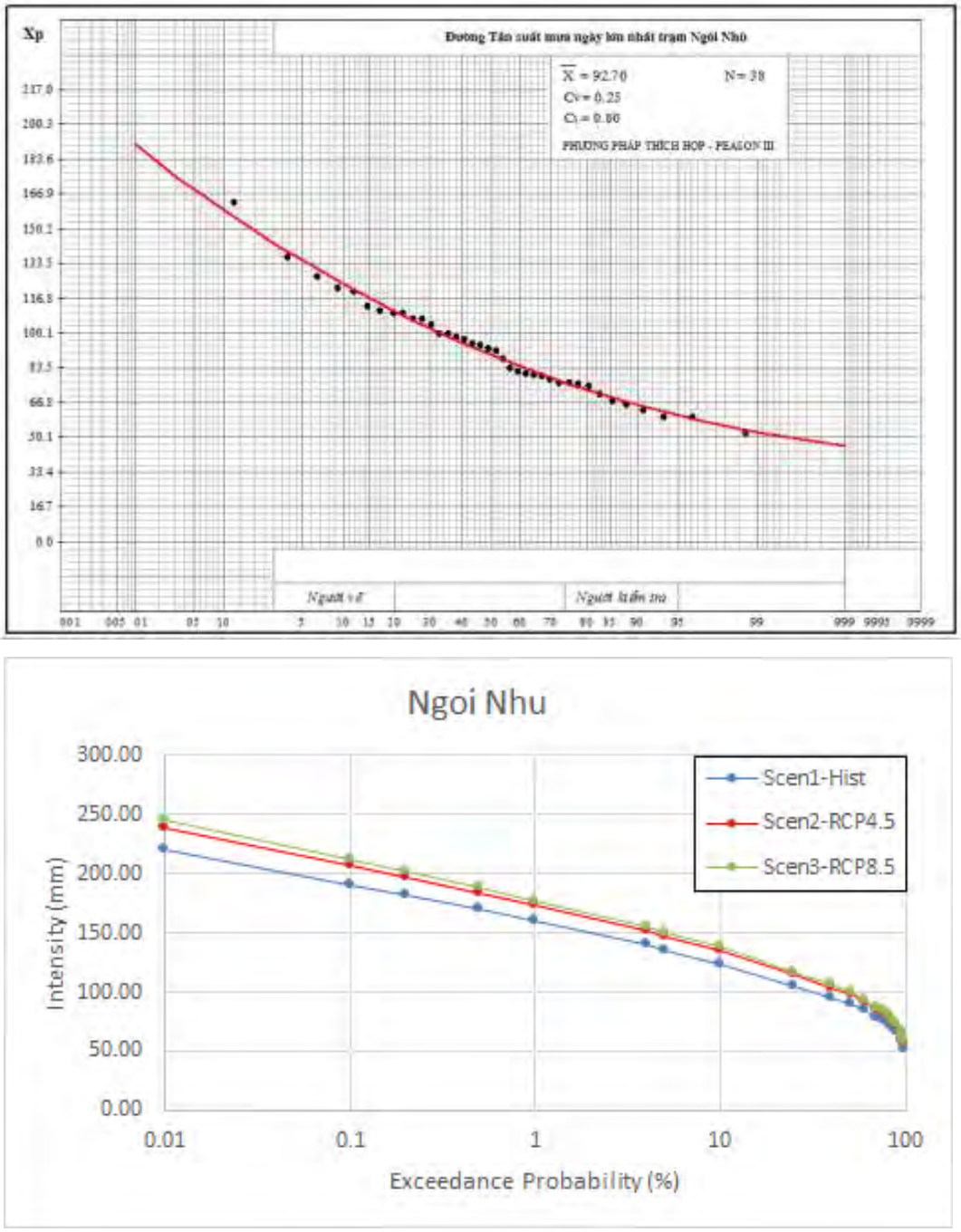


Figure D-13: Depth Duration Frequency Graph (top) and Intensity Duration Frequency Graph (bottom) for 24-h precipitation, Ngoi Nhu (designated #2)

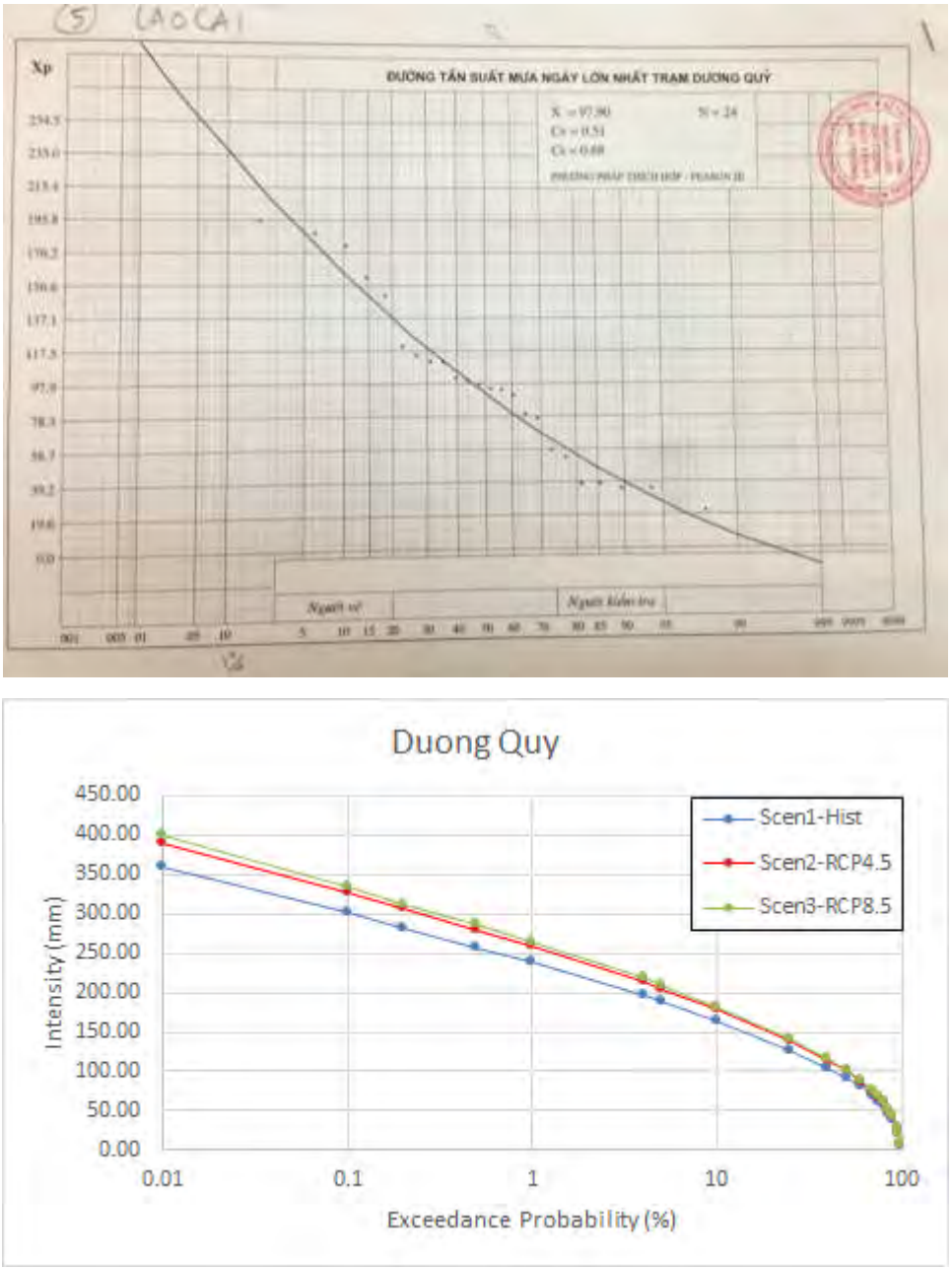


Figure D-14: Depth Duration Frequency Graph (top) and Intensity Duration Frequency Graph (bottom) for 24-h precipitation, Duong Quy (designated #5)

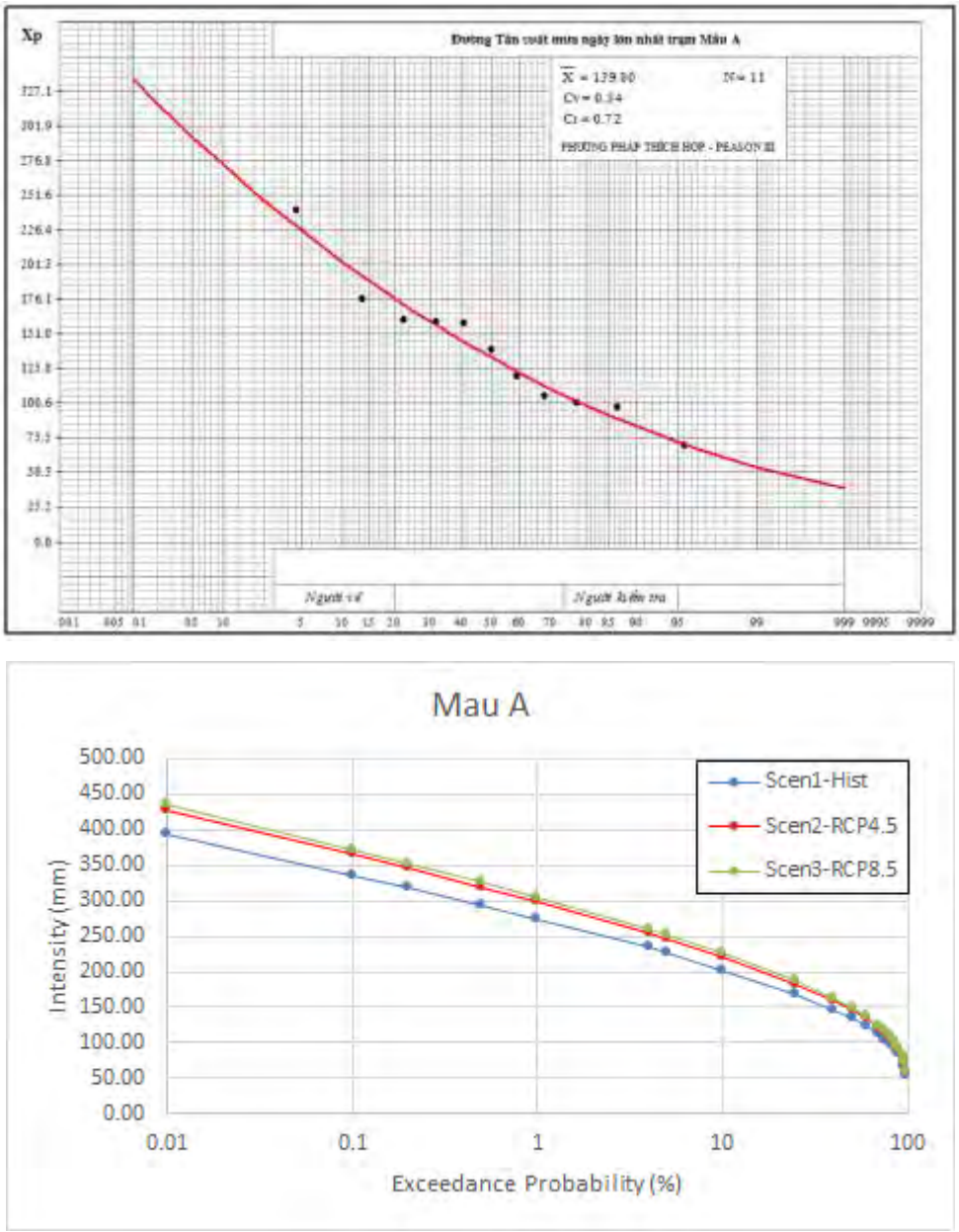


Figure D-15: Depth Duration Frequency Graph (top) and Intensity Duration Frequency Graph (bottom) for 24-h precipitation, Mau A (designated #6)

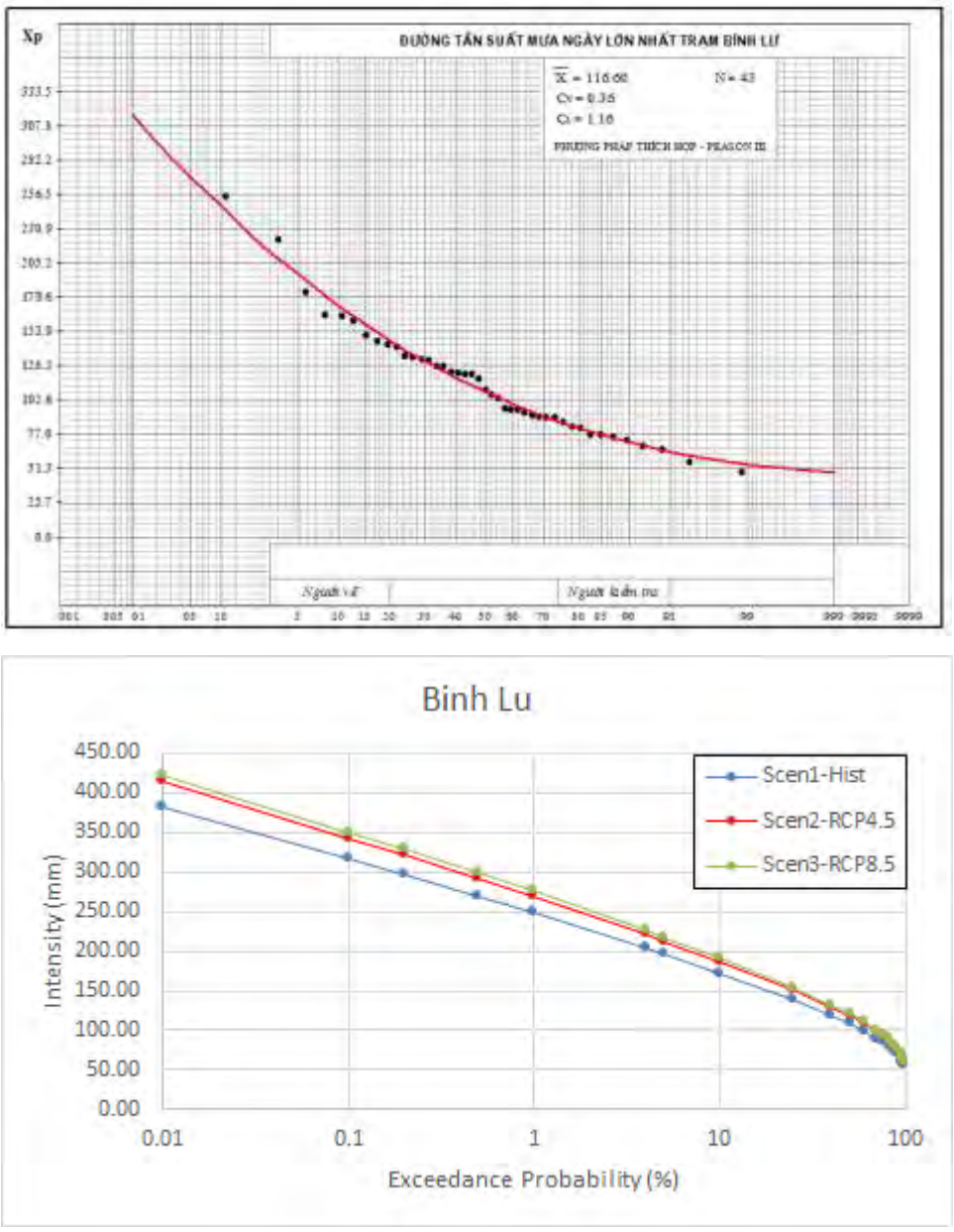


Figure D-16: Depth Duration Frequency Graph (top) and Intensity Duration Frequency Graph (bottom) for 24-h precipitation, Binh Lu (designated #7)

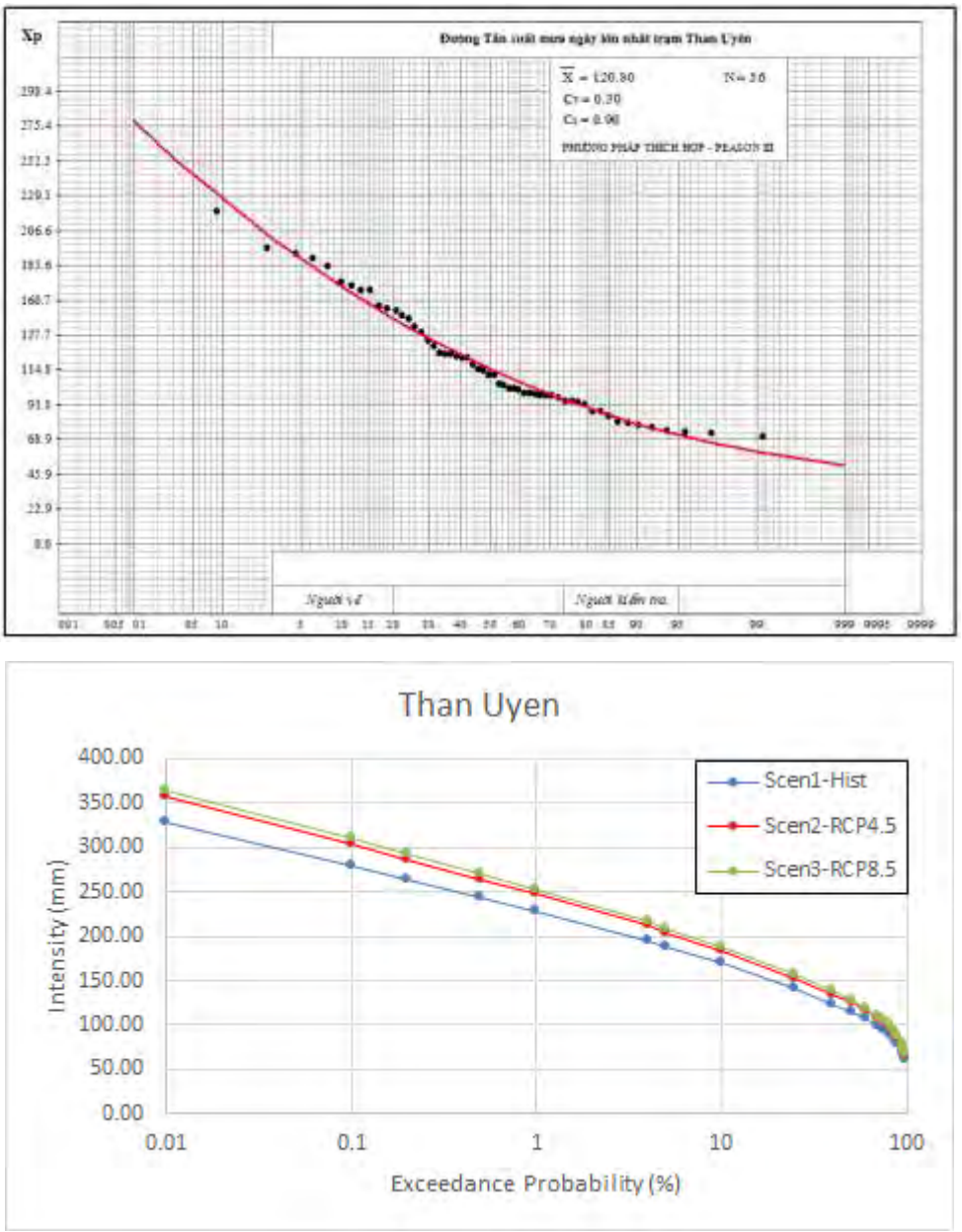


Figure D-17: Depth Duration Frequency Graph (top) and Intensity Duration Frequency Graph (bottom) for 24-h precipitation, Than Uyen (designated #8)

133. **Humidity.** Average annual humidity in the province is between 83% (Lai Chau) and 86% (Yen Bai). The period with highest humidity is typically February to July (**Table D-4**).

Table D-4: Monthly humidity in the project provinces (%)

	Yen Bai		Lao Cai		Lai Chau	
Year / Month	2010	2016	2010	2015	2012	2016
Average year	86	86	84.9	83.7	84	83
1	88	90	85.3	85.3	79	79
2	86	81	76.0	84.0	73	72
3	84	89	78.8	81.5	71	76

4	87	90	83.5	79.8	81	79
5	87	86	83.5	77.3	90	85
6	84	82	84.8	80.3	91	88
7	83	86	84.5	82.0	85	88
8	87	87	88.3	85.0	88	87
9	87	85	88.0	86.5	84	83
10	84	83	88.0	86.5	87	82
11	85	88	88.0	86.8	85	78
12	87	85	89.8	89.0	84	83

Source: Provincial Statistical Yearbooks, 2016

D.2.2.Wind speed and wind direction

134. Wind directions are influenced by the climate and the topography of the project area. the main wind direction in the year includes the North-East (from November to March) and the South-West or East-Southeast (April - October) The average annual wind speed is 1.3 m/s, the average wind speed between the months of the year ranges from 1.0 to 1.8 m/s.

Table D-5: The average wind speed in the project provinces

Month		1	2	3	4	5	6	7	8	9	10	11	12	Average
Yen Bai	V_{Ar} (m/s)	1	2	1	2	2	1	1	1	1	1	1	1	1
	Wind direction	ENE	E	E	ENE	SW	SE	SW	SW	SW	WSW	ESE	SE	SW-7
Lao Cai	V_{Ar} (m/s)	1	1	2	2	1	1	1	1	1	1	1	1	1
	Wind direction	SE	SE	ESE	E	SE	S	SE	E	SW	ESE	SE	ESE	E-4
Lai Chau	V_{Ar} (m/s)	2	2	2	2	2	2	2	2	1	1	2	2	2
	Wind direction	NW	SE	SE	ESE	NW	SW	NNE	SSW	NW	NW	SE	SE	ESE-4

Source: Domestic EIA (January 2018)

D.2.1.Climate Change

135. As part of the initial climate risk screening for the project, ADB identified the climate risk associated with this project as “high” mainly because of risks associated with flooding, landslide/rockfall, wild fire, temperature increase and precipitation increase. Under future climate conditions:

136. For the climate change scenarios, the period of interest is mid-21st century (2041-2060). Uncertainty associated with future climate change projections is accounted for by considering outputs from different climate models and emissions scenarios, referred to as Representative Concentration Pathways (RCPs) for the Intergovernmental Panel on Climate Change’s (IPCC’s) Fifth Assessment Report (AR5).

137. Monthly precipitation totals, daily precipitation means, daily precipitation maximums, daily maximum temperature and daily minimum temperature were obtained at a 0.44°x 0.44° (~50 km x 50 km) spatial resolution from the CORDEX South Asia datasets for five different GCM/regional climate model (RCM) combinations for current (1986-2005) and future (2041-2060) time horizons and two different greenhouse gas emission scenarios (RCP4.5 and RCP8.5).

138. **Projected changes to precipitation.** Under future climate conditions, monthly total and daily maximum rainfall and maximum/minimum daily temperatures are projected to

increase across the region. The projected increases under RCP8.5 are greater than those under RCP4.5.

139. The results for changes to mean monthly precipitation totals projected by the different GCM/RCMs suggest a high degree of uncertainty (both in the magnitude and direction of change and in the seasonality of the changes (i.e. which months the greatest changes will occur). However, results suggest some consensus that the May/June and Nov/Dec (i.e. pre- and post- the traditional July to October wet season months) will be wetter. This is true for both RCP4.5 and RCP8.5, with the magnitude of May precipitation increase possibly up to 59-61%, and the magnitude of December precipitation increase possibly up to 173%-208%. Similarly, results show some consensus that January to April will be drier, with projections suggesting monthly precipitation decreases greater than 60% for some months in the January to April period.

140. The projected changes to daily precipitation maximums are very uncertain – even more so than changes to mean monthly precipitation totals. However, as with projected changes to mean monthly precipitation totals, results show consensus for the months just before and just after the traditional wet season (July to October) to experience greater daily precipitation maximums. This is true for both RCP4.5 and RCP8.5, and is especially clear for December where projections consistently suggest daily precipitation maximums greater than 1.5-2 times what is experienced historically. Potential for such drastic increases to already problematic extreme precipitation is obviously a concern, however, results also show numerous cases where daily precipitation maximums during the rainy season are projected to decrease (sometimes by more than half what they are currently/historically).

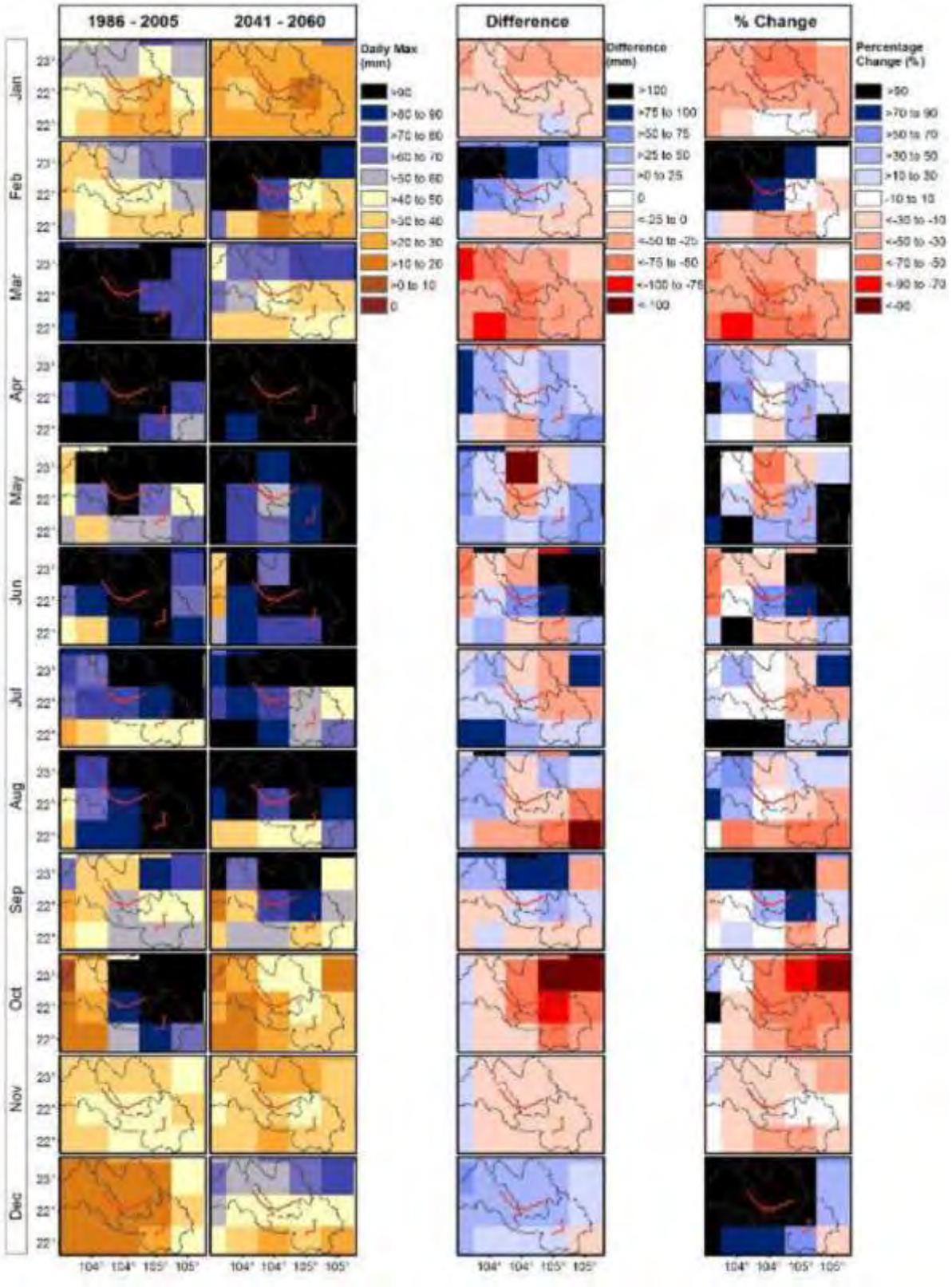


Figure D-18: Difference between current (1986-2005) and future (2041-2060) daily precipitation maximums within each month under the RCP4.5 climate change scenario (projections from GFDL-CM3 downscaled using CSIRO-CCAM). *Source: CRVA, February 2018*

141. The implications of these projected changes in monthly precipitation totals and daily precipitation maximums for both Nh32/NH279 and PR175 are similar. That is, for the climate-related hazards, there is an increased risk (likelihood and magnitude of impacts) of flooding,

landslides and rockfalls in the July to October wet season and an increased risk of wildfire from January to April.

142. **Projected changes to temperature.** The projected increases in temperature are far more certainty than those for rainfall. The CRVA concludes that it is very likely, under both RCP4.5 and RCP8.5, that mean maximum daily temperature will increase across the project area for all months of the year. The range of projected changes in maximum daily temperatures varies from, on average, 0.2-2.7°C for RCP4.5 and 1.1–3.1°C for RCP8.5 ("pessimistic"). The obvious implication of these projected increases in maximum daily temperatures is an increased risk of wildfire in the dry/hot months between December to April.

143. The CRVA concludes that NH32 and NH279 contain three zones with a Very High-risk rating for flood hazards. These flood prone zones are the low elevation areas near the Nam Chan River and a high density of smaller streams in: Tan Thuong, Son Thuy, and Phuc Than communes (Van Ban district); Tan Uyen Town; Pac Ta and Phuc Khoa communes (Tan Uyen district); and the Ban Bo and Binh Lu communes (Tam Duong district). PR175 contains two zones with a Very High-risk rating for flood hazards. These are the An Thinh and Mo Vang communes in the Van Yen District.

144. For NH32 and NH279, a Very High landslide risk was found for: Tan Thuong, Son Thuy, Hoa Mac communes (Van Ban district); Tam Duong district; and Tan Uyen district. PR175 was found to have Very High landslide risk in Suoi Quyen and An Luong communes. In these locations, landslides are triggered by the steep, thinly vegetated slopes and regular heavy precipitation events.

145. For PR175 the stretch of road between Km40 to Km41 is associated with a High-risk rating for rockfall hazards (where the first kilometer marker of PR175 was placed at first point of road near interchange 14 of the Noi Bai-Lao Cai expressway). For NH32 and NH279, a Very High risk of rockfall is identified for the area mainly located in Son Thuy commune (Van Ban district).

146. For NH279, a Very High-risk rating for wildfire hazard is found in the northeast of Van Ban district. For PR175, the risk of wildfire hazard is rated as High along most of the road.

147. The CRVA team identified a total of 30 "hot spot" sites (see Appendix A for details). Flood and landslides were the most common hazard types. For NH32 and NH279, 11 climate-related vulnerability "hot spots" were identified. Most of this vulnerability is associated with flooding due to the low elevation of the roads and frequent high-water levels experienced in the nearby Nam Chan River.

148. For PR175 there were 19 climate-related vulnerability "hot spots" identified. The biggest concern is about landslides and floods associated with high water levels in the Ngoi Thia River. PR175-1 (Km17+800) experienced severe flooding in 10-11 October 2017 flood. The highest water level rose to 3.5 meters above the road. PR175-11 (Km37+500) is regularly flooded after heavy rain and/or water releases from the upstream dam associated with the hydropower plant. The design of the bridge to replace An Luong spillway should consider the influence of the upstream dam on water levels downstream, especially in the heavy rainfall season (i.e. July to October).

D.2.2.Hydrology

149. The project area is in the main basin of Red River system (**Figure D-19**). Main sub-systems of the Red River system in Northwestern Viet Nam include the Lo River Basin, the Thao River Basin, the Da River Basin (Black River), the Day River Basin and the Cau River Basin. The project roads are located within the Da River Basin (NH32, part of NH279), and the Thao River Basin (part of NH279, PR175).

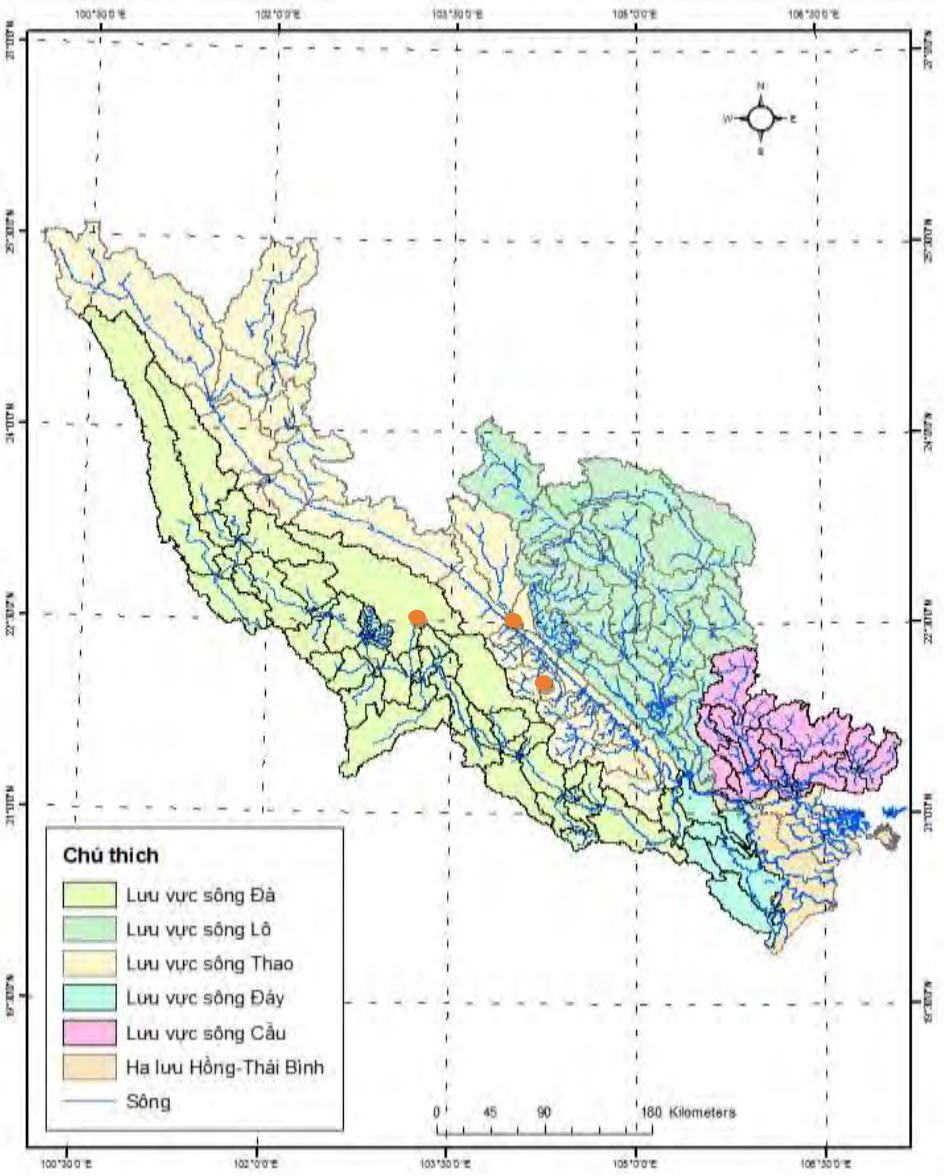


Figure D-19: Map separating basin of Red river - Thai Binh river

150. **Thao River** originates from the Wei Son Mountains in Yunnan Province, PRC. The river has a total length of 902 km with a basin area of 51,900km2. River flows vary depending on the season, with the flood season lasting for 5 months, from June to October, with flows accounting for about 71% of the annual flow.

151. **Da River** (Black River) also originates from Yunnan Province, PRC. The length of the river is 1010km, with a basin area of 52,900km2. Characteristics of the river shape and basin are favorable for rapid formation of speedy and fierce floodwaters. The flood season lasts from June to October, with water volume accounting for about 77% of the annual water flow. There are several hydropower plants along Da River, including Hoa Binh, Son La, Huoi Quang, Ban Chat. Currently Lai Chau hydropower plant is being built. With these projects, peak flows to downstream areas has been significantly reduced.

152. The project roads run along or cross several rivers and small streams. The hydrology of these rivers is characterized by a short time of concentration in upstream watersheds due to the steep slopes. The main rivers are described below.

a. **Red River:** The first two points of the project, including the connecting section of Nghia Lo and Lai Chau, are located near the Red River, some 200-400 meters

away. Although the project is not anticipated to adversely affect the quality or flow of the river, during the construction of the project, this will be an important shipping route for the transportation of raw materials and construction materials.

b. **Ngòi Thia River:** This is a tributary of the Red River, flowing in the western districts of Yen Bai province with a total length of 165km. From the beginning point to the end (Mau A-Nghia Lo town), Thuy Thia is on the left side of PR175, connecting Nghia Lo town. The stream crosses the project line at Km34 + 600, then running parallel to the right. During construction of the project, Thuy Thia may be exposed to adverse environmental impacts from construction activities.

c. **Ngòi Nhu River:** This is a small river in Van Ban district - Lao Cai province. The stream flows close to the left of the Lai Chau connection line from Km8 + 00 to Km9 + 200 and intersects with Khe Leach bridge (Km9 + 300).

d. **Ngòi Chan River:** A small river in the western part of Van Ban district, Lao Cai province, the stream flows near and is located on the right of the route connecting Lai Chau from Km23 + 200- to Km57. During construction of the project, Ngoi Chanh could be adversely affected by the project.

e. **Nam Mu River:** It is a tributary of the Song Da River, which flows in Lai Chau and Son La provinces. The river has a length of 181 km and a basin area of 3,433 km². The river runs from Km107 to Km109 and intersects with the route at Km119. The river is adjacent to the road from Km109 to Km117 + 300, and could be adversely affected during construction.

153. Names and locations of rivers and small streams near project roads are presented in **Table D-6**.

Table D-6: Rivers and streams in the project's area of influence

No.	Location	Name of River and Stream	Notes
I	***NH279***		
1.1	Km0+00	Red River	Near
1.2	Km9+200	Nhù River	Crossing
1.3	Km 22+670	Chút Stream	Crossing
1.4	Km23+200-Km57	Chăn River	Near, on the right
1.5	Km 31+683.5	Nậm Chố Stream	Crossing
1.6	Km 32+880	Nậm Miên Stream	Crossing
1.7	Km 35+950	Nậm Con Stream	Crossing
1.8	Km 42+320	Pom Khén	Crossing
1.9	Km 43+920	Nậm Xây Stream	Crossing
II	***NH32***		
2.1	Km72+850	Nậm Sắp Stream	Crossing
2.2	Km81+050	Mít Nọi Stream	Crossing
2.3	Km83+750	Mít Luông Stream	Crossing
2.4	Km89+800;	Nậm Đun Stream	Crossing and on the left from Km83+800-Km89+800
2.5	Km99+200	Nậm Cưởm Stream	Crossing
2.6	Km100+550	Nậm Chẳng Stream	Crossing
2.7	Km102+700	Nà Cóc Stream	Crossing
2.8	Km102+900	Nà Nọi Mông Stream	Crossing
2.9	Km103+750	Trạm Cả Stream	Crossing
2.10	Km106+950	Nậm Be Stream	Crossing
2.11	Km111+050	Nậm Bon Stream	Crossing
2.12	Km116+850	Nậm Tàng Stream	Crossing
III	***Bản Bo-Đông Pao section (new) and PR136 (Lai Chau province)***		
3.1	Km117+400	Nậm Lăm Stream	Crossing

3.2	Km119+700 and Km137+400	Nậm Mu River	Crossing and on the right from Km120+200 to Km137+400
3.3	Km127+350	Nậm Đích Stream	Crossing
3.4	Km133+650	Nậm Hon Stream	Crossing on the right from Km133+700 to Km136+600
IV	***PR175***		
4.1	Km0+600-Km10+00	Ngòi Bục Stream	Near, on the right
4.2	Km14+700	Khe Sấu Stream	Crossing and on the left from Km14+700 to Km16+400
4.3	Km34+600	Ngòi Thia River	On the left from Km16+400 to Km34+600 and on the right from Km34+600 to Km48+915
4.4	Km22+200	Thác Cá Stream	Crossing
4.5	Km29+100	Khe Sung Stream	Crossing
4.6	Km32+250	Khe Chầu Stream	Crossing

D.3. Ecological resources

D.3.1. Ecological region, sub-regions, forestry resources

154. North-western Viet Nam belong to the Northern Indochina Subtropical Forests terrestrial ecoregion, which extends across the northern Myanmar highlands, the southern part of Yunnan, and northern parts of Thailand, the Lao PDR, and Viet Nam.[3] This ecological region is dominated by evergreen and semi-evergreen forests, with sub-types such as lowland evergreen mixed closed and broad leaved humid forests less than 700m; lowland evergreen mixed closed and broad leaved humid forests in the South; low and medium mountainous evergreen mixed closed and broad leaved humid forests 500 – 1,500m.

155. In 2011, FAO, UN-REDD Viet Nam and the Research Centre for Forest Ecology and Environment of Forest Science Institute of Viet Nam introduced a stratification of Viet Nam's territory into forest eco-regions by considering ecological factors that influence greatly the formation and productivity of forest vegetation types.[4] The results of forest stratification identified 2 ecological zones, 8 ecological regions and 47 ecological sub-regions.

156. According to this stratification, the project area belongs to the Northwest ecological region, and 2 sub-regions, including Da River Upstream, and Hoang Lien Mountain Range (**Figure D-20**).

[3] BCA, WWF, Stockholm University, 2013. Ecosystems classification mapping in Viet Nam. Ha Noi, Viet Nam
[4] RCFEE. Final Report on Forest Ecological Stratification in Viet Nam. 2011. FAO, UN-REDD Programme. Hanoi.

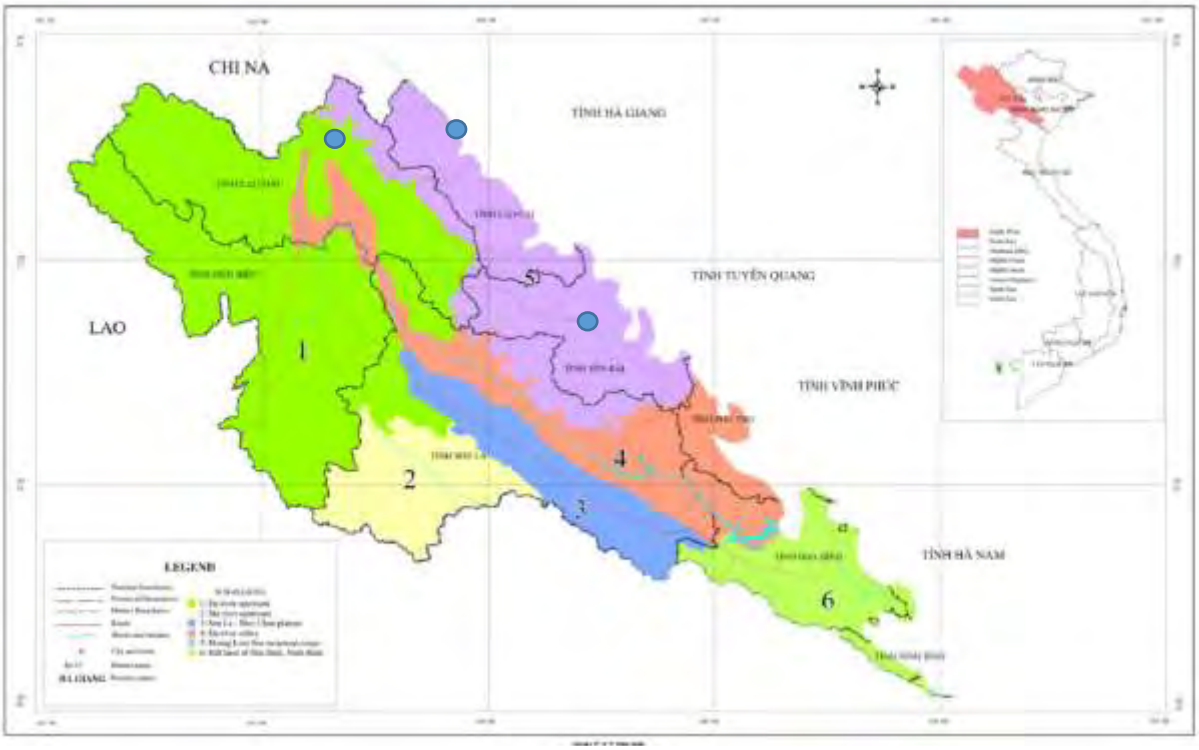


Figure D-20: Forest Ecological Stratification in Northwestern Viet Nam.

Source: RCFEE. Final Report on Forest Ecological Stratification in Viet Nam. 2011. FAO, UN-REDD Programme. Hanoi.

157. In the **Da river sub-region**, dominant forest types consist of *Litsea, Machilus* (belonging to family Lauraceae); *Lithocarpus*, genus *Castanopsis* (under the family Fagaceae) etc and some other species such as *Excentrodendron tonkinense*, *Taxotrophis illicifolia*, *Garcinia fagraeoides*, *Celtis* spp. Commercially-valued species are usually exhaustedly harvested; other species including *Aglaia* spp., *Pterospermum* spp., *Streblus macrophyllus* etc. The flora population includes other economic value species such as *Markhamia stipulata*, *Chukrasia tabularis*, *Streblus macrophyllus*, *Taxotrophis illicifolia*, *Streblus tonkinensis*. The average volume is 80-150 m3 /ha. - Different types of plantations consist of major species such as *Acasia* spp., *Eucalyptus* spp., *Bambusa* spp. and some indigenous broad-leaved species.

158. In **the Hoang Lien Son Mountain Range sub-region**, forests include evergreen mixed closed and broad leaved humid forests with the 2 sub-types, i.e. evergreen mixed hilly, low and medium mountainous closed and broad leaved humid forests at the elevation of 500-1500m and high mountainous evergreen mixed closed and broad leaved humid forests at over 1500m. The forest subtype of hilly, low and medium mountainous evergreen mixed closed and broad leaved humid forests at the elevation of 500-1500m has dominant species such as mountainous *Lithocarpus* species, *Quercus* species under the *Fagaceae* family; *Illicium* spp under the *Iliciaceae* family; *Eurya* species, *Camelia* and *Hartia* under the *Theaceae* family; some *Acer* species under the *Aceraceae* family; *Alnus nepalensis* under the *Betulaceae* family; Magnolia including *Manglietia* under the *Magnoliaceae* family, *Diplopanax* under the *Araliaceae* family; *Pentaphylax* under the *Pentaphyllaceae* family, *Rhodoleia* under the *Rhodoleiaceae* family, etc. or mixed with coniferous species such as *Fokienia hodginsii* under the *Cupressaceae* family, *Tsuga yunnanensis* and *Abies delavayi* under the *Pinaceae* family. The vegetation cover is characterized by dominant species such as *Ericaceae*, mainly including *Rhododendron* with 6-10 species, *Lyonia* with 2-3 species, *Gaultheria* with 2-3 species. The sub-type of high mountainous evergreen mixed closed and broad leaved humid forests > 1,500m in this region are developing on acidic and thin soil class. This forest subtype is formed by low timber trees including species of the following family as *Ericaceae*, *Illiciaceae*, *Rosaceae*, *Theaceae*, *Abies delavayi* and some bamboo species under the *Arundinariai*

family.

159. In general, forests in the project region have been strongly impacted by human activities. Primary natural forests do no longer exist, except isolated areas in legally protected areas (see below). There exists only modified secondary natural forest. Forest volume and yield in the region is quite low (on the average: 80- 245m3 /ha). Natural forest is mainly contained within the special use forests delineated by the Vietnamese Government.

Table D-7: Forest Classification in Viet Nam

In Viet Nam, forests are mainly classified by their use and origin: **Classification of forest by use** includes (i) protection forest, i.e. forest used primarily to protect water resources, soil conservation, erosion and desertification reduction, natural disaster mitigation, climate regulation, and environmental protection; (ii) special-use forest, i.e. forest used to preserve nature resources, national important ecosystems, forest genetic resources, contribution to scientific researches, historical protection, and tourism development along with environmental protection; and (iii) production forest, i.e. forest used mainly for the production and trading of woods, non-timber forest products. **Classification of forest by origin** includes the following 2 classes: (i) Natural forest, i.e. forest that is natural or being restored through natural regeneration. This includes 2 sub-classes, including (a) Primary forest: the forest has either not been affected at all or has been little affected by humans or natural disasters and the forest structure is relatively stable; and (b) Secondary forest: the forest has been affected by natural disasters or human-made forest structure change; (ii) Planted forest, i.e. forest formed by human intervention, including: (a) newly planted on abandoned land; (b) Forest replantation/rehabilitation; (c) Natural recovered forest (the forest that naturally recovered after being harvested).

160. The project's area of influence includes primarily production forest (concentrated along NH279 and PR175), protection forest (at sections Km131+200-Km134+200 and Km145+450-Km151+450 of NH279, and at western part of PR175), and some areas designated as special use forest (limited to the Hoang Lien Son National Park near NH32, and the Van Ban Nature Reserve, at section Km145+450-Km151+450 of NH279). **Figure D-21** and **Figure D-22** present land use maps along the project roads, including forestry zoning. The legend to the maps is provided in **Figure D-23**.

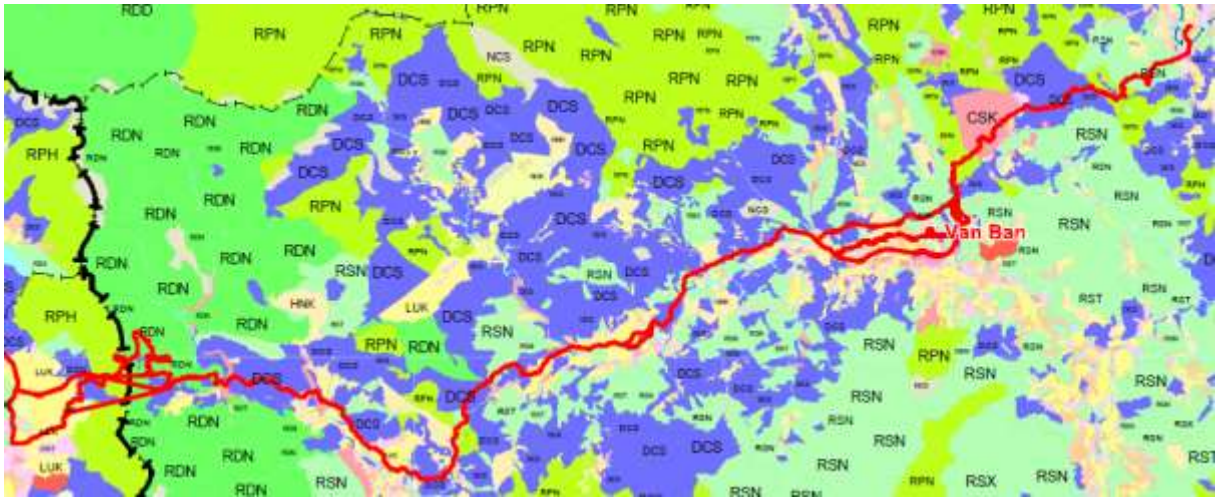


Figure D-21: Land use zoning map along NH279

Source: Lao Cai Province Department of Natural Resources and Environment.

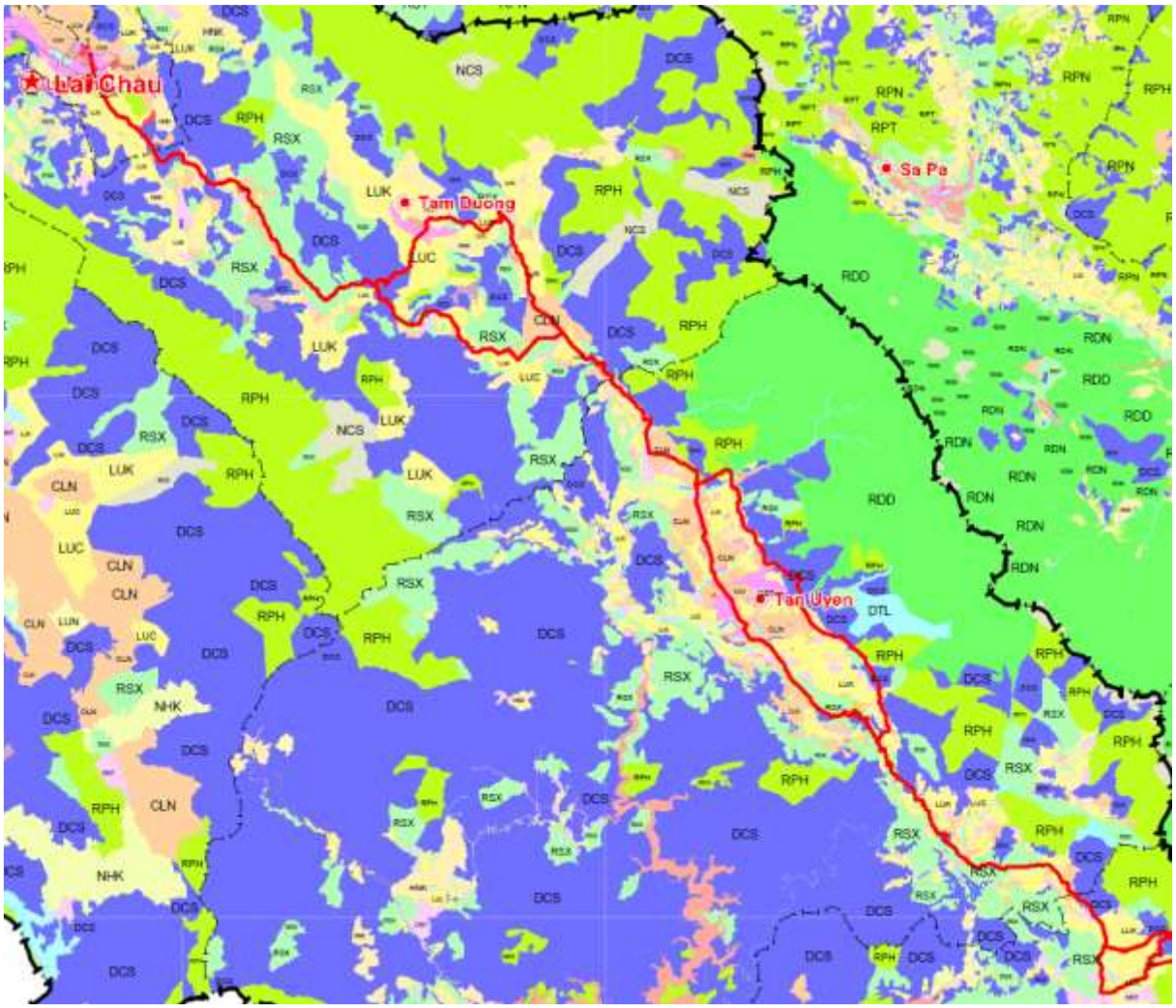


Figure D-22: Land use zoning map along NH32

Source: Lai Chau Province Department of Natural Resources and Environment.

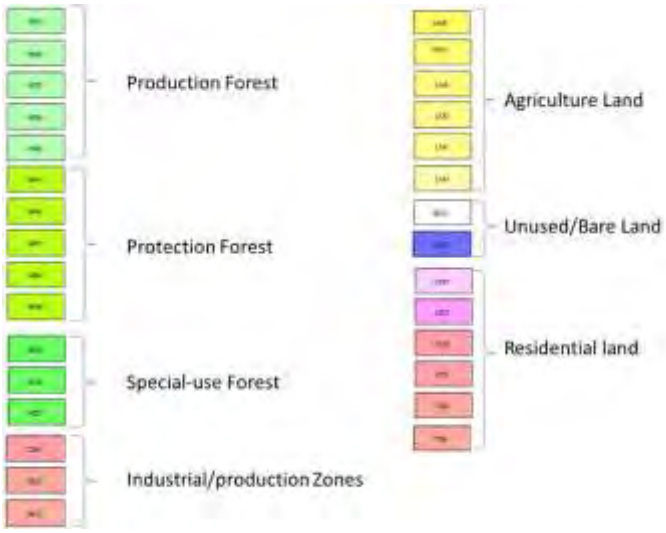


Figure D-23: Land use zoning categories

D.3.1.Legally protected sites

161. Biodiversity hotspots in the project area are mainly restricted to legally protected sites in the project provinces. Two of those sites are in proximity to the project roads. These include the Hoang Lien National Park and the Van Ban Nature Reserve in Lao Cai Province. Other legally protected sites in the project provinces are at much greater distances and will not be adversely affected by the project.

162. NH32 runs parallel to the **Hoang Lien Son National Park** (**Table D-8**). The road is more than 3km away from the boundary of the national park, and the proposed improvements (consisting primarily of road rehabilitation) are not anticipated to have any negative impact on the national park and its protection objectives. In fact, the project is anticipated to reduce the current pressure of traffic on the Hoang Lien National Park by diverting some 15% of the existing traffic on NH4D, which partly encroaches on the Hoang Lien National Park, onto the project roads (NH32, NH279). This was confirmed by Lai Chau and Lao Cai provincial departments of agriculture and rural development and the departments of natural resources and environment during stakeholder consultation in January 2018.

Table D-8: Overview of Hoang Lien National Park

On July 12, 2002 under Decision Number: 90/2002/QD-TTG the Prime Minister decided to upgrade Hoang Lien Conservation Zone in Sa Pa, Lao Cai province, into a national park belonging to the system of Viet Nam's special-use forests.

Location. Hoang Lien national park is in San Sa Ho, Lao Chai, Ta Van, Ban Ho communes (Sa Pa rural district) and part of Muong Khoa, and Than Thuoc communes (Than Uyen rural district), Lao Cai Province.

Boundary. Hoang Lien National Park borders Ta Thoi commune (Lao Cai town), Thanh Kim, Nam Sai, Nam Cang communes (Sa Pa district), Nam Xe commune (Van Ban district) in the east; Phong Tho commune (Lai Chau Province) in the west; Ho Mit, Pac Ta, Nam Can communes (Than Uyen district) in the south; Ta Giang Phinh, Ta Phin, Ban Khoang and Trung Trai communes (Sa Pa district). It has the following geographical coordinates:

- From 220 07' to 220 23' north.
- From 1030 00' to 1040 00' east.

Area and functional divisions. The national park has a total area of 29,845 ha, including (i) strict protection area: 11,875 ha; (ii) ecological restoration area: 17,900 ha; (iii) administration, tourism, service area: 70 ha. The buffer zone of Hoang Lien National Park has the area of 38,724 ha, including: Sa Pa town; Sa Pa, Lao Chai, Hau Thao, Su Pan, Ban Ho, Nam Sai, Nam Cang communes (Sa Pa district); Nam Xe commune (Van Ban district); Ho Mit, Than Thuoc, Muong Khoa communes (Than Uyen district)-Lao Cai Province and Ban Pho, Binh Lu communes (Phong Tho district-Lai Chau Province).

Mission and goals. The national park has the following objectives:

- To preserve the ecological system of high-mountain forests of Hoang Lien mountain range characterized by the typical subtropical ecology.
- To protect the biodiversity with many rare, precious and endemic wild flora and fauna species. To restore the forests' ecological systems and landscape, thus creating conditions for animals and plants of various species to live and grow.
- To conduct scientific research and environmental education.
- To develop ecological tourism, contributing to socio-economic stabilization and development in the locality.

Institutional arrangements. The People's Committee of Lao Cai Province oversees managing Hoang Lien National Park. The president of the People's Committee of Lao Cai Province is responsible for:

- To submit to the competent authorities for approval the investment project on construction and development of Hoang Lien National Park and investment project on development of buffer zone of Hoang Lien National Park following the current regulations.
- To submit to the competent authorities for approval investment project on the development of eco-tourism of Hoang Lien National Park.

The president of Lao Cai Province People's Committee is assigned to decide on the organization and structure of Hoang Lien National Park based on the provisions in the Regulation on management of special-use forests, protection forests and production forests which are natural forests promulgated together with the Prime Minister's Decision No.08/2001/QD-TTg of January 11, 2001 and the unified opinion of the Ministry of Agriculture and Rural Development.

Flora. Hoang Lien National Park has 2,847 species including 149 rare species. There are 133 species in the Viet Nam Red data book, including 32 threatened species in the world. Hoang Lien National Park has also a diverse system of endemic species with 167 species of orchid.

Fauna. There are 55 terrestrial vertebrates, including 96 mammal species, 346 bird species, 63 amphibian species and 50 reptile species. The national park has many species that are rare, endangered or in threat of extinction such as Western Black Crested Gibbon, Java Mouse-Deer, leopard, chamois, pangolins, and Indochinese silvered langur. Amphibians and reptiles such as turtles, snakes, and monitor lizards are endangered. Hoang Lien National Park has many butterflies which have conservation value, but also attract tourism. There are 304 species recorded, which belong to 138 varieties, 10 families.

163. The existing NH279 runs through the Ecological Restoration Subzone (ERS) of **Van Ban Nature Reserve**, a provincial nature reserve established in 2007 under Decision No. 399 (2007) of the Lao Cai People's Committee. Given the project roads alignment within the boundaries of the nature reserve, a more detailed description of the nature reserve is presented in the next section. The description of the reserve and its protection objectives is primarily derived from recent research conducted within the nature reserve, which is documented in publicly available scientific literature. Given the large volume of reference material which is available, it was considered unnecessary to conduct further studies to aquire primary data on the nature reserve in the framework of this EIA.

D.3.2.Hoang Lien Van Ban Nature Reserve

D.3.2.1. History, protection objectives

164. Hoang Lien – Van Ban Nature Reserve (HLVBNR) is in Van Ban district of Lao Cai Province. In 2007 Van Ban forest was included in the special-use forest system of Viet Nam and officially gazetted as a nature reserve per Decision No. 399 (2007) of the Lao Cai People's Committee, with an area of approximately 25,669 hectares in the administration areas of Nam Xe, Nam Xay and part of Liem Phu communes.

165. The management of the reserve is carried out by Lao Cai Forest Protection Department. In 2007, Hoang Lien - Van Ban Nature Reserve Management Board was established per Decision No. 702/QD-UBND dated 27 March 2007 of Lao Cai People's Committee.

166. The Hoang Lien Van Ban Nature Reserve (HLVBNR) Management Plan was formulated in 2008 and the HLVBNR Master Plan was approved in 2012. The formulation of these plans was informed by a series of surveys and research studies conducted in the reserve, focusing on vegetation types, vascular plants, small mammals, species-specific surveys (black gibbons, Taiwania cryptomerioides Hayta), among others.[5] The Master Plan

[5] Including but not limited to: (i) Institute of Ecology and Biological Resources (2012). Final report on Survey and assessment project of current status of vascular plant diversity at Hoang Lien Van Ban Nature Reserve, Lao Cai; (ii) North West Forest Inventory and Planning Sub-Institute (2012). Hoang Lien – Van Ban Field survey report for

guides development in HLVBNR until 2022. The two documents are complementary. Key features of the two plans are presented in **Table D-9**.

Table D-9: Comparison between HLVBNR Management Plan (2008) and Master Plan (2012)

Item	2008 Management Plan	2012 Master Plan	Notes
NR coordinates	21°53'16" to 22^{0}09'00" North 103°56'22" to 104°20'57" East	21^{0}24' to 21^{0}50' North 103°57' to 104°00' East	
Total Area	25,669 ha	25,093 ha	A decrease of 575.8 ha because removing part of agricultural land and residential land (Nam Si Tan village) and a part of the area converted into two hydropower plants (Nam Mu and Nam Xay Noi 2)
SPS Area	21,629.0 ha	21,629.0 ha	Unchanged
Population in SPS	None	None	
Population in ERS	14 households	14 households, 64 persons	
Management Staff	6	10	
Legal ground for management	Decision 186/2006/QD-TTg on the promulgation of forest management regulations	Decision 186/2006/QD-TTg on the promulgation of forest management regulations	Unchanged
Management method related to road construction			
Road construction in SPS	Strictly prohibited	Strictly prohibited	
Road construction in ERS	Limited by regulations	Must comply and be aligned with the approved Master Plan; No harm to the forest.	
Hydropower plants	Unknown	3: Nam Mu, Nam Xay Noi 2, Nam Khoa	

preparation of Conservation and Sustainable Development Masterplan for Hoang Lien – Van Ban Nature Reserve, for the period 2013-2020; (iii) Nguyen Trong Binh and Nguyen Toan Thang, (2008). Characteristics of vegetation cover in Hoang Lien Van Ban Nature Reserve, Lao Cai. Journal of Agriculture and Rural Development, 3: 62-66; (iv) Nguyen Truong Son, Shin-ichiro Kawada, Junj Moribe, Abramov Alexei V. (2009), The survey of small mammals in Hoang Lien National Park and Van Ban Area, Lao Cai Province. Proceedings in the 3rd National Symposium on Ecology and Biological Resources; (v) Report on black gibbons and fauna in Nam Xa, Nam Xa commune, Van Ban district (2000); (vi) Report on Survey Results of *Taiwania cryptomerioides Hayta* in Hoang Lien – Van Ban Area (2001, 2006).

Notes: SPS = Strictly protected subzone; ERS = Ecological restoration zone.

167. The protection objectives of the HLVBNR as per the HLVBNR Master Plan 2012[6] are defined as follows:

a. to protect the valuable and precious gene resources of the wild flora and fauna of Viet Nam including the populations of globally threatened western black crested gibbons *Nomascus concolor*, beautiful nuthatch *Sitta Formosa* and the pine *Taiwania cryptomerioides*;

b. to protect and maintain the water sources used for local irrigation and agricultural production in the buffer zones and by downstream users;

c. to enhance local people's awareness of natural resource and environmental conservation, and enhance local livelihoods of buffer zone residents through implementing programs of forest regeneration, protection and production.

D.3.2.2. Biophysical context

168. HLVBNR is in the Hoang Lien Mountain Range between 210°24' to 210°50' North and 103°57' to 104°00' East. The topography of the nature reserve from north to east is characterized by high mountains and hills intermixed with valleys.

169. The **topography** of the nature reserve in communes of Nam Xé and Nam Xay consists of two mountain ranges which are perpendicular to each other. The northern range has high mounts over 1,700m (high mountainous terrain) and lowering to the east. The southern range has separate narrow ridges, stretching from west to east. Most of the terrain is in the high mountains and medium mountains with valleys and interstate rivulets; high degree of fragmentation; height average of 700 - 2,913 m; slope average of 20 - 50^0. In the area there are some high peaks such as Lang Cung (2,913m), followed by Nam Kang Ho Tao (2,835m), Sinh Cha Pao (2,833m).

170. There are **no major rivers** within VBNR, but there are several streams that originate mainly from Nam Xe and Nam Xay communes. The two main streams include Nam Khoa stream and Nam Xay Luong stream. These two streams have many small tributaries from the Hoang Lien Son range at the western boundary and then come to the Nam Chan River and then to the Red River

D.3.2.3. Zoning of the HLVBNR

171. According to HLVBNR Masterplan to 2020, the nature reserve has clearly defined boundaries. The reserve is located within the administrative boundaries of three communes: Nam Xay, Nam Xe and Liem Phu, and is divided into 19 forest blocks: (447, 462, 473, 486, 488, 500, 506, 510, 518, 528, 522, 526, 527, 528, 533, 534, 535, 537, 529). The total area of the NR is 25,093 ha.

172. The reserve is divided in 2 separate areas, including Area 1 (in Nam Xay and Man Xe communes), and Area 2 (Liem Phu commune). Area 1 is significantly larger (24,422.7ha) than Area 2 (670ha). The project road (NH279) is in the center of Area 1 and does not encroach on Area 2 (**Figure D-24**).

[6] Lao Cai Province People's Committee (2012). Hoang Lien Van Ban Nature Reserve (HLVBNR) Master Plan.

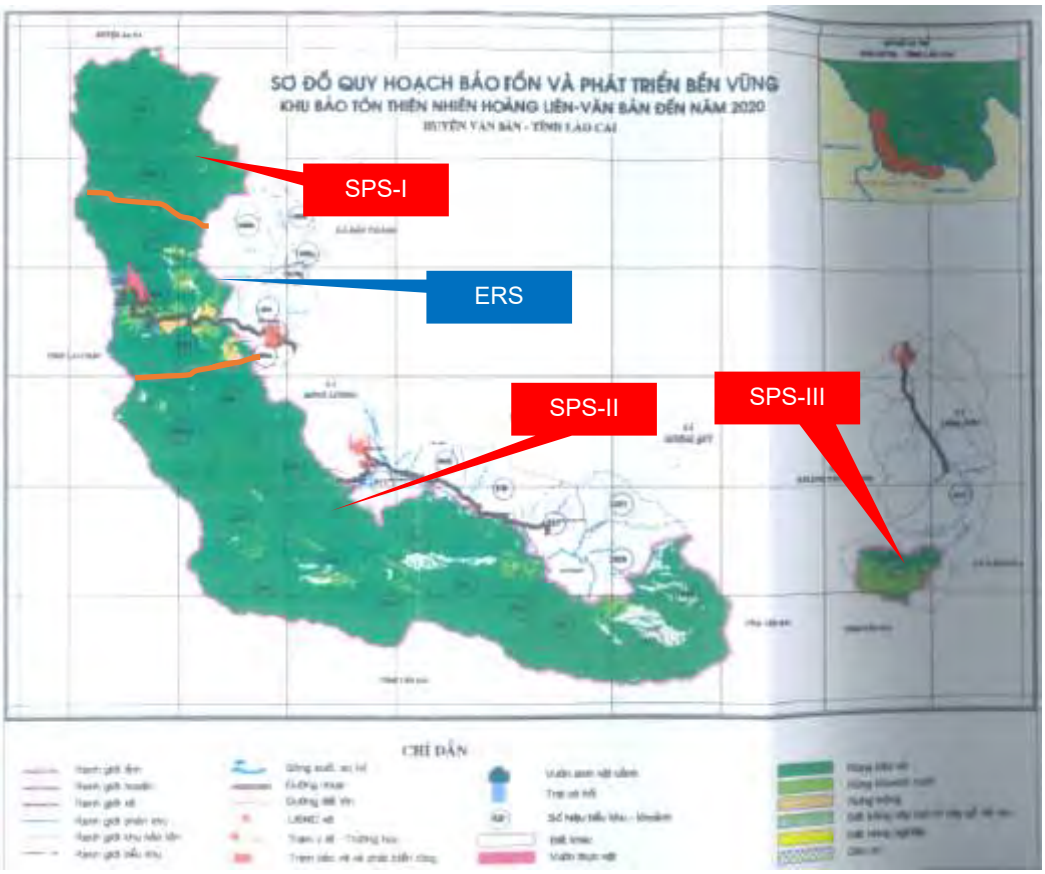


Figure D-24: The Boundaries of the HLVBNR. Left: Area 1; Right: Area 2. Brown line in center-left is the current alignment of NH279

D.3.2.4. Functional subzones

173. The nature reserve is further divided in functional subzones, including strictly protected subzones (SPS), ecological reforestation subzones (ERS) and a small service-administration subzone (SAS). The SPS and ERS are described below.

D.3.2.4.1. Strictly protected subzone (SPS)

174. The total area of the SPS is 21,629.0 ha, accounting for 78% of the nature reserve. SPS is divided into three areas within three communes, which are SPS I in Nam Xe commune (Area 1), SPS II in Nam Xay commune (Area 1), and SPS III in Liem Phu commune (Area 2).

175. SPS I covers 8 forest blocks (447, 462, 473, 500, 506, 510, 518, 528); SPS II covers 8 forest blocks: 522, 526, 527, 528, 533,534,535 and 537; and SPS III covers forest block 529. Strictly protected subzones are currently not inhabited. However, surrounding villagers still regularly collect NTFPs and graze cattle.

176. The **functions of the SPSs** are: (a) to protect and maintain the present ecological and biological systems against any activities that negatively affect this function, such as wood exploitation, firewood collecting and wildlife hunting; (b) to monitor the forest ecological system and sample plots in the sectors and (c) to conduct applied scientific research on the status and conservation of wild animal and plant populations and valuable genetic resources. Selected artificial works such as renovation of roads, climbing staircases etc. are allowed if these are in line with the projection objectives of the zone.

177. The management of the SPS must comply with Decision 186/2006/QD-TTg on the promulgation of forest management regulations. The following table provides management requirements of the SPS of the HLVBNR.

Table D-10: SPS management requirements

Activities	Forest impacts	Management measures
Logging, forest burning	Destroying the ecosystem, breaking canopy, forest structure; Disturbance to wildlife	All acts of tree exploitation and transportation are strictly forbidden
Exploitation of non-timber forest products (NTFP) such as rattan, medicinal plants, honey, orchids etc	Depletion of resources and disturbance of wildlife	NTFP collection must be controlled and compliant with sustainable harvesting regulations
Growing cardamom under the canopy of the forest	Destruction of canopy layer, forest structure, restriction of regenerated tree species	No more new expansion of the planted area; controlling area and planning for the existing area
Hunting birds and wild animals	Destroying biodiversity, depleting resources and increasing the risk of extinction of wildlife	All hunting and trapping activities in the nature reserve are strictly prohibited
Construction of houses, roads and public works	Facilitate deforestation, fragmentation of habitats of wildlife	To be minimized; the construction must comply with the planning and the current legal framework

Source: Hoang Lien – Van Ban Nature Reserve Master Plan, 2012

D.3.2.4.2. Ecological Restoration sub-zones (ERS)

178. The ERS covers 3 forest blocks (486, 488, 473), with the total area of 3,350.2 ha, accounting for 19.6% of the area of the reserve. The ERS consists mainly of poor secondary natural forest, young planted forest for ecological restoration. The ERS also includes farmland and paddy fields, residential areas (one village with 14 households), and the NH279 (paved class IV or lower mountainous road).

179. The functions of the ERS are: (i) to reforest and afforest the area of the natural forest ecological systems lost due to human disturbances; (ii) to serve the function of mitigating conflict between conservation goals of the SPS and economic development of people living in the ERS by effective participatory land use planning and making forest land near their resident areas available to local farmers for protection.

180. The management of the ERS must comply with Decision 186/2006/QD-TTg on the promulgation of forest management regulations. The following table provides management requirements of the SPS of the HLVBNR.

Table D-11: ERS management requirements

Activities	Forest impacts	Measures
Detailed land use planning	Create conditions for management, protection, conservation and sustainable development	High priority, encouraged with the involvement of local communities
Slash and burn	Destroying forests, narrowing the habitats for wildlife	It is strictly forbidden to practice slash and burn cultivation, to expand and to renovate swidden fields
Logging, tree burning	Destroying forests, impeding forest regeneration	Prohibited
Reforestation by native trees	Expand the habitat of forest animals, increase biodiversity	Encouraged

Natural regeneration through forest protection contracts and benefits	Restore and regenerate the forest ecosystem, expand the habitat for forest animals	Encourage and invest
Hunting, trapping animals in all forms	Depletion of forest resources	All acts of hunting and trapping are strictly prohibited
Construction of roads and other infrastructure works	Facilitate the exploitation of forest resources	Comply with the approved planning; No harm to the forest
Exploitation of non-timber products	It will affect forest and forest resources if over-exploited	Restricted and under the management and guidance of the Management Board

Source: Hoang Lien – Van Ban Nature Reserve Master Plan, 2012

D.3.2.5. Forest Ecosystem

181. The forest area of the nature reserve is 25,669 hectares, and covers 95 per cent of the total natural area of the Nam Xe, Nam Xay and Liem Phu communes. Natural forest accounts for approximately 82% (primarily located within the SPS-I to SPS-III), and plantation forest accounts for 18% of the forested land (located in the ERS). The area boasts four main types of forest: Tropical rainforest closed evergreen forest; low montane evergreen tropical lowland evergreen forest; medium closed evergreen moist montane forests; and montane cold evergreen forest. Furthermore, there are also areas of mixed bamboo and secondary evergreen lower mountain forest.

182. The HLVB Master Plan (2012) further classifies forest based on the quality of the forest. Rich forest (i.e. primary natural forest) covers an area of 16,894ha (equal to 67% of the NR area). The forest is primarily located with SPS-I to SPS-III. Medium, poor and restored forest (i.e. secondary natural forest) covers an area is 5,291ha (accounting for 21%).

183. Rich and medium forests are in the remote areas of forest blocks 447, 462, 500, 506, 510, 518, 522, 526, 527, 528, 533, 534, 535. The current and future alignment of NH279 (**Figure D-25**, red line) passes through Forestry Blocks 473, 486 and 488 of the ERS.

Table D-12: Status of forest land types in HLVBNR

TYPE OF FOREST	TOTAL	COMMUNE		
		Liem Phu	Nam Xay	Nam Xe
Total area	25,093.55	670.50	10,520,20	13,902.85
A. Forest land area	25,093.20	670.50	10,520,20	13,902.50
I. Area with forest	*23,525.10*	*253.00*	*10,215.80*	*13.056,30*
1. Natural forest	*23,372.00*	*253.00*	*10,215.80*	*12,903.20*
1.1. Timber forest	*22,186.20*	*253.00*	*9,445,90*	*12,487.30*
- Rich	16,894.80		7,579,80	9,315.00
- Medium	2,670.00	114.20	705.70	1,850.10
- Poor	104.80			104.80
- Restored forest with yield	2,516.60	138,80	1,160.40	1,217.40
1.2. Rocky Mountain	1,027.50		718.00	309.50
1.3. Mixed forest (wood, bamboo)	158,30		51,90	106.40
2. Planted forests	*153.10*			*153.10*
- Planted forest with yield	123.10			123.10
- Planted forests without yield	30.00			30.00
II. Unplanted land	1,568.10	417.50	304.40	846.20
- Ia	413.60		206.50	207.10
- Ib	362.70			362.70
- Ic	791.80	417.50	97,90	276,40
B. Non-forest land (office)	0.35			0.35

Source: Hoang Lien Van Ban Nature Reserve; Additional survey result in 10/2012.

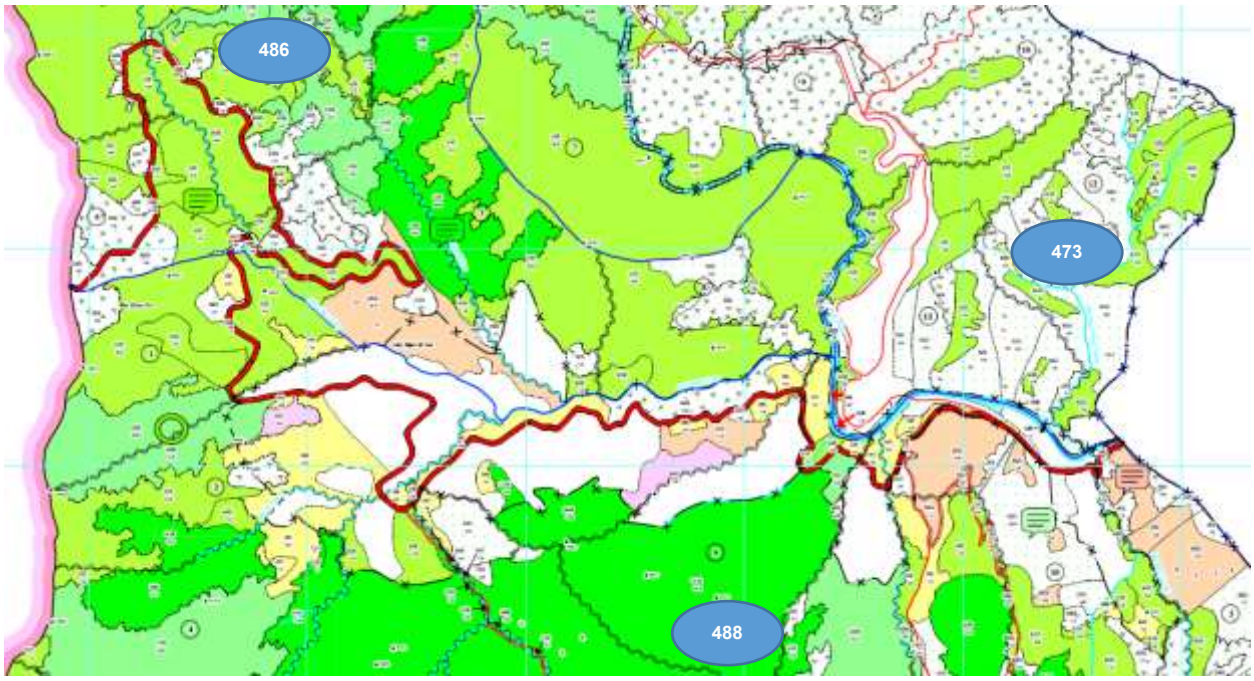


Figure D-25: Current alignment of NR279 in Van Ban Nature Reserve (Forest Blocks 473, 486, 488)

D.3.2.6. Other Ecosystems

184. In addition to the dominant forest ecosystem, the nature reserve includes four ecosystems: grassland ecosystem; village ecosystem; upland agriculture ecosystem.

185. The **grassland ecosystem** of the reserve includes pastures that have long been located along National Highway 279 to Khau Co and along Nam Xay Stream. In addition, some areas are cleared by slash-and- burn farming or burned every year for cattle raising, which are distributed on high slopes in blocks 473, 488, 527, 532 and 537.

186. The **Aquatic ecosystem** is small and concentrated mainly along the two main streams.

187. **Village ecosystems** are scattered within the nature reserve, but mainly along the NH279 where the terrain is less steep.

188. **Upland agriculture ecosystem** in the nature reserve is not large. Rice fields are near the residential areas, while maize and cassava are farmed far away and often encroach on the forest, which can easily cause forest fire. This ecosystem is distributed along the road 279, along Nam Xay Stream. Cardamom fields are scattered and at very high elevation (from 1.300m and above) and far, often under the canopy of large trees of old forests.

D.3.2.7. Flora

189. Based on research material[7] relating to the flora of the nature reserve and additional surveys conducted in 2012[8], the flora of this area is considered rich and varied. Flora of the

[7] Key literature reviewed includes the following: (i) Bird Life International & Forest Inventory and Planning Institute. 2001. Hoang Lien Son Nature Reserve - Van Ban. Information on existing and recommended protected areas in Viet Nam. Hanoi; (ii) Nguyen Trong Binh and Nguyen Toan Thang. 2008. Characteristics of vegetation cover in Hoang Lien Van Ban Nature Reserve, Lao Cai . Journal of Agriculture and Rural Development, 3: 62-66; (iii) Lao Cai province. 2007. Hoang Lien Van Ban NR Project, Lao Cai.

[8] Institute of Ecology and Biological Resources. 2012. Final report. Survey and assessment of current status of vascular plant diversity at Hoang Lien Van Ban, Lao Cai.

nature reserve includes 1,487 species of 747 genera and 179 families of 6 vascular plant species. The distribution of flora is shown in the following table.

Table D-13: Distribution of vascular plant species in the HLVBNR

Species	Family		Genera		Species	
	no	%	No	%	no	%
Ferns *(Psilotophyta)*	1	0.56	1	0.13	1	0,07
Mosses *(Lycopodiophyta)*	2	1,12	3	0.40	6	0.40
Horsetails *(Equisetophyta)*	1	0.56	1	0.13	1	0,07
Ferns *(Polypodiophyta)*	21	11,73	51	6.83	95	6,39
Conifers *(Pinophyta)*	7	3.91	12	1,61	15	1,01
Flowering plants *(Magnoliophyta)*	147	82.12	679	90,90	1,369	92.06
Total:	**179**	**100.0**	**747**	**100.0**	**1,487**	**100.0**

Source: Institute of Ecology and Biological Resources, 2012. Final report Survey and assessment of current status of vascular plant diversity at Hoang Lien Van Ban, Lao Cai.

190. To protect species at risk of extinction, the government issued Decree No. 32/2006 / ND-CP dated 10/03/2006 of the Government on management of forest plants and endangered and rare animals; prohibiting exploitation and limited use of some rare plant species. The lists of rare plants of Hoang Lien Van Ban NR is built according to the following bases:

- Red Book of Viet Nam (2007).
- List of CITES.
- Decree No. 32/2006/ND-CP.

191. The flora in the nature reserve includes a total of 34 rare species listed in the Red Book of Viet Nam (2007), accounting for 2.29% of total species. Two species are considered Critically Endangered (CR), including *Taiwania cryptomerioides and Aucuba japonica*; 14 species are classified Endangered (EN) and 18 species are classified as Vulnerable (VU).

192. ***Taiwania cryptomerioides*** is a large coniferous tree in the cypress family Cupressaceae. It is one of the largest tree species in Asia, reported to heights of up to 90 m tall and with a trunk up to 4 m diameter above buttressed base. It is primarily endangered by illegal logging for its valuable wood. The species is classified as VU per IUCN Red List.

193. ***Aucuba japonica***, commonly called spotted laurel, Japanese laurel, or Japanese aucuba, is a shrub (1-5m) native to rich forest soils of moist valleys. It is a common garden plant in many countries and not classified in the IUCN Red List.

Table D-14: List of species in the NR classified as CR, EN, VU per the Viet Nam Red Book (2007)

No	Scientific name	Viet Nam Name	Family	Classification
1	*Fokienia hodginsii*	Pơ mu	Cupressaceae	EN
2	***Taiwania cryptomerioides***	**Bách tán Dài loan**	**Taxodiaceae**	**CR**
3	*Enicosanthelum petelotii*	Nhọc trái khớp lá mác	Annonaceae	EN

No	Scientific name	Viet Nam Name	Family	Classification
4	*Paudopia ghorta*	Dinh vàng	Bignoniaceae	EN
5	*Sindora tonkinensis*	Gụ lau	Ceasalpiniaceae	EN
6	*Tsoogiodendron odorum*	Giổi thơm	Magnoniaceae	VU
7	*Asarum balansaewith*	Tế hoa balansae	Aristolochiaceae	EN
8	*vernonia volkameriifolia*	Cúc hồng	Asteraceae	EN
9	***Aucuba japonica***	**Ô rô bà**	**Aucubaceae**	**CR**
10	*Berberis wallichiana*	Hoàng liên gai	Berberidaceae	EN
11	*Mahonia nepalensis*	Hoàng liên ô rô	Berberidaceae	EN
12	*Podophyllum tokinensis*	Bát giác liên	Berberidaceae	EN
13	*Markhamia stipulata*	Thiết Dinh	Bignoniaceae	VU
14	*canarium trandenum*	Trám Den	Burseraceae	VU
15	*Codocopsis celebrica*	Ngân Dằng	Campanulaceae	VU
16	*Dipterocarpus retusus*	Chò nâu	Dipterocarpaceae	VU
17	*Hopea ferrea*	Chò kiền kiền	Dipterocarpaceae	EN
18	*Hopea mollisima*	Táu mặt quỷ	Dipterocarpaceae	VU
19	*Parashorea*	Chò chỉ	Dipterocarpaceae	VU
20	*Vatica subglabra*	Táu nước	Dipterocarpaceae	EN
21	*Gautheria fragrantissium*	Chân thụ thơm	Ericaceae	VU
22	*Lithocarpus bacgiangensis*	Dẻ bắc giang	Fagaceae	VU
23	*Quercus macrocalyx*	Sồi Dấu to	Fagaceae	VU
24	*Gynocadia odorata*	Giang tím bịu	Flacourtiaceae	EN
25	*Cinnadenia paniculata*	Kháo xanh	Lauraceae	VU
26	*strychnos ignatii*	Mã tiền lông	Loganiaceae	VU
27	*Ardisia Silvestri*	Lá khôi	Myrsinaceae	VU
28	*Aeginetia indica*	Lệ dương	Orobanchaceae	VU
29	*Platanus kerrii*	Chò nước	Platanaceae	VU
30	*Fallopia multiflora*	Hà thủ ô Dỏ	Polygonaceae	VU
31	*glabra Murraya*	Nguyệt quế nhẵn	Rutaceae	VU
32	*Madhuca pasquieri*	Sến mật	Sapotaceae	EN
33	*Kadsura heteroclita*	Xưn se tạp	Schisandraceae	VU
34	*Alniphyllum eberhardtii*	Lá dương Dỏ	Styracaceae	EN

Source: Hoang Lien – Van Ban Nature Reserve Master Plan, 2012

194. Four species present in the HLVBNR are included in the List of natural plant species banned for global commercial trade (CITES), including three species included in Appendix 2 (*Cyathea contaminans, podophylla C.* and *C. spinulosa), and* 1 species included in Appendix 3 (*Podocarpus nerifolius)*.

Table D-15: List of species on the CITES list of protected flora

no	Scientific species name	Vietnamese name	Scientific family name	Vietnamese name
1	*Cyathea contaminans*	Ráng gỗ bẩn	*Cyatheaceae*	Dương xỉ gỗ
2	*Cyathea podophylla*	Ráng gỗ dày	*Cyatheaceae*	Dương xỉ gỗ
3	*Cyathea spinulosa*	Ráng gỗ gai	*Cyatheaceae*	Dương xỉ gỗ
4	*Podocarpus nerifolius*	Thông tre lá dài	*Podocarpaceae*	Kim giao

Source: Hoang Lien – Van Ban Nature Reserve Master Plan, 2012

195. 15 species need protection per *Decree 32/2006/ND-CP*.[9] In the HLVBNR, 3 species below to Group I (*Berberis wallichiana, Anoectochilus spp* and *Taiwania cryptomerioides) and 12 species belong to* Group II.

Table D-16: Plants protected per Decree 32/2006/ND-CP

no	Scientific species name	Vietnamese name	Scientific family name	Group
1	***Berberis wallichiana***	**Hoàng liên gai**	***Berberidaceae***	**I**
2	***Anoectochilus spp.***	**Kim tuyến**	***Orchidaceae***	**I**
3	***Taiwania cryptomerioides***	**Bách tán Dài loan**	***Taxodiaceae***	**I**
4	*Asarum balansaewith*	Tế hoa balansae	*Aristolochiaceae*	II
5	*Asarum reticulatum*	Tế hoa	*Aristolochiaceae*	II
6	*Markhamia stipulata*	Thiết Dinh	*Bignoniaceae*	II
7	*afzelia xylocarpa*	Gõ Dỏ	*Caesalpiniaceae*	II
8	*Erythrophloeum fordii*	Lim xanh	*Caesalpiniaceae*	II
9	*Sindora tonkinensis*	Gụ lau	*Ceasalpiniaceae*	II
10	*hodginsii*	Pơ mu	*Cupressaceae*	II
11	*Fibraurea tinctoria*	Hoàng Dằng	*Menispermaceae*	II
12	*Stephania hernandiifolia*	Dây mối	*Menispermaceae*	II

[9] Group I includes species banned from exploitation and use for commercial purposes; Group II includes species restricted to exploit and use for commercial purposes.

13	*Stephania kwangsiensis*	Bình vôi	*Menispermaceae*	II
14	*Dendrobium nobile*	Hoàng thảo cẳng gà	*Orchidaceae*	II
15	*Thalictrum foliosum*	Thổ hoàng liên	*Ranunculaceae*	II

Source: Hoang Lien – Van Ban Nature Reserve Master Plan, 2012

196. *Berberis wallichiana* is a shrub growing to 3 m. The roots of the plant are antibacterial and are used in Viet Nam in the treatment of diarrhea, dysentery, ophthalmia and dyspepsia. *Anoectochilus* are orchids appreciated for their beauty as well as their therapeutic use. *Taiwania cryptomerioides* has already been described above.

D.3.2.8. Fauna

197. The nature reserve includes 486 animal species of 89 families and 27 orders, as listed in **Table D-17**. The most important species found in the area include the globally threatened western black crested gibbon (*Nomascus concolor)*, the Owston's civet (*Chrotogale owstoni)* and the Vietnamese salamander (*Paramesotriton deloustali).*

Table D-17: Fauna in Hoang Lien Van Ban NR

Phylum/Class	No. of species	IUCN	VN red book
Mammals	60	12	20
Birds	310	3	7
Reptiles and amphibians	116	6	20
total	**486**	**21**	**47**

Source: Hoang Lien – Van Ban Nature Reserve Master Plan, 2012

198. **Mammals.** The Hoang Lien – Van Ban Nature Reserve Master Plan, 2012 lists 60 species of 22 families in 8 orders, of which 12 species are identified by IUCN as globally threatened or Near Threatened (**Table D-18**). Out of these, 3 species (Clouded Leopard, Leopard and Pangolin) were only recorded based on the information provided from local people, which suggests they may have been locally extinct. According to IBA, mammal diversity and abundance are relatively low because of intensive hunting pressure. Biodiversity at the site is threatened by over-exploitation of natural resources, clearance of land for agriculture, accidental fire and hunting.

199. The **western black crested gibbons (*N. concolor*)** are of particular importance because their distribution is restricted to one area spanning the countries of Lao PDR, Cambodia, the PRC and Viet Nam. *N. concolor* was believed to be extinct in Viet Nam, until in 1999 it was rediscovered by Fauna & Flora international (FFI) in a forest spanning Mu Cang Chai District, Yen Bai Province and Muong La District, Son La Province.[10] This is considered to be the largest and only viable population of this species in Viet Nam. Another smaller and more fragmented population was discovered in the Van Ban Nature Reserve.

200. There is strong quantitative evidence that the population of *N. concolor* has declined by more than 50% in half a generation and it can thus be confidently inferred that a decline of more than 80% has occurred during the past three generations. The area of occupancy and extent of occurrence of this species have been reduced, mainly due to the ongoing threat of hunting. In 2011, the national population was estimated at less than 250 individuals, with some 50 mature individuals. According to FFI, Mu Cang Chai Species and Habitat Conservation Area, Yen Bai Province and neighboring Muong La District, Son La Province, are the only

[10] Rawson, B. M, Insua-Cao, P., Nguyen Manh Ha, Van Ngoc Thinh, Hoang Minh Duc, Mahood, S., Geissmann, T. and Roos, C. 2011. *The Conservation Status of Gibbons in Viet Nam*. Fauna & Flora International/Conservation International, Hanoi, Viet Nam.

locations with a viable population in Viet Nam.

201. According to FFI, the *N. concolor* population at Hoang Lien-Van Ban Nature Reserve is very small and has been severely reduced since 2000. In a 2009 survey only two gibbon groups with a minimum of five individuals were heard by researchers. Gibbons are understood to be distributed in two widely separated areas: (i) in the northern Phinh Ho area, and (ii) in the Ho Nam Mu-Nam Dao Panh.

202. Hunting is the primary threat to gibbons in the reserve. Other threats include cardamom cultivation and fuelwood collection which are widespread in the reserve and degrade gibbon habitats. Conservation actions at this reserve since 2000 included gun confiscation, awareness campaigns and the establishment of community patrol groups and subsequent reserve designation in 2007. According to FFI, investing further conservation funds to protect gibbons in this reserve are considered a low priority, because the population is so small and fragmented that its chance of persistence is very low.

203. **Owston's Civet** is known to occur across a wide latitudinal range of both eastern Lao PDR and Viet Nam. Owston's Civet is listed as Endangered in the IUCN Red List because of an ongoing population decline, inferred to exceed 50% over the last three generations (taken as 15 years) and suspected to continue for the next three. This is inferred from over-exploitation; Owston's Civet is taken for meat and traditional medicine (including its bones, scent gland, and penis). Hunting is a severe threat because the species is primarily ground-dwelling and so is exposed to the very high levels of snaring and other forms of ground-level trapping throughout its range. Camera-trapping indicates that the civet is nocturnal, largely solitary and presumably largely active at ground level.

204. **Birds.** The bird fauna of Hoang Lien Van Ban NR includes 310 species, in 50 families under 15 orders.[11] They include many important bird species, especially the globally Vulnerable (VU) beautiful nuthatch (*Sitta Formosa*). The nuthatch occurs primarily in mature broadleaved forests at altitudes from 1,500-2,400 m. Main threats to the species include forest loss, degradation and fragmentation, predominantly because of shifting cultivation.

205. **Reptiles and amphibians.** There are 64 species of reptile amphibians. Hoang Lien Van Ban NR recorded 64 species of reptiles, belonging to 11 families under 2 orders and 52 of amphibian species of 7 families under 2 orders. Species subject to protection include the Tam Dao salamander (*Paramesotriton deloustali).* This species is listed VU in the Red Book and Group IB in Decree 32/2006/ND-CP. Other species of conservation priority include the various turtle species (*Platysternon megacephalum, Geoemyda spengleri, Pyxidea mouhoti*); the King Cobra (*Naja hannah*; and frog species (*Paa spinose, Paa yunnanensis*). Most of these species are threaten by hunting for food or traditional medicine, or for the pet trade.

Table D-18: List of threatened species potentially present in Hoang Lien Van Ban Natural Reserve

Scientific name	English name	Vietnamese name	Conservation status (VIE)	IUCN status	Notes
Mammals					
Crocidura dracula	White-toothed shrews	Chuột chù Duôi trắng	T	LC	
Myotis siligorensis	Himalayan whiskered bat	Dơi tai sọ cao	R	LC	
Nycticebus coucang	**Slow Loris**	**Cu li lớn**	**V, IB**	**VU**	Collected for use as pets.

[11] Steven R.Swan MG & Sheelagh O'Reilly. 2004. Technical Report No.1. Project Community-based Conservation for ecosystems in Hoang Lien Son mountains.

Scientific name	English name	Vietnamese name	Conservation status (VIE)	IUCN status	Notes
Nycticebus pygmaeus	**Lesser Slow Loris**	**Cu li nhỏ**	**V, IB**	**VU**	Endemic to Indochina. Exploited for traditional "medicine", food and for the pet trade.
Macaca arctoides	**Stumptail Macaque**	**Khỉ mặt Dỏ**	**V, IIB / VU**	**VU**	Habitat: dense evergreen forests. Hunted and traded for food, sport and traditional "medicine". Habitat loss is a relatively lower threat compared to hunting
Macaca assamensis	**Assam Macaque**	**Khỉ mốc**	**V, IIB / VU**	**NT**	Decline in Viet Nam due to hunting, traditional "medicine," food, and the pet trade. Prefers dense forest and does not usually occur in secondary forest.
Macaca mulatta	Rhesus macaque	Khỉ vàng	V, IIB	LC	
Trachypithecus phayrei	**Phayre's Leaf-monkey**	**Voọc xám**	**E, IB**	**EN**	Major threat is hunting for traditional "medicine" and bushmeat
Nomascus concolor	**Black Crested Gibbon**	**Vượn Den tuyền**	**E, IB / EN**	**CR**	Reported to occur at elevations of 1,600-2,000 m. Threatened by human impact on habitat and hunting pressure.
Ursus malayanus	**Sun Bear**	**Gấu chó**	**E, IB / LR**	**VU**	Prefers interior mature and/or heterogeneously structured primary forests. Commonly poached for their gall bladders (i.e., bile) and paws.
Ursus thibetanus	**Asiatic Black Bear**	**Gấu ngựa**	**E, IB / VU**	**VU**	Commonly poached for their gall bladders (i.e., bile) and paws.
Aonyx cinereus	**Asian Small-clawed Otter**	**Rái cá vuốt bé**	**V, IIB / LR**	**VU**	Threaten by poaching, destruction of habitat, pollution of streams.
Chrotogale owstoni	**Owston's Civet**	**Cầy vằn bắc**	**R, IIB / VU**	**EN**	Endemic to Lao PDR and Viet Nam. Taken for meat and traditional medicine (including its bones, scent gland, and penis). Affected by habitat loss, degradation and fragmentation.
Prionodon pardicolor	Spotted Linsang	Cầy gấm	IB	LC	
Viverra zibetha	Large Indian Civet	Cầy giông	IIB / VU	LC	
Viverricula indica	Small Indian Civet	Cầy hương	IIB	LC	
Neofelis nebulosa	**Clouded Leopard**	**Báo gấm**	**V, IB / VU**	**VU**	Prefers closed forest. Hunted for skins, bones for medicines, meat for exotic dishes and live animals for the pet trade.
Catopuma temminckii	Asiatic Golden Cat	Báo lửa	IB / VU	NT	
Prionailurus bengalensis	Leopard Cat	Mèo rừng	IB	LC	
hylopetes alboniger	Particolored Flying Squirrel	Sóc bay trắng Den	R	LC	

Scientific name	English name	Vietnamese name	Conservation status (VIE)	IUCN status	Notes
petaurista petaurista	Common Giant Flying Squirrel	Sóc bay trâu	R, IB	LC	
petaurista elegans	Spotted Giant Flying Squirrel	Sóc bay sao	R, IB	LC	
Ratufa bicolor	Black Giant Squirrel	Sóc Den	IIB	NT	
Birds					
Polyplectron bicalcaratum	Grey Peacock-Pheasant	Gà tiền mặt vàng	T, IB	LC	
Lophura nycthemera	Silver Pheasant	Gà lôi trắng	R, IB	LC	
tyto alba	Common Barn-owl	Cú lợn lưng xám	IIB	LC	
Otus spilocephalus	Mountain Scops-owl	Cú mèo La tu sơ	IIB	LC	
Buceros bicornis	Great Hornbill	Hồng hoàng	T, IIB	NT	
Aceros undulatus	Wreathed Hornbill	Niệc mỏ vằn	T, IIB	LC	
Anorrhinus tickelli	Brown Hornbill	Niệc nâu	IIB / VU	NT	
Picus rabieri	Red-collared Woodpecker	Gõ kiến xanh Dầu Den	T	NT	
Copsychus malabaricus	White-rumped shama	Chích choè lửa	IIB	LC	
Garrulax afinis steratus	Black-faced Laughingthrush	Khướu cổ trắng	IIB	LC	
Garrulax leucolophus	White-crested laughingthrush	Khướu Dầu trắng	IIB	LC	
Garrulax monileger	Lesser necklaced laughingthrush	Khướu khoang cổ	IIB	LC	
Garrulax pectoralis	Greater Necklaced Laughingthrush	Khướu ngực Den	IIB	LC	
Garrulax maesi maesi		Khướu xám	IIB	NA	
Garrulax erythrocephalus	Chestnut-crowned Laughingthrush	Khướu Dầu hung	IIB	LC	
Garrulax rufogularis	Rufous-chinned Laughingthrush	Khướu cằm hung	IIB	LC	
Garrulax Sannio	White-browed Laughingthrush	Bò chiêu	IIB	LC	
Garrulax canorus	Chinese Hwamei	Hoạ mi	IIB	LC	
Garrulax milnei	Red-tailed Laughingthrush	Khướu Duôi Dỏ	IIB	LC	
Garrulax squamatus	Blue-winged Laughingthrush	Khướu vảy	IIB	LC	
Gracula religiosa	Common hill myna	Yểng	IIB	LC	
Sitta solangiae	Yellow-billed Nuthatch	Trèo cây mỏ vàng	LR	NT	

Scientific name	English name	Vietnamese name	Conservation status (VIE)	IUCN status	Notes
Sitta formosa	**Beautiful Nuthatch**	**Trèo cây lưng Den**	**VU**	**VU**	Occurs in mature broadleaved forests. Occurs primarily from 1,500-2,400 m. Main threat is forest loss, degradation and fragmentation, predominantly as a result of shifting cultivation
Psittacula alexandri	Red-breasted Parakeet	Vẹt ngực Dỏ	IIB	NT	
Reptiles, Amphibians					
Gekko Gekko	Tokay Gecko	Tắc kè	T	NA	
Acanthosaura lepidogaster	Brown Pricklenape	Ô rô vẩy	T	LC	
Physignathus concincinus	Chinese water dragon	Rồng Đất	V	NA	
Naja naja	Indian cobra	Rắn hổ mang	V, IIB	NA	
Naja hannah	**King Cobra**	**Rắn hổ mang chúa**	**E, IB**	**VU**	Harvested for skin, food, and especially medicinal purposes.
Bungarus fasciatus	Banded Krait	Rắn cạp nong	T, IIB	LC	
ptyas korros	Indo-Chinese rat snake	Rắn ráo	T, IIB	NA	
Ptyas mucosus	Oriental ratsnake	Rắn ráo trâu	V, IIB	NA	
Achalinus spinalis	Grey Burrowing Snake	Rắn xe Diếu lam	R	LC	
E. Porphyracea	black-banded trinket snake	Rắn sọc Dốm Dỏ	t	NA	
Elaphe prasina	Green Trinket Snake	Rắn sọc xanh	t	LC	
Elaphe radiata	Radiated ratsnake	Rắn sọc dưa	IB	NA	
Ovophis monticola	Chinese Mountain Pit Viper	Rắn lục núi	R	LC	
Platysternon megacephalum	**Big-headed Turtle**	**Rùa to Dầu**	**R, IIB / EN**	**EN**	Endangered due to specific trade demand in Viet Nam
Pelodiscus sinensis	**Chinese softshell turtle**	**Ba ba trơn**	**VU**	**VU**	Wild populations exploited for food. Commercially farmed in vast numbers
Manouria impressa	**Impressed Tortoise**	**Rùa núi viền**	**V, IIB / VU**	**VU**	
Geoemyda spengleri	***Black-breasted leaf turtle***	**Rùa Dất Spengli**	**EN**	**EN**	Considered threatened by the levels of trade and scarcity of this species.
Pyxidea mouhoti	**Keeled box turtle**	**Rùa sa nhân**	**IIB / EN**	**EN**	Wild populations exploited for food.
Paramesotriton deloustali	Tam Dao Salamander	Cá cóc Tam Dảo	R, IB / VU	LC	Endemic to Northern Viet Nam. Not a migrant. Collected locally for use in traditional medicines and the domestic pet trade.

Scientific name	English name	Vietnamese name	Conservation status (VIE)	IUCN status	Notes
Bufo galeatusi	Bony-headed toad	Cóc rừng	R	LC	
Bufo pageoti	Tonkin toad	Cóc Pa gio *	LR	NT	Stream-breeding amphibian
Megophrys longipes	Red-legged horn frog	Cóc mắt chân dài	T	NT	Inhabits undisturbed evergreen rainforest and montane moss forest. Threatened by local forest clearance
Megophrys feae	Fea's Horned Frog	Cóc mày phê	R	LC	
Chaparana delacouri	Tonkin Asian Frog	ếch vạch	T	LC	Endemic to southern PRC, northern Viet Nam
Paa spinosa	**Spiny Paa Frog**	**Ếch gai**	**T**	**VU**	Collected for consumption. Breeds in streams.
Quasipaa verrucospinosa		Ếch gai sần	T / LR	NT	Collected for consumption. Recorded in and around streams in hill and lower montane evergreen forest.
Paa yunnanensis	**Yunnan spiny frog**	**Ếch cóc**	**EN**	**EN**	Threatened primarily by collection for human consumption
Odorrana chapaensis	Viet Nam Sucker Frog	Ếch bám Dá Sa Pa	LR	NT	Found on the ground in closed-canopy primary forest up to four metres from water.

Notes: CR: Critically endangered; EN: Endangered; VU: Vulnerable; LR: Low risk; (Viet Nam Red Book). IB, IIB = Appendix IB, IIB of Decree 32 (2006). Group IB includes species banned from exploitation and use for commercial purposes; Group IIB includes species restricted to exploit and use for commercial purposes.

206. The baseline assessment concludes that none of the areas along NH279 located within the ERS of the Van Ban Nature Reserve classifies as critical habitat per ADB's Safeguard Policy Statement (2009). The ERS classifies as modified habitat (i.e. altered natural habitat) formed by the removal of native species during resource harvesting, land use conversion and/or the introduction of alien species of plants and animals. The ERS is not an area with biodiversity that has significant social, cultural or economic importance to local communities, or a habitat required for the survival of critically endangered or endangered species; such areas/habitats are located within the SPS of the reserve.

207. The assessment concludes that (i) the project acts in a manner consistent with the nature reserve master plan (2012); (ii) the project is supported by nature reserve managers, local communities, and provincial authorities (as documented in Section I); and (iii) the proposed upgrade of the NH279 within the ERS is legally permitted.

D.4. Socio-economic conditions

208. In October 2017, a socio-economic survey was conducted in the affected localities. The main findings of the survey are presented below.

D.4.1.Economic conditions

D.4.1.1. Yen Bai Province

209. Agriculture is the main economic activity in the province, accounting for 65% -100% of the economic structure. Small-scale industry and construction, commerce and services account for a small proportion and are mainly small retailers in densely populated areas. Specifically, each economic activity is as follows:

a. Agriculture: The people mainly cultivate rice and grow crops, in addition, people also grow some other fruit trees such as bananas, guava, apples and industrial

crops such as cinnamon. Mainly livestock are buffalo, cow, pig, duck, chicken.

b. Small-scale industry and industry: In the project area, the activities of small-scale handicraft and industrial production are diversified and are mainly made of beans and mechanical production.

c. Trade and services: Most of residential areas are located on both sides of PR175 with the main business related to selling consumer goods, construction materials, petrol.

d. Income: Average income per capita is low and fluctuates between VND 10-28 million per year. The poverty rate is quite high, even in some communes up to 60-70%.

Table D-19: The economic characteristics of communes / towns in Yen Bai province belong to the project area

No	Wards/ Town	Income (million VND / person / year)	The rate of poor households (%)	The economic structure (%)		
				Agriculture	Industry and construction	Trade and services
1	An Thinh	28	25	65	15	20
2	Đai Son	17	46	98	0	2
3	Mo Vang	17.5	52.8	75	10	15
4	TTNT. Lien Son	19	12.3	100	-	-
5	Au Luong	14.4	70.26	94	0	6
6	Son Luong	12.5	63.7	92	2	6
7	Suoi Quyen	10	66	100	0	0

Source: Socio-economic survey data, 2017

D.4.1.2. Lao Cai Province

210. The project area has diverse economic activities. Trade and services are quite developed in Son Thuy and Khanh Yen townships, and the remaining villages of the province are primarily occupied in the agriculture sector (over 70%). Specifically, each economic activity is as follows:

a. Agriculture: The people mainly cultivate rice and grow crops, in addition, people also grow some other fruit trees such as bananas, guava, apples and industrial crops such as cinnamon or timber trees such as Acacia. Livestock mainly includes buffaloes, cows, pigs, ducks and chicken.

b. Small-scale industry and industry: There are many handicraft and industrial production activities, including food processing, mechanical production. Concentrated production activities such as mining, construction material production, agro-forestry processing occur in some localities, especially in the eastern part of the project road NH279.

c. Trade and services: Concentrated mainly on densely populated areas on the two sides of NH279, with the main business forms related to the sale of consumer goods, construction materials and petrol.

d. Income: The average income per capita is unevenly distributed to 26-47 million VND per person. In Khanh Yen and surrounding communes, the average income is around 12 VND million per year. The poverty rate is quite high, even in some communes up to 40-60%.

Table D-20: Economic Characteristics of Communes / Towns in Lao Cai Province in the Project Area.

No	Wards/ Town	Income (million VND / person / year)	The rate of poor households (%)	The economic structure (%)		
				Agriculture	Industry and construction	Trade and services
1	Hoa Mac	26	62	85	5	10
2	Tan Thuong	17.5	39	80	8	12
3	Son Thuy	12	47.6	40	30	30
4	Khanh Yen Thuong	26	9.91	75	10	15
5	Khanh Yen town	47	15	20	30	50
6	Lang Giang	27	28.54	70	10	20
7	Duong Quy	23.5	31.58	85	3	12
8	Tham Duong	11.2	44.21	94	1	5
9	Minh Luong	13	47.2	92	3	5
10	Nam Xe	12	28.3	90	7	53

Source: Socio-economic survey data, 2017

211. Housing conditions: Except for the central areas of the commune and Khanh Yen town where people live in the building (level 4 or 2 floors or more). In other areas people mainly live in their traditional stilt houses.

D.4.1.3. Lai Chau Province

212. In the localities in the project area, the economic activity is not diversified, the share of agriculture in the economic structure is large, except for Binh Lu, San Thang and Dong Phong. Economic activities related to handicraft-industry and construction are mainly agricultural and forestry processing and small-scale production. Trade activities and services are underdeveloped, limited to densely populated areas and townships. Specifically, each economic activity is as follows:

a. Agriculture: The people mainly cultivate rice, maize and other crops. In addition, people grow fruit trees, timber trees and industrial crops such as tea or sugarcane. Livestock mainly includes buffaloes, cows, pigs, ducks, chickens, goats.

b. Small-scale industry and industry: There are small-scale industrial and handicraft production activities related to agricultural and forestry product processing, mechanical production and building materials. Industrial production activities are underdeveloped.

c. Trade and services: Commercial activities mainly take place in densely populated areas, district centers, with small retail forms occupying a large proportion.

d. Income: Annual income per capita ranges from 13-39 million, of which the high is seen in the Lai Chau area, significantly higher than in other parts of the province. There is a relatively high rate of poor households, especially in remote communes, where the poverty rate averages 33%.

Table D-21: Economic characteristics of communes / towns in Lai Chau province in the project area

No	Wards/	Income		The economic structure (%)

	Town	(million VND / person / year)	The rate of poor households (%)	Agriculture	Industry and construction	Trade and services
1	Phuc Than	25	34.3	80	5	15
2	Muong Khoa	13	49.6	98	1	1
3	Tan Uyen	23	17.52	50	15	35
4	Phuc Khoa	23	26.1	100	0	0
5	Pac Ta	23	25.4	70	20	10
6	Than Thuoc	24	28.8	54.18	33.82	12
7	Trung Đong	18.5	32.62	82	6	12
8	San Thang	29	2.4	60	20	20
9	Phuong Đong Phong	39	1.5	20	30	50
10	Ban Giang	17	28	90	9.8	0.2
11	Binh Lu	22	16.9	55	20	30
12	Na Tam	14	57.89	98.6	0	1.4
13	Ban Bo	20	40.6	95	0	5
14	Ban Hon	18	26.6	94	2	4

Source: Socio-economic survey data, 2017

213. According to the results of interviews with affected households, about 60% of the respondents are farmers. The average income per person is about 2.5-4 million VND / person / month. All respondents used hygienic water, at least one television set and one telephone.

214. Housing conditions: The central areas of Tan Uyen town and Lai Chau city people live in buildings (level 4 or 2 floors or more). In other areas people mainly live in their traditional stilt houses.

D.4.2.Social conditions

D.4.2.1. Yên Bai Province

215. Population: The project area is typical of the North West where population density is low. Population structure shows that 40-50% of people are in working age. Female population accounts for 50.5%.

Table D-22: The demographics of the communes in Yen Bai province belong to the project area

No	Wards/ Town	Area (ha)	Population		In working age	
			households	people	Male	Female
1	An Thinh	2660.87	2379	9433	2620	2568
2	Đai Son	8000	780	4000	1111	1089
3	Mo Vang	9955.09	931	4314	1198	1174
4	TTNT. Lien Son	1126.26	1301	4887	2420	2467
5	Âu Luong	6851	807	3958	893	879
6	Son Luong	2119	110	402	111	110
7	Suoi Quyen	3477.26	317	1670	457	461

Source: Socio-economic survey data, 2017

216. Ethnicity: In the communes of the Yen Bai project area in Van Yen and Van Chan districts, ethnic minority communities such as Dao, Tay, Mong, Nung, Muong, Giay co-exist with the Kinh people. Except for An Thinh commune, where Kinh majority accounts for 77%,

other localities account for more than 50% of ethnic minorities.

217. Culture and belief: The project area has a low proportion of people participating in religions, mainly people follow traditional beliefs.

218. Education: 100% of the communes in the project area have kindergartens, primary schools, junior high schools. However, the proportion of people who have graduated from high school is low and according to statistics show that the proportion of high school graduates is only 31%.

219. Health: Most localities have clinics and each district has a general hospital and a preventive medicine center. According to statistics, most communes have doctors, doctors and midwives.

220. Water supply and drainage: The survey results show that only 40-50% of people have access to hygienic water with the main source of dug wells and water from mountain streams. Sanitation systems in residential areas are not guaranteed and the percentage of people having hygienic latrines is about 50-55%.

221. Power supply, communication: The percentage of people who are supplied with electricity is about 40-100%. In addition, the project area has good access to information when 100% of affected households have mobile phones and televisions.

222. Garbage collection and treatment: The survey shows that domestic waste is collected and treated in An Thinh commune, the rest is processed by the people themselves.

D.4.2.2. Lao Cai Province

223. Population: The project area in Lao Cai is Van Ban district where the topography is mainly mountainous so population density is low. Population structure shows that nearly 50% of people are in working age and female population accounts for about 50.3%.

Table D-23: Demographics of communes in Lao Cai province in the project area

No	Wards/ Town	Area (ha)	Population		In working age	
			households	people	Male	Female
1	Hoa Mac	2591.9	692	3397	570	420
2	Tan Thuong	3723	836	3960	1090	997
3	Son Thuy	5875	722	3286	913	895
4	Khanh Yen Thuong	2690.93	898	4106	1222	1096
5	Khanh Yen town	750	1892	6753	1846	1868
6	Lang Giang	2996	932	4439	1202	1306
7	Duong Quy	10462.57	1250	5889	1168	1200
8	Tham Duong	5995.16	432	2240	614	618
9	Minh Luong	3509	1055	5198	1554	1458
10	Nam Xe	17113	236	1256	451	297

Source: Socio-economic survey data, 2017

224. Ethnicity: Except for the Khanh Yen town, the percentage of Kinh people is about 45%. In the remaining communes, the Kinh majority only make up 10% of the total population. Minority groups present here are Dao, Tay, Thai, Mong, Giay.

225. Culture and belief: The project area has a low proportion of people participating in religions, mainly people who follow the traditional beliefs of their ethnic communities.

226. Education: 100% of the communes in the project area have kindergartens, primary schools, junior high schools. In general, the population has been provided with lower secondary education, the percentage of people who have graduated from high school is still

low.

227. Health: Most localities have commune health stations and at district level have general hospitals and health centers. According to statistics, about 50% of communes have doctors and 100% of communes have midwives.

228. Water supply and drainage: The living conditions of the people are very favorable with 80% - 100% of households using hygienic water with main water supply and automatic water supply system. Sewerage is generally ensured by the drainage of drains.

229. Power supply, communication: According to survey results, 100% of residents in the area have access to the national grid. In addition, the project area has good access to information when 100% of affected households have mobile phones and televisions.

230. Garbage collection and treatment: In all communes in the project area, only Khanh Yen Thuong and Khanh Yen township have access to centralized waste collection system. Local people recycle daily waste at home.

D.4.2.3. Lai Chau Province

231. Population: Except for Dong Phong Ward, the population density is quite high with more than 2,000 persons / km2. Other localities have low population density. Population structure shows that nearly 60% of people are in working age. Female population accounts for 50.1%.

Table D-24: Population of the communes in Lai Chau province in the project area

No	Wards/ Town	Area (ha)	Population		In working age	
			Households	People	Male	Female
1	Phuc Than	6285.83	2086	10087	5096	4991
2	Muong Khoa	8457.9	1425	7132	2015	2145
3	Tan Uyen town	7020.16	3401	14755	4085	4110
4	Phuc Khoa	8457.9	996	4306	2100	2206
5	Pac Ta	9664.17	1313	6256	1769	2063
6	Than Thuoc	2878.81	831	3628	850	1050
7	Trung Đong	6284.52	1388	7074	3637	3437
8	San Thang	2375.49	1162	4413	1337	1311
9	Đng Phong	528.54	2608	10954	3280	3293
10	Ban Giang	3560.23	810	3694	1119	1097
11	Binh Lu	4468.46	1168	5116	2551	2565
12	Na Tam	2416.98	672	3567	1243	872
13	Ban Bo	7767.7	1103	4979	2485	2494
14	Ban Hon	5443.06	557	2682	885	870

Source: Socio-economic survey data, 2017

232. Ethnicity: According to the survey results, except for Tan Uyen town, Binh Lu commune and Dong Phong ward, Kinh people account for 30-45% of the total population. Ethnic minorities make up more than 60% of the population, including Tay, Thai, Dao, Kho Mu, Giay, Mong, Lao.

233. Culture and beliefs: The project area has a low proportion of people involved in religions and is mainly Buddhist, with most people participating in traditional beliefs of the community.

234. Education: 100% of the communes in the project area have kindergartens, primary schools, junior high schools. In general, the population has been provided with lower secondary education. The percentage of people who have graduated from high school is still low.

235. Health: Most localities have commune health stations and at district level have general hospitals and health centers. According to statistics, about 45% of communes have doctors and 100% of communes have midwives.

236. Water supply and drainage: The living conditions of the people are very favorable with nearly 80% of households using hygienic water from self-flowing water system from the mountain. Drainage systems are generally not guaranteed when most wastewater is not collected and treated.

237. Power supply, communication: According to survey results, 96-100% of residents in the area have access to the national grid. In addition, the project area has good access to information when 100% of affected households have mobile phones, TVs and refrigerators.

238. Garbage collection and treatment: In all communes in the project area, only around the town of Tan Uyen and in Lai Chau city is the collection and treatment of garbage. Local people recycle daily waste at home.

D.5. Environmental Baseline Data

239. The project owner has coordinated with the Institute of Transport Science and Technology (the domestic EIA institute with a license for monitoring activities) to conduct air quality, noise, vibration, surface water quality, groundwater quality, soil and river sediment quality monitoring in the project's area of influence.

240. The methods of measurement and environmental analysis used are in accordance with MONRE regulations, Vietnamese standards for monitoring methods, analysis of environmental parameters and comparative evaluation.

D.5.1. Sampling locations

241. Selection of environmental quality monitoring sites in the selected project area were based on: (i) the selected sites must be representative of the environmental quality of the project area; (ii) location and characteristics of emission sources; (iii) sensitive characteristics of the recipients. The locations of environmental monitoring are shown in the below tables and figures.

Table D-25: Sampling locations

No	Sampling locations	Coordinates	Code
I	***Air quality, noise and vibration***		
1.1	Staring point NH279: IC.16 – Km198+730	22°09'09.2"N; 104°20'37.8"E	KK01, ON01 and R01
1.2	Khanh Yen Town	22°05'25.7"N; 104°15'36.2"E	KK02, ON02 and R02
1.3	Starting point of Duong Quy bypass	22°03'29.9"N; 104°09'07.5"E	KK03, ON03 and R03
1.4	Khau Co pass that is near Ta Nang 2 bridge	22°2'9.7"N, 103°58'14.8"E	KK04, ON04 and R04
1.5	Muong Than T-junctions (Km352+500-NH32)	22°0'59.9"N, 103°54'52.5"E	KK05, ON05 and R05
1.6	Intersections of NH32 and PR107	22°6'53.4"N, 103°49'8.1"E	KK06, ON06 and R06
1.7	Pac Ta residential area-Pac Ta commune	22°4'20.1"N, 103°51'8.4"E	KK07, ON07 and R07
1.8	Tan Uyen town	22°11'23.2"N, 103°44'50.6"E	KK08, ON08 and R08

1.9	Ban Bo residential-Ban Bo commune (Km398, NH32);	22°16'29.8"N, 103°41'04.5"E	KK09, ON09 and R09
1.10	Dong Pao residential area-Ban Hon province	22°17'51.0"N, 103°34'21.6"E	KK10, ON10 and R10
1.11	Intersections of PR136 and Lai Chau by pass (Km34+800, NH4D)	22°22'5.2"N, 103°29'00.3"E	KK11, ON11 and R11
1.12	Staring point: IC14-Km149+705 (Noi Bai-Lao Cai expressway)	21°52'46.00"N, 104°40'25.4"E	KK12, ON12 and R12
1.13	Che Ve residential area- An Thịnh commune	21°51'44.9"N, 104°38'24.0"E	KK13, ON13 and R13
1.14	Khe Ngoai residential area- Mo Vang commune	21°46'20.7"N, 104°38'37.2"E	KK14, ON14 and R14
1.15	Intersections of NH32 (Km209+500) and PR175	21°39'1.6"N, 104°30'3.9"E	KK15, ON15 and R15
II	***Surface water and sediment***		
2.1	Nam Cho bridge	22° 3'14.8"N, 104° 8'31.5"E	NM1 and TT1
2.2	Ta Nang 1 bridge	22°2'17.9"N, 103°58'31.1"E	NM2 and TT2
2.3	Ta Nang 2 bridge	22°2'9.9"N, 103°58'13.8"E	NM3 and TT3
2.4	Can bridge	22°2'20.9"N, 103°56'41.4"E	NM4 and TT4
2.5	Nam Sap 2 bridge	22°2'58.5"N, 103°54'46.7"E	NM5 and TT5
2.6	Nam Lam bridge	22°16'22.1"N, 103°40'46.4"E	NM6 and TT6
2.4	Nam Mu bridge	22°16'10.8"N, 103°39'28.7"E	NM7 and TT7
2.8	Nam Dich bridge	22°17'31.8"N, 103°36'18.4"E	NM8 and TT8
2.9	Nam Hon bridge	22°18'41.0"N, 103°33'38.8"E	NM9 and TT9
2.10	Dan Xay bridge	21°52'45.9"N, 104°40'34.0"E	NM10 and TT10
2.11	Dap Tran bridge	21°48'42.2"N, 104°37'45.5"E	NM11 and TT11
2.12	Thac Ca bridge	21°42'5.8"N, 104°38'1.6"E	NM12 and TT12
III	***Groundwater***		
3.1	Ngầm Thỉn residential area- Tan Thuong commune	22°9'3.1"N, 104°20'36.5"E	NN1
3.2	Khe Lếch residential-Son Thuy commune	22°7'57.4"N, 104°17'5.2"E	NN2
3.3	Sân Bay village- Khanh Yen Thuong commune	22°5'45.5"N, 104°15'38.4"E	NN3
3.4	Khanh Yen town	22°5'24.9"N, 104°15'33.7"E	NN4

3.5	Hô Phai village-Lang Giang commune	22°5'4.9"N, 104°13'19.4"E	NN5
3.6	Thái Hòa village-Hoa Mac commune	22°5'24.2"N, 104°12'13.0"E	NN6
3.7	13 village-Duong Quy commune	22° 3'28.1"N, 104° 8'55.2"E	NN7
3.8	Bô village-Tham Duong commune	22° 2'50.1"N, 104°6'43.7"E	NN8
3.9	No.2 Minh Ha village- Minh Luong commune	22° 0'28.7"N, 104°3'23.8"E	NN9
3.10	Tu Ha village-Nam Xe commune	22°2'5.4"N, 104°1'33.3"E	NN10
3.11	Xa Bo village-Phuc Than commune	22°1'0.0"N, 103°54'52.8"E	NN11
3.12	Pak Ta village-Pak Ta commune	22°4'21.1"N, 103°51'8.1"E	NN12
3.13	Phieng Phat 2-Trung Dong commune	22° 7'25.9"N, 103°48'1.73"E	NN13
3.14	Chom Chang village-Than Thuoc commune;	22° 9'4.3"N, 103°46'27.1"E	NN14
3.15	3 Quarter-Tan Uyen Town	22°11'22.6"N, 103°44'51.4"E	NN15
3.16	Phuc Khoa village-Phuc Khoa commune	22°13'39.0"N, 103°43'17.7"E	NN16
3.17	Ban Bo village-Ban Bo commune	22°16'29.9"N, 103°41'3.30"E	NN17
3.18	Na Hieng village-Na Tam	22°16'19.9"N, 103°40'23.6"E	NN18
3.19	Na Ca-Binh Lu commune	22°16'58.6"N, 103°37'52.5"E	NN19
3.20	Dông Pao No.1 village-Ban Hon commune	22°17'48.8"N, 103°34'23.7"E	NN20
3.21	Na Bo village-Ban Giang commune	22°20'28.9"N, 103°31'22.8"E	NN21
3.22	Can Dang village-San Thang commune	22°20'41.6"N, 103°30'38.2"E	NN22
3.23	No.24 quarter-Dong Phong ward	22°22'27.5"N, 103°29'7.6"E	NN23
3.24	Che Ve village-An Thinh commune	21°52'16.1"N, 104°39'9.4"E	NN24
3.25	No.2 village-Dai Son commune	21°50'48.5"N, 104°37'4.8"E	NN25
3.26	Khe Ngoai village-Mo Vang commune	21°47'1.7"N, 104°38'20.8"E	NN26
3.27	Khe Cam village-An Luong commune	21°40'52.2"N, 104°37'9.8"E	NN27
3.28	Vang Ngan village-Suoi Quyen commune	21°40'51.0"N, 104°35'19.2"E	NN28

3.29	Son Luong commune	21°39'29.1"N, 104°30'22.9"E	NN29
3.30	Nong Truong Lien Son town	21°39'18.5"N, 104°30'26.0"E	NN30
IV	***Soil***		
4.1	Tan Thuong commune	22°9'3.8"N, 104°20'34.7"E	D1
4.2	Son Thuy commune	22°7'51.6"N, 104°16'52.1"E	D2
4.3	Khanh Yen Thuong commune	22°5'43.4"N, 104°15'38.8"E	D3
4.4	Khanh Yen town	22°5'24.1"N, 104°15'36.8"E	D4
4.5	Lang Giang commune	22°5'5.2"N, 104°13'14.3"E	D5
4.6	Hoa Mac commune	22°5'26.3"N, 104°12'9.8"E	D6
4.7	Duong Quy commune	22°3'26.2"N, 104°8'55.2"E	D7
4.8	Tham Duong commune	22°2'50.0"N, 104°6'46.2"E	D8
4.9	Minh Luong commune	22°0'29.5"N, 104°3'25.8"E	D9
4.10	Nam Xe commune	22°2'5.4"N, 104°1'30.1"E	D10
4.11	Phuc Than commune	22°1'7.9"N, 103°54'53.6"E	D11
4.12	Pak Ta commune	22°4'26.5"N, 103°50'58.8"E	D12
4.13	Trung Dong commune	22°7'28.7"N, 103°48'4.6"E	D13
4.14	Than Thuoc commune;	22°9'15.1"N, 103°46'1.4"E	D14
4.15	Tan Uyen Town	22°11'23.3"N, 103°44'50.8"E	D15
4.16	Phuc Khoa commune	22°13'38.2"N, 103°43'29.4"E	D16
4.17	Ban Bo commune	22°16'22.1"N, 103°40'45.6"E	D17
4.18	Na Tam	22°16'19.5"N, 103°40'21.9"E	D18
4.19	Binh Lu commune	22°16'57.6"N, 103°37'52.6"E	D19
4.20	Ban Hon commune	22°18'39.2"N, 103°33'39.0"E	D20
4.21	Ban Giang commune	22°20'24.9"N, 103°31'27.5"E	D21

4.22	San Thang commune	22°20'42.6"N, 103°30'39.3"E	D22
4.23	Dong Phong ward	22°22'24.8"N, 103°29'6.8"E	D23
4.24	An Thinh commune	21°52'45.6"N, 104°40'29.2"E	D24
4.25	Dai Son commune	21°50'57.5"N, 104°37'2.4"E	D25
4.26	Mo Vang commune	21°47'4.4"N, 104°38'21.6"E	D26
4.27	An Luong commune	21°40'55.3"N, 104°37'10.5"E	D27
4.28	Suoi Quyen commune	21°40'44.7"N, 104°35'22.1"E	D28
4.29	Son Luong commune	21°39'25.4"N, 104°30'24.5"E	D29
4.30	Nong Truong Lien Son town	21°39'18.0"N, 104°30'24.2"E	D30

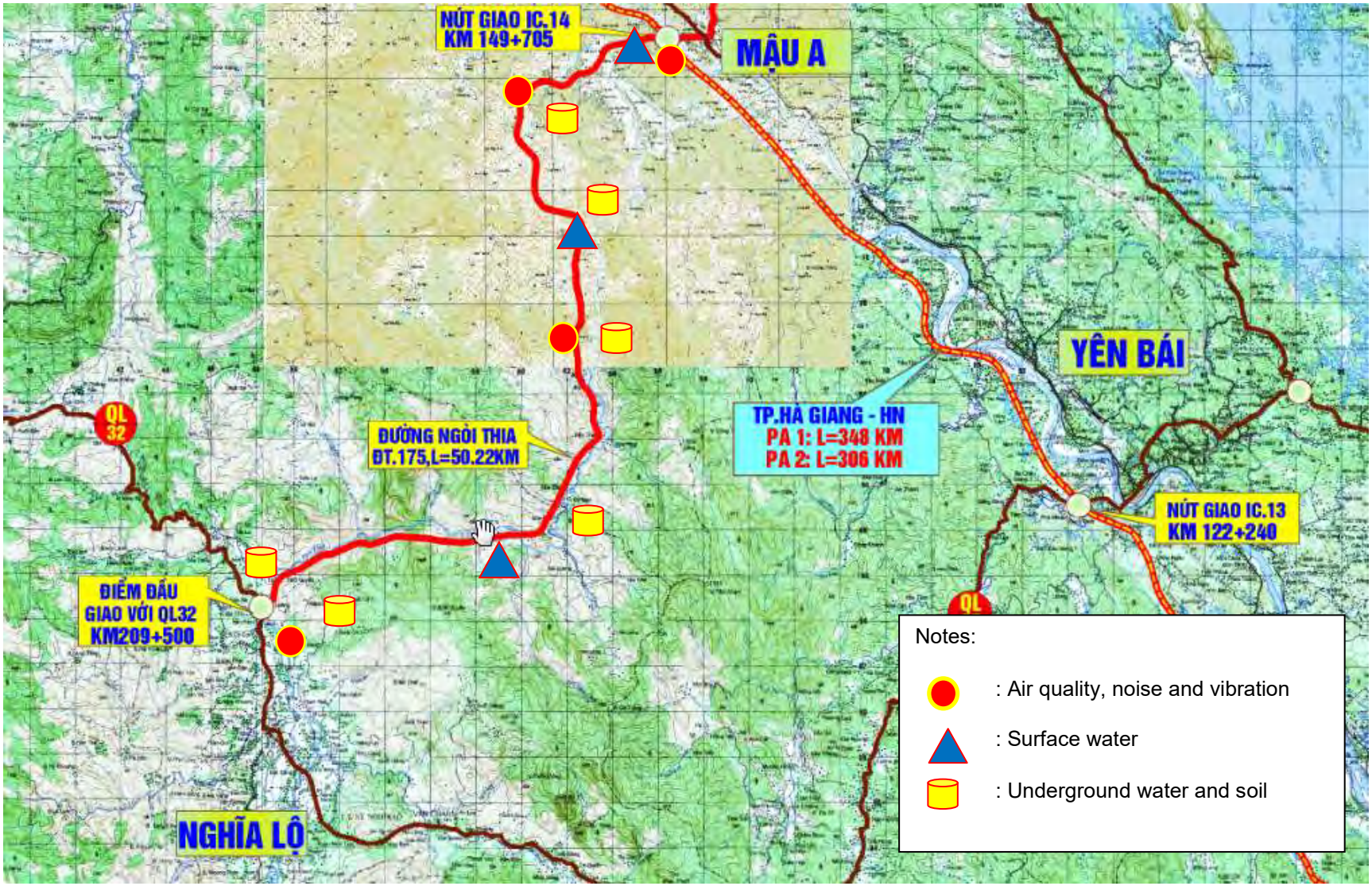


Figure D-26: Monitoring locations on PR175

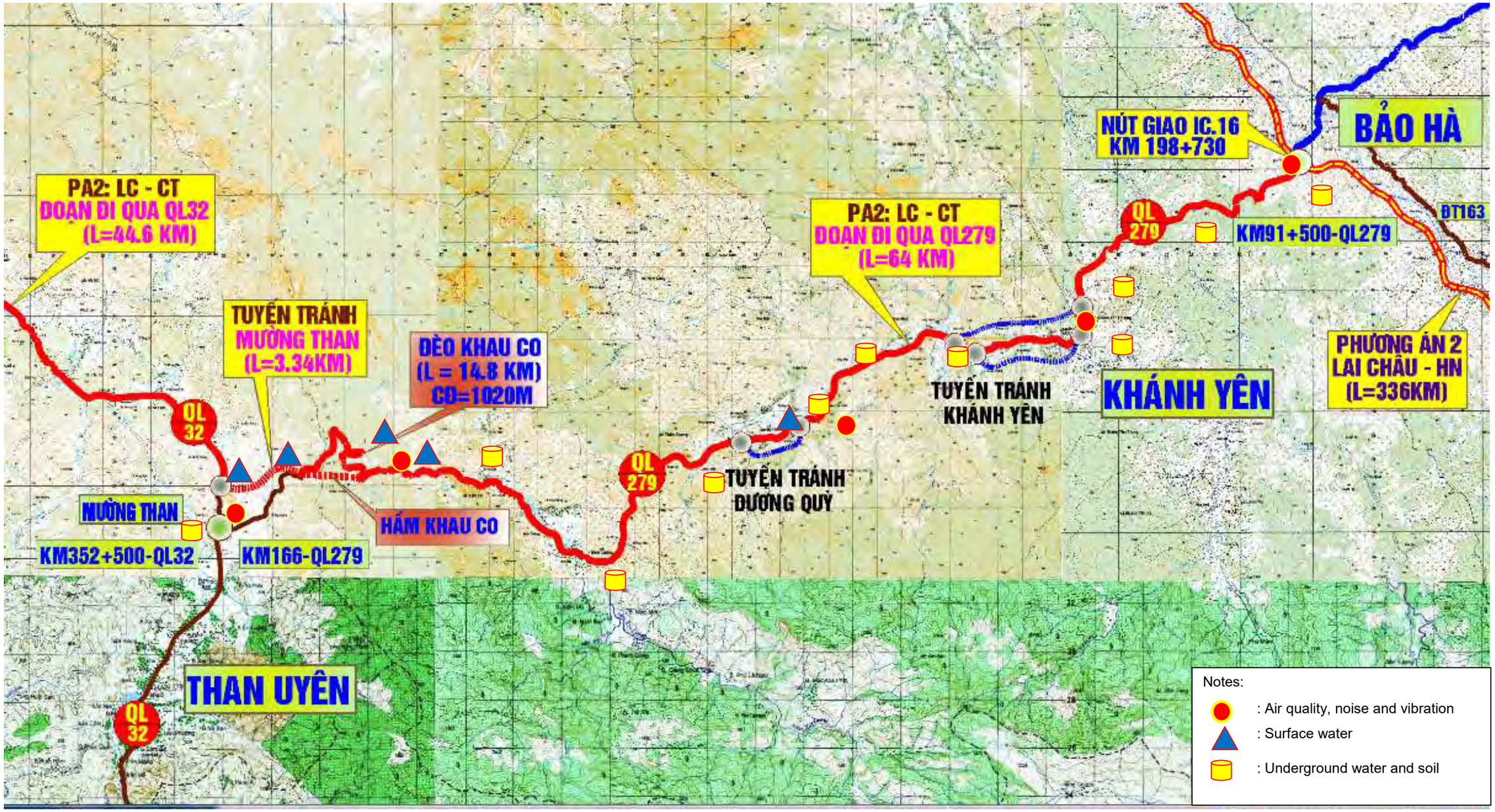
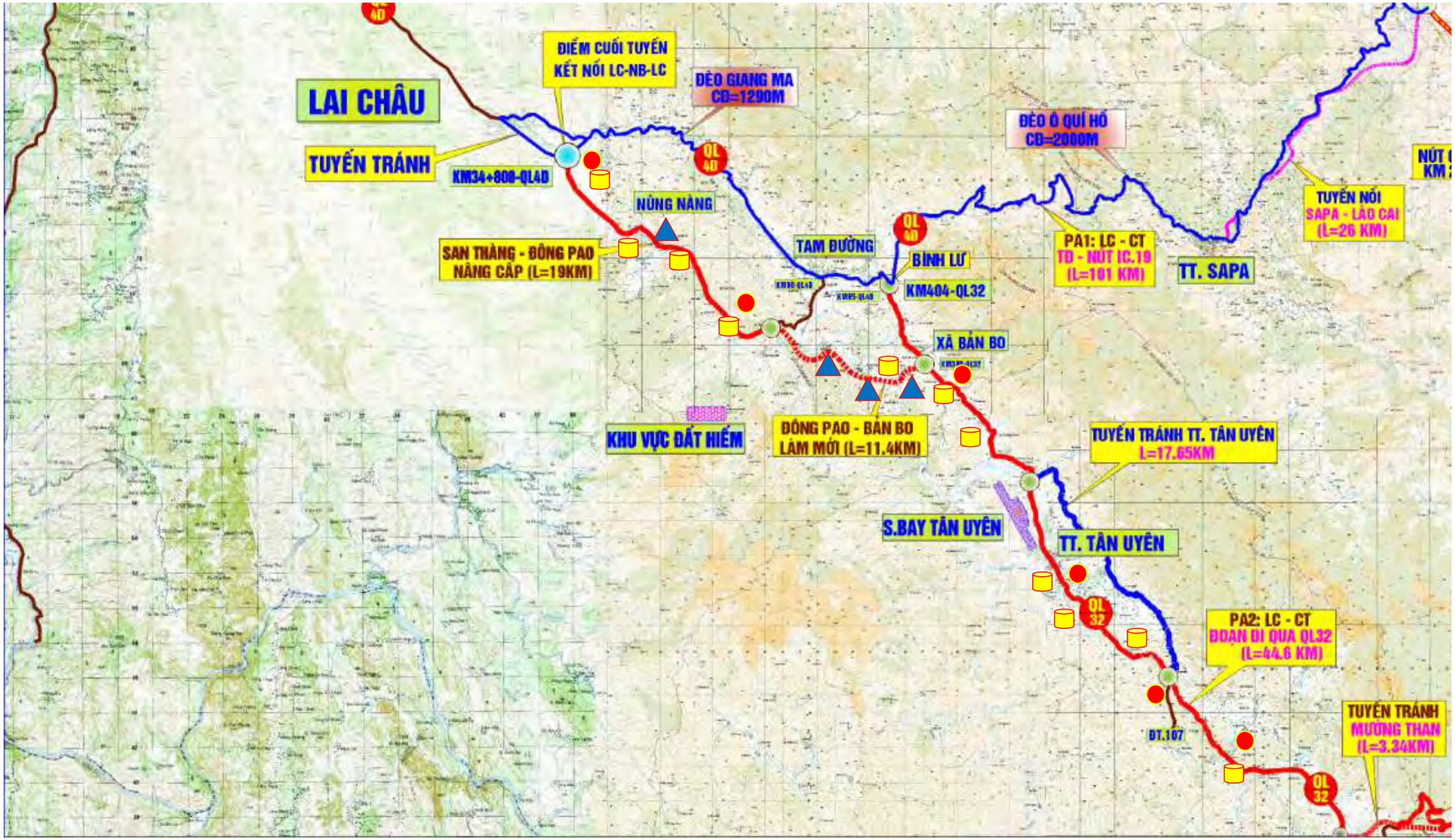


Figure D-27: Monitoring locations on NH279



Monitoring Locations on NH32

D.5.2.Evaluation parameters and frequency of monitoring

242. Indicators of environmental quality monitored, analyzed and evaluated are defined in the following table.

Table D-26: Evaluation parameters and frequency of monitoring, sampling

No	Parameter	Frequency	Thiết bị Do Dạc, lấy mẫu	Tiêu chuẩn tham chiếu
1	**Air:** Air temperature, humidity, pressure, wind speed, wind direction, dust (TSP), SO_2, NO_2, CO	Monitoring time 16h / day, frequency 2h / times	- Dust sampler: Dustscan Scout Aerosol Monitor. - Gas sampler: Air Sampler - CASELLA-Apex. - Micrometers: Kestrel 4500.	National technical standards of Viet Nam for ambient air quality QCVN 05:2013/BTNMT.
2	**Equivalent noise level:** Leq.	Monitoring time 15 hours / day, 3 times / 1 hour, 10 minutes / measurement.	Noise meter RION - Model NL - 21 SOUND Level Meter Japan.	National technical noise standards QCVN 26:2010/BTNMT.
3	**Vibration level:** Lva_{eq}	Monitoring time 15 hours / day, 3 times / 1 hour, 10 minutes / measurement.	Vibration Meter - Vibration Level Meter VM - 53A.	National technical standards on vibration QCVN 27:2010/BTNMT.
4	**Surface water:** temperature, pH, conductivity, DO, COD, BOD5, TSS, heavy metals (Cd, Pb, As, Zn), grease, E. coli, coliform.	1 sample / 1 location	All parameters such as temperature, pH, DO, conductivity were measured at the field using D-54 and OM-51 instruments, Horiba, Japan. Other parameters such as BOD, COD, heavy metals, microorganism ... will be sampled, stored and analyzed in the laboratory.	National technical standards on surface water quality QCVN 08-MT:2015/BTNMT.
	Groundwater: pH, conductivity, hardness, TS, COD, heavy metals (Cd, Pb, As, Zn), Coliform	1 sample / 1 location	Parameters such as pH, conductivity, hardness were measured at the scene with D-54 and OM-51 instruments, Horiba, Japan. Other parameters such as COD, heavy metals, microorganisms ... will be sampled, stored and analyzed in the laboratory.	National technical standards QCVN 09-MT:2015/BTNMT.
5	**Sediment:** Cu, Pb, Zn, Cd	1 sample / 1 location	Excavators	National technical standards QCVN 43:2012/BTNMT.

6	**Soil:** Cu, Pb, Zn, Cd	1 sample / 1 location	Drill cylinder	National technical standards QCVN 03-MT:2015/BTNMT.

D.5.3.Measurement results and comments

D.5.3.1. Quality of air environment (general)

243. In general, the quality of the micro-climate in the area is typical of tropical monsoon climate. At the time of the survey, temperature varied between 26.0-33.9oC, the moisture from 65.3% -88.3%, the wind speed from 0.2 m/s -6.3 m/s (NE), the atmospheric pressure from 920-1011 mbar.

Table D-27: Summary of results of microclimate measurement in the project area

No	Sample symbol	Parameters				
		Temperature (^{0}C)	Pressure (mbar)	Humidity (%)	Wind speed (m/s)	Wind direction
1	KK01	27,0-31,1	1003-1008	70,3-81,3	0,5-1,9	NE
2	KK02	27,2-32,9	980-1010	76,0-82,2	0,8-1,6	NE
3	KK03	27,2-32,9	1001-1007	70,9-80,9	0,9-6,3	NE
4	KK04	27,6-33,9	943-970	73,4-83,5	1,3-2,1	NE
5	KK05	26,4-33,4	932-983	67,2-74,6	0,6-2,4	NE
6	KK06	26,1-31,8	948-971	70,3-86,2	0,6-3,2	NE
7	KK07	24,7-32,9	945-967	72,5-80,1	0,9-2,6	NE
8	KK08	26,6-33,0	943-976	65,4-74,2	1,3-3,3	NE
9	KK09	27,0-31,2	937-963	75,9-82,5	0,9-2,4	NE
10	KK10	26,1-32,4	933-958	73,6-88,3	1,1-3,0	NE
11	KK11	27,3-33,7	920-940	66,3-74,3	1,2-2,6	NE
12	KK12	26,0-31,8	1003-1011	65,5-74,5	0,4-5,6	NE
13	KK13	27,3-31,9	1001-1010	65,9-74,6	0,2-2,7	NE
14	KK14	27,6-31,7	999-1008	65,3-74,5	1,2-2,4	NE
15	KK15	27,5-31,3	1001-1010	66,3-73,7	1,0-2,8	NE

D.5.3.2. Air quality

244. Measurements of air quality in the project area are shown in the following table. Compared with QCVN 05: 2013 / BTNMT, it can be concluded that:

a. Total Dust (TSP): At the test site, the TSP values are within the QCVN 05: 2013 / BTNMT standard.

b. Concentration of gases (CO, SO2, NO2): At the measurement sites, the gas concentration values were within QCVN 05: 2013 / BTNMT standard.

Table D-28: Measurement results of project air quality (1-h average)

No	Sample symbol	Analytical parameters *(µg/m^3)*			
		TSP	CO	NO_2	SO_2
1	KK01	185,3	1287	193,5	146,6
2	KK02	169,8	1236	176,8	134,5
3	KK03	168,5	1205	170,9	135,9

No	Sample symbol	Analytical parameters *(µg/m³)*			
		TSP	**CO**	**NO_2**	**SO_2**
4	KK04	105,1	815	96,3	86,7
5	KK05	115,8	1079	104,1	96,0
6	KK06	118,9	1106	109,8	97,8
7	KK07	117,2	1068	110,2	102,3
8	KK08	117,6	1067	109,9	99,6
9	KK09	120,8	1070	111,3	102,5
10	KK10	121,5	1069	108,0	103,6
11	KK11	120,4	1070	109,6	101,5
12	KK12	115,9	1074	99,0	98,4
13	KK13	115,5	1070	98,9	90,2
14	KK14	117,9	1067	101,0	95,1
15	KK15	154,3	1065	124,1	119,4
QCVN 05:2013/BTNMT (Average 1h)		**300**	**30,000**	**200**	**350**

D.5.3.3. Noise level

245. The results of noise measurement are presented in **Table D-29**. Results indicate that noise levels along the roads are generally compliant with QCVN 26: 2010 / BTNMT and the IFC (2007) standard for commercial areas, but exceeding noise level recommended by IFC (2007) for residential areas during daytime. This is not surprising given the proximity of the residential areas to the roads with partly heavy traffic and frequent use of vehicle horns. Noise levels at night are significantly lower given the almost total absence of traffic on these roads.

Table D-29: Summary of noise measurement results of the project area

No	Sample symbol	The average value Leq (6h - 21h)	QCVN 26:2010/BTNMT Common area	WB/IFC 2007 Standard
1	ON01	65.7	**70**	**70/55**
2	ON02	66.5	**70**	**70/55**
3	ON03	66.9	**70**	**70/55**
4	ON04	61.4	**70**	**70/55**
5	ON05	66.2	**70**	**70/55**
6	ON06	65.8	**70**	**70/55**
7	ON07	67.0	**70**	**70/55**
8	ON08	66.2	**70**	**70/55**
9	ON09	67.1	**70**	**70/55**
10	ON10	66.1	**70**	**70/55**
11	ON11	66.5	**70**	**70/55**

No	Sample symbol	The average value Leq (6h - 21h)	QCVN 26:2010/BTNMT Common area	WB/IFC 2007 Standard
12	ON12	65.7	**70**	**70/55**
13	ON13	65.9	**70**	**70/55**
14	ON14	67.6	**70**	**70/55**
15	ON15	67.1	**70**	**70/55**

D.5.3.4. Vibration

246. The results of the survey are presented in **Table D-30**. Detailed results are presented in domestic EIA. Results indicate that vibration levels are within the QCVN 27: 2010 / BTNMT standard.

Table D-30: Vibration levels in the project area

No	Sample symbol	Vibration acceleration results (L_{va})(6h - 21h)	QCVN 27:2010/BTNMT Common area
1	R01	42,6	**70**
2	R02	41,4	**70**
3	R03	43,3	**70**
4	R04	40,6	**70**
5	R05	43,7	**70**
6	R06	44,1	**70**
7	R07	43,2	**70**
8	R08	40,7	**70**
9	R09	40,1	**70**
10	R10	35,4	**70**
11	R11	40,8	**70**
12	R12	44,2	**70**
13	R13	43,0	**70**
14	R14	43,6	**70**
15	R15	42,7	**70**

D.5.3.5. Surface water quality

247. Results of measurement and analysis of surface water quality are presented in **Table D-31** and **Table D-32**. More details are presented in the domestic EIA. Compared to the threshold of QCVN 08-MT: 2015 / BTNMT type B1, the following can be concluded:

a. For physical and chemical factors: TSS at all monitoring sites from NM2 to NM12 are within the standard (50 mg/L) type B1. At the NM1 site, the TSS value slightly exceeded the standard (53.4 mg/L). All other parameters complied with the standard.

b. For biochemical factors (DO, COD and BOD5): Values are all within the standard for class B1.

c. For oil: Values are all within the standard for class B1.

d. For heavy metals: Concentrations of heavy metals at all sites are within the standard for class B1.

e. Coliform: Concentrations are within the standard for class B1.

248. Thus, in general, surface water quality achieved QCVN 08 MT: 2015 / BTNMT class B1.

Table D-31: Results of surface water quality analysis

No	Analysis criteria	Unit	Result									QCVN 08-MT:2015/ BTNMT (Class B1)
			NM1	NM2	NM3	NM4		NM5	NM6	NM7		
						Morning	Afternoon			Morning	Afternoon	
1	Temperature	^oC	18.4	17.2	17.3	16.5	17.2	16.5	17.4	15.5	18.4	-
2	pH	-	7.5	7.7	7.6	8.1	7.8	7.6	7.7	7.7	7.5	5.5-9
3	DO	mg/L	5.2	5.5	5.4	5.7	5.5	4.8	4.5	4.8	5.1	≥4
4	BOD_5	mg/L	8.4	5.6	6.1	5.4	5.3	10.1	12.1	6.2	5.8	15
5	COD	mg/L	20.6	10.7	10.2	9.2	9.4	22.5	25.8	10.1	9.2	30
6	TSS	mg/L	53.4	12.4	13.7	10.3	9.7	32.4	35.0	11.5	12.7	50
7	NH_4^+	mg/L	0.25	0.12	0.1	0.12	0.08	0.42	0.55	0.15	0.11	0.9
8	NO_3^-	mg/L	1.7	0.46	0.32	0.28	0.32	3.5	4.1	0.58	0.64	10
9	PO_4^{3-}	mg/L	0.14	0.04	0.055	0.042	0.035	0.22	0.25	0.12	0.15	0.3
10	Fe	mg/L	1.1	0.52	0.47	0.25	0.31	0.8	1.1	0.32	0.28	1.5
11	Mn	mg/L	0.35	0.16	0.21	0.18	0.19	0.24	0.32	0.21	0.18	0.5
12	Pb	mg/L	0.031	KPHT	KPHT	KPHT	KPHT	0.017	0.025	KPHT	KPHT	0.05
13	Hg	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.001
14	As	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.05
15	Grease	mg/L	0.2	KPHT	KPHT	KPHT	KPHT	0.15	0.32	KPHT	KPHT	1
16	Coliform	MPN/100mL	4.520	1.750	1.720	1.450	1.410	5.120	5.210	2.100	2.080	7.500

Table D-32: Results of surface water quality analysis

No	Analysis criteria	Unit	Result							QCVN 08-MT:2015/ BTNMT (Columne B1)
			NM8	NM9	NM10		NM11		NM12	
					Morning	Afternoon	Morning	Afternoon		
1	Temperature	^oC	17.6	18.4	20.2	21.5	20.7	21.8	20.5	-
2	pH	-	7.7	7.2	7.4	7.5	7.5	7.7	7.8	5.5-9
3	DO	mg/L	5.2	4.9	4.2	4.3	4.8	5.1	5.1	≥4
4	BOD_5	mg/L	13.2	9.5	10.1	9.8	7.2	6.5	7.4	15
5	COD	mg/L	27.5	21.2	22.5	21.7	16.4	15.7	18.2	30
6	TSS	mg/L	35.4	18.5	37.4	35.6	25.4	24.6	21.4	50
7	NH_4^+	mg/L	0.48	0.41	0.45	0.38	0.28	0.22	0.37	0.9
8	NO_3^-	mg/L	4.6	3.52	3.82	4.15	1.15	1.23	2.12	10
9	PO_4^{3-}	mg/L	0.22	0.18	0.18	0.22	0.12	0.17	0.08	0.3
10	Fe	mg/L	0.52	1.1	0.55	0.52	0.35	0.31	0.25	1.5
11	Mn	mg/L	0.24	0.35	0.18	0.27	0.21	0.13	0.14	0.5
12	Pb	mg/L	0.015	0.037	KPHT	KPHT	KPHT	KPHT	0.012	0.05
13	Hg	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.001
14	As	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.05
15	Dầu mỡ	mg/L	0.18	0.22	0.25	0.31	KPHT	KPHT	KPHT	1
16	Coliform	MPN/100mL	5.520	5.700	5.100	5.040	4.750	4.610	3.570	7.500

Notes: (i) *QCVN 08-MT: 2015 / BTNMT - National technical standards on surface water quality; Type B1: For irrigation or other purposes of similar water quality or use purposes such as B2; B2: Water navigation and other purposes with low quality water requirements; (ii) KPHT: Not detected*

D.5.3.6. Quality of underground water

249. The results of measurement and analysis of underground water quality are summarized in **Table D-33** to **Table D-36**. Additional information is presented in the domestic EIA. The results indicate that all parameters at all monitoring sites comply with QCVN 09-MT: 2015 / BTNMT.

Table D-33: Summary of groundwater quality analysis results

No	Analysis criteria	Unit	Result								QCVN 09-MT:2015/ BTNMT
			NN1	NN2	NN3	NN4	NN5	NN6	NN7	NN8	
1	pH	^oC	7.1	6.7	7.2	7.1	6.9	7.2	7.4	7.2	5.5 - 8.5
2	Temperature	-	20.2	19.5	19.7	20.2	20.5	19.7	20.2	19.8	-
3	TDS	mg/L	250.7	310.2	270.4	315.6	415.8	372.8	314.3	334.2	1.500
4	Stiffness	mg/L	152	265	180.3	190.7	320.8	182.7	220.6	195.7	500
5	DO	mg/L	1.1	0.8	1.2	0.9	1.3	1.4	1.2	1.3	-
6	COD	mg/L	2.2	3.1	1.8	1.5	2.7	1.6	2.1	2.5	4
7	NO_3^-	mg/L	5.1	6.2	3.5	2.3	4.3	3.5	4.3	3.1	15
8	Cl^-	mg/L	41.5	54.7	27.8	31.2	65.2	25.3	31.1	25.4	250
9	Cr^{6+}	mg/L	0.011	0.023	0.012	0.011	0.019	0.012	0.017	0.018	0.05
10	Fe	mg/L	1.5	4.8	2.1	1.8	4.2	1.8	2.1	1.8	5
11	As	mg/L	0.011	0.018	0.0085	0.0092	0.012	0.014	0.012	0.009	0.05
12	Zn	mg/L	1.1	2.2	1.3	1.1	1.7	0.73	0.84	0.77	3
13	Hg	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.001
14	Coliform	100MPL/100mL	2	2	1	1	1	2	1	2	3

Note: - KPHT: Not detected

Table D-34: Summary of groundwater quality analysis results

No	Analysis criteria	Unit	Result								QCVN 09-MT:2015/ BTNMT
			NN9	NN10	NN11	NN12	NN13	NN14	NN15	NN16	
1	pH	^oC	7.3	7.4	7.5	7.6	7.3	7.6	7.8	7.7	5.5 - 8.5
2	Temperature	-	20.5	20.7	19.4	20.1	20.7	20.5	19.4	20.3	-
3	TDS	mg/L	412.8	385.3	415.6	394.5	315.4	384.3	337.2	275.7	1.500
4	Stiffness	mg/L	216.4	292.6	320.7	212.7	182.8	210.8	175.6	138.4	500
5	DO	mg/L	1.1	1.4	1.2	1.3	1.1	1.1	1.3	1.2	-
6	COD	mg/L	1.2	2.3	1.9	2.4	1.9	2.3	1.9	2.5	4
7	NO_3^-	mg/L	4.7	5.1	2.8	1.9	2.2	2.7	1.8	2.1	15
8	Cl^-	mg/L	31.3	28.5	31.5	27.6	33.6	35.3	27.1	50.6	250
9	Cr^{6+}	mg/L	0.019	0.021	0.009	0.011	0.008	0.007	0.014	0.007	0.05
10	Fe	mg/L	2.1	2.3	1.7	1.5	1.7	1.4	2.2	1.9	5
11	As	mg/L	0.011	0.01	0.008	0.013	0.009	0.006	0.005	0.006	0.05
12	Zn	mg/L	1.2	1.1	1.3	1.5	1.4	1.2	1.7	2.3	3
13	Hg	mg/L	0.0008	0.0007	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.001
14	Coliform	100MPL/100mL	KPHT	1	1	1	2	1	2	1	3

Note: - KPHT: Not detected

Table D-35: Summary of groundwater quality analysis results

No	Analysis criteria	Unit	Result								QCVN 09-MT:2015/ BTNMT
			NN17	NN18	NN19	NN20	NN21	NN22	NN23	NN24	
1	pH	^oC	7.4	7.5	7.6	7.1	7.2	7.4	7.4	7.6	5.5 - 8.5
2	Temperature	-	21.1	18.7	19.5	19.7	20.2	20.3	20.3	20.2	-
3	TDS	mg/L	410.7	380.4	370.6	475.6	391.7	410.7	410.7	450.6	1.500
4	Stiffness	mg/L	315.2	230.8	192.4	316.4	264.8	312.5	312.5	335.7	500
5	DO	mg/L	1.5	1.3	1.2	1.1	1.3	1.1	1.1	1.4	-
6	COD	mg/L	2.8	1.9	1.8	2.2	1.8	2.2	2.2	2.1	4
7	NO_3^-	mg/L	1.9	1.5	2.1	1.9	1.5	4.5	4.5	4.3	15
8	Cl^-	mg/L	20.3	32.7	44.3	80.3	41.4	51.8	51.8	53.6	250
9	Cr^{6+}	mg/L	0.008	0.013	0.009	0.013	0.005	0.013	0.013	0.008	0.05
10	Fe	mg/L	1.5	1.2	1.7	2.5	1.9	2.9	2.9	1.5	5
11	As	mg/L	0.005	0.007	0.005	0.012	0.008	0.012	0.012	0.009	0.05
12	Zn	mg/L	1.7	0.85	0.73	1.7	0.95	1.7	1.7	1.8	3
13	Hg	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.001
14	Coliform	100MPL/100mL	1	1	1	2	1	2	2	2	3

Note: - KPHT: Not detected

Table D-36: Summary of groundwater quality analysis results

No	Analysis criteria	Unit	Result							QCVN 09-MT:2015/ BTNMT
			NN25	NN26	NN27	NN28	NN29	NN30	NN31	
1	pH	^oC	6.8	7.1	7.6	7.7	7.5	7.7	7.4	5.5 - 8.5
2	Temperature	-	21.5	20.9	21.5	21.4	21.7	21.5	21.3	-
3	TDS	mg/L	420.4	384.3	450.7	515.6	428.2	318.2	350.6	1.500
4	Stiffness	mg/L	183.6	175.6	284.9	347.2	305.6	192.8	210.8	500
5	DO	mg/L	1.1	1.2	1.1	0.85	1.2	1.1	1.3	-
6	COD	mg/L	1.5	1.9	2.2	2.6	2.5	2.2	1.9	4
7	NO_3^-	mg/L	5.1	4.7	3.4	5.5	5.1	3.7	4.1	15
8	Cl^-	mg/L	47.3	43.6	35.5	41.4	37.4	41.8	53.7	250
9	Cr^{6+}	mg/L	0.007	0.013	0.008	0.012	0.008	0.007	0.008	0.05
10	Fe	mg/L	3.2	4.1	4.7	3.7	4.4	3.4	2.9	5
11	As	mg/L	0.009	0.007	0.005	0.013	0.005	0.011	0.008	0.05
12	Zn	mg/L	1.1	0.85	1.3	1.1	0.92	1.4	1.5	3
13	Hg	mg/L	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	KPHT	0.001
14	Coliform	100MPL/100mL	1	2	1	1	2	1	2	3

Note: - KPHT: Not detected

D.5.3.7. Quality of soil environment

250. The results of analysis of agricultural land quality are summarized in **Table D-37**. Results indicate that soil quality complies with QCVN03-MT: 2015 / BTNMT for agricultural land. Soil is not contaminated by heavy metals.

Table D-37: Integrated analysis of soil quality

No	Analysis criteria	Unit	Results										QCVN 03-MT:2015/BTNMT (Agri soil)
			D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	
1	Copper (Cu)	mg/kg dry soil	12.9	16.7	11.1	13.2	19.5	20.2	13.2	25.2	13.9	21.7	100
2	Lead (Pb)	mg/kg dry soil	31.6	37.8	25.3	21.9	24.3	13.6	17.6	19.5	18.5	12.9	70
3	Zinc (Zn)	mg/kg dry soil	45.5	51.3	39.6	40.8	32.9	39.1	42.6	45.7	26.4	30.3	200
4	Cadmium (Cd)	mg/kg dry soil	0.72	0.96	0.77	0.65	0.71	0.65	1.1	0.81	1.05	0.55	1.5
5	Arsenic (As)	mg/kg dry soil	5.9	8.2	6.3	7.4	3.6	5.5	4.3	2.9	2.1	2.3	15
No	**Analysis criteria**	**Unit**	**Results**										**QCVN 03-MT:2015/BTNMT (Agri soil)**
			D11	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**	
1	Copper (Cu)	mg/kg dry soil	7.6	7.2	6.4	10.7	13.1	16.4	12.6	17.3	19.3	15.4	100
2	Lead (Pb)	mg/kg dry soil	3.8	11.6	5.2	7.6	9.8	17.2	10.9	12.4	12.6	9.6	70
3	Zinc (Zn)	mg/kg dry soil	21.4	18.4	14.5	12.1	16.5	31.5	22.1	26.9	19.8	22.7	200
4	Cadmium(Cd)	mg/kg dry soil	0.2	0.4	0.34	0.32	0.22	0.54	0.38	0.31	0.42	0.52	1.5
5	Arsenic (As)	mg/kg dry soil	0.9	0.6	1.1	0.5	1.3	3.6	1.1	5.4	2.3	4.8	15
No	**Analysis criteria**	**Unit**	**Result**										**QCVN 03-MT:2015/BTNMT (Agri soil)**
			D21	**D22**	**D23**	**D24**	**D25**	**D26**	**D27**	**D28**	**D29**	**D30**	
1	Copper (Cu)	mg/kg dry soil	8.3	10.5	12.9	10.4	12.3	10.6	13.1	12.6	16.3	12.6	100
2	metals lead (Pb)	mg/kg dry soil	4.9	4.9	10.1	30.1	28.6	21.1	30.3	30.2	24.7	21.5	70
3	Zinc (Zn)	mg/kg dry soil	12.1	13.9	17.8	41.8	37.8	32.9	39.2	38.4	46.4	45.6	200
4	Cadmium(Cd)	mg/kg dry soil	0.32	0.28	0.63	1.56	1.38	0.97	1.05	1.89	1.12	0.08	1.5
5	Arsenic (As)	mg/kg dry soil	0.9	1.3	3.3	1.13	1.22	2.13	0.98	0.85	1.51	1.36	15

D.5.3.8. Quality of sediment

251. The analysis results of sediment samples obtained at the same locations where surface water samples were taken indicate that all parameters are within the limits provided in QCVN 43:2012/BTNMT and which are presented in Table below.

Table D-38: Integrated analysis of sediment quality

No	Parameters	Unit	Results						Criteria: QCVN 43:2012/BTNMT (Fresh water sediment)
			TT1	TT2	TT3	TT4	TT5	TT6	
1	Copper (Cu)	mg/kg dry soil	125.4	117.8	121.5	117.4	132.3	87.5	197
2	Lead (Pb)	mg/kg dry soil	52.6	26.7	31.6	28.5	18.4	11.3	91.3
3	Zinc (Zn)	mg/kg dry soil	272.3	205.3	182.3	192.7	205.6	156.1	315
4	Cadmium (Cd)	mg/kg dry soil	2.1	1.5	1.1	0.81	1.1	0.73	3.5
5	Arsenic (As)	mg/kg dry soil	5.6	2.8	3.2	2.7	3.5	2.2	17.0
No	**Para-meters**	**Unit**	**Results**						**Criteria: QCVN 43:2012/BTNMT (Fresh water sediment)**
			TT7	TT8	TT9	TT10	TT11	TT12	
1	Copper (Cu)	mg/kg dry soil	91.2	75.1	115.4	97.2	101.6	115.6	197
2	Lead (Pb)	mg/kg dry soil	29.4	13.6	31.3	25.1	37.6	33.8	91.3
3	Zinc (Zn)	mg/kg dry soil	181.6	205.7	197.6	135.8	161.8	175.2	315
4	Cadmium (Cd)	mg/kg dry soil	1.1	0.82	1.15	0.91	1.5	2.1	3.5
5	Arsenic (As)	mg/kg dry soil	2.5	2.3	4.7	3.4	5.3	3.8	17.0

E. PROJECT ALTERNATIVES

E.1. With- and without project comparison

252. As part of the Region-wide Analysis for the North-Western Region, the PPTA consultant carried out of a Multi-Criteria Analysis of roads in the North-Western Region to verify that the selected sub-project roads represented the priority roads for improvement in the region.

253. The criteria comprised: (i) Inclusion in National Development Plans (Mid-term Master Plan) and Strategies; (ii) Poverty incidence; (iii) Economic and financial viability; (iv) Accessibility to GMS Corridors; (v) Environmental impacts; (vi) Social impacts; (vii) Financing mechanisms and options available for construction and maintenance; (viii) Opportunities available for private sector participation and incentives to stimulate participation; (ix) Interconnection integrity of the network, and; (x) Consistency in cross border road standards.

254. The Consultants applied the multi-criteria methodology to each of the candidate roads in the North-Western Region. Based on this analysis, PR175 came out with the highest priority and the NH279 came out in second position. The NH37 came out in third place (but is not one of the project roads as it has been upgraded under local financing). It is interesting to note that all these roads provide direct links to the Noi Bai Lao Cai Expressway, and improving corridor connectivity is the main aim of the current project.

255. The only existing way of connecting the Noi Bai - Lao Cai Expressway with NH32 is from Lao Cai to Lai Chau via Sapa. The do-nothing alternative would be to continue relying on this existing road corridor. This is a very mountainous road susceptible to extreme winter weather conditions, including heavy snowfall. The alignment NH279 fulfils a vital function by linking the Noi Bai - Lao Cai Expressway with NH32, thus forming a strategic conduit to Lai Chau. Due to the mountainous terrain to the north and south of NH279 there are no alternative routes.

256. The other project roads came out with slightly lower priority, which could be expected because they are generally running parallel to the Noi Bai - Lao Cai Expressway and therefore contribute slightly less to the aim of improving corridor connectivity.

Table E-1: With- and without project. Comparison on environmental implications

Environmental and social issues	Without Project	With Project
Impact on air quality	(+) Not affected by construction activities. (-) Poor road conditions and bottlenecks result in high dust emissions and vehicle exhaust emissions at traffic bottlenecks (mainly around villages). (-) Emissions from vehicles will increase as the traffic density rises on narrow, bad roads	(-) Dust and noise levels will temporarily increase during road enhancement works. However, this effect is temporary, localized and can be controlled. (+) During operation, vehicle exhaust emissions from vehicles will likely increase as the traffic increases. However, the increase is expected to be totally offset by improved road conditions which will significantly reduce dust emissions and eliminate existing exhaust “hotspots” where traffic congestion is common (especially near villages).
Impact on surface water quality	(+) Not affected by construction activities.	(-) Bridge construction or road construction near surface bodies can result in surface water quality

	(-) Poor road conditions along rivers could result in accidents with risk of spills contaminating surface water.	deterioration. However, the impact only occurs during construction and can be mitigated. (+) Improved road conditions are anticipated to significantly reduce the risk of accidents and thus spills.
Impact on groundwater and soil quality	(+) Not affected during construction. (-) Poor road conditions along rivers could result in accidents with risk of spills contaminating groundwater.	(+) Not anticipated to be affected during construction. (+) Improved road conditions are anticipated to significantly reduce the risk of accidents and thus spills.
Impact on forestry resources	(+) Not affected during construction. (-) Roadside vegetation along NH279 and PR175 is currently strongly affected by dust emissions.	(-) The improvements to existing roads will require localized removal of road-side vegetation. This will mainly affect shrubs, but could also affect trees. (+) Dust emissions are anticipated to significantly reduce, lessening the impact on roadside vegetation.
Impact on biodiversity	(+) Not affected	(+/-) No significant impact on Van Ban Nature Reserve and its biodiversity values anticipated. Increased traffic volume on NH279 is expected to be fully offset by improved traffic conditions which will reduce noise and vehicle exhaust intensities. No significant incremental impact on habitat fragmentation anticipated (NH279 runs through ecological restoration subzone of the nature reserve, consisting primarily of highly modified habitats of low biodiversity value).
Traffic Safety	(-) The risk of traffic accidents increases as traffic volume increases. (-) Traffic safety in villages remains high.	(-) Traffic safety may be temporarily affected during construction. Sound traffic management system required to address these. (+) The risk of traffic accidents during operation is anticipated to significantly reduce.
Land acquisition and resettlement	(+) No land acquisition and involuntary resettlement required.	(i) The project will require significant land acquisition and resettlement (category A). Affected people will be fully compensated to ensure that they are not worse-off because of the project.

E.2. Road alignment options at Khau Co Pass

257. On Khau Co pass (NH279) from Km150 to Km162, there are numbers of curves with radius R=20-30m and gradients up to 10%. Three alternatives were considered, including (i) using the existing road alignment with minimal rehabilitation works (i.e. keeping road class at mountainous road class IV or lower); (ii) upgrading the existing pass road to mountainous road class III; and (iii) constructing a tunnel. Three tunnel alignments were considered, with various lengths (1.7km to 3.0 km).

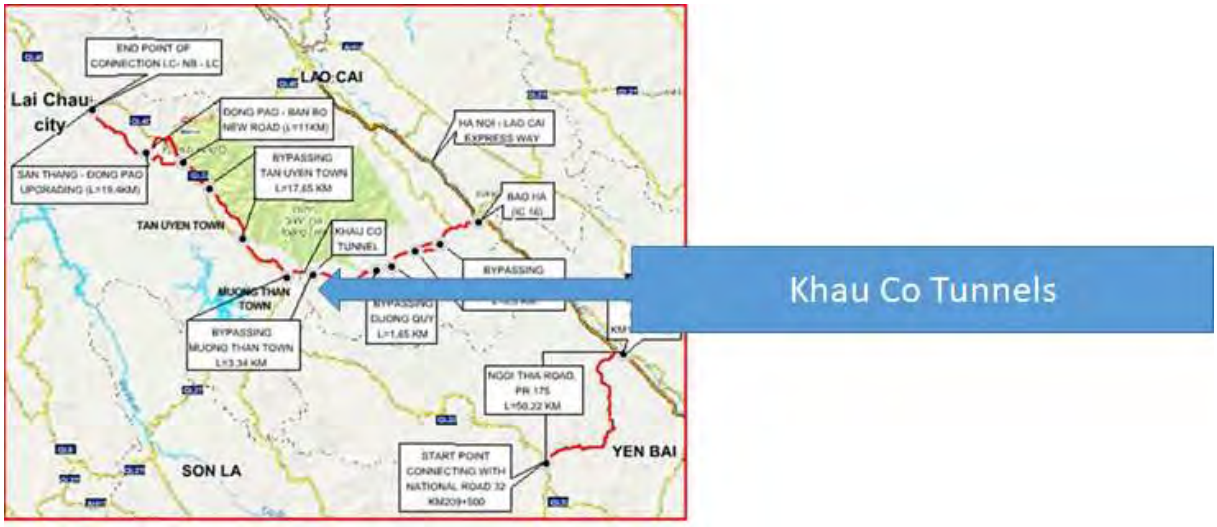


Figure E-1: Khau Co Pass

Figure E-2: Khau Co Tunnels Options, Existing Alignment

Figure E-3: Khau Co pass on NH279

Table E-2: Comparison of Options, Khau Co Pass

INDICATOR	OPTION 1	OPTION 2	OPTION 3
Route direction	Following the existing NH279. Minimal rehabilitation works within existing ROW. Road class: Mountainous road class V or lower.	Following to extent possible NH279, but with adjustment of vertical and horizontal alignment to ensure mountainous road class IV requirements	New 1.7km tunnel, connecting to existing NH279
Smallest radius curve, m.	20-30	60	60
Largest longitudinal slope, degrees.	10	8	8
Advantages	The route follows existing road alignment and makes use of the existing roadbed. Investment construction cost is lower than options 2 and 3. No removal of vegetation required.	Construction costs are slightly lower than option 3. Travel time is shorter than option 1. The route ensures mountainous road category III standard.	The route includes a tunnel which significantly reduces travel time and encroachment on the Van Ban Nature Reserve (ERS).
Disadvantages	Class III standard cannot be achieved, affecting travel time and comfort. The road remains in the ERS of the Van Nature Reserve.	Route requires significant realignments to ensure class III mountain road standard. This will require significant cuts and large viaduct. Investment costs are significantly higher than option 1, but not significantly lower than option 3. Significant removal of forest required in the ERS of the Van Ban Nature Reserve.	Most expensive option, both in terms of investment costs and operational costs. Significant earthwork required. Health and safety concerns during construction.
Recommendation	Option 3 is the preferred option from an environmental point of view as it would reduce the road's existing footprint on the Van Ban nature reserve. It is also the preferred option of provincial authorities, including the Van Ban Nature Reserve Management Board. However, this option is not viable from an economic point of view given the relatively low traffic forecast. Option 3 could be adopted in the future. Option 1 will make use of the existing road and bridges with minimal rehabilitation works. The option's footprint on the Van Ban nature reserve will not increase. However, traffic will be affected and the road may not attract the traffic forecasted. Option 2 would require significant cuts and large viaducts within the ERS of the Van Ban Nature Reserve. This option is not supported by the Van Ban Nature Reserve Management Board. Investment costs of option 2 are not significantly lower than those of option 3. It is proposed to adopt **Option 1** using the existing road alignment. The tunnel option could be adopted in the future.		

E.3. Bypass alternatives

258. Alternative alignments to the existing road alignment were considered by the PPTA consultant at the Preliminary Engineering Design Stage. Alternative alignments were considered at 8 sections. For each section, at least one alternative alignment was proposed of which only one alternative alignment was recommended based on key factors such as construction costs, environmental impacts, resettlement impacts, preferences of local authorities, community safety,

traveling time, etc.

E.3.1. Bypass of Khanh Yen Town

259. Khanh Yen Town is in the section of Km108 + 300 - Km111 + 400 on NH279 which is 3.1km in length. The current road surface is 8-12m wide and has sidewalks of about 3m width each side through the town center. To pass Khanh Yen Town, three options were considered (from Km105+500 - Km113+750).

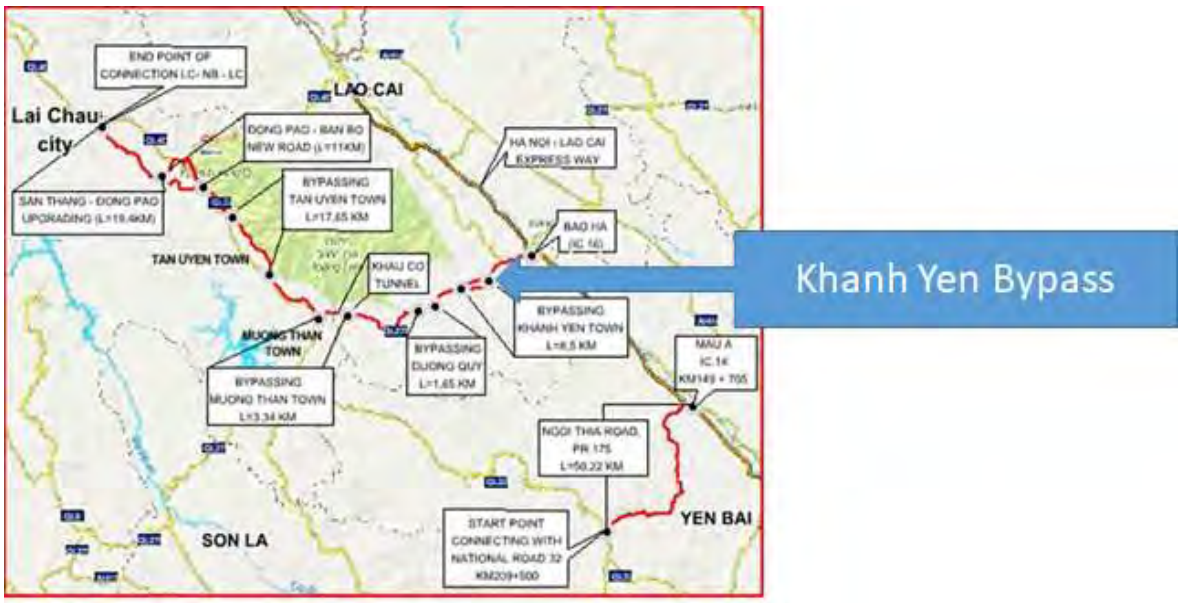


Figure E-4: Khanh Yen Bypass

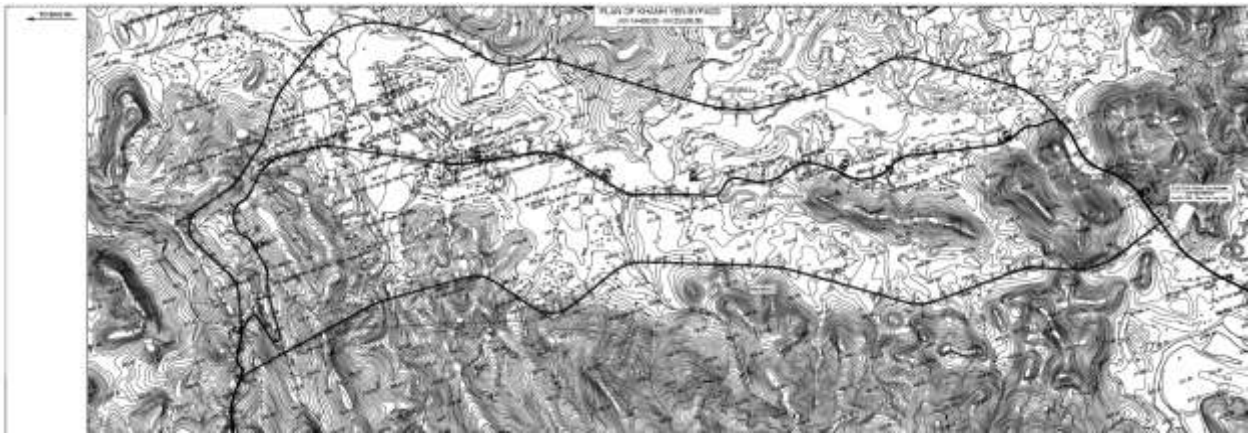


Figure E-5: Khanh Yen Bypass Options

260. **Option 1: Following existing alignment of NH279.** This route coincides with existing NH 279 alignment. Road surface widening is needed to ensure class III mountainous road standard. Substandard locations will be improved to meet required designed standard. The length of route following existing road is about 8.25km. Some 3.1km will make use of existing road and renew the road surface; 5.15km of upgrading and widening will be required. The option has no bridge structures.

261. **Option 2: Bypassing the left side of Khanh Yen Town.** NH279 passes Khanh Yen Town in a valley area. The bypass could run on the left side of the existing road and avoid

residential areas. The bypass is 300~800m far from the existing road. The total length is about 8.5km of which the new section is 6.85km long and the upgraded section 1.65km. There would be two bridges of 35m in length.

262. **Option 3: Bypassing the right side of Khanh Yen Town.** The provincial authority proposed a bypass on the right side of Khanh Yen Town. The route of this option is a totally new road of about 6.5km in length. The bypass would be 300~800m from the existing road. There would be two tunnels of 310 m in length, and 3 bridges of 245m in length.

Table E-3: Comparison of options, Bypass of Khanh Yen Town

INDICATOR	OPTION 1	OPTION 2	OPTION 3
Route direction	Following the existing NH279	Bypassing the left side of Khanh Yen town	Bypassing the right side of Khanh Yen town
Length of route, km	8.25	8.5	6.5
Length of section using existing road, km	3.1	0	0
Length of upgraded and expansion sections, km	5.15	1.65	0
Length of new section	0	6.85	6.5
Smallest radius curve, m.	60	60	60
Biggest longitudinal slope, m.	8	8	8
Number of bridges/ length (new construction).	0	2 bridges / 70m	3 bridges / 245m
Number of tunnels/ length (new construction).	0	0	2 tunnels / 310m
Estimated total investment cost	7.2 M USD	11 M USD	37.7 USD
Advantages	The route follows existing road then makes use of the roadbed. 3.1 km length has sufficient road width. This route is shorter than that of option 2. Investment construction cost is the lowest.	The route is following a new direction that has no effect on residents living along both route sides. There exists land space between the new and the existing road which will facilitate socio-economic development.	The route is following a new direction that has no effect on residents living along both route sides. There exists land space between the new and the existing road which will facilitate socio-economic development. The route length is shortest in comparison with other 2 options.
Disadvantages	The route follows existing road that will affect residents living along both route sides during construction and road operation in the future.	The route length is more than in option 1. This route is totally new therefore Investment construction cost is bigger than option 1.	Investment construction cost is the highest.

INDICATOR	OPTION 1	OPTION 2	OPTION 3
Recommendation:	The existing NH279 route passing through Khanh Yen Town is convenient for upgrading and expansion to the class III mountainous road standard. Households in the substandard section are more than 3~5m far from the road. Construction cost for the option following the existing road is lowest. **Option 1** is recommended in the near future. The bypass option could be adopted in the future.		

E.3.2. Bypass Duong Quy Commune

263. The populated area of Duong Quy commune is in section Km122+700 - Km123+700 along NH279 for 1.0km in length. The road is currently class V mountainous road standard. Two options for the route running through Duong Quy commune center were considered.

Figure E-6: Duong Quy Bypass

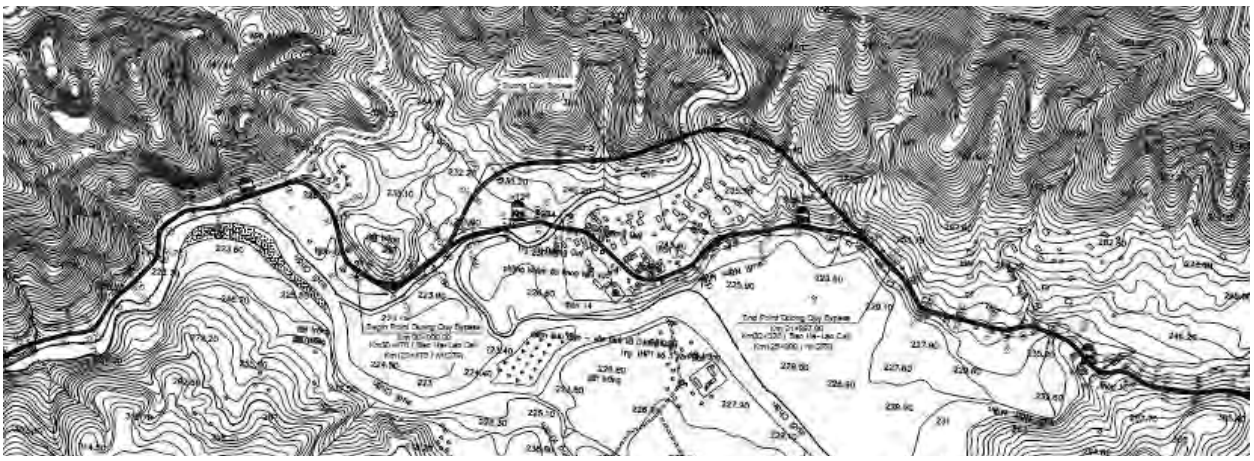


Figure E-7: Duong Quy Bypass Options

264. **Option 1: Following existing NH279 alignment.** The route coincides with NH 279 although road widening is needed to ensure class III mountainous road standard. Substandard

locations will need to be improved to meet the required designed standard. The length of route following existing road is about 1.5km. This option will make use of one bridge which is in good condition on the route (Lang Mac Bridge). Building one new bridge at the existing overflow position is intended. This will be a 12m slab girder bridge.

265. **Option 2: Bypassing center of Duong Quy Commune.** This bypass option is running on the left side of the existing road following the existing mountains foot. There is no option to the right as this this is restricted by Nam Mien and Chan streams. The bypass is about 300m from the existing road. The length of this route is about 1.65km, all of which is totally new road. One bridge will be constructed of 43.1m length.

Table E-4: Comparison of options, Duong Quy Bypass

INDICATOR	OPTION 1	OPTION 2
Route direction	Following the existing NH279	Running on the left side of the existing NH279
Length of route, km	1.5	1.65
Length of upgraded and expansion section, km	1.5	0
Length of new section	0	1.65
Smallest radius curve, m.	60	60
Biggest longitudinal slope, m.	8	8
Number of bridges/ length (new construction).	1 bridge / 24m	1 bridge / 43.1m
Estimated total investment cost	2.4 M USD	2.8 M USD
Advantages	The route follows existing road then makes use of the existing roadbed. This route is shorter than that of option 2. Investment construction cost is lower than option 2.	The route follows a new direction that does not affect residents living along the two route sides. This facilitates construction. Alignment plan is better than option 1. There exists land space between the new and the existing road which will facilitate socio-economic development.
Disadvantages	The route follows existing road that will affect residents living along the two route sides during construction and road operation in the future. There needs to be strict traffic control during construction.	The route length is more than option 1. This route is totally new therefore investment construction cost is bigger than option 1.
Recommendation	The length of option 2 is only 150m longer than option 1; both options need construction of one bridge; total investment cost of option 2 is 367,727 USD higher than the option 1. However, alignment plan of option 2 is better than option 1 with most avoidance of residential properties, this lessens land acquisition and makes construction less intrusive. It is proposed to select **Option 2** bypassing the center of Duong Quy commune.	

E.3.3. Bypass Tan Uyen town

266. Tan Uyen town is in the section of Km379+800 - Km384+000 NH.32 (4.2km in length). The current road is 8-12m wide and sidewalks have about 2m width on each side for sections going through town center. Other sections meet class IV mountainous road standard. For bypassing Tan Yen town, two options were considered from Km370+500 - Km387+000 on NH32.

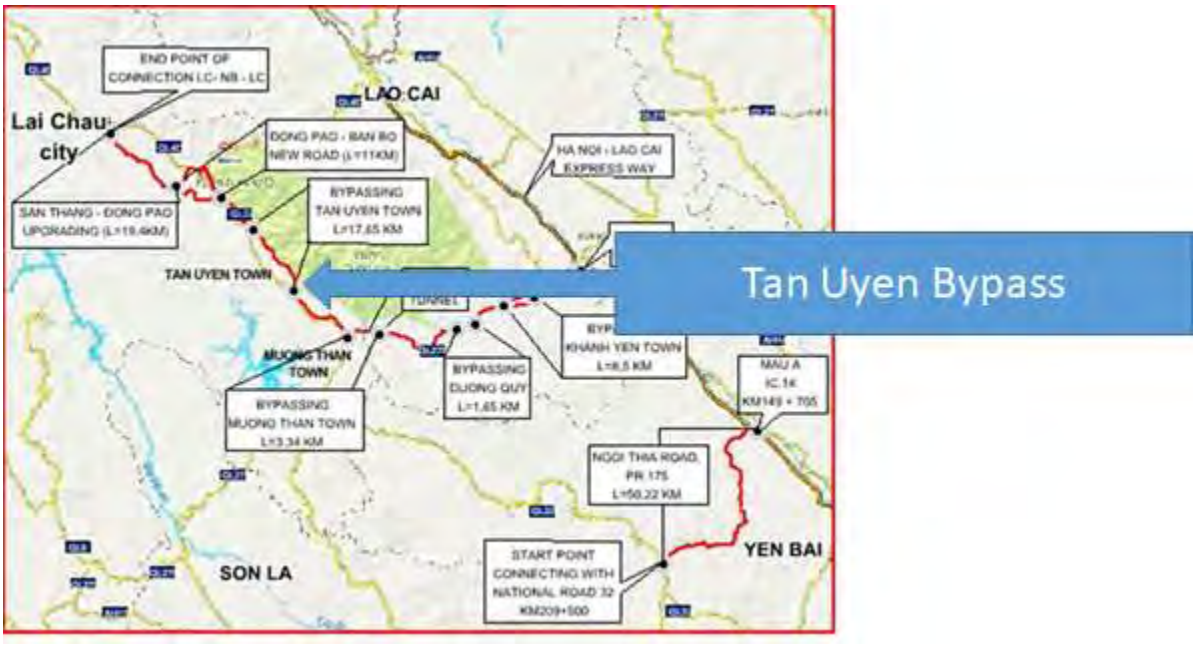


Figure E-8: Tan Uyen Bypass

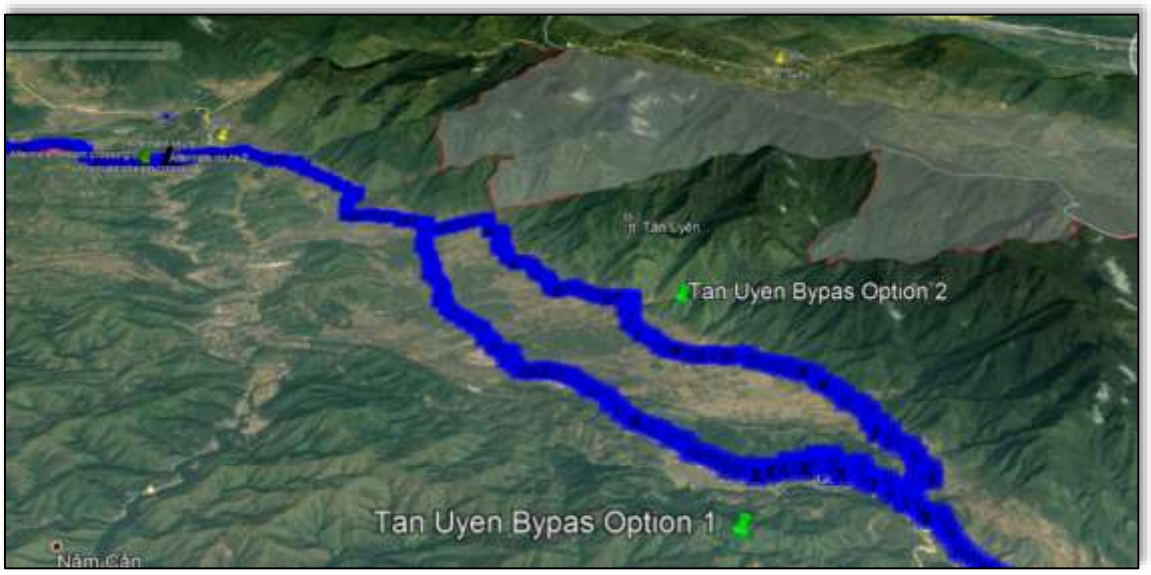


Figure E-9: Tan Uyen Bypass Options

267. **Option 1: Following existing NH32.** The route follows NH 32. Some road widening is needed to ensure class III mountainous road standard. Substandard locations will be improved to meet required designed standard. The length of route following existing road is about 16.5km. This route will make use of 6 bridges still in good condition.

268. **Option 2: Bypassing Tay Uyen Town to the right.** The starting point is at Km370+500 NH32 at Khau Gieng commune. The ending point is at Km387+000 NH32. The total length is about 17.65km. From starting point, it turns right to run along Hoang Lien Son mountains chains, passing through Khau Gieng, Hua Cuom, Tat Xom, Na Coc communes, then connecting with NH32 at Km387+00. Currently, the bypass direction coincides with Lai Chau's plan. This road of 17.65km in length is being constructed in accordance with class B rural road standard.

Table E-5: Comparison of Options, Tan Uyen Bypass

INDICATOR	OPTION 1	OPTION 2
Route direction	Following the existing NH32	Running on the right side of NH32, along Hoang Lien Son mountains chains, passing through Khau Gieng, Hua Cuom, Tat Xom, Na Coc communes.
Length of route, km	16.5	18.5
Length of route using the existing road, km	4.2	0
Length of section with rehabilitation of the existing road.	12.3	0
Smallest radius curve, m.	60	60
Biggest longitudinal slope, m.	8	8
Number of bridges/ length (new construction).	6 bridges kept intact	3 bridges / 122.4m
Estimated total investment cost	6.7 M USD	30.4 M USD
Advantages	The route follows existing road then makes use of the existing roadbed. This route is shorter than that of option 2. Investment construction cost is lower than option 2.	The route follows a new direction that does not affect residents living along the road. There exists land space between the new and the existing road which will facilitate socio-economic development.
Disadvantages	The route follows existing road that affects residents living along the two route sides during construction and road operation in the future.	Route is totally new therefore investment construction cost is bigger than option 1. The new alignment runs closer to boundary of the national park, with potential impacts on its protection objectives.
Recommendation	Option 1 will make use of 4.2km of road of sufficiently good standard and use all bridges on the route. The length and construction cost is smaller than option 2. It is proposed to adopt **Option 1**.	

E.3.4. Bypass of Minh Luong Commune

269. The populated area of Minh Luong commune is in section Km137+800 - Km140+500 along NH279 for 2.8km in length. The road is currently class V mountainous road standard. There are two options for the route running through Minh Luong commune center.

Figure E-10: Minh Luong Bypass Options

Figure E-11: Minh Luong Bypass Options

270. **Option 1: Following Existing NH279.** The route coincides with NH 279 although road widening is needed to ensure class III mountainous road standard is met. Substandard locations will need to be improved to meet the required designed standard. The length of route following existing road is about 2.8km (Km137+800 - Km140+500).

271. **Option 2: Bypassing center of Minh Luong Commune.** This bypass option is running on the right side of the existing road following the existing mountains foot. There is no option to the right as this this is restricted by Nam Mien and Chan streams. The bypass is about 300m from the existing road. The length of this route is about 2.6km, all of which is totally new road. One bridge will be constructed of 15m length.

Table E-6: Comparison of Options, Minh Luong Bypass

INDICATOR	OPTION 1	OPTION 2
Route direction	Following the existing NH279	Running on the left side of the existing NH279
Length of route, km	2.8	2.6

Length of upgraded and expansion section, km	2.8	0
Length of new section	0	2.6
Smallest radius curve, m.	60	125
Biggest longitudinal slope, m.	7	4
Number of bridges/ length (new construction).	1 bridge / 15m	1 bridge / 15m
Estimated total construction cost	0.975M USD	1,497M USD
Advantages	The route follows existing road then makes use of the existing roadbed. Investment construction cost is lower than option 2.	The route follows a new direction that does not affect residents living along the two route sides. This facilitates construction. Road is shorter, alignment plan is better than option 1. Traffic Safety is very much improved
Disadvantages	The route follows existing road that will affect residents living along the two route sides during construction and road operation in the future. This route is longer than that of option 2. Traffic Safety Issue during and after construction	This route is totally new therefore investment construction cost is bigger than option 1. The road alignment may affect a cemetery and careful definition of the alignment is required to avoid encroachment on the cemetery.
Recommendation	The length of option 2 is 200m shorter than option 1; both options need construction of one bridge; total construction cost of option 2 is 522,000 USD higher than the option 1. The traffic safety will be better with option 2, the alignment plan of option 2 is better than option 1 with most avoidance of residential properties, this lessens house acquisition and makes construction less intrusive. It is proposed to select **Option 2** bypassing the center of Minh Luong commune	

F. ENVIRONMENTAL AND SOCIAL IMPACTS

F.1. Approach to Screening and Scoping of Environmental Impacts

272. The project will be implemented in line with the national master plan of the transport sector and will strengthen the connectivity between the Northwest region of Viet Nam and the Kunming-Ha Noi-Hai Phong Economic Corridor. Most of the works will consist of upgrading of existing roads, although 3 new bypasses are proposed.

273. The approach to screening of environmental impacts for the Project follows the guidance contained in a range of documents relevant to environmental assessment of road projects including the following key documents. In this EIA the ADB's Safeguard Policy Statement (SPS), 2009 is of paramount importance.

a. ADB's Safeguard Policy Statement (SPS), 2009
b. IFC General Environmental, Health and Safety Guidelines, April 2007
c. Viet Nam Technical Guideline for EIA for Transport Project, 2002
d. World Bank (WB) Environmental Assessment Sourcebook, Vol.2, Guideline for Environmental Assessment for Roads and Highways Projects, 1991.

274. Issues for inclusion in the environmental assessment were identified through the EIA scoping process. Based on knowledge of the existing environment, the project characteristics and experience with the typical potential impacts of road development, those issues for which environmental impacts were likely to occur were identified.

275. A range of technical investigations was carried out for each of the identified environmental issues to determine the effect that the project may have on characteristics of the surrounding environment. Potential impacts were categorized according to the project phases, i.e. pre-construction, construction, post construction or operation, in which they occurred. Impacts from accidents or unforeseen circumstances were also identified. This process was carried out to ensure mitigation measures could be developed which were appropriate to each project phase.

276. The classification of Environmental Impacts of the project follows international classifications considering specific conditions of the project site. In this EIA, environmental impacts of the project (which are deemed to be negative) are classified into 5 levels:

a. No impact: means unapparent and negligible influence on the natural and socio-economic environments at the project site and its surroundings.
b. Minor impact (or small impact): means slight influence on a small portion of population (for example, some households at each commune) or a small area of natural ecosystems (for example, less than 1.0 ha), short-term impact.
c. Intermediate (or medium impact): means influence on a portion of population or a relatively large area of natural ecosystems (for example 1.0 – 10.0 ha of forest), short-term impact, mitigatable.
d. Significant impact: means significant influence on a large portion of population (various communes inside and around the project ROW) or a large area of natural ecosystems (more than 10.0 ha in this project), long-term impact, high discharging volume of waste, no mitigation measures.
e. Unknown impact: means influence that is unpredictable as lacking information or data (for instance, impacts due to earthquake, heavy flood, etc. in this project area).

277. Each impact is also categorized in terms of its duration (short-term or long-term), reversibility (reversible or irreversible). For those identified impacts for which it was possible and/or necessary, mitigation measures were developed. The following hierarchy of mitigation strategies (from highest priority to lowest priority) was implemented:

a. Avoiding the impact (e.g. recommending measures to be implemented during detailed design to avoid impact on biodiversity hotspots);
b. Minimizing the impact (e.g. installing wastewater treatment systems to treat effluent before discharge);
c. Mitigating the impact (e.g. rehabilitating areas where forest has been affected because of the project); or
d. Compensating for the impact (e.g., providing financial compensation for those who will lose land as part of the Project).

F.2. Screening of Environmental Impacts

F.2.1. Positive Impacts

278. **Enhancing traffic safety.** The upgrading and expansion of sections NH279 and NH32 will help improve the road quality and reduce traffic accident "black spots". The project's economic analysis estimated that the project will lead to a traffic accident reduction rate of at least 10%, which is considered conservative given the current state of some road sections. The construction of the Duong Quy and Minh Luong bypasses will reduce traffic loads in densely populated areas on the existing NH279, improving community safety at these locations. The connection between Ha Noi-Lao Cai expressway and Nghia Lo town project will upgrade PR175 to grade-IV road. Road safety will improve due to better road quality, reinforced slopes, and old bridges being repaired or replaced with new structures.

279. **Promoting socio-economic development.** The project will reduce travel time from Nghia Lo town, Lai Chau province and Van Ban district, Lao Cai province to the trading centers of the Red River delta, reducing costs of transport and storage. Construction contractors are expected to employ around 250 local workers during the construction phase, providing employment opportunities and additional sources of income for local families.

F.2.2. Negative Impacts

280. Negative impacts may occur during the construction and operation phase. Potential impacts and risks during construction include: (i) air pollution; (ii) noise and vibration; (iii) soil erosion and localized landslide; (iv) blocking natural drainage capacity; (v) inadequate solid waste disposal; (vi) pollution of streams and water courses; (vii) impact on forestry resources and intrusion into nature reserves; (viii) illegal poaching and logging; (ix) cultural conflicts between workers and local residents; (x) inadequate material storage, handling and transport on roads; (xi) inadequate borrow pits management; (xii) inadequate disposal of unwanted excavated materials.

281. The nature of each type of impact will depend on the nature, extent and location of the activities undertaken, and the duration of these activities. Construction crews cause temporary disturbance to residents as the work moves along the road. Construction camps are semi-permanent and must be removed at project completion. Borrow pits, from which materials are extracted, are intended to be temporary but can be transformed into something useful such as fishponds if local villagers request it and so become a permanent feature of benefit to the residents.

282. In the operational phase, potential impacts are increased vehicular emissions and noise, traffic safety, and potential impacts on protection objectives of legally protected sites (i.e. the Van Ban Nature Reserve).

283. The table below summarizes the potential impacts of the project as identified as scoping stage.

Table F-1: Summary of potential environmental impacts of the Project (Scoping stage)

Stage	Physical						Biological			Social			Others					
	Air, noise, vibration	Soils	Solid waste	Hazardous waste	Drainage	Erosion, sedimentation	Terrestrial ecology	Aquatic ecology	Risk of forest fire	Land acquisition, resettlement	Traffic disturbance	Historical and cultural works	Mine Risk / UXO	Infrastructure	Occupational Health and Safety	Dividing residential land	Traffic Safety	Traffic emissions
Pre-construction	L	L	L	L	N	N	N	N	N	M	N	M	M	L	L	N	L	L
Construction	M	M	S	M	M	M	S	M	M	N	M	L	L	M	M	M	M	M
Operation	L	N	L	N	L	L	N	N	N	N	N	N	N	N	N	N	M	M

Notes:

Impact levels are classified as follows:

None (N) - Not anticipated

Minor (L - Low) - minor, localized, temporary;

Medium (M- Medium) - Moderate, mostly reversible, manageable, localized and temporary;

S - Significant – Significant, irreversible impact on the original state

F.3. Impacts mitigated at Preliminary Design Stage

284. Project design including detailed design could produce adverse long-term impacts on natural and socio- economic environments if environmental factors are not adequately considered. Typically, adverse impacts relating to project design include land acquisition and resettlement, encroachment on legally protected sites, impact on forestry resources, visual impacts (i.e. landscape disfiguration), land acquisition and resettlement, and other risks.

285. Some of these impacts have been mitigated by careful surveys, calculations and consultations with local governments in the conduct of the preliminary design. Key measures implemented at **preliminary design stage** to minimize the project's social and environmental impacts included the following:

- The partial re-alignment of 3 sections of the highway enabled to avoid directly affecting existing residential areas (see list in Section E.3). The re-alignment also resulted in a significant reduction of involuntary resettlement in these populated areas.
- The proposed Tan Uyen bypass, which would have reduced the distance between the project road and the Hoang Lien National Park (HLNP), was not supported on environmental grounds as it may have had some impact on the National Park's protection objectives.
- The tunnel originally proposed at Khau Co Pass was supported on environmental grounds as it would have significantly reduced the existing road's footprint on the Van Ban Nature Reserve. However, given the low traffic forecast and high investment costs, the tunnel is not considered economically viable at this stage. As a result, the project proposes to limit road rehabilitation works within the boundary of the ERS of the nature reserve to minor rehabilitation works without road widening. This will minimize the incremental impact on the nature reserve's protection objectives, assessed as not significant. The tunnel option may be considered at a later stage when traffic demand justifies the significant investment. Should such an alternative be considered at some stage, an EIA will need to be undertaken to specifically address associated noise and vibration impacts as well as spoil management in detail.
- All disaster-prone areas along the project roads have been identified and mapped (Appendix A). Protection/improvement measures including slope and embankment stabilization works, rehabilitation or reconstruction works (primarily for bridges) have been included in the preliminary design and cost estimates.

F.4. Impacts/risks to be addressed at Detail Design Stage

286. Additional measures will need to be implemented at **detail design stage** to further reduce the project's social and environmental impacts:

- Negative **aesthetic impacts** can be expressed as a product of the poor consideration of design principles and resulting lack of harmony between the road design and various features of the landscape such as natural relief and morphology of the landscape, hydrology, vegetation, structure and pattern of the landscape, village areas, etc. The roads pass through hilly areas mixed with small valleys with vegetation of food crops, forest, and hence cutting slopes and removal of roadside vegetation is unavoidable and will result in changes in aesthetics and the landscape. Key following design features to minimize landscape disfiguration shall be included in the detailed design include: (i) minimizing vertical re-alignment of the roads to reduce deep cuts and refill works; (ii) the application of natural materials (rocks, stones, riprap) or greened concrete frames for embankment and slope stabilization.
- Project infrastructure design shall account for projected increases in precipitation and

runoff. Bridge clearances, road drainage and culvert capacity shall be adjusted to ensure that these are **climate-proof**. For that purpose, the DD consultant will be required to apply projected climate data (precipitation, peak runoff) rather than historic climate data. Projected climate data (IDF curves) has been generated by the CRVA team and shall be used as basis for the detailed design (see Figures D13-D17). The DD consultant shall also critically review climate-related risks at the hotspots identified by the CRVA team, and consider incorporating adaptation measures for those sites as recommended by the CRVA team (Appendix A). Exact cost estimates of climate-proofing of the project roads is not possible at preliminary design stage, but are estimated to amount to 1% of the total investment costs.

- **Noise modeling.** Once road alignment is clearly defined and other design parameters (traffic forecast, road geometry, curve radii, surface etc) are identified, the DD consultant shall conduct a detailed noise modelling of operational noise, using an internationally accepted metholodogy. The noise model shall be based on a detailed inventory of sensitive receptors along the project roads. The model shall be used to assess whether noise intrusion is likely to affect residential property or noise sensitive dwellings during operation, and to test the efficiency of possible noise mitigation measures. The DD consultant shall incorporate necessary noise mitigation measures in the project design, and ensure that these are reflected in the bidding documents for works contracts.
- **Blasting plan preparation.** Blasting may not be needed if rock breaking can be accomplished in another cost-effective manner. This should be investigated during Detailed Design. If blasting is to be used, then a blasting plan must be prepared, including vibration calculations / modelling when details for blasting are clear. This is a site-specific document as it depends on the type of material to be extracted, the quantity and the ultimate use of the extracted material. Such a plan must detail maximum amounts of explosive to be used at any one time, pattern blasting, use of millisecond delays and means of initiation. All of these factors can be modified to ensure the blast is carried out in a controlled acceptable manner.
- **Forestry resources** will be affected, but this EIA was only able to generate estimates of the impacted area. The detail design will need to minimize encroachment on forest, and to conduct a detail survey to quantify the exact scope of impact on various forest types (special-use forest, protection forest, secondary natural forest). This information will be used as basis for the forest compensation replanting plan, to be developed by the project owner and to be approved by the relevant provincial People's Committees in compliance with Circular 23/2017/TT0-BNNPTNT.

F.5. Pre-Construction Phase

F.5.1. Land Acquisition and Resettlement

287. **Impact.** Improved roads and new alignments will require widening of existing roads. Several bypasses are proposed. As a result, the project will require the acquisition of privately owned land (in Viet Nam land is considered as the National common land, the people only have rights to use the land and own the properties on that land), and the resettlement of people. The provincial authorities will do the expropriation of properties for the project. By its nature, expropriation causes economic loss and social and psychological disruption for affected individuals and their families. Naturally, the greater the number of people involved, the greater the disruption and loss.

288. According to the draft resettlement plans developed for the project (3 RPs have been prepared, one per province), the project is expected to affect an estimated 957 households comprised of 4,370 people. The most common impact is loss of residential land (713 households) followed by loss of productive land (465 households) and impacts on businesses (209 households). 6 of the 277 households with affected houses are expected to require relocation. However, the

resettlement plans anticipate that 241 households will have severe permanent impacts on their livelihoods. Other impacts include loss of trees, crops and secondary structures.

289. An estimated 38.2 ha of land is expected to be acquired for the project. Tam Duong district in Lai Chau Province is the district with the largest land losses (12.9ha) due to the intended bypass. The locations in Lao Cai Province experiencing the greatest loss is Duong Quy Commune (3.1ha) and Minh Luong (2.5ha), due to bypasses. The locations in Yen Bai Province experiencing the greatest losses are Dai Son Commune in Van Yen District (4.5ha) and Suoi Quyen Commune in Van Chan District (1.7ha). A total of 32.6ha of productive land is expected to be acquired. The largest category of affected land is production forestry land (20.18ha), followed by agriculture land (12.5ha).

Table F-2: Distribution of land losses of affected communities and affected households per draft Resettlement Plans

	Productive Land				**Residential Land**	**Graves**
	Agriculture Land	Forestry	Total	Productive Trees		
	(ha)	(ha)	(ha)	[Number]	(ha)	[Number]
Yen Bai Province	2.52	4.39	6.91	8,758	1.03	0
Lao Cai Province	1.73	6.66	8.40	9,431	3.46	6
Lai Chau Province	8.21	9.13	17.34	2,416	0.99	1
Total	12.46	20.18	32.65	20,605	5.48	7

290. The project will also require relocation of 7 tombs. The relocation of tombs is a sensitive issue. According to the traditions and beliefs of the Vietnamese people, grave relocation has a profound effect on the spiritual life of not only an individual but also the whole family.

291. The project is classified as Category A for Involuntary Resettlement per ADB's Safeguard Policy. The impact is thus classified as **Significant** and **Irreversible**.

292. **Mitigation/Compensation.** A Resettlement Framework and a draft Land Acquisition and Resettlement Plans (LARP) for each province have been prepared by the Project[12], and will further developed and finalized based on a Detailed Measurement Survey at Detailed Design stage. The project has also developed an Indigenous Persons Plan / Ethnic Minority Plan (IPP) based on ADB's SPS (2009) to minimize the impacts associated with land acquisition and resettlement on ethnic minority peoples. The grave relocation will be carried out as part of the overall site clearance procedure. Graves are considered as physical cultural resources and the costs associated with moving graves are covered in the LARP.

293. Implementation of the social safeguard plans will be monitored by an independent monitor in compliance with ADB's SPS (2009). If the project needs temporary land for construction, the PMU2 will lease land from the owner in accordance with the Civil Code. If the property or land is damaged or contaminated it will be restored to the status quo before vacating the premises. PMU2 will create and coordinate a grievance redress mechanism for affected people to make complaints and obtain redress.

F.5.2. Impact on Forestry Resources

294. **Impact.** Road widening and construction of new road section will encroach on different

[12] The Resettlement Plans are disclosed on the Project website (www.adb.org)

forestry zones, including production forest, protection forest and special-use forest. The exact impact cannot be ascertained at this stage as the final road alignment and extent of road widening will only be defined at detail design stage. In the framework of this EIA, the impact on forestry resources was estimated based on an overlay of the project roads and land use maps provided by the Government. Since site clearance may impact beyond the actual road width (most importantly in steep area requiring cuts on slopes and slope protection works), the estimated impact zone was multiplied by a conservative factor of 3. Based on these assumptions, and through cross-validation with the resettlement plans, an estimated 23.1 hectares of forest will be affected by the project (**Table F-3**).

295. Special-use forest likely to be affected by the project is located exclusively within the boundaries of the Ecological Restoration Subzone (ERS) of the Van Ban Nature Reserve (**Figure D-21**). Protection Forest is located at various sections of NH32, NH279 and PR175, but primarily on the West side of the Khau Co Pass (**Figure D-22**). Forest types affected by the project include secondary natural forest (mainly within Van Ban Nature Reserve) and planted forest. None of the forest areas affected by the project classifies as critical habitat. No primary natural forest will be affected. **-> Medium** and **Irreversible Impact**.

Table F-3: Impact on Forestry Resources along Project Roads

Road	Production Forest (ha)	Protection Forest (ha)	Special-Use Forest (ha)	Total (ha)
NH32	9.13	0.13	0.12	9.38
NH279	6.66	0.27	0.86	7.79
PR175	4.39	1.56	0	5.95
TOTAL	**20.18**	**1.96**	**0.98**	**23.12**

Source: PPTA estimates based on preliminary engineering design, February 2018

296. **Mitigation.** The production forest including production trees affected by the project will be compensated through the provincial resettlement plans. In accordance with Circular 23/2017/TT0-BNNPTNT "Provisions on Replacement Afforestation upon Conversion of Forest Use Purpose to Other Purposes" which became effective 1 January 2018, the impact of the project on forestry resources must be fully offset. Per circular, conversion of special-use and protection forest is only possible if and once plans for forest replacement are prepared and approved by provincial People's Committees (Clause 2, Article 2). Since the project is anticipated to affect forestry resources in different provinces, separate forest replacement plans must be developed and implemented for each province (Clause 1a, Article 3). Two options are possible for replacement afforestation. These are presented below.

297. **Option 1** – Project owner develops and implements plan (per Article 3). At this stage of project processing (i.e. prior to FFM), it is anticipated that the Ministry of Transport (through the PMU2) will take responsibility to formulate the province-level replacement afforestation plans for submission to the People's Committees of Lao Cai, Lai Chau and Yen Bai Province. The PMU2 will be supported by a forestry specialist hired under the construction supervision consulting services. The plans must be formulated using the template provided in Appendix 1 of Circular 23/2017/TT0-BNNPTNT (and presented in Appendix B of this EIA).

298. A Dossier for the plan approval shall be submitted to the provincial Departments of Agriculture and Rural Development (DARD). The Dossier shall consist of: a written proposal for plan approval (using the form provided in Annex 01 of Circular 24/1013/TT-BNNPTNT, and presented in Appendix B of this EIA), the proposed Replacement afforestation plan, the design map and other relevant documents. The provincial DARDs will appraise the Dossier and the Replacement Afforestation Plan, which are subsequently approved by the provincial People's

Committee.

299. After the replacement is approved by the Provincial People's Committee, the PMU2 will need to organize the detail design and exact cost estimates of forest replanting, to be submitted to the DARD. The detail forest replanting plan must be prepared in accordance with Circular 23/2016/TT-BNN dated 30/6/2016.

300. Implementation of the approved forest replanting plan is usually handed over to forest management boards or units at province or district level, in accordance with Circular 23/2016/TT-BNN.

301. **Option 2:** Project owner delegates responsibility to provincial authorities (per Article 4). Alternatively, and as defined in Circular 23/2017/TT0-BNNPTNT, MOT may also decide to hand over responsibility for replacement afforestation plan development and implementation to provincial authorities (Article 4). If this option is chosen, then MOT will need to request the People's Committees of the provinces to approve a plan on payment for forest replacement. The application must be submitted to the provincial People's Committee and must include a written application for approval for the plan on payment for forest replacement; a description of the investment project in which the forest is repurposed (enclosed with the application).

302. The People's Committees of provinces (in consultation with the provincial DARD) will identify the exact scale of impact of the project of forestry resources; define the unit price for afforestation, the total amount due, and the deadline for the project owner to pay the charge for forest replacement. The unit price for forest replacement will include the charge for survey, plan preparation, and replanting of forest, and the administrative expense until the forest is formed, according to the average estimate for the afforestation in local area by the time project owner pays the charge. The total amount due must be paid prior to commencement of forest clearance, to the Forest Protection and Development Funds of the respective province who will manage the amount of payment for forest replacement and carry out the disbursement according to the approval of People's Committees of provinces to carry out the forest replacement. Per Clause 3, Circular 23/2017/TT0-BNNPTNT, the Forest Protection and development Fund shall be used for the development and protection of special-use and protection forest (not production forest).

303. **Cost estimates for forest compensation (special-use and protection forest).** Costs for compensation replanting have been estimated based on past project experiences. These are presented in **Table F-4**. Compensation replanting of one hectare is estimated to cost approximately 195 million VND, or $8,480. Based on current estimates, some 4 hectares of protection and special-use forest will be affected by the project. Assuming a 3:1 compensation replanting as per the New Forestry Law (Article 21), a total of 12 hectares will need to be replanted. Total costs for compensation replanting are anticipated to amount to 2.34 million VND, or $102,000. These costs will be covered by the loan.

Table F-4: Cost Estimates for Compensation Replanting for One Hectare of Affected Forest

No.	ITEM	UNIT	QUANTITY	UNIT PRICE (VND)	AMOUNT (VND/ha)
1	**DIRECT COSTS**				**149,000,000**
	Cost for Replanting				**112,000,000**
	Manpower	Working-days per ha	100	200,000	20,000,000
	Material (Tree seedlings)	Trees/ha	2,000	46,000	92,000,000
	Maintenance Costs				**37,000,000**

	Material (replacement seedlings)	VND/ha		10,000,000	10,000,000
	Manpower (4 years)	Working-days per ha	180	150,000	27,000,000
2	**TAXABLE INCOME**	5.5% of Direct Costs			**8,195,000**
3	**COST FOR PLAN PREPARATION**	7.9% of Direct Cost			**11,733,750**
	Total A	A =1+2+3			**168,928,750**
4	**VAT**	VAT = 5%			**8,446,438**
	Total B	B = A + 4			**177,375,188**
5	**CONTINGENCY**	10% of Total B			**17,737,519**
	TOTAL	B+5			**195,112,706**

F.5.3. Encroachment and impact on legally protected sites

F.5.3.1. NH32 (Hoang Lien National Park)

304. **Impact.** NH32 approaches within proximity to the Hoang Lien National Park. The existing alignment is about 4 km distant and the originally proposed bypass alternative to the east would have brought the road to about 3km from the HLNP. The new alignment was rejected, partly on environmental grounds. The rehabilitation and operation of the existing road is not anticipated to have any negative impact on the National Park. This was confirmed by relevant provincial authorities. In fact, the project is anticipated to reduce the current pressure of traffic on the Hoang Lien National Park by diverting some 15% of the existing traffic on NH4D, which partly encroaches on the Hoang Lien National Park, onto the project roads (NH32, NH279). **-> No/positive impact.**

305. **Mitigation.** No mitigation measures required.

F.5.3.2. NH279 (Hoang Lien Van Ban Nature Reserve)

306. **Impact.** As described extensively in Section D.3.2 of the EIA, the existing NH279 currently passes through the Hoang Lien Van Ban Nature Reserve (HLVBNR). The alignment of NH279 within the VBNR passes between several blocks of forest which are designated Ecological Restoration Subzones (ERS). Several alignments were considered including upgrading the existing road, a tunnel and viaducts (see Section E.2). All studied alternatives encroach on the Ecological Restoration Subzone (ERS) of the HLVBNR. The selected alternative (i.e. minor road rehabilitation works of the existing road with minimal road widening at localized sites) does not encroach on the Strictly Protected Subzone (SPS) of the Reserve or any area classifying as critical habitat per ADB's Safeguard Policy Statement (2009). Permission was obtained from the HLVBNR Management Authority through the EIA appraisal process by MONRE. Sustainable development is permitted within the ERS. Each forest block that include sections of NH279 contains several different types of forest and these have been identified (**Figure F-1**).

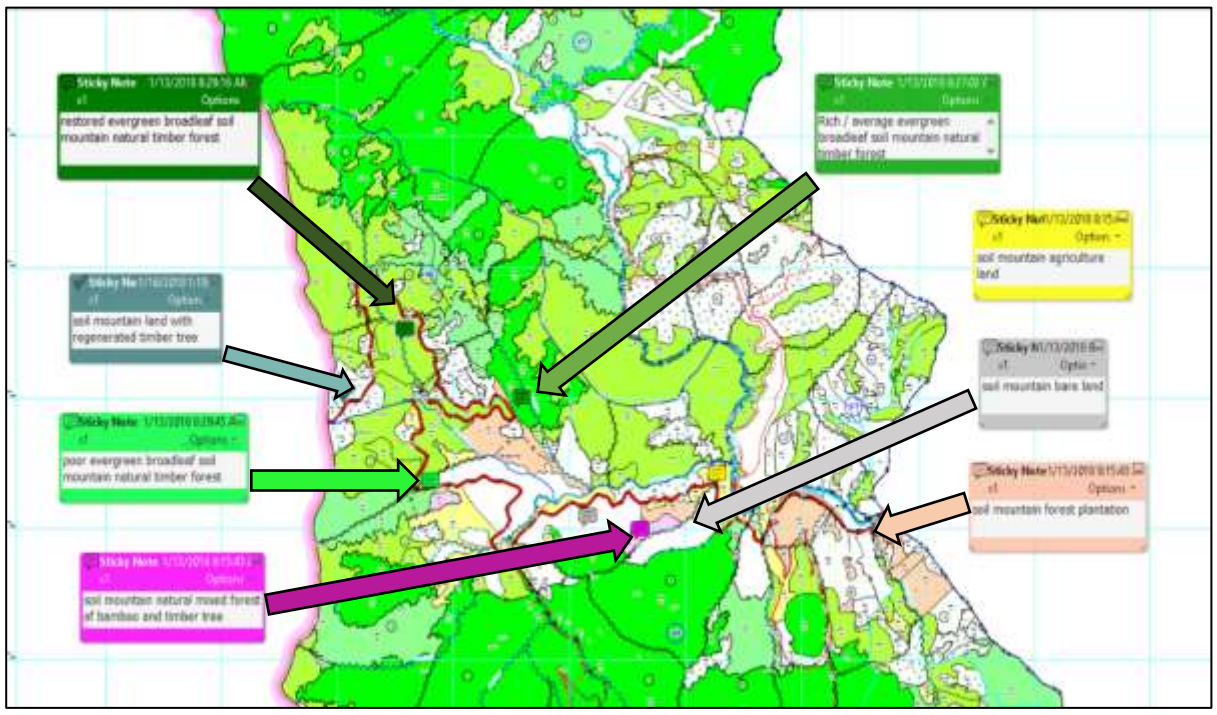


Figure F-1: Forest Types in the ERS of the Van Ban Nature Reserve

307. None of these forest types classify as critical habitat per ADB's Safeguard Policy Statement (2009) or prohibit the rehabilitation of the road, which is defined in the Nature Reserve's master plan. The HLVBNR Management Authority and Lao Cai provincial forest protection department (FPD), the department of natural resources and environment (DONRE) and the department of agriculture and rural development (DARD) have been consulted and support the project (see Section I.4). The HLVBNR Management Authority has expressed some concerns over temporary impacts during construction, including inadequate spoil management, encroachment on forestry resources beyond the road's ROW, and illegal hunting or collection on forest products by construction workers.

308. The operation of NH279 is not anticipated to have significant incremental impacts on the nature reserve and its protection objectives. HLVBNR Management Authority confirmed that there are no major wildlife crossings on NH279. Since the project's intervention in the ERS will be limited to minor road rehabilitation works without significant traffic increase, the project is not expected to significantly increase the risk of accidental road kills or reduce wildlife crossing opportunities. HLVBNR Management Authority have checkpoints on NH279 to police illegal activities such as poaching animals and illegal logging. HLVBNR Management Authority committed to install additional guard check posts on the road to discourage and indeed arrest poachers. They have been successful in this in previous years and quoted that several vehicles have been impounded from poachers.

309. **->** The impact of the Project on the HLVBNR is classified as **Medium/Moderate, potentially Irreversible Impact.**

310. **Mitigation/Protection.** Permission for the works must be obtained from VBNR Management authority by means of a domestic EIA which is submitted to MONRE and forwarded to them, and by review of the Detail Design. The concerns expressed by the HLVBNR Management Authority are addressed in the EMP. Mitigation measures are defined below.

a. Detail Design shall be developed in consultation with, and be reviewed by Van Ban Nature Reserve Management Authorities and Lao Cai DARD;

b. No construction camps, asphalt mixing plants, material storage sites and other

construction facilities are to be in protection or secondary forest areas.

c. No activities beyond the ROW are allowed in Van Ban Nature Reserve.

d. No construction staging area, borrow area, spoil disposal site and haul road shall be established within a protected area. The proximity to Van Ban Nature Reserve and exclusion from it must be stressed to the contractor's workers.

e. Cutting of trees for firewood and for use in the project shall be prohibited. Contractors shall not buy or use wood from illegal sources (that come from the illegal logging).

f. Prohibit workers from hunting wild animals. Poaching of rare, endangered species shall be prohibited.

g. Any poaching or tree cutting in Van Ban Nature Reserve will be severely punished and workers may be subject to summary dismissal.

h. All precautions must be taken to avoid causing forest fires in the dry season.

i. Awareness raising and training is to be provided to all construction workers and staff on the nature reserves and they must be warned of the consequences for disobeying instructions. For that purpose, the PMU will recruit a forestry and ecology specialist as part of the construction supervision consulting services.

F.5.4. UXO Removal

311. **Risk.** The project area has been affected by the war, so there is a risk of presence of unexploded ordnances (UXO) in some of the land recovered by the project. The risk is especially high where new road sections are constructed or at bypass locations. **-> Potentially Significant Risk.**

312. **Mitigation.** PMU2 will hire a demining unit prior to demolition and ground level operations. The cost of clearing landmines is estimated at VND6.5 billion. The contractors shall only commence site works after being advised from PMU2 that the project areas are already cleared of UXO. If during construction contractors detect UXO, they must isolate the area and report to PMU2. The contractor is strictly forbidden to dismantle, handle or remove any UXO. unexploded ordnance. PMU2 will report to the local authority who will contact the army agency for handling.

F.5.5. Contractor Orientation, Preparation of Construction Environment Management Plans

313. Following contract award but before site works commence, each work contractor must produce a construction environment management plan (CEMP). Upon contract signing, the PMU2 shall hold a short course to orient contractors on EIA and EMP requirements, CEMP preparation requirements, any additional mitigation measures that may be required during construction phase.

314. The CEMP shall define (i) project description and implementation schedule; (ii) the contractor's environmental management system, including institutional arrangements for environment, health and safety management; inspection and monitoring arrangements for EHS; emergency response procedures; environment training commitments; communication and grievance redress mechanism; and reporting arrangements; (iii) environmental mitigation and control plan, including risk screening; identification of sensitive receptors (environmental constraints maps); identification of risk mitigation measures; and (v) all risk management sub-plans, method statements, which shall include, but not necessarily be limited to:

a. Materials Management Plan (MMP), giving arrangements for supply of construction materials to avoid unnecessary stockpiling outside project site.

b. Spoil Disposal Plan (SDP), for handling and disposal excavation spoils so that contractors dispose overburden in sites approved by local authorities.

c. Waste Management Plan (WMP), for handling, transport, storage and disposal of solid and liquid wastes and hazardous materials at sites approved by local authorities.

d. Drainage Management Plan (DMP), to ensure that construction works will not cause ponding or flooding at construction camps, borrow/quarry areas, other areas used for project-related activities and adjacent areas.

e. Silt Control Plan (SCP), to ensure that construction works will not cause excessive runoff and siltation of adjacent waterways within the Project site.

f. Temporary Traffic Management Plan (TTMP), to control safe interaction of vehicular traffic and pedestrians during construction.

g. Utilities Plan (UP), to avoid interruption to power, water supply telecoms and irrigation systems.

h. Noise and Dust Control Plan (NDCP), to minimize impacts to sensitive receptors (residential areas, schools, hospitals, etc.) due to construction works, sourcing and transport of construction materials, and other project-related activities.

i. Health and Safety Plan (H&SP), to ensure worker and community safety, and prevent accidents during construction works.

315. The CEMPs shall be submitted to the CSC and PMU2 for review and clearance prior to construction works.

F.5.6. Securing Permits for Quarries and Spoil Disposal Sites, Work Areas

316. The contractors shall obtain all required environmental permits prior to operation of any quarry site, borrow area, spoil disposal site and construction site. Whenever possible, raw materials provided to the Project shall be purchased from local and available sources. Location of licensed quarries in the project area is shown in **Table C-12**. Contractors must confirm that any such quarry or spoil disposal site has the relevant environmental permits. If the contractors operate their own quarry site or spoil disposal site, the required environmental permits shall be obtained by provincial Departments of Natural Resources and Environment (DONRE), and shall be submitted to the CSC prior to operation of the quarry/borrow or spoil disposal areas.

F.6. Construction phase

F.6.1. Summary of impacts during construction

317. Impacts related to project activities during construction are shown in the Table below.

Table F-5: Summary of impacts during construction

Type of impact	Nature	Impact range	Duration	Magnitude
Air quality	-	Localized	Temporary	Medium
Surface water quality	-	Localized	Temporary	Medium
Change in river flow regime	-	Localized	Long-term	Low
Soil and groundwater quality	-	Localized	Short-term	Low
Noise	-	Localized	Temporary	Medium
Vibration	-	Localized	Temporary	Low
Waste (Hazardous and Non-Hazardous)	-	Localized	Short-term	Low
Obstructing existing traffic flow	-	Local-area	Short-term	Medium
Affect community	-	Localized	Temporary	Medium
Terrestrial Ecosystems	-	Localized	Short-term	Medium

Aquatic Ecosystems	-	Localized	Short-term	Medium
Public health and safety issues	-	Local-area	Short-term	Medium
Labor and socio-economic issues	+/-	Local-area	Short-term	Positive

Note: -ve is a negative impact; +ve is a positive impact

F.6.2. Impacts on Air Quality

F.6.2.1. Impact on Air Quality, General

318. **Impact.** Road upgrade and construction is expected to generate a short-term and temporary increase in ambient dust. Earthworks and rock crushing activities will be the main sources of dust. The works in any given section of the road will generally be of short duration and in many locations, there will be sufficient buffer distance between the work corridor and the residents such that no significant impact is expected from the construction works on residential areas in terms of dust. The increased dust level may disturb some people, especially people who live near transporting routes and construction sites. The increased sulfur dioxide and carbon monoxide concentrations in the area are not, however, expected to exceed environmental standards because the construction equipment working on each section of the road will be few. **-> Medium, Short-term, Reversible Impact.**

319. **Mitigation.** It is good practice to control all dusty materials at source so that nuisances do not occur and visibility on the adjacent road is not impaired and so that road safety can be maintained or improved. The following mitigation measures shall be undertaken by works contractors:

a. Water shall be used to suppress dust at all locations in the dry season. If the surface is dry, water shall be sprinkled at least once a day on the road and exposed surfaces when work is carried out within 50 m of residences or roadside food stalls.

b. If works have given rise to complaints over dust, the contractors shall investigate the cause and report it in the monthly progress reports and review and propose alternative mitigation measures before works recommence.

c. All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations (TCVN 5949 – 1998). Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions. Smoke emitting vehicles and equipment shall not be allowed and shall be removed from the project.

d. Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin sheets to avoid impact from dust. Speed limits shall be imposed on such vehicles.

e. Stockpiles should not be located within 100 m of schools, hospitals or other public amenities such as wells and pumps and should be covered with tarpaulins when not in use and at the end of the working day to enclose dust. If large stockpiles are necessary, they should be enclosed with side barriers and covered when not in use.

f. No open burning is allowed on site.

F.6.2.2. Air Pollution from House Demolition

320. **Impact.** The project needs to dismantle 80 level 4 houses, 3 two-storey houses, 2 flat roof houses and 18 temporary houses. The volume of demolition is estimated at 2,100 tons, and this may give rise to dust. The demolition works stretch across the entire route and at each location the volume of demolition is not substantial. **-> Minor, Short-term, Localized and Reversible Impact.**

321. **Mitigation.** In the process of dismantling these works, contractors will apply dust prevention measures such as watering or canvas covers so the amount of dust generated will be negligible.

F.6.2.3. Air pollution from Soil Excavation and Transportation

322. **Impact.** In general, the amount of dust and waste generated by earthwork (excavation, transportation and backfill) is expected to be small, ranging from 0.125 to 0.655 mg/m^3 for dust, from 2.7 to 2.8 mg/m^3 for CO, 0.039 mg/m^3 for SO_2, and 0.036 to 0.053 mg/m^3 for NO_2. However, on the two routes, existing dust levels are quite high, from 0.306 - 3.342 mg/m^3. For NH279 and NH32, dust concentrations at 50m from the centerline is not anticipated to exceed QCVN 05: 2013 / BTNMT - National technical standard for ambient air quality. However, at 20m, dust concentrations are expected to exceed the standard. Some residential areas are located only 10-15m from the construction site, who could be affected. **-> Medium, Temporary, Short-Term, Reversible Impact.**

323. **Mitigation.** The aim is to maintain ambient air quality within the permitted limits of QCVN 05: 2013 / BTNMT: National Technical Regulation for ambient air quality. To minimize air pollution caused by dust and emissions from excavation and related activities, several measures should be taken by contractors:

a. When selecting a temporary location, consider the prevailing wind direction and location of sensitive objects around. Locations of temporary rocks and construction materials must be at least 100m from any sensitive area and at least 50m from residential areas, protecting against spillage, affecting sensitive objects.

b. Spray water at least once per day when the weather is dry, or temperature is high.

c. Only use machinery and equipment that qualify for "Technical Safety and Environmental Protection".

d. Absolutely no burning of solid waste such as plastic, cloth, tar, etc. and other hazardous wastes are allowed on the construction site and near other residential or sensitive areas.

e. Workers will collect construction materials and wastes at the place prescribed at the end of each working day or at the end of the working shift.

f. Turn off the engines of machinery and equipment if these vehicles stay in place for more than 5 minutes.

g. Carrying waste away from the site, bringing it to the repository for reuse or transfer to the dumping site as soon as possible, no more than 24 hours in the passage through urban or residential areas;

h. Set up and maintain a high fence of 2.5m in site locations with large excavation or embankments or near sensitive sites.

i. Provide dust masks for construction workers and ask them to use them when working in dusty conditions.

F.6.2.4. Air pollution from Concrete Batching Plants

324. **Impact.** Concrete mix operations are a main source of pollution. A concrete batching plant with a capacity of 80 m^3/hour is planned to be installed at two locations including at connection between NH279 and NH32, and near Nam Mu Bridge on the Lai Chau link. The amount of dust generated depends on factors such as technology used, management level, etc. According to the WHO Rapid Assessment, the discharge load of pollutants from the calibration station are as follows:

- Dust dispersed directly from mixing station: 0.05 kg/ton of concrete
- Dust dispersed from material dump: 142 kg/1000 m2/year

325. With a capacity of 80 m^3/h, the discharge load from the mixing plants is estimated at 8.8 kg/hour when the density of non-steel concrete is 2,200 kg/m^3. Based on the WHO emission factor, the discharge load from the material dump is 0.0142 kg/h. If the height is 1.5m from the

ground, the amount of dust in the air mass due to the emission from the mixing plant will be = 1629,6 µg/m^3/s. Dust from the material dump is estimated at 10,95 µg/m^3/s. The calculated dust emission from the concrete batching plant is 148 times higher than the amount of dust emitted from the material dump. This effect will occur during the working phase of the batching plant. The generation of dust at mixing stations is unavoidable. The stations will be located far from any residential area, so the main impacts are on the construction workers. **-> Moderate, Mid-term, Reversible Impact.**

326. **Mitigation.** Measures to be implemented by Contractors (or batching plant operators) to limit dust emissions during the operation of concrete batching plant shall include:

a. The location of cement concrete batching stations must be far from the residential areas, giving preference to locations where there are many green trees to limit the spread of dust.

b. Operators of batching plants shall secure a permit to operate the batching plant prior to its operation.

c. Construction material storage areas should be covered or watered to minimize the spread of dust.

d. Spray water regularly in the concrete mixing plant to minimize the spread of dust on hot days.

e. Arrange the wheel wash tank for vehicles entering and leaving the mixing plant to limit the sludge in the mixing area to the road.

f. Use of conveyor belts to limit dust generation.

g. Do not grind material in mixing area.

h. Set up the fence around concrete batching plant.

327. Air quality monitoring will be conducted by the CSC to confirm compliance with QCVN05: 2013 / BTNMT. The Project Owner will require contractors to take measures if deemed necessary to maintain acceptable air quality and fully satisfy the standard.

F.6.2.5. Air pollution from Asphalt Concrete Mixing plants

328. **Impact.** Two asphalt concrete batching plants (estimated capacity of 100 tons/hour) will be installed and operated to serve the project. Asphalt concrete mixing plants generate dust and gaseous emissions. The aggregate composition of the asphalt concrete is sand, grit, rock, and stone; fuel oil consumption is 8 kg/ton of product, diesel fuel consumption is 1.1 liters/ton of product. The emission factors of the asphalt mixing plant are given below.

Table F-6: Emission factor of asphalt concrete mixing station

Procedure		Emission factor (kg / ton)				
		PM_{10}	NO_x	SO_2	VOC_s	CO
1. Mix the batch	Use air:					
	- No filter	2.2	0.013	0.025	0.0072	0.17
	- With filter	0.0098				
	Oil:					
	- No filter	2.2	0.084	0.12	0.02	0.035
	- With filter	0.03				

2. Continuous blending	Use air:					
	- No filter	2.2	0.015	0.0017	0.022	0.028
	- With filter	0.0041				
	Oil:					
	- No filter	2.2	0.038	0.028	0.03	0.018
	- With filter	0.015				

Source: NP_i, 2005

329. With such coefficients of emissions, the predicted loading of some exhaust gases of a 100 ton/h asphalt concrete plant is shown in the table below. Therefore, the anticipated amount of emissions is not significant, with the location of the asphalt mixing plants far from residential areas, the impact level of the emissions from these batches is minor and can be controlled through the mitigation measures. **-> Minor, Mid-term, Reversible Impact.**

Table F-7: Emissions of 100 tons/h asphalt concrete mixing station

Capacity (tons/h)	100	Parameter				
		PM_{10}	NO_X	SO_2	VOC_S	CO
No filter	Coefficient	2.2	0.038	0.028	0.03	0.018
	Load (kg/h)	220	3.8	2.8	3	1.8
Yes filter	Coefficient	0.015				
	Load (kg/h)	1.5	3.8	2.8	3	1.8

330. **Mitigation.** Measures to minimize impacts from asphalt concrete mixing stations include:

a. Batching plants shall not be in any legally protected area, near sensitive areas by a distance less than 2km, near residential areas by less than 500m.

b. Use asphalt concrete mixing plant with dust treatment system such as filter cloth bag or cyclone to prevent dust spread.

c. Use asphalt mixing plant with gas treatment system by wet or dry treatment to prevent the spread of toxic gases.

d. Construction material storage areas should be covered or watered to minimize the spread of dust.

e. Regularly spray water to the area inside the asphalt concrete mixing plant to minimize the spread of dust on hot days.

f. Arrange the wheel wash tank for vehicles entering and leaving the mixing plant to limit the sludge in the mixing area to the road.

g. Use of conveyor belts to limit dust generation.

h. Do not grind material in mixing area.

F.6.3. Noise

331. **Impact.** During pre-construction (house demolishing) and construction, there will be several noise pollution sources due to operations of many types of machines and vehicles. However, the noise level will vary with different machines. Noise levels from a point source such as a piece of construction equipment will attenuate 6 dBA per doubling of distance over hard surfaces. Over a “soft” or vegetated surfaces, noise levels will attenuate 9 dBA per doubling of distance. Workers on construction sites may be affected if working near the noise source.

Table F-8: Noise level generated by machinery

No.	Transport vehicles and construction machinery	Noise level at distance of 1m from the source		Noise level at distance of 20m from the source	Noise level at distance of 50m from the source
		Range	Average		
01	Bulldozer		93.0	67.0	59.0
02	Roller	72.0 - 74.0	73.0	47.0	39.0
03	Excavator	72.0 - 84.0	78.0	52.0	44.0
05	Grader	80.0 - 93.0	86.5	60.5	52.5
06	Road paver	87.0 - 88.5	87.7	61.7	53.7
07	Truck	82.0 - 94.0	88.0	62.0	54.0
08	Concrete mixer	75.0 - 88.0	81.5	55.5	47.5
09	Mobile crane	76.0 - 87.0	81.5	55.5	47.5
	National Technical Regulation 26/2010/BTNMT applying for normal areas: 6 AM to 9PM is 70 dBA; from 9PM to 6AM is 55 dBA				
	IFC Guideline (2007) applying to daytime level in residential, institutional and educational facilities is 55dBA				
	According to the Ministry of Health (MOH standard): Noise at the production area is 85 dBA for 8 hours of noise exposure				

332. Comparing the anticipated noise levels of machinery with the National Technical Regulation on Noise-QCVN 26:2010/BTNMT, the MOH standard and the IFC 2007 guideline value, noise levels at the distance of 20m from the noise source are anticipated to comply with Vietnamese requirements, while the IFC 2007 guideline value will only be achieved at 50m from the noise source. Such noise levels are assessed as medium impact since most of the construction sites are more than 20m far from the residential areas, while some residential areas are expected to be impacted, albeit short-term and temporarily. **-> Moderate, Short-term, Reversible Impact.**

333. **Mitigation.** Most of the construction sites are located away from sensitive receptors (i.e. residential areas, schools, hospitals, religious structures and sensitive ecosystems), so noise does not generally affect them. However, there are still some residential areas located very near construction sites, so mitigation measures must be applied at places where noise exceeds allowable standards. Works contractors will be required to develop a Noise and Dust Control Plan (NDCP) as part of their CEMP. In all instances, mitigation measures must be applied for those receptors within 50m and at places where noise exceeds allowable standards. The following measures should be undertaken whenever noise nuisance is potentially intrusive:

a. All works must be conducted during the hours of 07h00 to 19h00

b. Night time work, or working on public holidays or Sundays is generally prohibited unless a special permit is secured from the Project Owner and local authorities.

c. All noisy equipment must be fitted with silencers.

d. All equipment and machinery on site shall be periodically inspected for noise levels

and the necessary repairs and adjustments shall be made to ensure safety and shall not cause noise to exceed prescribed standards.

e. Contractors to limit the number of machines operating simultaneously to reduce cumulative noise. For example, during excavation and transport, the truck engine is switched off when the bulldozer is operated.

f. Natural noise barriers such as piles of sand or other materials should be exploited when siting noisy equipment such as compressors.

g. Use temporary noise barriers at sensitive receptors.

h. If it is necessary to work near houses, then a public awareness campaign should be carried out. Individual households should be approached and the works explained to the occupants prior to commencement of works.

i. All workers should wear ear muffs if working in areas with noise levels above 90dB(A).

334. The effectiveness of noise mitigation measures will be monitored regularly through noise level measurements at sensitive sites, to be conducted by the CSC. Projected noise levels should not exceed Viet Nam standards (i.e. QCVN 26:2010/BTNMT) and IFC Guidelines (2007).

F.6.4. Vibration

335. **Impact.** During construction, machines such as compactors, excavators, bulldozers, transporters, rollers, etc. will be used. The operation of these devices will cause vibrations. Estimated vibration levels are shown in below. Beyond the 10m range, the vibration level is anticipated to reach the standard allowed under QCVN 27: 2010 / BTNMT. **-> Minor, Short-term, Reversible Impact.**

Table F-9: Vibration decreases with distance from the construction equipment

Order	Device	Source vibration (r0 = 10m)		Vibration decreases with distance							
				r=12m		r=14m		r=16m		r=18m	
		L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)
1	Excavator	80	1.72	70.5	0.58	61.1	0.20	51.9	0.07	42.6	0.02
2	Bulldozer	79	1.53	69.5	0.51	60.1	0.17	50.9	0.06	41.6	0.02
3	Heavy truck	74	0.86	64.5	0.29	55.1	0.10	45.9	0.03	36.6	0.01
4	Rollers	82	2.17	72.5	0.73	63.1	0.25	53.9	0.08	44.6	0.03
5	Compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03
QCVN 27: 2010 / BTNMT, the allowable 75dB from 6 - 21h and the background from 21h -6h.											
DIN 4150, 1970 (LB Germany), 2mm / s: no damage; 5mm / s: mortar; 10mm / s: Possible damage to bearing detail; 20 40mm / s: damage to bearing detail.											

336. **Mitigation.** The following measures to control vibration impacts shall be implemented by

Contractors:

a. Apply modern construction technology to reduce vibration and avoid affecting people (e.g. instead of using the hammer machine for piling steel sheet, the contractor should use pile presses to reduce vibration.

b. Prohibit large trucks to transport materials at night through residential areas along the project.

c. Conduct inspection and regular maintenance of construction machinery and equipment.

d. Spread out the operation of construction equipment, especially for equipment that produces high vibration.

e. Replace the vibration method with alternatives such as bored piles instead of impact piles.

F.6.5. Blasting

337. **Impact.** Blasting is unlikely to be required but may be necessary at some locations if hard rock must be removed. The method to be used will be based on a hole diameter of 30- 50mm, a hole depth of 2-2.5m and 20 millisecond delayed electrical initiation. Blasting will cause vibration, dust generation and emissions such as CO, CO_2, SO_2 etc. as shown in the following table. Immediately after blasting, large amounts of dust and emissions are released. However, this amount of waste is local and the concentration of dust and exhaust gases generated by blasting will decline as distance from the explosion increases. At 1 km from the center of the blast, the dust and noise levels are still higher than the permissible range being from 0.4 to 0.6 mg/m3 for dust of 75-80 dB for noise.

Table F-10: Emissions level after blasting

Order	Measurement area	Dust (mg/m^3)	Noise (dB)	Waste gas (mg / m^3)		
				CO	CO_2	SO_2
1	After blasting at a distance of30-40m	500-600	160	1%	2%	-
2	Rock explosion after blasting	1.6-5	90-110	1.3-2	0.2	0.73
3	1km to the wind direction	0.4-0.6	75-80	-	-	-

Source: Scientific Report: Urgent Problems of the Working Environment in Stone Mining and Processing in Viet Nam, 1999.

338. One of the most important factors in assessing the environmental impact of blasting is the minimum safety distance to a person to avoid noxious gases. According to research results of Dong Nai Department of Industry (2006), when studying the stone mines in Dong Nai province, the safe distance calculated for each explosion is as given below.

Table F-11: Safety Distance Calculation of gas when blasting

Numerical order	Explosion size Q (kg)	Safe distance r (m)
1	100	70

2	200	88
3	300	100
4	400	111
5	500	119
6	1,000	150

Source: Dong Nai Department of Industry (2006)

339. In addition, the safe distance to avoid impacts on building caused by a single explosion is given below. Thus, with the explosive mass expected to be used in each explosion of about 150kg, the distance safe from gases for the nearest person is greater than 80m and the safe radius of the explosion to avoid damages to buildings is greater than 120m from the explosion. **-> Moderate, Short-Term, Localized Impact.**

Table F-12: Results of safe radius calculation for Impacts on Buildings

Numerical order	Explosion size Q (kg)	Safe distance r min (m)
1	100	96
2	200	136
3	300	166
4	400	192
5	500	215
6	1.000	304

Source: Dong Nai Department of Industry (2006)

340. **Mitigation.** At this stage of project preparation, the specific requirement for blasting is not known. If blasting is required, only controlled blasting will be allowed. Blasting will only be carried out in line with the rules set down by the local authorities and provincial DONRE in the prescribed manner and after prior notice to all residents and the local town authorities.

341. The need for blasting will have been defined during Detailed Design. If blasting is to be used, then a blasting plan should have been prepared by the DD consultant, including vibration calculations / modelling when details for blasting are clear. This is a site-specific document as it depends on the type of material to be extracted, the quantity and the ultimate use of the extracted material. Such a plan details maximum amounts of explosive to be used at any one time, pattern blasting, use of millisecond delays and means of initiation. All of these factors can be modified to ensure the blast is carried out in a controlled acceptable manner.

342. One month prior to the blasting in any area, the contractors shall undertake a condition survey including photographs of all residences within 500 m of the blast sites. The condition of the residences shall be agreed with the CSC in case there are any future claims for damage to residences due to the blasting.

343. All blasting shall be carried out in the daytime and at regular intervals after siren warnings. All residents within 500 m of the blast sites shall be kept informed of the plans and progress of blasting and residents shall be temporarily evacuated and provided with alternative accommodation if required.

344. No blasting will be allowed at night. Controlled blasting will strictly follow the license requirements from DONRE and other authorities.

345. Where the vibration from blasting may exceed the maximum permissible level, the contractor will modify blasting patterns and calculate a reduced charge or use pattern blasting

with 20 millisecond delays for future blasts to minimize damage.

346. Blasting shall be under careful and strict management of properly trained and licensed personnel. The contractors shall observe proper warning and precautionary measures to ensure safety of residents, pedestrians, motorists and structures during blasting.

F.6.6. Impact on Surface Water

F.6.6.1. Impact on Surface Water, General

347. **Impact.** The project roads intersect drainage basins that generally modify the natural flow of surface water by concentrating flows at certain points and, in some cases, increasing the speed of flow. Depending on local conditions, these changes can induce flooding, soil erosion, and siltation of streams. Sedimentation, changes in biological activity in streams and on their banks, uncontrolled construction activities, and spills of chemical and pollutants can all have adverse effects on surface water quality. Surface water sources close to construction sites might be polluted by pollutants produced from construction activities such as solid and liquid wastes produced from worker's camps and leakage of oil, grease, and spill of toxic chemicals, and poor management of batching plants. By taking mitigating measures, water pollution from construction is expected to be Medium (low volume of discharge, low concentration of pollutants), temporary (during construction time), short-term (not permanent). Rainwater runoff can be clean if kept segregated from oily or dirty areas. If clean it can directed to perimeter surface storm water drains. **-> Medium, Mid-Term, Generally Reversible Impact**

348. **Mitigation.** The Contractors will be requested to prepare Drainage Management Plan (DMP), a Silt Control Plan (SCP), and a Waste Management Plan (WMP), and an Emergency Response Plan (ERP) as part of their CEMP prior to the commencement of the civil works. These plans will clearly identify sensitive surface water bodies and defined necessary protection measures. Key measures to be implemented include the following:

a. All construction camps must contain adequate septic tanks with below ground soak ways to avoid odor generation. Storage capacity of septic tanks should be 24 hours waste water generation.

b. Lubricants shall be stored in dedicated enclosures with a sealed floor at least 50 m from water bodies.

c. Solid waste from construction activities shall not be thrown in rivers.

d. Construction storage/stockpiles shall be provided with bunds to prevent silted run-off.

e. Stockpiled materials shall be covered to reduce run-off.

f. Stockpiling or borrow sites will not be allowed within 100 m of water body.

g. Work in rivers will be scheduled during dry season.

h. Bare slopes shall be stabilized immediately after works are completed.

i. Washing of machinery and vehicles in surface waters shall be prohibited.

j. If complaints are received, water samples will be taken and analyzed by the Contractor. Impacts shall be determined by reference to the baseline results from the preconstruction stage. The criteria will be based on the QCVN 08 2008 BTNMT.

F.6.6.2. Impact on Surface Water, Bridge Construction

349. **Impact.** It is expected that the project will build 10 bridges on the connecting section of Lai Chau province (NH32, NH279) and 3 bridges on the route linking Nghia Lo town (PR179). The construction method for foundation construction of abutments is bored pile using bentonite solution to stabilize the pile wall. During construction, a large amount of bentonite solution with

high solids content will be produced. The amount of waste from each bridge is presented in **Table F-13**. This waste, if discharged directly into the stream, will degrade water quality due to increased suspended solids and turbidity. This would lead to adverse effects on aquatic life such as bottom fauna, limiting the growth of aquatic plants that are submerged in water and affecting the habitat of aquatic life. These impacts take place only at locations where bridges are being constructed. This effect only occurs in the first 4 months of the construction phase when the foundation work of abutments takes place. **-> Moderate, Localized, Partly Irreversible Impact.**

Table F-13: The amount of bentonite effluent from bridge construction

Order	*Chainage*	*Bridge name*	*Length (m)*	*Volume of bentonite effluent (m^3)*
Route connecting Lai Chau (NH279, NH32)				
1	Km 31+683.50	Nam Cho	43,10	139
2	Km 56+650.00	Ta Nang 1	21,1	77
3	Km 57+350.00	Ta Nang 2	21,1	77
4	Km 61+350.00	Cau Can	109,3	217
5	Km 63+345.00	Nam Sap 23	60,15	208
6	Km 107+020.00	Nam Lam	28,1	90
7	Km 109+600.00	Nam Mu	142,35	250
8	Km 117+450.00	Nam Dich	76,15	184
9	Km 123+750.00	Nam Hon	34,1	95
Route connecting Nghia Lo town (PR175)				
10	Km 0+085.00	Dan Xay	110,2	212
11	Km 15+275.00	Dap Tran	110,2	215
12	Km 30+728.00	Thac Ca	72,2	182

Source: Domestic EIA, February 2018

350. **Mitigation.** To minimize the impact due to wastewater containing bentonite from bridge construction the following measures shall be implemented by Contractors:

a. Firmly consolidate river banks using stones, concrete and other suitable retaining measures at each bridge construction site and ensure that water courses (rivers, canals, etc.) shall be kept free of excavation spoil and construction debris, floating and submerged.

b. Construction wastewater shall be collected and treated prior to discharge to the water body in compliance with QCVN 24:2009/BTNMT.

c. Temporary silt curtains shall be provided at pier construction sites the area of impact.

d. Disposal of slurry from bridge construction in the water body shall be forbidden.

e. Dredged material shall be collected and stored temporarily at a minimum of 30m from the water body for dewatering for at least 24h and disposed to an approved disposal site.

f. Spillage of bentonite mud in agricultural land shall be cleaned immediately to prevent caking and hardening.

g. Machinery for bridge construction shall be repaired and washed at designated locations at least 100 m from the water body. No machine repair and washing on bridge construction site shall be allowed.

h. Surface water quality shall be monitored monthly be contractors to confirm no significant impact on water quality. Surface water quality will be regularly monitored by the CSC to confirm no significant impact on water quality.

F.6.6.3. Impact on Surface Water, Concrete batching plant

351. **Impact.** Two concrete batching plants are planned to be installed. These will serve the construction of abutments, bridges and castings, and making beams. Hence, a significant amount of wastewater will be generated during this cement-concrete mix, casting abutments, piers and beams. This type of wastewater contains high levels of total suspended solids (TSS). Compared with QCVN 40: 2011 / BTNMT, the TSS in the wastewater from these activities are expected to be 6.6 times higher than that of column A and 3.4 times that of column B of QCVN 40: 2011 / BTNMT. This type of wastewater is only generated when activities mix concrete production and pour concrete. Spillage of wastewater from concrete mixing activities could pollute rivers and streams near construction sites. Wastewater that contains these solids, once it enters the water, rapidly settles and accumulates in a narrow area near the spill area. In addition, with the coating effect, these solids can change the physical and chemical conditions of river sediments. This would negatively affect ecosystems such as reducing phytoplankton density, and burying benthic organisms.

352. In addition, according to empirical results, the pH value of the effluent from the production and pouring process usually ranges from 11 to 13. Thus, this is the source of high alkaline wastewater so when discharged directly into the environment without treatment, it will break the soil structure, and affect soil organism in the surrounding area. In addition, with such a high pH value when entering the water environment, it would negatively affect aquatic life. **-> Moderate, Mid-Term, Potentially Irreversible Impact.**

353. **Mitigation.** Wash water should be directed to a settling tank and then sludge allowed to dry and be removed to approved landfill. Compliance with QCVN 40: 2011 / BTNMT must be ensured. This shall be demonstrated through regular monitoring of effluent quality.

F.6.6.4. Impact on Surface Water, Vehicle Maintenance and Site Equipment

354. **Impact.** In the construction phase, machines, equipment and vehicles involved in construction will be centralized / maintained in the maintenance area located at each construction site. Along with this activity is the layout of the fuel supply area. These activities create waste oil and oily wastewater. The project is expected to mobilize about 584 pieces of equipment and machinery for construction and the frequency of washing and maintenance is expected every 2 weeks during the 3 years of construction of the project. The average amount of wastewater from the maintenance of equipment and machinery will be about 11.6m^3 on each occasion. Wastewater from maintenance activities of machinery and equipment not only contains oil but also a large amount of suspended solids and organic. Compared with QCVN40: 2011 / BTNMT, oils and organic matter are derived from the maintenance of machinery and equipment lower than GHCP when discharged into receiving water class B.

Table F-14: Flow and discharge of wastewater from equipment maintenance

Type of waste water	Flow (m3/day)	Concentration of pollutants		
		COD (mg/l)	Oil (mg / l)	SS (mg/l)
From equipment maintenance	4,3	20 - 30	-	50 - 80
From washing equipment	6,24	50 - 80	1.0 - 2.0	150 - 200

From cooling device	1,0	10 - 20	0.5 - 1.0	10 - 50
Total	11,64	30 - 49	0,6 - 1,3	81 - 124
QCVN40: 2011 / BTNMT, column A		*50*	*5*	*50*
QCVN40: 2011 / BTNMT, column B		*100*	*10*	*100*

355. Column A of QCVN40: 2011 / BTNMT limits the pollutant parameters of industrial wastewater to discharge into receiving water sources used for domestic water supply. Column B limits pollution parameters in industrial wastewater when discharged into receiving water sources not used for domestic water supply. Wastewater from the maintenance, cleaning and cooling of construction machinery in the area is not anticipated to exceed the standard for oil. However, SS concentrations may exceed QCVN 40: 2011 / BTNMT, column B. **-> Moderate, Mid-Term, Reversible Impact.**

356. **Mitigation.** To minimize impact due to wastewater from washing, maintenance of machinery the following measures should be taken.

a. After washing vehicles and equipment, water shall be collected and pre-treated by sedimentation to remove suspended solids. Oil and grease shall be collected in grease traps or by skimming.

b. The contractor shall not place car wash, maintenance of machinery, near surface water sources such as ponds, rivers and streams.

F.6.6.5. Impact on surface water, Workers Camps

357. **Impact.** It is expected that around 360 workers will participate in the construction of different categories. According to the TCXDVN 33:2006, for rural towns and rural areas, each user has a low average level of 100 liters/day. The amount of wastewater generated is 80% of the water supply. The project is anticipated to require 17 work camps (see **Table C-11**). With 15 to 40 workers living in each camp, 0.8 to 3.2 m^3 of wastewater will be generated each day, or 24-96 m^3 per month. Based on the load factor of urban wastewater discharged by WHO, 1993, Vol. "Quick assessment method", discharge load and concentration of pollutants in domestic wastewater are as follows:

Table F-15: Load of pollutants in domestic wastewater

Order	Pollutant	Load (g/person.Day)	Concentration (mg/l)	QCVN 14:2008/BTNMT - Column B
1	BOD_5	45-54	562-675	50
2	COD	72-102	900-1275	-
3	Suspended solids	70-145	875-1812	120
4	Grease	10-30	125-375	20
5	Total Nitrogen	6-12	75-150	-
6	Ammonia	2.4-4.8	30-60	10
7	Total Phosphorus	0.8 - 4.0	10-50	-

358. Anticipated concentrations of pollutants such as BOD_5, ammonium, total phosphorus, TSS, oil and grease in wastewater are quite high. Without treatment, discharge domestic wastewater will degrade water quality and pollute the water around the camp area. Camps will cause adverse impacts not only to the health of the community and workers, because of the risk of outbreaks of common diseases in the area such as fever or diarrhea. **-> Minor, Localized, Reversible Impact.**

359. **Mitigation.** To prevent the deterioration of surface water quality by wastewater from workers camps, several measures should be taken:

a. Set up worker camps at least 100 meters away from surface water.

b. Construction contractors must install separate toilets for men and women, which must be self-contained to treat wastewater.

c. Waste water from the camp is to be collected and treated to ensure that the parameters meet the requirements of QCVN 14: 2008 / BTNMT before discharging into the general drainage system of the area.

d. In case the contractor arranges to lodge workers in houses in the project area, domestic wastewater needs to be treated before discharge. Septic tanks may need to be installed.

e. At the construction sites of bridges and roads in densely populated areas, the Contractor shall construct portable toilets. At suitable intervals full containers will be replaced or siphoned away.

f. Remind the workers to use toilet facilities at the designated place.

F.6.6.6. Construction Site Runoff / Stormwater

360. **Impact.** If rain water falls within the construction site, it may become contaminated with oils, grease, lubricants and carry a silt load. This may lead to local inundation and loss of surface water quality. **-> Minor, Temporary, Reversible Impact.**

361. **Mitigation.** To prevent adverse impacts of storm water runoff in construction areas, the following measures should be applied:

a. Develop a reasonable construction plan to limit excavation in the rainy season.

b. Accelerate construction time of all items, especially in the rainy season.

c. Do not leave construction materials, and loose soil and dirt in the area lying in the open.

d. Check the operation of horizontal culverts and drainage channels along the route; they should be inspected and cleared until good drainage is ensured.

e. Cover material yards and compaction sites to prevent soil erosion and spillage.

f. Materials and chemicals, such as fuel oil and lubricants, to be placed in locations designed to avoid spills and leaks. These storage locations must be at least 100 meters from the water source and have a roof, concrete floor and walls or solid fences to avoid spills.

g. Avoid dropping fuel oil, grease, and chemicals into the surrounding environment to avoid overflowing rainwater.

F.6.7. Impacts on groundwater

362. **Impact.** In principle, road drainage and soil excavation can lower the water table in surrounding areas, while embankments and structures can raise the water table by restricting flow. The potential effects include deterioration of vegetation, increased susceptibility to erosion,

loss of water for drinking as well as for agricultural uses. Use of bentonite for stabilizing boreholes for bridge pile construction can cause groundwater pollution by intrusion of pollutants carried by runoff through these boreholes. The project is not expected to cause these negative impacts on groundwater resource if protection measures defined in the EMP for surface water pollution control (as described above) are implemented. **-> Minor, Temporary Impact.**

363. Groundwater quality will be regularly monitored by the CSC to confirm no significant impact on water quality.

F.6.8. Impact on Soils, Soil Erosion

364. **Impact.** During the construction of the project, especially the bypass routes and the new road sections, land is affected by the construction activities such as: road dredging, slope grading, transportation of construction vehicles. The contaminants will also have some impact on the soil environment.

365. The construction of new bypass and new roads has sloping terrain mainly through steep hill slopes and is divided by river valleys so that these areas are prone to soil erosion. At present, the soil is covered by shrubs or weeds that help reduce soil erosion by rain and runoff. However, when the project goes into construction, the vegetation clearing and soil excavation works lead to increased soil erosion due to rain and runoff of rainwater during heavy rains and rains (from May to October). Due to the presence of surface runoff, not only does erosion occur in the construction site and soil erosion leads to lower agricultural lands. This would have indirect impacts on the quality of surface water, aquatic animals and plants, and burial of agricultural land on the downstream side.

366. During the construction process, the soil is likely to be contaminated by grease or spillage from the maintenance of machinery, dismantling and transportation equipment; storage of oil and grease. This will cause negative impact on animals and soil microorganisms. The soil is disturbed by oil and grease, which makes the plant grow poorly. Impacts on the land environment mainly occur on bypass roads. For existing roads, the main impact is on agricultural land on both sides of the road.

367. Construction activities such as surface coverings and land levelling will be done to recover some agricultural land being cultivated. This disrupts the existing agricultural crop systems on this agro-ecosystem, which significantly reduces the area of agricultural land. In addition, agricultural crop systems on the sloping sides of the bypass roads are often susceptible to erosion and spillover. Placing soil around the plant as in some sensitive locations.

368. The major impacts on the soil environment occur during the construction period, with a high concentration during May to October on the bypass routes. **-> Minor, Mid-Term, Partly Reversible Impact.**

369. **Mitigation.** Soil stabilization shall be a priority. Soil erosion control requires the following:

a. Temporary landfill and waste rock from excavation and construction work will be concentrated in separate dumps. Dumps will be located at the open strip within the site and away from surface waters.

b. Store materials in areas of about $20m^2$ for easy covering when it rains to avoid soil erosion and dust release on sunny days. Dumps will be constrained to avoid spillage by piles or hard walls.

c. Along the slopes of both sides of the road will be filled with loading soil or panels, walls to prevent the construction area with the surrounding land to prevent the amount of sediment in the overflow into the low side of the street.

d. Schedule program works to ensure that excavation is completed for each roadbed and compacted before the rainy season.

e. Stabilize the slope and prevent erosion before the peak time of the rainy season.

f. Make sure that the roadside slope is re-vegetated after completion of construction.

g. To prevent possible impacts on the environment surrounding the spoil disposal sites, spoil prior to dumping should be checked for toxic substances present in the soil to determine if soil exceeds QCVN 03-MT: 2015 / BTNMT.

F.6.9. Excavation Material, Inert Waste

370. **Impact.** While cut-and-fill balance will be targeted through optimized design at detail design stage. In addition, the upgrade and rehabilitation of the existing roads will generate significant amounts of inert waste (road surface and parts of road subgrade). Large amounts (approximately 6.35 million m^3, detailed in **Table F-16**) of spoil and inert waste are expected to be generated during construction. It is difficult to design for balances between cut and fill volumes of earth at each location, and haulage to disposal sites may be expensive. This creates a need for environmental management of inert material and excavated soil.

Table F-16: Estimated amount of excavated soil and inert waste arising at various sites

Road Section	Soil, waste rock (m3)	Inert waste (m^3)
San Thang – Dong Pao	480,477	280
Dong Pao – Ban Bo	776,318	340
NH32	156,716	430
NH279	2,883,941	295
PR175	2,016,719	610
TOTAL	**6,314,171**	**1,955**

Source: Domestic EIA, February 2018

371. Spoil is traditionally used by local people to amend their plots or embankments on agricultural land. Some spoil is used to level land planned for development in villages along the road. The remaining material that cannot be re-used is usually transported to spoil disposal sites. Soil in the project site is not contaminated, as observed during baseline monitoring (see Section D.5.3.7). However, if improperly managed, spoil disposal can result in (i) soil erosion and sedimentation of downslope water bodies, potentially leading to interference of river hydrology, deterioration of water quality, and induced flood risks; (iii) impact on ecological resources and natural habitats (primarily forests in the project area) if disposed at inadequate locations; and (iii) reduction of agricultural productivity if spoil is applied wrongly. **-> Significant, Long-Term, Partly Irreversible Impact**

372. During construction, works contractors will be required to develop a soil and erosion protection as well as a spoil disposal plan as part of their site-specific construction EMPs (CEMPs). The plans will define protection measures including the following:

a. Spoil disposal shall only be to Provincial DONRE and DOC approved areas;

b. Trucks transporting spoils shall be tightly covered with tarpaulin or other suitable materials to minimize dust emission and spills;

c. Wheel washing shall be undertaken to remove mud to ensure that access roads are kept clean;

d. Road surfaces shall be regularly cleaned of spilled spoil;

e. Earthwork and spoil disposal shall not cause sedimentation and obstruction of flow of

watercourses, damage to agricultural land and densely vegetated areas;

f. The spoils disposal site shall be adequately protected by avoiding formation of steep slopes and grassing to prevent erosion to surface watercourses.

373. All contractors will be requested to submit environmental document of disposal sites to the CSC for review and approval before putting disposal site into operation. Environmental document of Disposal site is as described below:

a. Spoil Disposal Plan (estimation volume, type of spoils, schedule for disposing, etc.)

b. Environmental protection measures (dust, land slide, run-off water collection prevention, etc.)

c. Location map of approved disposal sites

d. Drawings of working layout of disposal sites

e. Drawings of cross-section of disposal sites

f. Drawings of dike and drainage system

g. Approval letter from local authorizes.

F.6.10. Solid waste

F.6.10.1. Demolition Waste

374. **Impact.** The project is expected to require removal of 103 houses, mostly of grade 4 with a demolition volume of about 2,100 tons. With the principle that affected households will re-use or recycle materials from their houses to the extent possible, the volume of solid waste from this activity will be significantly reduced. **-> Minor, Short-term, Irreversible Impact.**

375. **Mitigation.** Reuse or recycle demolition where possible. Non-re-usable parts shall be disposed of in a licensed disposal site.

F.6.10.2. Domestic Waste

376. **Impact.** It is expected that there will be around 360 workers involved in the construction of different project categories, with the expected waste generation rate of 0.35 kg / person per day. The amount of waste generated each month will be 150-600 kg, depending on the number of workers at each camp site. Solid waste will generate unpleasant smell, discomfort to the community, potentially causing water and soil pollution. If not properly managed, solid waste can affect the health of workers and people living near the camp. As solid waste collection services are not available in most residential areas along the project roads, measures need to be taken to prevent the adverse effects of domestic waste. **-> Moderate, Mid-Term, Reversible Impact.**

377. **Mitigation.** Before construction, each Contractor will develop a Contractor Waste Management Plan (WMP) as part of the CEMP, and secure all necessary permits/contracts for solid waste collection and treatment. The contractor shall sign a contract with a functional unit to collect solid waste in compliance with Decree 59/2007 / ND-CP dated 09 April 2007 on solid waste management and Decree 38/2015 / ND. -CP dated 24/04/2015 on Waste Management and Scrap. Specific waste management measures include:

a. Daily waste shall be temporarily stored on site in a separate area approved by the CSC before they are collected and processed by functional units.

b. Daily waste shall be collected separately in garbage cans with lids, watertight to avoid odors, leaks, attract flies, mice and other pathogens.

c. Each site, camp site and workplace headquarters of the building management board must arrange 1-2 tanks of 200-liter capacity.

d. Domestic wastes must be regularly disposed of according to the system of waste collection in the locality.

e. Containers should be tightly closed, free from spills, resistant to sunlight, and not corrode.

f. It is not permitted to bury or burn solid waste at the scene.

g. Training of workers on sanitation and occupational hygiene shall be given.

F.6.10.3. Other Construction Waste

378. **Impact.** Construction activities will generate various types of construction waste, which according to Vietnamese regulations are classified in different categories. These are traditionally managed in different ways, as described below.

a. Iron and steel scrap, cement packaging is collected to sell scrap for recycling or reuse.

b. Wood formwork is reused.

c. Soil, stone, broken bricks are utilized thoroughly in construction (see section on spoil below).

d. Waste mud is transported to a dumping site that has been authorized by the local authority.

e. Bentonite sludge generated during construction of bored piles after settling and drying is discharged at appropriate landfill (see section on Bentonite sludge).

379. **Mitigation.** Measures taken to minimize the adverse effects of construction solid waste should include:

a. Segregation of wastes shall be observed. Organic waste (biodegradables) shall be collected and disposed of on site by composting (no burning is allowed on site).

b. Construction/workers' camps shall be provided with garbage bins.

c. Burning of construction and domestic wastes shall be prohibited.

d. Disposal of solid wastes into canals, rivers, other watercourses, agricultural field and public areas shall be prohibited.

e. There will be no site-specific landfills established by the contractors. All solid waste will be collected and removed from the work camps and disposed in local waste disposal sites.

f. During transportation of construction solid waste, it is not allowed to overload vehicles, the waste must be covered and waste not dropped on to the road.

g. Vehicles transporting waste must have wheels washed before leaving the site to clean the sticky soil from their tires.

h. Organize educating the workers, raising awareness of environmental sanitation and waste management.

F.6.10.4. Hazardous Waste, Hazardous Materials

380. **Impact.** Hazardous substances such as oils and lubricants can cause significant impacts if uncontrolled or if waste is not disposed correctly. Hazardous waste generated in the project includes waste oil, oil-based mop, grease. The amount of waste oil generated during the construction process depends on the following factors: (i) Number of means of transport and construction on site; (ii) The amount of grease and oil emitted by means of transportation and construction; (iii) Oil change cycle and maintenance of machinery and equipment. The average

amount of grease from transport vehicles and mechanized construction is 7 liters/servicing time. The period of oil change and maintenance of machinery and equipment is maximum of 3 months. The number of vehicles and machinery to be used for the replacement of grease used in the project is 584 vehicles.

381. The amount of waste oil generated in the whole project is: (584 vehicles x 10 liters/time)/3 months = 1,947 liters of waste oil per month. In addition, the project also generates mop grease and grease boxes, estimated at 97 kg per month. In addition, the project will install several different locations to store fuel oil and asphalt, where there is potential for leakage and spills.

382. Poor management of hazardous waste and hazardous materials could lead to significant soil and water pollution. These substances are highly toxic and insoluble in water, so when they enter the environment they spread widely and long lasting. As such, these substances combined with runoff will cause adverse environmental impacts in wet rice fields, ponds and natural flows in the project area. **-> Medium, Long-Term, Potentially Irreversible Impact.**

383. **Mitigation.** Each Contractor will develop a Waste Management Plan (WMP) and an Emergency Response Plan (ERP) as part of their CEMP. The following measures will need to be reflected therein:

a. Ensure that safe storage of fuel, other hazardous substances and bulk materials are agreed by PMU2 and have necessary approval permits from DONRE and local authorities.

b. Vehicle maintenance and refueling areas will be confined to designated areas in construction sites designed to contain spilled lubricants and fuels.

c. Fuel and other hazardous substances shall be stored in areas provided with weather shielding lightweight roof, impervious flooring and curbs to contain spilled liquids. Absorbent materials such as sand should be provided to mop up spills.

d. There must be appropriate information and training programs in the workplace that help the workers to be aware of and have a way to deal with hazardous chemicals in the workplace.

e. Hazardous wastes must be collected separately, placed in containers marked as hazardous waste with sealed lids and identification labels as prescribed. They must be placed in a safe place with non-permeable floor, a roof, and fire insulation. They should be stored at least 100m away from any water source.

f. The contractor must contract a functional unit to handle the waste or sell it to a company that is licensed to recycle used oil.

g. Chemical wastes of all kinds must be stored and disposed of at the approved site in accordance with local regulations.

h. Contractors are required to obtain the necessary waste treatment certificate.

i. Used oil or oil contaminated with PCBs must be stored safely to prevent leakage or damage to workers and the environment.

j. Asphalt or asphalt products that cannot be reused must be returned to the supplier.

k. The contractor must prepare an Emergency Response Program, and implement the program after any incidents. In such cases, the contractor must submit a report to the CSC, explaining the reasons and remedies or damages.

F.6.11. Impact on Terrestrial Ecosystems

384. **Impact.** A major concern is the fact that the existing NH279 currently passes through the

Hoang Lien Van Ban Nature Reserve (HLVBNR). The alignment of NH279 within the VBNR passes between several blocks of forest which are designated Ecological Restoration Subzones (ERS). The planned works require minor road widening and this will not encroach on the Strictly Protected Subzone (SPS) of the Nature Reserve. According to HLVBNR Management Authority sustainable development is permitted within the ERS and the planned works have been approved in principle.

385. Permission to upgrade the NH279 was obtained from the HLVBNR Management Authority through the EIA appraisal process by MONRE. However, often nature reserves are elevated to National Park status and it is imperative that no actions of the road upgrade jeopardize this prospect. The existing road from Km145 + 450-Km152 + 600 on NH279 (Km51 + 350-Km58 + 500 of project) passes directly between several of the blocks of the ERS of the HLVB Nature Reserve and construction activities involving large machines may cause noise and vibration which may temporarily drive away animals, seeking shelter in the deeper recesses of the forests. This is a temporary dislocation as the animals will return when the disturbance moves on or is finished. Per HLVBNR Management Authority, CR and EN species known to be present in the nature reserve do usually stay in the SPS of the reserve and are not located within the ERS of the reserve given the current levels of habitat disturbance. The ERS consists mainly of poor secondary natural forest, and young planted forest for ecological restoration. The ERS also includes farmland and paddy fields, residential areas and the NH279 mountainous road).

386. The objectives of the HLVBNR are to protect the valuable and precious gene resources of the wild flora and fauna of Viet Nam including the populations of globally threatened western black crested gibbons *Nomascus concolor*, beautiful nuthatch *Sitta Formosa* and the pine *Taiwania cryptomerioides.* The nature reserve also provides protection to rivers and streams used for local irrigation, agricultural production and, very importantly, for hydroelectric power.

387. As described in Section D.3.2.8, the most important animal species found in the project area include the globally threatened western black crested gibbon (*Nomascus concolor)*, the Owston's civet (*Chrotogale owstoni)* and the Vietnamese salamander (*Paramesotriton deloustali).* These and other species classified as critically endangered (CR), endangered (EN) or vulnerable (VU) are mainly threaten from exploitation for traditional medicine, food and for pet trade. The black crested gibbon has not been sighted in the ERS of the nature reserve and is reported to occur at elevations of 1,600-2,000 m. This and other primates prefer interior mature and/or heterogeneously structured primary forests. The Owston's civet is hunted for meat and traditional medicine (including its bones, scent gland, and penis). The Vietnamese salamander is not a migrant, and is collected locally for use in traditional medicines and the domestic pet trade. The globally Vulnerable (VU) beautiful nuthatch (*Sitta Formosa*) occurs primarily in mature broadleaved forests at altitudes from 1,500-2,400 m. Main threats to the species include forest loss, degradation and fragmentation, predominantly because of shifting cultivation.

388. The flora in the nature reserve includes a total of 34 rare species listed in the Red Book of Viet Nam (2007). Two species are considered Critically Endangered (CR), including *Taiwania cryptomerioides and Aucuba japonica*; 14 species are classified Endangered (EN) and 18 species are classified as Vulnerable (VU). *Taiwania cryptomerioides* is a large coniferous tree in the cypress family Cupressaceae. It is one of the largest tree species in Asia, reported to heights of up to 90 m tall and with a trunk up to 4 m diameter above buttressed base. It is primarily endangered by illegal logging for its valuable wood. The species is classified as VU per IUCN Red List. *Aucuba japonica*, commonly called spotted laurel, Japanese laurel, or Japanese aucuba, is a shrub (1-5m) native to rich forest soils of moist valleys. It is a common garden plant in many countries and not classified in the IUCN Red List.

389. As the project will only rehabilitate the project road within the boundaries of the ERS of the nature reserve, it is not anticipated to result in incremental impacts on the reserve's protection objectives or significantly increase habitat fragmentation or forest loss. However, construction activities will involve construction workers entering the nature reserve, which could promote illegal logging and hunting if not properly controlled. Workers may also be tempted to purchase fire wood

or food off local persons who in turn are involved in illegal practices. Such illegal activities and purchases must be discouraged.

390. In addition, the project roads are located adjacent to protection forests as various sections, as documented in Section F.5.2. In addition, the construction activities may cause forest fires in the dry season, from October to March. Fires cause ecological damage as well as economic losses to households and local communities. **-> Medium/Moderate, potentially Irreversible Impact.**

391. **Mitigation/Protection.** During construction, the following measures must be undertaken to protect the ecology of the Van Ban Nature Reserve (VBNR):

a. No batching plants, workers camps, materials storage areas, borrow pits, spoil disposal sites shall be located within the VBNR;

b. No vehicle maintenance is allowed in the VBNR;

c. Workers may not cut firewood or hunt wild animals for food in the VBNR. No trading in wild animals is allowed;

d. Workers must not buy wild animals or firewood from residents in the VBNR;

e. Any workers found poaching or illegally cutting timber will be summarily dismissed;

f. All construction activities, parking of vehicles etc must take place alongside the roads. No excursions are allowed into the VBNR;

g. No open burning is allowed on site due to the risk of forest fires.

h. Encroachment on the nature reserve beyond the ROW is strictly prohibited and shall be monitored/supervised by the CSC and the external environment monitor.

392. Training will be provided by the CSC, with support of the HLVBNR Management Authority to contractors and construction workers, to provide information on the nature reserve's sensitivities, and to instruct them on prohibited activities including collection of non-timber forest products, wildlife poaching and others.

F.6.12. Impact on Aquatic Ecosystems

393. **Impact.** During the construction phase, the most important impact on the aquatic ecosystem is sedimentation, which together with the water that is swept from the surface when entering the waterways causes increased turbidity, with high suspended solids. This will affect the photosynthetic capacity of aquatic plants, bury the benthic species, and reduce the amount of dissolved oxygen in the water, leading to adverse impacts on aquatic life. As discussed earlier, the construction of bored piles may lead to bentonite discharge into surface water at bridge construction sites, leading to declining fisheries resources. The spill-over of solid domestic wastes, construction solid wastes and hazardous solid waste from construction sites to surface water systems creates risks of polluting the aquatic environment and affecting habitats of aquatic species. The discharge of untreated domestic wastewater and construction machinery wastewater will pollute receiving water sources.

394. There are several tributary streams flowing into the main river at Tu Doi that are known to be well stocked with fresh water fish resources and these are currently undergoing a fisheries resources audit. These streams are also extremely valuable in terms of hydroelectric potential. High levels of silt and sediment in such streams is extremely damaging to hydro power station turbine blades and the feedstock waters must be kept clear and low in sediment transport. **-> Moderate, Short-Term, Generally Reversible Impact.**

395. **Mitigation.** The measures defined earlier to minimize surface water pollution will directly contribute to the protection of aquatic ecosystems.

F.6.13. Risk of Landslides and Embankment Collapses during Construction

396. Most of the sections of the project pass through sloping terrain and there are many places where landslides and bank collapse occur in the months of June to October (see Appendix A). In addition, the project will decrease the slope from 8% -10% to 7%. These construction activities will temporarily reduce the relative stability of the existing slopes, increase the risk of landslides. Landslides may encroach on agricultural land, endanger construction workers as well as block traffic.

397. During construction of bridge piers, the blocking of the river can change the river flow, causing the flow velocity to increase. Especially in the rainy season, when floods may occur from upstream, flow velocity may increase significantly. This will increase local erosion due to scouring at the bridge site. **-> Medium, Short-Term Risk**

398. **Mitigation.** To mitigate the risk of landslides and bank collapses during construction, the following measures should be adopted:

a. Minimize removal of stabilizing vegetation on existing slopes. Enhance vegetation cover for sloping roofs;

b. Construct temporary drainage facilities at all excavated areas to divert surface runoff and to avoid runoff water flowing over bare and unstable areas;

c. Closely monitor potentially unstable sites throughout construction period and temporary halt construction activities as needed;

d. Regularly check open drainage ditches and horizontal drainage along the route to avoid long-standing waterlogging and soil erosion;

e. In cases where erosion or bank collapses occur, mobilize the means to repair in time to ensure the traffic flow is not disrupted;

f. Install final slope stabilization works as defined in the detailed design as soon as possible to minimize the period of risk of landslides and slope collapses;

g. After the slope is finished, establish longitudinal ditches to ensure longitudinal drainage while simultaneously removing the soil and rock during the excavation on the sloping side, ensuring the drainage of the surface when it rains.

F.6.14. Social Impacts

F.6.14.1. Construction activities affecting local business

399. **Impact.** At the densely populated areas along the project roads, business activities of people primarily include food sellers, motorbike repairs, groceries, petrol stations, catering and catering services. Construction activities may temporarily impede access to the stores, causing inconvenience. This could affect income of the people. However, the project's impact on local businesses is expected to be limited since most shops are not near the edge of the road and the impact will be short term. In addition, the construction of roads could affect access to agricultural and production forest areas, which are important livelihoods in the project area. Public consultation confirmed that the project is fully supported by all residents in villages serviced by the project roads. However, continuous consultations will be required to ensure that potentially affected business owners and farmers are aware of project activities and schedule. Temporary land acquisition and impacts on livelihoods are addressed through the land acquisition and resettlement plans (LARP) **-> Minor, Short-term, Reversible Impact.**

400. **Mitigation.** In addition to the measures defined in the LARP, the following measures shall be implemented by the Contractors prior to and during construction to minimize the impact of construction on local businesses.

a. Consult with shop owners, farmers and forestry managers at least two weeks before construction starts to agree on and provide temporary access to their businesses/production areas. Inform on the planned construction activities and likely impacts;

b. Consult shop owners, farmers and forestry managers regularly to seek their feedback on impacts such as emissions, dust, noise, traffic safety at least two weeks prior to commencement of construction;

c. Do not store raw materials or waste within 20m of businesses or shops. Arrange traffic control staff for loading and unloading of raw materials and wastes;

d. Provide compensation for products and properties damaged by the project activities;

e. Resolve immediately any inconvenience caused by project activity.

F.6.14.2. Labor-related social problems

401. **Risk.** Social problems relating to labor force are often involved in road projects due to the large number of workers hired. It is expected that about 360 construction workers will come from other regions to participate in the construction of the project. Unavoidably, social strife can arise between workers hired from different areas and residents or even between workers. Project implementation will give increased employment opportunities for local communities. This has the potential to lead to child labor on the jobsite if contractors fail to properly control the age of the workers. Additionally, such a large number of workers can bring social issues such as drug abuse, pity crime, gambling and prostitution. **-> Moderate, Mid-Term Risk.**

402. **Mitigation.** Workers-related social risks will be mitigated by Contractors by applying active measures such as:

403. Workers-related social risks will be mitigated by applying active measures such as:

a. To the extent possible, hire local staff. The project can employ about 270 local, female and male workers. For some jobs requiring re-training, the contractor will select among the employees hired locally to train them for new skills so they can do the job well;

b. Collaborate with local authorities to publish information on the project, including construction items, environmental and social issues related to the project, introduce construction personnel from other places to the community. Organize regular exchanges between workers and local people;

c. All workers shall be properly registered. Child labor is strictly prohibited.

d. Conduct regular orientations and awareness raising of workers on how to prevent infectious diseases such as HIV/AIDS (to be conducted through the implementation of the Gender Action Plan)

e. Implement a strict and zero-tolerance policy to regulate gambling, prostitution, theft, wildlife poaching and forest product collection.

F.6.14.3. Community and Occupational health and safety

404. **Risk.** Unfortunately, incidents can happen at anytime and anywhere on the sites because of carelessness, although safety regulations are always considered for every construction work. Consequently, such incidents can cause a heavy burden on the society and family (e.g. serious injuries).

405. In the context of road construction, accident risks will be unavoidable due to operation of construction equipment and other construction activities. Risks due to fire, bank collapses and occupational accidents will also cause injuries for workers and local people. Development and strict

compliance with safety regulations will minimize incident risks.

406. Poor sanitation in workers camps will lead to the emergence of several diseases such as dengue fever, eye disease, gastrointestinal disease, etc. If not controlled this can spread to the community. In addition, infectious diseases such as HIV / AIDS, hepatitis A / B / C are also likely to spread due to workers' concentration and possible prostitution in the area.

407. In addition to increasing the risk of spreading contagious diseases, large numbers of residential residents mixed with local communities will lead to overcrowding of the local health system, especially for commune health stations and district hospitals.

408. **Mitigation.** Works contractors will be required to develop a Health and Safety Management Plan (H&SP) as part of their CEMP. The following measures should be reflected in the plan by contractors:

409. **For Work Camps:**

a. Properly set up work camps in close consultation with local authorities. Control and maintain work camps, and strictly manage workers.

b. Worker camps will be located at pre-defined locations and/or as agreed with local communities and CSC and PMU2. Contractors shall provide shelter, water and electricity facilities that ensure workers living in camps at the site receive sanitary and human living conditions. Separate toilets shall be provided for male and female workers.

c. No construction camps are to be in forest areas. Workers shall be prohibited from cutting trees for firewood. The contractors will not permit the use of wood as a fuel for cooking and water heating in all camps and living accommodations. The Contractors shall not buy or use wood from illegal sources that come from the illegal logging. Workers must not hunt wild animals for food nor buy them from illegal sources such as poaching. Use of guns and hunting equipment by workers will be banned and workers dismissed if taking or using forest timber or hunting or in possession of wildlife.

d. Camp site will be cleaned up to the satisfaction of local authorities after use. Land used for campsites shall be restored to the original condition as far as practicable and the area shall be planted with appropriate trees / shrubs as soon as practicable after it is vacated and cleaned.

e. Measures to prevent the outbreak of diseases shall be implemented e.g., provision of insecticide treated mosquito nets to workers, installation of proper drainage to avoid formation of stagnant water, etc.

f. Standing water will not be allowed to accumulate in the temporary drainage facilities or along the roadside, to prevent proliferation of mosquitoes.

410. **For occupational health and safety**: Worker occupational health and safety is generally governed by the Labor Code of Viet Nam, Decree 06/CP (20 Jan 1995), Decree / 202 ND-CP OP (27 Dec 2002) and Circular 13/ BYT 24 October 1996).

a. Appoint qualified environment, health and safety staff at least one month prior to construction start to look after implementation of required environmental mitigation measures, and to ensure that health and safety precautions are strictly implemented;

b. At least one month before construction commences the contractors will demonstrate to PMU2 and CSC that the H&S Plan will be properly resourced;

c. The contractors will instruct and induct all workers in health and safety matters (induction course) including construction camp rules and site agents/foremen will follow up with toolbox talks on a weekly basis.

d. Provide fencing on all areas of excavation greater than 2 m deep. Implement fall

prevention and protection measures for works at height (i.e. higher than 2m);

e. Workers shall be provided with of appropriate personal protective equipment such as safety boots, helmets, gloves, protective clothes, breathing mask, goggles, and ear protection at no cost to the workers.

f. Ensure audible reversing signals are installed on all construction vehicles.

g. Where worker exposure to traffic cannot be eliminated, protective barriers shall be provided to shield workers from traffic vehicles. Contractor will install separation devices e.g., traffic cones and barrels to delineate the work zone.

h. On the construction site all workers should be equipped with safety belts, anti-fall protection grid and lifejackets for construction workers on high and above rivers.

i. The contractor shall prepare an accident response plan including rescue teams, organizational rescue and plan (leader, self-implementation) and identify the addresses needed to contact in an emergency including hospitals in the project area and district hospitals.

j. Maintain a record of all occupational accidents, including near misses, and report all major accidents involving serious injury or death within 24-h to the CSC and the PMU2; ensure that all accidents are investigated in compliance with the Vietnamese Law on Occupational Safety.

411. **For community health and safety:**

a. The contractors will provide information boards near the work sites to inform the public on how to approach the works. The contractors will provide warning signs at the periphery of the site warning the public not to enter;

b. Fencing will be installed prior to excavation work commencing on all sides of temporary excavations;

c. Contractors will provide appropriate drains so that the outfalls of the surface run-off from the works are diverted away;

d. Contractors will ensure that storm drains are cleared to maintain storm water flow;

e. Reconnect any power, water supply, telecommunications and irrigation systems interrupted by the works;

f. Contact all relevant local authorities for utilities and local village groups to plan reconnecting of power, water supply, telecommunications and irrigation systems;

g. Relocate and reconnect utilities in advance of construction works and coordinate with the relevant utility company at the provincial and district levels for relocation and reconnection well before works commence;

h. Inform affected communities well in advance of any disruptions;

i. If utilities are accidentally damaged during construction, it shall be reported to the CSC, PMU2 and utility authority and repairs arranged immediately at the contractor's expense;

j. Conduct regular consultation and information meetings with nearby communities in accordance with the communication plan defined in the EMP.

F.6.14.4. Temporary Traffic Disturbance

412. **Impact.** During construction, large volumes of materials will need to be transported to the road construction areas and removed to the disposal sites. The roads to be upgraded and rehabilitated under the project are at the same time the main material transport routes. Transportation of materials by large trucks could further damage these roads, disrupt traffic and

increase the risk of traffic accidents. Moving sand, stone and gravel materials in vehicles may cause spillages on the road which may be hazardous for cars and two-wheel vehicles.

413. Except for NH32, the remaining roads including PR175 (connecting road Nghia Lo), and NH279 all have narrow widths (about 5.5m). Upgrade and rehabilitation of existing sections of the roads will temporarily occupy half of the road, which will hinder traffic flows, resulting in traffic congestion and traffic accidents. In addition, the construction will create a difference in height between the traffic and construction. This will increase the risk of traffic accidents for two-wheel vehicles, especially during night time.

414. The project will also require replacement of existing bridges to build new, higher grade and climate-proof bridges. Where new bridges will be located at the identical site as existing bridges, the construction of temporary bridges to avoid traffic interruption will be required. **-> Significant, Mid-Term, Reversible Impact.**

415. **Mitigation.** Each Contractor is required to develop a Temporary Traffic Management Plan (TTMP) was part of the CEMP. The main objectives of the plan shall be to maximize the safety of the workforce and the road users. The main secondary objective will be to keep traffic flowing as smoothly as possible.

a. Set up clear traffic signal boards and traffic advisory signs at the roads going in and out the road and bridge construction sites to minimize traffic build-up.

b. Provide signs advising road users that construction is in progress and that the road narrows to one lane using cones.

c. Communicate through local officials to the public the scope and schedule of construction, as well as specific construction activities causing disruptions or access restrictions.

d. Coordinate with local traffic authorities to implement traffic diversion schemes to avoid inconvenience to road users, ensure smooth traffic flow and avoid or minimize accidents, traffic hold ups and congestion.

e. Employ flag persons to control traffic at the station sites for safety reasons when construction equipment is entering or leaving the work area.

f. Define and observe schedules for different types of construction traffic trips (e.g., haulage of spoils, delivery of construction materials, etc.).

g. Avoid movements of noisy vehicles during night time in vicinity of sensitive receivers.

h. Implement suitable safety measures to minimize risk of adverse interactions between construction works and traffic flows through provision of temporary signals or flag controls, adequate lighting, fencing, signage and road diversions.

i. Regular maintenance of selected temporary routes.

j. Restriction of using too many pieces of construction equipment at interchanges at rush hour.

k. Limit of using too many pieces of floating construction equipment at bridge construction sites.

l. Vehicle speed limit along the route and ensure conformity with each section having residential areas and intersections.

m. Limit transporting materials during the rainy season and avoid overloading vehicles compared to the load of the structure existing roads and bridges.

n. Repair damaged pavement of local road.

F.6.15. Impact on Culture and Archaeology

416. **Risk.** No legally protected physical cultural resources have been identified along the project roads. During public consultation, several villages have highlighted the potential impact of project roads on tombs and graveyards. The relocation of these tombs is addressed through the LARP. However, construction activities may affect religious or cultural buildings by disrupting entry and exit pathways of visitors, dust from excavation sites, temporary storage of materials, and waste areas. Cultural activities of ethnic minority people in the project area are concentrated in community cultural activities and these areas are not within the construction area. Therefore, the construction should not cause significant adverse impacts on the cultural and religious activities of ethnic minority communities. However, the culture and beliefs of the Tay, Muong, Nung, Dau, Lu, H'Mong need to be respected. Labor from localities with different cultural traits can generate negative effects such as the abuse of cultural beliefs transformed into superstition.

417. If works reveal archaeological relics then this is a “chance find” and must be reported to the local authorities. There must be disclosure of chance finds of archaeological remains and artefacts. It may be necessary to stop work until an investigation has been completed. The project will devise procedures to deal with discovery of archaeological relics. **-> Minor Risk, but Potentially Significant and Irreversible Impact.**

418. **Mitigation.** Contractors will take the following precautions to avoid disturbance of any yet undiscovered archaeologically valuable artefacts:

a. Site agents will be instructed to keep a watching brief for relics in excavations.

b. Should any potential items be located, the local authorities will immediately be contacted and work will be temporarily stopped in that area.

c. If the item is of potential significance an officer from the Department of Culture and Information (DCI) will be invited to inspect the site and work will be stopped to allow time for inspection.

d. Until DCI has responded to this invitation work will not re-commence in this location until agreement has been reached between DCI, CSC and PMU2 as to any required mitigation measures, which may include structured excavation.

F.7. Post Construction Phase

F.7.1. Post Construction Site Clearance

419. **Impact/Risk.** Upon completion of material extraction activities, quarry and borrow pits shall be dewatered and fences installed to minimize health and safety risks. Borrow pits are to be left in a tidy state with stable side slopes and proper drainage to avoid creation of water bodies favorable for mosquito breeding. To avoid drowning when pits become water-filled, measures such as fencing, providing flotation devices such as a buoy tied to a rope, etc. shall be provided. When construction is completed, the contractors must clean up the construction sites by removing all equipment and buildings and carrying out site remediation work. **-> Moderate, Reversible Impact.**

420. A **5% retention on payment** to contractor shall be withheld until a project completion report is filed. The PMU2 shall notify at contract signing that the 5% retention is contractually binding. Failure to clean up site may result in financial penalties. A separate contractor can be hired to carry out clean up and costs back charged to 5% retention.

421. **Mitigation.** Contractors must take the following measures before demobilizing:

a. All construction sites must be cleared of debris and waste materials

b. Site to be returned to same state as before occupancy

c. All stockpiled materials to be removed from site

d. All waste materials to be removed from sites

e. All septic tanks should be removed and excavations made good

f. All containers, scrap wood, scrap metal etc. to be removed from site and sold to recycling company or disposed of at approved sanitary landfill

g. Borrow pits to be fenced off and warning signs for no swimming erected. Benches in borrow pits to be graded to gentle slope to avoid drowning

h. If requested by local villagers borrow pits can be converted to fishponds or water storage reservoirs but safety of children is paramount.

i. Works should be carried out in liaison with community heads.

F.8. Operation Phase

422. Impacts during operation include impacts and risks to physical and social-economic resources. Physical impacts include those on soils, water resources, air quality, and noise. Impacts on socio-economic resources include traffic accidents, flooding and climate change risks to infrastructure, and rapid development of service, industrial and urban areas along the road. These are discussed in more detail below.

F.8.1. Impact on Air Quality

423. Emissions by vehicular traffic will cause impacts on the environment, and be one of factors contributing to greenhouse effect. Road traffic generates dust and gaseous air pollutants. Total Hydrocarbon (HC), Carbon Monoxide (CO), Carbon Dioxide (CO_2), Nitrous oxide (NOx), Sulphur dioxide (SO_2), Particulates (TSP) and Lead (Pb) emissions of the project were estimated based on the traffic forecast prepared in the framework of the project's economic analysis (which differentiates traffic forecasts by road section, and by vehicle type), the total road length, and emission factors for typical vehicles.

Table F-17: Current and forecasted traffic on project roads, normal traffic (i.e. without project scenario)

Year	Road		Normal Traffic								
	Road section	Road length (km)	Car	Small Bus	Large Bus	Light truck	Medium truck	Heavy truck	Heavy truck	Motorcycle	TOTAL
	Assumptions			*< 25 seats*	*> = 25 seats*	*2 axles, 4 wheels*	*2 axles, 6 wheels*	*3 axles*	*4 or more axles*		
2018	NH 279, from Khau Co to Kha Yen	21	86	26	21	110	59	65	74	185	625
	NH 279, from Kha Yen to Bao Ha	53.5	668	631	149	207	167	126	96	1,048	3,092
	NH 32, PR136	66.5	471	16	33	510	125	131	107	604	1,998
	PR 175	56.2	108	37	18	78	71	42	31	726	1,110
	Total		1,333	710	221	904	421	364	308	2,563	6,825
2024	NH 279, from Khau Co to Kha Yen	21	128	39	32	167	89	99	112	209	875
	NH 279, from Kha Yen to Bao Ha	53.5	182	83	75	189	112	76	73	577	1,368
	NH 32, PR136	66.5	707	24	50	775	189	199	163	683	2,791

	PR 175	56.2									0
	Total		1,018	146	157	1,131	390	374	348	1,470	5,034
2031	NH 279, from Khau Co to Kha Yen	21	195	59	48	258	137	152	172	232	1,254
	NH 279, from Kha Yen to Bao Ha	53.5	276	126	114	292	172	118	114	639	1,852
	NH 32, PR136	66.5	1,073	37	76	1,198	293	308	252	757	3,994
	PR 175	56.2									0
	Total		1,545	222	239	1,748	603	577	538	1,629	7,100
2041	NH 279, from Khau Co to Kha Yen	21	321	98	79	438	234	259	294	261	1,984
	NH 279, from Kha Yen to Bao Ha	53.5	456	208	189	496	293	200	193	718	2,753
	NH 32, PR136	66.5	1,770	61	126	2,036	498	523	428	850	6,291
	PR 175	56.2									0
	Total		2,547	367	394	2,971	1,025	982	915	1,829	11,028

Source: Economic Analysis of PPTA Consultant (January 2018)

Table F-18: Forecasted diverted traffic on project roads (i.e. traffic diverted from other roads onto project roads)

Year	Road		Diverted Traffic								
	Road section	Road length (km)	Car	Small Bus	Large Bus	Light truck	Medium truck	Heavy truck	Heavy truck	Motorcycle	TOTAL
	Assumptions			*< 25 seats*	*> = 25 seats*	*2 axles, 4 wheels*	*2 axles, 6 wheels*	*3 axles*	*4 or more axles*		
2024	NH 279, from Khau Co to Kha Yen	21	19	6	5	25	13	15	17	31	131
	NH 279, from Kha Yen to Bao Ha	53.5	27	12	11	28	17	11	11	86	205
	NH 32, PR136	66.5	106	4	8	116	28	30	24	102	419
	PR 175	56.2	177	60	29	129	118	70	52	852	1,487
	Total		329	82	53	299	177	126	104	1,072	2,242
2031	NH 279, from Khau Co to Kha Yen	21	29	9	7	39	21	23	28	35	191
	NH 279, from Kha Yen to Bao Ha	53.5	41	19	17	44	26	18	37	96	298
	NH 32, PR136	66.5	161	6	12	180	44	46	38	114	600
	PR 175	56.2	268	92	44	200	183	109	80	950	1,925
	Total		500	125	80	462	273	195	183	1,195	3,013
2041	NH 279, from Khau Co to Kha Yen	21	48	15	12	66	35	39	48	39	302
	NH 279, from Kha Yen to Bao Ha	53.5	68	31	28	74	44	30	63	108	447
	NH 32, PR136	66.5	266	9	19	305	75	78	64	129	945
	PR 175	56.2	442	151	73	340	311	184	136	1,070	2,707
	Total		824	206	132	785	464	332	311	1,346	4,401

Source: Economic Analysis of PPTA Consultant (January 2018)

Table F-19: Forecasted generated traffic on project roads (i.e. induced traffic as result of project)

Year	Road		Generated Traffic								
	Road section	Road length (km)	Car	Small Bus	Large Bus	Light truck	Medium truck	Heavy truck	Heavy truck	Motorcycle	TOTAL
	Assumptions			*< 25 seats*	*> = 25 seats*	*2 axles, 4 wheels*	*2 axles, 6 wheels*	*3 axles*	*4 or more axles*		
2024	NH 279, from Khau Co to Kha Yen	21	26	8	6	33	18	20	22	42	175
	NH 279, from Kha Yen to Bao Ha	53.5	36	17	15	38	22	15	15	115	273
	NH 32, PR136	66.5	141	5	10	155	38	40	33	137	558
	PR 175	56.2	35	12	6	26	24	14	10	170	297
	Total		239	41	37	252	102	89	80	464	1,304
2031	NH 279, from Khau Co to Kha Yen	21	39	12	10	52	28	30	35	47	251
	NH 279, from Kha Yen to Bao Ha	53.5	55	25	23	58	34	24	23	128	371
	NH 32, PR136	66.5	215	7	15	239	58	61	50	152	798
	PR 175	56.2	54	18	9	40	37	22	16	190	385
	Total		363	63	57	389	157	137	123	517	1,805
2041	NH 279, from Khau Co to Kha Yen	21	64	20	16	88	47	52	59	52	397
	NH 279, from Kha Yen to Bao Ha	53.5	91	42	38	99	59	40	39	144	551
	NH 32, PR136	66.5	354	12	25	406	99	104	85	172	1,258
	PR 175	56.2	88	30	15	68	62	37	27	214	541
	Total		598	104	93	661	267	233	210	582	2,747

Source: Economic Analysis of PPTA Consultant (January 2018)

Table F-20: Forecasted total traffic on project roads (i.e. sum of normal traffic, induced traffic and generated traffic)

Year	Road		Total traffic								
	Road section	Road length (km)	Car	Small Bus	Large Bus	Light truck	Medium truck	Heavy truck	Heavy truck	Motorcycle	TOTAL
	Assumptions			*< 25 seats*	*> = 25 seats*	*2 axles, 4 wheels*	*2 axles, 6 wheels*	*3 axles*	*4 or more axles*		
2018	NH 279, from Khau Co to Kha Yen	21	86	26	21	110	59	65	74	185	625
	NH 279, from Kha Yen to Bao Ha	53.5	668	631	149	207	167	126	96	1,048	3,092
	NH 32, PR136	66.5	471	16	33	510	125	131	107	604	1,998
	PR 175	56.2	108	37	18	78	71	42	31	726	1,110

	Total		1,333	710	221	904	421	364	308	2,563	6,825
2024	NH 279, from Khau Co to Kha Yen	21	173	53	43	225	120	133	151	283	1,181
	NH 279, from Kha Yen to Bao Ha	53.5	246	112	102	255	151	103	99	779	1,846
	NH 32, PR136	66.5	955	33	68	1046	256	269	220	922	3,768
	PR 175	56.2	212	73	35	155	142	84	62	1022	1,785
	Total		1,586	270	247	1,682	669	589	532	3,006	8,580
2031	NH 279, from Khau Co to Kha Yen	21	263	80	65	348	185	205	235	314	1,696
	NH 279, from Kha Yen to Bao Ha	53.5	373	171	155	394	233	159	173	864	2,521
	NH 32, PR136	66.5	1,449	50	103	1,616	395	415	340	1,024	5,392
	PR 175	56.2	322	110	53	240	219	130	96	1,140	2,310
	Total		2,407	410	375	2,599	1,033	909	844	3,341	11,919
2041	NH 279, from Khau Co to Kha Yen	21	434	132	107	591	316	349	400	352	2,682
	NH 279, from Kha Yen to Bao Ha	53.5	615	281	255	670	396	270	294	970	3,751
	NH 32, PR136	66.5	2,390	82	170	2,748	672	705	578	1,150	8,494
	PR 175	56.2	530	182	87	408	373	221	163	1284	3,249
	Total		3,969	677	619	4,417	1,756	1,546	1,435	3,757	18,176

Source: Economic Analysis of PPTA Consultant (January 2018)

424. The project's **total incremental emission loads** are assessed as the difference between the no-project and the project-alternatives (i.e. total traffic minus normal traffic) using HDM-4 Version 2.

Table F-21: Results of air pollution contributions from road in 2031 and 2041 (in tons per Year)

	Annual Emission Quantities in Tons Per Year							
	Year	**HC**	**CO**	**NOx**	**CO2**	**SO2**	**Par**	**Pb**
Baseline (2018)	2018	160.1	325.2	444.9	41,323.5	19.0	78.7	2.5
Normal traffic (i.e. without project)	2031	267.6	436.8	826.8	69,142.9	38.8	159.1	2.9
	2041	430.1	637.3	1,427.8	118,814.5	67.6	276.8	4.9
With project alternative	2031	272.4	511.3	802.2	69,678.5	35.8	146.8	3.6
	2041	381.4	659.0	1,213.0	104,252.7	54.8	224.4	5.1
Incremental emissions (as compared to 2018 baseline)	2031	112.37	186.06	357.4	28,355.0	16.78	68.04	1.05
	2041	221.36	333.8	768.2	62,929.3	35.8	145.7	2.6
Increase in Percent (as compared to 2018 baseline)	2031	70%	57%	80%	69%	88%	86%	42%
	2041	83%	76%	93%	91%	92%	92%	88%

425. With a total length of 151 kilometers, the project is currently generating 160 tons/year of HC, 325 tons/year of CO, 445 tons/year of NOx, 19 tons/year of SO2, 78 tons/year of TSP, and 2.5 tons of Pb. With the project, these figures will increase to 272 tons/year of HC, 511 tons/year of CO, 802 tons/year of NOx, 35 tons/year of SO2, 147 tons/year of TSP, and 3.6 tons of Pb by 2031; and 381 tons/year of HC, 659 tons/year of CO, 1,213 tons/year of NOx, 54 tons/year of SO2, 224 tons/year of TSP, and 5 tons of Pb by 2041. This represents and average increase of 83% HC emissions, 76% CO emissions, 93% NOx emissions, 92% SO2 emissions, 92% TSP emissions, and 88% Pb emissions from 2018 to 2041.

426. However, these incremental emissions do not account for the fact that without project, emissions would also increase because of increased traffic on the existing roads which are in most sections of poor quality. The induced emissions were established based on traffic forecast on project roads for the with- and without project scenarios for the period from 2021 to 2041 (20 years) using HDM-4 Version 2. The induced emissions, i.e. those attributed to the project as compared with the without-project scenario, are much smaller and even become negative for some of the pollutants (**Table F-21**). These figures are indicative only, and should be interpreted with caution as these are generated based on several assumptions. However, it appears plausible that the project will not result in significant additional total emissions as compared to the no-project scenario.

Table F-22: Emissions induced by the Project

		HC	CO	NOx	CO2	SO2	Par	Pb
Without project								
Total (2021-2041)	tons	5,885.0	9,539.4	18,398.2	1,547,353	860.5	3,529.8	67.0
Average emissions	tons/year	294.2	477.0	919.9	77,367	43.0	176.5	3.4
With project								
Total (2021-2041)	tons	5,807.3	10,724.0	17,378.5	1,511,939	775.2	3,183.7	77.3
Average emissions	tons/year	290.4	536.2	868.9	75,597	38.8	159.2	3.9
Induced emissions (as compared to "without project" scenario)								
Total (2021-2041)	tons	-77.7	1,184.6	-1,019.7	-35,413	-85.3	-346.1	10.3
Emission increase (absolute)	tons/year	-3.9	59.2	-51.0	-1,770	-4.3	-17.3	0.5
Emission increase (%)	%	-1%	12%	-6%	-2%	-10%	-10%	15%

427. **Absolute CO_{2eq} emissions** for the baseline year (2018) were estimated based on actual traffic counts and amount to 41,323 tons per year (**Table F-21**). These absolute emissions are anticipated to increase to 69,678.5 tons per year (2031) and 104,252.7 tons per year (2041). These figures represent the sum of normal traffic (i.e. traffic that would use the project roads even if no improvements were made); diverted traffic (i.e. traffic that changes from an original route to the project road because of the road improvement); and generated traffic (i.e. traffic that occurs only because of the improvement to the roads, due to the reduction in perceived costs).

428. The sum of diverted plus generated traffic thus represents the relative or **net CO_{2eq} emissions**, i.e. the net increase in CO_{2eq} emissions generated by the project as compared to “business as usual” or “without project”. For the period 2021-2041 (20 years), the cumulative net CO2eq emissions are estimated at -35,400 tons (**Table F-22**), representing an average annual emission reduction of approximately 2,000 tons as compared with the no-project alternative.

429. **Air quality modelling** was done by the EIA institute in the framework of the domestic EIA for NH279 (where more sensitive receptors are located, including many villages and the Van Ban Nature Reserve), by applying the Sutton model, with average wind velocity for that area of 2m/s, and taking the height of the road surface compared to the ground as 0.5 m, gives a height z = 2m. The results of the forecast of project-induced air quality (i.e. assuming zero air pollution as baseline) is given in

430.

431. **Table F-23**.

Table F-23: Results of air pollution contributions from road in 2031 and 2041 (in ug/m3)

Year	Road		Distance		

		Pollut-ant	5m	15m	20m	25m	30m	QCVN 5:2013/ BTNMT	QCVN 6:2009/ BTNMT
2031	NH279	TSP	87.5	35.1	23.4	17.3	13.5	300	-
		CO	4,067.9	3,742.8	3006.8	2,137.2	1713.6	30,000	-
		HC	602.6	402.4	277.2	205.3	159.8	-	5,000
2041	NH279	TSP	135.3	54.2	36.2	26.8	20.8	300	-
		CO	6,291.9	5,789.2	4,650.7	3,305.6	2,650.5	30,000	-
		HC	932.0	622.4	428.8	317.5	247.1	-	5,000

** QCVN 05: 2013 / BTNMT National Technical Regulation on ambient air

432. The modelling results indicate that by 2031 the contribution of the project to air pollution at 30m from the road for NH279 will amount to 4% of the QCVN 5:2013/ BTNM standard value of 300ug/m^3 for TSP; 13% of the QCVN 5:2013/ BTNM standard value of 350ug/m^3 for CO; and 8% of the QCVN 5:2013/ BTNM standard value of 200ug/m^3 for HC. The increments for NH32 are of a similar order.

433. These contributions are below the threshold of 25% that applies to non-degraded airsheds; and similar the threshold of 10% that applies to ecologically sensitive locations, as required per IFC Guideline 1.1 (Air Emissions and Ambient Air Quality).

434. An independent air quality modelling exercise was conducted for CO2, NOx and TSP in the framework of this EIA. Air quality at various distances from the project road was calculated by modelling one bypass at Khan Yen for CO_2, Total Particulates (TSP) and NOx. The model used was CALINE4 which is the California Department of Transportation Line Source Dispersion Model used for road traffic analysis.

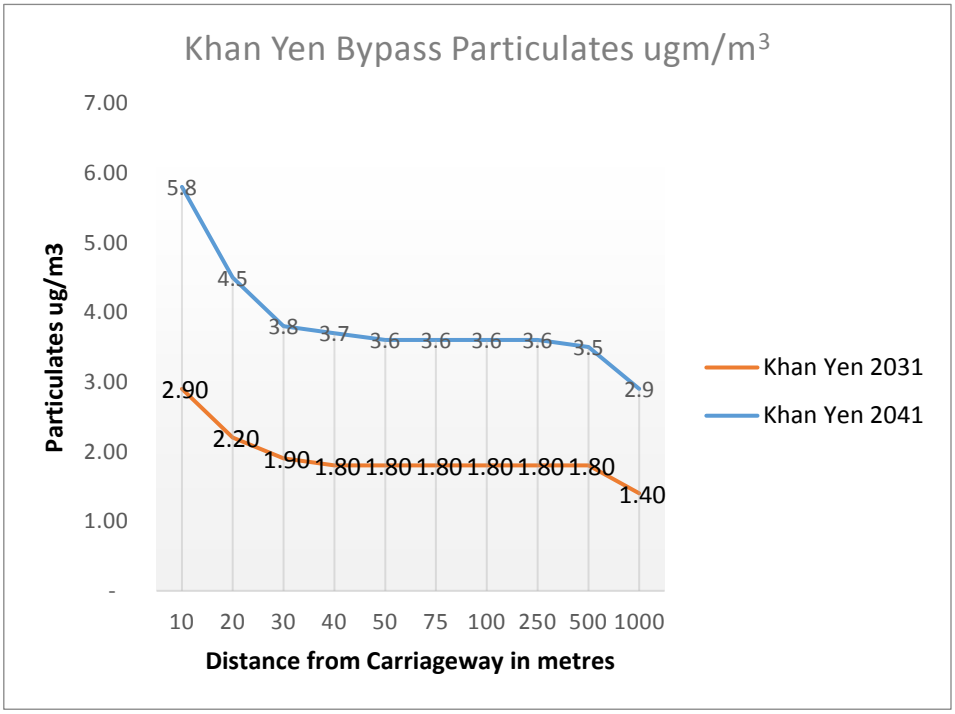


Figure F-2: Projected air quality at various distances from the road in 2031 and 2041-TSP

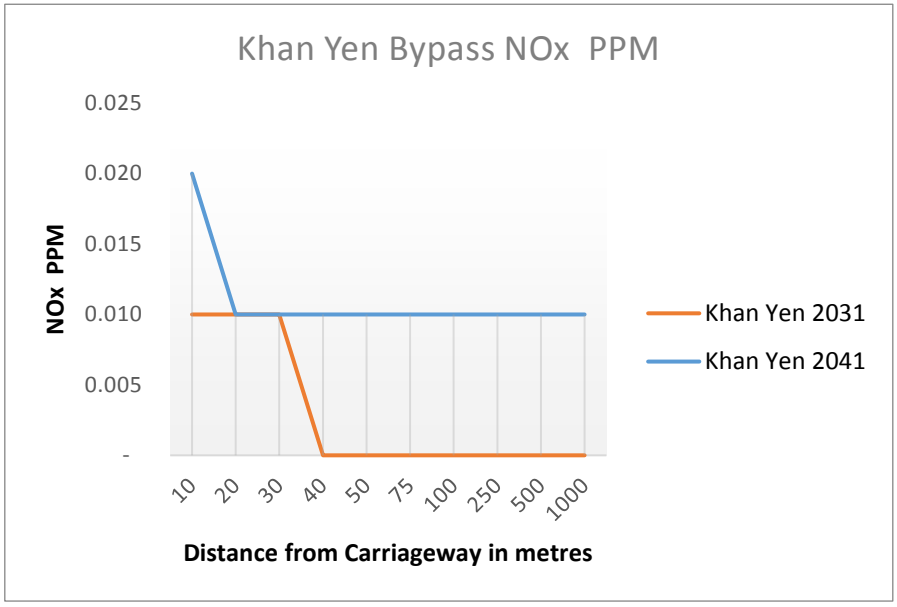


Figure F-3: Projected air quality at various distances from the road in 2031 and 2041-NOx

435. The results indicate that for all pollutants concentrations along the NH279 road (10m from the road), the pollutant levels comply with QCVN 5:2013/ BTNM. Thus, at the operational stage of the project, increased vehicle traffic is not anticipated to degrade air quality in the project area. It is concluded that the project will not have any significant effect on air quality sensitive receptors such as residents and ecologically sensitive sites. More importantly, the project is expected to significantly reduce dust emissions along project roads. Current dust levels are very high during dry period especially along NH279 and PR175 where most sections of the road are in very poor conditions or are earth tracks. **-> Minor, Localized, Reversible Impact.**

436. **Mitigation.** Strict access control for vehicles not complying with emission standards of Viet Nam (QCVN 05:2009/BGTVT) shall be enforced by the local traffic police. Project roads shall be regularly maintained to avoid accumulation of fine particles that could result in high dust levels. Regular air quality monitoring will be conducted by provincial Departments of Natural Resources and Environment (DONRE) during the operation period of the roads.

F.8.2. Traffic Noise

437. Traffic will generate noise. Noise levels depend upon four main sources: (i) vehicles, (ii) friction between vehicles and the road surface, (iii) driver behavior, and (iv) construction and maintenance activities. In general, the loudness of traffic noise is increased by heavier traffic volume, higher speeds, and greater numbers of trucks. Vehicle noise is a combination of the noise produced by the engine, exhaust, and tires. The loudness of traffic noise can also be increased by defective mufflers or other faulty equipment on vehicles.

438. Per IFC Environmental Health and Safety Guidelines – General EHS Guidelines (Environmental Noise Management), noise impacts of a project should not exceed levels as defined in the Guidelines for Community Noise, World Health Organization (WHO, 1999), or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

439. The dB scale of noise measurement is a logarithmic one. In general terms, all other factors remaining the same, it would take a 22% increase in traffic volume to cause a 1 dB (A) increase in noise levels, a 58% increase in traffic to cause a 2 dB(A) increase and a 100% increase in traffic to cause a 3 dB(A) increase. Typical noise levels for passenger vehicles are 72 to 74 dB(A) at 88 km per hour at 15 meters; typical noise levels for medium trucks are 80 to 82

dB(A) at 88 km per hour (55 miles per hour) at 15 meters (50 feet); and typical noise levels for heavy trucks are 84 to 86 dB(A) at 88 km per hour (55 miles per hour) at 15 meters (50 feet).

440. The Nordic traffic noise forecasting method as modified by the Transport and Traffic Institute was used in the domestic EIA to project the increase in noise along project roads for the period 2031 and 2041. An average speed in residential areas of 50km/h was assumed, and 60km/h outside of residential areas. Forecasts of traffic noise on both sides of NH32 and NH279 after expansion are shown in the table below.

Table F-24: Traffic Noise forecast for 2031 and 2041

Road		Year	Noise level (dBA)					
			7.5m	10m	15m	20m	25m	30m
NH32	Outside residential area	2031	70.4	66.3	65.1	63.8	62.3	61.5
	In residential area		67.7	63.6	62.2	60.7	59.5	58.7
NH279	Outside residential area		66.8	64.1	63.2	61.8	59.1	57.8
	In residential area		65.2	63.1	62.3	59.5	57.8	56.5
NH32	Outside residential area	2041	71.5	68.1	66.7	65.2	64.4	62.6
	In residential area		69.1	65.4	64.5	61.9	60.1	59.8
NH279	Outside residential area		67.4	65.2	64.1	62.7	61.5	59.7
	In residential area		66.3	64.5	63.4	61.8	60.2	58.8
QCVN 26:2010/BTNMT	*Daytime Standard*		*70*					
	Night Standard		*55*					
IFC Standard	*Daytime (Residential Areas)*		*55*					
	Night time (Residential Areas)		*45*					

Source: Domestic EIA, February 2018

441. The above projections indicate that noise levels along the project roads in 2031 and 2041 will comply with the Viet Nam daytime standard of 70dB Leq[13] at 10-20m from the centre line, but will exceed the WHO daytime guideline value for residential areas of 55dB at a distance of 30 m or less from the road centerline. Beyond 20m the noise level is not projected to exceed the permissible Viet Nam limit (70dBA) during daytime so the impact on the communities on both sides of the road will be not be significant. However, the forecast results also show that most households living along the project roads will be affected by noise within 30 meters of the road during the night. The noise level at 100m is projected to be 55dB(A), which meets the Vietnamese night time standard and the IFC daytime standard of 55dB(A) but exceeds the IFC guideline value of 45dB(A) at night.

442. To assess if the second condition of the IFC Guideline is met (i.e. project results in a maximum increase in background levels of 3 dB at the nearest receptor location off-site), noise levels for 2031 and 2041 were projected at the sites where baseline monitoring was conducted.

443. Noise projections have been made using the US Federal Highway Authority model 2.0. Model assumptions are presented in Appendix E. Existing ambient levels have been taken from measurements made by the local consultants during the baseline study.

444. The desired noise standard is not to exceed the existing ambient Leq noise level by more than 3dB(A). In one location ON4, which has a low baseline, the noise levels may be increased by

[13] The descriptor used is Leq or continuous sound level. This is measured over a stipulated time period and is the logarithmic average of all noise measured over this time period. In accordance with the Vietnamese standard of 0600 hours to 2100 hours which equates to “daytime”. 2100 hours to 0600 is deemed to be “nighttime”.

3dBs at distances less than 50metres from the road centerline. All other predicted levels for 2031 or 2041 are equal to or less than the existing ambient at distances beyond 20 metres from the road centerline. Therefore, at distances more than 20 metres from the road centerline (or 12.5 metres from the carriageway edge) the ambient will not be increased by more than 3dBs (see Table F-21).

Table F-25: Comparison of projected noise levels with Ambient

Sampling point	Baseline Leq (6h - 21h)	Distance (m) at which 2031 level equals ambient	Distance (m) at which 2041 level equals ambient
ON01	65.7	15	20
ON02	66.5	12.5	17.5
ON03	66.9	12.5	17.5
ON04	61.4	30	50
ON05	66.2	15	20
ON06	65.8	15	20
ON07	67.0	12.5	15
ON08	66.2	15	20
ON09	67.1	12.5	15
ON10	66.1	15	20
ON11	66.5	12.5	17.5
ON12	65.7	10	12.5
ON13	65.9	7.5	10
ON14	67.6	7.5	10
ON15	67.1	7.5	10

445. As noted in one location ON4, which has a low measured baseline, the noise levels may be increased by 3dBs at distances less than 50metres from the road centerline. **-> Moderate, Long-Term Impact.**

446. **Mitigation.** This EIA recommends that a more detailed analysis of the project's impact on noise sensitive receptors be conducted at detailed design stage, and that the need fo noise management measures be included in the Detailed Design, and the BOQ of bidding documents. A more detailed noise projection model shall be established once the exact road alignment is defined. The model shall account for exact road alignment, traffic forecast and other road parameters, as well as a full inventory of all sensitive receptors along the project roads. The model shall be used to assess adequacy and effectiveness of various noise mitigation measures considered to ensure compliance with the IFC noise guideline values of 55dB/45dB (daytime/nighttime).

447. In theory, there are many options that can be used to reduce or mitigate traffic noise. These include traffic management (including speed control), road design, smoother pavement surface, and noise barriers including walls or earthen berms. Road design should avoid steep grades and sharp corners to reduce noise resulting from acceleration, braking, gear changes, and the use of engine brakes by heavy trucks at critical locations. Generally, smooth, well-maintained surfaces such as freshly laid asphalt without grooves and cracks will keep noise to a minimum.

448. Speed limit signs and signs to prohibit the use of horns shal be set at entrance into villages and the Van Ban Nature Reserve. Construction of noise barriers between the roads and the affected receivers can reduce noise levels, however, these walls would also impede access to the roads and impact on local businesses. The construction of walls along mountainous roads is not a common practice, especially in Viet Nam.

F.8.3. Road Maintenance

449. During the operational phase of the Project, the Provincial Departments of Transport (PDOT) will maintain the roads. Throughout operation of bridges and roads the Road Administration Agency under the PDOT shall carry out repairs and maintenance. These maintenance activities will create certain impacts on the surrounding environment, including dust, emissions and solid waste. Repair and maintenance activities may also include the removal of existing pavement and rebuilding of the pavement surface which will result in the generation of large quantities of pavement dust. Normally. this type of dust is large particle size so the level of dispersion is not high. The repair activities will involve the use of mechanical excavators, dump trucks, graders, road rollers, and generators. These operations will generate noise and impact on the surrounding area. The noise level recorded at the distance of 15 m will likely be between 75-80dB(A). **-> Minor, Short-Term, Reversible Impact.**

450. **Mitigation.** The Road Administration Agency shall carefully plan and implement road maintenance and repair works. The following measures shall be considered:

a. Use exclusively machinery and equipment with "Technical safety and environmental protection" certificate.

b. Implement watering to reduce dust during repair, maintenance works to reduce dust spread to the surrounding environment.

c. Contractors doing repair and maintenance of bridge and road works must collect and manage construction solid waste in order to avoid overflowing to the existing road sections.

d. Solid wastes generated during temporary storage on both sides of the road should be covered to avoid spreading dust during hot dry days or erosion during rainy days.

e. During and after completion of repair and maintenance of bridges and roads, construction contractors must collect and transport wastes to dispose of them at construction licensed dumps.

f. Locate noise generating equipment at a location with appropriate distance so that the noise travelling to residential areas and office buildings is less than 70dBA and to schools or clinics is no greater than 55dBA.

g. All equipment and machinery on site shall be periodically inspected for noise levels and the necessary repairs and adjustments shall be made to ensure safety and shall not cause noise to exceed prescribed standards.

h. The contractor shall restrict the operation of machinery and equipment at the same time to reduce the accumulated noise level. For example. during excavation and transport. the truck engine is switched off when the bulldozer is operated.

F.8.4. Fire Incidents

451. **Impact.** Forest fires can occur when contractors are doing maintenance work or during carriage of flammable materials on steep slopes. Road users may also cause forest fires at rest areas or when disposing burning materials such as cigarettes **-> Significant Risk, with Potentially Significant Impacts.**

452. **Mitigation.** The priority is to prevent negligence of road users that may cause a fire. The following measures will apply:

a. Signs shall be placed along fire-prone sections of the project roads to alert drivers of the risk of wild fires.

b. Regulations on storage of flammable materials: Petroleum products used for repair works shall be stored in separate isolators, away from sources capable of igniting, which shall be equipped with temperature monitoring equipment, fire alarm equipment.

c. Arranging fire prevention means in construction/repair works

d. Placing fire extinguishers, fire-fighting tanks and oxygen cylinders regularly at construction sites and at petrol and oil depots.

e. Fire-fighting equipment and facilities shall be inspected and regularly maintained.

f. The maintenance contractor shall develop a plan to prevent and respond to fire.

F.8.5. Traffic Safety

453. The rehabilitation and widening of the project roads is likely increase the vehicle speed on the roads, which may increase the risk of traffic accidents. However, traffic safety in general is expected to significantly improve due to improved road conditions and clear signage. Routine safety measures, including signage and road markings will be provided to reduce traffic risks, especially in accident-prone areas Pedestrian crossings will be provided in each village serviced by the project roads. A road safety audit will be conducted before the roads are open to traffic. The economic analysis conducted for the project anticipates a 10% reduction in traffic accidents. **-> Positive Impact.**

F.9. Cumulative Environmental Impact Assessment

454. Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to in this document as “developments”) when added to other existing, planned, and/or reasonably anticipated future ones.

455. In order to obtain information on known and potential future projects which may have a cumulative interaction with the proposed project roads, research (via internet) and consultation with government bodies in Viet Nam was undertaken. Responses were received from the provincial Departments of Planning and Investment (DPI) of Lao Cai, Lai Chau and Yen Bai. The Prioritized Capital Project Lists in period of 2015 to 2020, approved by the provincial PPCs are the main source of information for the assessment of potential cumulative impacts.[14]

456. The Prioritized Capital Project List of **Lao Cai Province** includes 18 priority investments for the period 2015-2020 in the fields of Agriculture – Forestry; Industry – Construction; Trading – Tourism – Services; 04 of these priority investments are large investments (i.e. more than $100 million). 05 projects are estimated to cost $15-44 million, while the remaining 9 projects are small-scale investments (i.e. smaller than $15 million). See **Table F-26** and **Figure F-4**.

Table F-26: Planned developments in the area of influence of NH279

[14] Including (i) The "Prioritized Capital Project List of Lao Cai Province in period of 2015 to 2020", approved per Decision No 2381/QD-UBND dated 30/07/2015; Decision No 3670/QD-UBND dated 18/08/2017 and Decision No 5557/QD-UBND dated 12/12/2017 of Lao Cai PPC; (ii) The "Prioritized Capital Project List of Lai Chau Province in period of 2016 to 2020", approved per Decision No 1189/QD-UBND dated 14/09/2016 of Lai Chau PPC; and (iii) The Prioritized Capital Project List of Yen Bai Province, 2012-2020”, approved per Decision Decision No 1154/QD-TTg.

	Project name - filed	Location	scope of work	Description	Estimated investment (Million USD)	Investment type
1	Agriculture applied high technology Project	Sa Pa District	450 ha	Establishment of agricultural farm using Japanese technology 15 km far from Sa Pa Town	35	PPP, Private Investment (PI), JV
2	Lao Cai Air port	Cam Con commune, Bao Yen District	526 ha	Capacity of 560.000 passenger per year and 660 tons of wood per year Closed to Ha Noi – Lao Cai Highway	231	JV, BOT, FDI, BCC, PI
3	Power Plan applied new technology (Aqua - Power)	Bao Thang District, Lao Cai City	Capacity of 280MW	Construction of a new power plan with the capacity of 280 MW Closed to Ha Noi – Lao Cai Highway	220	FDI, PI
4	Investment Project on Steel Manufacturing Plant applied high technology	Tang Loong Industrial Zone, Bao Thang District	Capacity of 800.000 tons per year	Construction of plant and other auxiliary facilities Closed to Ha Noi – Lao Cai Highway	152	FDI, PI
5	Investment Project on electronic wire and cable Manufacturing Plant applied high technology	Tang Loong Industrial Zone, Bao Thang District	Capacity of 200.000 tons per year	Construction of plant and other auxiliary facilities Closed to Ha Noi – Lao Cai Highway	140	FDI, PI
6	Investment Project on Lao Cai Golf Course	Bat Xat and Bao Thang Districts	Two courses with 18 holes	Construction of two golf courses with 18 holes	44	JV, FDI, PI
7	Construction of storing system to preserve agro-forestry-fishery products	Kim Thanh – Lao Cai Trading zone	18.7 ha	Construction of a storing system with the capacity of 90.000 tons Closed to Ha Noi – Lao Cai Highway	15	BCC, FDI, PI
8	Treatment and Processing waste GYPS to artificial gypsum	Tang Loong Industrial Zone, Bao Thang District	15 ha	Construction of a plant and other auxiliary facilities Closed to Ha Noi – Lao Cai Highway	18	DDI, PPP

9	Luxury resort complex	Lao Cai Commune, Sa Pa District	20 ha	Construction of 4-5 starts hotels, villages and shopping house 20 km far from Sa Pa Town	26	JV, DDI

Source: Decision No 2381/QD-UBND dated 30/07/2015; Decision No 3670/QD-UBND dated 18/08/2017 and Decision No 5557/QD-UBND dated 12/12/2017 of Lao Cai PPC

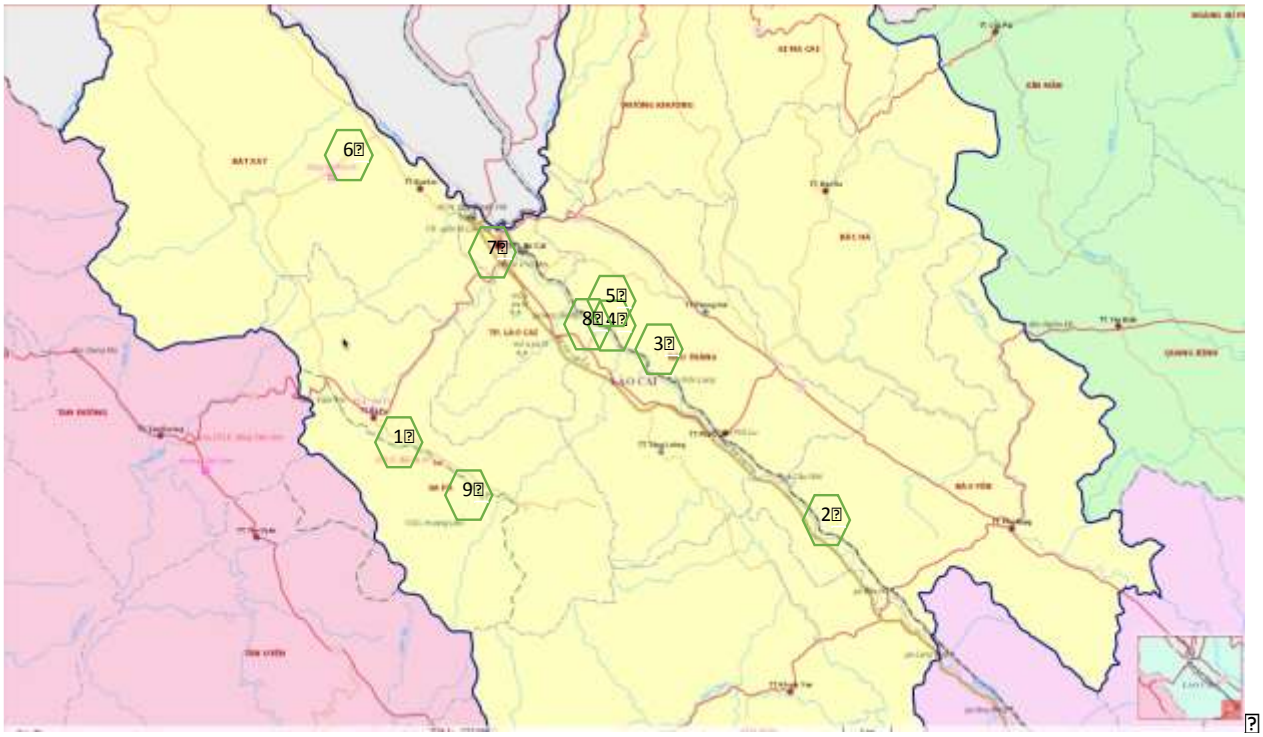


Figure F-4: Location of proposed/planned large developments in the project's area of wider influence, Lao Cai Province

457. The Prioritized Capital Project List of **Lai Chau Province** includes 38 priority investments for the period 2016-2020 in the fields of Agriculture – Forestry - Aquaculture, Industry – Construction, Social Culture – Science – Education; Trading – Tourism – Services. Only 01 of these priority investments is a large investment (i.e. more than $50 million). 04 projects are estimated to cost $15-33 million, while the remaining 33 projects are small-scale investments (i.e. smaller than $15 million). See **Table F-27** and **Figure F-5**.

Table F-27: Planned developments in the area of influence of NH32

	Project name - filed	**Location**	**scope of work**	**Description**	**Estimated investment (Million USD)**	**Investment type**
1	Development of Integrated Agro-Forestry-Fishery Farm Model	Entire Province	50-500 ha	Constructing integrated farms on the area of entire province	22	BCC, JV, FDI

2	Infrastructure Investment Project for Phuc Than Industrial zone	Phuc Than Commune, Than Uyen District	100 ha	Construction of Basic Infrastructure, i.e. internal road, drainage, water supply. Close to NH32 (Yen Bai to Lai Chau) and NH279 (Lai Chau – Lao Cai)	33	BCC, JV, FDI
3	Construction of Phuc Than Urban Area	Phuc Than Commune, Than Uyen District	50 ha	Construction of the Infrastructure, houses Close to NH32 (Yen Bai to Lai Chau) and NH279 (Lai Chau – Lao Cai)	55	BCC, JV, FDI
4	Construction of the infrastructure for Pusamcap spiritual tourist area	Lai Chau City	790 ha	Construction of access roads, drainage…. Close to NH4D – Lai Chau to Lao Cai	22	BCC, JV, FDI, BOT, PPP
5	Construction of Sin Ho highland tourist area	Sin Ho District	500 ha	Construction of the infrastructure, guest houses, auxiliary facilities i.e. restaurant, shops	22	BCC, JV, FDI, BOT,

Source: Prioritized Capital Project List of Lai Chau Province 2016-2020.

Figure F-5: Location of proposed/planned large developments in the project's area of wider influence (Lai Chau Province)

458. The Prioritized Capital Project List of **Yen Bai Province** includes 34 priority investments for the period 2012-2020 in the fields of Transportation; Agriculture and Tourism; 03 of these priority investments are big investments (i.e. more than $50 million). 08 projects are estimated to cost $18-42 million, while the remaining 23 projects are small-scale investments (i.e. smaller than $15 million). See **Table F-28** and **Figure F-6**.

Table F-28: Planned developments in the area of influence of PR175

	Project name	Location	scope of work	Description	Estimated investment (Million USD)	Investment type
1	Upgrading NH32 (Nghia Lo – Mau A section)	Nghia Lo Town, An Luong, Mau A Communes of Van Yen District	14 km	Upgrading NH32 (Nghia Lo – Vach Kim section) linking to Noi Bai-Lao Cao Expressway going through Nghia Lo, An Luong and Mau A) 1km to Noi Bai-Lao Cai expressway	52	MoT
2	Upgrading NH32C (Hien Luong – Yen Bai City Section)	Ha Hoa, District, Phu Tho Province and Yen Bai City, Yen Bai Province	17 km	Upgrading NH32C (Hien Luong – Yen Bai City Section) from Km79 - Km96+500 connecting Phu Tho Province to Yen Bai Province	33	MoT
3	Upgrading NH37 (Yen Bai city-Ba Khe section)	Yen Bai City, Van Chan District	60 km	Upgrading NH37 (Yen Bai city-Ba Khe section) connecting Van Chan District to Yen Bai City	42	MoT
4	Building a road connecting NH32C to Noi Bai Lao Cai Expressway	Yen Bai City	11.30	Building a road connecting NH32C to Noi Bai Lao Cai Expressway	35	Government Investment (GI)
5	Building Tuan Quan bridge over the Red river	Yen Bai City	4 km	Building Tuan Quan bridge connecting Thanh Hung commune to Bao Luong Bridge	30	Government Investment (GI)
6	Building Yen Bai-Thai Nguyen railway	Thai Nguyen and Yen Bai Provinces	N/a	Building Yen Bai-Thai Nguyen railway	N/a	MoT
7	Mu Cang Chai habitat and species conservation zone; Na Hau-Van Yen nature conservation zone	Mu Cang Chai District	N/a	Mu Cang Chai habitat and species conservation zone; Na Hau-Van Yen nature conservation zone	N/a	JV, BCC, FDI, PI
8	Building Yen Bai City Bypass road connecting to NH37	Yen Binh, Tran Yen District and Yen Bai City	17.5 km	Building Yen Bai City Bypass road connecting to NH37	50	MoT
9	Building a road connecting PR170 to NH70 and Noi Bai-Lao Cai Expressway	Luc Yen, Yen Binh, Van Yen Districts	28.5 km	Building a road connecting PR170 to NH70 and Noi Bai Lao Cai Expressway	30	ODA, Government Investment (GI)

10	Building a road connecting NH70 to Noi Bai-Lao Cai Expressway	Luc Yen, Van Yen Districts	27 Km	Building a road connecting NH70 to Noi Bai-Lao Cai Expressway	23	ODA, Government Investment (GI)
11	Building Bach Lam bridge over the Red river	Yen Bai City	1.46 km	Building Bach Lam bridge	18	Government Investment (GI)

Source: Decision No 1154/QD-TTg of the President of Viet Nam

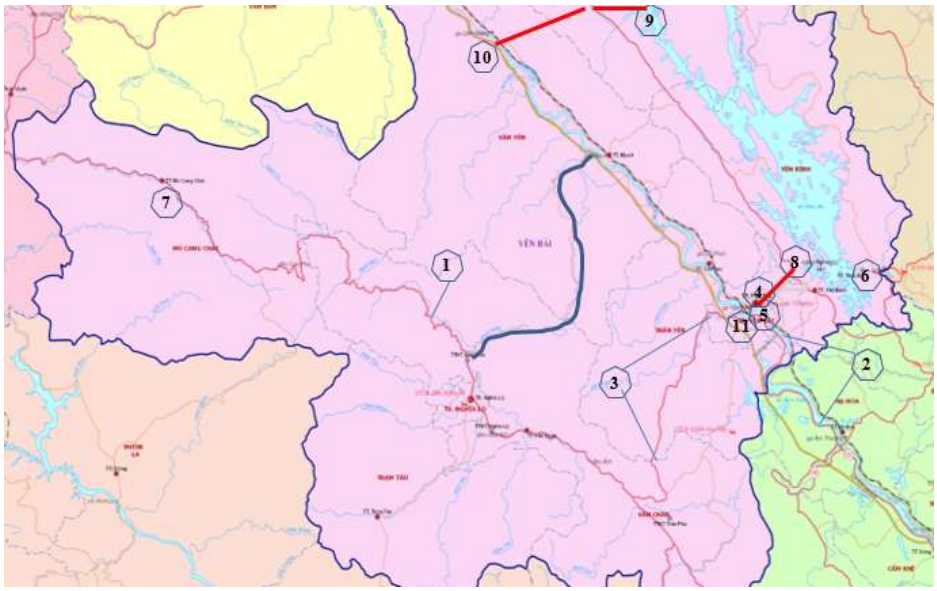


Figure F-6: Location of proposed/planned large developments in the project's wider area of wider influence (Yen Bai Province)

459. Information on the precise timescales and location of the proposed developments has been requested from the relevant authorities, but was not yet available at the time this EIA was prepared (February 2018). In addition to the development proposals identified above, there are likely to be several other (yet undefined) projects that may be undertaken in the proposed project area.

460. Owing to the lack of information on location, extent and timeframe of these developments, it is not currently possible to assess precise cumulative impacts that may occur. In general, the cumulative impacts of future projects with the proposed improvements to NH32, NH279 and PR175 are anticipated to be localized in nature. Most known planned projects in the provinces are small scale and are generally unlikely to have a cumulative effect on any resources and receptors when their influence is considered in combination with the proposed project. Should the larger scale development projects take place in proximity of and concurrent to works on the proposed road rehabilitation works, possible cumulative impacts may include:

461. **Use of natural resources:** road developments and basic infrastructure development in industrial parks, as well as tourism infrastructure, are likely to require large amounts of aggregates during construction. There may be significant cumulative impacts from transportation of aggregates from the quarries to the construction sites, and from the operation of concrete batching plants.

462. **Water resources:** There is the potential for pollution of surface water resources during construction in the same way as for the proposed project. The cumulative impact is considered to be potentially negative; however, like road construction, large volumes of fuel, oil or chemicals are unlikely to be used during construction of these large infrastructure projects.

463. **Ecology:** Cumulative impacts from the road infrastructure and industrial park development

projects may include permanent removal of habitat. This is considered of lower significance, as these projects are mostly upgrades or brownfield developments and will be in general an extension to the existing footprints rather than completely new ones in areas of undisturbed habitat.

464. **Air quality:** At locations where construction of the proposed project passes near dwellings, construction dust may cause a temporary nuisance to residents. Should the proposed construction of NH32 in Yen Bai Province be carried out at the same time as PR175, there could be some additional dust in the atmosphere or the duration of increased dust concentrations could be longer in Nghia Lo. However, the long-term benefits of these projects in terms of increased access, improved road safety, reduced dust emissions are considered likely to outweigh short-term construction impacts and will support overall economic development of the region.

465. **Noise and vibration:** At locations where construction of the proposed roads passes near dwellings, noise may cause a temporary disturbance to residents as well as vibration may cause damage to the most vulnerable properties. Should the construction of NH32 in Nghia Lo coincide with the road construction activities, there is a potential of cumulative noise and vibration impacts. Again, the long-term benefits of these projects are considered likely to outweigh short-term construction impacts.

466. **Community health and safety:** Should the planned construction of the NH32 and PR175 take place at the same time as the construction of the proposed Pusamcap spiritual tourist area (Lai Chau Province) or NH32 (Yen Bai Province), it would have the effect of lengthening the period for which affected people are exposed to noise, dust and vibration disturbance and the risk of road traffic accidents.

467. **Traffic:** The proposed project will involve many vehicle movements on public roads that are also used by other developments and construction projects, as well as the public. This could have a cumulative impact in terms of temporary congestion or an increased risk of accidents, and is considered to be a potentially negative. There may be significant cumulative impacts from general construction traffic movements, including transportation of aggregates from the quarries to concrete batch plants and construction sites.

468. **Unplanned events:** New developments will not be permitted within the ROW of the project roads, and any development with potential significant environmental impacts will be subject to environmental impact assessment in accordance with the Viet Nam Law on Environmental Protection (2014). Keeping third-party developments at safe distance from the project roads means that third-party incidents are unlikely to escalate to include the project roads or vice versa.

469. **Potential In-Combination Impacts**: Potentially significant in-combination impacts (i.e. cumulative impacts caused by various project activities occurring at the same location and time) are considered to be mainly restricted to the construction phase. The assessment has identified the properties/communities near the ROW of the proposed project roads that will potentially experience a combination of temporary effects associated with increased noise, vibration, localized dust generation, visual intrusion and potentially temporary degradation in air quality due to the number and proximity of vehicle movements while construction is being undertaken in that area. There is also expected to be an increased number of vehicle movements on local roads during the construction phase of the Project.

470. In common with the rest of the proposed project, landowners and tenants of affected landholdings may be subject to a combination of localized disruption to their current agricultural regimes and construction effects of the type described above. Given the temporary nature of construction works and the fact that works along the ROW are scheduled to progress in a linear manner, any such effects are anticipated to be short term, the significance of which are expected to vary depending on the timing, extent and nature of operations undertaken and the effectiveness of the mitigation employed.

471. **Cumulative Greenhouse Gas emissions from road construction**: The construction and

improvements of the roads will generate significant amounts of Greenhouse Gas (GHG) emissions through (i) the extraction/production of construction materials, (ii) their transport and (iii) the consumption of engines used for their laying. GHG emissions for the project were estimated based on the Transport Emissions Evaluation Model for Projects (TEEMP) tool developed by CleanAir Asia[15], and average values for highways and provincial roads recommended by ADB[16] and the World Bank.[17] Based on these references, total GHG gas emissions are projected to be in the lower range of 207-794 tons of CO_{2eq} per kilometer of road construction. With a total length of 151 km, the construction/upgrade of the proposed roads is expected to generate 40,800 to 156,000 tons of CO2eq during the entire construction period, or some 13,600 to 52,200 tons of CO2eq per year (assuming a construction period of 3 years).

472. Earthwork/material extraction and pavement are the biggest contributors to GHG emissions (50-70%). Material transport is also a significant GHG producer, with around 25% for highways. Culverts, structures and other auxiliary facilities contribute some 10-15% of the total GHG emissions.

473. **Greenhouse Gas emissions from road operation** were estimated in Section F.8.1.

474. **Absolute CO_{2eq} emissions** for the baseline year (2018) were estimated based on actual traffic counts and amount to 41,323 tons per year (**Table F-21**). These absolute emissions are anticipated to increase to 69,678.5 tons per year (2031) and 104,252.7 tons per year (2041). These figures represent the sum of normal traffic (i.e. traffic that would use the project roads even if no improvements were made); diverted traffic (i.e. traffic that changes from an original route to the project road because of the road improvement); and generated traffic (i.e. traffic that occurs only because of the improvement to the roads, due to the reduction in perceived costs).

475. The sum of diverted plus generated traffic thus represents the relative or **net CO_{2eq} emissions**, i.e. the net increase in CO_{2eq} emissions generated by the project as compared to "business as usual" or "without project". For the period 2021-2041 (20 years), the cumulative net CO2eq emissions are estimated at -35,400 tons (**Table F-22**), representing an average annual emission reduction of approximately 2,000 tons as compared with the no-project alternative.

[15] http://cleanairasia.org/transport-emissions-evaluation-model-for-projects-teemp/

[16] http://www.adb.org/documents/reports/estimating-carbon-footprints-road-projects/default.asp.

[17] The World Bank. 2010. Greenhouse Gas Emissions Mitigation in Road Construction and Rehabilitation. A Toolkit for Developing Countries.

G. ENVIRONMENTAL MANAGEMENT PLAN

G.1. Introduction

476. This Environmental Management Plan (EMP) is developed for the Northern Mountain Road Connectivity Project (the project). It identifies the potential project environmental impacts and defines mitigation measures and monitoring requirements for the pre-construction, construction, and operational stages of the project. It also defines the institutional arrangements and mechanisms, the roles and responsibilities of different institutions, procedures and budgets for implementation of the EMP. The EMP seeks to ensure environmental protection activities during preconstruction, construction, and operation continuously improve to prevent, reduce, or mitigate adverse environmental impacts and risks. The EMP draws on the findings of this EIA, the Project Preparation Technical Assistance (PPTA) reports and the domestic EIA prepared for the project, and discussions and agreements with relevant government agencies and the Asian Development Bank (ADB).

477. This EMP is based on proposed preliminary engineering design as of March 2018. Detailed engineering design is yet to be initiated. The EIA and EMP will updated once detailed design is complete, and will be disclosed on the ADB public website (www.adb.org). The EMP will also be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to include EMP implementation costs in their bids for project works.

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

479. The bidding documents for construction contracts will be based on standard ADB documents for international and national competitive bidding, and will include contract clauses requiring the contractor to implement the relevant clauses of the EMP. Contractor Environmental Specifications have been drafted (see Appendix C). These standard Contractor Specifications will be included in the Bidding Documents for works contracts.

G.2. Objectives

480. The objectives of the environmental management plan are to address environmental protection issues that arise before, during and after the project, including the following:

- Develop a management plan for the implementation of environmental mitigation measures throughout the project as approved by the PMU2.
- Describe the role and responsibilities of relevant organizations in environmental and social management.
- During detailed design, identify any changes to the project concept which may have environmental consequences and update the EIA.
- As part of detailed design, carry out comprehensive audits of loss of assets and forestry resources based on the confirmed project scope and land acquisition requirements and assets pertaining to those lands.
- Ensure that all compensation entitlements are settled before commencement of construction activities.

- Ensure that all necessary environmental approvals have been obtained.
- Provide regular measurement of environmental quality during project implementation, to detect negative impacts on the environment and to propose measures to prevent and reduce environmental pollution according to the current regulations and regulations in Viet Nam.
- Provide a rapid response mechanism for environmental problems and incidents, and manage emergency resolution of environmental incidents
- Ensure that the project reaches an acceptable conclusion with no significant residual adverse environmental effects.

G.3. Institutional arrangements and responsibilities for EMP implementation

481. The **Ministry of Transport** is the Executing Agency (EA). MOT will be responsible for the overall implementation and compliance with loan assurances, the EIA and the EMP (including Environmental Monitoring Plan).

482. The EA has established a **Project Management Unit (PMU2).** The PMU2 will be responsible, on behalf of the EA, for the day-to-day management of the project. The PMU2 will coordinate procurement and consultant recruitment. It will engage the construction supervision consultant (CSC) and contract an external monitoring consultant (EMC) to conduct independent verification of EMP implementation and environmental impact monitoring results during the construction and operational stages of the project.

483. The PMU2 will have the overall responsibility to supervise the implementation of environment mitigation and monitoring measures, ensure the contractors' compliance with environmental management requirements, and coordinate the Grievance Redress Mechanism (GRM) and report to ADB. The PMU2 will assign an environmental specialist on its staff to coordinate and manage EMP implementation. Furthermore, the PMU2 will be responsible for construction supervision and quality control. To ensure that the contractors comply with the EMP provisions, the PMU2 with the help and technical support of the CSC, will prepare specification clauses for incorporation into the bidding procedures: (i) a list of environmental management and monitoring requirements to be budgeted by the bidders in their proposals; (ii) environmental clauses for contractual terms and conditions; and (iii) the full EMP.

484. The **PMU2 environmental specialist** will (i) review CEMPs submitted by the contractors; (ii) supervise contractors and their compliance with the EMP and their CEMPs; (iii) conduct regular site inspections; (iv) act as local entry point for the project GRM; (iv) coordinate implementation of the capacity building and training program related to environment; (v) prepare inputs to the quarterly project progress reports and (vi) coordinate the preparation of the semi-annual environment monitoring reports and submit them to ADB.

485. **Construction contractors** will be responsible for implementing the mitigation measures during construction under the supervision of the PMU2 and the CSC. In their bids, contractors will be required to respond to the environmental management and monitoring requirements defined in the EMP. Each contractor will be required to develop site specific construction EMPs (CEMPs) and will assign one person responsible for EMP implementation supervision and monitoring, and one qualified person responsible for construction and occupational health and safety. Contractors will conduct noise, air and surface water quality monitoring at construction site boundaries and nearby sensitive receptors to confirm compliance with relevant Vietnamese ambient quality standards as well as the IFC (2007) standard for noise and air quality. Each works contractor will submit monthly progress reports to the CSC. These reports will include reporting on EMP implementation performance.

486. **Detailed Design Consultant (DD Consultant).** The PMU2 will hire a DD consultant to

prepare the detailed design of the project. The DD consultant will be required to ensure that the following is reflected in DD: (i) minimize encroachment on forest land, and establish exact scope of impact on different forest zones (production, protection and special-use forest); (ii) assess whether noise intrusion is likely to affect residential property or noise sensitive dwelling such as hospitals during operation. If levels are found to be intrusive when compared with Viet Nam legislation and IFC standards then remedial measures may have to be incorporated in the design. These can be road side barriers, grassed soils mounds between the roads and the sensitive receptors if space permits, or smoother pavements. These aspects are within the control of the DD consultant. Another alternative is to provide double glazing to windows in buildings but this does not protect open spaces; (iii) consider in more detail remedial measures for impacts from operational air pollution. Locations of intersections, laybys and crossing points which all slow down traffic can be considered and their location optimized; and (iv) ensure that project infrastructure is climate-proof. For that purpose, the findings and recommendations of the CRVA shall be used and integrated into project design whenever possible.

487. **Construction Supervision Consultant.** The PMU2 will hire a construction supervision consultant (CSC) to advise and support the PMU2 throughout project implementation, supervise construction works, and provide oversight of contractors' environmental management performance, amongst others. With regard to environment, the CSC will advise the PMU2 and contractors on all aspects of environmental management and monitoring for the project. The CSC will (i) assist in updating the EMP and environmental monitoring program, as needed; (ii) assist the PMU2 to ensure that the EMP provisions are included in the tender documents and civil works contracts; (iii) prior to implementation of civil works, review and clear the CEMPs prepared by contractors to ensure that these are consistent with the provisions of the EMP; (iii) supervise the implementation of the mitigation measures specified in the EMP and the CEMPs through regular site visits and review of monthly reports of the contractors; (iv) coordinate environmental monitoring in accordance with the monitoring plan;[18] (v) prepare semi-annual environment monitoring reports in English and Vietnamese and submit them to ADB, MOT, MONRE and provincial DONREs for review and disclosure; (vi) provide training to the PMU2 and contractors on ADB SPS 2009, the IFC Environmental, Health and Safety (EHS) Guideline, EMP implementation, and GRM in accordance with the training plan defined in the EMP (Table G-9); (vii) identify any environment-related implementation issues, and propose necessary corrective actions; (viii) if required, update the EIA and EMP reports for changes in the project during project implementation (for example if there is a minor or major scope change) that would result in adverse environmental impacts not within the scope of the approved EIA/EMP; (ix) assist the PMU2 to establish a Grievance Redress Mechanism (GRM), and provide training for the PMU2, contractors and other GRM access points; (x) provide support to the PMU2 in organizing public meetings in the project affected areas prior to mid-term mission to present and discuss EMP implementation progress, solicit community opinions and concerns, and agree on required corrective actions; and (xi) prior to project completion report, organize surveys to assess community satisfaction with project implementation, project outputs, and EMP implementation performance, and draft the project completion report (PCR).

488. **External Monitoring Consultant (EMC).** As required by ADB's Safeguard Policy Statement (2009) for environment Category A projects, the environment performance of the project will be verified by an independent EMC, to be contracted by the PMU2. The EMC will review EMP implementation and monitoring activities and results of the contractors and the CSC, assess EMP implementation performance, visit the project sites and consult potentially affected people, discuss assessment with the PMU2 and the CSC; and suggest corrective actions. The EMC will prepare annual reports for submission to MOT and ADB. These reports will be disclosed to the public through the project website.

489. **Provincial Departments of Natural Resources and Environment (DONRE).** The provincial DONREs will have the following duties during project implementation: (i) monitor the

[18] The CSC may contract a licensed entity to conduct the environmental effect monitoring as defined in the EMP.

implementation of mitigation measures identified in the EIA report and approved by MONRE to minimize the project impacts in the construction and operation phases (compliance monitoring); (ii) investigating environmental incidents (pollution and damages to natural resources caused by the project); (iii) resolution of environmental issues generated by the project; and (iv) resolution of environment-related complaints in accordance with the GRM established for the project.

490. **Provincial Department of Agriculture and Rural Development (DARD).** DARD will review forest replanting compensation plan submitted by PMU2, calculate amount of monetary compensation to be paid to DARD by PMU2 for cutting of trees and taking of protected and/or special-use forest. DARD will supervise implementation of tree replanting compensation plan and report to Provincial People's Committee, PMU2 and ADB.

491. **Van Ban Nature Reserve Management Authority.** Prior to construction, the Authority will review DD to ascertain that necessary measures have been incorporated into project design; review relevant CEMP of work contractors to ascertain that necessary protection measures have been incorporated into the CEMP. During construction, the authority will support CSC in providing training and awareness raising to relevant works contractors on sensitivities of the Nature Reserve, prohibited activities; conduct regular site visit and interviews with relevant works contractors to assess their compliance with protection measures; and inform CSC and PMU2 of observed non-compliances and illegal practices by works contractors.

492. **Local communities.** According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and the PMU2. If unexpected problems occur, they will report to the CSC and PMU2.

493. Overall environmental responsibilities are outlined in **Table G-1**.

Table G-1: Roles and responsibilities of relevant parties in the environmental monitoring system

Agency/Unit	Responsibility		
	Tendering & Pre-construction	Construction	Operation (until PCR is issued)
Ministry of Transport (MOT)	The Executing Agency (EA) for the project responsible for overall implementation and compliance with loan assurances and the EMP. Supervisory and advisory function to PMU2.		
Project Management Unit (PMU2)	Established by the EA, responsible for the day-to-day management of the project. Has overall responsibility delegated by the EA for supervising construction works, the implementation of environment mitigation measures, coordinating the project level GRM and reporting to ADB. The PMU2 will coordinate procurement and consultant recruitment. It will engage the construction supervision consultant (CSC) and contract an external monitoring consultant (EMC) to conduct independent verification of EMP implementation and environmental impact monitoring results during the construction and operational stages of the project.		
	- Appoint one staff to coordinate EMP implementation; - Recruit the DD consultant, ensuring that EMP requirements pertaining to DD are incorporated in the DD; - Recruit the CSC, ensuring that adequate budget and human resources are allocated for EMP coordination; - Recruit an external monitoring consultant (EMC) to monitor EMP implementation and to verify monitoring information submitted by PMU2 to ADB; - Ensure that EIA and EMP are updated at detailed design stage, and submitted to ADB for review and disclosure; - Ensure that tender documents for works contracts include the Project EMP and specify requirement for preparation and implementation of construction EMP (CEMP) - Review the CEMPs with assistance from CSC; - Based on final project design, prepare and submit to provincial	- Supervise contractors and their compliance with the EMP and their CEMPs; - Conduct regular site inspections; - Establish an environmental grievance redress mechanism, acceptable to ADB, to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the Project's environmental performance; act as local entry point for the GRM; - Coordinate implementation of the capacity building and training program related to environment - Prepare inputs to the quarterly project progress reports. - Coordinate the preparation of the semi-annual environment monitoring reports and submit them to MOT, MONRE and ADB. - Implement changes or adjustments according to MONRE recommendation to protect the environment according to Viet Nam's standards, laws, and regulations. - Based on the results of EMP monitoring, identify environmental corrective actions and prepare corrective action plan(s), as maybe necessary, for submission to ADB.	- Implement the EMP in the first three year of operation (until PCR is issued); - Investigate and monitoring of environmental matters in the first three years of operation; - Coordinate the preparation of the semi-annual environment monitoring reports and submit them to MOT and ADB.

	authorities forest replanting compensation plans in accordance with national requirements.		
Detailed Design Consultant (DD Consultant)	- Minimize encroachment on forest land, and establish exact scope of impact on different forest zones (production, protection and special-use forest); - Conduct detailed noise modeling at sensitive receptors using internationally accepted methodology; assess whether noise intrusion is likely to affect residential property or noise sensitive dwellings during operation. Incorporate and cost remedial measures in the design; - Consider in more detail remedial measures for impacts from operational air pollution; - Ensure that project infrastructure is climate-proof. For that purpose, the findings and recommendations of the CRVA shall be used and integrated into project design whenever possible. - Update project EIA and EMP (Apr-18) to reflect final project design.	- N/A	- N/A
Construction Supervision Consultant (CSC)	- Engage environment specialists to undertake regular project monitoring and reporting based on EMP provisions; - Review and update the EMP and environmental monitoring program, as needed; - Assist the PMU2 to ensure that the EMP provisions are included in the	- Supervise the implementation of the mitigation measures specified in the EMP and the CEMPs through regular site visits and review of monthly reports of the contractors; - Coordinate environmental monitoring in accordance with the monitoring plan; - Incorporate in the environmental monitoring reports the results of environmental effects monitoring and undertake data analysis.	- Coordinate environmental monitoring in accordance with the monitoring plan; - Prepare semi-annual environment monitoring reports in English and Vietnamese and submit them to ADB and PMU2 for review and disclosure; - Prior to project completion report, organize surveys to assess community satisfaction with project implementation, project outputs, and EMP

	tender documents and civil works contracts; - Prior to implementation of civil works, review and clear the CEMPs prepared by contractors to ensure that these are consistent with the provisions of the EMP	- Prepare semi-annual environment monitoring reports in English and Vietnamese and submit them to ADB and PMU2 for review and disclosure; - Provide training to the PMU2 and contractors on ADB SPS 2009, the IFC Environmental, Health and Safety (EHS) Guideline, EMP implementation, and GRM in accordance with the training plan defined in the EMP - Identify any environment-related implementation issues, and propose necessary corrective actions; - Suspend any activity that triggers serious negative environmental impacts; suspending construction if contractors fail to observe requirements in the EMP or take mitigation measures recommended by the PMU2; - If required, update the EIA and EMP reports for changes in the project during project implementation that would result in adverse environmental impacts not within the scope of the approved EIA/EMP; - Assist PMU2 to establish a Grievance Redress Mechanism (GRM), and provide training for the PMU2, contractors and other GRM access points; - Provide support to the PMU2 in organizing public meetings in the project affected areas prior to mid-term mission to present and discuss EMP implementation progress, solicit community opinions and concerns, and agree on required corrective actions.	implementation performance, and draft the project completion report (PCR).
External Monitoring Consultant (EMC)		- Verify the monitoring information provided the contractors to the PMU2, and the monitoring information provided by PMU2 to ADB; - Conduct site visits of the project sites and consult potentially affected people; - Determine if the EMP is being implemented properly; assess the effectiveness of the EMP and the local grievance redress mechanism. - Discuss the assessment with the PMU2 and the CSC; and suggest corrective actions. - Prepare annual reports for submission to PMU2/MOT (in Vietnamese) and ADB (in English).	- Verify the monitoring information provided the contractors to the PMU2, and the monitoring information provided by PMU2 to ADB; - Conduct site visits of the project sites and consult potentially affected people; - Determine if the EMP is being implemented properly; assess the effectiveness of the EMP and the local grievance redress mechanism. - Discuss the assessment with the PMU2 and the CSC; and suggest corrective actions. - Prepare annual reports for submission to PMU2/MOT (in Vietnamese) and ADB (in English).
Works Contractors	- Recruit a qualified Environmental Officer and a Construction Safety	- Carry out noise monitoring monthly as defined in the EMP and the CEMP;	- N/A

	Engineer on a full-time basis to ensure proper implementation of the CEMP. - Prepare and submit to PMU2, CSC and ADB a CEMP prior to commencement of civil works.	- Submit monthly reports to the PMU2 and the CSC on the monitoring results and implementation of the CEMP (as part of regular progress reports); - Implement additional environmental mitigation measures, as necessary; - Apply all mitigation measures defined in EMP/CEMP during construction of road and bridges; - Ensure safety of construction workers and local people during construction; - Comply with Viet Nam and ADB policies on environmental protection including biodiversity conservation during construction.	
Department of Natural Resources and Environment (DONRE)	- Issue relevant permits as required (batching plants, spoil disposal sites, work camps)	- Monitor the implementation of mitigation measures identified in the EIA report and approved by MONRE to minimize the project impacts in the construction phase (compliance monitoring); - Investigate environmental incidents (pollution and damages to natural resources caused by the project); - Resolution of environmental issues generated by the project; - Resolution of environment-related complaints in accordance with the GRM established for the project.	- Monitor the implementation of mitigation measures identified in the EIA report and approved by MONRE to minimize the project impacts in the construction phase (compliance monitoring); - Investigate environmental incidents (pollution and damages to natural resources caused by the project); - Resolution of environmental issues generated by the project; - Resolution of environment-related complaints in accordance with the GRM established for the project.
Provincial Department of Agriculture and Rural Development (DARD).	- review forest replanting compensation plan submitted by PMU2, approve plan (on behalf of Provincial PC); - calculate amount of monetary compensation to be paid to DARD by PMU2 for cutting of trees and taking of protected and/or special-use forest.	- Supervise implementation of tree replanting compensation plan and report to Provincial People's Committee, PMU2 and ADB.	- Manage newly planted forest areas.
Van Ban Nature Reserve Management Authority	- Review DD to ascertain that necessary measures have been incorporated into project design; - Review relevant CEMP of work contractors to ascertain that	- Support CSC in providing training and awareness raising to relevant works contractors on sensitivities of the Nature Reserve, prohibited activities; - Conduct regular site visit and interviews with relevant works contractors to assess their compliance with protection measures;	- Manage Nature Reserve

	necessary protection measures have been incorporated into the CEMP;	- Inform CSC and PMU2 of observed non-compliances and illegal practices by works contractors.	
Department of Department of Labor, Invalids and Social Affairs (DOLISA)	N/A	- Conduct periodic visits of construction sites; - Investigate accidents, if any, in compliance with the Law on Occupational Health and Safety No. 84/2015/QH13, and the procedures defined in Joint Circular No. 12/2012/TTLT-BLDTBXH-BYT guiding the statement, investigation, statistics and reports on occupational accidents.	N/A
Provincial road asset management agency			- Properly maintain project infrastructure, including drainage system, slope stabilization works, and re-vegetated areas.

G.4. Contractor Obligations Prior to Construction

G.4.1. Preparation of Contractor or Construction EMP (CEMP)

494. Following contract award but before site works commence, each work contractor must produce a construction or contractor environment management plan (CEMP). Upon contract signing, the PMU2 shall hold a short course to orient contractors on EIA and EMP requirements, CEMP preparation requirements, any additional mitigation measures that may be required during construction phase.

495. The CEMP shall define (i) project description and implementation schedule; (ii) the contractor's environmental management system, including institutional arrangements for environment, health and safety management; inspection and monitoring arrangements for EHS; emergency response procedures; environment training commitments; communication and grievance redress mechanism; and reporting arrangements; (iii) environmental mitigation and control plan, including risk screening; identification of sensitive receptors (environmental constraints maps); identification of risk mitigation measures; and (v) all risk management sub-plans, method statements, which shall include, but not necessarily be limited to:

a. Materials Management Plan (MMP), giving arrangements for supply of construction materials to avoid unnecessary stockpiling outside project site.

b. Spoil Disposal Plan (SDP), for handling and disposal excavation spoils so that contractors dispose overburden in sites approved by local authorities.

c. Waste Management Plan (WMP), for handling, transport, storage and disposal of solid and liquid wastes and hazardous materials at sites approved by local authorities.

d. Drainage Management Plan (DMP), to ensure that construction works will not cause ponding or flooding at construction camps, borrow/quarry areas, other areas used for project-related activities and adjacent areas.

e. Silt Control Plan (SCP), to ensure that construction works will not cause excessive runoff and siltation of adjacent waterways within the Project site.

f. Temporary Traffic Management Plan (TTMP), to control safe interaction of vehicular traffic and pedestrians during construction.

g. Utilities Plan (UP), to avoid interruption to power, water supply telecoms and irrigation systems.

h. Noise and Dust Control Plan (NDCP), to minimize impacts to sensitive receptors (residential areas, schools, hospitals, etc.) due to construction works, sourcing and transport of construction materials, and other project-related activities.

i. Health and Safety Plan (H&SP), to ensure worker and community safety, and prevent accidents during construction works.

496. The CEMPs shall be submitted to the CSC and PMU2 for review and clearance prior to construction works. Where works are located within the Van Ban Nature Reserve, the CEMP shall also be submitted to the Van Ban Nature Reserve Management Authority for review. The CEMP is a dynamic document and may be subject to change by the contractor as the work progresses. Periodic reviews may be necessary and these should in fact be encouraged.

G.4.2. Securing Permits for Quarries and Spoil Disposal Sites, Work Areas

497. The contractors shall obtain all required environmental permits prior to operation. These include quarries, spoil disposal sites, concrete and asphalt batching plants, agreements to occupy private land or government land for work camps, working areas, etc. Whenever possible, raw materials provided to the Project shall be purchased from local and available sources.

Location of licensed quarries in the project area is shown in **Table C-12** of the EIA. Contractors must confirm that any such quarry or spoil disposal site has the relevant environmental permits. If the contractors operate their own quarry site or spoil disposal site, the required environmental permits shall be obtained by provincial Departments of Natural Resources and Environment (DONRE), and shall be submitted to the CSC prior to operation of the quarry/borrow or spoil disposal areas.

G.4.3. Mitigation Measures

498. Potential environmental issues and impacts during the pre-construction, construction and operation phases, as identified in the EIA as well as corresponding mitigation measures designed to minimize the impacts are identified in **Table G-2** to **Table G-4**. Mitigation or safeguard includes two types of environmental measures:

499. Measures that will permanently become part of the infrastructure such as slope stabilization works, culverts and underpasses, road signage and markings are included in the main civil work contract costs, and are estimated to amount to 3% of the total investment costs. The only exception for this project is the Tree Replanting Compensation Plans in protection and special-use forest ($ 102,000), to be financed by the PMU2 (MOT) through the project loan.

500. Temporary measures during the construction stage (e.g. dust suppression by watering, use of quiet / low noise powered mechanical equipment, provision of sedimentation basins for suspended solids in construction site runoff, provision of sanitary facilities for construction workers, etc) will be included in the tender documents to ensure that contractors include them in their budgets. The implementation of these measures is estimated to cost 1% of the total investment costs.

501. The mitigation measures defined in the EMP will be (i) checked and where necessary re-designed by the CSC prior to construction and the EMP subsequently updated, as needed; (ii) incorporated into tender documents (where appropriate), construction contracts, and operational management plans; and (iii) implemented by contractors under supervision of the PMU2 and the CSC. The effectiveness of these measures will be evaluated based on the results of the environmental effect monitoring conducted by the CSC, and through EMP compliance verification conducted by the EMC.

Table G-2: Environment management measures to be considered at Detailed Design Stage

Project activities	Potential Environmental Impact/ Environment Consideration	Mitigation/Management measures	Location	Estimated marginal cost (USD)	Responsibility – Implementation	Responsibility – Supervision
Pre-construction						
Detailed design	Widening of roads may encroach on protection and special-use forest, and require cutting of trees. Compensation must be paid.	Optimize highway alignment during detailed design to minimize land acquisition, minimize encroachment on protection and special-use forest, and reduce number of trees to be cut. Establish clear scope of impact; count area of land take and number of trees. Prepare and submit forest replanting compensation proposal in compliance with Circular 23/2017/TT0-BNNPTNT using templates provided in Appendix B of the EIA. Inform Provincial DARD who will determine amount of money to be paid from PMU2 to DARD. Secure approval of the plan and secure funds for plan implementation prior to construction works.	Along the project roads	$102,000	DD Consultant PMU2 and DARD	MOT / PMU2 / DARD, Van Ban Nature Reserve Management Authority
	Landscape disfiguration due to poor design	Minimize vertical/horizontal re-alignment of the roads to reduce deep cuts and refill works; Apply natural materials (rocks, stones, riprap) or greened concrete frames for embankment and slope stabilization.	Along the project roads	TBD	DD Consultant	MOT / PMU2
	Intrusive noise levels during operation from increased vehicles. If levels are found to be intrusive when compared with Viet Nam legislation and IFC standards then remedial measures may have to be incorporated in the design.	Conduct detailed analysis of the project's impact on noise sensitive receptors based on detailed noise projection modelling. The model shall account for exact road alignment, traffic forecast and other road parameters, as well as a full inventory of all sensitive receptors along the project roads. The model shall be used to assess adequacy and effectiveness of various noise mitigation measures considered to ensure compliance with the IFC noise guideline values of 55dB/45dB (daytime/nighttime).	In affected noise sensitive areas	TBD	DD Consultant	MOT / PMU2

		Incorporate remedial measures in the project design, such as side barriers, grassed soils mounds between the roads and the sensitive receptors if space permits, smoother pavements, traffic speed control, and others.				
	Excessive air pollution during operation from increased vehicles.	Consider in more detail remedial measures for impacts from operational air pollution. Locations of intersections, laybys and crossing points which all slow down traffic can be considered and their location optimized.	In congested areas where air pollution dispersion is hindered	TBD	DD Consultant	MOT / PMU2
	Rock blasting resulting in excessive vibration, damage to properties and injuries to staff and communities	Clarify need for blasting. If blasting is needed, then prepare a blasting plan, including vibration calculations / modelling when details for blasting are clear. The plan shall detail maximum amounts of explosive to be used at any one time, pattern blasting, use of millisecond delays and means of initiation.	Along project roads where blasting is required	Included in DD Consultant contract	DD Consultant	MOT
	Overwhelming of drainage causing flooding	The sizing and design of box culverts, pipe culverts, longitudinal drainage, bridges and slope stabilization works must be determined based on hydrological and hydraulic studies which account for increased runoff due to climate change. The findings of the CRVA must influence the detailed design of drainage structures.	Along the project roads in flood prone areas	Estimated at 1% of total works (included in works contracts)	DD Consultant	MOT / PMU2
Site clearance and handover to contractor	Investigation and removal of unexploded ordnances (UXO) Major safety risk to workers and nearby communities	Engage experienced Military Engineering Unit or accredited contractor for safe detection and removal of UXO.	Along ROW, at spoil disposal sites	To be determined. Outside of EMP scope.	PMU2, UXO contractor	District PCs
Interaction with residents and NGOS	Public complaints and grievances related to construction and operation activities	Establish and implement the grievance redress mechanism (GRM) as defined in the EIA. Disclose and disseminate the GRM to affected people. Ensure that PMU2 staff has capacity to supervise the GRM. Prior to start of site works, residents and establishments, local authorities and other stakeholders who are likely to be affected by the project shall be informed on the construction schedule and activities, potential	MOT office, District PCs	No marginal cost (included in training budget of CSC)	PMU2, CSC	District PCs, MOT / PMU2 / CSC

		environmental impacts and mitigation measures through public meetings at each commune.				
Bidding document preparation	Works contractors failing to meet environmental management obligations.	Ensure that bid documents refer to the EMP and include clauses defined in this EMP. Make sure contractors understand EMP is contractually binding.	N/A	No marginal cost	PMU2, CSC	MOT / ADB

Table G-3: Environment management measures to be considered at Construction Stage

Potential Environmental Impact	Project activities	Mitigation measure	Location	Estimated marginal cost (USD)	Responsibility – Implementation	Responsibility – Supervision
Adverse environmental impacts from construction activities if environmental management system is not in place. Compliance is a contractual requirement	Preparation and implementation of CEMP	Contractors shall engage one full-time environmental officer and one full-time construction safety engineer to oversee proper implementation of Project EMP and CEMP provisions. Develop a submit to CSC for approval a CEMP which shall include, but not necessarily be limited to: Materials Management Plan (MMP), Spoil Disposal Plan (SDP), Waste Management Plan (WMP), Drainage Management Plan (DMP), Silt Control Plan (SCP), Temporary Traffic Management Plan (TTMP), Utilities Plan (UP), Noise and Dust Control Plan (NDCP), Health and Safety Plan (H&SP). The CEMP shall be reviewed and cleared by the CSC before site-access is granted.	All sites	No marginal cost, to be covered by works contractors	Works contractors	MOT / PMU2 / CSC / ADB

	Securing of all necessary environmental permits	Obtain all required environmental permits prior to operation of any quarry site, borrow area, spoil disposal site and construction site. Whenever possible, raw materials provided to the Project shall be purchased from local and available sources. Location of licensed quarries in the project area is shown in Table C 12 of the EIA. If the contractors operate their own quarry site or spoil disposal site, the required environmental permits shall be obtained by provincial Departments of Natural Resources and Environment (DONRE), and shall be submitted to the CSC prior to operation of the quarry/borrow or spoil disposal	All sites	No marginal cost, to be covered by works contractors	Works contractors	MOT / PMU2 / CSC

Potential Environmental Impact	Project activities	Mitigation measure	Location	Estimated marginal cost (USD)	Responsibility – Implementation	Responsibility – Supervision
Reduced vegetation coverage, leading to increased potential for soil erosion.	Vegetation clearance within ROW	Removal of vegetation outside the project's ROW is strictly prohibited. Dispose removed vegetation in accordance with national and local regulations, and only in limited cases with strict conditions (burning shall only be allowed for less than 100 kg at a time; more than 500m from residential areas and other sensitive receptors such as schools, hospital, culturally significant sites, etc. and fuel storage sites, 200 m from worker camps) with available and sufficient fire prevention devices and manpower for fire extinguishing.	Within and along ROW, especially at bridge locations and steep slopes	No marginal cost.	Works contractor	MOT / PMU2 / CSC
Temporary disruption of basic services	Relocation of public infrastructure facilities (water, wastewater, electricity etc)	Implement approved LARP and the following measures: (i) Water supply pipelines, power, supply, communication lines and other utilities shall be re-provisioned before construction works commence; (ii) Provisions shall be made to preserve the operation of current facilities in sufficient quantity and in agreement with the local community. (iii) Re-provisioning shall be undertaken in coordination with the utility company and affected households; (iv) Affected households shall be notified well in advance of such disruption.	As specified in LARP.	Included in LARP budget.	PMU2, District Resettlement Committees	District PCs, External Resettlement Monitor

Potential Environmental Impact	Project activities	Mitigation measure	Location	Estimated marginal cost (USD)	Responsibility – Implementation	Responsibility – Supervision
Incursion into and impacts on Protection or Special-Use Forests, Van Ban Nature Reserve	Establishment and operation of Construction worker's camps, asphalt mixing plants, concrete batching plants material storage sites	No construction camps, asphalt mixing plants, material storage sites and other construction facilities are to be in protection or secondary forest areas. No activities beyond the ROW are allowed in Van Ban Nature Reserve.	At workers camps, construction and spoil disposal sites	No marginal cost	Works contractors, CSC	MOT / PMU2 / CSC
	Construction activities (general)	Cutting of trees for firewood and for use in the project shall be prohibited. Contractors shall not buy or use wood from illegal sources (that come from the illegal logging). Prohibit workers from hunting wild animals. Poaching of rare, endangered species shall be prohibited. Any poaching or tree cutting in Van Ban Nature Reserve will be severely punished and workers may be subject to summary dismissal. All precautions must be taken to avoid causing forest fires in the dry season. Awareness raising and training is to be provided to all construction workers and staff on the nature reserves and they must be warned of the consequences for disobeying instructions. Any workers found poaching or illegally cutting timber will be summarily dismissed; No vehicle maintenance is allowed in the VBNR; No open burning is allowed on site due to the risk of forest fires. Encroachment on the nature reserve beyond the ROW is strictly prohibited and shall be monitored/supervised by the CSC and the external environment monitor.	Van Ban Nature Reserve	No marginal cost	Works contractors	MOT / PMU2 / CSC / EMC

Impact on air quality from construction activities	Construction activities (general)	Water shall be used to suppress dust at all locations in the dry season. If the surface is dry, water shall be sprinkled at least once a day on the road and exposed surfaces when work is carried out within 50 m of residences or roadside food stalls. If works have given rise to complaints over dust, the contractors shall investigate the cause and report it in the monthly progress reports and review and propose alternative mitigation measures before works recommence. All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations (TCVN 5949 – 1998). Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions. Smoke emitting vehicles and equipment shall not be allowed and shall be removed from the project. Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin sheets to avoid impact from dust. Speed limits shall be imposed on such vehicles. Stockpiles should not be located within 100 m of schools, hospitals or other public amenities such as wells and pumps and should be covered with tarpaulins when not in use and at the end of the working day to enclose dust. If large stockpiles are necessary, they should be enclosed with side barriers and covered when not in use. No open burning is allowed on site.	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC
	Air pollution from Soil Excavation and Transportation	Ensure ambient air quality within the permitted limits of QCVN 05: 2013 / BTNMT: National Technical Regulation for ambient air quality. When selecting a temporary location, consider the prevailing wind direction and location of sensitive objects around. Locations of temporary rocks and construction materials must be at least 100m from any sensitive area and at least 50m from residential areas, protecting against spillage, affecting sensitive objects.	At all soil excavation areas and along spoil transportation routes	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Spray water at least once per day when the weather is dry, or temperature is high. Only use machinery and equipment that qualify for "Technical Safety and Environmental Protection". Absolutely no burning of solid waste such as plastic, cloth, tar, etc. and other hazardous wastes are allowed on the construction site and near other residential or sensitive areas. Workers will collect construction materials and wastes at the place prescribed at the end of each working day or at the end of the working shift. Turn off the engines of machinery and equipment if these vehicles stay in place for more than 5 minutes. Carrying waste away from the site, bringing it to the repository for reuse or transfer to the dumping site as soon as possible, no more than 24 hours in the passage through urban or residential areas; Set up and maintain a high fence of 2.5m in site locations with large excavation or embankments or near sensitive sites. Provide dust masks for construction workers and ask them to use them when working in dusty conditions.				
	Air pollution from concrete batching plant operation	Ensure ambient air quality within the permitted limits of QCVN 05: 2013 / BTNMT: National Technical Regulation for ambient air quality. The location of cement concrete batching stations must be far from the residential areas, giving preference to locations where there are many green trees to limit the spread of dust. Operators of batching plants shall secure a permit to operate the batching plant prior to its operation. Construction material storage areas should be covered or watered to minimize the spread of dust.	At concrete batching plants	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Spray water regularly in the concrete mixing plant to minimize the spread of dust on hot days. Arrange the wheel wash tank for vehicles entering and leaving the mixing plant to limit the sludge in the mixing area to the road. Use of conveyor belts to limit dust generation. Do not grind material in mixing area. Set up the fence around concrete batching plant.				
	Air pollution from asphalt batching plant operation	Batching plants shall not be located in any legally protected area, near sensitive areas by a distance less than 2km, near residential areas by less than 500m. Use asphalt concrete mixing plant with dust treatment system such as filter cloth bag or cyclone to prevent dust spread. Use asphalt mixing plant with gas treatment system by wet or dry treatment to prevent the spread of toxic gases. Construction material storage areas should be covered or watered to minimize the spread of dust. Regularly spray water to the area inside the asphalt concrete mixing plant to minimize the spread of dust on hot days. Arrange the wheel wash tank for vehicles entering and leaving the mixing plant to limit the sludge in the mixing area to the road. Use of conveyor belts to limit dust generation. Do not grind material in mixing area.		No marginal cost	Works contractors	MOT / PMU2 / CSC
Noise and vibration Impacts during various stages of construction	Construction activities resulting in excessive noise.	Ensure compliance with Viet Nam standards (i.e. QCVN 26:2010/BTNMT) and IFC Guidelines (2007). All works must be conducted during the hours of 07h00 to 19h00	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Night time work, or working on public holidays or Sundays is generally prohibited unless a special permit is secured from the Project Owner and local authorities. All noisy equipment must be fitted with silencers. All equipment and machinery on site shall be periodically inspected for noise levels and the necessary repairs and adjustments shall be made to ensure safety and shall not cause noise to exceed prescribed standards. Contractors to limit the number of machines operating simultaneously to reduce cumulative noise. For example, during excavation and transport, the truck engine is switched off when the bulldozer is operated. Natural noise barriers such as piles of sand or other materials should be exploited when siting noisy equipment such as compressors. Use temporary noise barriers at sensitive receptors. If it is necessary to work near houses, then a public awareness campaign should be carried out. Individual households should be approached and the works explained to the occupants prior to commencement of works. All workers should wear ear muffs if working in areas with noise levels above 90dB(A).				
	Construction activities resulting in excessive vibration.	Ensure compliance with standard allowed under QCVN 27: 2010 / BTNMT. Apply modern construction technology to reduce vibration and avoid affecting people (e.g. instead of using the hammer machine for piling steel sheet, the contractor should use pile presses to reduce vibration. Prohibit large trucks to transport materials at night through residential areas along the project. Conduct inspection and regular maintenance of construction machinery and equipment.	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Spread out the operation of construction equipment, especially for equipment that produces high vibration. Replace the vibration method with alternatives such as bored piles instead of impact piles.				
	Blasting, resulting in excessive noise, vibration and safety issues.	Blasting shall only be carried out in line with the rules set down by the local authorities and provincial DONRE in the prescribed manner and after prior notice to all residents and the local town authorities. One month prior to the blasting in any area, the contractors shall undertake a condition survey including photographs of all residences within 500 m of the blast sites. The condition of the residences shall be agreed with the CSC in case there are any future claims for damage to residences due to the blasting. All blasting shall be carried out in the daytime and at regular intervals after siren warnings. All residents within 500 m of the blast sites shall be kept informed of the plans and progress of blasting and residents shall be temporarily evacuated and provided with alternative accommodation if required. No blasting will be allowed at night. Controlled blasting will strictly follow the license requirements from DONRE and other authorities. Where the vibration from blasting may exceed the maximum permissible level, the contractor will modify blasting patterns and calculate a reduced charge or use pattern blasting with 20 millisecond delays for future blasts to minimize damage. Blasting shall be under careful and strict management of properly trained and licensed personnel. The contractors shall observe proper warning and precautionary measures to ensure safety of residents, pedestrians, motorists and structures during blasting.	All construction sites (where blasting is required)	No marginal cost	Works contractors	MOT / PMU2 / CSC
Impact on surface water quality from construction activities	Construction activities (general)	Ensure compliance with QCVN 08 2008 BTNMT. All construction camps must contain adequate septic tanks with below ground soak ways to avoid odor generation.	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Storage capacity of septic tanks should be 24 hours waste water generation. Lubricants shall be stored in dedicated enclosures with a sealed floor at least 50 m from water bodies. Solid waste from construction activities shall not be thrown in rivers. Construction storage/stockpiles shall be provided with bunds to prevent silted run-off. Stockpiled materials shall be covered to reduce run-off. Stockpiling or borrow sites will not be allowed within 100 m of water body. Work in rivers will be scheduled during dry season. Bare slopes shall be stabilized immediately after works are completed. Washing of machinery and vehicles in surface waters shall be prohibited.				
	Bridge construction	Ensure compliance with QCVN 08 2008 BTNMT. Firmly consolidate river banks using stones, concrete and other suitable retaining measures at each bridge construction site and ensure that water courses (rivers, canals, etc.) shall be kept free of excavation spoil and construction debris, floating and submerged. Construction wastewater shall be collected and treated prior to discharge to the water body in compliance with QCVN 24:2009/BTNMT. Temporary silt curtains shall be provided at pier construction sites the area of impact. Disposal of slurry from bridge construction in the water body shall be forbidden.	Bridge construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Dredged material shall be collected and stored temporarily at a minimum of 30m from the water body for dewatering for at least 24h and disposed to an approved disposal site. Spillage of bentonite mud in agricultural land shall be cleaned immediately to prevent caking and hardening. Machinery for bridge construction shall be repaired and washed at designated locations at least 100 m from the water body. No machine repair and washing on bridge construction site shall be allowed.				
	Batching plants operation, leading to surface water pollution	Wash water should be directed to a settling tank and then sludge allowed to dry and be removed to approved landfill. Compliance with QCVN 40: 2011 / BTNMT must be ensured. This shall be demonstrated through regular monitoring of effluent quality	Concrete batching plants	No marginal cost	Works contractors	MOT / PMU2 / CSC
	Vehicle and site equipment maintenance, work camp operation	After washing vehicles and equipment, water shall be collected and pre-treated by sedimentation to remove suspended solids. Oil and grease shall be collected in grease traps or by skimming. The contractor shall not place car wash, maintenance of machinery, near surface water sources such as ponds, rivers and streams. Set up worker camps at least 100 meters away from surface water. Construction contractors must install separate toilets for men and women, which must be self-contained to treat wastewater. Waste water from the camp is to be collected and treated to ensure that the parameters meet the requirements of QCVN 14: 2008 / BTNMT before discharging into the general drainage system of the area. In case the contractor arranges to lodge workers in houses in the project area, domestic wastewater needs to be treated before discharge. Septic tanks may need to be installed.	Equipment maintenance areas, work camps	No marginal cost	Works contractors	MOT / PMU2 / CSC

		At the construction sites of bridges and roads in densely populated areas, the Contractor shall construct portable toilets. At suitable intervals full containers will be replaced or siphoned away. Remind the workers to use toilet facilities at the designated place.				
	Construction site runoff, storm water management	Develop a reasonable construction plan to limit excavation in the rainy season. Accelerate construction time of all items, especially in the rainy season. Do not leave construction materials, and loose soil and dirt in the area lying in the open. Check the operation of horizontal culverts and drainage channels along the route; they should be inspected and cleared until good drainage is ensured. Cover material yards and compaction sites to prevent soil erosion and spillage. Materials and chemicals, such as fuel oil and lubricants, to be placed in locations designed to avoid spills and leaks. These storage locations must be at least 100 meters from the water source and have a roof, concrete floor and walls or solid fences to avoid spills. Avoid dropping fuel oil, grease, and chemicals into the surrounding environment to avoid overflowing rainwater.	Equipment maintenance areas, work camps	No marginal cost	Works contractors	MOT / PMU2 / CSC
Impact on soil, groundwater	Excavation and earthwork along project roads	Store materials in areas of about 20m2 for easy covering when it rains to avoid soil erosion and dust release on sunny days. Dumps will be constrained to avoid spillage by piles or hard walls. Along the slopes of both sides of the road shall be filled with loading soil or panels, walls to prevent the construction area with the surrounding land to prevent the amount of sediment in the overflow into the low side of the street.	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Schedule program works to ensure that excavation is completed for each roadbed and compacted before the rainy season. Stabilize the slope and prevent erosion before the peak time of the rainy season. Make sure that the roadside slope is re-vegetated after completion of construction. To prevent possible impacts on the environment surrounding the spoil disposal sites, spoil prior to dumping should be checked for toxic substances present in the soil to determine if soil exceeds QCVN 03-MT: 2015 / BTNMT.				
	Management of spoil	Spoil disposal shall only be to Provincial DONRE and DOC approved areas; Trucks transporting spoils shall be tightly covered with tarpaulin or other suitable materials to minimize dust emission and spills; Wheel washing shall be undertaken to remove mud to ensure that access roads are kept clean; Road surfaces shall be regularly cleaned of spilled spoil; Earthwork and spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas; The spoils disposal site shall be adequately protected by avoiding formation of steep slopes and grassing to prevent erosion to surface watercourses.	Along spoil transportation routes, at spoil disposal sites	No marginal cost	Works contractors	MOT / PMU2 / CSC
Generation of solid wastes causing land, water, and air pollution and public health problems.	Activities generating domestic waste (general)	Daily waste shall be temporarily stored on site in a separate area approved by the CSC before they are collected and processed by functional units. Segregation of wastes shall be observed. Organic waste (biodegradables) shall be collected and disposed of on site by composting (no burning is allowed on site).	Work camp sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Daily waste shall be collected separately in garbage cans with lids, watertight to avoid odors, leaks, attract flies, mice and other pathogens. Each site, camp site and workplace headquarters of the building management board must arrange 1-2 tanks of 200-liter capacity. Domestic wastes must be regularly disposed of according to the system of waste collection in the locality. Containers should be tightly closed, free from spills, resistant to sunlight, and not corrode. It is not permitted to bury or burn solid waste at the scene. Training of workers on sanitation and occupational hygiene shall be given.				
	Generation of hazardous waste, hazardous material storage	Ensure that safe storage of fuel, other hazardous substances and bulk materials are agreed by PMU2 and have necessary approval permits from DONRE and local authorities. Vehicle maintenance and refueling areas will be confined to designated areas in construction sites designed to contain spilled lubricants and fuels. Fuel and other hazardous substances shall be stored in areas provided with weather shielding lightweight roof, impervious flooring and curbs to contain spilled liquids. Absorbent materials such as sand should be provided to mop up spills. There must be appropriate information and training programs in the workplace that help the workers to be aware of and have a way to deal with hazardous chemicals in the workplace. Hazardous wastes must be collected separately, placed in containers marked as hazardous waste with sealed lids and identification labels as prescribed. They must be placed in a safe place with non-permeable floor, a roof, and fire insulation. They should be stored at least 100m away from any water source.	Work areas, workers camps	No marginal cost	Works contractors	MOT / PMU2 / CSC

		The contractor must contract a functional unit to handle the waste or sell it to a company that is licensed to recycle used oil. Chemical wastes of all kinds must be stored and disposed of at the approved site in accordance with local regulations. Contractors are required to obtain the necessary waste treatment certificate. Used oil or oil contaminated with PCBs must be stored safely to prevent leakage or damage to workers and the environment. Asphalt or asphalt products that cannot be reused must be returned to the supplier. The contractor must prepare an Emergency Response Program, and implement the program after any incidents. In such cases, the contractor must submit a report to the CSC, explaining the reasons and remedies or damages.				
Risk of landslides, bank collapses during construction	Primarily during earthwork, roadbed construction	Minimize removal of stabilizing vegetation on existing slopes. Enhance vegetation cover for sloping roofs; Construct temporary drainage facilities at all excavated areas to divert surface runoff and to avoid runoff water flowing over bare and unstable areas; Closely monitor potentially unstable sites throughout construction period and temporary halt construction activities as needed; Regularly check open drainage ditches and horizontal drainage along the route to avoid long-standing waterlogging and soil erosion; In cases where erosion or bank collapses occur, mobilize the means to repair in time to ensure the traffic flow is not disrupted;	At steep slopes and along rivers	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Install final slope stabilization works as defined in the detailed design as soon as possible to minimize the period of risk of landslides and slope collapses; After the slope is finished, establish longitudinal ditches to ensure longitudinal drainage while simultaneously removing the soil and rock during the excavation on the sloping side, ensuring the drainage of the surface when it rains.				
Disruption of local livelihoods	Construction activities affecting local businesses	Consult with shop owners, farmers and forestry managers at least two weeks before construction starts to agree on and provide temporary access to their businesses/production areas. Inform on the planned construction activities and likely impacts; Consult shop owners, farmers and forestry managers regularly to seek their feedback on impacts such as emissions, dust, noise, traffic safety at least two weeks prior to commencement of construction; Do not store raw materials or waste within 20m of businesses or shops. Arrange traffic control staff for loading and unloading of raw materials and wastes; Provide compensation for products and properties damaged by the project activities; Resolve immediately any inconvenience caused by project activity.	Construction sites in proximity to businesses and farmland	No marginal cost	Works contractors	MOT / PMU2 / CSC
Labor-related social problems	Work camp operation, road construction	To the extent possible, hire local staff. The project can employ about 270 local, female and male workers. For some jobs requiring re-training, the contractor will select among the employees hired locally to train them for new skills so they can do the job well; Collaborate with local authorities to publish information on the project, including construction items, environmental and social issues related to the project, introduce construction personnel from other places to the community. Organize regular exchanges between workers and local people;	Work camps, at construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC

		All workers shall be properly registered. Child labor is strictly prohibited. Conduct regular orientations and awareness raising of workers on how to prevent infectious diseases such as HIV/AIDS (to be conducted through the implementation of the Gender Action Plan) Implement a strict and zero-tolerance policy to regulate gambling, prostitution, theft, wildlife poaching and forest product collection.				
Impact on community and occupational health and safety	Work camp operation (health and hygiene)	Properly set up work camps in close consultation with local authorities. Control and maintain work camps, and strictly manage workers. Contractors shall provide shelter, water and electricity facilities that ensure workers living in camps at the site receive sanitary and human living conditions. Separate toilets shall be provided for male and female workers. Camp sites shall be cleaned up to the satisfaction of local authorities after use. Land used for campsites shall be restored to the original condition as far as practicable and the area shall be planted with appropriate trees / shrubs as soon as practicable after it is vacated and cleaned. Measures to prevent the outbreak of diseases shall be implemented e.g., provision of insecticide treated mosquito nets to workers, installation of proper drainage to avoid formation of stagnant water, etc. Standing water will not be allowed to accumulate in the temporary drainage facilities or along the roadside, to prevent proliferation of mosquitoes.	Work camps	No marginal cost	Works contractors	MOT / PMU2 / CSC
	Occupational health and safety	Appoint qualified environment, health and safety staff at least one month prior to construction start to look after implementation of required environmental mitigation measures, and to ensure that health and safety precautions are strictly implemented;	All construction sites, work camps	No marginal cost	Works contractors	MOT / PMU2 / CSC

		At least one month before construction commences the contractors will demonstrate to PMU2 and CSC that the H&S Plan will be properly resourced; The contractors will instruct and induct all workers in health and safety matters (induction course) including construction camp rules and site agents/foremen will follow up with toolbox talks on a weekly basis. Provide fencing on all areas of excavation greater than 2 m deep. Implement fall prevention and protection measures for works at height (i.e. higher than 2m); Workers shall be provided with of appropriate personal protective equipment such as safety boots, helmets, gloves, protective clothes, breathing mask, goggles, and ear protection at no cost to the workers. Ensure audible reversing signals are installed on all construction vehicles. Where worker exposure to traffic cannot be eliminated, protective barriers shall be provided to shield workers from traffic vehicles. Contractor will install separation devices e.g., traffic cones and barrels to delineate the work zone. On the construction site all workers should be equipped with safety belts, anti-fall protection grid and lifejackets for construction workers on high and above rivers. Prepare an accident response plan including rescue teams, organizational rescue and plan (leader, self-implementation) and identify the addresses needed to contact in an emergency including hospitals in the project area and district hospitals. Maintain a record of all occupational accidents, including near misses, and report all major accidents involving serious injury or death within 24-h to the CSC and the PMU2; ensure that all accidents are investigated in compliance with the Vietnamese Law on Occupational Safety.				

	Community health and safety	Provide information boards near the work sites to inform the public on how to approach the works. The contractors will provide warning signs at the periphery of the site warning the public not to enter; Fencing will be installed prior to excavation work commencing on all sides of temporary excavations; Provide appropriate drains so that the outfalls of the surface run-off from the works are diverted away; Ensure that storm drains are cleared to maintain storm water flow; Reconnect any power, water supply, telecommunications and irrigation systems interrupted by the works; Contact all relevant local authorities for utilities and local village groups to plan reconnecting of power, water supply, telecommunications and irrigation systems; Relocate and reconnect utilities in advance of construction works and coordinate with the relevant utility company at the provincial and district levels for relocation and reconnection well before works commence; Inform affected communities well in advance of any disruptions; If utilities are accidentally damaged during construction, it shall be reported to the CSC, PMU2 and utility authority and repairs arranged immediately at the contractor's expense; Conduct regular consultation and information meetings with nearby communities in accordance with the communication plan defined in the EMP.	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC
Temporary Traffic Disturbance as result of construction activities	Construction activities (General)	Develop Temporary Traffic Management Plan, secure its approval by local authorities and the CSC. Set up clear traffic signal boards and traffic advisory signs at the roads going in and out the road and bridge construction sites to minimize traffic build-up.	All construction sites, transportation routes	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Provide signs advising road users that construction is in progress and that the road narrows to one lane using cones. Communicate through local officials to the public the scope and schedule of construction, as well as specific construction activities causing disruptions or access restrictions. Coordinate with local traffic authorities to implement traffic diversion schemes to avoid inconvenience to road users, ensure smooth traffic flow and avoid or minimize accidents, traffic hold ups and congestion. Employ flag persons to control traffic at the station sites for safety reasons when construction equipment is entering or leaving the work area. Define and observe schedules for different types of construction traffic trips (e.g., haulage of spoils, delivery of construction materials, etc.). Avoid movements of noisy vehicles during night time in vicinity of sensitive receivers. Implement suitable safety measures to minimize risk of adverse interactions between construction works and traffic flows through provision of temporary signals or flag controls, adequate lighting, fencing, signage and road diversions. Regular maintenance of selected temporary routes. Restriction of using too many pieces of construction equipment at interchanges at rush hour. Limit of using too many pieces of floating construction equipment at bridge construction sites. Vehicle speed limit along the route and ensure conformity with each section having residential areas and intersections. Limit transporting materials during the rainy season and avoid overloading vehicles compared to the load of the structure existing roads and bridges. Repair damaged pavement of local road.				

Impact on Culture and Archaeology	Excavation works, foundation works	Site agents shall be instructed to keep a watching brief for relics in excavations. Should any potential items be located, the local authorities will immediately be contacted and work will be temporarily stopped in that area. If the item is of potential significance an officer from the Department of Culture and Information (DCI) will be invited to inspect the site and work will be stopped to allow time for inspection. Until DCI has responded to this invitation work will not re-commence in this location until agreement has been reached between DCI, CSC and PMU2 as to any required mitigation measures, which may include structured excavation.	All construction sites	No marginal cost	Works contractors	MOT / PMU2 / CSC
Poor construction completion resulting in environmental pollution and safety issues	Post-Construction Site Clearance	A 5% retention on payment to contractor shall be withheld until a project completion report is filed. The PMU2 shall notify at contract signing that the 5% retention is contractually binding. Failure to clean up site may result in financial penalties. A separate contractor can be hired to carry out clean up and costs back charged to 5% retention. Contractors must take the following measures before demobilizing: All construction sites must be cleared of debris and waste materials Site to be returned to same state as before occupancy All stockpiled materials to be removed from site All waste materials to be removed from sites All septic tanks should be removed and excavations made good All containers, scrap wood, scrap metal etc. to be removed from site and sold to recycling company or disposed of at approved sanitary landfill	All construction sites, bridge sites, spoil disposal sites, quarries, work camps	No marginal cost	Works contractors	MOT / PMU2 / CSC

		Borrow pits to be fenced off and warning signs for no swimming erected. Benches in borrow pits to be graded to gentle slope to avoid drowning If requested by local villagers borrow pits can be converted to fishponds or water storage reservoirs but safety of children is paramount. Works should be carried out in liaison with community heads.				

Table G-4: Impacts and Risks during Project Operation, Mitigation Measures

Project activities	Potential Environmental Impact	Mitigation measure	Location	Estimated marginal cost (USD)	Responsibility – Implementation	Responsibility – Supervision
Operation						
Noise from vehicles	Noise nuisance	Noise monitoring shall continue during operation phase to determine the need for additional noise mitigation measures; The construction of additional noise mitigation measures shall be done upon official request of local district or commune' authorities and if ambient noise levels exceed the IFC standard. MOT shall conduct detailed design and construct them at the noise sensitive places. Ensure that all vehicles such as trucks, buses, cars and motorcycles meet the Vietnamese Standard of Noise for Road Vehicles (TCVN 5948 – 1999); as such, all vehicles running on the roads shall have the licenses by Viet Nam Register or competent authorities certifying their compliance to the noise standard. Traffic Police shall regularly check noise of vehicles and impose regulatory fines to any vehicle that produces noise exceeding the allowable limit. Do not plan and set up new sensitive noise receptors (hospitals, schools, churches, temples…) in less than 100 m	At noise sensitive sites	TBD	MOT, PMU2	Provincial PCs

High Speeds	Traffic accidents	Conduct road safety audit prior to road opening, and regular road safety campaigns during project operation. Develop and implement emergency response plan and procedure to respond to traffic accidents.	Entire roadways	No marginal cost, part of highway operational budget	PMU2, MOT Traffic Police	MOT
More traffic	Air pollution may locally increase because of increased traffic flows	Strict access control for vehicles not complying with emission standards of Viet Nam (QCVN 05:2009/BGTVT)	Entire roads	No marginal cost	MOT	DONRE
Fire Risk	Increased risk of fires	Signs shall be placed along fire-prone sections of the project roads to alert drivers of the risk of wild fires. Regulations on storage of flammable materials: Petroleum products used for repair works shall be stored in separate isolators, away from sources capable of igniting, which shall be equipped with temperature monitoring equipment, fire alarm equipment. Arranging fire prevention means in construction/repair works Placing fire extinguishers, fire-fighting tanks and oxygen cylinders regularly at construction sites and at petrol and oil depots. Fire-fighting equipment and facilities shall be inspected and regularly maintained. The maintenance contractor shall develop a plan to prevent and respond to fire.	Entire roads	No marginal cost	MOT	DONRE

G.5. Environmental monitoring plan

502. An environmental monitoring plan has been defined for the project in accordance with the Government of Viet Nam and ADB requirements. The plan focuses on environmental compliance monitoring and environmental quality monitoring (e.g. air, water, soil, vibration and noise) during pre-construction, construction and operation.

503. Monitoring will include **environmental compliance monitoring** (to be conducted by the PMU2 with support of the CSC, and to be verified by the EMC) and **environmental impact monitoring** (to be conducted by the CSC, potentially to be sub-contracted to a licensed monitoring entity). Contractors will also be required to conduct frequent noise monitoring around construction sites. Monitoring arrangements defined for this project are described below.

504. **Environmental effect monitoring. Table G-5** shows the environmental effect monitoring program specifically designed for this project, defining the requirements, including, scope, location, parameter, duration and frequency of monitoring during pre-construction, construction and operational stages. Environmental effect monitoring will include monitoring of air quality, noise, water quality and soil quality, and will be conducted in compliance with relevant Vietnamese standards and procedures, including but not necessarily limited to:

- Circular No. 28/2011/TT-BTNMT: Regulation of technical procedures of environmental monitoring for ambient air and noise.
- Circular No. 29/2011/TT-BTNMT: Regulation of technical procedures of environmental monitoring for surface water.
- Circular No. 30/2011/TT-BTNMT: Regulation of technical procedures of environmental monitoring for groundwater.
- Circular No. 33/2011/TT-BTNMT: Regulation of technical procedures of soil monitoring.

505. Quarterly environmental monitoring of air quality, noise during construction phase will be conducted by the CSC. Provincial DONREs will conduct air quality and noise monitoring during the operation phase. The EMC will be hired by PMU2 to verify monitoring results. Monitoring shall in principle be conducted at the sites included in the baseline monitoring, but new points have been identified given the partly new alignment of the road and sensitive receptors identified in the framework of the EIA. The costs for environmental effect monitoring by the CSC have been estimated at $30,800. This estimate does not include noise monitoring to be conducted by the contractors.

506. Works contractors will be required to conduct noise monitoring during peak construction period around construction sites and nearest sensitive receptors (residential areas, Van Ban Nature Reserve).

507. The environmental monitoring results will be compared with relevant Vietnamese performance standards and the IFC Environment, Health and Safety Guidelines where these are applicable. Non-compliance with these standards will be highlighted in the monitoring reports. Monitoring results will be submitted by the CSC (through the PMU2) to provincial DONREs, PMU2 and ADB through the semi-annual environmental monitoring reports (see reporting plan in **Table G-8**).

508. During construction, **CEMP compliance monitoring** will be conducted as the works are carried out by the CSC. Compliance monitoring will be done on a weekly basis by the CSC, and compiled in monthly reports. These should be discussed with the contractors as necessary but at

a minimum monthly. The monthly reports will be consolidated in the semi-annual environmental monitoring reports, to be submitted to the EMC, ADB, MONRE and DONRE by the CSC, through the PMU2. The PMU2 will also conduct regular (monthly) site visits to assess the contractors' compliance with their CEMPs.

509. The **timing of the monitoring** is important. The following list is for guidance and is indicative only.

- Liquid emissions from sites must be checked every three months or after heavy rain if overflowing is reported. Measurements in streams and water courses must be made.
- Dust emissions on site must be checked weekly by visual inspection and monthly by examining records of water spraying. Ambient air quality must be checked over a 24-hour continuous period at sensitive receptors in the event of complaints.
- Noise levels must be checked every three months at site perimeters, or in the event of a complaint, at night as well as during the daytime.
- Correct removal and disposal of waste and waste engine oil and grease must be checked weekly by visual inspection of the camps and checking of records from the waste disposal contractors.
- Noise and vibration must be checked at sensitive receptors in the event of complaint.
- Reinstatement of borrow pits and quarries must be checked after closure of the facility.

Table G-5: Environmental Monitoring during construction

No.	Monitoring items	Pre-construction	Construction phase	Applied standard
I	Ambient noise/vibration monitoring			
	1. Parameter	Leq, L50, Lmax	Leq, L50, Lmax	QCVN 26/2010/BTNMT
	2. Frequency	1 location/day, Once	Every 3 months	
	3. Monitoring position	Baseline environmental locations should be established at boundary of construction sites, and at sensitive receptors (residential areas, Van Ban Nature Reserve). At a minimum, the monitoring locations shall include: *1) Route connecting Lai Chau province* Location 1: Starting point of the project: Intersection IC.16 - Km198 + 730. Location 2: Avoid Khanh Yen town Location 3: The route avoiding Duong Quy Commune Location 4: Khau Pass (Van Ban Nature Reserve) Location 5: Muong Than junction (Km352 + 500-QL32) Location 6: Giao duc10 with DT107 Location 7: Tan Uyen Transit Line Location 8: Ban Bo (at the intersection with National Road 32 - Km398) Location 9: At the section of San Thien - Dong Pao Location 10: End point connected to TP. Lai Chau (Km34 + 800 -QL4D). *(2) Route connecting Nghia Lo - Yen Bai* Location 11: Intersection IC.14 (Km149 + 705) Location 12: Dai Phac commune		

No.	Monitoring items	Pre-construction	Construction phase	Applied standard
		Location 13: Mo Vang commune. Position 14: Crossing point with National Road 32 at Km209 + 500		
II	Ambient air monitoring			
	1. Parameter	TSP, CO, NO2, SO2, HC, microclimate	TSP, CO, NO2, SO2, HC	QCVN 05 :2013/BTNMT, QCVN 06:2009/BTNMT
	2. Frequency	1 location/day	Every 3 months	
	3. Monitoring position	Baseline environmental locations should be established at boundary of construction sites, and at sensitive receptors (residential areas, Van Ban Nature Reserve). At a minimum, the monitoring locations shall include: *1) Route connecting Lai Chau province* Location 1: Starting point of the project: Intersection IC.16 - Km198 + 730. Location 2: Avoid Khanh Yen town Location 3: The route avoiding Duong Quy Commune Location 4: Khau Pass (Van Ban Nature Reserve) Location 5: Muong Than junction (Km352 + 500-QL32) Location 6: Giao duc10 with DT107 Location 7: Tan Uyen Transit Line Location 8: Ban Bo (at the intersection with National Road 32 - Km398) Location 9: At the section of San Thien - Dong Pao Location 10: End point connected to TP. Lai Chau (Km34 + 800 -QL4D). *(2) Route connecting Nghia Lo - Yen Bai* Location 11: Intersection IC.14 (Km149 + 705) Location 12: Dai Phac commune Location 13: Mo Vang commune. Position 14: Crossing point with National Road 32 at Km209 + 500		
III	Surface water/wastewater quality monitoring			
	1. Parameter	pH, temperature, DO, TSS, T-N, T-P, BOD5, COD, oil and grease, Coliform	pH, temperature, DO, TSS, BOD5, COD, DO, oil and grease, Coliform	QCVN 08:2008/BTNMT; QCVN 14:2008/BTNMT; QCVN 24:2009/BTNMT
	2. Frequency	1 location/day	Every 3 months	
	3. Monitoring position	At outfall from construction camps, upstream and downstream of all project bridges. At a minimum, the monitoring locations shall include: (i) Route connecting Nghia Lo town: NTSH1 - Camp at Km3 + 00. NTSH2 - Camp at Km12 + 300. NTSH3 - Camp at Km22 + 600 NTSH4-Camp at Km37 + 800 (ii) Lai Chau connection route: NTSH5 - Camp at Km91 + 800 (QL279) NTSH6-Camp at Km102 + 100 (QL279) NTSH7 - Camp at Km112 + 500 (QL279) NTSH8-Camp at Km123 + 200 (QL279) NTSH9-Camp at Km138 + 800 (QL279) NTSH10 - Camp at Km149 + 800 (QL279)		

No.	Monitoring items	Pre-construction	Construction phase	Applied standard
		NTSH11-Camp at the intersection of the end of Muong Than NTSH12-Camp at Km367 + 450 (National Road 32) NTSH13 - Camp at Km379 + 200 (National Road 32) NTSH14 - Camp at Km389 + 800 (National Road 32) NTSH15 - Camp at Km 109 + 600 NTSH16 - Camp at Km 117 + 450 NTSH17 - Camp at Km126 + 00 NTSH17 - Camp at Km136 + 00 Two sides of Khau Co Pass Nam Mu Bridge on the route connecting Lai Chau; Dan Bridge, Dam and Spillway on the route connecting Nghia Lo town		
IV	Excavated spoil: If required as indicated in the material management plan			
	1. Parameter	Cu, Pb, Zn, Cd, As	Cu, Pb, Zn, Cd, As	QCVN 03:2008/BTNMT
	2. Frequency	As needed	As needed	
	3. Monitoring position	As defined in the material management plan		
V	Traffic: during construction, the contractors monitor and report the traffic route and driving performance.			

510. Non-compliance with these standards will be highlighted in the monitoring reports. Monitoring results will be submitted by the PMU2 through the semi-annual environmental monitoring reports.

Table G-6: Cost of environmental monitoring

Categories	**Unit**	**Quantity**	**Unit price (VNĐ)**	**Cost (VNĐ)**
Air [12 positions x 8 samples / position (continuous measurement from 6h to 22h, 2h for 01 sample) x 3 months / batch x 60 months]				***58,596,096***
TSP	Form	768	76,297	58.596.096
Emissions from asphalt concrete mixing plant (2 positions x 4 samples / locations x 3 months / batch x 60 months)				***123,654,400***
TSP	Form	64	412,700	26.412.800
NOx	Form	64	522,400	33.433.600
SO2	Form	64	551,900	35.321.600
CO	Form	64	445,100	28.486.400
Noise and vibration [12 positions x 16 samples / position (continuous measurement from 6h to 21h, 1h get 01 sample) x 3 months / batch x 60 months]				***205,615,104***

Noise Level Equivalent (Laeq)	Form	1536	66,932	102.807.552
Vibration	Form	1536	66,932	102.807.552
Surface water (2 samples / position x 8 locations x 3 months / batch x 60 months)				***179,466,880***
pH	Form	128	40,180	5.143.040
NH4+	Form	128	109,636	14.033.408
COD	Form	128	307,972	39.420.416
Surfactant	Form	128	122,596	15.692.288
Biochemical oxygen demand (BOD5)	Form	128	84,341	10.795.648
Total Suspended Solids (TSS)	Form	128	86,746	11.103.488
NO3-	Form	128	120,801	15.462.528
Grease	Form	128	307,972	39.420.416
PO43-	Form	128	112,387	14.385.536
Coliform	Form	128	109,454	14.010.112
Waste water treatment plant batching stations (1 sample / position x 2 positions x 3 months / batch x 60 months)				***40,499,472***
pH	Form	16	40,180	642.880
TSS	Form	16	123,257	1.972.112
COD	Form	16	172,114	2.753.824
Mn	Form	16	292,330	4.677.280
Fe	Form	16	292,330	4.677.280
Cd	Form	16	332,819	5.325.104
TN	Form	16	292,330	4.677.280
TP	Form	16	292,330	4.677.280
Cr (VI)	Form	16	120,801	1.932.816
General grease	Form	16	572,726	9.163.616
Other expenses (moving, staying, stationary, reporting)				*100,000,000*
				707,831,952 VND ($30,800)

Note: Cost estimates as defined in the domestic EIA, February 2018. These estimates are projected and may vary according to the actual project situation. The CSC will be requested to prepare a detailed monitoring program and submit it to the PMU2 for approval.

G.6. Procedure in case of Infringement

511. The compliance framework, based on the environmental requirements established by the EMP and Environmental Specifications included in bidding documents, will be strictly enforced by the CSC. Minor and major infringements will be determined according to the following categorization table:

Table G-7: Category of Infringement & Remediation

Category of Infringement	Definition	Remediation
Minor Infringement	Incident which causes temporary but reversible damage to the environment, community property, people.	– Minor clean-up operations – Minor restoration activities – Adjustments to construction practices – Compliance with EMP and CEMP
Major Infringement	Incident where there is long-term or irreversible damage to the environment, community property, and people	– Major clean-up operations – Comprehensive investigation of incident, including reporting – Major restoration requiring engineering measures – Major restoration of community property – Compensation to affected communities or persons.

512. For **minor infringements**—an incident which causes temporary but reversible damage—the contractor will be given a reasonable period to remediate the problem and to restore the environment or strengthen safety procedures. If restoration is done satisfactorily during this period, no further actions will be taken. If it is not done during this period, the PMU2 will immediately arrange for another contractor to do the restoration, and deduct the cost from the offending contractor's next payment.

513. For **major infringements**—an incident where there is long-term or irreversible damage or negligence to construction safety resulting severe injury or death of workers or community members—there will be a thorough internal and independent (i.e. by relevant authorities such as DONRE or DOLISA) investigation of the incident. Financial penalties may apply in addition to the cost for restoration activities.

514. The compliance framework will be applied as follows:

- The CSC will identify or be notified of an infringement (community member, local government);
- The CSC in consultation with relevant stakeholders (PMU2, DONRE, and DOLISA) will assess whether it is a minor or major infringement.

515. For minor infringements:

- The CSC will establish the required mitigation measures, and issue a notice to correct, defining period, which is a maximum of five days to remedy the situation.
- The Contractor will review the recommendation and confirm (i) the level of infringement (minor/major); (ii) the mitigation measures; and (iii) the mitigation period. If they do not agree, they will work with the CSC and the PMU2 to reach mutually acceptable recommendations.
- The Contractor shall remedy the infringement in accordance with the recommendations within the agreed period.
- The CSC shall confirm the infringement is satisfactory remedied in the period.
- If the infringement is not remedied satisfactorily in the period the CSC shall inform the PMU2. The PMU2 shall immediately arrange for a separate contractor to undertake the necessary works and the cost of this shall be deducted from the next payment to the offending contractor.

516. For major infringements:

- The Contractor and/or CSC shall immediately inform the PMU2 of the incident;
- The PMU2 shall immediately inform the appropriate provincial authorities if appropriate (DONRE, DOLISA);
- The PMU2, in consultation with the CSC and other provincial authorities as appropriate, shall agree upon mitigation and clean-up measures to be undertaken immediately by the contractor or by specialists to be procured at the contractor's expense. To minimize the environmental impacts the restoration activities should be completed within ten days.
- In case of serious accidents incurring severe injury or death of construction workers or community members, the PMU2 will ensure that an investigation is conducted in accordance with the relevant Vietnamese regulations (Law on Occupational Health and Safety No. 84/2015/QH13, and the procedures defined in Joint Circular No. 12/2012/TTLT-BLDTBXH-BYT guiding the statement, investigation, statistics and reports on occupational accidents).
- PMU2 shall apply a financial penalty, not to exceed 1% of the contract cost, for each major infringement, in addition to any costs associated with the infringement not borne by the contractor.

517. Any conflicts between the Contractor and CSC shall be resolved by the PMU2. ADB expects to receive the following information related to serious project-related infringements or incidents: (i) a written notice of the incident within 24 hours; (ii) the minutes of the investigation issued by relevant authorities (DOLISA or DONRE) within 30 days; and (iii) a full inventory of minor and major infringements and accidents, to be reported in the semi-annual environment monitoring report to ADB.

G.7. Reporting Plan

518. The following reports related to the implementation of the EMP will be prepared and submitted to relevant agencies. Frequencies and responsibilities are shown in **Table G-8**.

519. **Monthly progress reports by the contractors** (to the CSC). Each works contractor will submit monthly progress reports to the CSC. These reports will include reporting on EMP implementation performance as well as results of the monthly monitoring of noise.

520. **Monthly reports by the CSC** (to the PMU2). The CSC will submit monthly project progress reports to the PMU2. These reports shall also include a comprehensive section on EMP and CEMP implementation progress, grievances received, minor and major infringements, occupational accidents, and necessary corrective actions.

521. **Semi-annual environmental monitoring reports by PMU2** (to ADB). The PMU2 will submit semi-annual environmental monitoring reports in English and Vietnamese to ADB for clearance and disclosure. The reports will follow the template prescribed by ADB. Semi-annual reporting shall continue after construction completion until the project completion report is issued.

522. **Annual external verification reports by the EMC** (to PMU2, ADB, and DONRE). The EMC will submit annual independent EMP verification reports to PMU2, ADB and provincial DONREs. These reports will be disclosed to AHs. Independent EMP verification shall continue after construction completion until the project completion report is issued.

523. **Mid-term review report on EMP implementation** (by CSC/PMU2 to ADB). Not later than 1 month prior to the project's mid-term review mission, the PMU2, with support of the CSC, will submit a mid-term review report on EMP implementation to ADB.

524. **Draft project completion report on EMP implementation** (by CSC/PMU2 to MOT and ADB). No later than 3 months after the completion of the construction work, the CSC and PMU2 will gather compliance monitoring information from all contractors and provide a completion report on construction mitigation to ADB and MOT. The report will show the timing, extent, and success of the completed mitigation measures, and the maintenance and monitoring needs during operation.

Table G-8: Environmental Reporting Plan

Environment Reports		From	To	Reporting Frequency
Construction Phase				
Progress reports by contractors	Internal project progress report by construction contractors, including progress reporting on CEMP implementation, environmental effect monitoring, public consultation, occupational health and safety, training etc.	Contractors	CSC, PMU2	Monthly
Project progress reports by CSC	Internal project progress report including EMP and CEMP implementation progress	CSC	PMU2	Monthly
Semi-annual environmental monitoring reports	Internal EMP implementation reports, including compliance with the EMP and CEMPs, training plan and consultation plan, GRM, etc., following the template prescribed by ADB.	PMU2, CSC	ADB, DONREs, AHs (disclosed)	Semi-annual
Annual external verification reports on EMP implementation	External report on EMP implementation performance and compliance	EMC	PMU2, ADB, DONRE, contractors, AHs (disclosed)	Annual
Mid-term report on EMP compliance	Internal report on EMP implementation progress and compliance, proposed adjustments to the EMP and EMP implementation arrangements, as input to the mid-term review mission	CSC, PMU2	ADB	Before Mid-term review mission
Operational Phase				
Reports to ADB and disclosed to AHs	Semi-annual internal environmental monitoring reports, including results of environmental effect monitoring	PMU2	ADB	Semi-annual (until PCR is issued)
	External environment monitoring report	EMC	ADB, PMU2, PMU2, Lang Son DONRE, AHs	Once after one year of operation

Notes: ADB = Asian Development Bank; AHs = affected households; EMC = external environmental monitoring consultant; PCR = project completion report; PMU2 = Project Management Unit; CSC = Construction Supervision Consultant; DONRE = Department of Natural Resources and Environment

G.8. Capacity building, Training

525. The capacity of PMU2 and contractors' staff responsible for EMP implementation and supervision will be strengthened. All parties involved in implementing and supervising the EMP must understand the goals, methods, and practices of project environmental management. The project will address the lack of capacities and expertise in environmental management through (i) institutional capacity building, and (ii) training.

526. **Institutional strengthening.** The capacities of PMU2 to coordinate environmental management will be strengthened through a set of measures:

i. The appointment of a qualified environment specialist within the PMU2 in charge of EMP coordination, including GRM and coordination of environmental impact monitoring, training, reporting, etc.;
ii. The contracting of environmental specialists, forestry specialist, communication specialist, and construction safety engineers under the construction supervision consultancy services (CSC); and
iii. The contracting of an External Monitoring Consultant (EMC) to guide and verify PMU2, CSC and contractors in implementing the EMP and ensure compliance with ADB's Safeguard Policy Statement (SPS 2009);

527. **Training.** The PMU2 and contractors will receive training in CEMP preparation, EMP and CEMP implementation, supervision, and reporting, the Grievance Redress Mechanism, protection measures in legally protected sites, and construction safety. Training will be facilitated by the environmental specialists under the construction supervision consultancy services (CSC). The tentative training plan (**Table G-9**) shall be reviewed by the CSC based on a training needs assessment and refined in their technical proposal. The cost for this program, estimated at $5,625 will be included in the CSC contract. In addition, each works contractor will conduct daily box meetings and monthly trainings on construction site safety and environmental protection requirements for all construction staff.

Table G-9: Tentative EMP-related Training Program

Training	Attendees	Contents	Times	Period (days)	No. of persons	Cost ($/person /day)	Total Cost
EMP requirements and responsibilities, CEMP preparation, implementation	PMU2, PMU2, contractors	Laws/guidelines of Viet Nam in environmental protection, ADB Safeguard Policy Statement 2009, National Technical Regulations for the Environment, Organization of environmental management in PMU2/PMU2. CEMP preparation requirements and procedures, roles and responsibilities, monitoring, supervision and reporting procedures, review of	Twice - Once prior to, and once after one year of project implementation	2	20	25	$1,000

Training	Attendees	Contents	Times	Period (days)	No. of persons	Cost ($/person /day)	Total Cost
		experience (after 12 months)					
Environment protection measures in nature reserve	PMU2, contractors	Van Ban Nature Reserve – protection objectives, do's and don'ts. Procedure and penalties in case of non-compliance	Once prior to, and once after 6 months of project implementation	2	50	25	$2,500
EMP monitoring and reporting requirements	PMU2, contractors	Monitoring methods, data collection and processing, reporting systems, occupational health & safety during construction	Once (at beginning of project construction)	1	15	25	$375
Grievance Redress Mechanism, Public consultation	PMU2, contractors, DONRE	Roles and responsibilities, procedures, review of experience (after 12 months)	Twice - Once prior to, and once after one year of project implementation	2	20	25	$1,000
Occupational and community health and safety	PMU2, PMU2, contractors	Construction safety requirements, procedures and responsibilities; key regulations (Law on Occupational Health and Safety No. 84/2015/QH13, Joint Circular No. 12/2012/TTLT-BLDTBXH-BYT)	Twice - Once prior to, and once after one year of project implementation	2	15	25	$750
						Total estimated cost:	$5,625
Notes: PMU2 = Project Management Unit; DONRE = Department of Natural Resources and Environment. The daily rate per person includes costs for course material preparation, rental of training facilities, and food.							

G.9. Consultation, Participation and Information Disclosure

528. Plans for public involvement during construction and operation stages have been developed during project preparation (**Table G-10**). The PMU2 has main responsibility for public participation during project implementation, but will be supported by the CSC. Affected communities will be involved and consulted through site visits, investigations of specific issues, interviews, and public meetings. The budget for public consultation is estimated at approximately **$10,000**.

Table G-10: Public Consultation Plan

Organizer	Format	Frequency	Subject	Attendees
Construction Stage				
Contractors	Public meetings	Prior to start of construction works; quarterly thereafter	Presentation of planned activities and schedule; anticipated impacts and mitigation measures; GRM	Potentially affected households, ward PC representatives
PMU2, CSC	Public meetings & site visits and informal interviews	Once before construction commences (public meetings) and semi-annually thereafter during construction (site visits and informal interviews)	Presentation of planned activities and schedule; anticipated impacts and mitigation measures; GRM	Potentially affected households, ward PC representatives
PMU2, CSC	Expert workshop	As needed, based on public consultation	Comments and suggestions on mitigation measures, public opinion	Experts of various sectors, county/ district EPBs
CSC	Public opinion survey	Once at MTR stage	Public satisfaction with EMP implementation	Potentially affected households, ward PC representatives
Operational Stage				
PMU2, CSC	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Potentially affected households, ward PC representatives
CSC, PMU2	Public satisfaction survey	Once at PCR stage	Public satisfaction with EMP implementation Comments and suggestions	Potentially affected households, ward PC representatives

H. PUBLIC GRIEVANCE REDRESS MECHANISM

H.1. Project Grievances

529. A project grievance can be defined as an actual or perceived project-related problem that gives ground for complaint by an affected person (AP). As a general policy, the EA (Ministry of Transport - MOT) and IA (Project Management Unit No.2- PMU2) will work proactively to prevent grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. Nonetheless, it is possible that unanticipated impacts may occur if the mitigation measures are not properly implemented or unforeseen issues occur.

530. To address complaints, a project grievance redress mechanism (GRM) will be developed in accordance with ADB requirements and Government procedures. A GRM is a systematic process for receiving, recording, evaluating and addressing AP's project-related grievances transparently and in a reasonable period. The GRM will be established by PMU2 prior to the commencement of any land acquisition or resettlement activities, and will operate during the pre-construction, construction and operation phases.

H.2. Grievance Redress Mechanism

531. The proposed GRM integrates resettlement, environment and technical issues into a single structure. The structure considers Vietnamese laws and provisions for complaint handling as well as nuances of the operating environment and cultural attitudes toward lodging complaints. Specifically, the structure enables the GRM to:

- provide a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen as fair, effective, and lasting;
- build trust as an integral component of broader community relations activities; and
- enable a systematic identification of issues or problems, facilitating corrective actions and pre-emptive engagement.

532. The proposed GRM includes the following elements:

- a grievance receipt and registration system to provide ways for community members to register complaints and confirm they have been received;
- grievance eligibility assessment to determine if the issues raised in the complaint fall within the mandate of the GRM and if the complaints are legitimate;
- grievance assessment and investigation to clarify concerns raised in the complaint, to gather information on the situation, and to identify how the issues might be resolved;
- joint problem-solving, in which all relevant project stakeholders engage in a dialogue and action planning to resolve the problem;
- grievance tracking, including maintenance of written records of grievances, monitoring, public information disclosure and reporting to the affected people; and
- grievance closure, including community feedback and confirmation of resolution of the problem.

533. APs are entitled to lodge complaints regarding any aspect of affected environment, land acquisition and resettlement, such as noise, pollution, entitlements, rates and payment and procedures for resettlement, income restoration programs, etc.

534. The principles and procedures of the GRM are based on provisions of the Land Law No. 45/2013/QH13, dated 29/11/2013; Law on Grievances No. 02/2011/QH13, dated 11/11/2011;

Law on Denunciations No. 03/2011/QH13, dated 11/11/2011; Law on Receiving of Residents No. 42/2013/QH13, dated 25/11/2013; Decree No. 75/2012/ND-CP, dated 03/10/2012 of the Government Stipulating Detailed Regulations on Some Articles of Law on Grievance 2011; Decree No. 76/2012/ND-CP, dated 03/10/2012 of the Government Stipulating Detailed Regulations on Some Articles of Law on Denunciation 2011; Circular No. 06/2013/TT-TTCP, dated 30/9/2012 of the Government Inspectorate Stipulating Procedures of Denunciation Settlement, Circular No. 07/2014/TT-TTCP, dated 31/10/2014 of the Government Inspectorate Stipulating Procedures of Settling Grievances, Denunciating Letters and Letters of Requests; ADB's SPS (2009) and ADB's Public Communications Policy (2011). According to the Land Law No. 45/2013/QH13, a grievance must be submitted within 90 days of the time they receive the decision of land acquisition or become aware of the actions of the administrative action in question. In circumstances, such as sickness, natural calamity, or required to work or study in a distant location or other objective constraints, that time will not be counted within the 90 days mentioned above.

535. The GRM consists of several escalating stages. Complaint resolution and decision making are undertaken by PMU2's Environmental and Social Unit (ESU) in consultation with the District Grievance Redress Units of Than Uyen, Tan Uyen, Lai Chau City, Tam Duong (Lai Chau Province), Van Yen, Van Chan (Yen Bai Province), Van Ban (Lao Cai Province) then by a Provincial-level Grievance Redress Committee (GRC) of respective provinces, if required. The roles and responsibilities of PMU2 ESU, DGRU/CGRU and GRC are presented below.

536. **Environment and Social Unit of PMU2 (PMU2 ESU)**: The unit consists of social and environmental staff at PMU2, supported by staff members, preferably one or two members based in respective Districts. Staff of PMU2 ESU will (i) receive all complaints from APs seeking access to the GRM; (ii) register the complaints; (iii) determine complaint eligibility; (iv) send confirmation of eligibility to the complainant; (v) forward the complaint to relevant contractor (during construction) or facility operator (during operation), DGRU/CGRU and GRU; (vi) follow up with the DGRU/CGRU and the GRC on status of complaint redress; (vii) investigate the complaint and identify corrective actions that are within the mandate of MOT; (viii) inform AP on the proposed corrective action; (ix) track and record all decisions taken; (x) maintain a complaint registration, tracking and monitoring system; and (xi) report to MOT, respective districts (07) and provinces (03) on the implementation and result of the corrective action plans.

537. **District/City Grievance Redress Units (DGRU/CGRU) (07)**: The Unit consists of 6 officers of six relevant District/City divisions: Center for Land Fund Development, Natural Resources and Environment, Inspectorate, Finance, Construction, and Resident Receiving Office. The Units are chaired by the Vice Chairmen of 07 respective District People's Committees/City People's Committee. The DGRU/CGRU will (i) determine eligibility of complaints relating to resettlement and environment, (ii) conduct an assessment of complaints that relate to resettlement and environment, (iii) send confirmation of eligibility to the AP in case the complaint is related to resettlement and environment, with copy to PMU2 ESU; (iv) identify the corrective action plan and send it to the AP with copy to PMU2 ESU for further processing; (v) execute the plan and report the implementation, result of the plan implementation to PMU2 ESU; (vi) participate in GRC meetings if invited; (vii) monitor implementation of grievance resolution processes under their jurisdiction.

538. **The Grievance Redress Committees of respective Provinces of Lai Chau, Yen Bai and Lao Cai (GRC):** The Committee consists of 5 officers of five relevant provincial departments: Natural Resources and Environment, Inspectorate, Finance, Construction, and Resident Receiving Office. The Committee is chaired by the Vice Chairman of respective PPC. The Committee will (i) determine eligibility of appeals; (ii) conduct the assessment of appeals; (iii) send confirmation letter of eligibility to the AP with a copy to PMU2 ESU; (iv) identify corrective action

plans for appeals; (v) manage and supervise the implementation of the plan; and (iv) inform PMU2 ESU on the decision of the corrective action plan.

539. The GRM stages are presented below and illustrated in **Figure H-1**.

Stage 1: Submission of complaint.

a. The AP submits a written complaint to PMU2 ESU staff, or as letter, or email (with attached signed letter). Contact details of PMU2 ESU will be posted at the construction sites. A registered and legally recognized civil society organization (CSO) with valid representation authorization may file a complaint on behalf of an AP through PMU2 ESU.
b. Complaints can also be sent directly to the works contractor (during construction through a hotline number that will be posted for construction-related matters (such as noise, dust, access to property and other matters) which require immediate action, or to the operator (during the operation phase). Contractors are required to register the complaint, and report to PMU2 ESU on complaints received and actions taken.

Stage 2: Registration, Eligibility Assessment, Confirmation of Eligibility [max. 5 working days]

a. PMU2 ESU registers the complaint in a grievance registry and identifies the nature of the complaint. If the complaint relates to resettlement (case 1), PMU2 ESU forwards the complaint to the relevant DGRU/CGRU for further processing. If the complaint relates to other matters such as environment, project design, damage to property or others (case 2), PMU2 ESU proceeds to the next step.
b. The DGRU/CGRU (case 1) or PMU2 ESU (case 2) determines whether the complaint is eligible for the GRM using the screening procedure.
c. If the complaint is deemed ineligible, the complainant is informed of the decision and the reasons for ineligibility.
d. If the complaint is deemed eligible, the DGRU/CGRU (case 1) or PMU2 ESU (case 2) identifies how the complaints should be investigated and addressed and who will be responsible for these actions, and informs the relevant parties accordingly. Options include: (i) the works contractor (during construction phase); (ii) the operator (during operation phase); (iii) the Center for Land Fund Development; (iv) the DGRU/CGRU; (iv) PMU2 ESU; (v) others.
e. The DGRU/CGRU (case 1) or PMU2 ESU (case 2) sends a confirmation of eligibility to the complainant, with copy to PMU2 ESU for case 1. The letter provides information on when a decision will be made regarding the complaint, and the main agency in charge of addressing the complaint.

Stage 3: Assessment and Identification of Action [max. 10 working days]

a. If the complaint is eligible, the entity identified under Stage 2(d) conducts an assessment and gathers information about the complaint to determine how it might be resolved.
b. If outside experts or technical information is needed, the entity identified under Stage 2(d) may seek such guidance and may request all parties concerned (including the complainant, as relevant) to participate in the grievance redress process.
c. The entity identified under Stage 2 (d), in consultation with PMU2 ESU, drafts a time-bound action plan including responsibilities for plan implementation.
d. The entity identified under Stage 2(d) submits the assessment letter including time-bound action plan to the complainant. PMU2 ESU is copied in the letter.

Stage 4: Confirmation by AP, or First Appeal [max. 10 working days]

a. The complainant confirms in writing consent with the proposed action plan to execute immediately the action plan.
b. The complainant may submit an appeal to GRC of respective Provinces in the following cases: (i) no response is provided within 30 days after acknowledgement of the complaint; (ii) the complainant disagrees with the decision under Stage 3.

Stage 5: Review, Eligibility Assessment and Confirmation of Appeal by GRC of respective Provinces [max. 5 working days]

a. The GRC informs PMU2 ESU/concerned DGRU/CGRU that the complainant appealed the decision, and requests all relevant documents and issued decisions from PMU2 ESU/concerned DGRU/CGRU. The GRC, in consultation with the DGRU/CGRU determines whether the appeal is eligible using their own screening procedure.
b. If the appeal is deemed ineligible, the complainant is informed of the decision and the reasons for ineligibility.
c. If the appeal is deemed eligible, the GRC identifies who and how the complaint should be investigated and addressed, and informs the relevant parties accordingly.
d. The GRC sends a confirmation of eligibility to the complainant with copy to PMU2 ESU for registration. The letter provides information on when a decision will be made regarding the complaint, and the main agency in charge of addressing the complaint.

Stage 6: Assessment and Identification of Action by GRC [max 10 working days]

a. If the complaint is eligible, the entity identified under Stage 5 (c) conducts an assessment and gathers information about the appeal to determine how it might be resolved.
b. If outside experts or technical information is needed, the entity identified under Stage 5 (c) may seek such guidance and may request all parties concerned (including the complainant, as relevant) to participate in the grievance redress process.
c. The entity identified under Stage 5 (c), in consultation with PMU2 ESU, drafts a time-bound action plan including responsibilities for plan implementation.
d. The entity identified under Stage 5 (c) submits the assessment letter including time-bound action plan to the complainant. The DGRU/CGRU and PMU2 ESU are copied in the letter.

Stage 7: Confirmation by AP, or Second Appeal [max 10 working days]

a. The complainant confirms agreement in writing with the Decision and the proposed action plan.
b. The complainant may appeal to the local court in the following cases: (i) no response is provided within the 30 days after acknowledgement of the appeal; (ii) the complainant disagrees with the decision in Stage 6. In fact, at any time in the GRM the AP may appeal to the local court system if they so choose.
c. If the AP is not satisfied with the outcome of the GRM, they may send their grievance directly to ADB's Southeast Asia Department (SERD) through ADB Viet Nam Resident Mission. If the AP is not satisfied with the responses of SERD, they can also directly contact the ADB's Office of the Special Project Facilitator.

Stage 8: Implementation of Action, Monitoring, and Reporting [duration: as defined in the Decision and time-bound action plan]

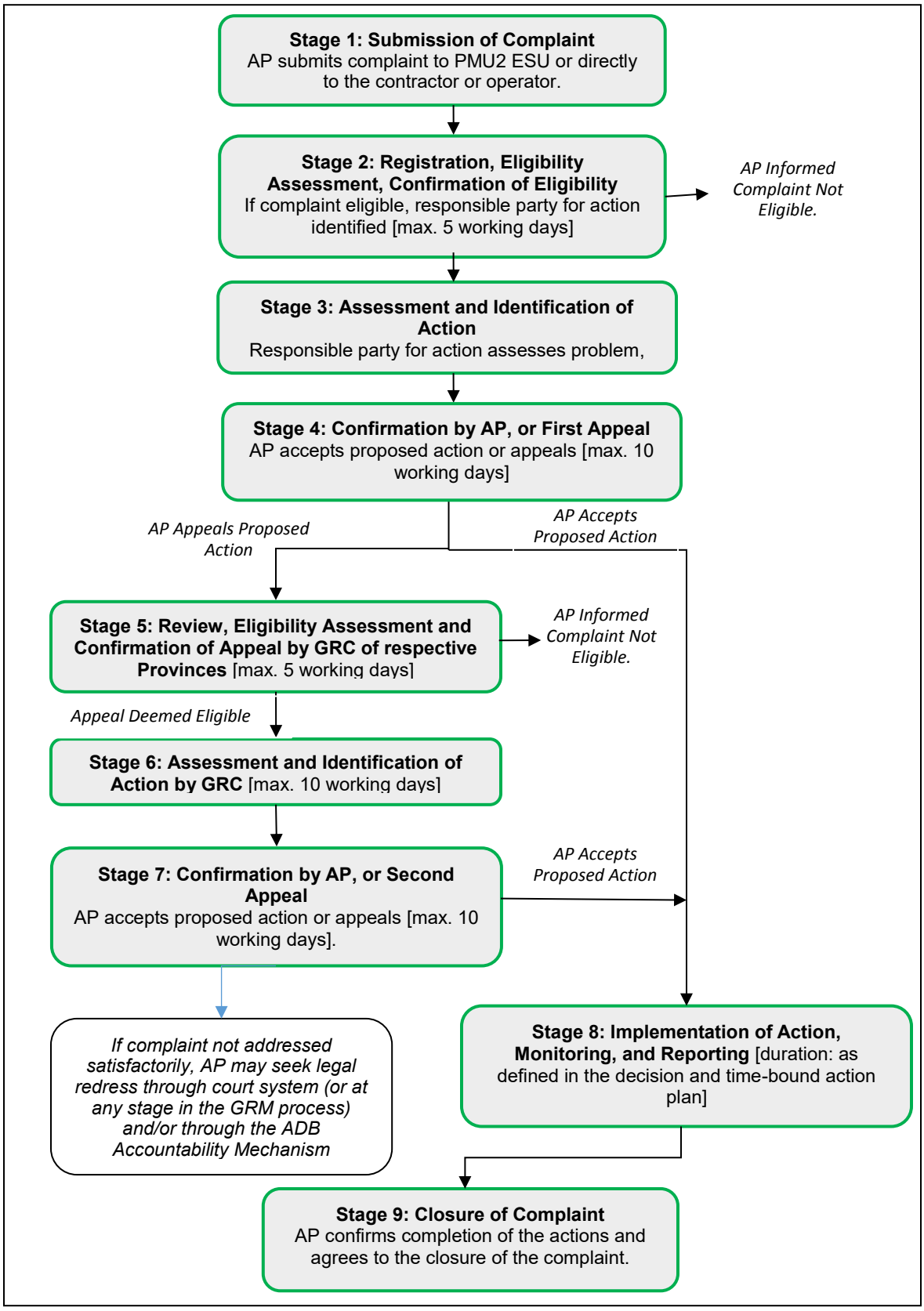
a. Implementation of the Decision and action plan commences, with close collaboration of relevant project stakeholders depending on the type of complaint.
b. PMU2 ESU monitors the implementation of actions and records findings, to be filed through the grievance administration system. As part of the monitoring process, PMU2 ESU consults the relevant project stakeholders, as needed.

Stage 9: Closure of Complaint

a. When the decision/actions are implemented and when monitoring is completed, PMU2 ESU prepares a final report which is shared with the complainant, DGRU/CGRU and GRC, and filed.
b. The complainant confirms completion of the actions and *agrees* to the closure of the complaint. The grievance dossier is closed and filed in the project archive.

540. The AP will not have to pay any fee for his/her case (official or unofficial). APs will be encouraged to use the above GRM. However, the GRM does not impede access to the country's judicial or administrative remedies by APs, at any stage, if they so wish.

Figure H-1: Project GRM



I. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

I.1. 10.1. Information Disclosure

541. Formal disclosure to affected persons and stakeholders of information on the Northern Mountain Road Connectivity Project in three Northern Provinces of Lao Cai, Lai Chau and Yen Bai that occurred during the preparation of the EIA is meant to form the beginning of continued information disclosure and stakeholder involvement as the Project is implemented. As part of the stakeholder communication strategy for the project, regular information exchange, and meetings with stakeholders are strongly encouraged throughout implementation of the Project.

542. Project information (including a written project summary and information on land acquisition, compensation and the GRM) and a written summary of the draft domestic EIA were disclosed in October 2017 to APs and stakeholders as part of the public consultation process (see below) by local environmental consultants. The commune people's committees received the summary of this project EIA in Vietnamese prior to the public consultation process (see below).

543. The finalized domestic EIA will be posted on the EA's website, and hard copies will be provided to offices of District PCs and communal offices along the proposed roads. The final draft EIA will be disclosed on the EA's and ADB's website, and at the offices of District PCs. Similarly, all Project progress reports with references to stakeholder consultation minutes, environmental monitoring, and reports on EMP implementation released by the EA/IA will be available at the same offices and websites.

I.2. 10.2. Public Consultation Process

544. Public consultation was conducted to help identify opportunities and risks, improve subproject design and implementation, and increase subproject ownership and sustainability. Public consultation is specifically required by the ADB's environmental and social safeguard policies. Public consultation in preparation of the domestic EIA (approved by MONRE) must also comply with the public consultation requirements as per Government's Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan, and Circular No. 27/2015/TT-BTNMT dated 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plan.

545. High level consultations with provincial authorities were conducted in January 2018 while wide scale consultations at community level were conducted from 25 January 2018 to 10 February 2018 through questionnaires and public meetings in all three project provinces of Lao Cai, Lai Chau and Yen Bai. The latter were held at the Ward/Town/Commune PC.

546. Public consultation was conducted jointly for environment and resettlement related matters. The objectives of public consultation were as follows:

- To share all information on the tentative activities of the project with local community and stakeholders;
- To gather opinions/comments and concerns from local authorities and the community on local environmentally sensitive matters;
- To provide residents with details on resettlement, environment, gender as well as ethnic minority issues through village loudspeaker system and subproject information brochures/leaflets;

- To collect opinions and feedback of the local communities regarding the subproject implementation;
- To respond questions from local communities concerning the project and safeguard policies.

547. The public meeting followed a 3-step procedure:

- The consultant introduced the project including project location, and alignment of proposed roads for development/improvement;
- The environmental consultant presented ADB's environmental policy, safety regulations in the Viet Nam road sector, anticipated environmental impacts and respective mitigation measures (as identified in the draft EIA), the grievance redress mechanism for environmental and resettlement problems; and
- The social/resettlement consultant presented ADB's resettlement plan; impacts due to the acquisition of land and properties; policies of GOV and local authorities, the Project's policies in compensation for loss as the state acquired land and properties on land; and potential impacts due to land acquisition/resettlement.

548. About two weeks prior to public consultation, the consultant informed and cooperated with the local authorities to invite representatives of the affected HHs to attend public consultation meetings. Attending the meeting were representatives of the People's Committee, Farmer's Union, Viet Nam Fatherland Front, Women's Union, Youth Union, administration officials, head of residential areas and households affected by the subprojects.The total number of participants involved in public consultation was 1,110 in all three provinces. The results of the public consultation meetings are described in the following section.

I.3. Results of Community Level Stakeholder Consultation

549. Summary of consultation meetings are summarized in **Table I-1**. Meeting attendance sheets are presented in **Appendix D**. In general, the project is fully supported by the residents along the project roads. The main concerns expressed by consulted project stakeholders include the following:

a. The proposed bypasses are supported. Several additional bypasses are recommended to be include in the project to avoid densely populated towns and minimize future traffic accidents.

b. The project owner and contractors are requested to implement strictly environmental protection measures during the construction stage of the subprojects to avoid negative effects on life and livelihoods of the local community, especially roadside businesses.

c. The project owner and contractors are requested to use construction methods that prevent/minimize noise, soil erosion, landslides. Contractors should conduct slope protection during construction stage of the roads.

d. The project owner and contractors are requested that wastewater, waste, noise, and dust will not affect people's life.

e. The project owner is requested to provide detailed description of road alignment to avoid affecting houses and other property, community health and safety during construction and operation of the improved roads.

Table I-1: Summary of Public Consultation Results at Community Level

Ward/ Commune	Meeting place/Date	Participants	Number of participants			Opinion of the community	Feedback from the project consultants
			Total	Male	Female		
Lao Cai Province							
1. Minh Luong Commune	People's Committee of Minh Luong Commune Feb 2, 2018	Representatives of local authorities: Commune Chairman, Party Secretary, Cadastral – Construction Officer. Project consultants	25	15	10	- Support the policy of road construction of the project. - Project implementation should minimize impacts on local people. - The commune wants to build a bypass road to ensure traffic safety, avoid noise, and minimize environmental sanitation. However, the bypass road will run through a graveyard, the communal culture house and 10 households in Hamlet 3. - Some households want to keep the existing road (upgraded) so as not to affect the agricultural land area (rice land). - More details of the new road should be provided.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC. - The alignment of the proposed bypass will be reviewed to minimize impact on agricultural land and the tombs. - Information on the project and construction plan will be publicized.
2. Tham Duong Commune	Commune People's Committee Feb 2, 2018	Representative of local authorities: Commune Chairman, Cadastral – Construction Officer Project consultant	46	22	24	- Local people are very excited with the improvement of the road. - Need clearance agreement before construction time. - Need to pay attention to resettlement area for better living. - Request for compensation in accordance with State regulations.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC. - Information on the project and construction plan will be publicized
3. Duong Quy Commune	People's Committee of Duong Quy Commune	Representatives of local authorities: Commune Chairman, Commune Party Secretary. - Project consultant	63	42	21	- The commune wants to make another route because the proposed bypass may encroach on the cemetery of the whole commune and will go through the high hills which make it difficult to construct. The bypass road should go through the field. This will give the commune more	- All opinions and comments from the people are well recorded. - The alignment of the proposed bypass will be reviewed to minimize impact on agricultural land and the cemetery.

						opportunities for business and development. - Projects need to ensure minimal impacts on environment and the people.	
4. Hoa Mac Commune	Hoa Mac Commune People's Committee Feb 1, 2018	- Representative of local authorities: Commune Chairman, Commune Vice Chairman, Head of Police. - Project consultant	47	25	22	- Commune people and authorities support the road construction project. - Questions about compensation policy and road design. - The compensation must be public and transparent.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC.
5. Son Thuy Commune	Cultural House of Khe Lech village, Son Thuy commune Jan. 29, 2018	Representatives of local authorities: Vice Chairman of the People's Committee, cadastral officer Project consultant	42	17	25	- The local people agree to support the project, but it is necessary to consider the drainage to avoid flooding for people because the existing road is much higher than the house. - It is necessary to consider the resettlement area, if any. - The project should pay due attention to the living environment of the people.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC. - DD consultant will be required to ensure that drainage of properties and agricultural fields is not impacted by the road. - Environmental issues will be dealt with a proper EMP.
6. Lang Giang Commune	People's Committee of Lang Giang Commune Jan. 31, 2018	Representatives of local authorities: Vice Chairman of the People's Committee, cadastral officer Project consultant	43	25	18	- The people and the commune authorities agree to support the project implementation in the area and expect the project to deploy quickly. - The roadside houses are already built backward to prepare for the road widening and less impacts are expected. - The compensation must be adequate for the people, ensuring the interests of the people.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC.
7. Khanh Yen Town	Khanh Yen Town People's Committee	Representatives of the local government: the chairman of the town, the vice chairman of the	32	18	14	- People and local authorities suggested to build a town bypass to avoid hospital, schools, high volume of cars running through the town, about 400 cars a day.	- All opinions and comments from the people are well recorded. - The bypass option was considered and analyzed during preliminary design, but is considered too expensive and involving too much land acquisition

		town council, the secretary of the town party committee, the chief of the town, the president of the Fatherland Front. Project consultant				The bypass should go southward to reduce impacts on the people.	at this stage. It may be considered in the future.
8. Khanh Yen Thuong Commune	People's Committee of Khanh Yen Thuong Commune	Representatives of local authorities: Chairman of the Commune People's Committee, Vice Chairman of the Commune People's Committee. Project consultant	13	8	5	- Require consulting units, designers to coordinate with the commune authority to implement the project for best results. - Ask for the price of compensation and detailed design plans. - Environmental issues should be seriously considered by the project and avoid house damages and subsidence.	- All opinions and comments from the people are well recorded.
9. Tan Thuong Commune	People's Committee of Tan Thuong Commune Jan. 29, 2018	- Representatives of local authorities: Chairman of the Commune People's Committee, Secretary of the Party Committee, Cadastral Officer. - Project consultant	18	11	7	- The people and the commune authorities support the project implementation. - Ask for the road detailed design, resettlement area, impacts on current business along the road. - A quarter of the population are living on road 279 so a resettlement area may be needed. - Compensation to people should be made at market prices.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC.
10. Nam Xe Commune	Commune People's Committee January 25, 2018	- Representative of local government: Chairman of Commune People's Committee, Secretary of Party Committee, Commune Cadaster.				- The commune expects the project to upgrade the route to facilitate trade in goods and transportation. - Concerns voiced over the traffic safety during the operation of the project: traffic accidents, traffic density. - Do not build worker camps near tomb areas.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC. - Environmental issues will be dealt with a proper EMP.

		- Project consultant				- The project should support ground leveling for Pom Khao Area, to host 30 households if relocation is required. - Environmental issues have been addressed by the project and serious implementation of mitigation measures is required. - The proposed widening of the road will not have large impacts on the forest.	
Lai Chau Province							
1. Ban Bo Commune	Commune People's Committee Feb 1, 2018	- Representatives of local authorities: Commune People's Committee chairpersons, commune cadastral official - Consultant Representative	25	17	8	- The commune fully supports the implementation of the project. - The recoverable assets should be adequately compensated to the people at reasonable rates. - During the construction process, the project should avoid affecting the environment and life of the people. - Around the cemetery area (km 116 + 800), sewage pipes should be installed away from graves.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB Lai Chau PPC. - Information on the project and construction plan will be publicized. - Environmental issues will be dealt with a proper EMP.
2. Phuc Khoa Commune	Phuc Khoa Commune People's Committee Feb 2, 2018	Representatives of local authorities: Chairman of the People's Committee, Party Secretary, cadastral staff of the commune. Consultant Representative	49	29	20	- Agree with the road construction. - The project needs to provide adequate compensation for the people. - It is necessary to provide support to people living on roadside trading (disrupting and limiting trading). - During the implementation of the project, land and property measurement must be open and transparent to the people. - The construction must ensure environmental safety, especially during rain to avoid subsidence and landslide.	
3. Tan Uyen town	People's Committee	Representatives of local authorities:	51	29	20	- Agree with the construction plan of the project.	

	of Tan Uyen town Feb 3, 2018	Vice Chairman of Commune People's Committee, Chairman of Fatherland Front Committee, Land Administration-construction official. Consultant Representative				- It is recommended to fully implement measures on environmental protection and compensation policies. - The construction of a bypass should be considered to reduce traffic density through the town. When the project goes into operation, large trucks passing through the town will cause traffic disruption and unsafety. - Care must be taken when constructing pavement, drainage, and monitoring should be in place for all the phases.	
4. Na Tam Commune	Na Tam Commune People's Committee Jan. 31, 2018	- Representative of local authorities: Vice Chairman of Commune People's Committee, Vice Chairman of Commune Council. - Consultant Representative	22	22	0	- Agreed with the policy of building road. - The project goes through two large fields of the commune and it is necessary to ensure water supply for rice farmers. - The construction should avoid a cemetery located at Km108 +500. - The implementation project should ensure the communal security and safety of the area. - Environmental mitigation measures must be fully implemented during construction. - For households losing their land and houses, they need to be compensated adequately.	
5. Ban Hon Commune	Commune People's Committee January 30, 2018	- Representatives of local authorities: Vice Chairman of Commune People's Committee, Chair of Fatherland Front Committee, Land Administration-construction official.	42	30	12	- Livelihood support should focus on supporting trees (orange, macadamia), livestock (chicken, etc.) suitable with local conditions. -For the household losing the house area but still living by the road will be affected by noise and vibration during project operation. Attention should be given to relocation and life stabilization.	

		- Consultant Representative				- When constructing, it is necessary to ensure proper environmental measures and drainage positions, avoiding the land for production of houses and fish ponds.	
6. Ban Giang Commune	Cultural House of La Bo Village January 30, 2018	- Representative of local government: Secretary of Commune Party Committee, Commune Cadastral chief officer, - Consultant Representative	74	44	30	- A bypass should be considered to avoid densely populated area. - Perennial crops (tea) need more support e.g. more seedling. - Appropriate compensation is needed for the affected people.	
7. Pac Ta commune - Tan Uyen district	People's Committee of Pac Ta Commune - Tan Uyen District	- Representative of local authorities: Commune People's Committee Chairman, Commune People's Committee Office - Consultant Representative	41	21	20	- Agree on the construction plan of the project. - Compensation unit price must be satisfactory, about 60 – 70% of the market price. - Property structures should be compensated according to the value at the time of construction, to ensure the rights of affected people. - It is necessary to take measures to manage waste rock so as not to affect the production land, gardens and houses. - It is necessary to arrange access paths to people's production areas to ensure agricultural production.	
8. Trung Dong Commune	People's Committee of Trung Dong Commune Feb 5, 2018	- Representative of local authorities: Commune Vice Chairman, Commune Land Officials - Consultant Representative	14	11	3	- Agree with the road construction. - Attention should be paid to ensuring publicity and transparency in the inventory of affected assets and land so that adequate compensation is provided to the people.	

						- Construction plans should not cause landslide, especially in the spring. - Need support for life stabilization for affected households.	
9. Than Thuoc Commune - Tan Uyen District	People's Committee of Than Thuoc commune - Tan Uyen district	- Representatives of local authorities: Commune People's Committee, Commune Cadastral official. - Consultant Representative	38	24	14	- Agreed with the policy of building this route. - During compensation and land clearance, it is necessary to measure and identify affected assets in a transparent manner and have the consent of the people. - Compensation should be based on market value. - It is necessary to ensure environmental safety and construction safety during construction.	
10. Dong Phong Ward	Cultural House of Cluster 24 - Dong Phong Ward Jan. 29, 2018	- Representatives of local authorities: Chairman of Commune People's Committee, Land Administration to build commune. - Consultant Representative	54	34	20	- Solid houses and class 4 houses have been built on agricultural land (not yet converted) along the section through Cluster 24. - A drainage system should be built to ensure water drainage in the area. - Agree with the compensation policies of the project. - The project owner should have measures to minimize dust, pollution, vibration during construction.	
11. Phuc Than Commune, Than Uyen District	People's Committee of Phuc Than Commune, Than Uyen Feb 1, 2018	- Representatives of local authorities: Chairman of Commune People's Committee, Commune Land Administration, Office staff - Statisticians - Consultant Representative	48	22	26	- Agree with the road construction. - The project must take measures to minimize the environmental impacts during construction. - Compensation plan should be made appropriate for affected people, assets and property. - Inventory measurement work needs to ensure transparency and equity for APs.	

12. San Thang commune	San Thang Commune People's Committee	- Representatives of local authorities: Chairman of Commune People's Committee, Commune Land Administration, Office staff - Statisticians - Consultant Representative	32	20	12	- Agree with road construction. - The project must take measures to minimize the environmental impacts. - The construction should not affect the power pole newly constructed on the left side of the road. - Compensation plan should be made appropriate for affected people, assets and property. - Inventory of loss measurement needs to ensure transparency and equity for APs.	
Yen Bai Province							
1. Lien Son Farm Town	People's Committee Office of Lien Son Farm Town Feb 2, 2018	- Representatives of local authorities: town vice-chairman, cadastral official. - Project consultant	18	10	8	- 100% of people support the road project. - The compensation and support must be clear and avoid losses to the affected people. For households doing business along the road who lose their land, other roadside land should be compensated for them to start over. - Plant trees along the road when operated. - 100% of people want to receive cash compensation for the construction and repair of the house. - Vocational training for young people is needed.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC. - Information on the project and construction plan will be publicized. - Environmental issues will be dealt with a proper EMP.
2. Suoi Quyen Commune	Suoi Quyen Commune People's Committee Feb 3, 2018	- Representatives of local authorities: commune vice-chairman, cadastral cadastral officer, village chief, secretary of the cell. - Project consultant	63	35	28	- More details of the house impacts and relocation plan should be provided. - Compensation price must be agreed on negotiation, while according to the regulations of Yen Bai province, the current price is VND 27mil/ha. - Concerns on impacts and compensation on rice fields and unregistered land.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC.

3. An Luong Commune	People's Committee of An Luong Commune Feb 5, 2018	Local government representatives: the commune office, youth union secretary, commune cadastral officials, village heads - Project consultant	65	36	29	- 100% of households want to keep the existing road alignment which does not affect land for production. - Strict and transparent measurement of loss and fair compensation. - Decisions to relocate or stay depend on the more details of compensation plan.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC. - No bypass is proposed for An Luong Commune. The road will follow the existing alignment.
4. Son Luong Commune	People's Committee of Son Luong Commune Feb 6, 2018	- Representatives of local government: commune chairman, land officer, Farmer's Union chairman, Women Union Chairperson, Youth Union Secretary of the commune - Project consultant	23	13	ten	- The situation of roads is very difficult and the road improvement is welcome. - The issue of compensation should be taken seriously and accurately. The current price specified by Yen Bai province is too low. - The widening of the road should not take much land so the business people can the remaining land and receive cash for home repair. - Need to have job support for rice farmers who lose farming land.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC.
5. Mo Vang commune	People's Committee of Mo Vang Commune Feb 07, 2018	- Representatives of local government: Commune Chairman, land officers, Farmer's Union chairman, Women Union Chairperson, Youth Union Secretary of the commune, commune office staff - Project consultant	29	16	13	- Concerns on compensation for land with and without right title. - The project owner must ensure the environmental impacts minimized for the people and the interests of the business households, must have monitoring units to ensure the environmental compliance.	- All opinions and comments from the people are well recorded. - The compensation process will be implemented in accordance with the requirements of ADB and Lao Cai PPC.
6. An Thinh commune	An Thinh Commune	- Representatives of	49	27	22	- Questions about the project implementation period.	- All opinions and comments from the people are well recorded.

	People's Committee Feb 08, 2018	Local Government : Chairman of the commune, cadastral officer, Secretary of the Party Committee, office staff, Farmer's Union chairman, Women Union Chairperson, Youth Union Secretary of the commune. - Project consultant				- Contractors should water the road regularly to avoid dust during construction. Should set up a community based supervision board. - The road expansion is quite convenient because of previous planning for road widening. - Should deal with all environmental issues, e.g. drainage ditches during construction.	- Community participation in supervision of the EMP is welcome and defined in the EMP.
7. Dai Son commune	Hamlet 2 Cultural House, Dai Son commune Feb 10, 2018	- Representatives of local authorities: Vice Chairman of the People's Committee, cadastral officer - Project consultant	44	25	19	- The implementation of the project is fully supported by local people. - It is necessary to ensure the environmental impacts minimized. Do not heat asphalt by burning used tires.	- All opinions and comments from the people are well recorded. - Environmental issues will be dealt with a proper EMP.

I.4. Results of Consultation with key Government Agencies

550. From 25-27 January 2018, consultation meetings were organized in the 3 project provinces with government agencies to present the initial findings of the environmental impact assessment and to seek their views of the project's potential environmental implications. Agencies consulted included provincial and district people's committees, provincial departments of natural resources and environment (DONRE), provincial department of agriculture and rural development, provincial and district forestry protection departments, and the Van Ban Nature Reserve Management Board. The PPTA consultant provided key findings of the EIA, which was followed by a Q&A session with the meeting participants. **Table I-2** shows the persons and agencies involved in the consultation process.

Table I-2: Agencies and individuals consulted

Van Ban, Lao Cai Province (25 January 2018)	
Full Name	**Position, Agency**
Pham Binh Minh	Vice Chairman of Van Ban District People Committee
Pham Van Cuong	Head of Economic Infrastructure Department, Van Ban District
Nguyễn Huy Việt	Head of Natural Resources and Environment Division, Van Ban District
Lê Quang Đồng	Deputy Director of Agriculture and Rural Development Department
Đặng Xuân Hoan	Deputy Director of the PDOT
Lai Chau, Lai Chau Province (26 January 2018)	
Giang A Tinh	Vice Chairman of the Provincial People's Committee
Vũ Văn Luật	Deputy Director of Department of Agriculture and Rural Development
Đỗ Văn Tính	Deputy Director of the Department of Natural Resources and Environment
Trần Văn Sứng	Vice Chairman of Tam Duong District People's Committee
Hoang Nguyen Ly	Deputy Head of Tam Duong Economic Infrastructure Department
Nguyen Van Bien	Director of Forest Protection Department
Vu Xuan Bang	Head of Than Uyen Forest Protection Unit
Pham Ngoc Phuong	Director of PDOT
Pham Minh Tuan	Vice Chairman of Lai Chau Provincial People's Committee
Đàm Vũ Hùng	Head of Natural Resources and Environment Division
Chu Thanh Minh	Head of urban management
Vuong The Man	Vice Chairman of Than Uyen District People's Committee
Hoang Dai Thang	Deputy Director of Provincial Department of Planning and Investment
Nguyen Sy Canh	Chairman of Ton Uyen District People's Committee
Yen Bai, Yen Bai Province (27 January 2018)	
Nguyen Chien Thang	Vice Chairman of the People's Committee
Đinh Khắc Yên	Deputy Chief of Office - Provincial People's Committee
Đỗ Việt Bách	Deputy Director of the Provincial Department of Transport
Hà Manh Cuong	Deputy Director of Department of Agriculture and Rural Development
Nguyễn Phúc Cường	Deputy Director of Department of Agriculture and Rural Development
Mai Mong Tuan	Chairman of the People's Committee of Van Chan District
Chu Quoc Tuan	Vice Chairman of the People's Committee of Nghia Lo Town
Vu Quang Hai	Chairman of the People's Committee of Van Yen District
Nguyen Tien Nam	Head of Economic Department

Mai Tien Dung	Deputy Head of Urban Management Department of Nghia Lo town
Dinh Xuan Truong	Head of Economic and Infrastructure Department of Van Chan
Le Tien Dung	Head of Natural Resources and Environment Department of Van Yen
Dinh Manh Cuong	Deputy Head of Economic and Infrastructure Department of Van Chan
Luu Hong Minh	Deputy Director of Agriculture and Rural Development
Nguyen Thi Xuan Huong	Deputy Director of Agriculture and Rural Development of Van Chan
Hoang Thi Chien	Deputy Head of Natural Resources and Environment Department of Van Yen District

551. The following tables summarize the main findings and feedbacks provided by the consultees, and the project team's responses to key queries. In general, the project is fully supported by government agencies at provincial and district level.

Table I-3: Feedback to draft EIA from agencies in Van Ban District, Lao Cai Province

Mr. Pham Binh Minh, Vice Chairman of Van Ban District People Committee	**Project team's response**
• The project is very important for the district's socio-economic development and to reduce existing bottlenecks. The eastern section of the road was currently used by more than 1,000 heavy trucks per day, which significantly affected traffic safety with regular traffic blockages due to traffic jams and road repairs. • The PPC and DPC fully support the tunnel option and the proposed by-passes to minimize impact on the Van Ban nature reserve (tunnel) and reduce the current burden of heavy traffic on existing residential areas (bypasses). • Whatever design option is chosen, the project will have environmental impacts. It is important to consider environmental impacts especially for the construction phase. • An improved road will have significant benefits in terms of dust and noise pollution, which are currently affecting residents along the road.	• The tunnel option has been considered, and was viewed as the preferred option from an environment point of view. However, given the low traffic demand forecast the tunnel option at this time is economically not viable. It may be considered at a later stage. • Environment impacts during construction will be managed through the EMP. An independent agency/consultant will monitor compliance with the EMP.
Mr. Nguyễn Huy Việt, Head of Natural Resources and Environment Division, Van Ban District	**Project team's response**
• Spoil disposal should be at spoil disposal sites authorized by the provincial Department of Construction. Many sites are suitable, but a permit must be secured prior to spoil disposal. • Borrow material (gravel, sand) must be procured from licensed quarries. The district has currently 7 licensed quarries. • The project is not anticipated to have significant impacts on the environment if the EMP is properly implemented.	• The need to secure permits for spoil disposal and to use licensed borrow pits is specified in the EMP. • EMP implementation will be supervised by the PMU2 and the CSC, and evaluated independently by an external monitor.
Mr. Lê Quang Đồng Deputy Director of Agriculture and Rural Development Department	**Project team's response**
• Conversion of natural forest requires Prime Minister approval as per Government Directive, conversion of natural forest is strictly prohibited without permission. With approval of the Investment Policy,	• The exact impact of the project on forestry resources will only be known at detailed design stage. A re-forestation plan ensuring full offset will be developed by the

the conversion of natural forest is considered approved. • A re-forestation plan is required to fully offset impacts at ratio 1:3. Re-forestation within the ecological restoration subzone (ERS) of the nature reserve is possible. The province may assign the nature reserve management board to implement the re-forestation plan, which should be financed through the project. • The road can be built in the Van Ban nature reserve, if in line with the nature reserve master plan. The project is not expected to have significant impacts on the nature reserve as it will only involve widening without re-alignment, and is far away from the strictly protection subzones.	PMU2 and implemented by licensed entity. The EA committed to finance the re-forestation plan. • The road is defined in the nature reserve master plan and does considered in line with the objectives of the master plan.
Mr. Ha, Vice-Director of the Van Ban Nature Reserve Management Board • This is an important project for the region; however, it could have environmental impacts if not properly managed. • The tunnel option is fully supported as it would reduce the current encroachment of the existing road on the nature reserve. • If the project only involves widening the road without re-alignment, the project will not have significant impacts on forestry resources in the reserve as existing land along the road is already converted. Should any forest be affected, then compensation re-planting in accordance with national regulations will be required. • Disposal areas for spoil should be carefully selected. No spoil should be disposed in the nature reserve. • The NRMB did not conduct any survey of wildlife crossings along the existing road, but does not consider the road an important fragmentation of habitats. CE/EN species are in strictly protected zones of the nature reserve. • Illegal poaching and wildlife trade have significantly reduced in last 10 years due to efforts to confiscate weapons and the establishment of 2 checkpoints along NH279. The project is not expected to induce illegal poaching or illegal mining.	**Project team's response** • The tunnel option has been considered, and was viewed as the preferred option from an environment point of view. However, given the low traffic demand forecast the tunnel option at this time is economically not viable. It may be considered at a later stage. • A re-forestation plan ensuring full offset will be developed by the PMU2 and implemented by licensed entity. The project owner committed to finance the re-forestation plan. • Spoil disposal within the reserve is strictly prohibited. This is clarified in the EMP.

Table I-4: Feedback to draft EIA from agencies in Lai Chau Province

Mr. Đỗ Văn Tính, Deputy Director of the Department of Natural Resources and Environment • DONRE fully supports the project. The project is not anticipated to have any impact on the Hoang Lien Son National Park, which is far away from the road. • The project must fully adhere to Vietnamese laws and regulations related to environment protection. • The implementation of environment mitigation measures by the contractors must be monitored.	**Project team's response** • The project will adhere to all relevant laws and regulations of the Government of Viet Nam, as well as ADB's Safeguard Policy Statement. • EMP implementation will be supervised by the PMU2 and the Engineer, and evaluated

	independently by an external environment monitor.
Mr. Vũ Văn Luật, Deputy Director of Department of Agriculture and Rural Development • DARD fully supports the project. The project is not anticipated to have significant impacts on forestry resources. Forest along the road is poor quality forest or plantation forest. • Should forestry resources be affected, then compensation planting at ratio 1:3 must be ensured per the New Forestry Law, to become effective 1 January 2019. Adequate budget should be earmarked.	**Project team's response** • A re-forestation plan ensuring full offset will be developed by the PMU2 and implemented by licensed entity. The project owner committed to finance the re-forestation plan.
Giang A Tinh, Vice Chairman of the Provincial People's Committee • PPC fully supports the project, including the tunnel option as it would reduce the current footprint on the Van Ban nature reserve. • PPC fully supports the proposed Tan Uyen bypass and the new road from Dong Pao to Ban Po as these would increase traffic safety, reduce land acquisition and resettlement, and improve urban environment. • Spoil disposal sites must be proposed by the IA, appraised by the provincial DONRE and approved by the PPC.	**Project team's response** • The tunnel option has been considered, and was viewed as the preferred option from an environment point of view. However, given the low traffic demand forecast the tunnel option at this time is economically not viable. It may be considered at a later stage. • The need to secure permits for spoil disposal sites is specified in the EMP.

Table I-5: Feedback to draft EIA from agencies in Yen Bai Province

Mr. Nguyen Chien Thang, Vice Chairman of the Provincial People's Committee • The PPC fully supports the project. The road is very important for the province, providing a critical link to Lai Chau Province. The project will have many beneficial impacts, most importantly socio-economic development. It will improve connectivity and access to markets, especially for local farming communities. • The road will follow the existing road alignment, and as such its upgrade is not expected to have significant impacts on the environment. • The PPC is committed to ensure compliance with the Vietnamese environmental regulatory framework and ADB's safeguard requirements.	**Project team's response** • No response required.
Mr. Nguyễn Phúc Cường, Deputy Director of Department of Natural Resources and Environment • The project's positive impact will outweigh potential negative impacts. • Since the road will follow the existing road alignment, earthwork and land acquisition are not expected to be significant. • Impacts during construction are anticipated and should be adequately addressed.	**Project team's response** • Environment impacts during construction will be managed through the EMP. An independent agency/consultant will monitor compliance with the EMP.
Mr. Hà Manh Cuong, Deputy Director of Department of Agriculture and Rural Development	**Project team's response**

• DARD fully supports the project, which it considers very important. The existing road is of poor quality. Many agricultural products are produced in the west part of the province. The road will improve access to markets for these products. • Forestry resources are likely to be affected. A re-forestation plan must be prepared and submitted to DARD for appraisal and to PPC for approval. The province will designate land area for reforestation and assign the Forestry Protection Department for its implementation.	• A re-forestation plan ensuring full offset will be developed by the PMU2 at detailed design stage and will be submitted for appraisal and approval to DARD and PPC, respectively. • The project owner committed to finance the re-forestation plan.

J. CONCLUSIONS

552. The EIA identified several potentially significant **environmental impacts** related to the design, upgrade and operation of the project roads, and proposed mitigation measures. The exact alignment of the project roads will need to be reconfirmed during detailed design. The preliminary design presented in the feasibility study and used as basis for the EIA foresees to use the existing alignment of NH32, NH279 and PR 175 to minimize fragmentation of settlements and minimize impacts on environmentally sensitive areas. 3 bypasses and 2 new road alignments are proposed which will remove existing transport bottlenecks, improve traffic safety, minimize resettlement and reduce existing noise and vehicular emission on residential areas. However, because of these bypasses and widening of the existing roads, the project will require the permanent acquisition of 38.2 ha of land, including 32.6 ha of productive land of various types (agricultural, forestry). These impacts are addressed through the provincial land acquisition and resettlement plans prepared for the project.[19]

553. The project is also expected to require removal of roadside vegetation to allow the widening of the project roads. Roadside vegetation is in most areas is of low ecological value as the areas and consists primarily of shrubs, production forest and highly disturbed secondary natural forest. Using a very conservative assessment methodology, the EIA estimates that 23.1 ha of **forest could be affected by the project**, including 20.2 ha of production forest, 2.0 ha of protection forest, and 1.0 ha of special-use forest. Special-use forest likely to be affected by the project is located exclusively within the boundaries of the Ecological Restoration Subzone (ERS) of the Van Ban Nature Reserve. Protection Forest is located at various sections of NH32, NH279 and PR175, but primarily on the West side of the Khau Co Pass. Forest types affected by the project include secondary natural forest (mainly within Van Ban Nature Reserve) and planted forest. None of the forest areas affected by the project classifies as primary natural forest.

554. The exact impact will be estimated at detailed design stage and will be fully offset through compensation replanting in compliance with Circular 23/2017/TT0-BNNPTNT "Provisions on Replacement Afforestation upon Conversion of Forest Use Purpose to Other Purposes" and the new Forestry Law, to become effective on 1 January 2019. Per the new Forestry Law (Article 21), forest classified as natural forest must be compensated through compensation replanting of an area 3 times the affected area. Compensation replanting will be financed by the project owner, but implemented by provincial forestry authorities. Tree replanting will be conducted exclusively in protection and special-use forest zones, as required per Circular 23/2017/TT0-BNNPTNT.

555. Without mitigation measures, **construction impacts** have the potential to be significant. The project is expected to generate 6.3 million m^3 of spoil. Suitable spoil disposal sites will be identified by district environmental protection authorities for excavated soil that can't be used for road embankment. These sites will be defined in the bidding documents for works contracts. The project will require the construction of 22 new bridges to cross rivers and streams. Bridge pier construction will avoid the high runoff season to minimize negative impacts on river hydrology, ecology and surface water quality. Other anticipated construction environmental impacts are fugitive dust, noise, disposal of solid waste, temporary traffic disturbance, and occupational and community health and safety at construction sites.

556. NH279 currently passes through the **Hoang Lien Van Ban Nature Reserve** (HLVBNR). The alignment of NR279 within the VBNR passes between several blocks of forest which are designated Ecological Restoration Subzones (ERS). Several alignments were considered including upgrading the existing road, a tunnel and viaducts. All studied alternatives encroach on the Ecological Restoration Subzone (ERS) of the HLVBNR, and

[19] The resettlement plans for the three provinces are available under separate cover at www.adb.org.

permission was obtained from the HLVBNR Management Authority (through the EIA appraisal process by MONRE). Sustainable development is permitted within the forest blocks. Each block contains several different types of forest and these have been identified. None of these forest types prohibit the rehabilitation of the road, which is defined in the Nature Reserve's master plan.

557. The HLVBNR Management Authority and Lao Cai provincial forest protection department (FPD), the department of natural resources and environment (DONRE) and the department of agriculture and rural development (DARD) have been consulted and support the project. The HLVBNR Management Authority has expressed some concerns over temporary impacts during construction. These concerns are addressed in the EMP. Spoil disposal within the boundary of the reserve will be strictly prohibited. Training will be provided by the CSC, with support of the HLVBNR Management Authority to construction workers, to provide information on the nature reserve's sensitivities, and to instruct them on prohibited activities including collection of non-timber forest products, wildlife poaching and others. The operation of NH279 is not anticipated to have significant incremental impacts on the nature reserve and its protection objectives. There are no wildlife crossings reported on NH279. HLVBNR Management Authority have checkpoints on NH279 to police illegal activities such as poaching animals and illegal logging.

558. NH32 currently passes about 4 km from Hoang Lien National Park. The rehabilitation of the road is not anticipated to have any negative impact on the National Park. This was confirmed by relevant provincial authorities. PR175 does not encroach on any protected area.

559. The project will rehabilitate or replace box culverts and pipe culverts to reduce the current risk of waterlogging. A traffic safety appraisal will be conducted in compliance with relevant Vietnamese regulations before the roads are open to traffic. The impact of vehicular emissions on local **air quality** is not expected to be significant. This will be confirmed through regular air quality monitoring by provincial Departments of Natural Resources and Environment (DONRE) during the operation period of the roads.

560. **Noise along project roads** is not anticipated to significantly (i.e. more than 3dB) increase because of the project, as compared to the without project (baseline). Beyond 20m the noise level is not projected to exceed the permissible Viet Nam limit (70dBA) during daytime so the impact on the communities on both sides of the road will be not be significant. However, the forecast results also show that most households living along the project roads will be affected by noise within 30 meters of the road during the night. The noise level at 100m is projected to be 55dB(A), which meets the Vietnamese night time standard and the IFC daytime standard of 55dB(A) but exceeds the IFC guideline value of 45dB(A) at night. It is however impossible and impractical at this stage of project preparation to identify the exact scope of impact. Therefore, this EIA recommends that a more detailed analysis of the project's impact on noise sensitive receptors be conducted at detail design stage, and that the need noise protection measures be included in the BOQ of bidding documents.

561. Absolute **CO2eq emissions** for the baseline year (2018) were estimated based on actual traffic counts and amount to 41,323 tons per year. These absolute emissions are anticipated to increase to 69,678.5 tons per year (2031) and 104,252.7 tons per year (2041). These figures represent the sum of normal traffic (i.e. traffic that would use the project roads even if no improvements were made); diverted traffic (i.e. traffic that changes from an original route to the project road because of the road improvement); and generated traffic (i.e. traffic that occurs only because of the improvement to the roads, due to the reduction in perceived costs). The sum of diverted plus generated traffic thus represents the relative or net CO2eq emissions, i.e. the net increase in CO2eq emissions generated by the project as compared to "business as usual" or "without project". For the period 2021-2041 (20 years), the cumulative net CO2eq emissions are estimated at -35,400 tons (Table F-22), representing an average annual emission reduction of approximately 2,000 tons as compared with the no-project alternative.

562. An **environmental management plan** (EMP) has been prepared to address the identified negative impacts. The EMP outlines potential impacts, mitigation and monitoring measures, institutional arrangements, training requirements, and an environment implementation budget that is 1% of the total civil works costs. The works contractors will be required to prepare site-specific construction EMPs (CEMPs) to manage environmental impacts based on the EMP of this EIA.

563. The following **EMP implementation arrangements** will be put in place to implement and supervise the EMP: (i) MOT as the Executing Agency will be responsible for the overall implementation and compliance with loan assurances, this EIA and the EMP; (ii) PMU2 will be responsible, on behalf of MOT, for the day-to-day management of the project. PMU2 will coordinate procurement and consultant recruitment. The PMU2 will have the overall responsibility to supervise the implementation of environment mitigation and monitoring measures, ensure the contractors' compliance with environmental management requirements, and coordinate the Grievance Redress Mechanism (GRM) and report to ADB. The PMU2 will appoint one qualified full-time staff to coordinate and manage EMP implementation; (iii) PMU2 will hire a construction supervision consultant (CSC) to advise and support the PMU2 throughout project implementation, supervise construction works, conduct environmental effect monitoring, provide oversight of contractors' environmental management performance, and provide training on EMP, amongst others. The CSC will include environment specialists, an occupational safety specialist, and a forestry specialist; (iv) each works contractor will develop a site-specific construction EMP (CEMP) and will assign one person responsible for EMP implementation supervision and monitoring, and one qualified person responsible for construction safety. Contractors will conduct noise monitoring at construction site boundaries and nearby sensitive receptors to confirm compliance with relevant Vietnamese ambient quality standards as well as the IFC (2007) standard for noise. The implementation of safeguard plans, including the EMP and the LARP, will be verified by an independent external monitoring consultant (EMC), to be contracted by the PMU2.

564. Meaningful **public consultations** were carried out during EIA preparation to inform the project design and environmental assessment process. In total, 1,100 potentially affected people in the project provinces as well as more than 50 representatives from relevant provincial and district authorities (including the People's Committees, the Departments of Agriculture and Rural Development (DARD, the Departments of Natural Resources and Environment (DONRE) and other specialized agencies such as the Van Ban Nature Reserve Management Board) were consulted. The responses are overwhelmingly positive and the project is receiving full support. Issues raised during public consultation relate to land acquisition and resettlement, and fears over poor environment management performance of contractors during construction, which could affect local environment and community health and safety. These concerns have been address through mitigation measures defined in the EMP. Consultation will continue during project implementation in accordance with the consultation plan defined in the EMP.

565. Environmental complaints will be handled through the project safeguards **grievance redress mechanism (GRM)** described in this EIA, coordinated by PMU2 and the CSC.

566. The project is classified as **medium climate risk**. A climate risk and vulnerability assessment (CRVA) was prepared by the CRVA Consultant financed through the Climate Change Fund (CCF). The DD consultant will be required to apply projected climate data (precipitation, peak runoff) rather than historic climate data. Projected climate data (IDF curves) has been generated by the CRVA team and shall be used as basis for the detailed design (Figures D13-D17). The DD consultant shall also critically review climate-related risks at the hotspots identified by the CRVA team, and consider incorporating adaptation measures for those sites as recommended by the CRVA team. Exact cost estimates of climate-proofing of the project roads is not possible at preliminary design stage, but are estimated to amount to 1% of the total investment costs.

567. This EIA **concludes** that the project is feasible from an environmental point of view. Some significant adverse and irreversible impacts are anticipated, justifying the environment Category A classification. Diligent implementation of the EMP by works contractors, to be closely monitored by the CSC and verified by an independent, external environmental monitoring consultant, will mitigate anticipated construction impacts and risks to acceptable levels.

K. APPENDIXES

APPENDIX A: DETAILS ON EXISTING CLIMATE-RELATED FLOOD-PRONE and LANDSLIDE-PRONE SITES

APPENDIX B: FORMS FOR REPLACEMENT AFFORESTATION PLAN PREPARATION AND SUBMISSION

APPENDIX C: DRAFT ENVIRONMENT CLAUSES TO BE INCLUDED IN THE BIDDING DOCUMENTS FOR WORKS CONTRACTORS

APPENDIX D: RECORDS OF PUBLIC CONSULTATION

APPENDIX E: TRAFFIC NOISE ANALYSIS

APPENDIX A

DETAILS ON EXISTING CLIMATE-RELATED FLOOD-PRONE AND LANDSLIDE-PRONE SITES

APPENDIX A: DETAILS ON EXISTING CLIMATE-RELATED FLOOD-PRONE and LANDSLIDE-PRONE SITES

1. In the framework of the Climate Risk and Vulnerability Assessment (CRVA) of the project, the consultant team conducted in-depth analysis of sites along the road prone to climate-induced failures, including landslides, rockfall, slope collapses or floods. The sites are listed and presented below.

2. **NH279-1** (Climate-related hazard: Landslide due to heavy precipitation and storms). The first site is located in Tan Thuong commune. As the steep slope on the left side of the road is covered with vegetation, it minimizes the risks of landslides. Vegetation at this site should be maintained.

Figure A1-1: Potential landslide site (NH279-1)

3. **NH279-2** (Climate-related hazard: Landslide or slope collapse due to heavy precipitation and storms). This site is located in a residental area (Village 5, Son Thuy commune). On top of the high slope, people grow cassava, and many large trucks full of ore (15-20 tons) are crossing throughout the day. The trucks get stuck as the road becomes muddy and slippery after heavy rain and the vibration from these trucks leads to localized landslides.

Figure A1-2: Landslide site (NH279-2)

4. **NH279-3** (Climate-related hazard: Flood due to heavy precipitation and storms). This site is in a low-lying area in Son Thuy commune. Despite that, no flood has been reported in recent years.

Figure A1-3: Potential flood site (NH279-3)

5. **NH279-4** (Climate-related hazard: Flood due to heavy precipitation and storms). This site is located near Khe Lech bridge**.** The area experienced heavy rains in 2016 and 2017, causing minor landslides. The water level came within 40 cm of rising over the bridge.

Figure A1-4: Flood site (NH279-4)

6. **NH279-5** (Climate-related hazard: Landslide and rockfall due to heavy precipitation and storms). This site is located in Khanh Yen Commune (Van Ban district) and is characterized by high bluff and exposed cliff. As the result of intense rainfall, the slope becomes vulnerable to failure that leads to landslides and rockfall. Underneath the road is a maize growing area which would easily be damaged.

Figure A1-5: Landslide and rockfall site (NH279-5)

7. **NH279-6** (Climate-related hazard: Floods and landslides due to heavy precipitation and storms). This site is in Lang Giang commue (Van Ban district). According to local people, this site is considered an area that is sensitive to floods and landslides. There are several reasons for this high sensitivity. On the left side, the mountain is structurally a mix of limestone and sandstone. Instablities in slopes usually precede landslides. In fact, there has been minor landslides occurring every year and these are almost certain to continue.

Figure A1-6: Flood and landslide site (NH279-6)

8. **NH279-7** (Climate-related hazard: Floods due to heavy precipitation and storms). This is a residential area of Hoa Mac commune (Van Ban district). The inhabitants of this area are mainly Tay people. *"In June 2016, floodwater rapidly rose after a night, the water level was higher than ever before"*, a local woman said. It hit 1 m above the road, or nealy a half of the first floor. After 2-3 hours, water gradually went down. Another woman reported that her fish pond was completely damaged. This is the low-lying area, if the road is built higher, houses from both sides would be more damaged by flooding.

Figure A1-7: Flood site (NH279-7)

9. **NH279-8** (Climate-related hazard: Landslide due to heavy precipitation and storms). This site is located in Hoa Mac commune (Van Ban district) and is similar to NH279-1. The slopes will be at risk of landslide as a result of the new construction and expansion of the road, when slopes are no longer covered by vegetation. There are several road sections that have similar characteristics to this site and this issue will become more sensitive if/when roads need to be expanded.

10. **NH279-9** (Climate-related hazard: Flood due to heavy precipitation and storms). Another site with high flood risk is located in residental area of village 13, Duong Quy Commune. The water-level rose approximately 40-50 cm above the road in 2016. Smaller vehicles like motorcycles were warned not to drive into flooded areas. Households located near the road also experienced flooding and will continue to be vulnerable to floods during and after the upgrade of the road at this site.

Figure A1-8: Flood site (NH279-9)

11. **NH279-10** (Climate-related hazard: Flood and flash flood due to heavy precipitation and storms). This site is one of those where floods occur regularly. In the valley, there is a stream flowing through this site. The stream stage is only a half meter below the road. In October 2017, the Khanun storm hit with intense rain, causing flash floods and landslides in Yen Bai. As a result, the bridge in Nghia Lo town collapsed and interrupted accessibility to the town. And at the bottom of the stream there are also many large rocks showing that flash floods have occurred in this stream. According to local people, their homes had flooded for an hour before flood waters subsided. The road has no barrier which means it is very dangerous for transport during flooding.

Figure A1-9: Flood site (NH279-10)

12. **NH279-11** (Climate-related hazard: Rockfall due to heavy precipitation and storms). This place is located at the foot of the mountain. The collapse of rock from moutain walls is related to natural characteristics such as discontinuities within the rock mass, intact condition of the rock mass, weathering susceptibility, external stresses. Geological fracture is the main reason for the high sensitivity of this site. This area has experienced landslides and rock falls before and is almost certain to experience landslides in the future.

Figure A1-10: Rockfall site (NH279-11)

13. **PR175-1** (Climate-related hazard: Flood due to heavy precipitation and flash flood). The trace from the recent flood (10-11 October 2017) indicates that water level rose 3.5 meters above the road. This resulted in significant social and economic costs due to disruption of trade and work-related travel for at least three days (i.e. up until 2am on the 14th October 2017 when the flood water subsided.

Figure A1-10: Hotspot PR175-1

14. **PR175-2** (Climate-related hazard: Landslide due to heavy precipitation and storms). This site is located in the Mo vang commune about 24 kilometers South of Mau A bridge. The heavy rainfall event (10-11 October 2017) increased the amount of water in the fill foundations which decreased the resistance to sliding. To mitigate this, stone embankments that provide open drainage should be used.

Figure A1-10: Hotspot PR175-2

15. **PR175-3** (Climate-related hazard: Landslide due to heavy precipitation and storms). This site is located in the Mo Vang commune about 25 kilometers South of Mau A bridge. This site experiences landslides on the right side every year during the wet. The location of the road near the toe of the slope results in an amount of lateral movement. For this mitigation, the hole is filled with material that is strong enough to prevent the buildup of hydrostatic pressure during the most intense rainfall. On the opposite side, the embankment is reinforced with stone and/or the slope is reduced.

Figure A1-10: Landslide site PR175-3

16. **PR175-4.** (Climate-related hazard: Flood due to heavy precipitation and storms). This site is about 26 kilometers South of Mau A bridge and is subject to frequent flooding (at least three flood events per year) due to low elevation and poor drainage. Adaptation will require appropriate culvert systems and/or elevation of the road. This has possible implications for nearby residents.

Figure A1-10: Flood site PR175-4

17. **PR175-5** (Climate-related hazard: Flood due to heavy precipitation). This site has low elevation and poor drainage.

Figure A1-10: Flood site PR175-5

18. **PR175-6** (Climate-related hazard: Landslide due to heavy precipitation and storms). Heavy precipitation and storms results in significant deformation at this site. To address this the new road should have a stone embankment. The exact embankment quantities should be determined by a geotechnical investigation prior to construction.

Figure A1-10: Landslide site PR175-6

19. **PR175-7** (Climate-related hazard: Landslide (and erosion) due to heavy precipitation and storms). The site is located in Mo Vang commnue along Ngoi Thia river. The location and geometry of this slide make it particularly susceptible to multiple drivers: (1) High overall precipitation corresponds to reduce resisting forces, thus decreasing stability of mass earth on both sides; (2) Increased storm frequency and intensity tend to make large movement resulting in landslide; (3) Higher water level from Ngoi Thia river also increase erosion at the toe of the slide removing material mass which provides resistance against sliding.

Figure A1-10: Landslide site PR175-7

20. **PR175-8** (Climate-related hazard: Landslide (sinkhole) due to heavy precipitation and storms). This location is different to other landslide sites. The scarp is on the right edge of the road adjacent to the mountain slope suggesting this is more likely a sinkhole. The ground beneath is not solid and has increasingly become too weak to support the road surface. Rain triggers the ground failure (e.g. recently, in the heavy rainfall event from 10-11 October 2017, half the width of the road was lost at this site).

Figure A1-10: Landslide site PR175-8

21. **PR175-9** (Climate-related hazard: Flood due to heavy precipitation and storms). This site is a typical spot of parts of this road that are low lying and have not been asphalted. There is no drainage line to protect the road from excessive rainwater. Heavy rain turns the road into slush, making driving on this public road very unsafe. Drivers (local residents) easily lose control of their vehicles when subjected to road sections like this during and after rain. It is recommended that culverts and improved drainage be installed.

Figure A1-10: Flood site PR175-9

22. **PR175-10** (Climate-related hazard: Flood due to heavy precipitation and storms). This site is located in Mo Vang commune. The route is in a low elevation area and therefore is flood-prone. The trace from the recent flood (10-11 October 2017) indicates that water level rose 50-60 cm above the road.

Figure A1-10: Flood site PR175-10

23. **PR175-11** (Climate-related hazard: Flood due to heavy precipitation and storms, combined with human drivers associated with the hydropower plant). The site is regularly flooded after heavy rain and/or water releases from the upstream dam associated with the hydropower plant. During heavy rainfall events, An Luong spillway releases water from the dam associated with the hydropower plant so that the water does not overtop and damage or destroy the dam. This exaggerates the impacts of flooding at PR175-11 and disrupts transportation until floodwater subsides (usually at least 2-3 hours later). Mo Vang commune (Van Yen district) was completely isolated in a recent flood. To avoid congestion and isolation, the recommended solution is to build a bridge so that vehicles can still pass through during heavy rainfall or spill events that lead to flooding.

Figure A1-10: Flood site PR175-11

24. **PR175-12** (Climate-related hazard: Landslide due to heavy precipitation and storms). This site is located near a hydroelectricity plant (in Suoi Quyen Commune, Nghia Lo district). The route goes along an area with poor vegetation and extremely high and steep slopes. Therefore, this site has very high potential for landslides during construction and during the life of the PR175.

Figure A1-16: Landslide site (PR175-12)

25. **PR175-13** (Climate-related hazard: Landslide due to heavy precipitation, storms and flash flooding). A landslide happened recently at this site. The sloop is not too high or steep and is covered in shrubs. However, the vibrations of vehicles passing by, combined with loose and saturated soil during heavy precipitation, storms or flooding means it is likely that landslides will continue to occur here.

Figure A1-17: Landslide site (PR175-7)

26. **PR175-14** (Climate-related hazard: Flooding and rockfall due to heavy precipitation, storms and flash flooding). The trace from the recent flood (10-11 October 2017) indicates that water level rose to 1.2 meter above the road at this location. During floods it is not possible for vehicles to pass through this location. As the erosive energy is concentrated on outside bank of the stream meander, the edge of the road has recently eroded. At the opposite side of the road, the steep slope is vulnerable to heavy rain. Rockfall damaged the road and left giant rocks.

Figure A1-15: Flood and rockfall site (PR175-14)

27. **PR175-15** (Climate-related hazard: Landslide and erosion due to heavy precipitation and storms). This site is located in Suoi Quyen commune. It is currently impacted by a landslide that steadily moves during the wet seasons. The landslides here are more to do with persistent rain over several weeks/months and associated saturation of soil rather than as a response to specific rainfall events. Movements of a few meters over every year during the July-October wet season is common at this location. The position of this landslide with respect to the high bluff leads to challenges associated with maintaining and repairing the road. Therefore, realignment of the road is recommended as an adaptation option for PR175-4.

Figure A1-14: Landslide and erosion site (PR175-15)

28. **PR175-16** (Climate-related hazard: Flooding due to heavy precipitation and storms). This site is located in Suoi Quyen commune, a location that experiences floods. The road was flooded with the highest level of 1.5 m in the time of Khanun storm (10-11 October, 2017).

Figure A1-13: Flood site (PR175-16)

29. **PR175-17** (Climate-related hazard: Landslide and erosion due to heavy precipitation and flash flooding). This site is located in Suoi Quyen commune along the Ngoi Thia River. The river side experienced significant collapses during the wet season (July-October) in 2017. The opposite side of the river has sensitive agriculture ecosystem covered by banana trees, grassland and scrubland. Another problem at this site is the susceptibility of the bluff below the road to water erosion. The confluence where a tributary joins the main stem of Ngoi Thia River results in more sensitivity to erosion in the flooding season or during other times when the river flow is strong. Data from the Department of Transportation (Yen Bai Province) indicates that this site has not experienced maintenance or repair. Extreme flash flood events are recorded here at a rate of 1.25 events each year (or five times every four years).

Figure A1-17: Landslide and erosion site (PR175-16)

30. **PR175-18** (Climate-related hazard: Landslide due to heavy precipitation and storms). This site is located on Suoi Quyen commune. The route goes through high terrain and has good drainage, steep slopes, sporadic soil, rock, small trees and good vegetation. However, the cutting into the slope for the road has increased the potential for landslides.

Figure A1-11: Landslide site (PR175-18)

31. **PR175-19** (Climate-related hazard: Erosion and flood due to heavy precipitation and storms). This site is along Son Luong bridge. Erosion is on the left side. Flooding caused by Ngòi Thia River will be a risk factor to bridge construction.

Figure A1-18: Flood and erosion site (PR175-19)

32. The table below lists the locations within the project roads that a regularly affected by climate hazards (i.e. the “hot spot” sites). Also shown are the site-specific structural and no-structural options that are recommended as most appropriated for adapting to and minimizing the risks and vulnerabilities associated with current and future climate hazards.

NH32/NH279	Climate hazard	Structural adaptation options	Non-structural adaptation options
NH279-1	Landslide	Cross-section design: Reduce slope gradient; Step cut (AOS08) Slope protection by cement concrete: shotcrete (with and without reinforcement) covers slopes (AOS04).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).

NH279-2	Landslide	Slope protection by grass and tree planting: vetiver grass, local grass (AOS02) Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02). Fire monitoring and alert system; Warmning; Fire protection by separation band (AON04).
NH279-3	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15) Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02). Fire monitoring and alert system; Warmning; Fire protection by separation band (AON04).
NH279-4	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by increasing the aperture of drainage works (AOS14) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15) Erosion protection by cement concrete retaining wall (AOS11).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
NH279-5	Landslide, Rockfall	Slope protection by cement concrete: concrete slabs, shotcrete (with and without reinforcement) covers slopes (AOS04). Cross-section design: Reduce slope gradient; Step cut (AOS08).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02). Realignment and integrate climate in the future planning (AON03)
NH279-6	Flood, Landslide	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Cross-section design: Reduce slope gradient; Step cut (AOS08). Slope protection by cement concrete: concrete slabs, shotcrete (with and without reinforcement) covers slopes (AOS04). Erosion protection by (cemented ashlar AOS12).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).

NH279-7	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13)	
NH279-8	Landslide	Slope protection by gabions and cemented ashlar retaining wall (AOS03). Reinforcement concrete retaining wall (AOS06). Cross-section design: Reduce slope gradient; Step cut (AOS08).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
NH279-9	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13)	Realignment and integrate climate in the future planning (AON03)
NH279-10	Flood	Flooding protection by increasing the aperture of drainage works (AOS14) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15) Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13)	Realignment and integrate climate in the future planning (AON03)
NH279-11	Rockfall	Slope protection by gabions and cemented ashlar retaining wall (AOS03). Reinforcement concrete retaining wall (AOS06).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175	**Climate hazard**	**Structural adaptation options**	**Non-structural adaptation options**
PR175-1	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Slope protection by gabions and cemented ashlar retaining wall (AOS03). Erosion protection by cemented ashlar (AOS12).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02). Realignment and integrate climate in the future planning (AON03)
PR175-2	Landslide	Slope protection by gabions and cemented ashlar retaining wall (AOS03). Erosion protection by cemented ashlar (AOS12).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-3	Landslide	Reinforcement concrete retaining wall (AOS06). Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).

		Embankment Slope protection by cemented ashlar (AOS12).	
PR175-4	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by increasing the aperture of drainage works (AOS14) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15)	Realignment and integrate climate in the future planning (AON03)
PR175-5	Flood, Landslide	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by increasing the aperture of drainage works (AOS14)	Realignment and integrate climate in the future planning (AON03)
PR175-6	Landslide	Reinforcement concrete retaining wall (AOS06). Slope protection by gabions and cemented ashlar retaining wall (AOS03). Embankment Slope protection by cemented ashlar (AOS12).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-7	Landslide, Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Reinforcement concrete retaining wall (AOS06). Slope protection by gabions and cemented ashlar retaining wall (AOS03). Erosion protection by cement concrete retaining wall (AOS11).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-8	Landslide	Reinforcement concrete retaining wall (AOS06). Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-9	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15)	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-10	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13)	Realignment and integrate climate in the future planning (AON03)

		Flooding protection by increasing the aperture of drainage works (AOS14) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15) Reinforcement concrete retaining wall (AOS06). Erosion protection by cement concrete retaining wall (AOS11).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-11	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by increasing the aperture of drainage works (AOS14) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15) Reinforcement concrete retaining wall (AOS06). Erosion protection by cement concrete retaining wall (AOS11).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-12	Landslide	Reinforcement concrete retaining wall (AOS06). Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-13	Landslide	Cross-section design: Reduce slope gradient; Step cut (AOS08). Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-14	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Flooding protection by constructing bridges/tunnels over/under flood-prone sites (AOS15) Reinforcement concrete retaining wall (AOS06). Erosion protection by cement concrete retaining wall (AOS11).	Realignment and integrate climate in the future planning (AON03) Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02).
PR175-15	Landslide	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Erosion protection by cement concrete retaining wall (AOS11).	Realignment and integrate climate in the future planning (AON03)

PR175-16	Flood	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Erosion protection by cemented ashlar (AOS12).	Realignment and integrate climate in the future planning (AON03)
PR175-17	Landslide	Erosion protection by cement concrete retaining wall (AOS11).	Realignment and integrate climate in the future planning (AON03)
PR175-18	Landslide	Slope protection by grass and tree planting: vetiver grass, local grass (AOS02). Slope protection by gabions and cemented ashlar retaining wall (AOS03).	Strengthen (or regenerate) vegetation coverage along the road alignment to enhance resilience to flooding or slope slump (AON02). Realignment and integrate climate in the future planning (AON03)
PR175-19	Flood - Erosion	Flooding protection by rising design elevation of center line and structure (bridges, culverts…) (AOS13) Erosion protection by cement concrete retaining wall (AOS11). Slope protection Erosion by cemented ashlar retaining wall (AOS10).	

APPENDIX B

FORMS FOR REPLACEMENT AFFORESTATION PLAN PREPARATION AND SUBMISSION

APPENDIX B: Forms for Replacement Afforestation Plan Preparation and Submission

Circular No. 23/2017 / TT-BNN, ANNEX 01:

REPLACEMENT AFFORESTATION PLAN

(Issued together with Circular 23/2017 / TT-BNN dated 15 November 2017 by the Minister of Agriculture and Rural Development)

I. GENERAL INFORMATION ABOUT INESTMENT PROJECT WITH PURPOSE OF FOREST CONVERSION TO OTHER PURPOSES

(General name of the investor, establishment decision, address, account number, transaction bank, field of operation, ...)

II. REASONS FOR DEVELOPMENT

.....

.....

III. OVERVIEW OF FOREST AREA AND FOREST LAND FOR CONVERSION OF PURPOSES

1. Name of the project:

.....

.....

2. Information on forest area expected to change the purpose of forest use for other purposes (statistics according to forest plots)

TT	Lot	Location			Area (ha)	Classification by original source			Classification by Use types			Volume	
		Plot	Sub-area	Administrative Unit (Commune, District, Province)		Natural Forest (condition)	Plantation		Special Use Forest	Protection Forest	Production Forest	Timber volume (m^3)	Bamboo (No. Trees)
							Main species	age					
1	*2*	*3*	*4*	*5*	*6*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1		...											
2		...											
...		...											
Total[1]													

[1] Sum up 2, 6, 14, 15; Column 2 - total lots

3. Purpose of use for forest area after transferring the forest land

.....

.....

.....

.....

IV. CONTENT OF FOREST ALTERNATIVE PLAN – REPLACEMENT AFFORESTATION PLAN

1. Area of replacement forest land:

- Place of planting: belonging to lot ... subarea…., are ..., Commune .... District ... Province

- Forest land type (protection, special use, production):

2. Plan for replanting forest

- Plant species

- Density

- Method of planting (mixed, pure species):

- Care and protection of planted forests:

- Time and schedule (details for each year)

- Construction of anti-fire road (km)

- Average investment per hectare by unit price issued by Provincial People's Committee (million VND):

- Total investment for replanting forest.

V. Recommendations

INVESTOR
(sign, seal)

Recipients:
-
-
-

Circular No. 23/2017 / TT-BNN, ANNEX II

PROPOSAL FOR APPROVAL OF REPLACEMENT AFFORESTATION PLAN

(Issued together with Circular No. 23/2017 / TT-BNN dated 15 November 2017 by the Ministry of Agriculture and Rural Development)

NAME OF AGENCIES ..... **-------**	**SOCIALIST REPUBLIC OF VIETNAM** **Independence - Freedom - Happiness** **----------**
Number: / . V / v approve the plans replacement afforestation for the conversion of forest area land into other purposes	*..... day ..... month ..... year .....*

Dear: ....

Organization Name:

Address:

In accordance with the *Circular No. 23/2017 / TT-BNN dated 15 November 2017 by the Ministry of Agriculture and Rural Development* on replacement afforestation for the conversion of forest area land into other purposes

Approved Project plan for replacement afforestation by the following:

1. Total forest area change the purpose of use to other purposes:

2. Forest type use purpose conversion to other purposes:

a) According to purpose of use (special use, protection, production): ....

b) By origin (natural forest, planted forest): ....

3. Area of land for afforestation:

4. Location of replacement afforestation : in plot, sub-area, area..... commune .... district ....

5. Being subject to forest land (protection, special use, production):

6. Alternative planting plan

a) Plant species

b) Method of planting (mixed, pure species):

c) Average investment per hectare (million VND):

d) Planting time:

e) Planting plan

e) Total replacement investment:

.... (name of the organization) undertakes to comply with state regulations For replanting forests, if the violation is fully responsible before the law . / .

Representative of the organization
(signed and stamped)

Recipients:
- As above;
- .....
- .....

APPENDIX C

ENVIRONMENTAL CLAUSES TO BE INCLUDED IN THE BIDDING DOCUMENTS FOR WORKS CONTRACTS

The following contract clauses for safeguarding the environment during construction will be incorporated into all the tender documents.

1.1 Site specific construction environmental management plan (CEMP):

1.1.1 The contractor shall prepare a site-specific construction environmental management plan (CEMP) prior to the commencement of construction works, and shall submit the plan to the PMU for review and to the CSC for review and approval. The plan shall include method statements on the implementation of pollution control and abatement measures, health and safety, as well as an emergency spill contingency plan for containing and cleaning up accidental chemical spills on construction sites. The CEMP shall be updated as needed as and when environmental issues not covered by the plan arise.

1.2 Siting of construction facilities:

1.2.1 Locations of concrete batching plants shall be at least 300 m downwind of the nearest air quality and noise protection target.

1.2.2 Locations of borrow and spoil areas shall be at least 500 m from residential areas and their exploitation subject to approval by provincial DONRE. No borrow or spoil areas shall be established in legally protected sites such as nature reserves.

1.2.3 Borrow areas and spoil disposal sites with long, steep slopes, susceptible to erosion shall be avoided and shall include small level cut-off drains to break up and redirect runoff.

1.2.4 Worker camps and equipment storage facilities shall be installed at locations identified in the project EIA, and shall be subject to approval by district authorities.

1.3 Construction time:

1.3.1 There shall be no night time (between 22:00 and 06:00 hours) construction within 500m from residential areas and within legally protected areas.

1.4 Protection of air quality

1.4.1 Provide dust masks to construction workers.

1.4.2 Assign haulage routes and schedules to avoid transport occurring in the central areas, traffic intensive areas or residential areas.

1.4.3 Spray water regularly on unpaved roads and access roads (at least once a day) to suppress dust; and erect hoarding around dusty activities.

1.4.4 Cover material stockpiles with dust shrouds or tarpaulin. For the earthwork management for backfill, measures will include surface press and periodical spraying and covering. The extra earth or dreg should be cleared from the project site in time to avoid long term stockpiling.

1.4.5 Minimize the storage time of construction and demolition wastes on site by regularly removing them off site.

1.4.6 Equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions.

1.4.7 Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substance onto public roads.

1.4.8 Keep construction vehicles and machinery in good working order, regularly service and turn off engines when not in use.

1.4.9 Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be

loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin.

1.4.10 In periods of high wind, dust-generating operations shall not be permitted within 100 m of residential areas. Special precautions need to be applied in the vicinity of sensitive receptors such as schools, hospitals, and legally protected sites.

1.4.12 Site all dredged material storage or disposal facilities at least 50 m from the nearest air quality protection target.

1.4.13 Unauthorized burning of construction and demolition waste material and refuse shall be subject to penalties for the Contractor, and withholding of payment.

1.5 Protection of the acoustic environment

1.5.1 Noise levels from equipment and machinery shall conform to the IFC EHS Standards, and machinery shall be properly maintained to minimize noise.

1.5.2 Only low noise machinery or equipment with sound insulation shall be employed.

1.5.3 Temporary noise barriers or hoardings shall be installed around the equipment to shield residences when there are residences within 20 m of the noise source.

1.5.4 Regularly monitor noise levels at construction site boundaries. If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation.

1.5.5 Provide the construction workers with suitable hearing protection (ear muffs) according to the worker health protection law of Viet Nam.

1.5.6 Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition.

1.5.7 Limit the speed of vehicles travelling on site (less than 8 km/h), prohibit the use of horns unless absolutely necessary, minimize the use of whistles.

1.5.8 Maintain continual communication with the villages and communities near the construction sites.

1.6 Protection of water quality

1.6.1 Portable toilets and small package wastewater treatment plants shall be provided on construction sites and workers camps for the workers and canteens; If there are nearby public sewers, interim storage tanks and pipelines shall be installed to convey wastewater to those sewers.

1.6.2 Sedimentation tanks shall be installed on construction sites to treat process water (e.g. concrete batching for bridge construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide (PAM) shall be used to facilitate sedimentation.

1.6.3 Construction machinery shall be repaired and washed at special repairing shops. No onsite machine repair and washing shall be allowed.

1.6.4 Storage facilities for fuels, oil, and other hazardous materials shall be within secured areas on impermeable surfaces, and provided with secondary containment and cleanup kits.

1.6.6 Material stockpiles shall be protected against wind and runoff waters which might transport them to surface waters.

1.6.7 Spills shall be cleaned up according to GOV norms and codes within 24 hours of the occurrence, with contaminated soils and water treated according to GOV norms and codes. Records must be handed over without delay to the PMU and the relevant provincial DONRE.

1.7 Protection of biological resources and wildlife

1.7.1 Preserve existing vegetation where no construction activity is planned.

1.7.2 Protect existing trees and shrubs during construction; where a tree has to be removed or an area of shrubs disturbed, replant trees and re-vegetate the area after construction.

1.7.3 Remove trees or shrubs only as the last resort if they impinge directly on the permanent works or necessary temporary works.

1.7.4 Where works are conducted in a legally protected site such as a nature reserve, the Contractor shall develop and implement additional protection measures to avoid any negative impact on the protected site's protection objectives. The Contractor shall conduct induction and regular awareness raising events and trainings for all construction workers, and monitor works contractors to ensure they act in compliance with the protected site's regulations.

1.7.4 Construction workers are prohibited from capturing any wildlife or to harvest forest products in the project areas.

1.8 Solid waste management, earth works and soil erosion

1.8.1 Establish enclosed waste collection points on site, with separation of domestic waste and construction & demolition (C&D) waste.

1.8.2 Set up centralized domestic waste collection point and transport offsite for disposal regularly by sanitation department.

1.8.3 Maximize the reuse of earth cut materials and C&D waste for filling and foundations of other construction works specified by the relevant local departments, or transport in enclosed containers to designated landfill site.

1.8.4 Confirm location of the borrow pit and temporary spoil storage and final disposal sites. Secure necessary permits from provincial authorities to operate these sites.

1.8.5 Develop spoil disposal site management and restoration plan, to be approved by responsible authority; obtain permit for the clearance of excavated earthworks.

1.8.6 Construct intercepting ditches and drains to prevent runoff entering construction sites, and diverting runoff from sites to existing drainage.

1.8.7 Construct hoardings and sedimentation ponds to contain soil loss and runoff from the construction sites.

1.8.8 Limit construction and material handling during periods of rains and high winds.

1.8.9 Stabilize all cut slopes, embankments, and other erosion-prone working areas while works are going on.

1.8.10 Stockpiles shall be short-termed, placed in sheltered and guarded areas near the actual construction sites, covered with clean tarpaulins, and sprayed with water during dry and windy weather conditions.

1.8.11 All earthwork disturbance areas shall be stabilized with thatch cover within 30 days after earthworks have ceased at the sites.

1.8.12 Immediately restore, level and plant landscape on temporary occupied land upon completion of construction works.

1.9 Construction site sanitation

1.9.1 Contractor shall provide adequate and functional systems for sanitary conditions, toilet facilities, waste management, labor dormitories and cooking facilities. The sites shall be effectively cleaned and disinfected. During site formation, the sites shall be sprayed with phenolated water for disinfection. Toilets and refuse bins shall be disinfected and timely removal of solid waste shall be ensured.

1.9.2 Rodents on site shall be exterminated at least once every 3 months. Mosquitoes and flies shall be exterminated at least twice each year.

1.9.3 Public toilets shall be provided in accordance with the requirements of labor management and sanitation departments in the living areas on construction site, and designated staff responsible for cleaning and disinfection shall be appointed.

1.9.4 Work camp wastewater shall be discharged into the municipal sewer system or treated on-site using portable systems or septic tanks.

1.10 Occupational safety

1.10.1 The Contractor shall appoint qualified full-time staff responsible for environmental, health and safety during construction.

1.10.2 Personal protective equipment (safety hats and shoes and high visibility vests) shall be provided to all construction workers.

1.10.3 Ear defenders for hearing protection shall be provided to workers operating and working near noisy power mechanical equipment.

1.10.4 Safety goggles and respiratory masks shall be provided to workers doing asphalt road paving and tunnel blasting.

1.10.5 Method statements shall be prepared and approvals obtained for hazardous activities such as blasting, excavation and working near water.

1.11 Food safety

1.11.1 Food hygiene in canteens on site shall be inspected and supervised regularly. Canteen workers must have valid health permits.

1.11.2 If food poisoning is discovered, effective control measures shall be implemented immediately to prevent it from spreading.

1.12 Disease prevention and health services

1.12.1 All contracted labor shall undergo a medical examination which shall form the basis of an (obligatory) health/accident insurance and welfare provisions to be included in the work contracts. The contractors shall maintain records of health and welfare conditions for each person contractually engaged.

1.12.2 Health clinic shall be established at location where workers are concentrated, which shall be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents.

1.12.3 A person responsible for health and epidemic prevention and education and training on food hygiene and disease prevention shall be specified to raise the awareness of workers.

1.13 Social conflict prevention

1.13.1 The following shall be prioritized: (i) employ local people for works, (ii) ensure equal opportunities for women and men, (iii) pay equal wages for work of equal value, and to pay women's wages directly to them; and (iv) not employ child or forced labor.

1.14 Community health and safety

1.14.1 A traffic control and operation plan shall be prepared together with the local traffic police prior to any construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning in advance. Haulage routes and schedules shall be assigned to avoid transport occurring in traffic intensive areas or residential areas.

1.14.2 Residents and businesses shall be informed in advance of the road construction activities, given the dates and duration of expected disruption, dusty and noisy activities, and access to the grievance redress mechanism. Local communities shall be alerted of the time and location of hazardous activities. Construction billboards, which include construction contents, schedule, responsible person and complaint hotline number, shall be erected at each construction site.

1.14.3 Clear signs shall be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues. Heavy machinery shall not be used at night, where possible, and all such equipment shall be returned to its overnight storage area/position before night. All sites shall be made secure, discouraging access by members of the public through appropriate fencing, signage and/or security personnel, as appropriate.

1.14.4 Continual communication with the villages and communities along the road alignments shall be maintained and the grievance redress mechanism shall be accessible and effective.

1.15 Utility interruption

1.15.1 Contractors shall assess construction locations in advance and identify potential for disruption to services and risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities shall be subject to full compensation, at the full liability of the contractor who causes the problem.

1.15.2 If temporary disruption is unavoidable the contractor shall, in collaboration with relevant local authorities such as power company, water supply company and communication company, develop a plan to minimize the disruption and communicate the dates and duration in advance to affected persons.

1.16 Environmental effect monitoring

1.15.3 The Contractor shall, at its own costs, conduct dust, noise and water quality monitoring during peak construction period around construction sites and nearest sensitive receptors (residential areas, rivers) in accordance with the environmental monitoring plan defined in the environmental management plan. Monitoring results shall be reported to the CSC and PMU through the monthly progress reports.

APPENDIX D

RECORDS OF PUBLIC CONSULTATION

(in Vietnamese, available on request)

APPENDIX E

TRAFFIC NOISE ANALYSIS

APPENDIX E: TRAFFIC NOISE ANALYSIS

A. Approach to Traffic Noise Calculations

Modeling
Traffic noise calculations are based on models which assume hemispherical non- directional radiation on a semi - infinite half space. Noise calculations are based on the Inverse Square Law, which follows a logarithmic rate of attenuation. This means that for a point source, such as a vehicle exhaust, noise levels decrease at the rate of 6dBs per doubling of distance. However, for a line source, such as a line of vehicles on a road carriageway, noise levels decrease at the rate of 3dBs per doubling of distance. This rule applies as long as the road segment is longer than the distance from the road to the receiver.

Attenuation
Noise attenuation is also affected by environmental conditions. Atmospheric temperature and humidity can cause atmospheric absorption. Temperature inversions can cause diffraction of propagating sound waves upwards and away from a receiver so diminishing received noise levels.

Wind speed is a factor. Wind blowing away from a receptor to the noise source can cause up to 10dBs of reduction. However, winds blowing from a noise source towards a receptor cause no increase in received noise levels.

Ground cover has an absorptive effect. Noise propagating over rough ground can be absorbed by grass, bushes, and other vegetation. Smooth surfaces such rock or gravel have less absorptive effect and concrete has virtually no absorptive effect. In fact, concrete can reflect sound waves back upwards and so increase received noise levels at a receptor.

Contrary to popular myth, trees cause very little attenuation. However, by screening the view of the road traffic the trees can cause up to a 10dBs reduction in “perceived” noise levels.

Reflections
Noise waves arriving at a solid surface such as a house’s façade or a brick wall reflect back, meet incoming sound waves and through a diffraction pattern cause superimposition of two sound waves causing an increase in noise levels. Noise levels measured at 1 m from a solid facade facing and incoming wave from can be 3dBs higher than a similar measurement made at the same location but in an open space. For this reason, noise measurements made in front of buildings are usually made at least 3m in front of the building.

Ambient Conditions
Ambient conditions can affect received noise levels. The predicted noise level should be added to the ambient noise level. If two noise levels are 10dBS or more apart the lower noise level causes no increase to the higher noise level. (e.g. 70dBs + 60dBs= 70dBs) If two noise levels are the same, then their addition causes the combined level to be 3dBs higher than their individual levels. (e.g. 70dBs + 70dBs = 73dBs)

Noise calculations have been made using the US Federal Highway Authority model, which considers all the above factors. Existing ambient levels have been taking from measurements made by the local consultants during the baseline study.

Descriptor Leq
The descriptor used is Leq or continuous sound level. This is measured over a stipulated time period and is the logarithmic average of all noise measured over this time period. In accordance with the Vietnamese standard of 0600 hours to 2100 hours which equates to "daytime". 2100 hours to 0600 is deemed to be "nighttime".

Standards
All residential noise standards are based on external noise levels, not internal. Therefore, the receptor point is given as outside the building.

Noise Reduction Techniques
In terms of noise reduction there are only three techniques:

- Reduction at source – such as quieter engines or a smoother pavement surface
- Reduction at receiver - such as double glazing windows. In Vietnam, where windows are open to assist natural ventilation, this is not appropriate
- Reduction between source and receiver – such as by a barrier. A barrier can be a road side vertical structure alongside the carriageway edge, a similar structure but in front of the receptors, or a grassy mound or similar halfway between source and receptor. This requires a large open space and landscaping.

B. Results of Noise Calculations

Ambient Measurements
The local EIA team carried out measurements to establish the existing ambient noise conditions. Measurements were taken in Leq dB(A).

Measurements were made at 15 locations. Noise predictions have been made at the same locations to allow predicted noise levels to be compared with ambients. The locations were as given in the table and Figures below.

Table E-1: Ambient Noise Measurements

No	*Noise*	Sampling locations	Coordinates	Ambient average value Leq (6h -
1.1	ON01	Starting point NH279: IC.16 – Km198+730	22º09'09.2"N; 104º20'37.8"E	65.7
1.2	ON02	Khanh Yen Town	22º05'25.7"N; 104º15'36.2"E	66.5
1.3	ON03	Starting point of Duong Quy bypass	22º03'29.9"N; 104º09'07.5"E	66.9
1.4	ON04	Khau Co pass that is near Ta Nang 2 bridge	22°2'9.7"N, 103°58'14.8"E	61.4
1.5	ON05	Muong Than T-junctions (Km352+500-NH32)	22°0'59.9"N, 103°54'52.5"E	66.2
1.6	ON06	Intersections of NH32 and PR107	22°6'53.4"N, 103°49'8.1"E	65.8
1.7	ON07	Pac Ta residential area-Pac Ta commune	22°4'20.1"N, 103°51'8.4"E	67.0
1.8	ON08	Tan Uyen town	22°11'23.2"N, 103°44'50.6"E	66.2
1.9	ON09	Ban Bo residential-Ban Bo commune (Km398, NH32);	22°16'29.8"N, 103°41'04.5"E	67.1

1.10	ON10	Dong Pao residential area- Ban Hon province	22°17'51.0"N, 103°34'21.6"E	66.1
1.11	ON11	Intersections of PR136 and Lai Chau by pass (Km34+800, NH4D)	22°22'5.2"N, 103°29'00.3"E	66.5
1.12	ON12	Staring point: IC14-Km149+705 (Noi Bai-Lao Cai expressway)	21°52'46.00"N, 104°40'25.4"E	65.7
1.13	ON13	Che Ve residential area- An Thịnh commune	21°51'44.9"N, 104°38'24.0"E	65.9
1.14	ON14	Khe Ngoai residential area- Mo Vang commune	21°46'20.7"N, 104°38'37.2"E	67.6
1.15	ON15	Intersections of NH32 (Km209+500) and PR175	21°39'1.6"N, 104°30'3.9"E	67.1

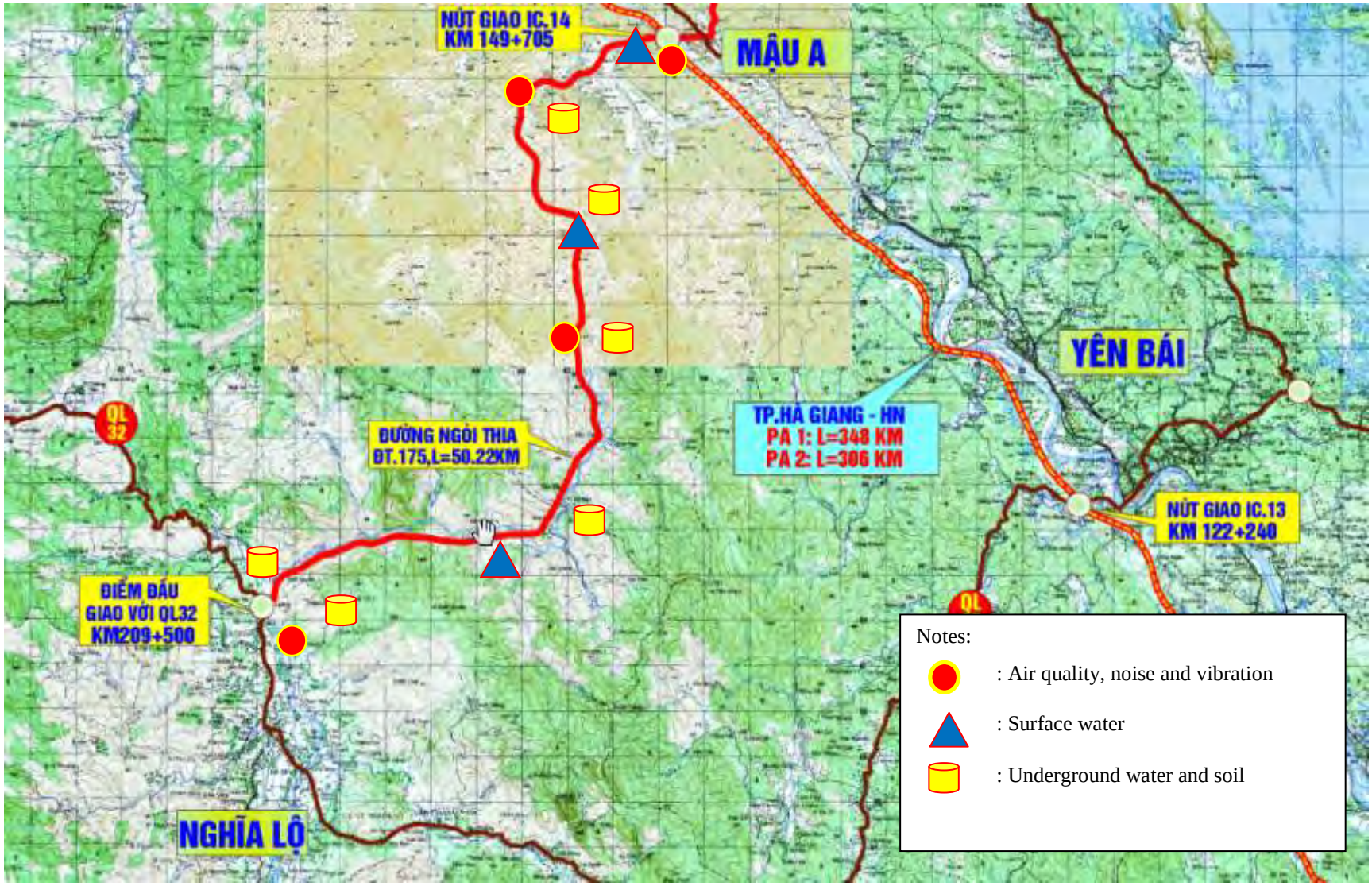


Figure E-1: Monitoring locations on PR175

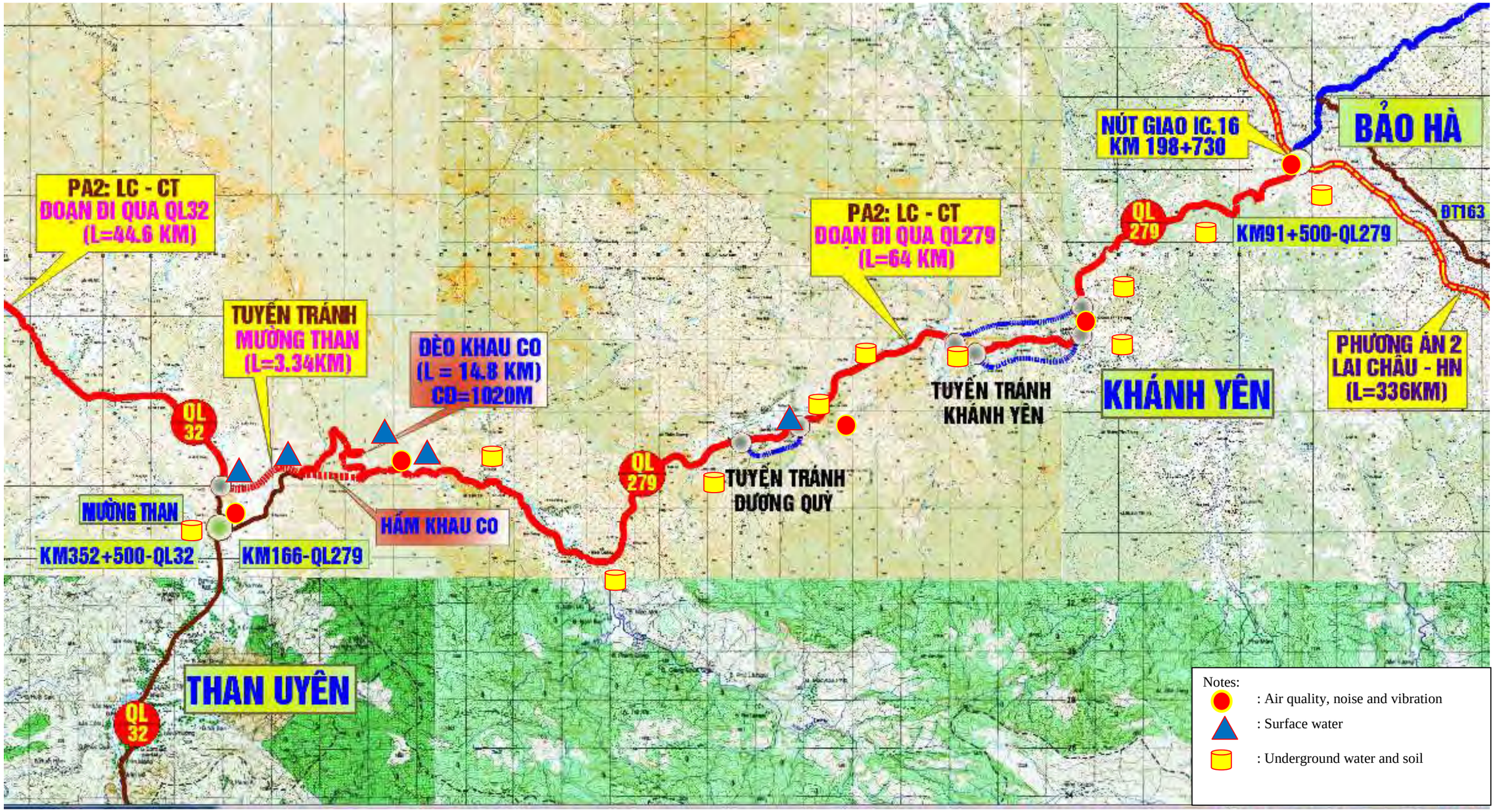


Figure E-2: Monitoring locations on NH279

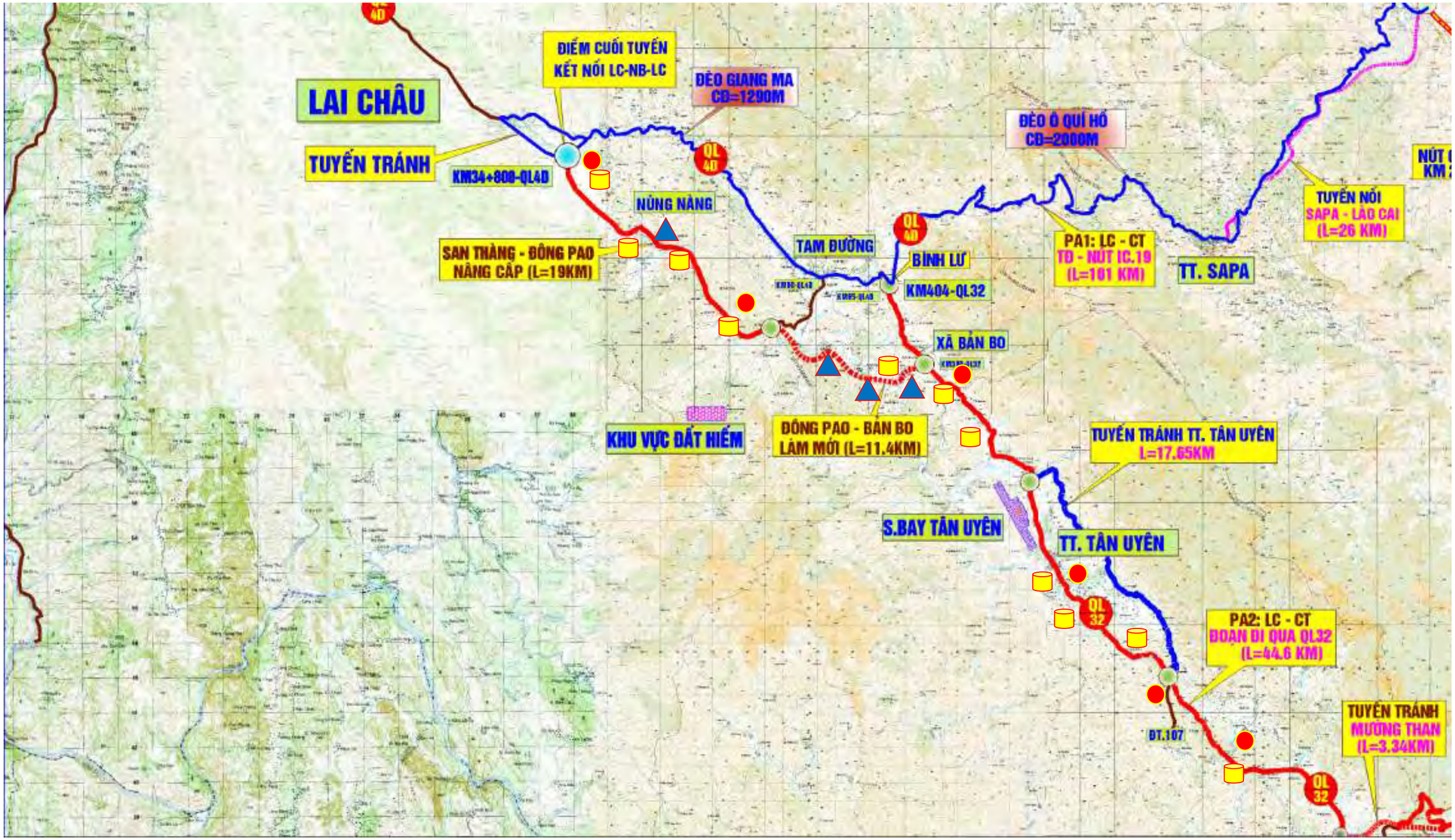


Figure E-3: Monitoring Locations on NH32

C. Noise Results

ON1

The noise calculation results for ON1 are given below.

Figure E-4: View of ON1

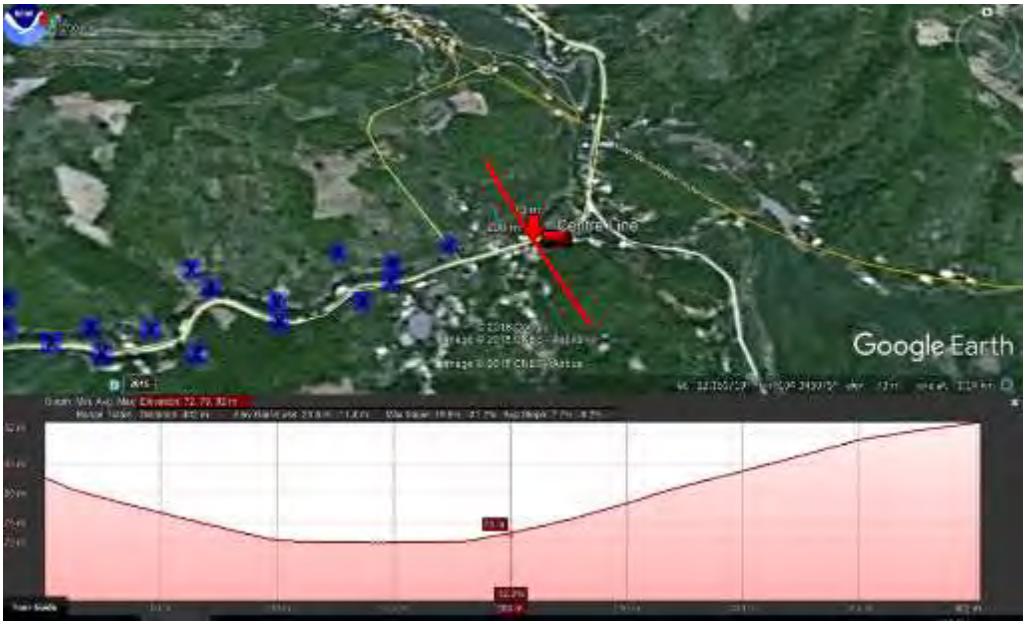


Figure E-5: Cross Section Profile of ON1

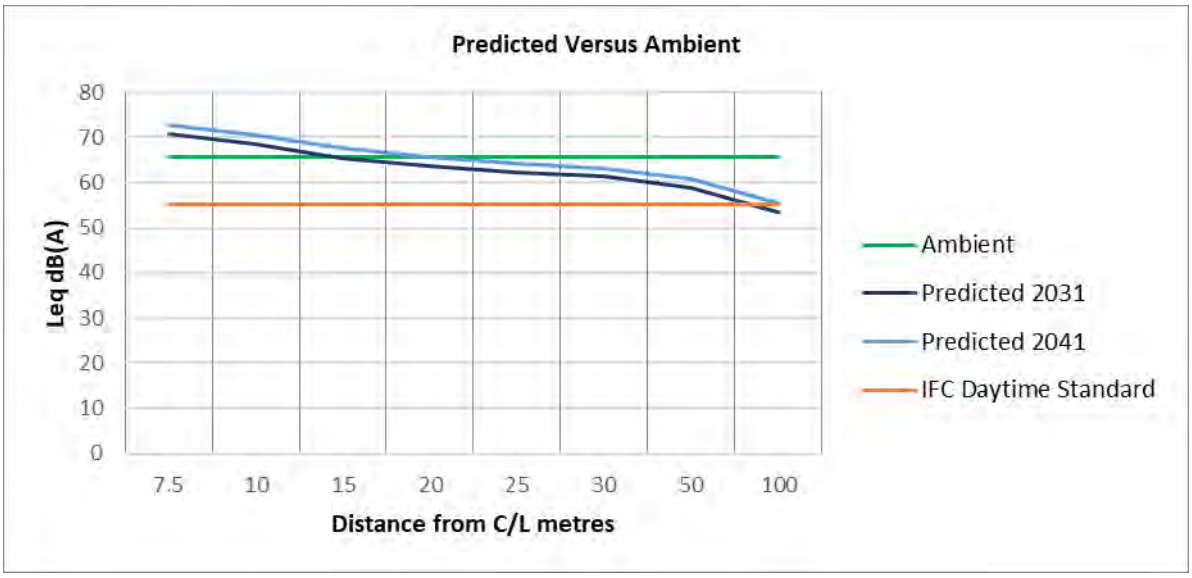


Figure E-6: ON1 Noise Results 2031 and 2041 vs Ambient and IFC Daytime Standard

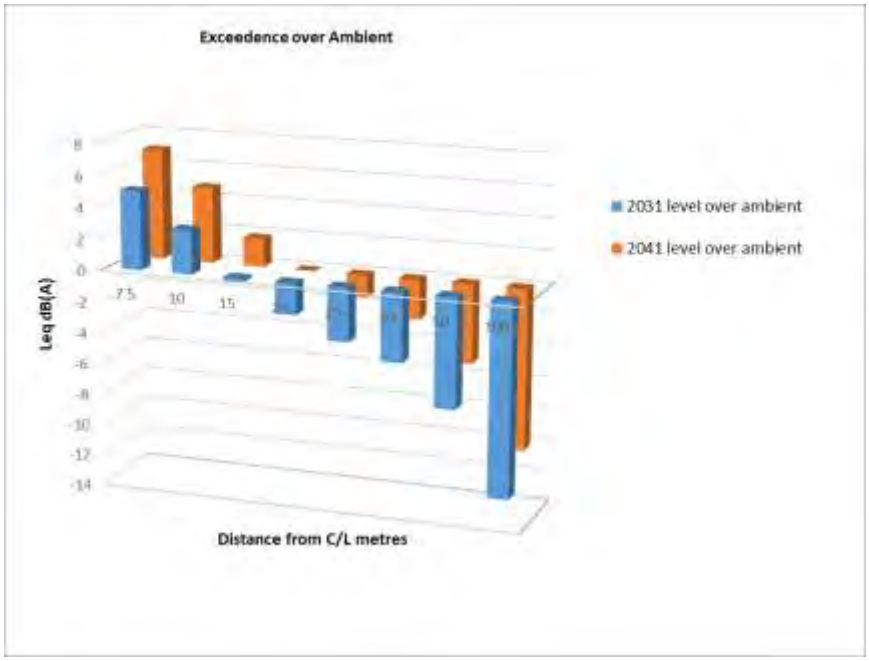


Figure E-7: ON1 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 65.7dB(A). Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 20 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON2

The noise calculation results for ON2 are given below.

Figure E-8: View of ON2

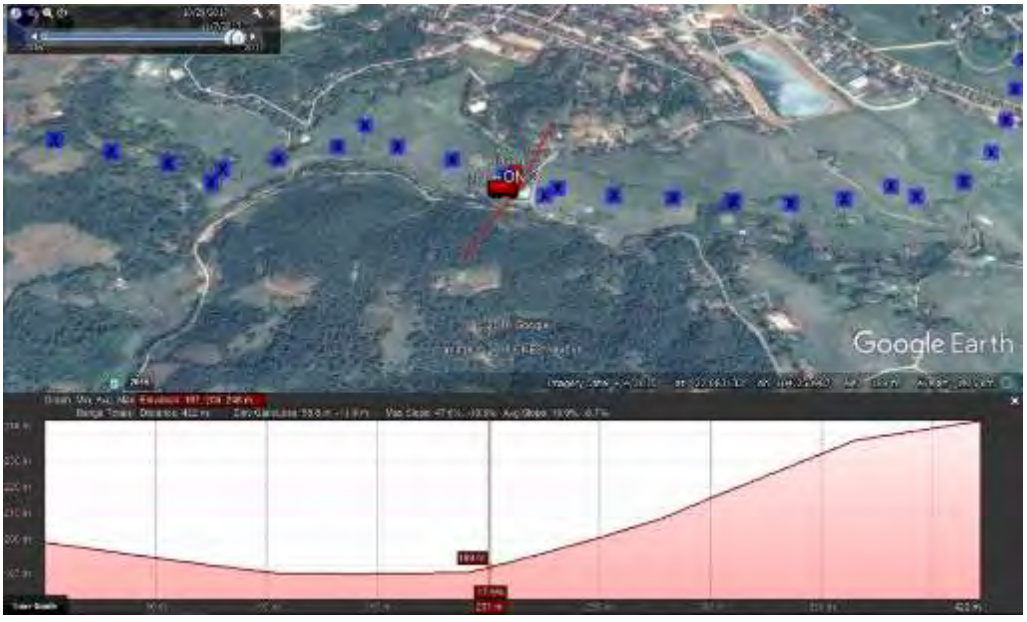


Figure E-9: Cross Section Profile of ON2

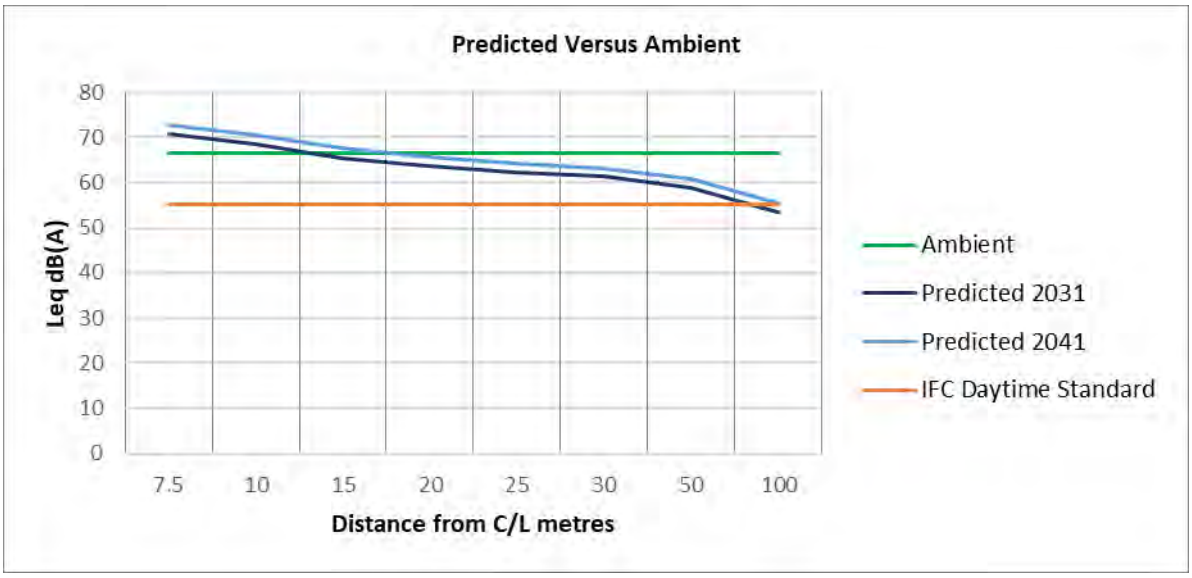


Figure E-10: Comparison of Noise Calculations Results for ON2 with Ambient and IFC Standard

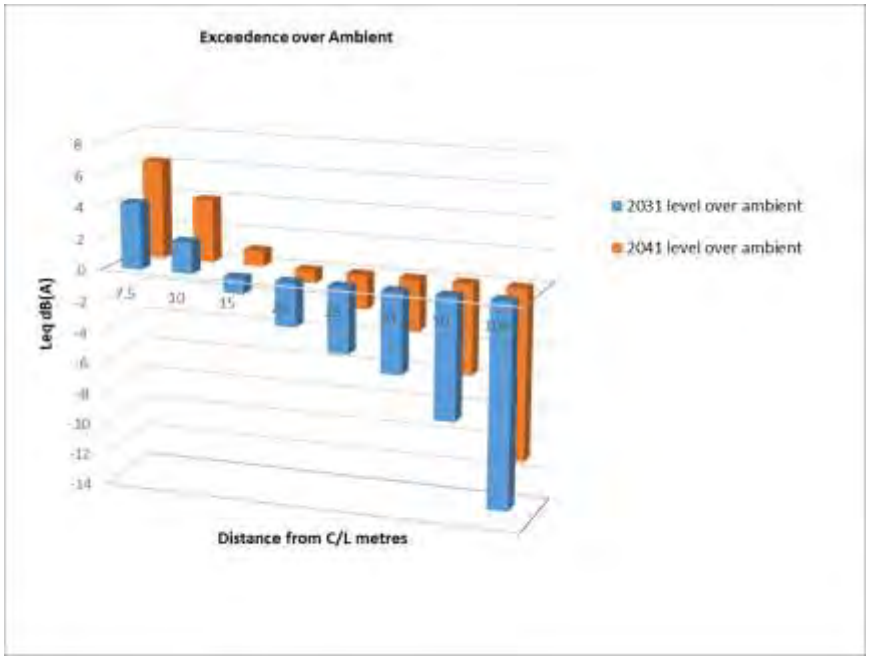


Figure E-11: ON2 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 66.5dB(A). Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 12.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances

beyond 17.5 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON3

The noise calculation results for ON3 are given below.

Figure E-12: View of ON3

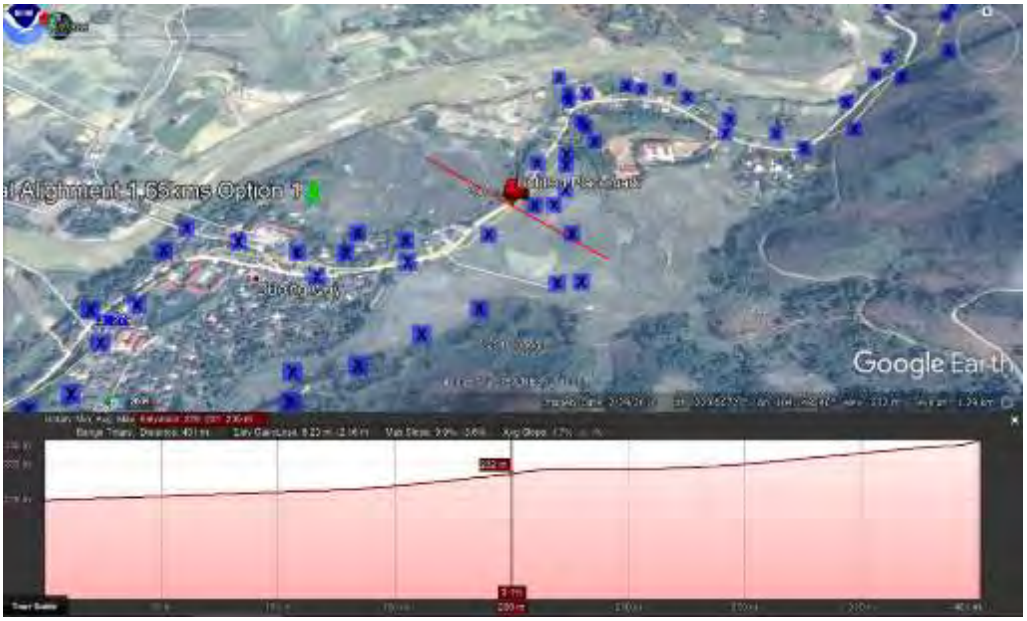


Figure E-13: Cross Section Profile of ON3

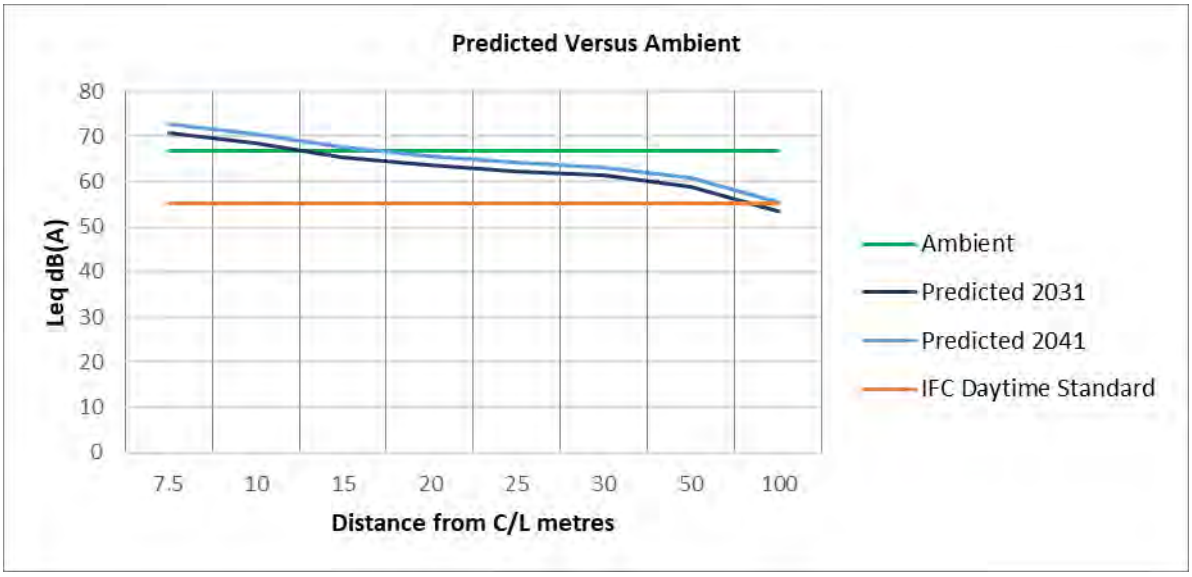


Figure E-14: Comparison of Noise Calculations Results for ON3 with Ambient and IFC Standard

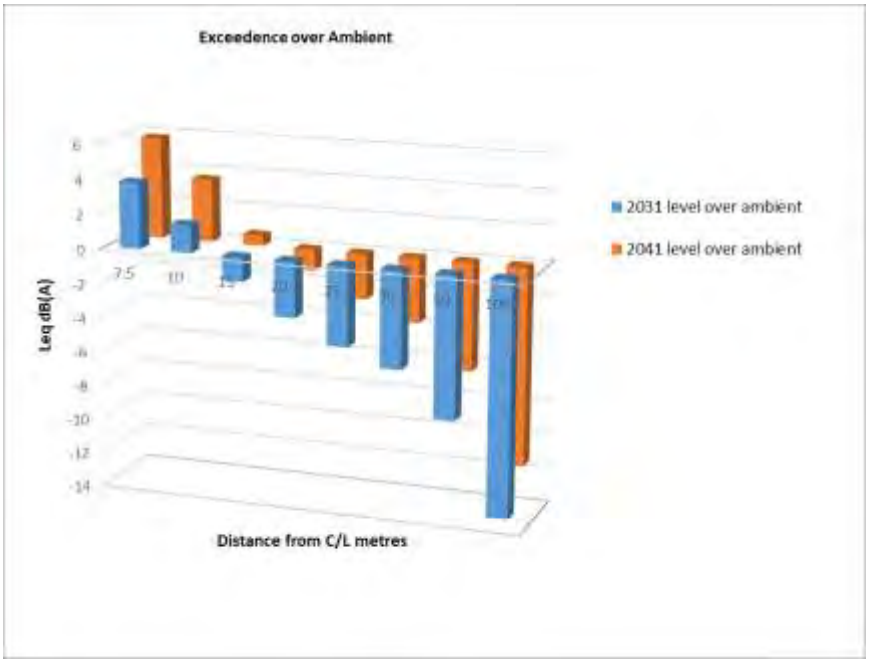


Figure E-15: ON3 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 66.9dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 12.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances

beyond 17.5 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON4

The noise calculation results for ON4 are given below.

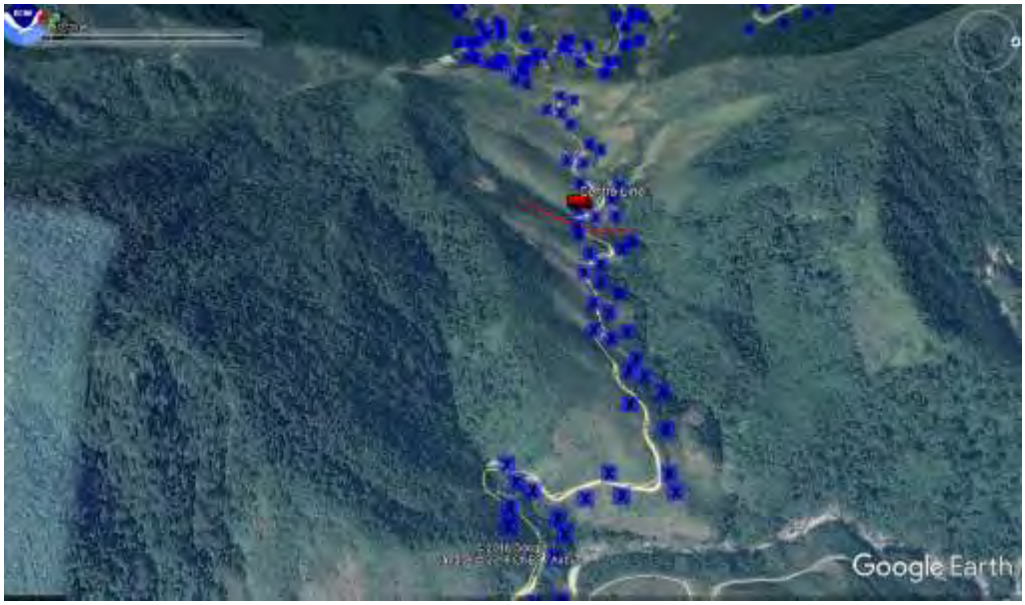


Figure E-16: View of ON4

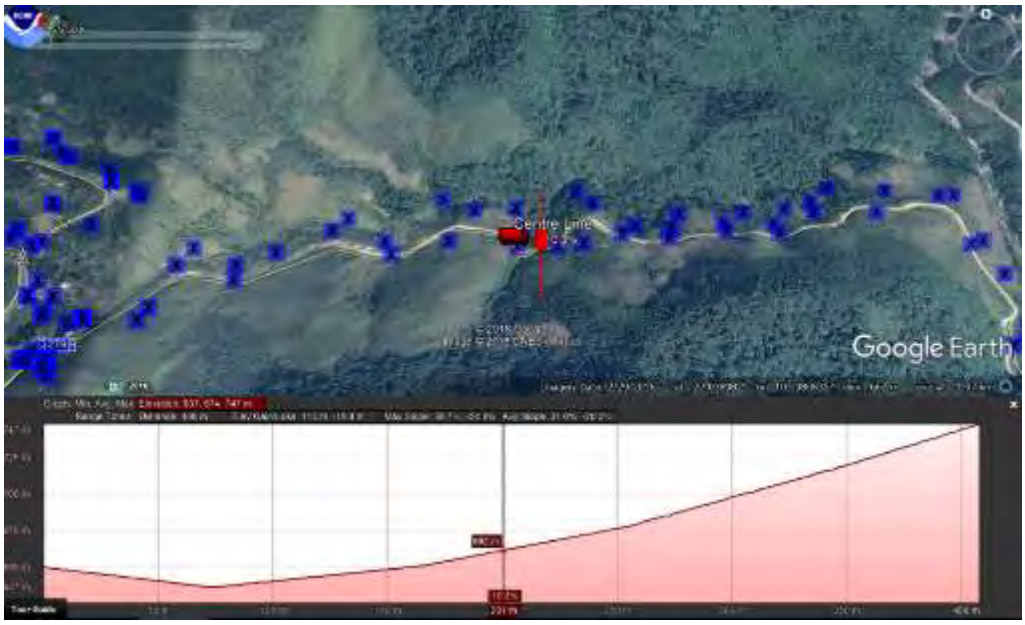


Figure E-17: Cross Section Profile of ON4

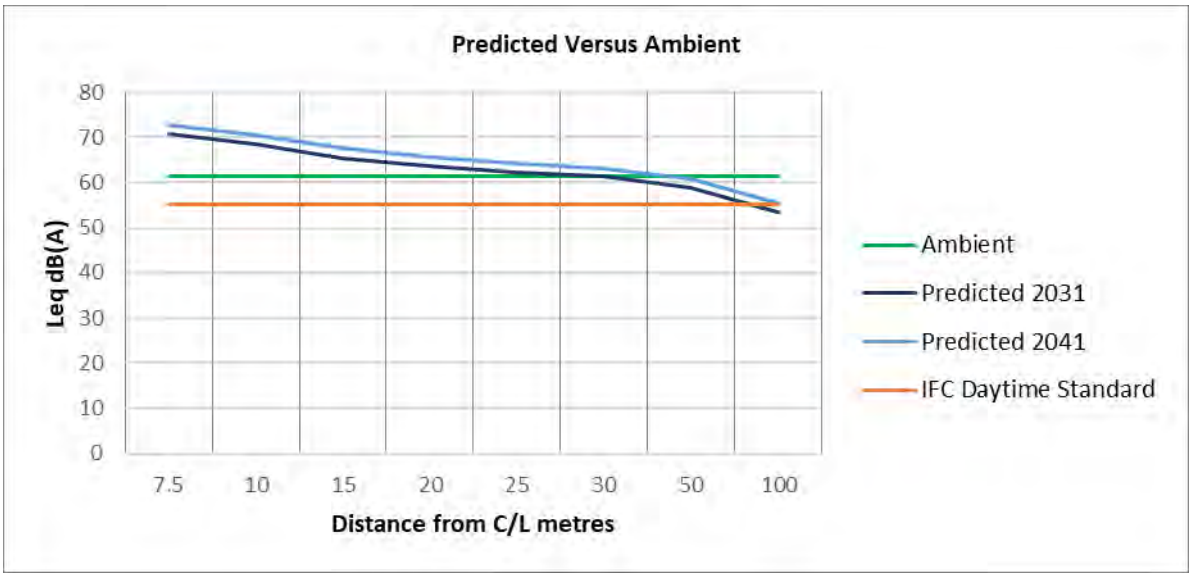


Figure E-18: Comparison of Noise Calculations Results for ON4 with Ambient and IFC Standard

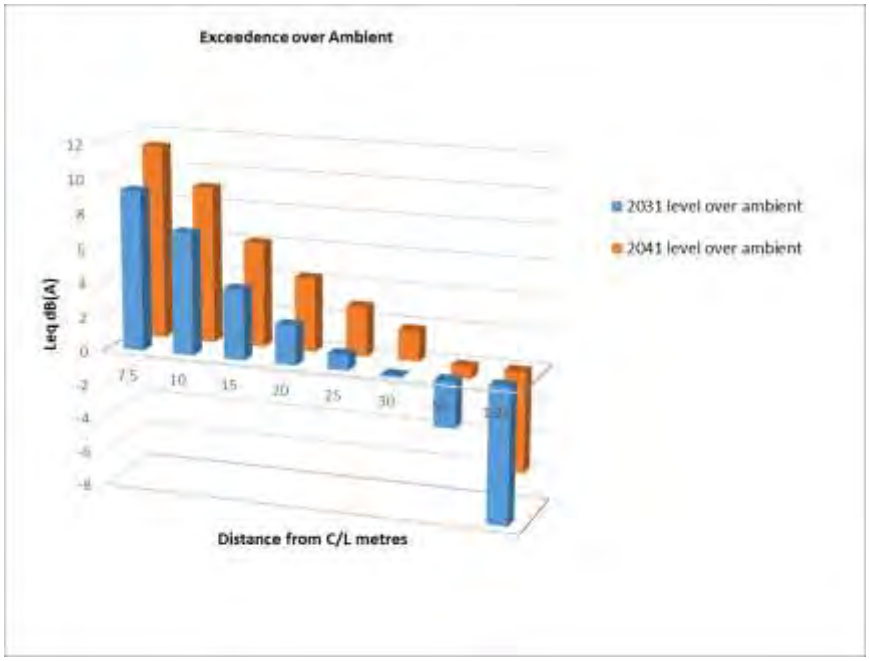


Figure E-19: ON4 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 61.4dB(A). This is the lowest measured ambient. Only at distances less than 20 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 30 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 25 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 50 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON5

The noise calculation results for ON5 are given below.

Figure E-20: View of ON5

Figure E-21: Cross Section Profile of ON5

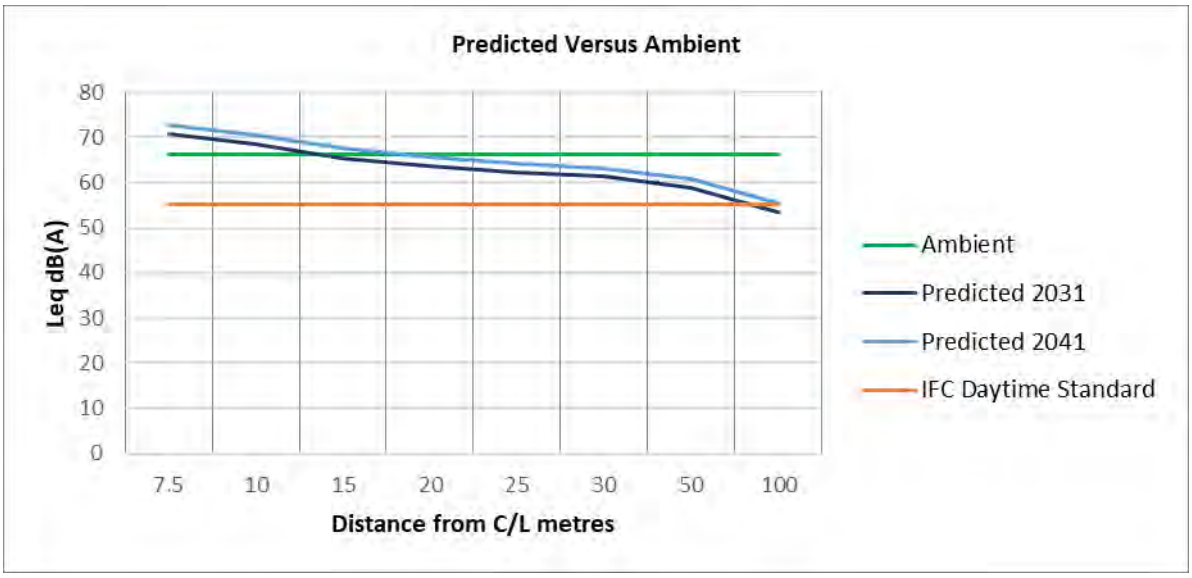


Figure E-22: Comparison of Noise Calculations Results for ON5 with Ambient and IFC Standard

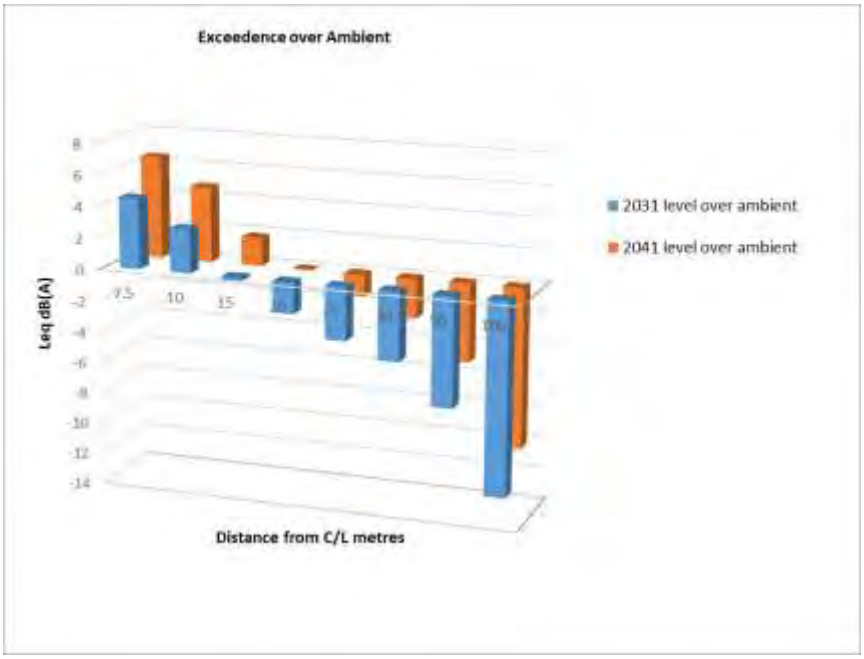


Figure E-23: ON5 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 66.2dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances

beyond 20 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON6

The noise calculation results for ON6 are given below.

Figure E-24: View of ON6

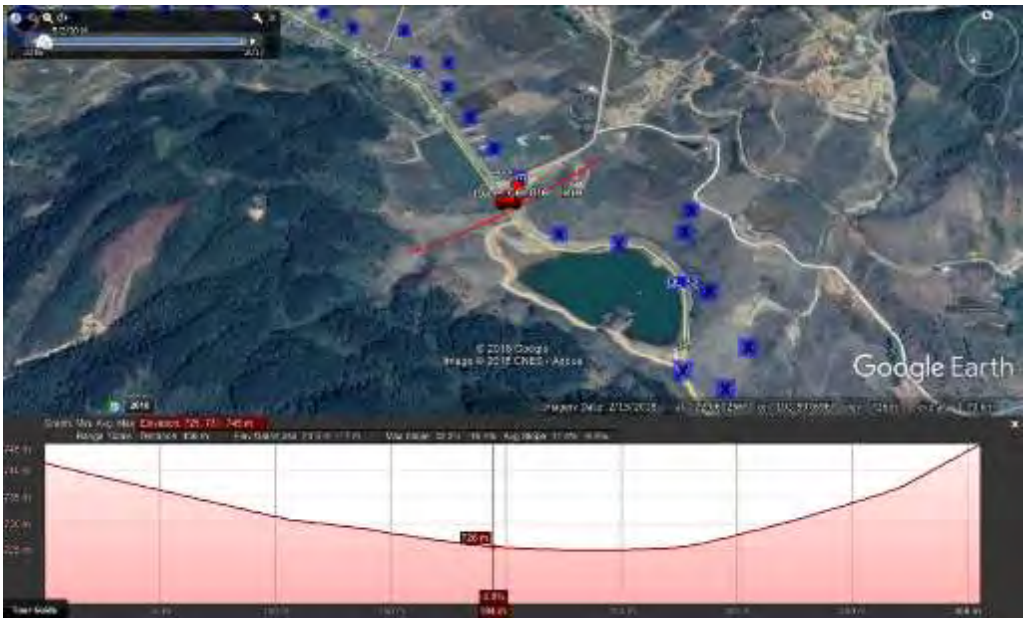


Figure E-25: Cross Section Profile of ON6

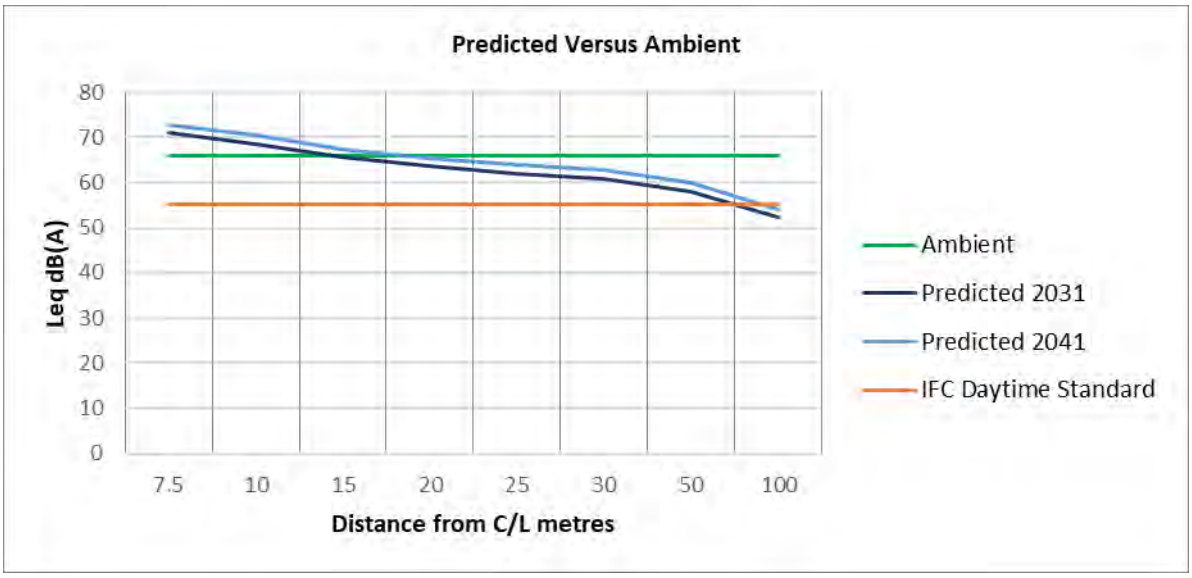


Figure E-26: Comparison of Noise Calculations Results for ON6 with Ambient and IFC Standard

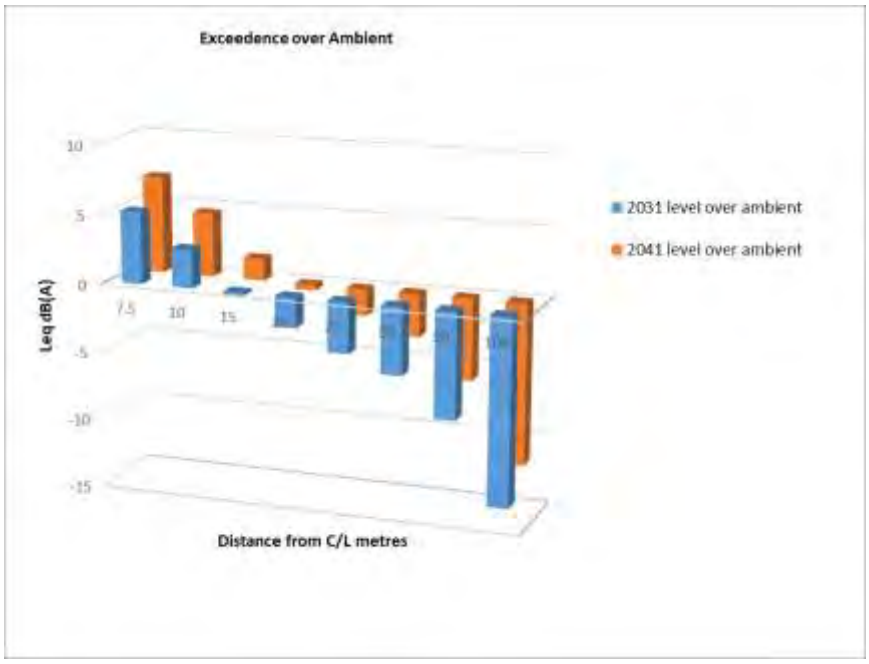


Figure E-27: ON6 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 65.8dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 20 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON7

The noise calculation results for ON7 are given below.

Figure E-28: View of ON7

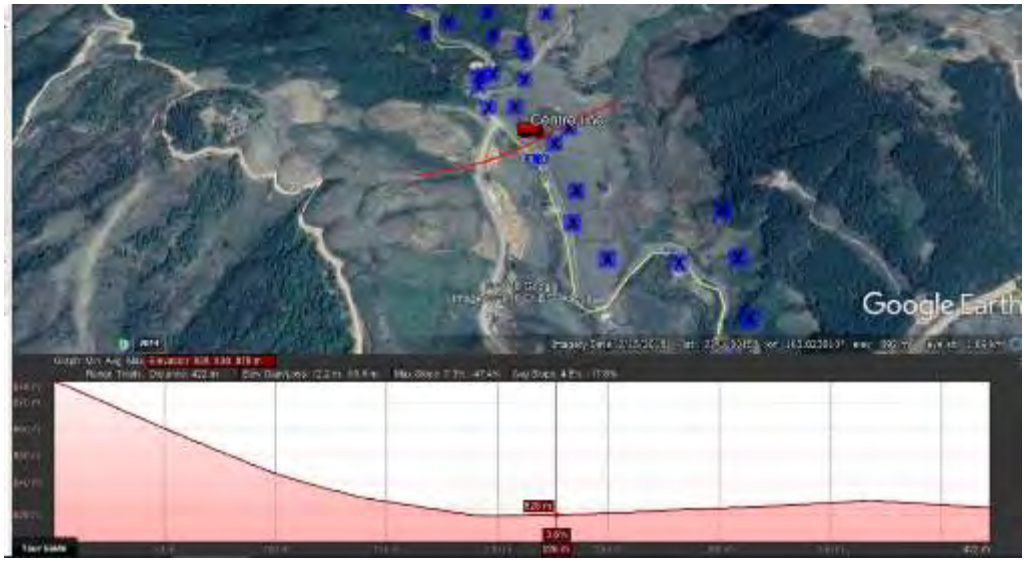


Figure E-29: Cross Section Profile of ON7

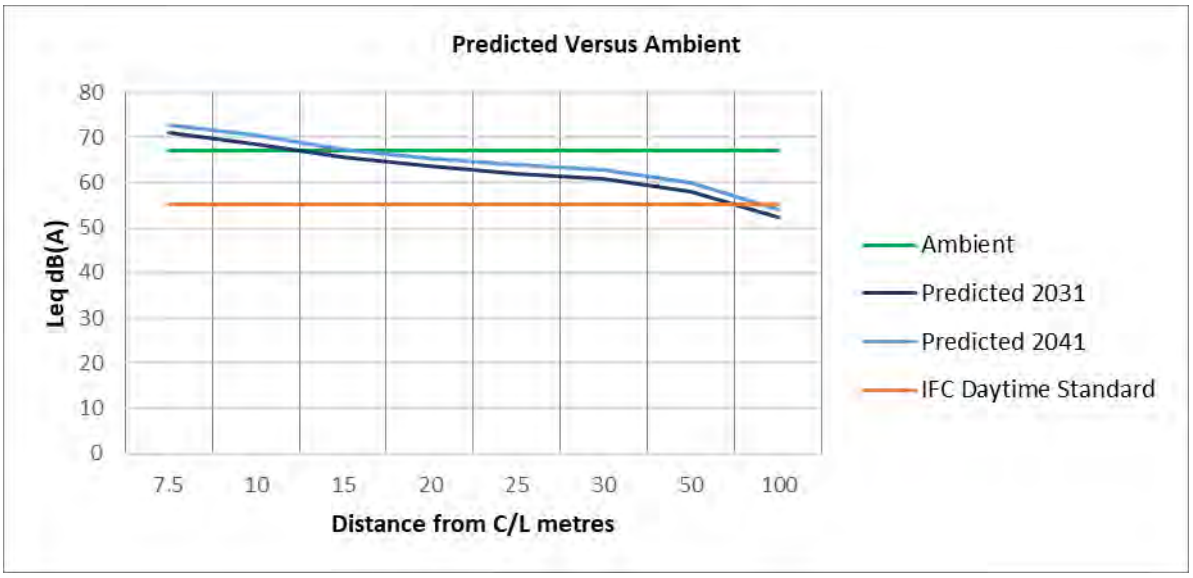


Figure E-30: Comparison of Noise Calculations Results for ON7 with Ambient and IFC Standard

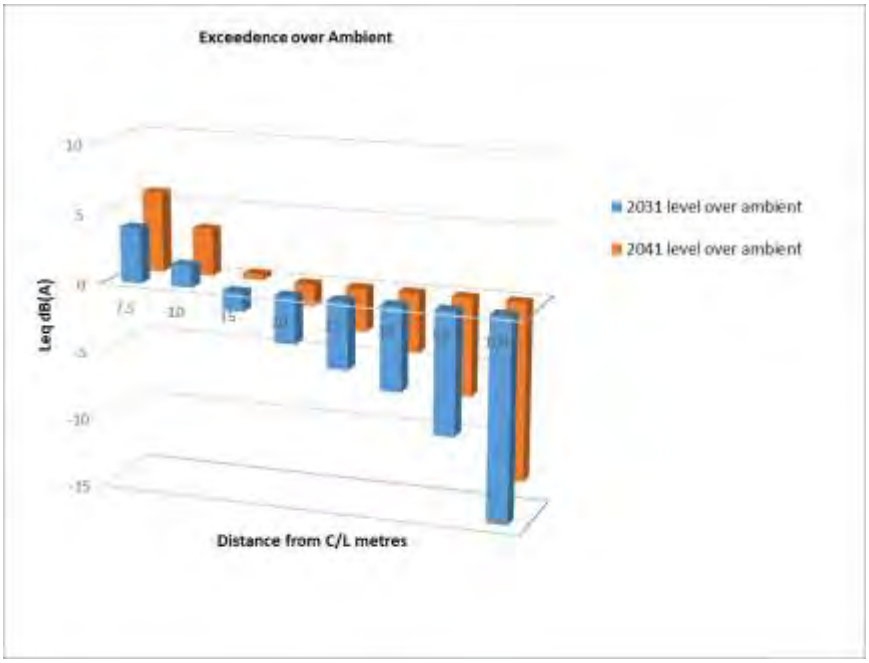


Figure E-31: ON7 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 67dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 12.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 12.5 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON8

The noise calculation results for ON8 are given below.

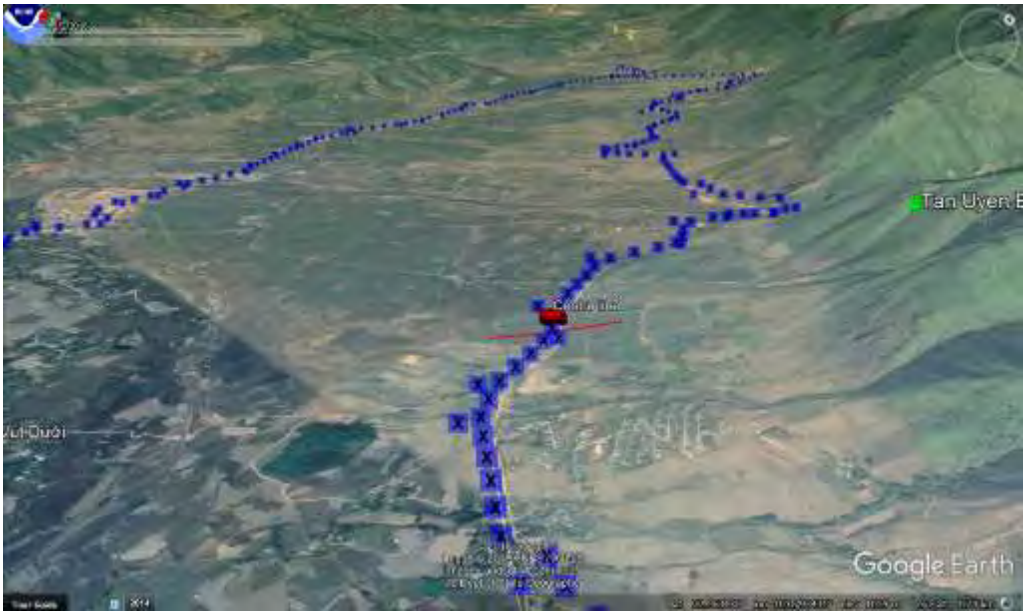


Figure E-32: View of ON8

Figure E-33: Cross Section Profile of ON8

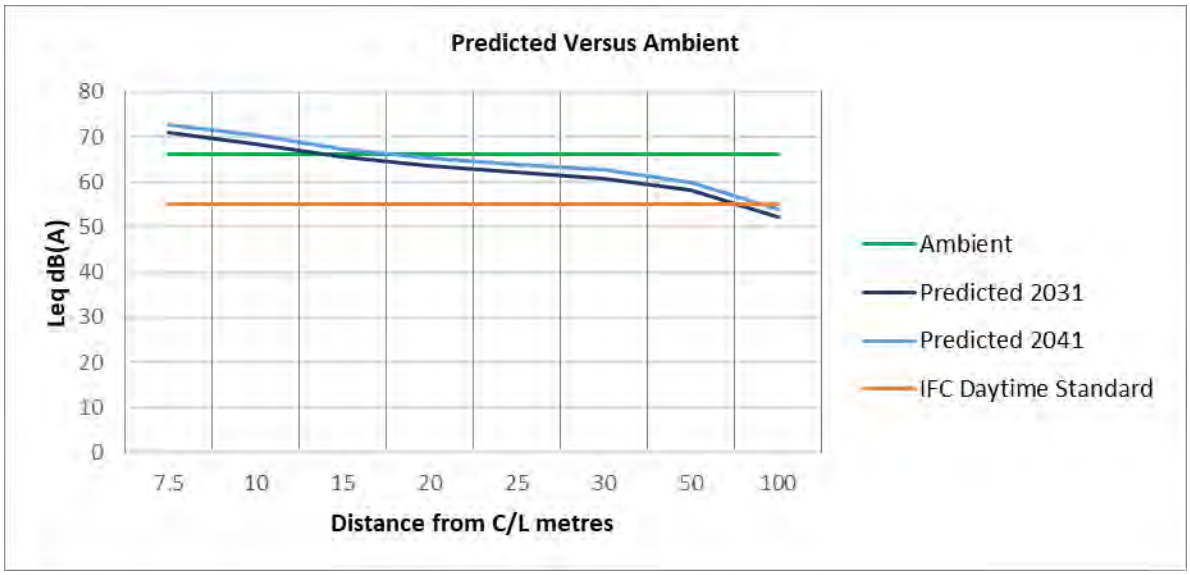


Figure E-34: Comparison of Noise Calculations Results for ON8 with Ambient and IFC Standard

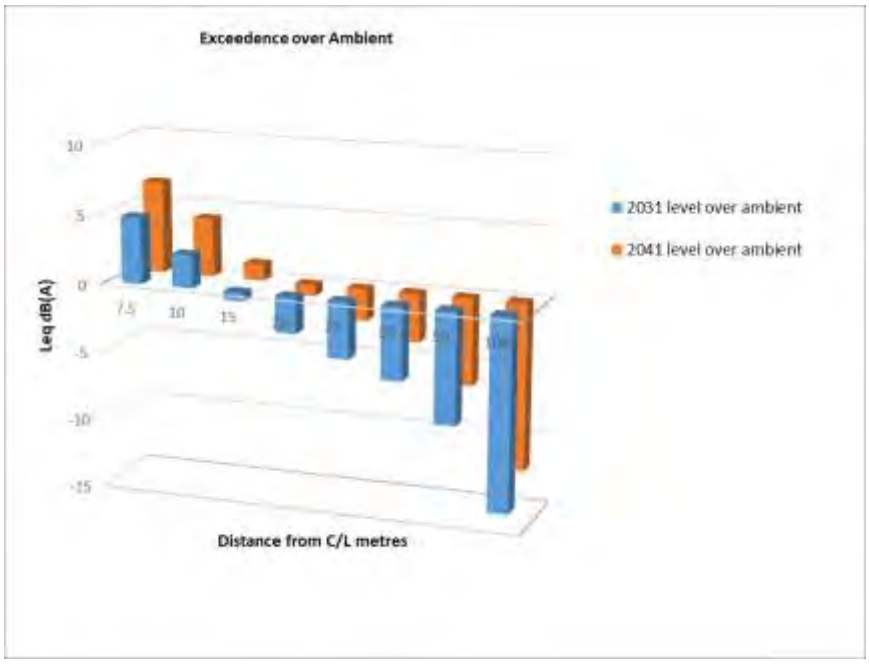


Figure E-35: ON8 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 66.2dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 20 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON9

The noise calculation results for ON9 are given below.

Figure E-36: View of ON9

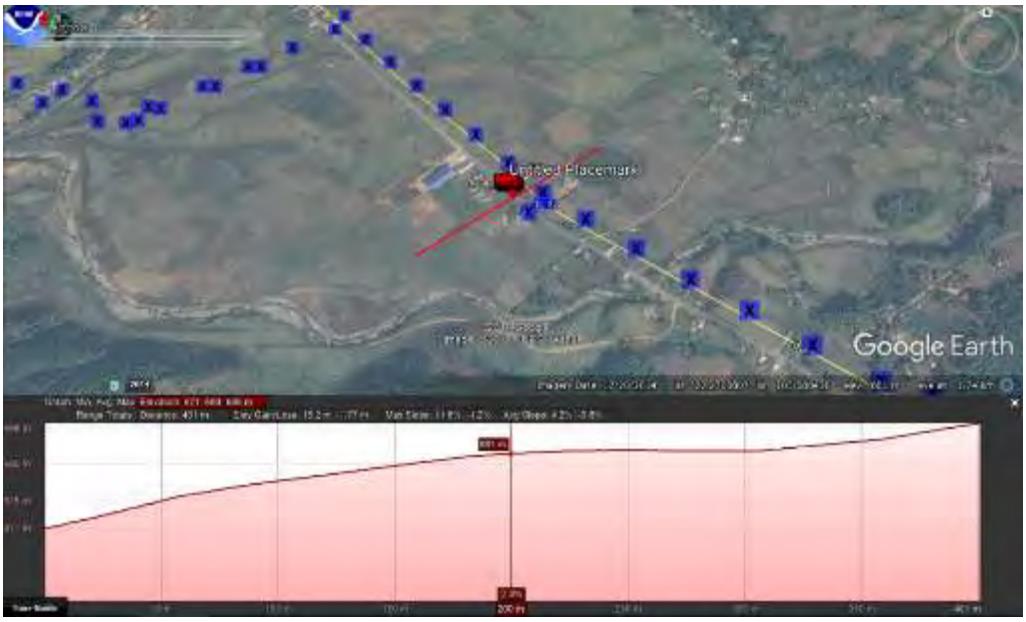


Figure E-37: Cross Section Profile of ON9

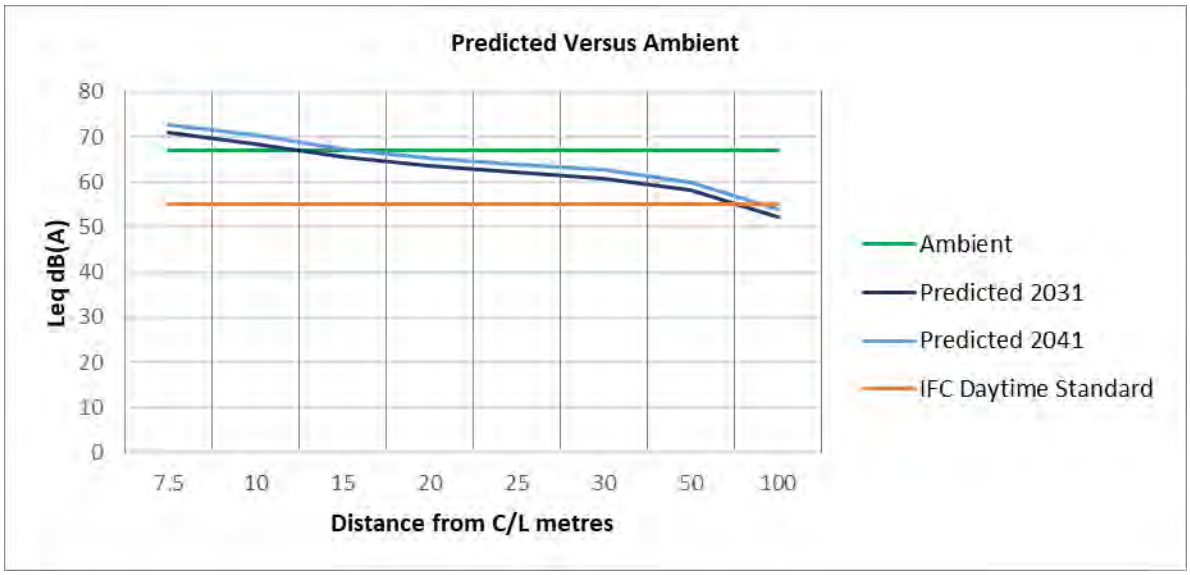


Figure E-38: Comparison of Noise Calculations Results for ON9 with Ambient and IFC Standard

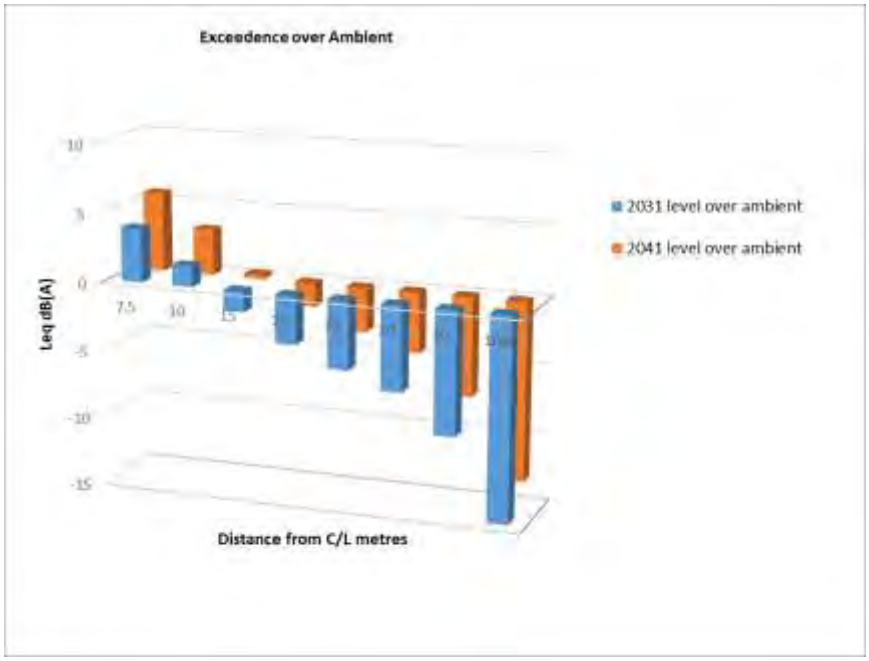


Figure E-39: ON9 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 67.1dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 12.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 12.5 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON10

The noise calculation results for ON10 are given below.

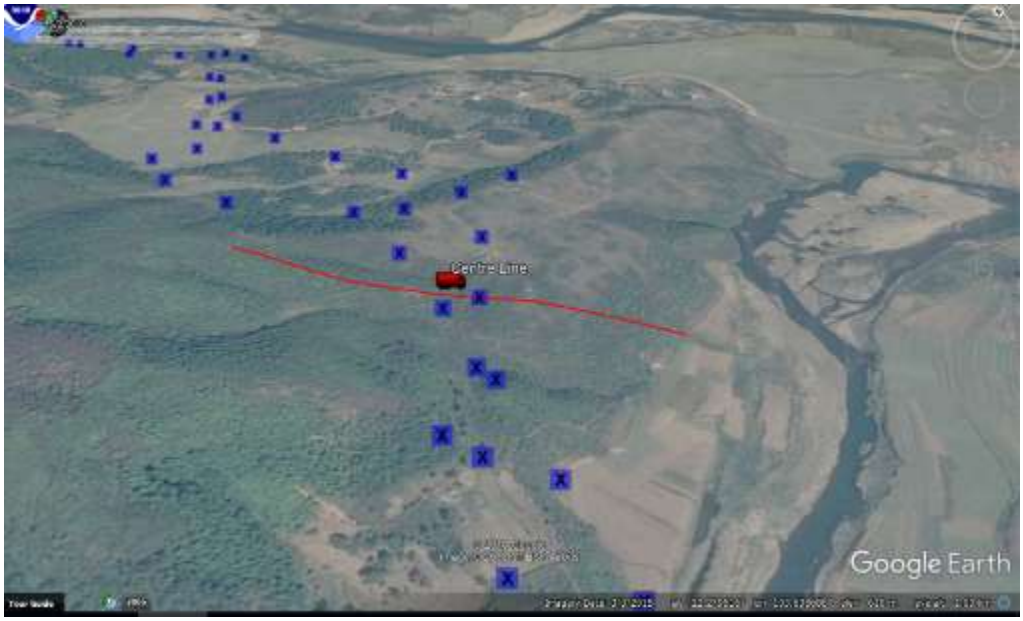


Figure E-40: View of ON10

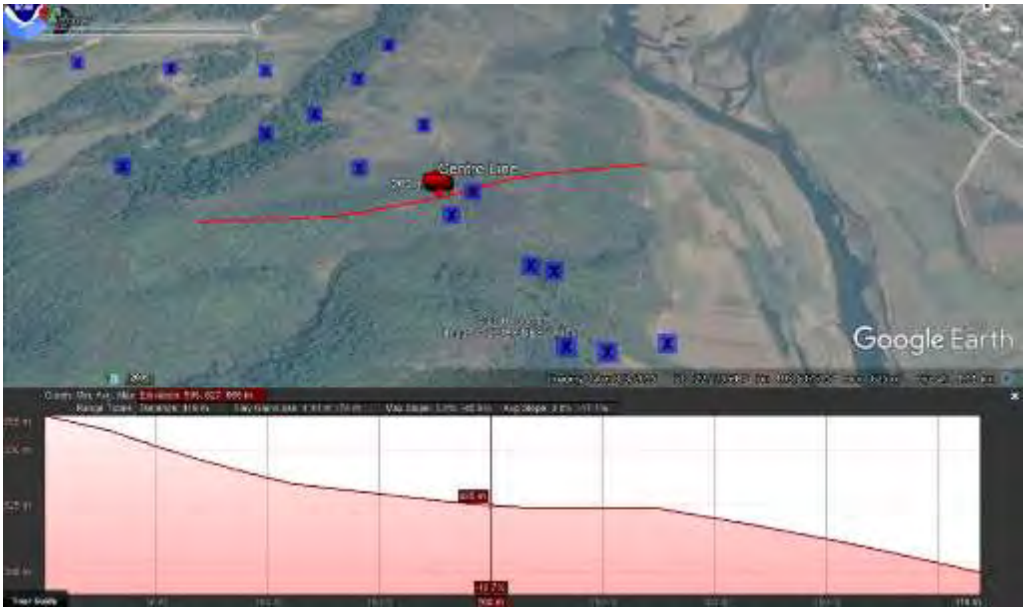


Figure E-41: Cross Section Profile of ON10

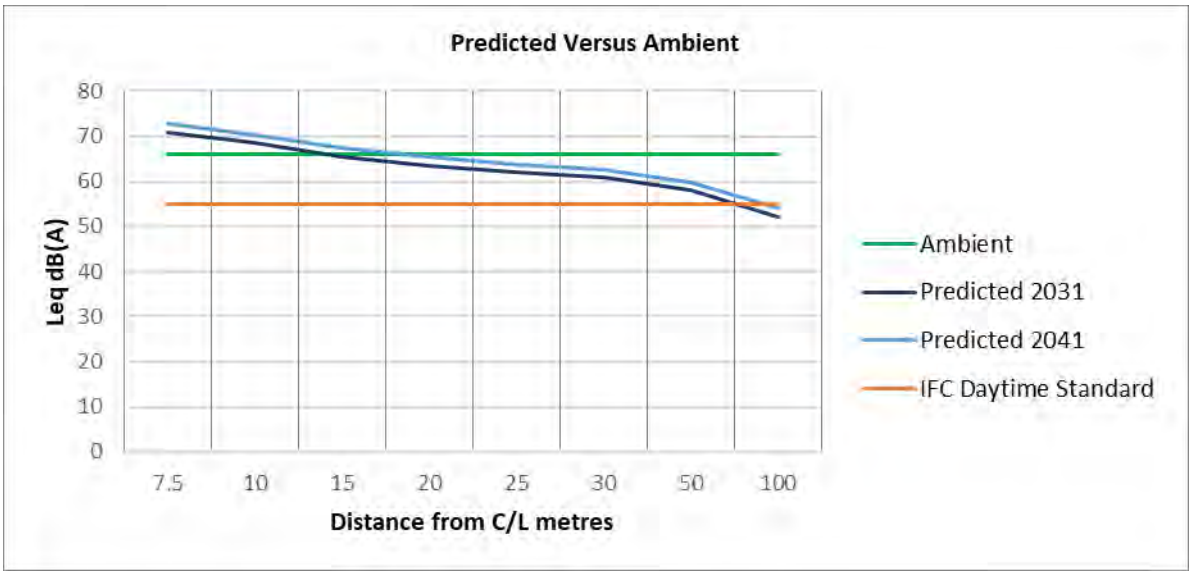


Figure E-42: Comparison of Noise Calculations Results for ON10 with Ambient and IFC Standard

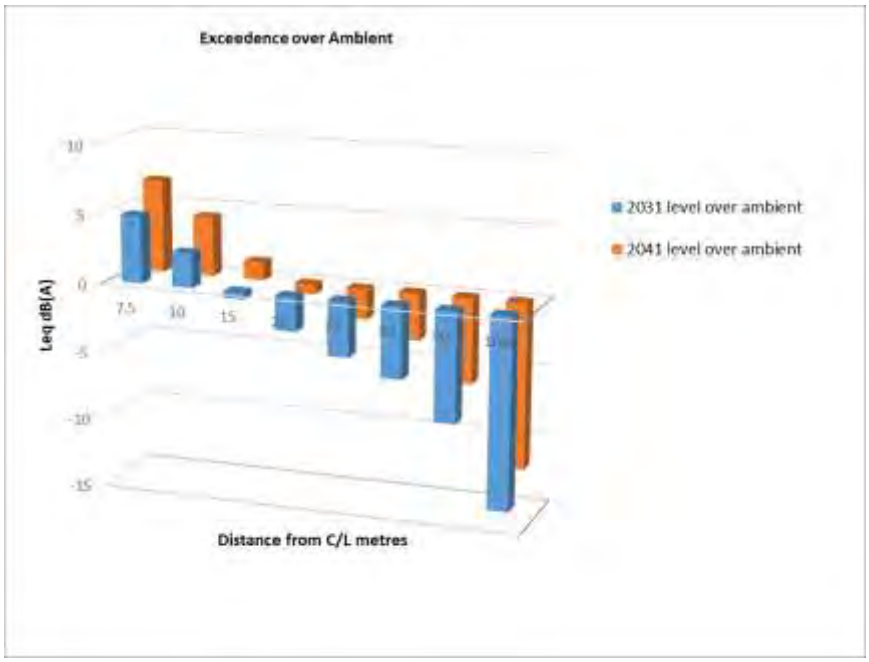


Figure E-43: ON10 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 66.1dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 15 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 20 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON11

The noise calculation results for ON11 are given below.

Figure E-44: View of ON11

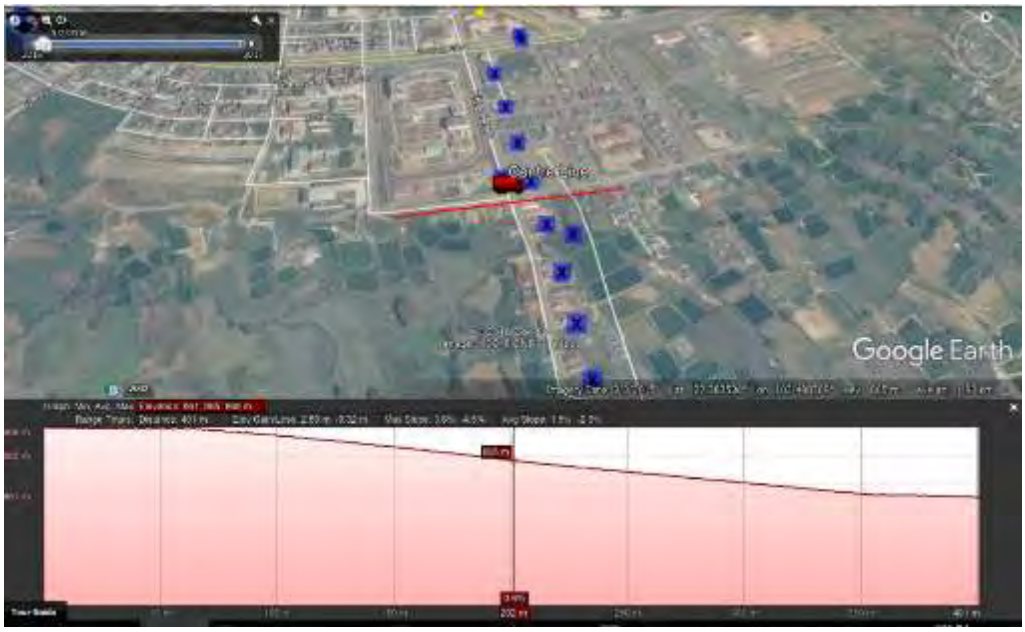


Figure E-45: Cross Section Profile of ON11

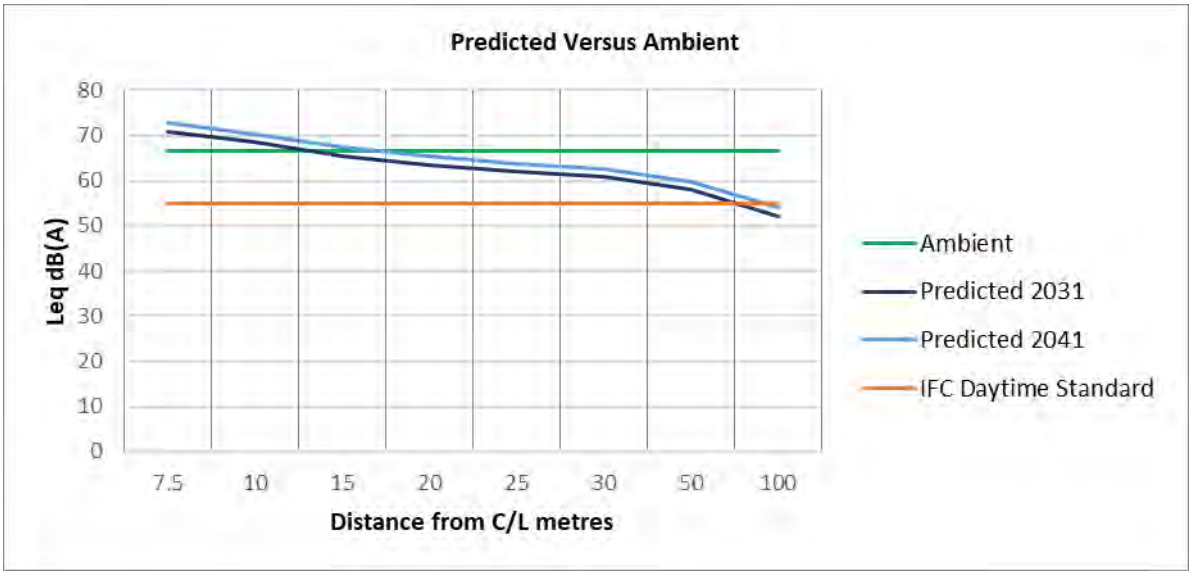


Figure E-46: Comparison of Noise Calculations Results for ON11 with Ambient and IFC Standard

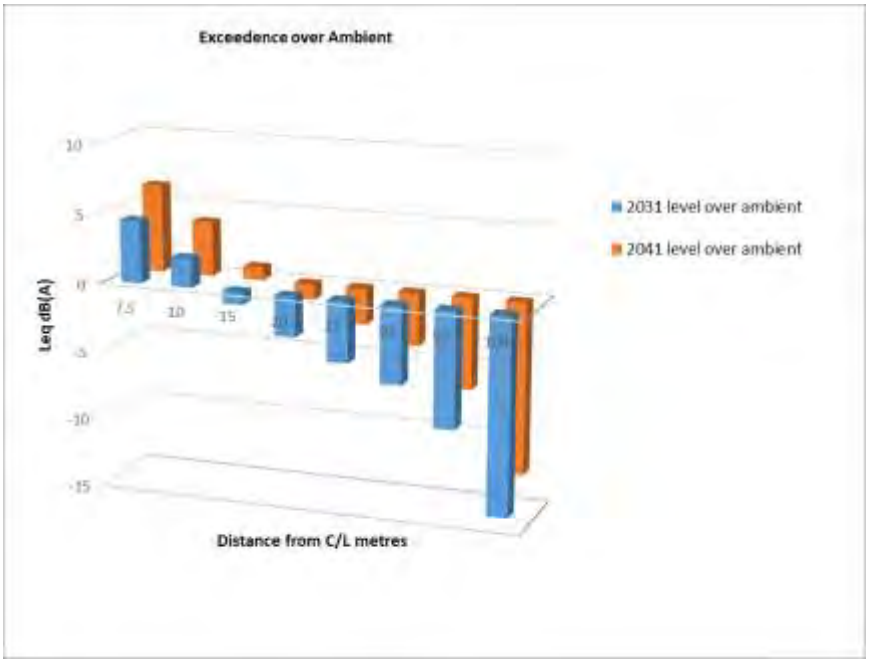


Figure E-47: ON11 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 66.5dB(A). Only at distances less than 10 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 12.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 15 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 17.5 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON12

The noise calculation results for ON12 are given below.

Figure E-48: View of ON12

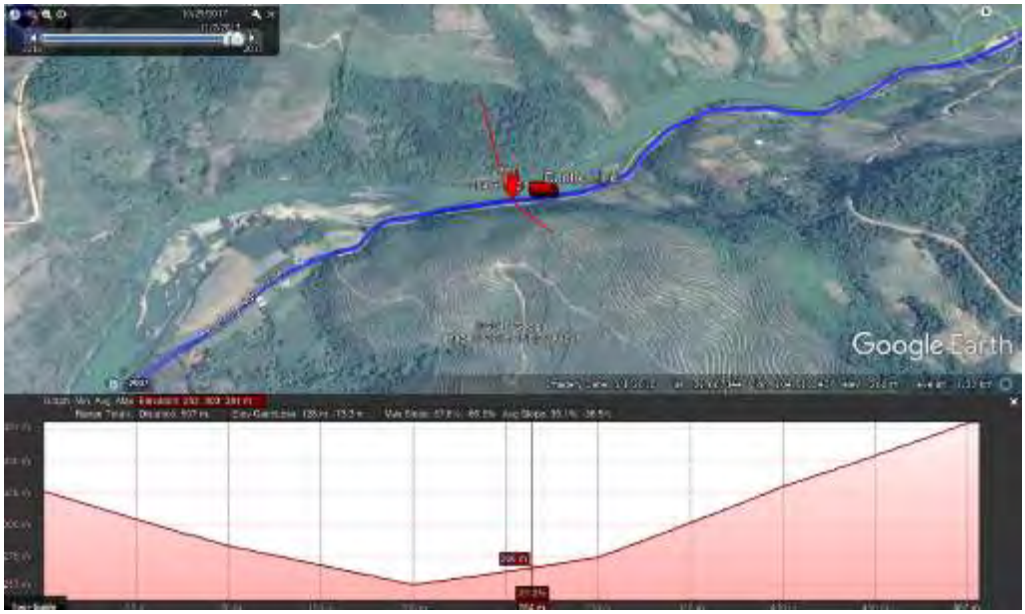


Figure E-49: Cross Section Profile of ON12

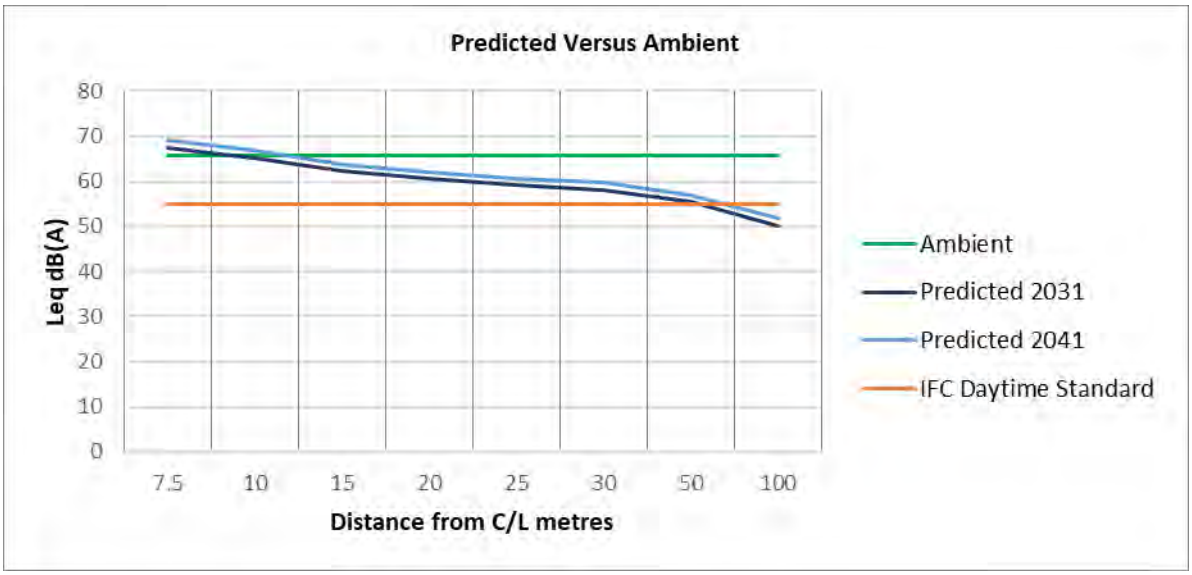


Figure E-50: Comparison of Noise Calculations Results for ON12 with Ambient and IFC Standard

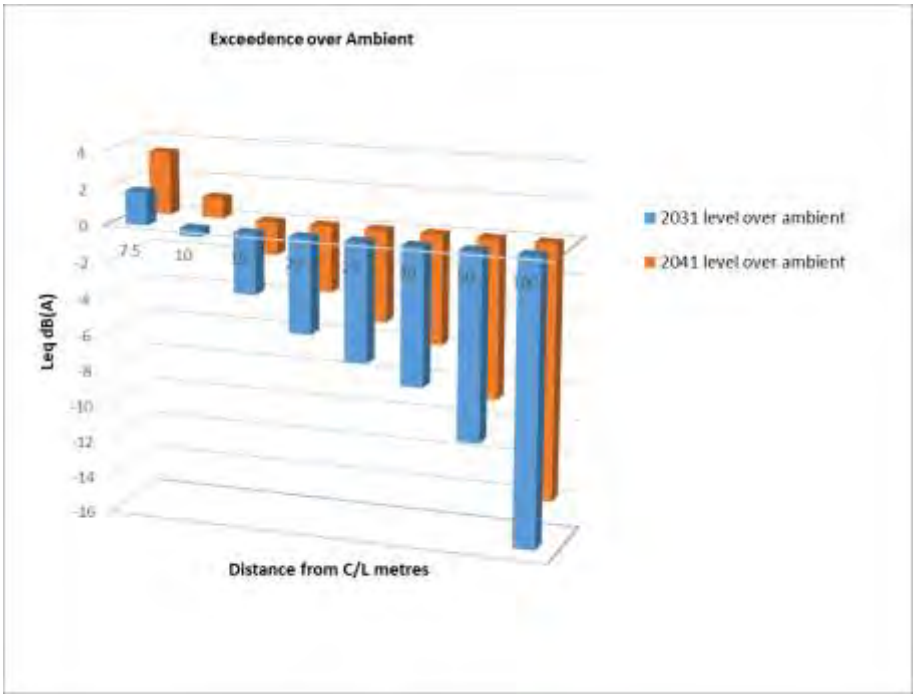


Figure E-51: ON12 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 65.7dB(A). Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 10 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 12.5 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

On13

The noise calculation results for ON13 are given below.

Figure E-52: View of ON13

Figure E-53: Cross Section Profile of ON13

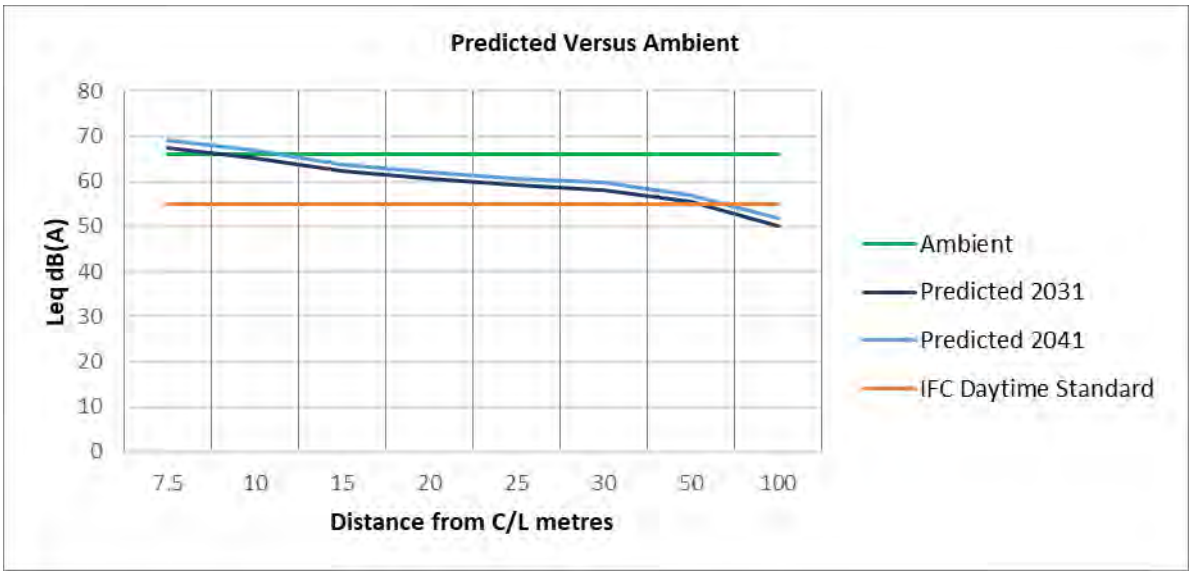


Figure E-54: Comparison of Noise Calculations Results for ON13 with Ambient and IFC Standard

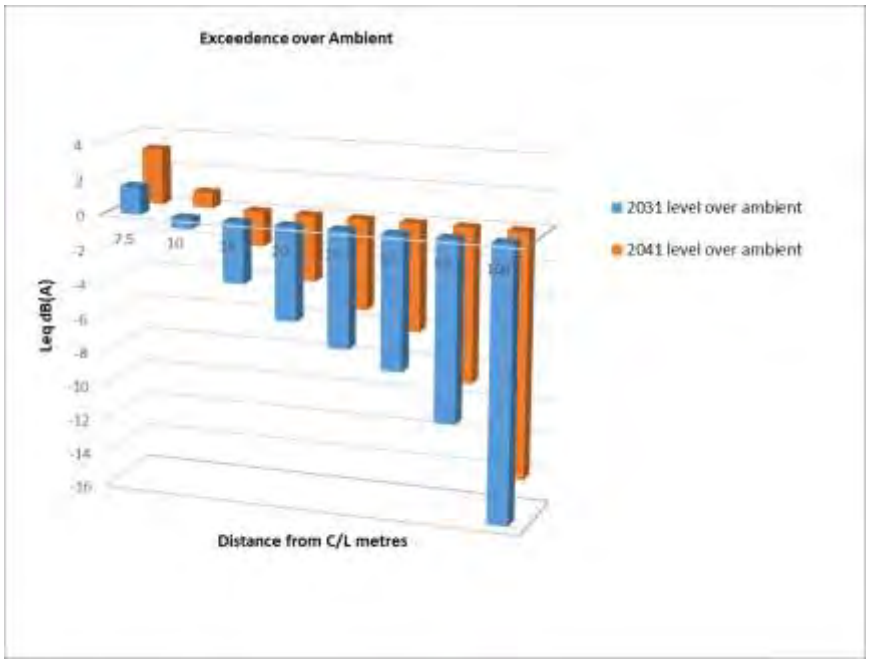


Figure E-55: ON13 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 65.9dB(A). Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 7.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 10 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON14

The noise calculation results for ON14 are given below.

Figure E-56: View of ON14

Figure E-57: Cross Section Profile of ON14

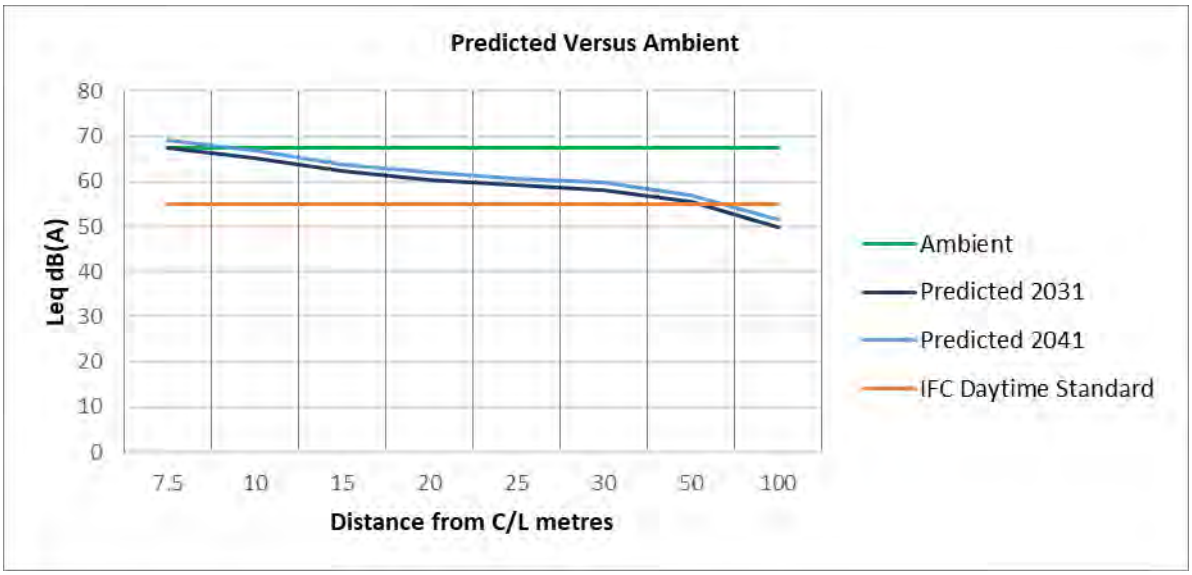


Figure E-58: Comparison of Noise Calculations Results for ON14 with Ambient and IFC Standard

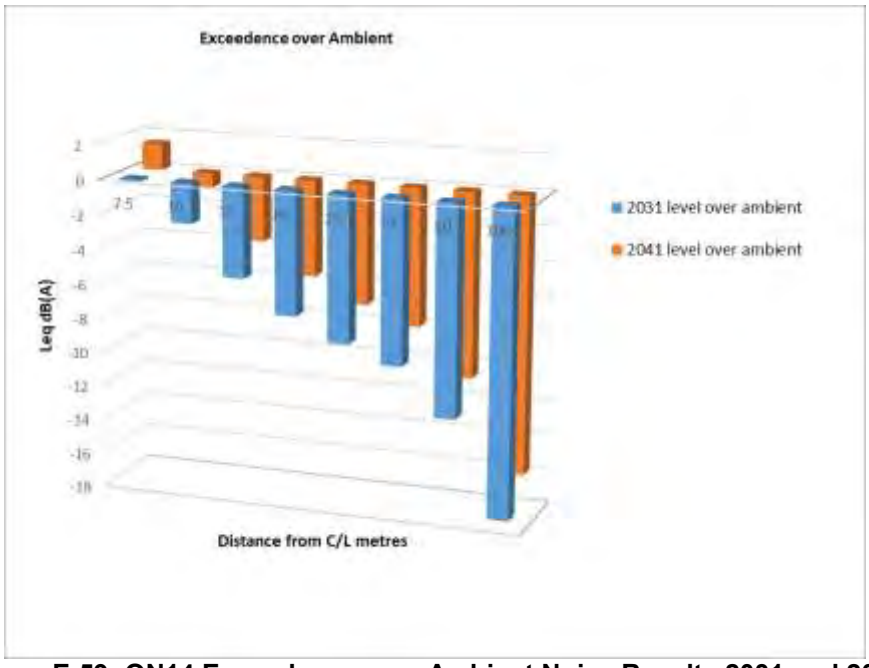


Figure E-59: ON14 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 67.6dB(A). Only at distances less than 5 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 7.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 10 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

ON15

The noise calculation results for ON15 are given below.

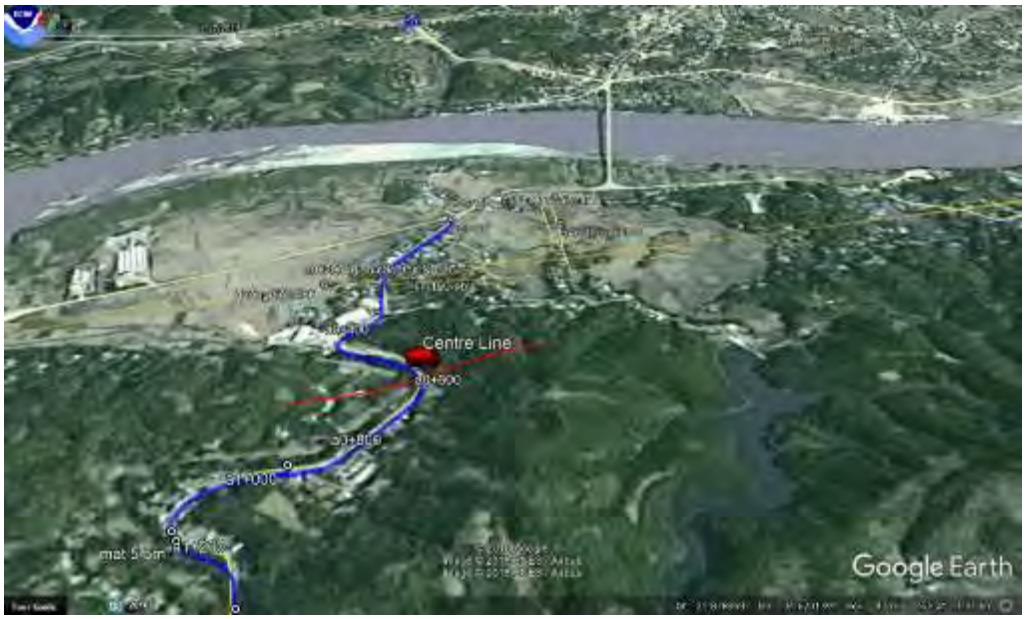


Figure E-60: View of ON15

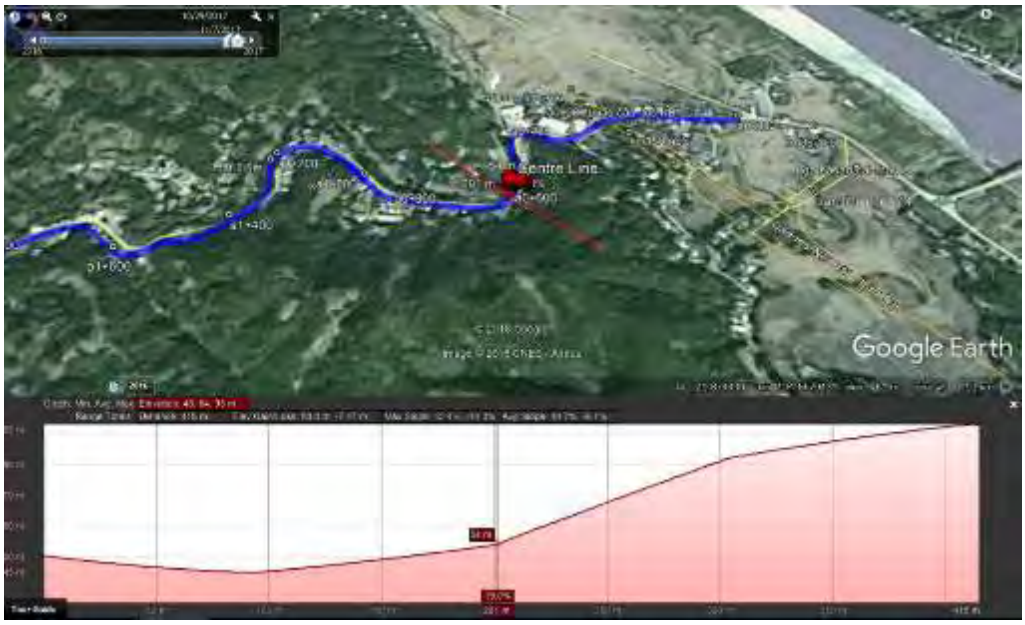


Figure E-61: Cross Section Profile of ON15

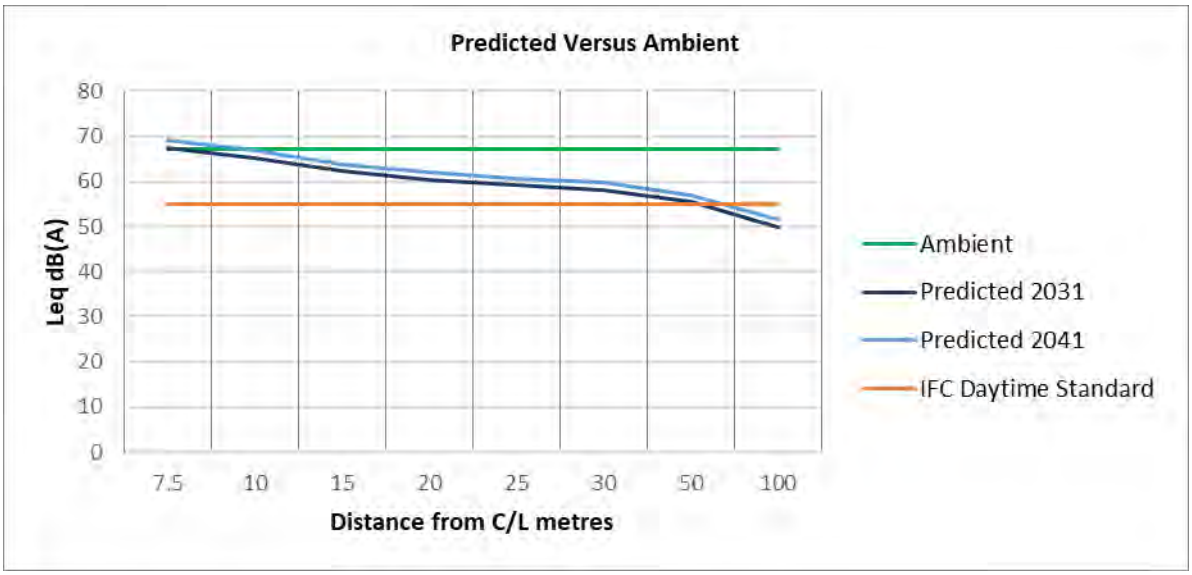


Figure E-62: Comparison of Noise Calculations Results for ON15 with Ambient and IFC Standard

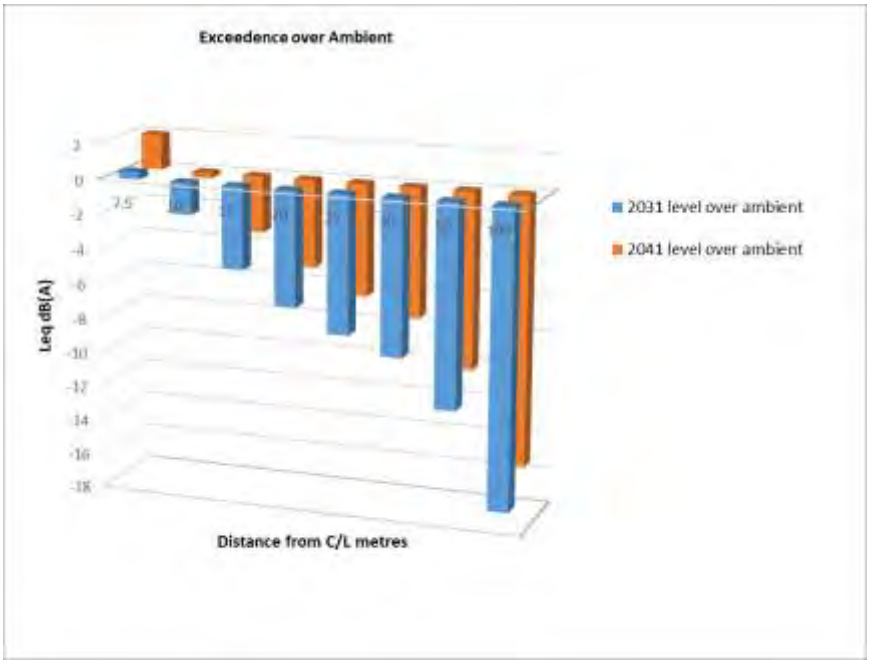


Figure E-63: ON15 Exceedance over Ambient Noise Results 2031 and 2041

The ambient Leq is 67.1Bd(A). Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2031 give noise levels more than 3dBs above the measured ambient noise level. At distances beyond 7.5 meters from the centerline the predicted noise levels in 2031 will not exceed the measured ambient noise level.

Only at distances less than 7.5 meters from the centerline will the predicted noise levels in 2041 give noise levels more than 3dBs above the measured ambient noise level. At distances

beyond 10 meters from the centerline the predicted noise levels in 2041 will not exceed the measured ambient noise level.

D. Conclusions

The desired noise standard is not to exceed the existing ambient Leq noise level by more than 3dB(A). In one location ON4, which has a low baseline, the noise levels may be increased by 3dBs at distances less than 50metres from the road centerline. Most of the predicted levels for 2031 or 2041 are equal to or less than the existing ambient at distances beyond 20 meters from the road centerline. Therefore, at distances more than 20 meters from the road centerline (or 12.5 meters from the carriageway edge) the ambient will not be increased by 3dBs at all but one sites.

Table E-2: Comparison of projected noise levels with baseline

Sampling point	Baseline Leq (6h - 21h)	Distance (m) at which 2031 Level equals ambient	Distance (m) at which 2041 Level equals ambient
ON01	65.7	15	20
ON02	66.5	12.5	17.5
ON03	66.9	12.5	17.5
ON04	61.4	30	50
ON05	66.2	15	20
ON06	65.8	15	20
ON07	67.0	12.5	15
ON08	66.2	15	20
ON09	67.1	12.5	15
ON10	66.1	15	20
ON11	66.5	12.5	17.5
ON12	65.7	10	12.5
ON13	65.9	7.5	10
ON14	67.6	7.5	10
ON15	67.1	7.5	10

As noted in one location ON4, which has a low measured baseline, the noise levels may be increased by 3dBs at distances less than 50metres from the road centerline. The potential impact of this on noise sensitive receptors should be investigated further in detailed design.

E. Traffic Data

NR279	2031	2041
Auto / Pick Ups	2385	3996
Medium Truck	303	514
Heavy Truck	579	983
Buses	79	130
Motorcycles	789	888
NR 32	2031	2041
Auto / Pick Ups	1966	1811
Medium Truck	1375	2336
Heavy Truck	133	225
Buses	347	573
Motorcycles	907	1022
PR 175	2031	2041
Auto / Pick Ups	551	918
Medium Truck	90	149
Heavy Truck	184	313
Buses	44	73
Motorcycles	944	1063

F. Traffic Mix Increases